A Tabulated Summary of the FDG PET Literature

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Key Words: FDG PET; Health Care Financing Administration; oncology; neurology; literature review; cardiology

J Nucl Med 2001; 42:1S–93S

This special supplement to *The Journal of Nuclear Medicine* is a detailed tabulation of literature on FDG PET in oncology (1993–June 2000), cardiology (1986–June 2000), and neurology (1980–June 2000). This document is a subset of the original document formally submitted to the Health Care Financing Administration (HCFA) in July 2000 to request expanded Medicare reimbursement for FDG PET. It has been improved by eliminating any errors in tabulation and further clarified as the result of comments from an independent review of the original HCFA submission. This document also differs from the original HCFA submission in that it does not include some background sections and lacks references that were identified but not used because of specific inclusion and exclusion criteria.

The goal of this document is to provide a summary of all FDG PET literature for the specified periods, with tabulated values of sensitivity, specificity, percentage in management changes, etc. This document is not intended to be a formal meta-analysis or cost-effectiveness analysis of the available literature. Instead, it is meant to provide an overview of the available literature, so that future detailed studies can use this document as a starting point.

Because of the difficulty of searching all FDG PET literature, this document inevitably does not include some research articles and abstracts that may be useful. The authors have tried to make the search as comprehensive as possible, but some literature may have been overlooked. Details of the literature search strategy are provided in Appendix A. Although a formal meta-analysis is not performed, a simple weighted averaging of data using various strategies is presented (Appendix B). This weighted averaging is meant to give only a general indication of the overall accuracy values and, therefore, should be interpreted with care. A data pooling analysis is also included.

The document is organized to show, first, how the tabulated data should be interpreted. This is followed by oncologic, cardiac, and neurologic application sections that provide, for each disease process, a disease background section, a case example illustrating the clinical implementation of FDG PET, an explanation of why FDG PET helped, a key management issues section (see also Maisey et al. (*285*)), and a summary of evidence for FDG PET with management change data for the disease and references to the relevant full literature search (in tabulated form) for the accuracy of FDG PET in specific applications. The numbers of patient studies utilized in calculating summary management changes are displayed in Tables 20 and 24 along with management figures and are embedded (without display) within the individual spreadsheets as selected from the data lines that report management change information. In addition, a summary of results from the literature search on FDG PET in all cancers is provided, as well as a summary of FDG PET literature searched for the oncologic, cardiac, and neurologic applications. A full reference list is also provided at the end. Appendix A gives details on the way in which literature was searched and analyzed, and Appendix B reports some alternate approaches to summarizing the data.

The average FDG PET sensitivity and specificity across all oncology applications are estimated at 84% (based on 18,402 patient studies) and 88% (based on 14,264 patient studies), respectively. The average management change across all applications is estimated to be 30% (based on 5,062 patients). These data were obtained combining 419 total articles and abstracts on studies in which FDG PET was used. Various methods of analysis were applied to these data (Table 25), which revealed only a small amount of variation in the ratio values. Specifically, the sensitivity of PET ranged from 84%–87%, the specificity ranged from 88%–93%, and the accuracy ranged from 87%–90%.

At the time of submission of this work, HCFA had just announced expanded coverage for FDG PET to include imaging for various aspects of lung, colorectal, esophageal,

Received Dec. 27, 2000; accepted Dec. 27, 2000.

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and head and neck cancers and melanoma and lymphoma. In addition, coverage for seizure work-ups and myocardial viability was approved. We are confident that with continued acquisition of data from well-designed clinical studies, true broad coverage for FDG PET can soon be a reality. We hope that readers of the journal will find this to be a valuable resource in better understanding the existing diversity of literature available for FDG PET.

INTERPRETING SPREADSHEETS IN THIS DOCUMENT

This report contains spreadsheets summarizing all FDG PET literature. A spreadsheet is provided for each disease under consideration, along with summary spreadsheets (see Table 1, lung cancer, as an example). On each specific disease spreadsheet, the name of the disease appears in the upper left-hand corner. The data is broken down into applications of FDG PET for diagnosis, staging, diagnosis and staging, recurrence, monitoring response, and other applications. Some diseases include a mixture of these applications and, therefore, have multiple listings in several categories.

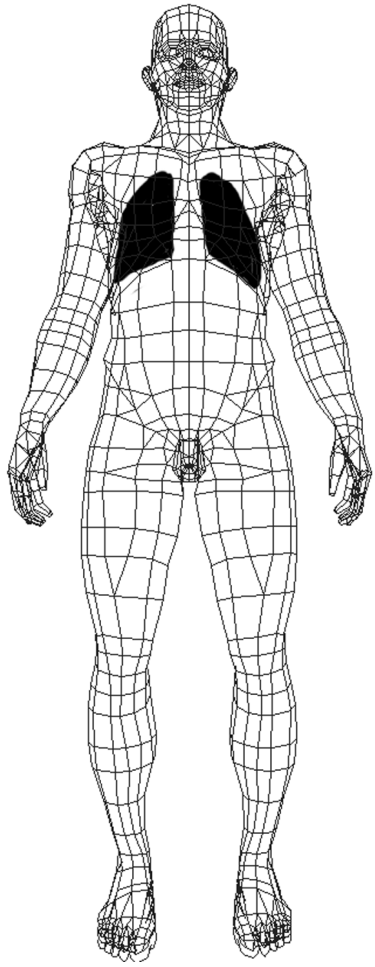
For each disease, the first author and year of publication of the article or abstract are listed in the far left column. The second column designates "A" for abstract or "RA" for research article. The third column lists the purpose of the study. The fourth column lists the total number of patients who were included initially in the study. The fifth column lists the total number of patient studies actually implemented and upon which results data were calculated (sometimes less than the total in the fourth column, because of patient drop out or other causes, and sometimes greater than the total in the fourth column, because multiple PET scans may have been counted). In some applications in which lesions were counted, a column is also listed for the number of lesions studied. Studies using nondedicated PET are indicated. Several additional columns show the percentages for sensitivity, specificity, predictive value, and accuracy for FDG PET and CT. The gold standard used for verifying FDG PET results is also listed in a separate column. If percent management changes were available, they are listed in the last column. Finally, beneath each table are footnotes highlighting details from specific studies to further clarify how the study populations were either composed or counted. Abbreviations used throughout the tables are listed alphabetically in Appendix C.

A summary for each application is provided in bold. The bolded summary totals for number of patients, number of patient studies, and number of lesions reflect the totals retrieved from the literature for all studies listing data that is inclusive of that application. Each study entry is listed with complete reported data that may include data relevant to several applications. This accounts for data repeated across applications within a given spreadsheet and is discussed in Appendix A. From within each application are selected the respective study data applicable to that application (e.g., recurrence data in instances in which both staging and recurrence data may have been listed in a given entry) and used in the weighted average formulas generating that application's summary values, which are listed in the statistical ratio columns. These selected N values for total patient studies and total lesions do not appear in the individual spreadsheets but are embedded in the formulas and appear with the application's summary values in the overall summary sheets at the end of this report. Note that a weighted average is used, which weights studies by the number of patients, so that results obtained with more patients are given more credit. If lesion-by-lesion analysis was performed, a separate value for that analysis is also listed.

All tabular matter is presented here in the form in which it was submitted to HCFA, with the exception of various corrections to tabulation errors found in certain spreadsheets and their carryover to the overall summary sheets, and the placement of table numbers according to the style of this journal.

ONCOLOGIC APPLICATIONS

Lung Cancer



Disease Background. Lung cancer is among the most frequent and most lethal of cancers striking both men and women. It is the most rapidly increasing tumor in indus-

trialized countries. Most lung cancers are caused by smoking. However, smoking is a less important factor in adenocarcinoma, the lung cancer most rapidly increasing in the United States. Lung cancer accounts for 22% of all cancers in men and 8% of all cancers in women. Five-year survival is achieved by only 13% of all lung cancer patients. Basic treatment for non-small cell lung cancer (NSCLC) is surgical, with only 20% of patients presenting as operable. Patients who are not operable receive palliative chemotherapy or radiation. Small cell lung cancer patients respond well initially to chemotherapy and radiation and generally do not undergo surgery. Their long-term prognosis is poor.

Case Example. A 62-y-old patient with known NSCLC was evaluated before planned lobectomy. The patient had no symptoms (e.g., headaches). FDG PET revealed extensive metastatic disease to the brain in addition to the primary cancer in the lung.

Why Did FDG PET Help? Because the FDG PET scan showed that the patient had much more extensive disease than previously thought (Fig. 1, arrows), lobectomy was not a management option for this patient. The patient had no symptoms related to the brain metastases, but the FDG PET whole-body survey scan caught tumor spread to the brain.

Key Management Issues.

- Diagnosing the lung mass
- Staging NSCLC
- Assessing recurrence
- Monitoring response to therapy

Summary of Evidence for FDG PET in Lung Cancer. For staging: An estimated 37% change (Table 1) was noted in management effect, based on 1,565 patient studies (Table 24).

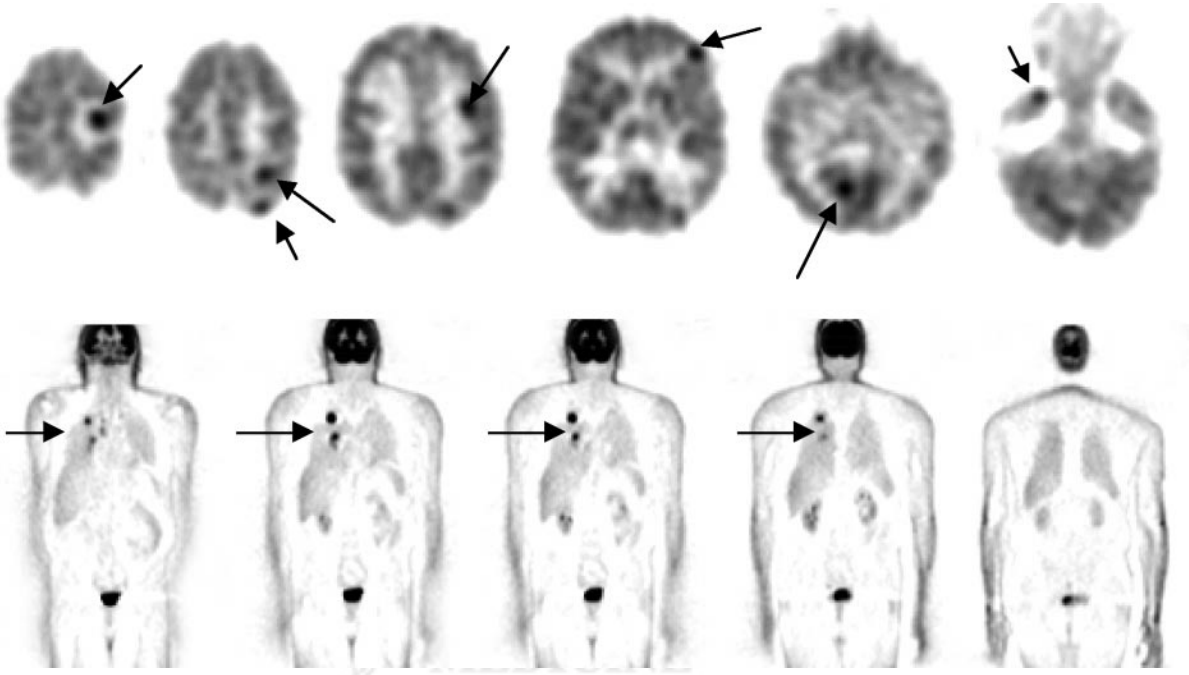


FIGURE 1. Case example, lung cancer.

TABLE 1

FDG PET in Lung Cancer: Results of Literature Search

LUNG CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT (%) Effect
Diagnosis																		
Menda, 2000[1]	A	dx/lung masses	127	127			97		61								pathol	
Higashi, 2000	A	dx	63		66		83		42		87		36		76		surg/biop	
Vaylet, 1998	RA	dx/pulm nodule	17	17			93		50		93		50		88			
Orino, 1998[2]	RA	dx/eval indeterm SPN < 3cm	23	23			88		67		88		67		83		histol/biop/cytol	
Nettelbladt, 1998	RA	dx/eval tumor in lung or mediastinum	17	17			93										histol/surg/cytol	
		mediastinal/hilar		14			100	50	100	80	100	50	100	80	100	71		
Shreve, 1998[3]	RA	dx/kn or susp lung nodules or masses	31	14		yes	93										dedPET used as ref std	
Lowe, 1998	A	eval of discrep b/w PET&other	113	25											80		multiple diagnostic tests	
Lowe, 1998	RA	eval solitary pulmonary nodules	89														pathol	
		by visual analysis		89			98		69						89			
		using SUV data		89			92		90						91			
		for SPNs < or = 1.5 cm , visual		34			100		74						85			
		for SPNs < or = 1.5 cm, SUV data		34			80		95						88			
Higashi, 1998[4]	RA	detect prim lung cancer	33	33			94										histol/thorac	
		< 2cm		7			86											
Hagberg, 1997[5]	RA	dx/eval pulm nodule/bronchogenic ca	49		54		93		70								histopath/cytopath	
		mediastinal lymph nodes/N2		18			67	56	100	100							surg pathol	
Wang, 1996	A	dx lung cancer	18		19		100										CT	
Sazon, 1996	RA	abnormal chest roentgenograms	107	107			100		52		87		100		89			
		mediastinal mets		32			100	81	100	56	100	65	100	75	100	69		
Knight, 1996[6]	RA	susp pulm lesion >1cm	48	45			100						100		88		pathol/clin & radiog 6 mo	
Bury, 1996	RA	eval SPN	50	50			100		88		94		100		96		invasive proced	
Hübner, 1996	RA	differential dx chest masses & SPN	26		52		100		73								histol/clin follow-up	
		SUV cutoff 3.8			52		81		85									
Hübner, 1995[7]	RA	prim unknown lung mass	54	23			100		67								histol/clin follow-up >1yr	
		recurr/proven lung ca or lymphoma		13			83		80									
		extrathoracic mets/susp pulm mets		18			87		83									
Duhaylongsod, 1995[8]	RA	detect susp prim lung cancer	100	87			97		82		92		92		92		biop/surg/observ>2yrs	
		recurring lung cancer		16			100											
Duhaylongsod, 1995[9]	RA	dx/indeterm pulm abnorm	53	53											92		serial chest xray/CT	
Dewan, 1995	RA	dx/eval lung lesions	33		35		100		78		93		100		94		TTNA	
Dewan, 1993	RA	dx/eval indeter SPN<3 cm by xray&CT	30	30			95		80		90		89		90		histol	
Slosman, 1993	RA	detect lung ca/prior to explor thorac	36	36			94		60		94		60		89		thoracotomy	
Hoh, 1993[10]	RA	detecting prim lung carcinoma	87	6			100										histol	
Patz, 1993[11]	RA	eval focal pulm abnormality on xray	51	51			89		100								biop/cytol eval sputum	
	Summary	**by patients**	**1255**	**1108**			**96**	**67**	**73**		**91**		**90**		**90**			
		by lesions			**278**		**91**		**68**		**89**		**58**		**82**			

TABLE 1 (*Continued*)

LUNG CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT (%) Effect
Staging																		
Hicks, 2000[12]	A	staging	63	63													compare to conv	47
Gupta, 2000	A	staging	97	77			94		98						96		2 y follow-up/surg/histol	59
Gupta, 2000	A	lymph nodes	105		295		87		91		75		96		82		lymph node sampling	
Schiepers, 2000[13]	A	staging	520	184											86		biopsy/follow-up	38
Schiepers, 2000[14]	A	management	173	129											87		histology 30%	44
Seltzer, 2000[15]	A	management	536	273														44
Rakotonirina, 2000	A	preop staging/NSCLC/dedPET	27		84		100										compar dedPET to OPET	
		preop staging/NSCLC/OPET				yes	73											
		prim/dedPET			28		100											
		prim/OPET				yes	96											
		mediastinal LN/dedPET			35		100											
		mediastinal LN/OPET				yes	66											
		mets/dedPET			21		100											
		mets/OPET				yes	52											
Schiepers, 2000	A	dx/staging	90	67			92		80		85		89				tiss dx/1 y follow-up	21
Oriuchi, 2000	A	staging mediastinal LN	36	16			100										FMT PET	
Crespo-Jara, 2000	A	dx of adrenal mass	19		24		89		100		100		75		92		surg pathol/CT/MRI/clin	
Matthies, 2000	A	differentiate benign/malig	35		36		95		94								surg pathol/follow-up	
Kim, 2000[16]	A	staging lung lesions															surg/cytology	
		other PET	91	91		yes	100											
		nodal staging	31	31			63	67	74	59								
Baum, 2000[17]	A	staging nsclc	63	63				76		47					90		CT/histol	52
		LN mets					82		94		82		94					19
		mediastinal LN					100											
Wong, 2000[18]	A	staging nsclc	78	78													surg pathol	23
Albes, 1999	RA	staging/nsclc/N1&2 vs N3	27	27			77	77	79	79					78	74	surg/rad lymphad/pathol	
Tatsumi, 1999	RA	assessing lung lesions/DedPET	23	23			100										comparison w FDG GCI	
		lung lesions/OPET		23		yes	96											
		mediastinal/DedPET		23			78		79						78			
		mediastinal/OPET		23		yes	78		93						87			
		hilar/Ded PET		23			100		84						87			
		hilar/OPET		23		yes	75		90						87			
Magnani, 1999	RA	mediastinal LN assessmt/nsclc	28	28			67	66	84	79	67	60	89	83	79	75	mediastinos/thorac	
Gupta, 1999	A	staging	78	78													mediastinos/thorac/histol	
		LN < 1 cm			93		87		84						85		histology	23
Saunders, 1999	RA	staging/primary disease	97	97			100										surg/biopsy/follow-up	37
		staging/mediastinal disease		84			71	20	97	90								
Al-Sugair, 1999	A	primary/secondary mets	314														follow-up/biopsy	
		suspicious definitive threshold		314			67		96									
		definitive threshold only		314			55		97									

TABLE 1 (*Continued*)

LUNG CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT (%) Effect
Staging	**(continued)**																	
Inagaki, 1999	A	NSCLC lymph staging	24	24			22	28									surgery/pathology	
				24		yes	100											
Ryu, 1999[19]	A	staging NSCLC	35	35			88		63								histopathological	
		mediastinal staging		35			75		91									
		after chemo mediastinal restage		35			58		93									
Marom, 1999[20]	RA	staging NSCLC	100	100			100	100							83	65	pathology	23
		mediastinal staging		100			92	25	93	98					85	58		
		lung mets		100			94	78	99	94	94	74	99	95	98	91		
Kutlu, 1998[21]	RA	pre-op staging NSCLC/concom lesions	21		25		93		100						96		histol/clin & radiol follow-up	
		prim		21			100											
Nettelbladt, 1998	RA	dx/eval tumor in lung or mediastinum	17	17			93										histol/surg/cytol	
		mediastinal/hilar		14			100	50	100	80	100	50	100	80	100	71		
Präuer, 1998	RA	preop eval/pulm coin lesions	50	50	54		90	100	83	52	88		86		87		histol	
Gliem, 1998[22]	A	eval malig in pleural disease	32	18			78										cytol/histol	
				14											78			
Lonneux, 1998[23]	RA	management comparison PET/SPET	42	28													hist/CT/bne scn	
		overall staging/PET		28											86			
		overall staging/SPET		28		yes									64			
		nodal staging/PET		28											62	69		
		nodal staging/SPET		28		yes									62			
		met staging/PET		28			92											
		met staging/SPET		28		yes	58											
Kalff, 1998[24]	A	management	47	47													follow-up	85
Steinert, 1998	A	surgery mgmt/nodal & met staging	107	100											21		biopsy/CT/MRI/bne scn	21
Gupta, 1998	A	preoperative nodal staging	103		126		95	63	91	60					94	61	histology	35
Weder, 1998[25]	RA	extrathoracic mets	100	94													histology/radiology	14
Weber, 1998	A	mediastinal staging/lung cancer	23	17			83		82						82		histol/LN dissection	
Vansteenkiste, 1998	RA	locoreg LN staging/potent oper nsclc	56		493		63	50	95	92	64	47	95	93	91	87	surg pathol	
Guhlmann, 1997	RA	staging nodes	46	46			80	50	100	75					88	59	histopathological	
Gupta, 1997[26]	A	staging	57	57			98		87		92		94		95		CT/histology	49
		nodal staging			39		96		86		90		94					
Trieu, 1997	A	staging of NSCLC	52	52			88	88	75	54					78	63	surgical pathology	38
Vansteenkiste, 1997[27]	RA	mediastinal lymph staging/NSCLC	50	50			67	67	97	59					88	64	surgical pathology	10
Gupta, 1997	A	pulm and lymph nodes	57		110		97		83		92		94		93		histology	
		PULM <3cm			26		94		75		89		86		88			
		PULM >3cm			30		95		100		100		90		97			
		LN <3cm			42		97		89		93		93		93			
		LN >3cm			12		100		89		83		100		92			

TABLE 1 *(Continued)*

LUNG CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT (%) Effect
Staging	**(continued)**																	
Hagberg, 1997[28]	RA	dx/eval pulm nodule/bronchogenic ca	49		54		93		70								histopath/cytopath	
		mediastinal lymph nodes/N2		18			67	56	100	100							surg pathol	
Steinert, 1997[29]	RA	mediast LN staging/NSCLC/N2 or N3	47		112		89	57	99	94	96	76	97	87	96	85	histopath/LNsmplg@thorac	
Bury, 1996	RA	mediastinal lymph staging/NSCLC	50	50			90	72	86	81							pathology/thoracotomy	
Sazon, 1996	RA	abnormal chest roentgenograms	107	107			100		52		87		100		89			
		mediastinal mets		32			100	81	100	56	100	65	100	75	100	69		
Gupta, 1996	RA	indeterminate SPN	61	61			93		88		92						histol	
Scott, 1996[30]	RA	mediast LN staging/NSCLC/N2 or N3	27	27			100	67	100	83					100	78	biop/surg	
		by LN stations			75		100	60	98	93	91	60			99	89		
Sasaki, 1996[31]	RA	detect mediast LN mets/NSCLC	29		71		76	65	98	87	93	61	93	89	93	82	histol	
Hübner, 1995[32]	RA	prim unknown lung mass	54	23			100		67								histol/clin follow-up >1y	
		recurr/proven lung ca or lymphoma		13			83		80									
		extrathor mets/susp pulm mets		18			87		83									
Valk, 1995	RA	staging NSCLC/mediastinal N2 dis	99	76			83	63	94	73	88	54	92	79	91	70	CT/surg/biop	
Chin, 1995[33]	RA	mediastinal staging/NSCLC/clin stg 1	30	30			78	56	81	86	64	63	89	87	80	77	pathol ex mediast LNs	
Wahl, 1994[34]	RA	staging mediastinal LN mets/nsclc	23	23			82	64	81	44					81	52	pathol	
Lewis, 1994[35]	RA	preop staging/nsclc	34	34													surg	41
Scott, 1994	RA	identify lung tumor	62	62			94		80		94		80		90		tiss based dx/CT	
		N2 lymph nodes		25			66		86		40		95		84		pathol	
Rege, 1993[36]	RA	known pulm nodules/bronchogenic ca	16	8			100	75									histol	
	Summary	**by patients**	**4238**	**4005**			**83**	**64**	**91**	**74**	**86**	**67**	**93**	**86**	**82**	**68**		**37**
		by lesions			**1885**		**83**	**57**	**92**	**85**	**77**	**54**	**94**	**92**	**90**	**83**		
Recurrence																		
Nunez, 1999	A	recurrence	56	11			100		67		71		100		82		pathology/follow-up	
Bury, 1999	RA	recurrence NSCLC	126	126			100	72	92	95	92	93	100	79	96	84	pathology/follow-up	
Hübner, 1995[37]	RA	prim unknown lung mass	54	23			100		67								histol/clin follow-up >1y	
		recurr/proven lung ca or lymphoma		13			83		80									
		extrathor mets/susp pulm mets		18			87		83									
Duhaylongsod, 1995[38]	RA	detect susp prim lung cancer	100	87			97		82		92		92		92		biop/surg/observ>2y	
		recurring lung cancer		16			100											
Inoue, 1995	RA	detecting recurrence	38		39		100		62		84		100		87		pathol/clin outcome	
Patz, 1994	RA	recurring bronchogenic carcinoma	43	43			97		100		100		89		98		chest xray/thorac CT	
	Summary	**by patients**	**417**	**337**			**98**	**72**	**92**	**95**	**93**	**93**	**97**	**79**	**96**	**84**		
		by lesions			**39**		**100**		**62**		**84**		**100**		**87**			

TABLE 1 *(Continued)*

LUNG CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT (%) Effect
Monitoring Response																		
Bury, 1999	RA	recurrence NSCLC	126	126			100	72	92	95	92	93	100	79	96	84	pathology/follow-up	
Ryu, 1999[39]	A	staging NSCLC	35	35			88		63								histopathological	
		mediastinal staging		35			75		91									
		after chemo mediastinal restage		35			58		93									
Bischoff, 1996[40]	A	monitoring chemo rspnse/sclc	39	39													histol	
	Summary	**by patients**	**200**	**270**			**94**	**72**	**90**	**95**	**92**	**93**	**100**	**79**	**96**	**84**		
Other																		
Crespo-Jara, 1999	A	detect bone mets	101	101			83										BS/CT/MRI/clin follow-up	
	Summary	**by patients**	**101**	**101**			**83**											

[1]Other analyses were performed.

[2]23 pts. 16 lung cancer pts. 1 lymphoma pt. 6 benign pts.

[3]Known or susp neoplasms included in pt gp. Lung data only reported here.

[4]33 pts w proven lung cancer. 31TP/2FN.

[5]49 pts. 54 pulm nodules. 18 pts staged for LN disease.

[6]48 pts. Gp1=27 pts. Gp2=21 pts w prior malig. SUR>2.5. Used pts=45. Gp1 acc=.81. Gp 2 acc=.95. Overall acc=.88.

[7]54 pts. Includes13 recurring pts w proven lung cancer or lymphoma.

[8]100 pts. Includes 16 previously resected (recurr). 13 pts excluded. Used pts=87. SUR>=2.5.

[9]Used criterion of SUR 2.5 or > for malignancy.

[10]87 pts of mixed cancer types/prim and recurrent.

[11]Sens and spec reported for benign lesions w SUR of 2.5 or less.

[12]11% more aggressive trtmt; 13% cur to palliative; 23% no further trtmt.

[13]23% resect to non-resect; 15% non-resect to resect.

[14]18% resect to non-resect; 26% non-resect to resect.

[15]44% major changes/14% minor.

[16]Lung lesions found to be other ca's as well.

[17]52%/19% cur to palliative.

[18]23% change in stage.

[19]Used SUV cutoff of 3.0.

[20]12% resect to non-resect; 11% non-resect to resect.

[21]21 pts. 25 concomitant lesions found on CT (26-1 excluded).

[22]12 lung/2 brst/2 pleura carcinosis/1 HD/1 unk prim.

[22]3 mesothelioma/4 pleural met of lung ca/7 paramalig pleura effusion.

[23]86% correct staging.

[24]85% overall/15% no changes.

[25]14% resect to non-resect.

[26]N staging 49% w chge of surgical plan.

[27]5 pts fd to have met nodes on PET not fd on CT.

[28]49 pts. 54 pulm nodules. 18 pts staged for LN disease.

[29]47pts/112 mediastinal lymph nodes. PET:25TP/1FP/3FN/83TN. CT:16TP/5FP/12FN/79TN.

[30]By 27 pts- CT:6TP/3FP/3FN/15TN PET:9TP/18TN.

[30]By 75 LN stations- CT:6TP/4FP/4FN/61TN PET:10TP/1FP/64TN.

[31]29 pts/71 mediastinal regions. PET:13TP/1FP/4FN/53TN. CT: 11TP/7FP/6FN/47TN.

[32]54 pts. Includes13 recurring pts w proven lung cancer or lymphoma.

[33]7TP/4FP/2FN/17TN. 30 pts clin stg I (T1-2,NO,MO).

[34]Pts included newly diagnosed and suspected nsclc.

[35]Mgmt change=14/34=41% of which 6 pts changed to non-surg therapy.

[36]Pts included bronchogenic carcinoma/met lesions to thorax/Hodgkin's disease.

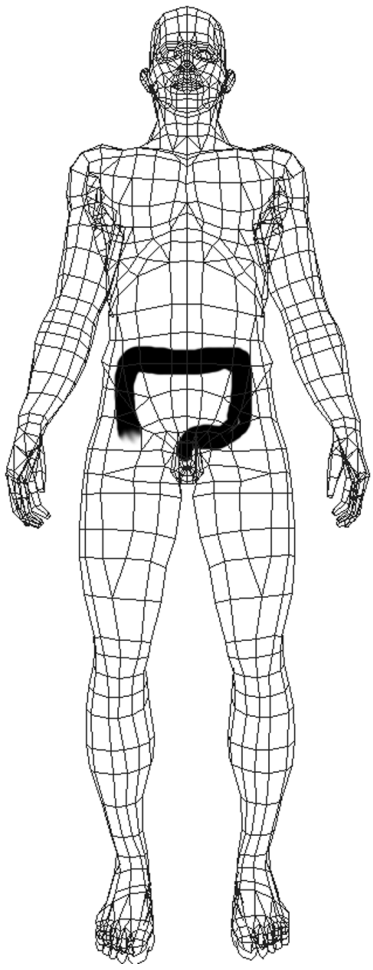
[37]54 pts. Includes13 recurring pts w proven lung cancer or lymphoma.

[38]100 pts. Includes 16 previously resected (recurr). 13 pts excluded. Used pts=87. SUR>=2.5.

[39]Used SUV cutoff of 3.0.

[40]PET 3-way classif of rspnse. Good correl to survival. NC/PD(7.6mo) PR(17.6mo) CR(32mo).

Colorectal Cancer



Disease Background. The colon and the rectum are parts of the large intestine and are responsible for absorption of various substances not absorbed by the small intestine. In western industrialized countries, colorectal cancer is the second most common cause of death from cancer. However, 20-fold variations in international incidence rates have been noted, with the highest rates found in Connecticut in the United States. Primary treatment is surgical, leading to a 50% 5-y survival rate. Adjuvant chemotherapy (chemotherapy before removal of the tumor) is now more commonly used. Radiation is sometimes used for rectal carcinoma and less often for colon cancer. Approximately 20% of patients with recurring cancers are eligible for further resection, with half relapsing early because of previously unidentified metastatic sites. Imaging helps to determine the spread (or lack thereof) of the primary tumor in the colon or rectum.

Case Example. A patient with carcinoma of the rectum was treated with surgery and radiotherapy. One year later, results of a blood test indicated rising carcinoembryonic antigen (CEA) levels. A CT scan did not reveal the site of tumor recurrence. An FDG PET study showed a liver focus (Fig. 2, arrows), which was proven by biopsy to be recurrent rectal cancer.

Why Did FDG PET Help? The liver metastasis was identified as the likely source of this patient's rising CEA blood marker. No other source was apparent. The patient, therefore, could be managed with this information. For patients with isolated liver recurrence, surgery for removal of a part of the liver is usually a good option.

Key Management Issues.

- Evaluating suspected recurrence and restaging
- Assessing response to treatment
- Evaluating liver lesions for metastatic disease

Summary of Evidence for FDG PET in Colorectal Cancer. For staging: An estimated 36% change was noted in management effect, based on 236 patient studies (Table 2).

For recurrence: An estimated 32% change was noted in management effect, based on 915 patient studies (Table 2).

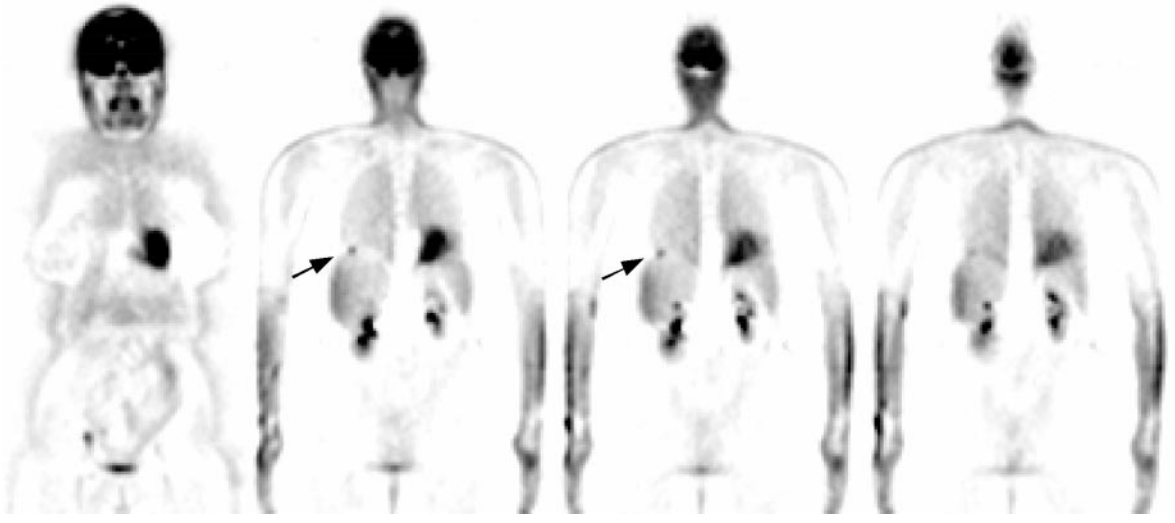


FIGURE 2. Case example, colorectal cancer.

TABLE 2

FDG PET in Colorectal Cancer: Results of Literature Search

COLORECTAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
No Articles																		
Staging																		
Amthauer, 2000	A	management	49	49													biop/surg/follow-up	42
Oyen, 2000	A	management	48	48													histopath/follow-up	15
Seltzer, 2000[1]	A	management	53	53													follow-up	42
Meta, 2000[2]	A	management	51	51													clin follow-up	40
Baehre, 2000	A	dual head coincidence	18		24	yes	96										immunoscintigraphy	
Beets, 1994	RA	management	35	35													histol/serial radiol follow-up	40
	Summary	.	**254**	**236**														**36**
		by lesions			**24**		**96**											
Dx/Staging																		
Abdel-Nabi, 1998[3]	RA	dx prim	48	44			100		43		90		100		91		CT/surg/histopath	
		staging LN mets		14			29											
				33				29		85								
		staging liver mets		43			88	38	100	97	100	50	97	86	98	81		
	Summary	**by patients**	**48**	**134**			**85**	**34**	**71**	**92**	**95**	**50**	**99**	**86**	**94**	**81**		
Recurrence																		
Whiteford, 2000[4]	RA	susp met or recur colorectal adenocarc																
		overall	105	105			87	66	68	59							histopath/clin follow-up	26
		detecting mucinous cancer		16			58											
		detecting nonmucinous cancer		93			92											
		locoregional recurrence		70			90	71										
		hepatic metastasis		101			89	71										
		extrahepatic metastases		101			94	67										
Zhuang, 2000	A	hepatic	72	72			100	76									surg/clin follow-up	
Lang, 2000	A	whole body/overall	156	156			88	80									CT/MRI	24
		whole body/local recurrence					73	61										
		whole body/distant mets					93	92										
Baehre, 2000	A	dual head coincidence	18		24	yes	96										immunoscintigraphy	
Montravers, 2000[5]	A	dx/recurr	53		85	yes									71	48	post surg histol	
Schirrmeister, 2000[6]	A	recurr/mgmt	100	100			98	91	90	72							histopath/clin follow-up	61
Peterson, 2000[7]	A	resid/recurr/post local ablation to liver mets	7		9		89	44									serial CT/CEA/biopsy	
Gamez, 2000[8]	A	whole body	18	18			100										histol/clin follow-up	

TABLE 2 (*Continued*)

COLORECTAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence	(cont.)																	
Imdahl, 2000[9]	RA	detect local recurrence	71	77			92		87		76		96				histol/surg	23
				68				88		89		81		93				
		detect hepatic mets		77			100		98		96		100					
				68				87		91		83		93				
		detect pulmonary mets		77			94		100		100		98					
				21				100		100		100		100				
Takeuchi, 1999[10]	RA	eval for local pelvic recurrence	23		25		94								100		CT/MRI/radiol/histol/biop	
Flamen, 1999	RA	staging recur colorectal adenocar/potent resect	103	60													histopath/clin follow-up 1y	20
		CDM inconclusive		13														62
Valk, 1999[11]	RA	whole body	115	115			95	78	79	50	97		69		93		histol/ser CT/clin follow-up	32
		local/pelvic			115		97		96									
		hepatic			115		95		100									
		whole body			691		93	69	99	96								
Yasuda, 1998	RA	liver mets/colorectal cancer	8		11		82	73									US/CT	
Maldonado, 1998	A	recurrence	18	18													not stated	50
Flamen, 1998[12]	A	hepatic	103	48			96	90	100	96							histol/clin follow-up>1yr	22
Flamen, 1998[13]		local/pelvic		37			81	59	100	95								
		retroperitoneal lymph node involvement		11			73	73	97	97								
		extra-abdominal		14			100											
Flanagan, 1998[14]	RA	whole body	22	22			100		71		89		100		91		pathol/LTradiol&clin follow-up	27
Keogan, 1997	RA	rectal recurrence	18	18			92		80		92		80		89		surg/biop/follow-up	
Delbeke, 1997[15]	RA	whole body	61	61			98		83		98		83		97		pathol/clin&radiol follow-up	28
		hepatic			127		91		96		99		71		92			
					96			81		60		92		38		78		
		extrahepatic			39		100		40		92		100		92			
					35			74		50		92		20		71		
Ruhlmann, 1997[16]	RA	whole body	59	59			100		67		92		100				histol/clin follow-up	
Ogunbiyi, 1997[17]	RA	local/pelvis	58	47			91	52	100	80							surg/histol/clin crse/autop	43
		hepatic		58			95	74	100	85								
Keogan, 1997	RA	local/pelvic	18	18			92		80								surg/biop/clin follow-up	
Vitola, 1996[18]	RA	whole body	24	24			95		80		95		80		92		surg/biop/clin follow-up	25
		hepatic			55		90		100		100		80		93			
		hepatic			33			86		58		78		70		76		
Lai, 1996[19]	RA	hepatic	34	34			93	100	57	14							surg/biop/serial CT	29
Schiepers, 1995[20]	RA	hepatic	76	83			94		100						98		surg/biop/clin follow-up	
				80												93		
		local/pelvic		83			94		97						95			
				74												65		
Bohdiewicz, 1995[21]	RA	detecting recurrence	12	12			80		50		89		33		75		pathol/CT	
Beets, 1994[22]	RA	management	35	35													histol/ser radiol follow-up	40
	Summary	**by patients**	**1387**	**2244**			**94**	**79**	**87**	**73**	**93**		**88**		**94**	**80**		**32**
		by lesions			**1460**		**93**	**71**	**96**	**89**	**98**	**89**	**74**	**41**	**87**	**67**		

TABLE 2 (*Continued*)

COLORECTAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																		
Bender, 1999[23]	PA	detect non-resect liver mets	10		11		100										follow-up 6 mos	
		rspnse to single hi-dose chemo			11										100			
Findlay, 1996[24]	PA	color liver mets/rspnse to 1st mo chemo	20		23		100		90								compar w tumor dimens CT	
	Summary	**by patients**	**30**															
		by lesions			**45**		**100**		**90**						**100**			
Other																		
No articles																		

[1] Major mgmt chges occurred in 42% pts w cancer other than lung (44%).

[2] 40%overall/43%clinstge/37%upstge/6%dwnstge/49%majmgmt/22%minmgmt/27%nochge/79%majupstg/16%minupstg/5%noneupstg/67%majdwn/33%mindwn/18%avdmajsurg or rad/22.2%perfsurg or rad.

[3] CT spec liver mets reported and listed as .97. It calcs to be 32/35=.91.

[4] 109 PET scans/105 pts/101 CT scans.

[5] 2x2 does not add to N=85 sites.

[6] 61%influence on therapy/14%addit info fm PET over conv/47%PET clarify contrad results conv.

[7] PET may identify residual disease or early recurrence after ablative therapy including those pts w neg CT scans.

[8] FDG-PET has superior accuracy than MET-PET&IS. Sens implied as 100% in abst. Rpts # of pts having ea lesion type but does not explicitly say tot # of lesions.

[9] 71 pts/77 PET investigations/68 CT scans. Chge-in-mgmt in 16/71 pts=22.5%.

[9] 71 pts/77 PET investigations/68 CT scans.

[9] 71 pts/77 PET investigations/21 CT scans.

[10] Sens based on 25 lesions from 23 colorectal cancer pts. An additional 6 prim lesions from rectal cancer pts were also included in study. Acc value based on DAR=2.8.

[11] 25/78 preop pts upstaged away from surg.

[12] This is % of correct chge in mgmt. 5 corr dwnstged+11 corr upstgd+5 corr for relapse+2 corr for excluding disease. Were also 2 incorr overstgd+5 incorr understgd.

[13] The total pts used for the 4 subgps=110 where tot pts in study =103. Some subgps overlap in pts(e.g. pt having pelvic and retroper simult).

[14] 4of15 guided to curative surg; 11 guided away from surg.

[15] 6 directed to surg/11 avoid unnecess surg. PET:54TP/1FP/1FN/5TN.

[15] PET:95TP/1FP/9FN/22TN.

[15] CT:66TP/6FP/15FN/9TN.

[15] PET:34TP/3FP/2TN.

[15] CT:23TP/2FP/8FN/2TN.

[16] Art reports PET wd have had a definitive impact on pt mgmt in at least 6 pts. 6/59=10% theor chge in mgmt.

[17] Tot used pts exceeds tot pts in study as diff #'s apply to diff subgps.

[18] Altered surgical plans in 6/24 pts. PET:18TP/1FP/1FN/4TN.

[18] PET:35TP/4FN/16TN.

[18] CT:18TP/5FP/3FN/7TN.

[19] 10/34 pts were influenced in clinical mgmt. Seems that 2FP reported in art are actually 2FN (for hepatic lesions by PET - 25/27 correct.)

[20] 76 pts/83 studies. Values calculated based on 83 studies for both pelvic and liver results. Liver PET:33TP/2FN/48TN.

[20] Pelvic PET:45TP/1FP/3FN/34TN.

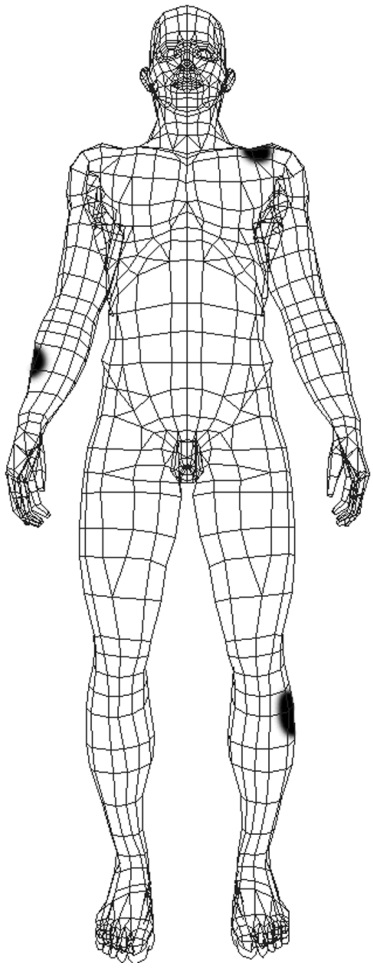
[21] 12 pts. 10 pts w colorectal carcinoma. 2 pts w ovarian carcinoma.

[22] Chge in mgmt=14/35=.40

[23] 10 pts. 11 mets. 6 responders w signif FDG decr. 5 non-responders(2 s.t. w sl FDG decr/3 progress w enhanced FDG.)

[24] Values obtained using a 15% decrease in pre-trtmt T:L ratio by 4-5 wks in compar w tumor rspnse.

Melanoma



Disease Background. With an increasing mortality rate second only to that of lung cancer, malignant melanoma is the most rapidly increasing cancer in white populations, with incidence increasing at >5%/y since 1973. The most common cancer striking young women between ages 25 and 29, melanoma accounts for 18% of all cancers in young adults 15–39 y old. Melanoma risk factors include preexisting skin lesions and lighter hair color, with red-haired and blond individuals having 3 and 2 times greater risk than average, respectively. An overall increase in risk appears related to strong solar ultraviolet radiation. Approximately 20% of patients who present with nodal metastases with no distant metastases are cured by surgery. For isolated metastases to the brain and lung, surgery can improve survival. Thus FDG PET's role in identifying truly isolated metastases is central to the making of rational decisions about radical surgical removal of metastases.

Case Example. A 63-y-old patient had a melanoma removed from the skin overlying the right scapula (shoulder region). A second metastasis was excised at the nape of the neck. An FDG PET scan was ordered to stage the patient's cancer. Increased FDG metabolism was seen after surgery at the shoulder site (Fig. 3, far right, top arrow). In addition, multiple metastases were seen within the anterior mediastinum, left lung, left adrenal, left axilla, and para-aortic nodes.

Why Did FDG PET Help? The FDG PET scan showed that the melanoma had spread to various tissues and that chemotherapy would be the only option.

Key Management Issues.

- Determining the stage of thick melanoma lesions at presentation
- Assessing nodal spread from lesions of intermediate thickness
- Confirming the recurrence of disease
- Monitoring response to treatment
- Restaging before surgical removal of isolated metastases

Summary of Evidence for FDG PET in Melanoma. For staging: An estimated 26% change was noted in management effect, based on 283 patients (Table 3).

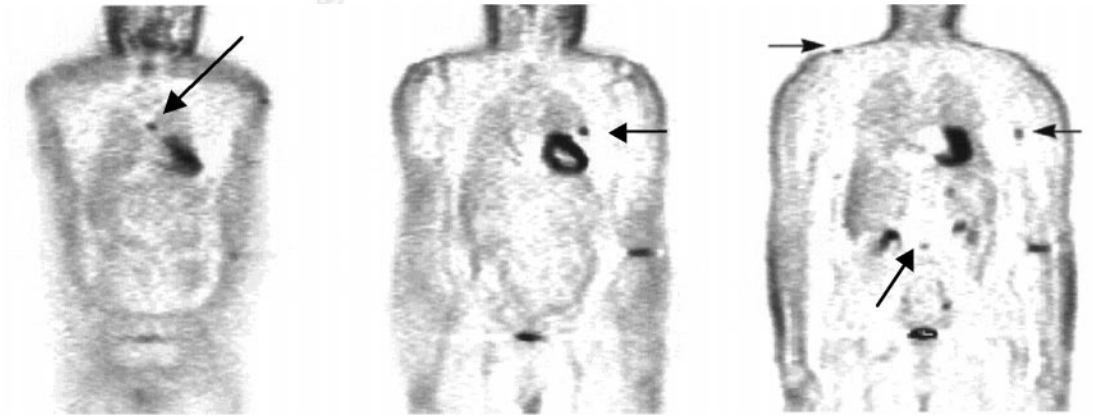


FIGURE 3. Case example, melanoma.

TABLE 3
FDG PET in Melanoma: Results of Literature Search

MELANOMA	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
No Articles																	
Staging																	
Acland, 2000[1]	RA	detect subclin met melan/overall	54	62		78		87								histol	
		stage I		35		50		87									
		stage II		9		33		100									
		stage III		17		93		50									
Jadvar, 2000[2]	RA	management/newly dx & recur	38	38												CT/clin follow-up 10 to 36 mos	8
Eigtved, 2000	RA	staging malig melan/stages II & III	38														
		all foci		38		97		56		88		83		87		clin ex/CT/US/radiog/liver fn/histol/clin follow-up	
		all foci		7			62		22								
		intra-abdominal foci				100	100	100	100								
		pulmonary/intrathoracic foci				100	33	100	33								
Paquet, 2000[3]	RA	staging metastatic melanoma	24	28										>80	>80	clin/pathol	
Wong, 2000	A	management	47	47												follow-up	34
Seltzer, 2000[4]	A	management	47	47												follow-up	34
Bohuslavizki, 2000	A	prim staging/therapy monitoring	82		189	72		70		93		32				histol	
Mruck, 1999[5]	RA	post-surg follow-up/hi-risk melan	50	51		100	92	95	82							CT/MRI/LN sonog/bne scint/histol/6 mo follow-up	
Wagner, 1999	RA	occult regional lymph node	70	70		17		96		50		82				SNB histol/clin follow-up exam	
Nguyen, 1999	RA	staging	45	51		81		80								biop/other radiog methods/clin follow-up 6 mos	33
Laningham, 1999	A	staging prim & recur	25	25		96										biop/clin crse	
Chisin, 1999	A	staging	21	21		91		90								histol/other correl data	
Steinert, 1998[6]	RA	known met or newly dx	55	24	83	89		29		93		20		84		biop/PCS/US/CT/MRI	
Macfarlane, 1998	RA	staging	24	24		85		92								histopath	
Hsueh, 1998	RA	at 6 months follow-up	87	87		72		92		78		89				clin crse	
		at 12 months follow-up	87	87		61		94									
Holder, 1998	RA	metastatic melanoma scan	100	100		94		83								biop/cytol	
		by lesions	100		8	100											
Rinne, 1998	RA	whole-body lesions	59	59		100		94						98		follow-up	
		whole-body patients	52	52		100		94									
		brain	15	15		100		100									
		neck LN	25	25		100		100									
		lung	37	37		70		100									
		mediastinum/hilus	20	20		71		100									
		liver	20	20		100		100									
		abdomen	33	33		100		94									
		abdominal LN	19	19		100		100									
		peripheral LN	49	49		97		100									
		bones	17	17		100		100									

TABLE 3 (*Continued*)

MELANOMA	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Staging	(cont.)																
Wagner, 1997	RA	regional lymph node eval	14		14	100		100								histol	
Damian, 1996	RA	staging	100	100	415	93										Xray/CT/MRI/Bne Scint	22
Blessing, 1995	RA	dx lymph nodes	83		83	74		93								histol/US	
Böni, 1995	RA	staging	39		39	91		67								Conv/biop	
Steinert, 1995	RA	dx metastatic melanoma	53		53	92		77								histol/other imag	
Gritters, 1993	RA	superficial lymph node	13	13		100		100								biop/physical exam	
		intra-abdominal LN & visceral			15	100											
	Summary	**by patients**	**1642**	**1327**		**83**	**88**	**91**	**75**	**70**		**85**		**91**	**80**		**26**
		by lesions			**899**	**87**		**68**		**93**		**28**		**84**			
Dx/Staging																	
No Articles																	
Recurrence																	
No Articles																	
Monitoring Response																	
No articles																	
Other																	
No articles																	

[1]Overall 54 pts/62 scans=Used #. 34 pts/35 scns stg I. 9 pts/9 scns stg II. 16 pts/17 scns stg III. 1pt/1scn stg IV.

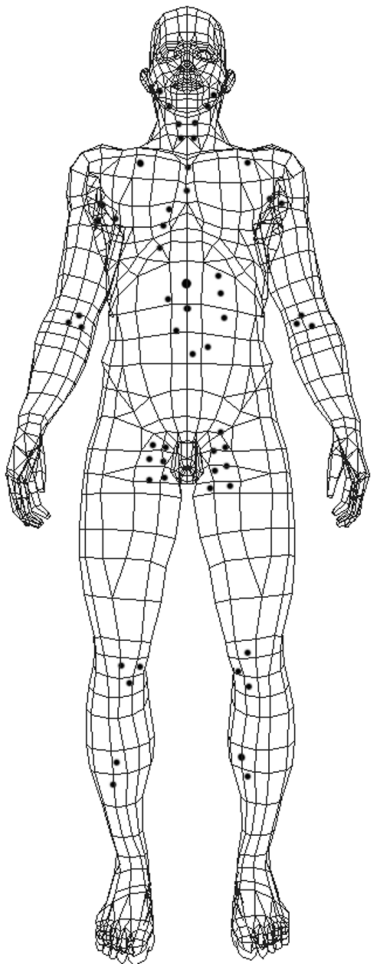
[2]3/38=8% had chge in surg mgmt from PET w no effect to WW strat or decis to init immunotherapy.

[3]24 pts/28 assessments.

[4]34% major/21% minor.

[5]50 pts/51 studies.

[6]Used pts=24. Values based on 83 lesions. 68TP/5FP/8FN/2TN.



Disease Background. Both Hodgkin's disease (HD) and non-Hodgkin's lymphoma (NHL) are common malignancies that are increasing in frequency. The underlying problem in lymphoma arises from the individual's white blood cells, cells involved in helping to fight infections. Significant differences exist between HD and NHL, and these differences factor into both diagnosis and treatment. HD begins as a unifocal disease located in a single group of malignant lymph nodes and spreads via adjacent associated lymph node groups. Limited disease is treated appropriately with radiation therapy, resulting in complete cures for a high percentage of patients. Even after recurrence, treatment still may result in permanent cure. Patients with advanced disease have a poorer prognosis and usually require chemotherapy in addition to other treatments. NHL is a multifocal disseminated disease, usually requiring combined chemotherapy, sometimes radiotherapy, and, in some instances, high-dose chemotherapy with bone marrow transplantation. In most patients the disease is ultimately fatal. However, long remission and cure can be induced effectively in high-grade tumors that would be rapidly fatal if untreated. Low-grade NHL, which has a better prognosis untreated, does not respond as well to chemotherapy and consequently can result in a worse prognosis after treatment.

Case Example. A 27-y-old man with lymphoma underwent an FDG PET study before chemotherapy in July 1999 (Fig. 4, top row). At that time, evidence of cancer was found in the right shoulder and thoracic spine (arrows). The first follow-up FDG PET scan (Fig. 4, middle row) showed nonspecific bone marrow response to chemotherapy (a common finding). The second follow-up scan (Fig. 4, bottom row) demonstrated complete remission, with the right shoulder and thoracic spine regions no longer showing increased FDG metabolism.

Why Did FDG PET Help? FDG PET showed that the chemotherapy was working and that the cancer cells were being destroyed. This helped doctors know that further treatment was not needed at that time and gave the patient a sense of relief that his condition was improving.

Key Management Issues.

- Staging the disease before treatment
- Monitoring response to treatment
- Detecting recurrence
- Making a differential diagnosis

Summary of Evidence for FDG PET in Lymphoma. For staging: An estimated 21% change was noted in management effect, based on 407 patient studies (Table 4).

For diagnosis/staging: An estimated 5% change was noted in management effect, based on 62 patient studies (Table 4).

For recurrence: An estimated 10% change was noted in management effect, based on 158 patient studies (Table 4).

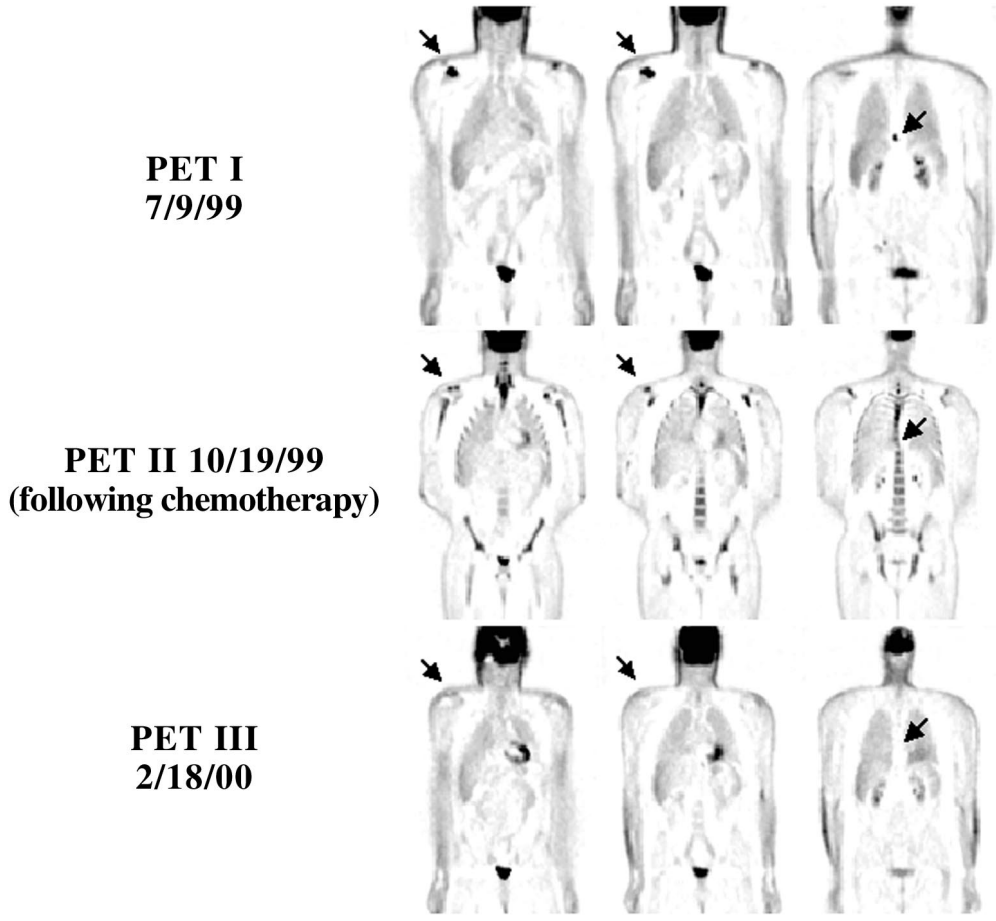


FIGURE 4. Case example, lymphoma.

TABLE 4

FDG PET in Lymphoma: Results of Literature Search

LYMPHOMA	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
Hoffman, 1993[1]	RA	lymphoma vs nonmalig CNS lesions/AIDS	11	11			100										CT/MRI/follow-up/biopsy	
	Summary	**by patients**	**11**	**11**			**100**											
Staging																		
Delbeke, 2000	A	staging	27	27													pathology	31
Yap, 2000	A	management	58	58													not stated	50
Kostakoglu, 2000	A	staging	86	86							67		84				biopsy	
Mart'nez-Lizaro, 2000	A	low-grade NHL	101	24			100	94	88	75							pathol/radiog/scint/clin follow-up	
		high/intermediate grade NHL		49			85	86									histology	
Bohuslavizki, 2000	A	HD/staging	37	37			91		69		46		96	74				
Dittmann, 2000	A	management	24	24													follow-up	8
Seltzer, 2000[2]	A	management	536	40													follow-up	50
Hwang, 2000	A	CoDe-PET/staging lymphoma	59	59		yes					86		86				histology	
Delbeke, 2000	A	NHL/HD management	45	45			58										pathology	6
Tatsumi, 2000	A	staging/NHL	30	30	206		87										Ga67/CT	
		other PET		30		yes	77											
Kostakoglu, 2000[3]	A	staging/dx/relapse	62	62			100										CT/clinical correl	5
Tomas, 2000	A	staging/prior/during/post ther	10	10	32	yes									95		GaSPECT	
Israel, 2000	A	staging/base/trtm/post trtmt/follow-up	35	35	123												Ga scint/CT/biop/follow-up	
Jacobson, 2000[4]	A	dx/staging/recurr	95	177			89		93		62		88	84			clin/imaging/histopath	
Shah, 2000[5]	RA	management of lymphoma	29	29				84		50							biop/clin observation	34
Lin, 2000	A	staging/lymphoma	46	46		yes	100										clinical staging/CT/Ga scint	
					110		96											
Hoffmann, 1999[6]	RA	extranodal B-cell lymphoma/MALT type	10	10			0										ophthal/otolaryn/gastros/endos	
																	entero/colonosc/CT/biop	
Moog, 1999	RA	Hodgkin/NHL staging	56	56										100			biop/MRI/CT/radiog studies	
Jerusalem, 1999	RA	Hodgkin/NHL evaluation	60	60													clin ex/CT/MRI/focal biop	3
Zinzani, 1999	RA	Hodgkin/NHL prognosis	44	44			100	100	96	17							clin outcome/survival	
Finke, 1999	A	MH/primary staging	93	93			89	65	99	97							biop/MRI/ US/ follow-up	
		NHL	93	93			100	73	99	96							biop/MRI/ US/follow-up	
Lin, 1999	A	staging/lymphoma	17	17		yes	100										clinical staging/CT/Ga scn	
					42		98											
Bangerter, 1999	RA	chest lymphoma/staging/follow-up	89	147			96		94		90		98				CT/clin follow-up exam	
Jerusalem, 1999	RA	Hodgkin/NHL restaging	54	54							100	42					outcome	
Moog, 1998[7]	RA	detect extranodal lymphoma spread	81		58		97	63	100	93							biop/clin follow-up	16
Carr, 1998	RA	detect lymphoma in bone marrow	50	50			81		76		62		90		78		unil iliac crest marrow aspir/biop	
Richter, 1998[8]	A	HD/NHL/staging/resid/recur/pre-ther	17	17			100		100								histol/clin follow-up	
		post-trtmt	46	46			90		100								histol/clin follow-up	
Bangerter, 1998	RA	Hodgkin/staging	44	44			86										conv staging/biop	14

TABLE 4 (*Continued*)

LYMPHOMA	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Staging	**(cont.)**																	
Stumpe, 1998[9]	RA	Hodgkin/staging	50	53			86		96						91		conventional staging	
				33				81		41						60		
		NHL/ staging		18			89		100						94		conventional staging	
				16				86		67						73		
Cremerius, 1998[10]	RA	assess residual dis/relapse post trtmt	27	27			100	100	92	17	94	60	100	100	96	63	biop/clin follow-up	
Hoh, 1997	RA	NHL/staging	18	18			89	89			22						conv staging/biop	22
Moog, 1997[11]	RA	prim nodal staging/malig lymphoma	60		740		90	86									biop/clin follow-up/CT	7
Newman, 1994	RA	NHL/Hodgkin/thoracicoabdominal lymphoma	16	16			81	81									laparotomy/CT/biop/clin follow	
Bares, 1993[12]	RA	detect susp or known malig lymphoma	22	16			92										LN biop/CT/3 mo follow-up	
	Summary	**by patients**	**2227**	**1796**			**90**	**81**	**93**	**69**	**74**	**48**	**91**	**87**	**88**	**64**		**21**
		by lesions			**1311**		**91**	**84**	**100**	**93**					**95**			
Dx/Staging																		
Kostakoglu, 2000[13]	A	staging/dx/relapse	62	62			100										CT/clinical correl	5
Jacobson, 2000[14]	A	dx/staging/recurr	95	177			89		93		62		88	84			clin/imaging/histopath	
Goldberg, 1993[15]	RA	known or susp malig process/abdom or pelvis	38	15			92										CT/clin findings	
	Summary	**by patients**	**195**	**254**			**92**		**93**		**62**		**88**	**84**				**5**
Recurrence																		
Spaepen, 2000[16]	A	predicting relapse	96	96			66		100						85		follow-up/biopsy/CT/MRI	14
Kostakoglu, 2000[17]	A	staging/dx/relapse	62	62			100										CT/clinical correl	5
Jacobson, 2000[18]	A	dx/staging/recurr	95	177			89		93		62		88	84			clin/imaging/histopath	
Maisey, 2000[19]	RA	assess residual mass post chemo/overall	61	24			50		69		44		73				MRI/CT/follow-up	
		HD		12			0		67		0		67					
		NHL		12			80		71		67		83					
Mikhaeel, 2000	RA	eval of residual masses on post-trtmt CT	32	32			80		95		89		91		91		CT/clin follow-up 38 mo/pathol	
Cremerius, 1998[20]	RA	assess residual dis/relapse post trtmt	27	27			100	100	92	17	94	60	100	100	96	63	biop/clin follow-up	
Richter, 1998[21]	A	HD/NHL/staging/residual/recur/pre-ther	17	17			100		100								histol/clin follow-up	
		post-trtmt	46	46			90		100								histol/clin follow-up	
de Wit, 1997[22]	RA	assess residual mass vs necrotic post trtmt	34	34			100	86	73	4	57	19	100	50			routine methods/scint/histol	
Dimitrakopoulou-Strauss, 1995[23]	RA	eval for possible second-line chemo	46	42	114		100										CT/MRI	
	Summary	**by patients**	**516**	**581**			**87**	**92**	**93**	**10**	**66**	**37**	**90**	**81**	**88**	**63**		**10**
		by lesions			**114**		**100**											

TABLE 4 (*Continued*)

LYMPHOMA	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																		
Jerusalem, 2000[24]	RA	early eval rspnse/polychemo 2-5 cycles/NHL	28	26			42		100		100		67				relapse/biop/clin follow-up	
Torizuka, 2000[25]	RA	response to RIT/NHL	14	8			100		100								phys ex/CT/bne mar biop/chem	
Tomas, 2000	A	staging/prior/during/post ther	10		32	yes									95		Ga SPECT	
Israel, 2000[26]	A	staging/base/trtmt/post-trtmt/follow-up	35	13		yes	100		60		43		100		69		CT/biop/follow-up	
Wiedmann, 1999[27]	RA	HD/eval response to chemoradiotherapy	23	22					77								CT/xray/US	
Bangerter, 1999	RA	chest lymphoma/staging/follow-up	89	147			96		94		90		98				CT/clin follow-up exam	
Richter, 1998[28]	A	HD/NHL/staging/residual/recur/pre-ther	17	17			100		100								histol/clin follow-up	
		post-trtmt	46	46			90		100								histol/clin follow-up	
	Summary	**by patients**	**262**	**279**			**90**		**93**		**88**		**94**		**69**			
		by lesions			**32**										**95**			
Other																		
No articles																		

[1]FDG uptake signif higher both qualitative/semiquantitative compared to nonmalig lesions.

[2]50 major/10 minor.

[3]5% upstaged.

[4]95 pts/177 scans.

[5]10/29 pts=34% w chge in clin mgmt.16 CT TP/5 CT FP/3 CT FN/5 CT TN.

[6]PET did not visualize histologically verified lesions in any of 10 pts studied. Study discontinued.

[7]13/81 pts=16% w reassignment of tumor stage from verified PET results.

[8]PET:16TP/1TN.

[8]PET:18TP/2FN/26TN.

[9]PET:24TP/1FP/4FN/24TN.

[9]CT:13TP/10FP/3FN/7TN.

[9]PET:8TP/1FN/9TN.

[9]CT:6TP/3FP/1FN/6TN.

[10]For CT visual image interpretations, all findings except complete remission were considered pathological.

[11]60 pts. 740 LN regions. 185 malig/555 benign. PET TP=167/CT TP=160. PET induced stage chge in 4 pts/60 pts=7%.

[12]22 pts. 14 susp/8 treated. 16 pts had PET. Detection rate = 23/25.

[13]5% upstaged.

[14]95 pts/177 scans.

[15]38 pts. 21 pts w liver tumor. 15 pts w lymphoma. 1 pt w hemangioma.

[16]13 of 96 received immed secondary trtmt.

[17]5% upstaged.

[18]95 pts/177 scns.

[19]61 pts. 58 pts used. 56 pts had MRI/24 PET/22 Both.

[20]For CT visual image interpretations, all findings except complete remission were considered pathological.

[21]PET:16TP/1TN.

[21]PET:18TP/2FN/26TN.

[22]Cannot duplicate Table 5 results from article reporting.

[23]42 pts studied w PET. Sens based on 114 malig lesions.

[24]2x2 of PET+/PET- vs Relapse/CR. 5TP/0FP/7FN/14TN. 1 init CR of PET+ ultim relap/7 of 21 CR of PET- ultim relap.

2 pts of init 23 PET- died.

[25]2x2 defined by trtmt response (CR&PR) vs no response and mean SUV-lean decline vs no decline at 33-70ds. N=8 pts.

6 TP=6 responders w signif decline. 2 TN=2 non-responders w no decline.

[26]35 pts/13pts w complete data by pts:3TP/4FP/6TN.

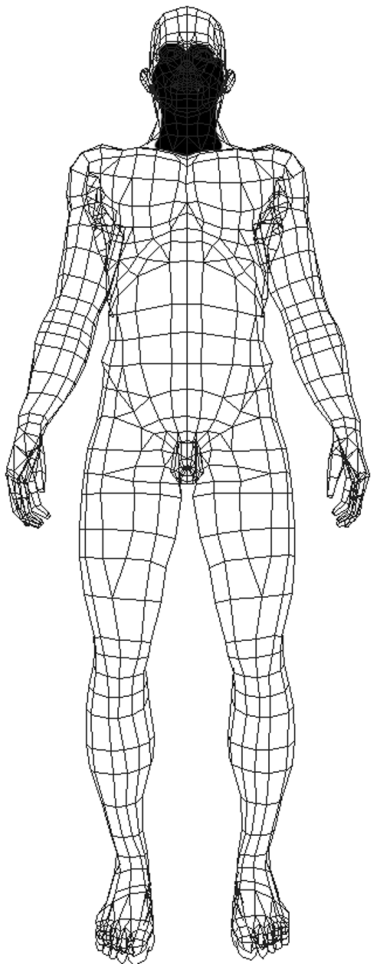
[27]23pts/42 exams/22 of 42 exams for rspnse to chemoradio. All pts in CR/5 FP/17 TN on PET.

PR,PD, suspic of relapse considered not CR.

[28]PET:16TP/1TN.

[28]PET:18TP/2FN/26TN.

Head and Neck Cancer



Disease Background. Cancer of the head and neck is relatively uncommon in the western world, occurring in 2%–4% of all cancers. In contrast, it comprises up to 40% of all cancers in some Asian countries. In the western cases, the majority are squamous cell tumors with a variable aggressiveness that depends on site and histological appearance. Strong environmental links have been found with tobacco and alcohol usage and with other factors, such as chemicals, fumes, and viruses. Multidisciplinary teams of head and neck surgical oncologists, radiation oncologists, imaging specialists, and medical oncologists operating in specialized centers are required for good outcomes. Treatment is directed at maintaining the form and function of the head and neck structures as well as eradicating the disease. Because of the need to limit surgery and the fact that local nodal spread is the most important prognostic factor, imaging has an important role in the management of these tumors. After treatment, conventional anatomical imaging procedures prove less useful because of the distortion of anatomy caused by treatment. Therefore, FDG PET is of particular importance in follow-up imaging of suspected recurrence.

Case Example. A patient with a right alveolar ridge carcinoma was referred for FDG PET scanning before surgery for staging purposes. Results of a CT scan (Fig. 5A, 5C) indicated that the tumor extended superiorly into the maxillary sinus. Registered PET and CT images showed uptake of FDG within the primary site arising from the alveolar ridge (Fig. 5B) but no evidence of tumor within the sinus itself (Fig. 5D). This illustrates how the FDG PET scan can identify the extent of disease when inflammatory tissue and tumor are co-located.

Why Did FDG PET Help? FDG PET helped because it determined that the tumor was localized and did not extend into the maxillary sinus. This directly aided the surgery for tumor removal.

Key Management Issues.

- Locating the site of primary disease
- Determining the extent of primary disease
- Staging of lymph node spread
- Detecting recurrence
- Assessing response to therapy

Summary of Evidence for FDG PET in Head and Neck Cancer. For diagnosis/staging: An estimated 33% change was noted in management effect, based on 15 patient studies (Table 5).

For recurrence: An estimated 33% change was noted in management effect, based on 15 patient studies (Table 5). Because management effect for both diagnosis/staging and recurrence is based upon the same single study of 15 patients, results should be interpreted with caution.

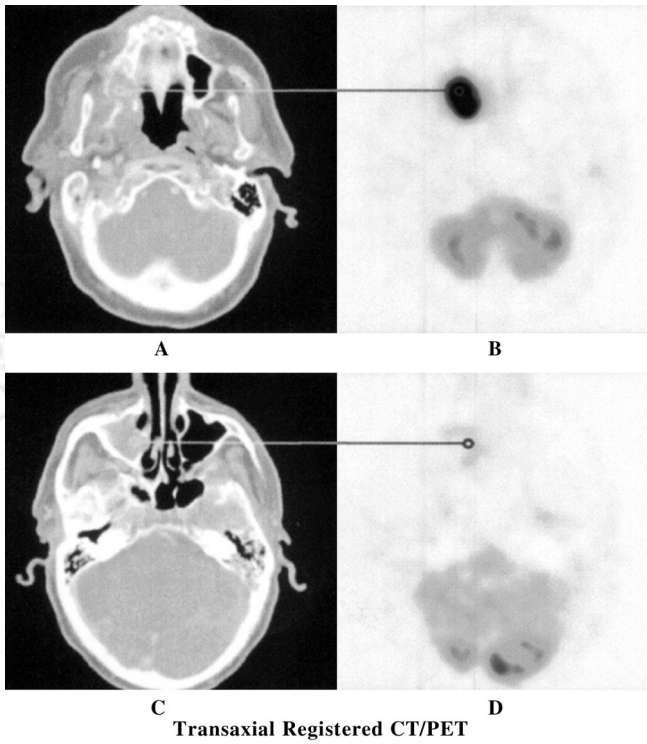


FIGURE 5. Case example, head and neck cancer. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography*. London, UK: Arnold, Hodder Headline Group; 1999.

TABLE 5
FDG PET in Head and Neck Cancer: Results of Literature Search

HEAD/NECK CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
Zimny, 2000	A	dx/prim/recur/H&N	36														CT/MRI/US/histol/follow-up	
		prim/recur		36		yes	82	59	70	70					78	62		
		LN mets/neck sides			68	yes	64	55	92	82					87	78		
Beuthien-Baumann, 2000	A	dx/oral mucosa carcinoma	39	39			95	72									surg/histology	
		lymph node mets			70		93		87		56		98		86			
		lymph node mets			59			29		94		36		79		71		
Henze, 2000	A	larynx/hypopharynx	19		17		88										histological	
Nowak, 1999[1]	RA	dx eval/kn or susp prim&recur/all	71		74		87	64	71	71	89	85	68	44	82	66	histol/clin follow-up	
		prim			48		87	67	67	44	92	84	55	24	83	63		
		recur			26		86	57	75	92	80	89	82	65	81	73		
		LN mets/nk sides			136		80	80	92	84	80	68	92	91	88	83		
Wong, 1997	RA	assessmt/prim	54	54			100										CT/MRI/histol/nk dissect	
		nodal disease		16			67	67	100	25						54		
		recurring/residual disease		12											100			
		post-treatment necks		13											100	54		
Grünwald, 1997	RA	primary tumors/thyroid cancer	54		55		92		84						87		clin eval/histol/follow-up	
Greven, 1994[2]	RA	detect prim	25	23	27		89										clin/radiographics	
	Summary	**by patients**	**298**	**193**			**93**	**66**	**70**	**56**					**87**	**58**		
		by lesions			**580**		**84**	**51**	**83**	**81**	**73**	**63**	**83**	**60**	**85**	**72**		
Staging																		
Li, 2000	A	assessmt/recurrence	43	43			91		86						88	66	biopsy/6 mo follow-up	
Keyes, 2000[3]	RA	imaging thorax/H&N cancer	56	9							33						other imaging/biop/clin follow-up	
Lang, 2000	A	cervical lymph node staging	62		91		75		95								neck dissect/histol	
Lowe, 2000	RA	recur detect/ser post-ther/Stge IIIorIV	44	16			100	38	93	85							biop/pathol	
Zimny, 2000	A	dx/prim/recur/H&N	36														CT/MRI/US/histol/follow-up	
		prim/recur		36		yes	82	59	70	70					78	62		
		LN mets/neck sides			68	yes	64	55	92	82					87	78		
Adams, 1998	RA	cervical LN staging	60		1284		90	82	94	85							histopathology	
Paulus, 1998	RA	initial lymph node staging	38	25			50	40	100	100					80	76	surg/histopath	
		local recurrence		13			71	100	100	83					85	92		

TABLE 5 (*Continued*)

HEAD/NECK CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Staging	(cont.)																	
Manolidis, 1998	RA	pre-op eval/local dis/prim&susp recurr	29		30		87		80						80		clin/radiol/histopath	
		local dis/prim&susp recurr			21			88		50						81		
		local dis/recur malig only		22			94		80						91			
		local dis/recur malig only		16				71		66						69		
		local dis/squamous cell carcin only		15			92		100						93			
		regional disease/prim&recur			30		80		85						83			
		regional disease/prim&recur			20			57		77						70		
		regional disease/recur malig only		22			89		85						86			
		regional disease/recur malig only		14				82								64		
		regional dis/squamous cell carcin only		15			75		100						80			
		distant metastases			28		90		94		90		94					
Wong, 1997	RA	assessmt/prim	54	54			100										CT/MRI/histol/nk dissect	
		nodal disease		16			67	67	100	25						54		
		recurring/residual disease		12											100			
		post-treatment necks		13											100	54		
Lowe, 1997	RA	response to chemo	28	27			90		83		95		71		89		tissue biopsies	
Benchaou, 1996	RA	pre-op assessmt N-staging/H&N ca	48		468		72	67	99	97	89	74	99	95	96	93	nk dissect/histopath	
		sub-digastric LN gps			52		86	86	90	84	86	78	90	90	89	85		
Braams, 1995	RA	lymph nodes	12	12			91		88								clin/MRI/histopathology	
Zeitouni, 1994	RA	detect known tumors/newly dx&recurr	7	7											100		biopsy	
Rege, 1994[4]	RA	extracranial H&N ca/detect prim	60	30			97										biopsy	
		LN involvement		34											94			
		recurring prim tum		17			90		100		100		88		94			
Lindholm, 1993[5]	RA	detect known tumors/prior to ther	14		21		90										histol/cytol	
	Summary	**by patients**	**591**	**468**			**87**	**62**	**89**	**73**	**86**		**78**		**88**	**67**		
		by lesions			**2113**		**84**	**77**	**95**	**87**	**89**	**74**	**99**	**95**	**94**	**90**		
Dx/Staging																		
Di Martino, 2000	RA	pretherapeutic dx nodal spread	40	40			82	82	87	94	77	88	91	91			nk dissect/LN biop/histol/clin crse	
Zimny, 2000	A	dx/prim/recur/H&N	36														CT/MRI/US/histol/follow-up	
		prim/recur		36		yes	82	59	70	70					78	62		
		LN mets/neck sides			68	yes	64	55	92	82					87	78		
Pai, 1999	RA	detect prim/pretherapy	7		7	yes	71	86			100	100			71	86	repeat MRI/endosc/3 mo follow-up	
		neck node mets/pretherapy			14		82	81	100	100	100	100	60	60	86	86		
		detect prim/posttherapy	19		23		100	100	100	67	100	45	100	100	100	74		
		neck node mets/posttherapy			46		100	100	91	95	33	50	100	100	91	96		
Cheon, 1999	RA	H&N/posttherapeutic recurrence	45	45			97	73	88	85					93	77	histol/clin follow-up/biop	
		<3mo post trtmt	18	18			100	67	86	71					94	69		
Farber, 1999	RA	recurrent	28	28			86		93		92		87		89		histol	
Conti, 1999	RA	susp local/ distant recur	30	30			100										histol	
Fischbein, 1998	RA	residual/recurrent H&N-(primary)	44	44			100		64		65		91				histol/biop/clin follow-up	

TABLE 5 (*Continued*)

HEAD/NECK CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Dx/Staging	**(cont.)**																	
Paulus, 1998	RA	initial lymph node staging	38	25			50	40	100	100					80	76	surg/histopath	
		local recurrence		13			71	100	100	83					85	92		
Maldonado, 1998	A	tumor recurrence	15	15													not stated	33
Wong, 1995[6]	RA	assess prim	17	17			100										histol	
		nodal mets		10											100		neck dissection	
		possible local recurrence	9	9											100			
Lindholm, 1993	RA	detect of known H&N	14		21		90										biopsy/histol/cytol	
	Summary	**by patients**	**360**	**330**			**88**	**69**	**83**	**85**	**76**	**88**	**90**	**91**	**88**	**73**		**33**
		by lesions			**179**		**83**	**78**	**94**	**85**	**66**	**60**	**93**	**93**	**89**	**84**		
Recurrence																		
Haenggeli, 2000	RA	detect resid tumor 3 mos post-trtmt	50	50			100		74		42		100		78		biop/follow-up 4 mos	
Lapela, 2000[7]	RA	detect recurrent H&N ca	56		81		95		93		91		87		90		histol/cytol/biop/follow-up	
					69			91		100						84		
Mueller, 2000	A	pre-op dx/recurr/hurthle cell ca	20		37		62										histol/cytol/follow-up	
Lowe, 2000	RA	recur detect/ser post-ther/Stge IIIorIV	44	16			100	38	93	85							biop/pathol	
Li, 2000	A	assessmt/recurrence	43	43			91		86						88	66	biopsy/6 mo follow-up	
Zimny, 2000	A	dx/prim/recur/H&N	36														CT/MRI/US/histol/follow-up	
		prim/recur		36		yes	82	59	70	70					78	62		
		LN mets/neck sides			68	yes	64	55	92	82					87	78		
Pai, 1999	RA	detect prim/pretherapy	7		7	yes	71	86			100	100			71	86	repeat MRI/endosc/3 mo follow-up	
		neck node mets/pretherapy			14		82	81	100	100	100	100	60	60	86	86		
		detect prim/posttherapy	19		23		100	100	100	67	100	45	100	100	100	74		
		neck node mets/posttherapy			46		100	100	91	95	33	50	100	100	91	96		
Stokkel, 1999	RA	loc relap/laryng/hypopharyng/post-rad	48	48		yes	100		71		77		100		85		endoscopy/biopsy	
Collins, 1998[8]	RA	susp recurr/prim H&N	28	37			94		100		100		71		95		FNAB	
Paulus, 1998	RA	initial lymph node staging	38	25			50	40	100	100					80	76	surg/histopath	
		local recurrence		13			71	100	100	83					85	92		
Maldonado, 1998	A	tumor recurrence	15	15													not stated	33
Wong, 1997	RA	assessmt/prim	54	54			100										CT/MRI/histol/nk dissect	
		nodal disease		16			67	67	100	25						54		
		recurring/residual disease		12											100			
		post-treatment necks		13											100	54		
Anzai, 1996[9]	RA	previously treated/clin suspic	12	12			88	25	100	75	100	67	80	33	92	42	histopath	
Wong, 1995[10]	RA	assess prim	17	17			100										histol	
		nodal mets		10											100		neck dissection	
		possible local recurrence	9	9											100			
Lapela, 1995[11]	RA	detect suspected recurrence	15		23		88		86		93		75		87		histol/follow-up to 22 mos	
					18			92		50		79		75		78		
	Summary	**by patients**	**511**	**426**			**93**	**54**	**83**	**74**	**73**	**67**	**91**	**33**	**87**	**65**		**33**
		by lesions			**386**		**84**	**95**	**92**	**86**	**77**	**55**	**91**	**95**	**90**	**85**		

TABLE 5 (*Continued*)

HEAD/NECK CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																		
Lowe, 2000	RA	recurr detect/ser post-ther/Stge IIIorIV	44	16			100	38	93	85							biop/pathol	
Lowe, 1997	RA	response to chemo	28	27			90		83		95		71		89		tissue biopsies	
Wong, 1997	RA	assessmt/prim/recurr/residual	54	54			67	67	100	25					100	54	surg	
Berlangieri, 1994[12]	RA	radiother and chemo/loc adv/non-met	6	6			100										clin response	
Haberkorn, 1993[13]	RA	assess early chemo effects	18		16		44										CT	
Chaiken, 1993[14]	RA	tumor rspnse&control post rad ther	19	19			100		100								pathol/other imaging	
		post rad/susp ex/inconclus MRI/H&N only		6			100		100		80							
	Summary	**by patients**	**169**	**128**			**84**	**60**	**95**	**39**	**92**		**71**		**96**	**54**		
		by lesions			**16**		**44**											
Other																		
No Articles																		

[1]PET:71pts/78 studies/74 locations. CT:75 pts/74 locations.

[1]Values based on 136 neck sides.

[2]Sens by lesions = 24/27=.89.

[3]56 pts w prim tumors. 9 studies w PET findings in the chest correlated w ref stds.

[4]60 pts total. 34 pts staging. 7 pts adv disease/laser excision. 19 pts recurrence.

[5]Comparison to 11C-methionine tracer in 14 head & neck cancer pts prior to therapy.

[6]14 pts w H&N prim tumors. 2 pts w lung prim tumors. 1 pt w occult prim tumor never found.

[7]Sens and spec of visual interpretation of PET depended on selected scheme of grading lesions.

[8]28 pts/37 FNAB & PET scans.

[9]Values based upon defining rating of 4 as positive on 5 point rating system from 0 to 4 where 0=def nt recur and 4=def recur.

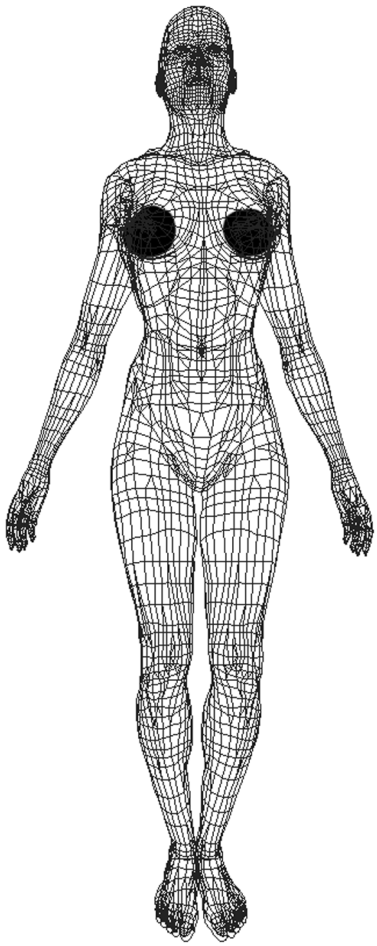
[10]4 pts w H&N prim tumors. 2 pts w lung prim tumors. 1 pt w occult prim tumor never found.

[11]Values based upon counting only lesions w hi uptke @ visual assessmt as +.

[12]Sens defined as exhibiting confirmed signif decline in tumor:nontumor FDG ratios.

[13]Sens=.44 based on positive response being decrease in FDG uptake. If definition includes no change w decrease, sens=.94.

[14]15 pts w H&N cancer. 4 pts w breast cancer.



Disease Background. In the United States, breast cancer is currently second only to lung cancer as the leading cancer causing death in women. It is the most common single cause of death for women ages 35–50 y. Cure can be achieved with early diagnosis and treatment, but a multidisciplinary approach is required. Treatment includes surgery, which is becoming progressively less radical, together with chemotherapy. Hormone and radiation therapy also are used therapeutically. Imaging is an important part of detection, staging, and management of most breast cancer patients. Although mammography has helped to detect breast cancer in many women, many cancers are missed in women who have dense breasts, implants, or have been treated previously for breast cancer. In addition, more methods are needed to better detect the spread of breast cancer and to monitor treatment and recurrence.

Case Example. A 61-y-old woman with breast cancer showed several foci of tumor involvement in the chest and spine (Fig. 6, top row) on her initial FDG PET scan. After chemotherapy, an FDG PET study was requested to look for tumor response to chemotherapy (Fig. 6, bottom row). The small foci of FDG accumulation seen throughout the chest and spine clearly had resolved. Post-therapy CT was positive (still showed tumor mass) because of necrosis and edema from therapy.

Why Did FDG PET Help? FDG PET showed that the chemotherapy was working and that this patient's breast cancer had responded to this particular type of chemotherapy. These changes were evident long before the CT scan showed any signs of response to treatment.

Key Management Issues.

- Determining if a breast mass is benign or malignant (This is especially difficult in dense breasts, implants, and after treatment. Approximately 60%–85% of breast biopsies are benign.)
- Staging of axillary and internal mammary lymph nodes
- Detecting metastatic disease
- Detecting local or distant recurrence
- Assessing the response of the tumor to treatment

Summary of Evidence for FDG PET in Breast Cancer. For diagnosis: An estimated 100% change was noted in management effect, based on six patient studies (Table 6). Because of the limited number of patient studies upon which this management change is based, this value should be interpreted with caution.

For staging: An estimated 24% change in management effect, based on 111 patient studies (Table 6).

For recurrence: An estimated 40% change in management effect, based on 23 patient studies (Table 6).

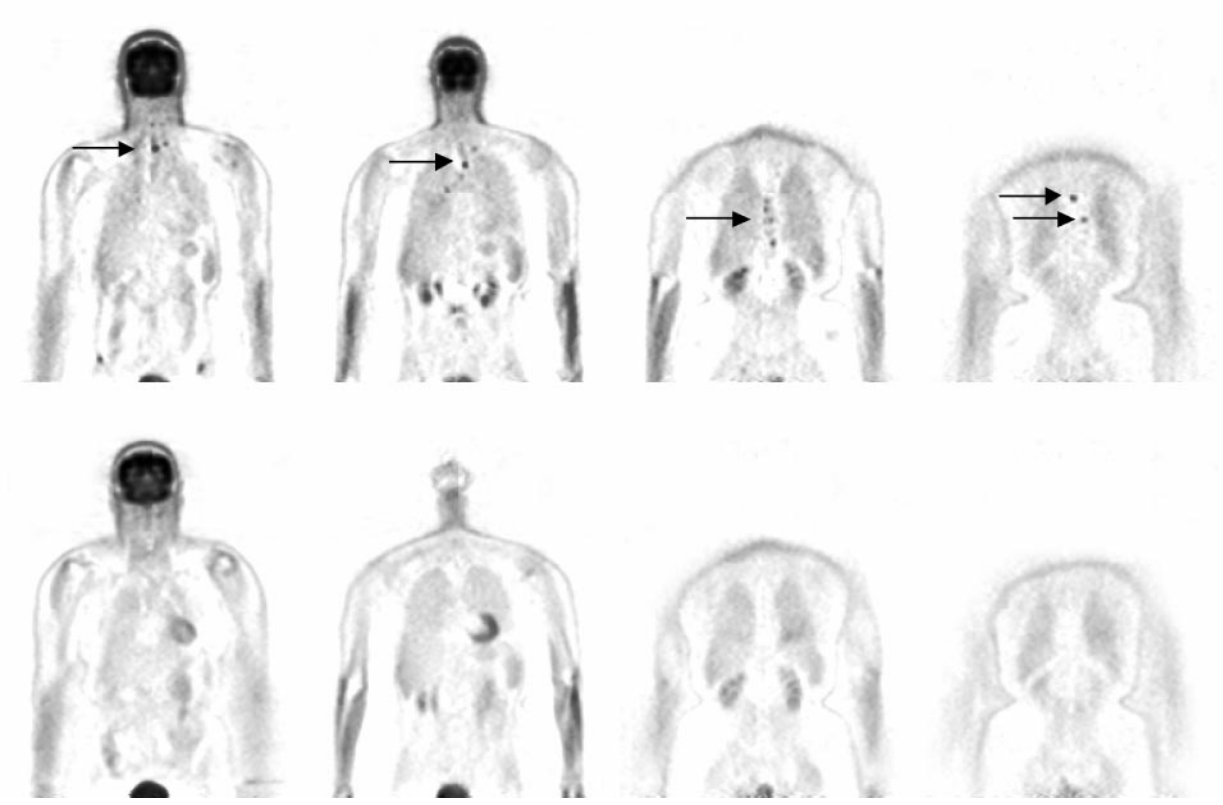


FIGURE 6. Case example, breast cancer.

TABLE 6
FDG PET in Breast Cancer: Results of Literature Search

BREAST CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
Fujii, 2000[1]	A	screening	6	6			83										palpation/US	100
Yutani, 1999	A	newly detected/prolif activity	28	28			100								100		lumpect/mastect	
Yutani, 1999[2]	RA	susp brst ca/prone vs supine image	52	18			94										excis biop/surg	
Noh, 1998	RA	primary breast mass	27	27			96		100						97		histology/phys ex/MM	
		axillary LN		27			100		92						96			
Palmedo, 1997	RA	breast masses	20	20			92		86								histopathology	
		axillae		12											100			
Yutani, 1997	A	newly detected/PETvsMIBI-SPECT	36	36			79										excis biopsyand/or mastect	
				36		yes	77											
Scheidhauer, 1996	RA	primary breast ca	30	30			91		86						90		histology/MM/US	
		axillary lymph nodes		18			100		89						94			
		distant mets		23			100		100						100			
Avril, 1996	RA	primary tumor	51		72		83		84		87		79		83		histology	
Crowe, 1994	RA	primary breast ca	28		33		100		100						100		phys ex/MM/axillary dissect	
		axillary LN			20		90		100						95			
Hoh, 1993[3]	RA	primary breast carcinoma	87	17			88										histol	
Adler, 1993	RA	breast masses	28		35		96		100								axillary node dissection	
		axillary lymph nodes			20		90		100									
Nitzsche, 1993	RA	primary breast masses	37	20			94		100		100		80		95		biopsy	
	Summary	**by patients**	**430**	**318**			**91**		**93**		**100**		**80**		**95**			**100**
		by lesions			**180**		**90**		**92**		**87**		**79**		**88**			
Staging																		
Schirrmeister, 2000	A	staging breast cancer	117	117			94		75						94		standard staging procedures	
		lymph nodes		117			79		92						89			
		distant mets		6			100											
Yap, 2000[4]	A	staging breast cancer	98	34													follow-up	21
Bellon, 2000	A	internal mammary nodes	30	27			50		86						81		CT/follow-up/xray	
Seltzer, 2000[5]	A	management	536	32													follow-up	42
Henze, 2000	A	dx clin susp	14		13		89		50		80		67		77		histology	
		LN/mets		14			100											
Bernstein, 2000	A	preop staging/IMLN	12	12													thoracic CT/biop	13
		prim tumor		8			100										biopsy/CT	
		IMLN		2			100											
		axillary LN		4			75											
Rostom, 1999	RA	prim tumor	109	93			91		83						89		histol/TCB/FNAB	
		lymph nodes		74			86		100						90			
		metastasis		19											100			

TABLE 6 (*Continued*)

BREAST CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Staging	**(cont.)**																	
Bleckmann, 1999	RA	prim/met	28		189		97										clin/other imaging/histopath	
Schirrmeister, 1999[6]	RA	detect met bone disease	34	33			100		100								MRI/planar xray/spiral CT/BS	12
Noh, 1998	RA	primary breast mass	27	27			96		100						97		histology/phys ex/MM	
		axillary LN		27			100		92						96			
Crippa, 1998	RA	axillary lymph nodes	72	72			85		91						89		histopathology	
Smith, 1998	RA	axillary lymph nodes	50	50			90		97		95		96		94		FNA cytology/axillary dissect	
		T1 tumors		7			100		100									
		locally advanced disease		24			93		100									
Bombardieri, 1998	A	pre-operative staging	134	134			89		87		83		92		88		histopathology	
Crippa, 1997[7]	RA	pre-op detect axillary mets/overall	82	83			84		85						84		pathol/surg	
		palpable nodes only		18			92		50						76			
		nonpalpable nodes only		65			79		89						86			
Bender, 1997	RA	susp recurrence/lymph nodes	75	75			97		91		88		98		93		histology/CT/MRI	
		lymph nodes		63				74		95		89		86		87		
		local recurrence		75			80		96		89		93		92			
		local recurrence		63				93		98		93		98		97		
		bone mets		75			100		98		94		100		99			
		bone mets		63				46		98		86		88		87		
		lung mets		75			83		97		71		99		96			
		lung mets		63				83		96		71		98		95		
		liver mets		75			100		97		50		100		97			
		liver mets		63				50		95		50		95		91		
Adler, 1997	RA	axillary lymph nodes	50	50			95		66		63		95		77		axillary LN dissection	
Scheidhauer, 1996	RA	primary breast ca	30	30			91		86						90		histology/MM/US	
		axillary lymph nodes		18			100		89						94			
		distant mets		23			100		100						100			
Utech, 1996	RA	axillary lymph nodes	124	124			100		75		69		100		84		surg/biopsy/LN dissection	
Crowe, 1994	RA	primary breast ca	28		33		100		100						100		phys ex/MM/axillary dissect	
		axillary LN			20		90		100						95			
Adler, 1993	RA	breast masses	28		35		96		100								axillary node dissection	
		axillary lymph nodes			20		90		100									
	Summary	**by patients**	**1678**	**2034**			**91**	**63**	**88**	**96**	**76**	**74**	**97**	**92**	**90**	**90**		**24**
		by lesions			**310**		**95**		**88**		**80**		**67**		**88**			

TABLE 6 (*Continued*)

BREAST CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Dx/Staging																		
Yutani, 2000	RA	detect susp brst ca/prim	40	40			79								80		biop/surg	
		axillary LN mets		16			50				100							
Noh, 1999[8]	RA	detect brst ca/augment brst/prim	8	9			100		83						89		MM/US/pathol	
		axillary LN mets		3											100			
	Summary	**by patients**	**48**	**65**			**75**		**83**		**100**				**83**			
Recurrence																		
Lonneux, 1999	A	recurrence	28	28			84		55		80		63		75		biop/PET imaging/follow-up	
		isolated tumor marker elev		21			100		50		76		100		81			
Eubank, 1999	A	staging nodal disease	69	69			30	88	89	95					61	92	biop/follow-up CT	
Sugawara, 1999	A	dx brachial plexopathy	26	26			100		67							63	surg/biop	
Gimenez, 1999	A	axillary metastases	53	53			84		100		100		89			90	histopath	
Hathaway, 1999	RA	recurrence	10	10			100		100								MRI/follow-up/clin data/surg	
Moon, 1998	RA	recurrence/mets by pt	57	57			93		79		82		92				biop/clin follow-up/imaging	
		recurrence/mets by les			41		85		79									
Maldonado, 1998	A	recurrence	23	23													conv studies	40
Bender, 1997	RA	susp recurrence/lymph nodes	75	75			97		91		88		98		93		histology/CT/MRI	
		lymph nodes		63				74		95		89		86		87		
		local recurrence		75			80		96		89		93		92			
		local recurrence		63				93		98		93		98		97		
		bone mets		75			100		98		94		100		99			
		bone mets		63				46		98		86		88		87		
		lung mets		75			83		97		71		99		96			
		lung mets		63				83		96		71		98		95		
		liver mets		75			100		97		50		100		97			
		liver mets		63				50		95		50		95		91		
	Summary	**by patients**	**341**	**977**			**80**	**90**	**85**	**96**	**88**	**93**	**89**	**98**	**82**	**89**		**40**
		by lesions			**41**		**85**		**79**									

TABLE 6 (*Continued*)

BREAST CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																		
Schelling, 2000[9]	RA	rspnse to 1st chemo/locally adv	22	16			100		85						88		histopath/GRD/MRD	
		2nd chemo		22			83		94						91			
Smith, 2000[10]	RA	chemo rspnse/prim&met/post 1st		30	31		90		74								pathol/surg	
Avril, 2000	A	eval chemo response	22	22			100		85								histopathology/MRD	
Gupta-Burt, 1999	A	resp to chemo/locally adv	14	13			57		100						77		surg pathology	
Smith, 1999	A	predict response to chemo	24	24			75		100								surg	
Dehdashti, 1999[11]	RA	rspnse to antiestr ther/ER+ met	11	11											100		follow-up eval 3-24 mos	
Hoh, 1998	A	predict response to chemo	22	22											100		follow-up	
Bassa, 1996[12]	RA	pre-op chemo/locally adv/prim	16	17			100		100								pathol/surg/MM/US/follow 3y	
		residual prim		17			75		100									
		init nodal involv		16			77		100									
		residual nodal involv		16			42		100									
Jansson, 1995[13]	RA	efficacy of polychemo/post 1st	16	16			67										clinical/radiog	
Nieweg, 1993	RA	rspnse to chemo	20	11			91										pathology	
		lymph nodes		5			100											
Wahl, 1993[14]	RA	mon chemohormonother/newly dx	11	11			100		100								clin/radiog/pathol	
	Summary	**by patients**	**178**	**269**			**81**		**96**						**92**			
		by lesions			**31**		**90**		**74**									
Other																		
No Articles																		

[1]FDG PET can find brst ca early enough for cur surg w few FP.

[2]Of 52 pts, 18 pts examined. 17 pts w brst ca/1 w fibrocystic disease. 16/17 detected by PET irrespective of pt positioning.

[3]87 pts included mixed cancer types/prim and met.

[4]Clinical stage 33%/major management 21%/minor management 38%/ no change 35%/avert surgery or radiation therapy 9%/addit surgery or radiation 27%/overall 29%.

[5]42% pts w other cancers.

[6]Chge in clin mgmt=4/34=11.7%. 34 pts. S=17/17; sp=16/16. 1pt w degen lesions.

[7]82 pts. 83 cases (ALNDs).

[7]Reported acc=13/17=76. 2x2 shows acc=14/18=78.

[8]8 pts. 9 cases for prim. 3 TP,1FP,5 TN. 3 pts w brst ca examined for LN mets. 2 TP,1TN.

[9]GRD=gross residual disease/nonresponding tumors. MRD=minimal residual disease/responding lesions. Values based on SUV decrease to <55% of baseline.

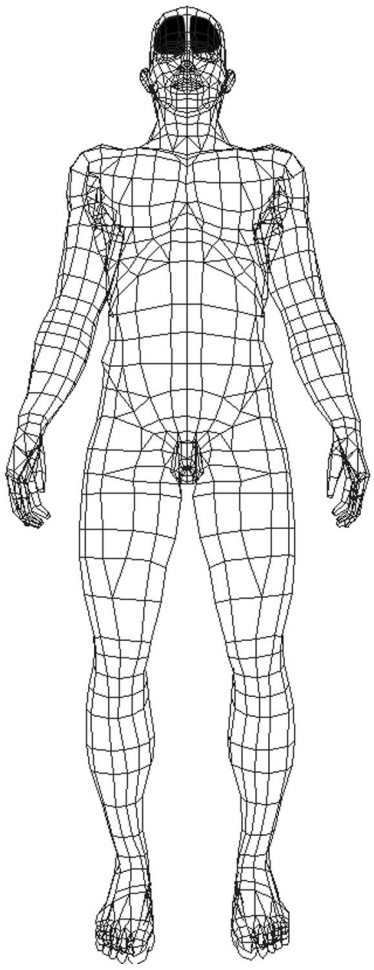
[10]Based on 20% reduction in DUR.

[11]Acc based on 2x2 defined as Responder/Nonresponder vs Met Flare +/-. 7TP/4TN.

[12]16 pts. 1 pt had bilateral breast cancer.

[13]Values for 1st PET 6 to 13 ds post 1st polychemo trtmt. 12 responders/4 non-responders. 8/12 responders w signif decrease in tracer uptake.

[14]Sens defined as 8 responders w signif decrease in FDG uptake. Spec defined as 3 non-responders w no decrease in FDG uptake.



Disease Background. The incidence of primary brain tumors in the population is 11 in 100,000, with overall metastatic brain disease being more common. Typically, space-occupying lesions are caused by primary tumors, with >50% of patients presenting with some form of epilepsy. New treatments are being introduced, including guided biopsy and surgery (which are frequently image guided), targeted radiation, chemotherapy, and radioactive seed implantation. Outlook remains poor, with survival <1 y for patients with high-grade tumors. Imaging is increasingly required to detect disease, particularly recurrent disease, and in planning and guiding therapy and biopsy. An especially difficult task is determining if cancer has come back after radiation therapy.

Case Example. The preferred treatment for brain tumors is surgical removal. FDG PET scans are useful for evaluating the efficacy of surgical procedures. A 64-y-old woman with a diagnosis of glioblastoma multiforme (aggressive brain tumor) was operated on to remove the tumor and was treated with radiation. Subsequent contrast-enhanced MRI (Fig. 7, left) suggested possible tumor recurrence. Note the area of contrast accumulation near the surgical region (white arrow). The lack of a corresponding FDG accumulation in that region in the FDG PET image (Fig. 7, right) suggested that the contrast enhancement observed in the MR image was the result of radiation necrosis and that no residual tumor was present at that time.

Why Did FDG PET Help? FDG PET helped by showing that an inconclusive finding on MRI was, in fact, the result of radiation and not residual tumor. Therefore, this patient did not need medical or surgical intervention.

Key Management Issues.

Initial management.

- Diagnosing and grading the malignancy
- Determining the extent for treatment planning
- Directing biopsy
- Determining prognosis

Post-treatment management.

- Differential diagnosis between recurrence and radiation necrosis
- Directing biopsy (This helps to determine where in the brain to sample the tissue, by differentiating tumor from necrosis and edema.)
- Determining the extent of tumor in treatment planning
- Monitoring response to treatment (surgery/radiotherapy/chemotherapy) (This involves differentiating tumor from necrosis and edema to determine how well the treatment affected the tumor.)

Summary of Evidence for FDG PET in Brain Tumors. For recurrence: An estimated 31% change was noted in management effect, based on 89 patient studies (Table 7).

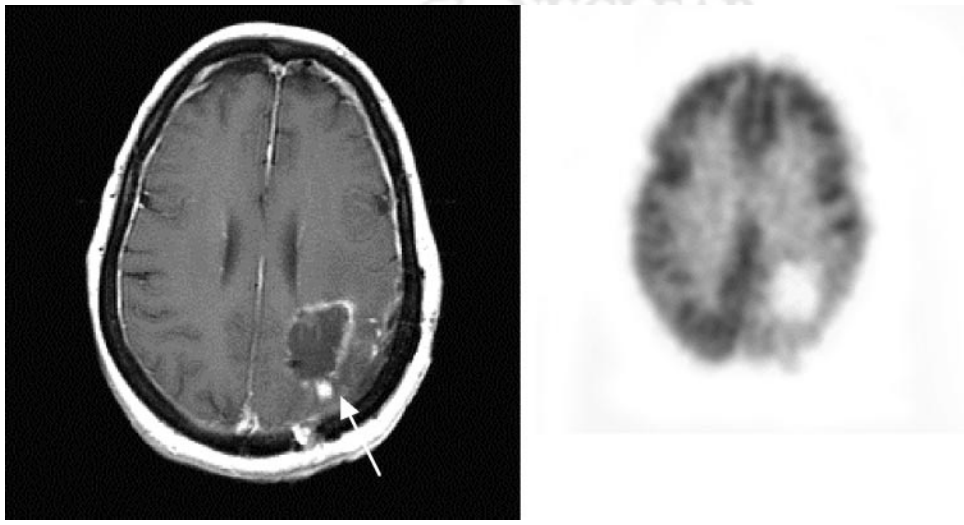


FIGURE 7. Case example, brain tumor.

TABLE 7
FDG PET in Brain Tumors: Results of Literature Search

BRAIN TUMOR	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
Hustinx, 1999[1]	RA	eval prim brain tumor	47	27		88										compare to normal gp	
Kincaid, 1998[2]	RA	predicting tumor grade	11	9		100										histol/TISPECT/CT/MRI	
	Summary	**by patients**	**58**	**36**		**91**											
Staging																	
Gupta, 1999[3]	RA	eval intracranial lesions	31	31		86										radiol/histol	
	Summary	**by patients**	**31**	**31**		**86**											
Dx/Staging																	
No articles																	
Recurrence																	
Cortes-Blanco, 2000[4]	A	recurrence	112														
		children		23		81		100						85		pathol/radiog/follow-up	
		adults		47		76		33						70			
		adults		11		71		50						67			
Stokkel, 1999[5]	RA	recurrence	16	16		62										follow-up CT or MRI	
				16	yes	92											
Thompson, 1999[6]	RA	rad necrosis vs recurr/prim glial	15	15		43		100								stereo biop/craniot/histol	
Bader, 1998	RA	detect recurrence	39	39		82		100						85		IMT-SPECT/CT/MRI/biop	
Kim, 1998[7]	RA	met br tumor	20	13		85	69									histol	
Berry, 1997	A	recurrence	17	17		82		100		100		75				biopsy	
Bader, 1997[8]	A	recurrence	21	21		92		100								biopsy/MRI	
Raja, 1997[9]	A	recurrence	19	19		92		100								MRI/follow-up	
Deshmukh, 1996[10]	RA	recurrence	75	89												pathol	31
Kahn, 1994[11]	RA	recurrence	19	21		81		40		81		40		71		biopsy/clin follow-up	
Janus, 1993[12]	RA	prim malig br tum/susp progress	50	20										75		surg	
	Summary	**by patients**	**403**	**367**		**79**	**69**	**77**		**90**		**56**		**76**			**31**

TABLE 7 (*Continued*)

BRAIN TUMOR	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																	
Ericson, 1996[13]	RA	stereotactically irrad br mets	31	17		82		83								autopsy/surg/histol	
Rozental, 1993[14]	RA	effects of BCNU on gluc uptke	6	6												CT/MRI	
Holthoff, 1993[15]	RA	effect of chemo on tumor metab	15	7												close clin follow-up	
	Summary	**by patients**	**52**	**30**		**82**		**83**									
Other																	
Weber, 1997[16]	RA	identification of tumor tiss	19	19		88		67		93		50		84		surg/biop	
Holzer, 1993[17]	RA	prognostic indicator survival	15	15		100										clin follow-up/2y	
	Summary	**by patients**	**34**	**34**		**93**		**67**		**93**		**50**		**84**			

[1] 20 normal pts=Gp1. 27 malig prim CNS pts=Gp2. S=.88 from visual analysis.

[2] All 9 lo-grade gangliogliomas. All showed decreased or normal PET. Considered 100% correlative to tumor grade.

[3] 31 pts. 22 pts w intracran met dis/9 pts benign.

[4] PET imaging in children reveals superior performance for detecting brain tumor recurrence and differentiating it than in adults.

[5] 18F-FDG gave poorer results than 201Tl SPET.

[6] PET believed insuffic to resolve rad necros vs tumor progression.

[7] 13/20 had met br tumor. 7 had prim tumor. PET found 11/13 and conv found 9/13.

[8] 2 pts w recurr had a chge of grade. s=12/13=.92. Was 1FN.

[9] Listed in spdsht what was reported. Reported sens is actually PPV, and reported spec is actually NPV.

[10] 28/89=.31 for chge in therapy. 86/89=.97 for playing clinical role. 53/89=.59 for withholding aggressive therapy. 75pts/89scans.

[11] 19 pts. 21 scans. 13TP/3FP/3FN/2TN. Both 201Tl SPECT and FDG PET were sensitive for lesions <1.6 cm or larger.

[12] 20 pts had surg. 9 w incr uptke and evid of tum. 6 w decr uptke and no evid of tum. 5 pts w no correl. Acc=15/20=.75.

[13] 2x2 of tumor growth (in spite of ther or regrowth post init fav rspnse) vs FDG incr/decr. 9TP/1FP/2FN/5 TN.

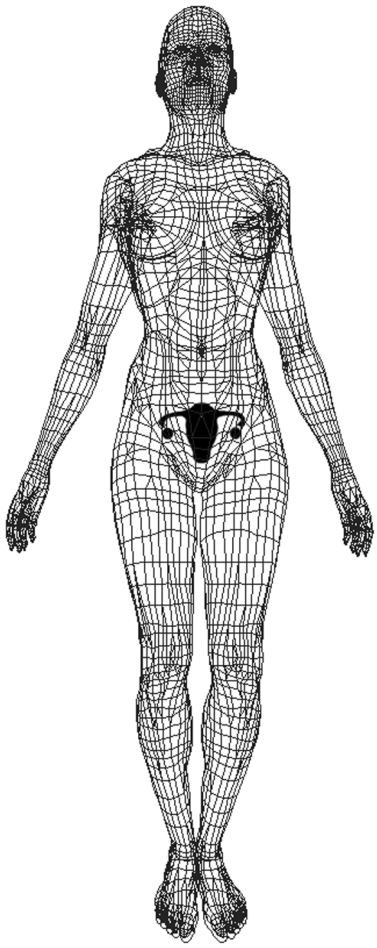
[14] Patients w largest % chge in FDG uptke following adjuv BCNU fd to have shortest survival.

[15] Data suggests the more marked decr in tum metab post chemo, the longer the period of init clin imprvemt.

[16] 19 pts. 16 w tumor. 3 non-tumorous. In 2x2, discordant readings (between 2 observers) assumed as positive.

[17] All pts had same trtmt to assess prognostic value of PET for survival time and recurrence. Since not truly a response to trtmt study, was put into OTHER.

Ovarian, Cervical, and Uterine Cancer



Disease Background. Ovarian cancer is the fifth leading cause of cancer death in women in the United States, with 14,500 deaths and 25,400 new cases diagnosed each year. Approximately one-third of all new cases will have metastatic disease at the time of diagnosis, with another third developing clinical metastases during the first year after surgical resection. The current recommendation for management of patients without evidence of metastatic disease at 1 y after diagnosis is to perform second-look laparotomy for clinical staging and possible tumor resection. For early-stage ovarian cancer, accurate diagnosis is very difficult.

Cervical cancer is one of the most common cancers, accounting for 6% of all malignancies in women, with an estimated 16,000 new cases of invasive cancer of the cervix and 5,000 deaths in the United States each year. The prognosis for this disease is markedly affected by the extent of disease at the time of diagnosis.

Cancer of the endometrium, a common type of cancer in women, is a disease in which cancer cells are found in the lining of the uterus (endometrium). Cancer of the endometrium is different from cancer of the muscle of the uterus (sarcoma of the uterus). Cancer of the endometrium is the most common pelvic gynecologic malignancy and accounts for 13% of all cancers in women. It is a highly curable tumor.

Case Example. A 50-y-old woman with a history of ovarian cancer showed rising tumor markers in an annual blood test that looked for possible tumor recurrence. A follow-up CT scan was unable to find the source of the recurrence. An FDG PET study showed that the tumor had metastasized to the right lobe of the liver (Fig. 8, arrows on site of metastasis viewed on 4 different sections through the whole body). No other areas of metastasis were seen.

Why Did FDG PET Help? FDG PET showed that the blood study was correct (it was not falsely elevated) and that the source of recurrence was the liver. This patient was confirmed through follow-up to have recurrence in the liver.

Key Management Issues.

- Staging lymph nodes
- Identifying recurrent disease after surgery and radiation
- Assessing response to treatment

Summary of Evidence for FDG PET in Ovarian, Uterine, and Cervical Cancer. For recurrence: An estimated 17% change was noted in management effect, based on 30 patient studies (Table 8).

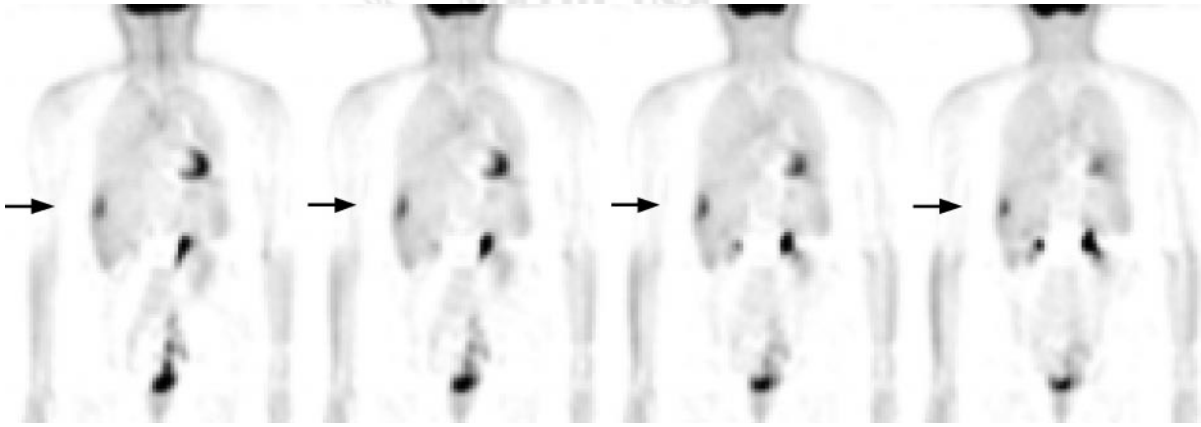


FIGURE 8. Case example, ovarian, cervical, and uterine cancer.

TABLE 8

FDG PET in Ovarian, Cervical, and Uterine Cancer: Results of Literature Search

OVARIAN/PELV MASS & UTERINE&CERVICAL	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
Grab, 2000	RA	characterize asymp adnexal masses	101	101		58		80		28		93		77		laparoscopy/histol	
Kubik-Huch, 2000	RA	dx prim/susp ovar lesion/presentation	19	7		100	100	67	67					86	86	laparotomy/histol	
		dx recurr/susp @ follow-up		10		100	40	50	50					90	43		
Fenchel, 1999[1]	RA	dx of pelvic mass	85	85		50		78		19		94			75	histopath	
Grigsby, 1999	A	prim tumor	36	36		97										CI (chest xray/lymphangiography/CT)	
Zimny, 1997	RA	primary/recur ovarian	26	26		84		86		94		67		85		surg/cytol/histol	
Römer, 1997	RA	dx of ovarian tumor	19	19		83		54		45		88		63		surg/histol	
	Summary	**by patients**	**286**	**284**		**66**	**100**	**77**	**67**	**34**		**90**		**77**	**76**		
Staging																	
Grigsby, 1999[2]	A	staging nodal&dist mets/prim carcin cervix	36	36												CI (chest xray/lymphangiography/CT)	
		pelv lymph nodes		36		72	21										
		para-aortic lymph nodes		36		31	18										
		lft supraclavicular LN's		36		11										biopsy	
		inquinal LN mets		36		3										biopsy	
		pulmonary uptake		36		14										biopsy	
Rose, 1999[3]	RA	staging/loc adv cerv ca	32	32													
		cervical tumors		32		91										histol	
		para-aortic LN mets		32		75		92		75		92				retroperitoneal lymphadenectomy	
		pelv node mets		17		100	45	100		100		100				surg	
Smith, 1998	A	staging/recurrent	57	57		94	85	96	76							histol	
Karlan, 1993	RA	staging/recurrent	13	13		50		100								surg	
	Summary	**by patients**	**138**	**399**		**54**	**48**	**96**	**76**	**84**		**95**					
Dx/Staging																	
Both, 2000[4]	A	primary/staging	22	22		95								100		surg/MRI	
Sugawara, 1999[5]	RA	dx/staging recurr/cerv ca	21	21		76										biop/phys exam/correl imaging	
		postvoid imaging		11		100											
		LN mets		7		86	57	100	100							surg/clin follow-up/CT	
Hübner, 1993[6]	RA	primary tumor/staging	51	51		83	82	80	53	86	77	76	62	82	72	surg/histol	
		recurrent/follow-up scans		14		86		100						93		biop/clinical survival	
	Summary	**by patients**	**94**	**126**		**86**	**79**	**82**	**59**	**86**	**77**	**76**	**62**	**87**	**72**		

TABLE 8 (*Continued*)

OVARIAN/PELV MASS & UTERINE&CERVICAL	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence																	
Kubik-Huch, 2000	RA	dx prim/susp ovar lesion/presentation	19	7		100	100	67	67					86	86	laparotomy/histol	
		dx recurr/susp @ follow-up		10		100	40	50	50					90	43		
Torizuka, 2000[7]	A	recurrence	11	11		75		100						82		surg/histol/clin follow-up >4 mos	
Kim, 2000	A	detect recurr/cerv ca*	101	101		100		90		89		100		91		clin follow-up/CT/MRI/biop	
		*NED post trtmt															
Nakamoto, 2000	A	detect recurr/gynecol malig	30	30		82		92						87		histopath/clin follow-up	
		susp recurr		16		86		100									25
		clin dis free		14		67		91									7
Sugawara, 1999[8]	RA	dx/staging recurr/cerv ca	21	21		76										biop/phys exam/correl imaging	
		postvoid imaging		11		100											
		LN mets		7		86	57	100	100							surg/clin follow-up/CT	
Smith, 1998	A	staging/recurrent	57	57		94	85	96	76							histol	
Zimny, 1997	RA	primary/recur ovarian	26	26		84		86		94		67		85		surg/cytol/histol	
Römer, 1997	RA	dx of ovarian tumor	19	19		83		54		45		88		63		surg/histol	
Casey, 1994	RA	residual/recur/abdom & pelv tum	9	9		83		100		100		75		89		second look laparotomy	
Karlan, 1993[9]	RA	staging/recurrent	13	13		50		100								surg	
Hübner, 1993[10]	RA	primary tumor/staging	51	51		83	82	80	53	86	77	76	62	82	72	surg/histol	
		recurrent/follow-up scans		14		86		100						93		biop/clinical survival	
	Summary	**by patients**	**357**	**417**		**88**	**76**	**90**	**75**	**85**	**77**	**92**	**62**	**87**	**43**		**17**
Monitoring Response																	
Kerrou, 2000[11]	A	detect recurr/rspnse to chemo	40	11	yes	100								100		surg histol/LT follow-up	
	Summary	**by patients**	**40**	**11**		**100**								**100**			
Other																	
No articles																	

[1] Sens of PET in detection of borderline-tumors and early stage ovarian cancer seems to be limited.

[2] FDG-PET sens for detecting nodal and dist mets in pts w carcinoma of cervix.

[3] PET-FDG accurately predicts both the presence and absence of pelvic and para-aortic nodal met disease.

[3] Art shows 30/32=.94 and not sens=.91 which is reported.

[4] sens=.95 for primary tumor/acc=1.00 for staging.

[5] Promising for detecting untreated or recurrent cervical cancer.

[6] 14 pts w repeat scans for recurrence. 6 TP/7 TN as described in art. 1 FN derived from Table 7.

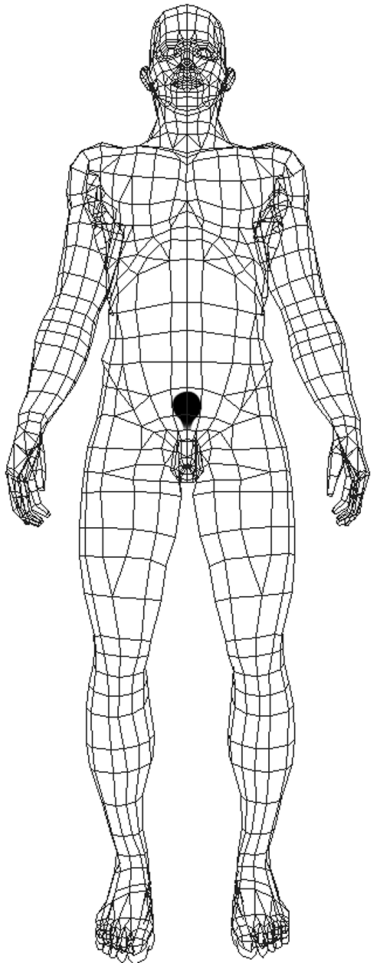
[7] PET is effective for detection and staging of ovarian cancer.

[8] Promising for detecting untreated or recurrent cervical cancer.

[9] 13 pts. 1/7 pts w clin evid of recur dis refused laparat/biop for pathol cnfrm. Considered as PET neg (FN). 6TP/6FN/1TN.

[10] 14 pts w repeat scans for recurrence. 6 TP/7 TN as described in art. 1 FN derived from Table 7.

[11] Abstract rpts overall sens=8/8, overall acc=11/11. 2x2's show sens=8/9, acc=10/11.



Disease Background. Bladder cancer is a disease in which cancer cells originate from the bladder wall. Approximately 70%–80% of patients with newly diagnosed bladder cancer will present with superficial bladder tumors. Those tumors that are noninvasive are often curable, and those that are deeply invasive are sometimes cured by surgery, irradiation, or a combination of modalities that includes chemotherapy. Some patients with distant metastases have achieved long-term complete response after treatment with combination chemotherapy regimens. The major prognostic factors in carcinoma of the bladder are the depth of invasion into the bladder wall and the degree of differentiation of the tumor. Transurethral surgery, intravesical medications, and cystectomy (bladder removal) have been used in the management of patients with superficial tumors and are all associated with 5-y survival rates for 55%–80% of patients treated. As with many cancers, the key to management is determining if the bladder cancer has spread beyond the bladder to the local lymph nodes or to distant parts of the body.

Case Example. A patient with cancer of the bladder was scanned for staging purposes. Focal increased FDG uptake was seen within the posterior aspect (back) of the bladder, indicating primary disease only (Fig. 9, arrow). Mild accumulation of FDG also was seen around a right total hip replacement (Fig. 9A), possibly indicating active inflammation or infection, although the patient did not complain of any hip pain.

Why did FDG PET help? FDG PET helped by showing no evidence of cancer spread beyond the bladder, so that local treatment (e.g., removal of the bladder) likely would benefit the patient.

Key Management Issues.

- Primary nodal staging
- Systemic metastases staging

Summary of Evidence for FDG PET in Bladder Cancer. For staging: An estimated 17% change was noted in management effect, based on 12 patient studies (Table 9).

For recurrence: An estimated 17% change was noted in management effect, based on 12 patient studies (Table 9). Because management effect for both staging and recurrence is based upon the same single study of 12 patients, results should be interpreted with caution.

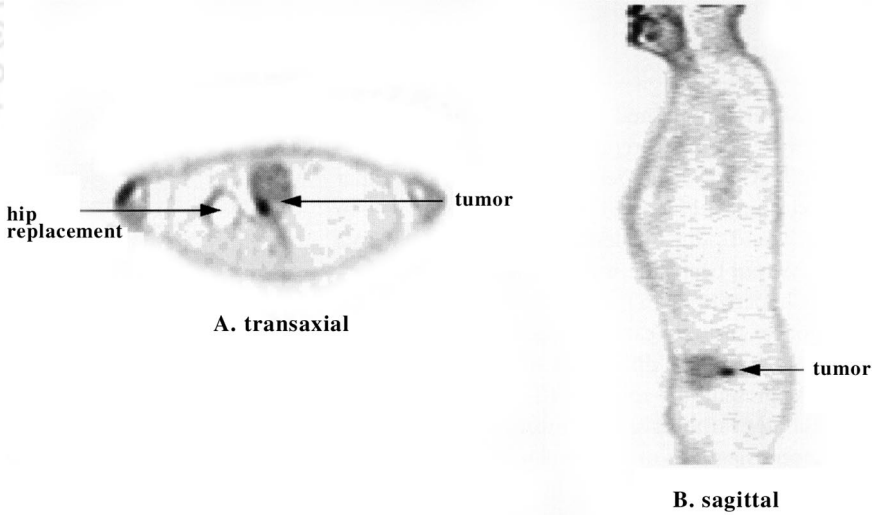


FIGURE 9. Case example, bladder cancer. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography.* London, UK: Arnold, Hodder Headline Group; 1999.

TABLE 9

FDG PET in Bladder Cancer: Results of Literature Search

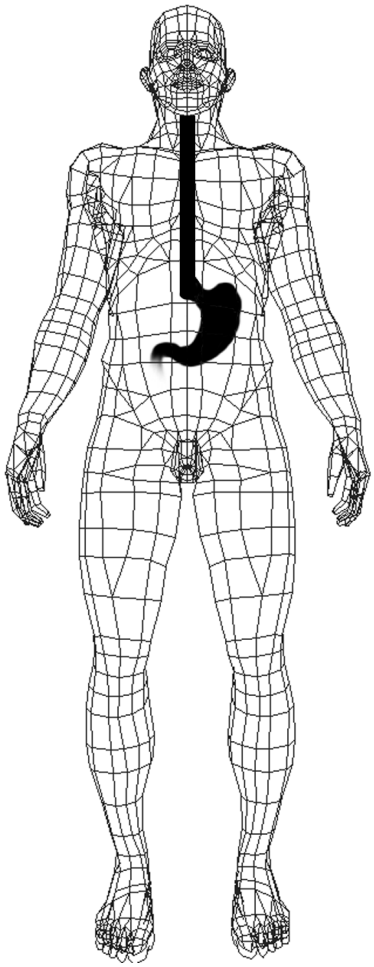
BLADDER CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																
No Articles																
Staging																
Bachor, 1999[1]	RA	lymph node staging	64	64	67		86		70		84		80		histol/lymphadenectomy	
Heicappell, 1999[2]	RA	pelv lymph node staging	8	8	67		100		100		83		88		histol/pelv LN dissection	
Kosuda, 1996[3]	A	staging/recur/LN mets/SUV 3.64	12	12	60										conv imaging	17
Bachor, 1995	RA	pre-op staging/prim	26	26	85										surg/histol	
		staging LN's		26	100		86		63		100		88			
	Summary	**by patients**	**110**	**136**	**76**		**87**		**71**		**88**		**83**			**17**
Dx/Staging																
Bachor, 1995	RA	pre-op staging/prim	26	26	85										surg/histol	
		staging LN's		26	100		86		63		100		88			
	Summary	**by patients**	**26**	**52**	**93**		**86**		**63**		**100**		**88**			
Recurrence																
Kosuda, 1996[4]	A	staging/recur/LN mets/SUV 3.64	12	12	60										conv imaging	17
	Summary	**by patients**	**12**	**12**	**60**											**17**
Monitoring Response																
No Articles																
Other																
No Articles																

[1]PET results seem better than CT or MRI.

[2]FDG-PET may be valuable diagnostic tool in staging pelvic LN's in bladder and prostate ca.

[3]FDG PET may be useful in dx of perivesical tumor growth or dist met in adv stage dis. Recurr fd in 2/12=17% post-trtmt.

[4]FDG PET may be useful in dx of perivesical tumor growth or dist met in adv stage dis. Recurr fd in 2/12=17% post-trtmt.



Disease Background (Gastric Cancer). Cancer of the stomach, also called gastric cancer, is a disease in which cancer cells originate from the tissues of the stomach. Cancer of the distal half of the stomach has been decreasing in the United States since the 1930s. However, in the last 2 decades, the incidence of cancer of the cardia and gastroesophageal junction (upper half of the stomach) has been rising rapidly. The incidence of this cancer, especially in patients younger than 40 y, has increased dramatically. In localized distal gastric cancer, >50% of patients can be cured. However, early stage disease accounts for only 10%–20% of all cases diagnosed in the United States. The remaining patients present with metastatic disease in either regional or distant sites. The overall survival rate in these patients at 5 y ranges from almost no survival for patients with disseminated disease to almost 50% survival for patients with localized distal gastric cancers confined to resectable regional disease. Even with apparent localized disease, the 5-y survival rate of patients with proximal gastric cancer is only 10%–15%. Although the treatment of patients with disseminated gastric cancer may result in palliation of symptoms and some prolongation of survival, long remissions are uncommon. Radical surgery represents the standard form of therapy with curative intent. Lesser surgical procedures also may play important roles in palliative therapy for patients with gastric cancer. Neoadjuvant or postoperative chemotherapy and/or radiation therapy are under clinical evaluation.

Disease Background (Esophageal Cancer). Carcinoma of the esophagus is increasing rapidly in frequency in the west, with the rise most apparent in patients with adenocarcinoma of the esophagus. Much of the increase is thought to be related to reflux esophagitis and Barrett's esophagus (conditions in which acid from the stomach damages the esophagus), but the exact cause is uncertain. Adenocarcinoma of the esophagus is now more prevalent than squamous cell carcinoma in the United States and western Europe, with most tumors located in the distal esophagus. Esophageal cancer is a treatable disease but is rarely curable. The overall 5-y survival rate in those cases amenable to surgery ranges from 5%–20%. The occasional patient with very early disease has a better chance of survival. Primary treatment modalities include surgery alone or chemotherapy with radiation therapy. Combined modality therapy (chemotherapy plus surgery or chemotherapy and radiation therapy plus surgery) is under clinical evaluation.

Case Example (Gastric Cancer). A 35-y-old patient underwent surgery for gastric cancer. At the time of surgery, a portion of the stomach was removed around the tumor site. During surgery, it was noted that lymph nodes near the stomach also were involved. The patient therefore underwent chemotherapy to treat for spread of the gastric cancer. A CT scan was performed after 6 mo and showed questionable enlargement of lymph nodes in the abdomen. An FDG PET scan was ordered to determine whether the lymph nodes seen on the CT scan were in fact consistent with tumor involvement. The FDG PET scan (Fig. 10) shows several areas of focal increased FDG accumulation in the midabdomen (arrow), confirming tumor recurrence.

Why Did FDG PET Help? FDG PET confirmed that the questionable findings on CT scan, in fact, were likely to be tumor. Sometimes the CT scan can show lymph node enlargement when no tumor has recurred. In the case shown, there was likely to be tumor recurrence, and the patient now could be managed with the maximal information in hand.

Case Example (Esophageal Cancer). A 59-y-old man with known esophageal cancer was referred for FDG PET scanning before surgery. CT demonstrated the presence of the primary tumor but no spread of disease. FDG PET showed uptake in the primary tumor (Fig. 11B, lower arrow) and a lymph node near the trachea (Fig. 11A, arrow, and 11B, upper arrow). The esophageal cancer had spread beyond the esophagus.

Why Did FDG PET Help? FDG PET showed that the cancer had spread beyond the esophagus. Esophageal surgery alone, therefore, was not the best way to manage this patient.

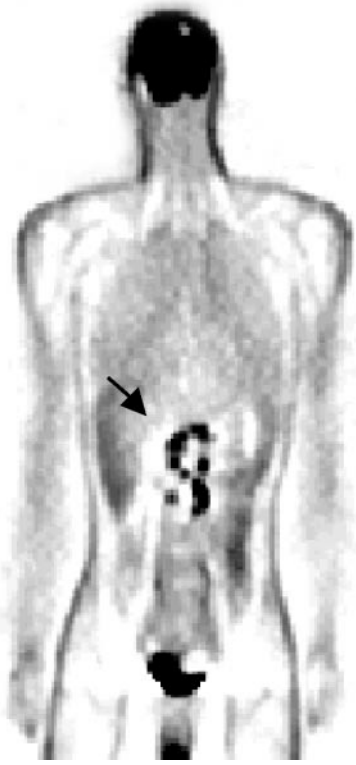


FIGURE 10. Case example, gastric cancer.

Key Management Issues.

- Staging for possible spread of tumor
- Assessing for recurrence

Summary of Evidence for FDG PET in Gastroesophageal Cancer. For diagnosis: An estimated 14% change was noted in management effect, based on 99 patient studies with 276 lesion sites (Table 10).

For staging: An estimated 20% change was noted in management effect, based on 229 patient studies (Table 10).

For diagnosis/staging: An estimated 14% change was noted in management effect, based on 109 patient studies (Table 10).

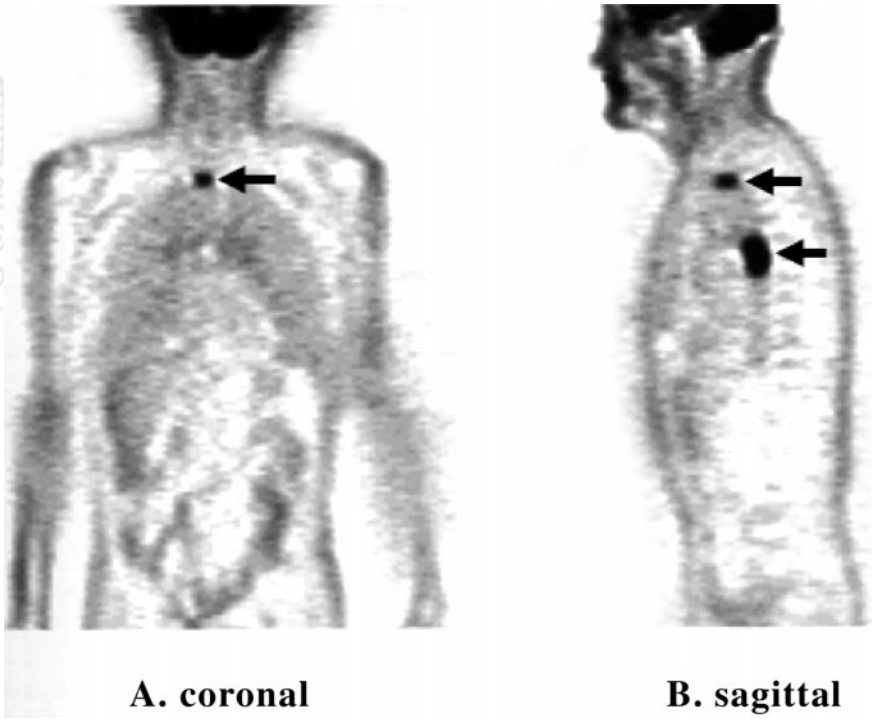


FIGURE 11. Case example, esophageal cancer. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography.* London, UK: Arnold, Hodder Headline Group; 1999.

TABLE 10

FDG PET in Gastroesophageal Cancer: Results of Literature Search

GASTRO-ESOPHAGEAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
Yeung, 1999[1]	RA	dx/staging/follow-up	109		276	80		95						86		histol/clin follow >6mo	14
					269		68		81						73		
Fukunaga, 1998[2]	RA	eval esophageal ca	48	48										98		surg/follow-up 7y/CT/US	
Kole, 1998	RA	primary tumor	26	26		96	81									surg/pathol	
Block, 1997	RA	primary tumor	58	58		94										biop/pathol	
Flanagan, 1997	RA	primary tumor	36	36		100										surg/biop	
	Summary	**by patients**	**277**	**168**		**96**	**81**							**98**			**14**
		by lesions			**545**	**80**	**68**	**95**	**81**					**86**	**73**		
Staging																	
Choi, 2000	RA	eval individ LN groups	61	48		57	18	97	99					86	78	esophagectomy/LN dissect	
Meltzer, 2000[3]	RA	init staging/esoph ca	47													surg/histol	
		locoreg LN		47		41	75	90	29	93							
		dist mets		10		70		90		70	29						
Cambier, 2000	A	metastatic disease	41	41		96		67						89		pathol/radiol/clin follow-up	
Que, 2000[4]	A	metastatic disease	17		15	93										operative/pathological	
Luketich, 1999[5]	RA	staging of distant mets	91	100		69	46	93	74					84	63	surg	16
Kole, 1998	RA	prim/lymph nodes	26	26		96	81									surg/pathol	
Rankin, 1998	RA	pre-op esophageal ca/prim	25	19		100	95									histol	
		peri-oesophageal nodes		18		38	50										
		left gastric nodes		19		11	56										
Luketich, 1997[6]	RA	staging esophageal ca/dist mets	50	35		88		93						91		surg	20
		local-regional nodal mets		21		45		100						48			
Block, 1997	RA	prim	58	58		97										pathol/ biop	29
		lymph node mets		21		52	29										
		distant metastases		17		100	29										
Flanagan, 1997	RA	prim	36	36		100										surg/tissue sampling	14
		lymph nodes		29		76	45										
	Summary	**by patients**	**452**	**545**		**73**	**50**	**90**	**69**	**89**	**29**			**83**	**68**		**20**
		by lesions			**15**	**93**											
Dx/Staging																	
Yeung, 1999	RA	dx/staging/follow-up	109	109		80	68	95	81					86	73	surg/pathol	14
	Summary	**by patients**	**109**	**109**		**80**	**68**	**95**	**81**					**86**	**73**		**14**

TABLE 10 (*Continued*)

GASTRO-ESOPHAGEAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence																	
Cambier, 2000	A	recurrence	41	41		100		43						73		pathol/follow-up	
	Summary	**by patients**	**41**	**41**		**100**		**43**						**73**			
Monitoring Response																	
Couper, 1998[7]	RA	chemo rspnse/oesophageal & gastric ca	14	13		100				36				46		CT/dysphagia scores/wt chge	
	Summary	**by patients**	**14**	**13**		**100**				**36**				**46**			
Other																	
No articles																	

[1]109 pts/PET: 276 sites (99pts) 131TP/6FP/32FN/107TN. CT: 269 sites 109TP/21FP/51FN/88TN.

[2]SUV Cutoff = 2.0.

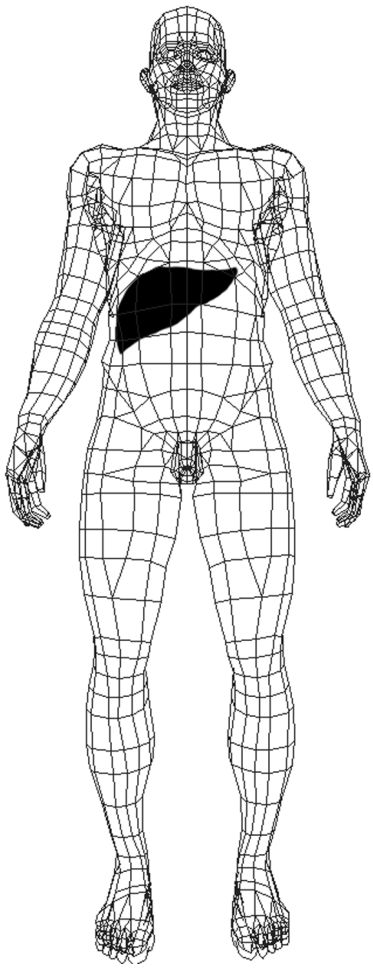
[3]Hi-sens mode(equiv is +). Mid-pt of range given(63-87).

[4]PET is better than CHOL for gastro cancer.

[5]91 pts/100 scns. PET:27TP/4FP/12FN/57TN. CT:18TP/16FP/21FN/45TN. 16/100 cases directed to not perform esophagectomy based on PET.

[6]20% of pts identified for unsuspected dist mets.

[7]Values based on 2x2 defined as Responder/Nonresponder vs FDG decr/FDG incr. 4 TP/7FP/2TN.



Disease Background. Adult primary liver cancer is a disease in which cancer cells start to grow in the tissues of the liver. People who have hepatitis B or C or cirrhosis, a disease of the liver, are more likely than other people to get adult primary liver cancer. Primary liver cancer is different from cancer that has spread from another place in the body to the liver. Hepatocellular carcinoma is a relatively uncommon tumor in the United States, although its incidence is rising. It is the most common cancer in some other parts of the world. Hepatocellular carcinoma is potentially curable by surgical resection, but surgery is the treatment of choice for only the small fraction of patients with localized disease. Prognosis depends on the degree of local tumor replacement and the extent of liver function impairment. Therapy other than surgical resection is best administered as part of a clinical trial. Hepatocellular carcinoma is associated with cirrhosis in 50%–80% of patients. Five percent of patients with cirrhosis eventually develop hepatocellular cancer, which is often multifocal. Childhood liver cancer, also called hepatoma, is a rare disease in which cancer cells are found in the tissues of a child's liver. Two types of cancer (hepatoblastoma and hepatocellular cancer) start in the liver and are identified by the way the cancer cells look under a microscope. Hepatoblastoma is more common in children younger than 3 y and may have a genetic cause. The overall survival rate for children with hepatoblastoma is 70% but is only 25% for hepatocellular carcinoma.

Case Example. A patient presented to his doctor with vague abdominal symptoms. The work-up, which eventually included a CT scan, revealed that the patient had enlarged lymph nodes near the portal region of the liver. An FDG PET scan was ordered to further evaluate for tumor. The scan revealed uptake of FDG within a focus in the right lobe of the liver (Fig. 12, center). No other foci were present, indicating that the tumor was confined to the liver. The patient went on to have an appropriate surgery for localized hepatoma.

Why Did FDG PET Help? FDG PET indicated that the tumor was localized and that the patient was a candidate for surgery.

Key Management Issues.

- Distinguishing between cirrhosis and hepatoma
- Assessing response to treatment and differentiating tumor from necrosis, edema, and scarring
- Identifying multifocal lesions

Summary of Evidence for FDG PET in Hepatocellular Cancer. For staging: An estimated 60% change was noted in management effect, based on 20 patient studies (Table 11).

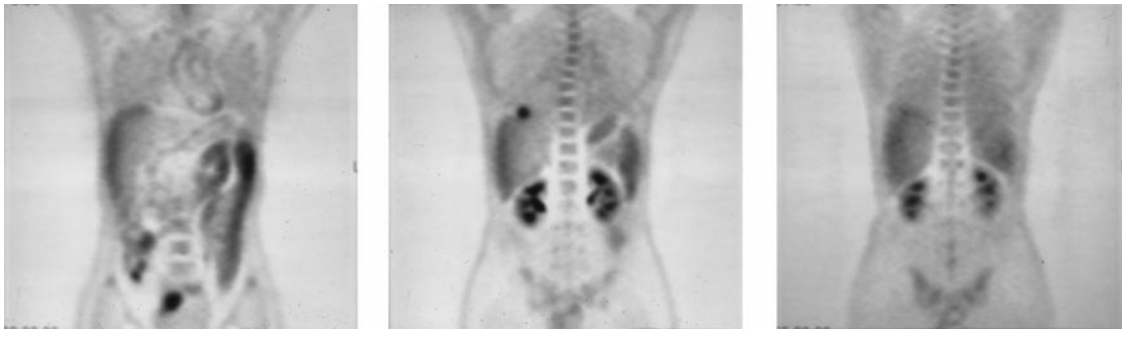


FIGURE 12. Case example, hepatocellular cancer.

TABLE 11

FDG PET in Hepatocellular Cancer: Results of Literature Search

LIVER / HEPATOCELLULAR Cancer	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
No Articles																		
Staging																		
Schoenberger, 2000	A	indeterm liver lesions	19	19			100		100		100		100		100		compare w hybrid PET	
				19		yes	87		100		100		67		89			
Abdel-Nabi, 1999[1]	A	pre-op staging liver mets	20	20			100										CT/histol/follow-up	60
Fröhlich, 1999[2]	RA	staging for surgery	168	168			68		95		65		95		91		surg/CT follow-up	
		lesions > 1 cm					97											
		lesions <= 1 cm					43											
Delbecke, 1998[3]	RA	pre-op eval/hep lesions/hepatocell ca	110	23			70										biop/surg/pathol/CT/follow-up	
Abdel-Nabi, 1998[4]	RA	staging liver mets		43			88	38	100	97	100	50	97	86	98	81	CT/surg/histopath	
	Summary	**by patients**	**317**	**292**			**77**	**38**	**97**	**97**	**76**	**50**	**94**	**86**	**93**	**81**		**60**
		by lesions																
Dx/Staging																		
Trojan, 1999	RA	detect/staging HCC/liver cirrhosis	14	14			50	79									US/helical CT/histol/p53/AFP	
		mod or poor differen HCC only		8			88											
	Summary	**by patients**	**14**	**22**			**64**	**79**										
Recurrence																		
Peterson, 2000[5]	A	ident resid or recurr	7	7	9		88	38									serial CT/CEA/biop	
	Summary	**by patients**	**7**	**7**														
		by lesions			**9**		**88**	**38**										
Monitoring Response																		
No articles																		
Other																		
No articles																		

[1] FDG PET more sensitive than CT in pre-op eval of liver mets; can select pts to benefit fm cur resect of liver mets.

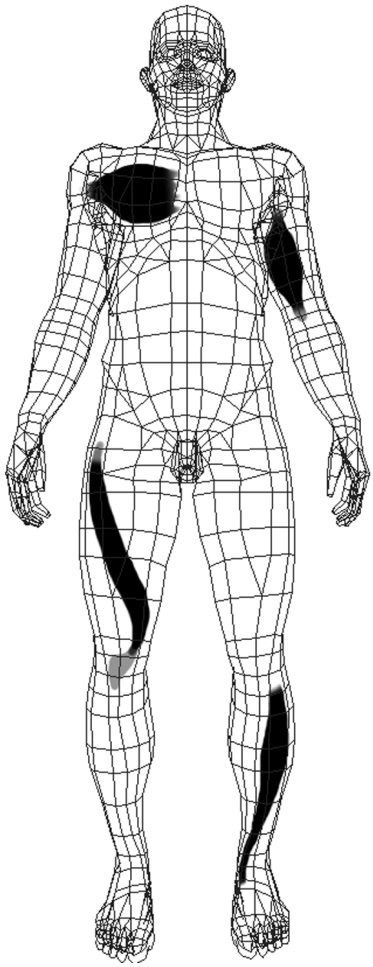
[2] FDG provides reliable hepatic staging for lesions >1cm.

[2] Did not report the TN's by lesions so did not have total lesion count for weighted average.

[3] 110 pts. Used pts=23 for hepatocellular carcinoma.

[4] CT spec liver mets reported and listed as .97. It calcs to be 32/35=.91.

[5] 2 pts had additional scans following additional ablation.



Disease Background. Adult soft tissue sarcoma is a disease in which cancer cells are found in the soft tissue of part of the body. The soft tissues of the body include the muscles, connective tissues (tendons), vessels that carry blood or lymph, joints, and fat. The prognosis for a patient with adult soft tissue sarcomas depends on several factors, including the patient's age and the size, histologic grade, and stage of the tumor. Factors associated with a poorer prognosis are age older than 60 y, tumors >5 cm, and high-grade histology. Although low-grade tumors usually are curable by surgery alone, higher-grade sarcomas (as determined by the mitotic index and the presence of hemorrhage and necrosis) are associated with higher local treatment failure rates and increased metastatic potential. Soft tissue sarcomas are rare in children and adolescents. There are many different kinds of soft tissue sarcoma, depending on the soft tissue in which the cancer begins. Rhabdomyosarcoma is the most common type of childhood soft tissue sarcoma. It begins in muscles around the bone and can be found anywhere in the body.

Case Example. A 41-y-old man had surgery and radiotherapy, first for a liposarcoma in the right thigh and 3 mo later for a solitary metastasis in the abdomen. He developed recurrent disease within the right thigh and was referred for FDG PET scanning. The FDG PET scan showed focal increased metabolism within the right thigh (Fig. 13A, B, and C), indicative of recurrent disease, surrounded by diffuse metabolism secondary to inflammation after surgery. High metabolism of FDG was also noted within lung metastases (Fig. 13C and D).

Why Did FDG PET Help? The FDG PET scan indicated lung and mediastinal metastases, in addition to local disease in the thigh. This meant that the patient would not benefit from treatment of the thigh region alone and would likely require chemotherapy.

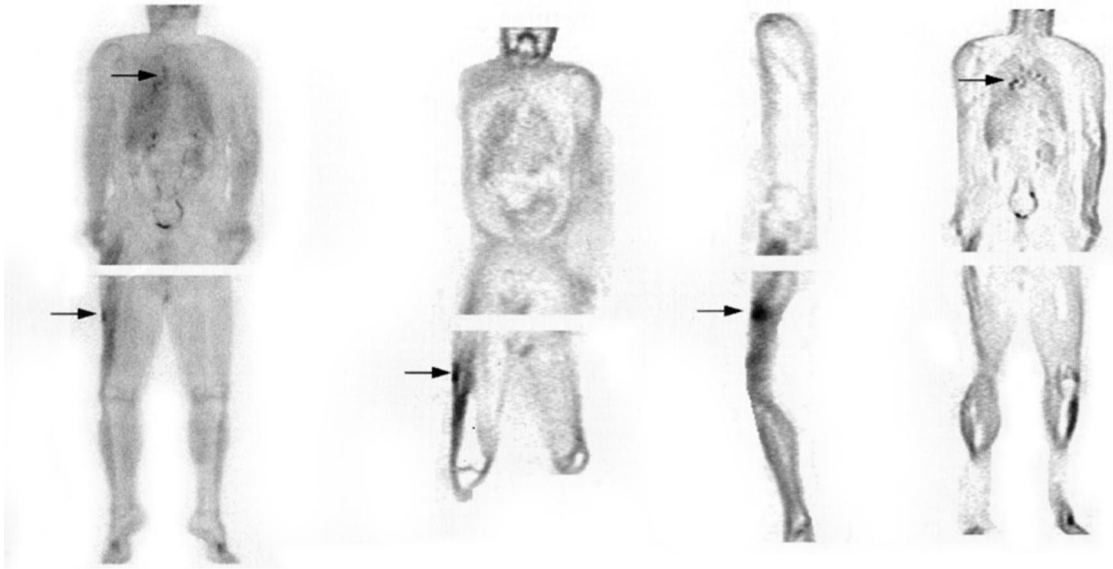


FIGURE 13. Case example, muscle and connective tissue tumors. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography.* London, UK: Arnold, Hodder Headline Group; 1999.

Key Management Issues.

- Following up sarcoma treatment
- Grading sarcoma
- Separating benign from malignant masses
- Selecting biopsy sites
- Assessing extent of sarcomas

Summary of Evidence for FDG PET in Muscle and Connective Tissue Tumors. Management change data for diagnosis and staging and other applications are not directly available from the literature (Table 12).

TABLE 12
FDG PET in Muscle and Connective Tissue Tumors: Results of Literature Search

MUSCLE&CONNECTIVE TUMOR	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																
Schwarzbach, 2000[1]	RA	pre-op assessmt STS/susp prim	50	59	91		88								histopath/surg/follow-up	
		susp local recurr		59	88		92									
Dimitrakopoulou-Strauss, 2000[2]	A	dx/prim/recur/STS	50												not stated	
		prim		19	91		88		91		88		89			
		recurr		31	88		92									
Lucas, 1999[3]	RA	eval soft tissue masses/sarcoma/qualitative	30	31	95		58								biop/spiral CT/surg/follow-up	
		quantitative/SUV cutoff 2.0			95		75									
		distant mets		10	67											
Gauthier, 1999[4]	A	assessmt/progress dis/soft tissue sarcoma	18	18	90		63		75		83		78		follow-up(av9mo)/histol	
Schwarzbach, 1999[5]	RA	prim	14	14	100										surg pathol/follow-up	
		susp loc recurr		10	100		100						100			
Schulte, 1999[6]	RA	eval of soft tissue tumors	102	102	97		66		84		92		86		biopsy/histol	
Nieweg, 1996[7]	RA	detect STS	22	21	100		67								histopath/biopsy	
	Summary	**by patients**	**286**	**374**	**94**		**72**		**84**		**90**		**85**			
Staging																
Lenzo, 2000[8]	A	staging/overall	20	20	93										anat imag/clin hist/LT follow-up(~3.3y)	
		dx/prim		8	88											
		response to ther/poor LT response			100											
		response to ther/good LT prognosis			71											
Lodge, 1999	RA	assess tumor malignancy	29	29	100		76								biop/histol/surg excis	
Lodge, 1998	A	differentiating STS from benign	27	27	82		94								biop/histol	
	Summary	**by patients**	**76**	**84**	**91**		**85**									
Dx/Staging																
Dimitrakapoulou-Strauss, 2000[9]	A	dx/skeleton sys/sp occ lesions	83	55	90		88		100		90				histol	
	Summary	**by patients**	**83**	**55**	**90**		**98**		**100**		**90**					

TABLE 12 (*Continued*)

MUSCLE&CONNECTIVE TUMOR	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence																
Jacobson, 2000[10]	A	recurrence	95	177	47		93		62		88		84		clin/imag/histopath	
Dimitrakopoulou-Strauss, 2000[11]	A	dx/prim/recur/STS	50												not stated	
		prim		19	91		88		91		88		89			
		recurr		31	88		92									
Hain, 1999[12]	RA	eval local recurr/amput/soft tissue sarcoma	16	16	50										clin follow-up (up to 8 y)	
Schwarzbach, 1999[13]	RA	prim	14	14	100										surg pathol/follow-up	
		susp loc recur		10	100		100						100			
Lucas, 1998[14]	RA	soft tissue sarcoma/local recurrence	62	72	74		94		82		91		89		MRI/CT/histol/biopsy/follow-up 3y2mo	
		lung mets		70	87	100	100	96	100	88	96	100	97	97		
Kole, 1997[15]	RA	detect local recurrence	17	17	93	77							94	67	biop/pathol/clin follow-up 6 mos	
	Summary	**by patients**	**254**	**426**	**66**	**96**	**95**	**96**	**75**	**88**	**90**	**100**	**89**	**91**		
Monitoring Response																
Lenzo, 2000[16]	A	staging/overall	20	20	93										anat imag/clin hist/LT follow-up(~3.3y)	
		dx/prim		8	88											
		response to ther/poor LT response		20	100											
		response to ther/good LT prognosis		20	71											
van Ginkel, 1996[17]	RA	hypertherm rspnse/isol limb perfus/loc adv STS	20	19									89		surg/pathol	
	Summary	**by patients**	**40**	**87**	**86**								**89**			
Other																
No articles																

[1] 50 pts. 59 masses.

[2] PET is helpful for the Dx of prim & recur STS. There is correl of FDG uptake and grading which can result in FNs for G I tumors.

[2] Abst did not provide enough data to complete 2x2 and verify spec=.92.

[3] 30 pts. 31 masses. For dist mets, 28/30 pts had WB PET scans. Of 10 w hi gde STS, 3 had dist mets. PET detected 2/3.

[4] With hi NPV, PET can help clinician in mgmt of pts for earlier dx of progressive disease.

[5] FDG PET is suitable for functional imaging of soft tissue sarcomas and detecting sarcoma recurrence.

[6] 102pts/102soft tiss tumors/35 benign tumors(25 benign, 10 tumor-like lesions)/67 malig tumors (66 sarcoma, 1 NHL).

[7] 22 pts. 18 pts w STS. 4 pts w benign lesions. 1 benign lesion read as equivocal; not included in analysis.18TP/1FP/2 TN.

[8] FDG is useful for staging & monitoring response to therapy in childhood STS. Promise for detecting occult met disease. Persistent FDG post-ther indic of poor lt prognosis. Neg FDG dur or post-ther suggest lt dis free surv. Overall stated sens=.93(18pts/21scans). Calcs to be 18/20=.90.

[9] The analysis of the dynamic FDG data offers a hi acc for differential Dx of space occupying lesions of skeleton system.

[9] Sarcoma(122scns/47pts)NHL(26scns/21pts)HL(21scns/18pts).

[10] Sarcoma(122scns/47pts)NHL(26scns/21pts)HL(21scns/18pts) + other cancers. 2x2 is based on 177 scans.

[11] PET is helpful for the Dx of prim & recur STS. There is correl of FDG uptake and grading which can result in FNs for G I tumors.

[11] Abst did not provide enough data to complete 2x2 and verify spec=.92.

[12] Of 16 pts, only 2 w recur. Many FPs in lower limb amputees persisting >=18 mos; many due to prosthesis pblms.

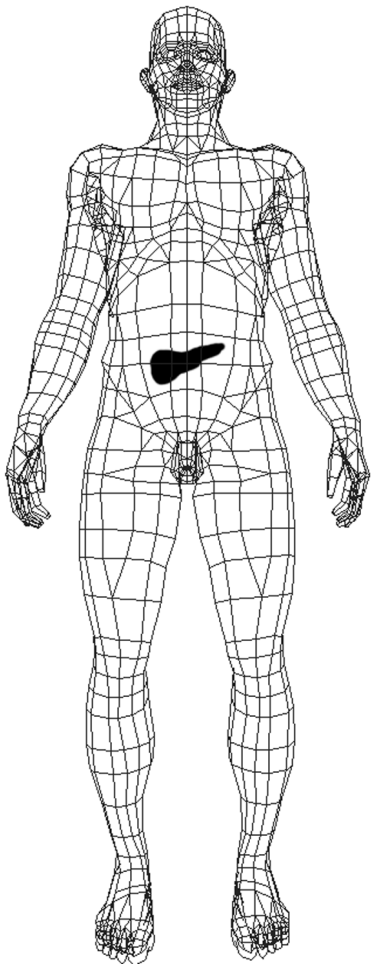
[13] FDG PET is suitable for functional imaging of soft tissue sarcomas and detecting sarcoma recurrence.

[14] 62 pts. 72 comparisons for local recurrence. 70 comparisons for lung mets.

[15] PET:14TP/1FN/2TN. CT/MRI:12TP/3FN/2FP.

[16] FDG is useful for staging & monitoring response to therapy in childhood STS. Promise for detecting occult met disease. Persistent FDG post-ther indic of poor lt prognosis. Neg FDG dur or post-ther suggest lt dis free surv. Overall stated sens=.93(18pts/21scans). Calcs to be 18/20=.90.

[17] Overall 17/19 responses correctly indicated by PET.



Disease Background. Pancreatic carcinoma is common in the United States, with approximately 30,000 patients each year diagnosed with pancreatic adenocarcinomas. Patients with inflammatory processes in the pancreas (pancreatitis) but no cancer can sometimes have high FDG uptake that is indistinguishable from cancers and, thus, must be differentiated from patients with cancer. FDG PET is being applied increasingly in pancreatic cancer diagnosis. Considering the very poor prognosis of pancreatic carcinomas, PET's greatest role may prove to be in helping to characterize masses appearing in the pancreas, as opposed to more general tumor staging. This is an active area of current investigation.

Case Example. A 52-y-old woman with a calcified pancreatic mass on CT (Fig. 14A, arrow) was referred for FDG PET scanning because of rising blood tumor markers. No uptake of FDG was seen within the mass (Fig. 14B). The patient was treated conservatively, under the assumption that she had inflammation of the pancreas (pancreatitis). Follow-up over 2 y with CT revealed no changes, indicating that FDG PET was correct and no tumor existed.

Why Did FDG PET Help? FDG PET demonstrated that there was no pancreatic tumor, sparing the patient pancreatic surgery.

Key Management Issues.

- Differentiating chronic pancreatic masses from cancer
- Staging nodal and liver metastases
- Assessing response to chemotherapy

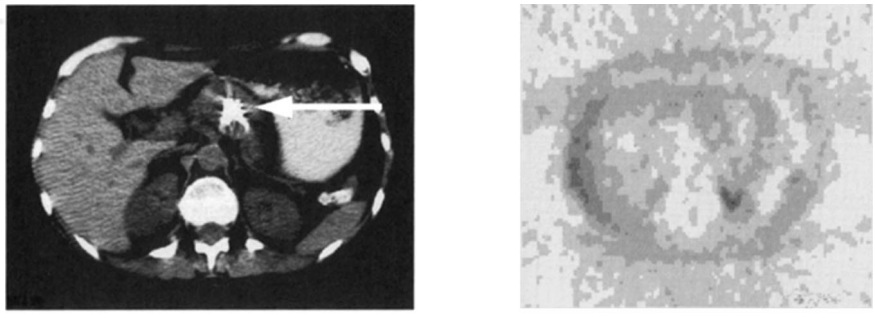
Summary of Evidence for FDG PET in Pancreatic Cancer. For diagnosis: An estimated 50% change was noted in management effect, based on 26 patient studies (Table 13).

For diagnosis/staging: An estimated 43% change was noted in management effect, based on 65 patient studies (Table 13).

For staging: An estimated 36% change was noted in management effect, based on 33 patient studies (Table 13).

For recurrence: An estimated 53% change was noted in management effect, based on 19 patient studies (Table 13).

For monitoring response: An estimated 16% change was noted in management effect, based on 19 patient studies (Table 13).



A. CT **B. FDG PET**

FIGURE 14. Case example, pancreatic cancer. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography.* London, UK: Arnold, Hodder Headline Group; 1999.

TABLE 13
FDG PET in Pancreatic Cancer: Results of Literature Search

PANCREATIC CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
Nakamoto, 1999[1]	RA	dx/liver mets	34	34		92		91		85		95		91		histol/surg/clin follow-up	
					51	90	69	91	100	93	100	87	71	90	82		
Imdahl, 1999[2]	RA	dx	48	48		96	81	100	89	100	91	94	76			histol/surg/endosc cholang/CT	
Nitzsche, 1997[3]	A	differential diagnosis	30	26										100		surg/histology	50
Chierichetti, 1997[4]	A	differential diagnosis	57	12		92										histology	
Friess, 1995[5]	RA	dx	80	80		94	79	88	69	91	77	98	71	91	74	histology	
Inokuma, 1995[6]	RA	dx	46	46		94	89	82	73	94	91	82	67	91	85	histol/surg/clin follow-up	
Stollfuss, 1995[7]	RA	dx	73	73		95		90		93		90		93		histol/surg/biop	
				68			80		74		83		71		78		
	Summary	**by patients**	**368**	**387**		**94**	**82**	**90**	**75**	**93**	**84**	**92**	**71**	**92**	**78**		**50**
		by lesions			**51**	**90**	**69**	**91**	**100**	**93**	**100**	**87**	**71**	**90**	**82**		
Dx/staging																	
Martin, 2000[8]	A	dx/staging	49	49		77		74		82		67				tiss dx/explor lapar/CT/clin	
Debelke, 1999[9]	RA	dx/staging	65	65		92	65	85	61	96	87	73	31	91	65	histol/clin & radiol follow-up	43
Zimny, 1997	RA	dx/staging	106	106		85		84		93		71		85		histol	
		lymph node involvement		26										46			
		metastases		31										52			
Bares, 1996[10]	RA	dx/staging	85	85		85		77		87		74		82		histopath/surg	
		lymph node metastases		31		61											
		liver metastases		13		54											
Bares, 1994	RA	different dx/susp pancr ca	40	40		93		85		93		85		90		histol	
		lymph node mets			17	76	18										
Bares, 1993	RA	dx/staging/detect pancr mass	15	15		92		100		100		67		93		histol/surg	
	Summary	**by patients**	**360**	**461**		**83**	**65**	**82**	**61**	**91**	**87**	**73**	**31**	**81**	**65**		**43**
		by lesions			**17**	**76**	**18**										
Staging																	
Franke, 1999[11]	RA	follow-up/pancreatic ca	19	19												surg/biop/clin follow-up	53
Fröhlich, 1999[12]	RA	staging	168	168		68		95		65		95		91		surg/CT follow-up 6 mos	
		>1cm			29	97											
		<=1cm			37	43											
Jadvar, 1999[13]	A	impact to mgmt/all stages	14	14		100		67						93		histol/LT clin follow-up 5-17 mos	14
	Summary	**by patients**	**201**	**201**		**70**		**93**		**65**		**95**		**91**			**36**
		by lesions			**66**	**67**											

TABLE 13 (*Continued*)

PANCREATIC CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence																	
Franke, 1999[14]	RA	follow-up/pancreatic ca	19	19												surg/biop/clin follow-up	53
	Summary	**by patients**	**19**	**19**													**53**
Monitoring Response																	
Shields, 1999[15]	A	eval trtmt rspnse/local adv	19	19		94										clin follow-up	16
Higashi, 1999[16]	RA	mon/unresect/pre&post IORT	12	12		100										surg/compare to CT	
		detection of liver mets		14		83		100									
	Summary	**by patients**	**31**	**45**		**92**		**100**									**16**
Other																	
No Articles																	

[1]Data suggests PET as adjuvant modality to confirm liver mets when other modals inconclusive.

[2]NPV=21/22=.95 where art reports .94.

[3]All prim lesions were classified correctly on PET.

[4]To obtain a 100% spec in detecting malignancies w PET, SUV w cut-off of 3 applied w sens=.875. 12 pts w pancr ca. Other pts w other maligs and non-malig conditions.

[5]Art reports PET PPV=.91 NPV=.98. 2x2 from reported results gives PPV=.92 NPV=.90.

[6]Focal increase of FDG uptake seems to be a highly specific sign of malignant tumor.

[7]Art reports PET NPV=.90. This is actually the spec. From 2x2, NPV=.93.

[8]PET alone unable to eval extrapancr ext (Stg II) & nodal involvmt (Stg III) or accurately identify confounding bowel activity.

[9]PET values listed are from cutoff level of SUV 3.0 Optimal cutoff value to differentiate benign from malig was 2.0.

[10]Use of PET in classifying pancr masses may lead to decrease in unnecess laparotomies in pts w benign disease.

[11]10/19=53% where PET gave addit info to clinicians which changed therap proced. In 5/19=26% PET directed to locoreg chemo. 9 pts non-resect tum dis & 10 pts suspic for tumor recurr after surg.

[12]66 malig lesions found in 22 pts. 29>1cm & 37<=1cm.

[13]2/14=14% redirected to additional chemo.

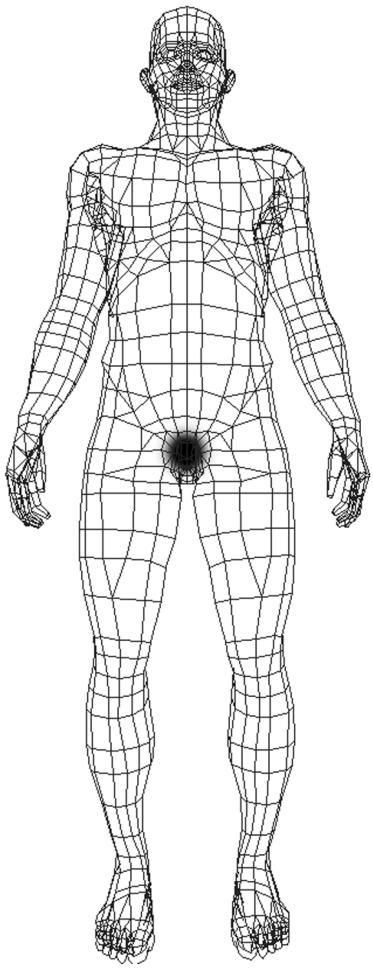
[14]10/19=53% where PET gave addit info to clinicians which changed therap proced. In 5/19=26% PET directed to locoreg chemo. 9 pts non-resect tum dis & 10 pts suspic for tumor recurr after surg.

[15]3/19(16%) post 1cycle trtmt had surg. Sens=.94=15/16 that PET predicted correctly whether resect or not post 1 cycle ther.

[16]Define decr in SUV from before to after IORT as indicative of partial response, then sens of PR=10/10=100 i.e.10 w PR had decr SUV, 2 w NC had incrsd SUV (due to abscesses).

[16]Follow-up PET after IORT on 12 pts/14 scans [2 pts had 2nd PET after IORT].

Prostate Cancer



Disease Background. Prostate cancer rates increased 141.8% between 1973 and 1994. In 1998, new prostate cancer cases totaled 184,500, or, in other terms, one new case every 3 min. Prostate cancer continues to be the most frequently occurring malignancy (aside from skin cancers), representing 29% of all new cancer cases in American men. One out of every six men is at lifetime risk for prostate cancer. Approximately every 13 min, a life is lost to prostate cancer in the United States. African-Americans have the highest prostate cancer incidence rates in the world, exceeding those for white males in the United States by 34%. Prostate cancer mortality rates are two times higher for African-American men than for white American men.

Case Example. A 75-y-old man, who was diagnosed with prostate cancer, was followed by blood levels for prostate specific antigen (PSA, a prostate tumor marker). A rising PSA was followed up with a CT scan (Fig. 15, left), which revealed lymph node involvement in the pelvis near the removed prostate. An FDG PET study confirmed what was seen on CT and, in addition, showed spread of cancer into the abdomen and chest (Fig. 15, middle and right).

Why Did FDG PET Help? FDG PET helped because it showed that the cancer had spread to distant sites and that local radiation to the pelvis alone was not likely to benefit the patient.

Key Management Issues.

- Further evaluation of equivocal bone lesions found with conventional imaging
- Differentiating benign from malignant lesions in bone
- Assessing treatment response when lesion is imaged initially
- Identifying metastatic disease in soft tissue

Summary of Evidence for FDG PET in Prostate Cancer. Management change data for staging patients are not directly available from the literature (Table 14).

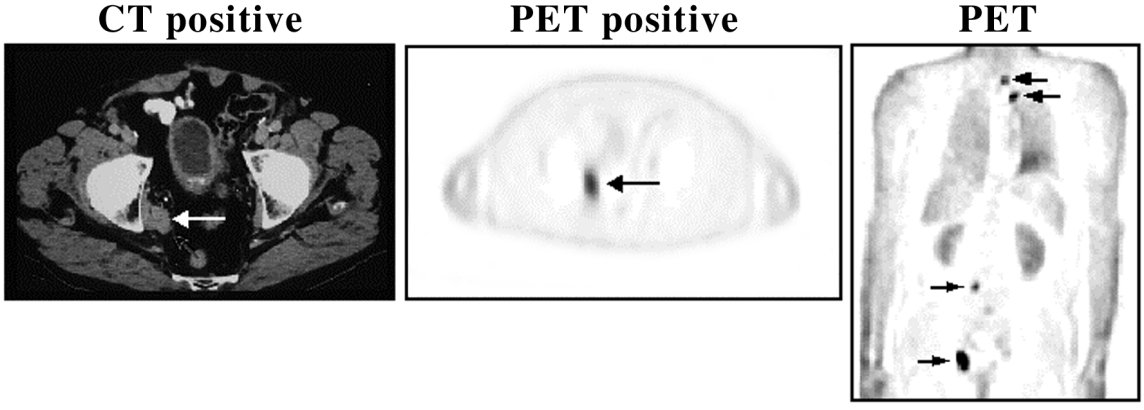


FIGURE 15. Case example, prostate cancer.

TABLE 14

FDG PET in Prostate Cancer: Results of Literature Search

PROSTATE CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																	
No Articles																	
Staging																	
Seltzer, 2000	A	prostate region	22													not stated	
		advanced prostate		5		0											
		rising PSA and/or refrac horm		17		12											
Sanz, 1999	RA	staging iliac & obturator LNs	21	11								73				surg pathol	
		post-trtmt/biochem progress/recurr		10								43				CT/bne scint	
Oyama, 1999[1]	RA	untreated pca	49	49		64		100								histopath/bne scint	
		bone mets		12		75											
Oyama, 1999[2]	A	trtmt rspnse/endocrine ther	11	11		91										histol	
Melchior, 1999[3]	A	trtmt rspnse/adv/andro with	32													serum PSA/pelv MRI ev 3 mo	
		T3 tumors/adv		16		81											
Heicappell, 1999	RA	staging pelv lymph nodes	17	17		67										histol	
Hara, 1998	RA	p ca/imag pelv to lowabd	10	10												histol	
Caputo, 1997	A	staging bone mets	21	21		50										compare w bone scan	
		staging soft tiss mets		21		40											
Shreve, 1996[4]	RA	staging of osseous mets	34		202	65				98						bne scan/CT/clin follow-up	
Hoh, 1996	A	trtmt rspnse/partial/adv dis	8	8		100										PSA decr>50%/meas dis >50% decr	
		trtmt rspnse/stable clin dis	8	8		75											
Yeh, 1995	A	staging bony mets/horm resis	11	11		20										compare w Tc-99m-MDP	
	Summary	**by patients**	**244**	**227**		**57**		**100**				**73**					
		by lesions			**202**	**65**				**98**							
Dx/Staging																	
No Articles																	
Recurrence																	
Seltzer, 2000	A	prostate region	22													not stated	
		advanced prostate		5		0											
		rising PSA and/or refrac horm		17		12											
Sanz, 1999	RA	staging iliac & obturator LNs	21	11								73				surg pathol	
		post-trtmt/biochem progress/recurr		10								43				CT/bne scint	
Seltzer,1999	RA	dist mets/PSA relapse/PSA>4	45	22		50	50									CT/monoclonal antibody/FNA	
		PSA<4		23		4	17										
		eval LN mets		12		67											
Jacobson, 1999[5]	A	dx recurr/elev tum markers	11	11		18										radiol exam/histol	
Haseman, 1996	RA	occult recur/elev PSA 3mo post ther	14	10		17				33		29				biop prostate bed/CYT-356	
	Summary	**by patients**	**113**	**121**		**26**	**33**			**33**		**36**					

TABLE 14 (*Continued*)

PROSTATE CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																	
Melchior, 1999[6]	A	trtmt resp/adv/andro with	32													serum PSA/pelv MRI ev 3 mo	
		T3 tumors/adv		16		81											
Oyama, 1999[7]	A	trtmt rspnse/endocrine ther	11	11		91										histol	
Hoh, 1996	A	trtmt rspnse/partial/adv dis	8	8		100										PSA decr>50%/meas dis >50% decr	
		trtmt rspnse/stable clin dis	8	8		75											
	Summary	**by patients**	**59**	**43**		**86**											
Other																	
No articles																	

[1]44 pts w histol proven pca. 5 benign control pts w BPH.

[2]Glucose util may be independent fm PSA or prost size for eval of endocrine ther.

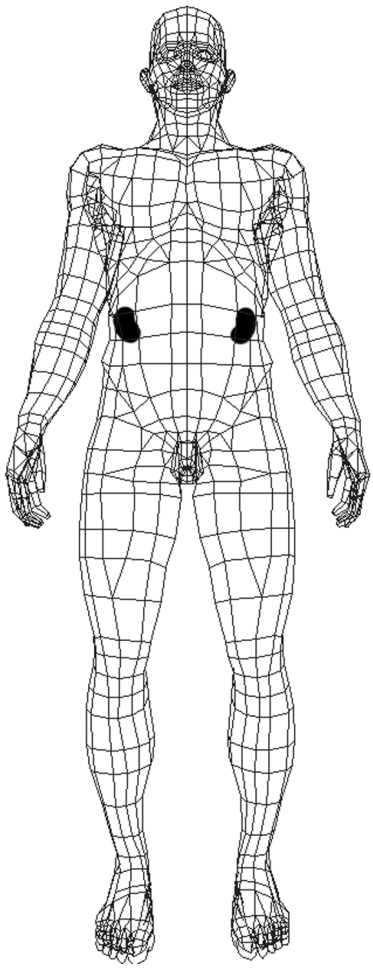
[3]Serial assessmt by FDG PET may be useful for optimizing neoadjuvant or intermittent hormonal ther.

[4]FDG PET can help identify osseous and soft-tissue mets w hi PPV. Less sens than bne scint for osseous mets.

[5]Yields for prostate pts w elev Tg, C, PSA are prob lower due to lower metabolic activ.

[6]Serial assessmt by FDG PET may be useful for optimizing neoadjuvant or intermittent hormonal ther.

[7]Glucose util may be independent fm PSA or prost size for eval of endocrine ther.



Disease Background. Renal cell cancer, also called renal adenocarcinoma or hypernephroma, can often be cured if diagnosed and treated when still localized to the kidney and to immediately surrounding tissue. The probability of cure is directly related to the stage or degree of tumor dissemination. Even when regional lymphatics or blood vessels are involved with tumor, a significant number of patients can achieve prolonged survival and probable cure. When distant metastases are present, disease-free survival is poor, although occasionally, patients will survive after surgical resection of all known tumor. Because a majority of patients are diagnosed when the tumor is still relatively localized and amenable to surgical removal, approximately 40% of all patients with renal cancer survive 5 y. Occasionally, patients with locally advanced or metastatic disease may exhibit indolent courses lasting several years. Late tumor recurrence many years after initial treatment occurs occasionally. Renal cell cancer is one of the few tumors in which well-documented cases of spontaneous tumor regression in the absence of therapy exist, but this occurs very rarely and may not lead to long-term survival. Surgical resection is the mainstay of treatment of this disease. Even in patients with disseminated tumor, locoregional forms of therapy may play an important role in palliating symptoms of the primary tumor or of ectopic hormone production. Systemic therapy has demonstrated only limited effectiveness.

Case Example. A 59-y-old man with a history of metastatic renal cell cancer and left kidney removal developed left-sided flank pain. Abdominal-pelvic CT was negative on initial review (Fig. 16, bottom row). FDG PET revealed a focus in the apex of the right lung and in the left flank (Fig. 16, top row, arrows). Because of the abnormality in the region of the left flank, the CT was reviewed again and a mass located in the posterior abdominal wall was found. Biopsy revealed metastasis from renal cell cancer.

Why Did FDG PET Help? FDG PET showed a lesion missed on CT and also showed that the renal cell cancer had spread to the lungs. The patient, therefore, could be managed better with systemic therapy and, because of the spread of the disease, was not likely to do well.

Key Management Issues.

- Detecting metastatic disease
- Assessing response of metastases to chemotherapy
- Determining nature of renal masses

Summary of Evidence for FDG PET in Renal Cell Cancer. Management change data for diagnosis and staging and other applications are not directly available from the literature (Table 15).

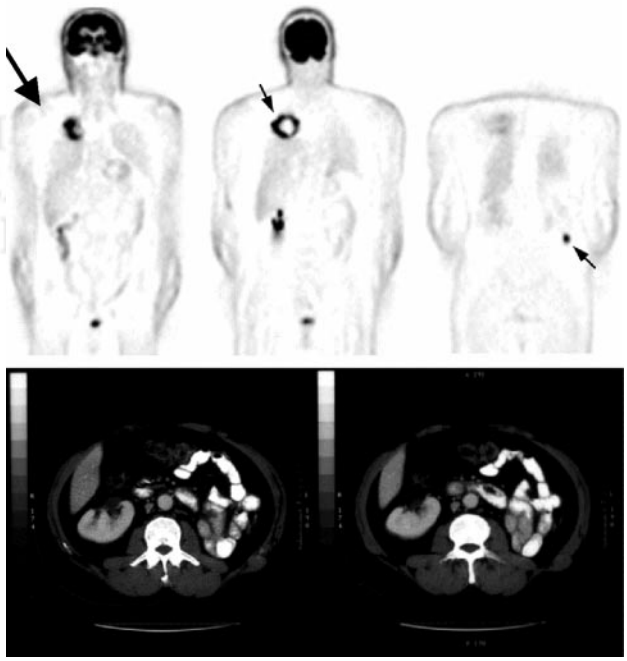
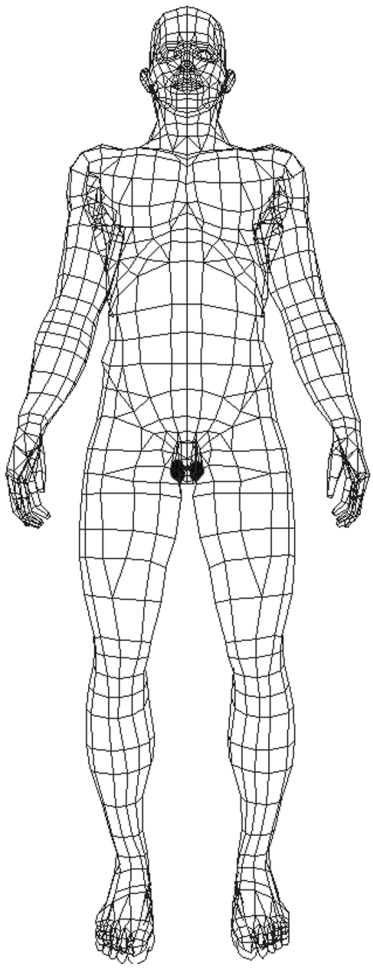


FIGURE 16. Case example, renal cell cancer.

TABLE 15
FDG PET in Renal Cancer: Results of Literature Search

RENAL CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																
Bachor, 1995	RA	primary dx	11	11	89										surg	
	Summary	**by patients**	**11**	**11**	**89**											
Staging																
Harrison, 2000[1]	RA	pre-op staging/adrenalect	8	4									100		surg/CT/follow-up 43 mos	
Lang, 2000	A	staging	46	46	74										clin follow-up	
Bachor, 1996	RA	staging	29	29	77										surg/histol	
Hoh, 1996	A	staging	22	22	80		100								clin follow-up/ CI	
	Summary		**105**	**101**	**76**		**100**						**100**			
Dx/Staging																
No Articles																
Recurrence																
No Articles																
Monitoring Response																
No articles																
Other																
No articles																

[1] 14 pts evaluated w PET. 2 pts showing isol mets/successful surg. 2 pts showing dissem mets/death.



Disease Background. Cancer of the testicle, a rare type of cancer, is a disease in which cancer cells are found in the tissues of one or both of a man's testicles. Cancer of the testicle is the most common cancer in men 15–35 y old. Men who have an undescended testicle (a testicle that has never moved down into the scrotum) are at higher risk of developing cancer of the testicle. This is true even if surgery has been performed to place the testicle in the appropriate place in the scrotum. Prognosis and choice of treatment depend on the stage of the cancer and the patient's general state of health.

Case Example. A 27-y-old man with testicular cancer had his left testicle removed. An abdominal CT scan indicated an enlarged lymph node in the lower abdomen. A CT-guided biopsy was performed but did not reveal cancer. An FDG PET scan was ordered to make sure the biopsy was not wrong. The scan showed a focus of activity in the abdominal lymph node (Fig. 17, arrows), suggesting cancer spread. A repeat biopsy confirmed tumor in the abdominal lymph node site.

Why Did FDG PET Help? FDG PET showed that the biopsy was wrong, and, in fact, tumor was present in the abdomen. Furthermore, the tumor did not appear to have spread elsewhere. Knowing the presence of tumor in that region changed management for the patient, who would have received only testicular surgery but now could receive additional treatment for spreading testicular cancer.

Key Management Issues.

- Monitoring response to treatment
- Staging of primary disease
- Assessing residual mass
- Further evaluating raised markers

Summary of Evidence for FDG PET in Testicular Cancer. For staging: An estimated 22% change was noted in management effect, based on 27 patient studies (Table 16).

For recurrence: An estimated 51% change was noted in management effect, based on 53 patient studies (Table 16).

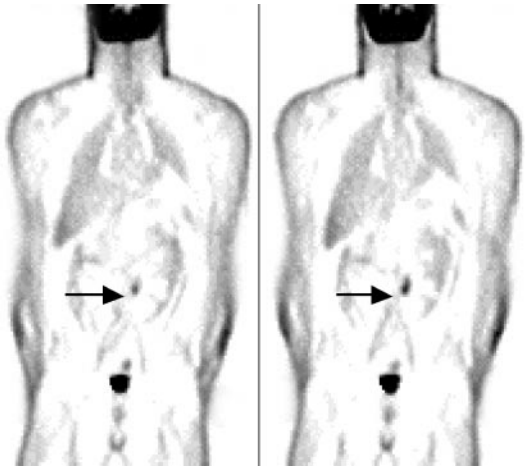
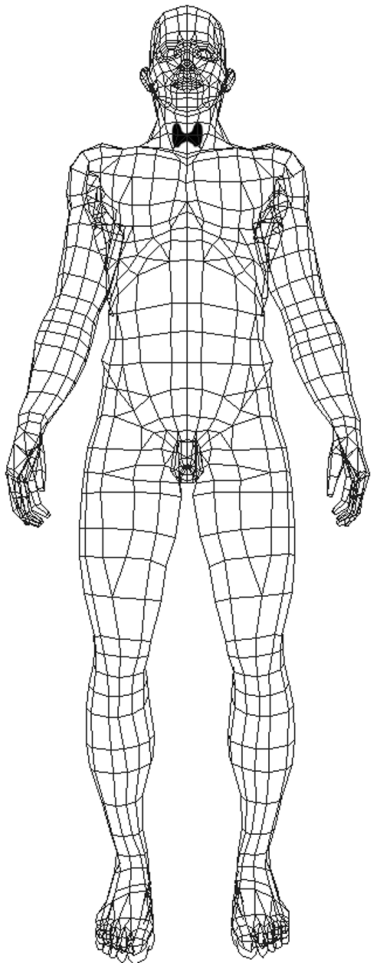


FIGURE 17. Case example, testicular cancer.

TABLE 16
FDG PET in Testicular Cancer: Results of Literature Search

TESTICULAR CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																
No articles																
Staging																
Albers, 1999	RA	staging	37	37	70	40	100	78					92	68	LN dissect/clin follow-up	
Cremerius, 1999	RA	staging	50	50	87	73	94	94	87	85	94	89			clin follow-up/retroper lymphad	
Hain, 1999	A	staging	27	27											histol/clin follow-up	22
Nuutinen, 1996	A	metastatic cancer	13	13	100		89								histol/surg/follow-up	
Harms, 1995	A	metastatic cancer	29	29	79		90								clin course/histol	
	Summary	**by patients**	**156**	**156**	**82**	**59**	**94**	**87**	**87**	**85**	**94**	**89**	**92**	**68**		**22**
Dx/Staging																
No articles																
Recurrence																
Hain, 1999	A	recurrence	53	53											biop/follow-up	51
	Summary	**by patients**	**53**	**53**												**51**
Monitoring Response																
No articles																
Other																
de Wit, 1999	A	germ cell tumor	133	133	80	88	92	48	88	57	86	83	87	66	histol/clin follow-up	
	Summary	**by patients**	**133**	**133**	**80**	**88**	**92**	**48**	**88**	**57**	**86**	**83**	**87**	**66**		



Disease Background. Cancer of the thyroid is a disease in which cancer cells are found in the tissues of the thyroid gland. People who have been exposed to large amounts of radiation or who have had radiation treatment for medical problems in the head and neck have a higher chance of getting thyroid cancer. The cancer may not occur until 20 y or longer after radiation treatment. The four main types of cancer of the thyroid are: papillary, follicular, medullary, and anaplastic. The chance of recovery depends on the type of thyroid cancer, whether it is only in the thyroid or has spread to other parts of the body (stage), and the patient's age and overall health. Some types of thyroid cancer grow much faster than others. Although thyroid cancer is relatively uncommon, it is nonetheless the most common malignancy of the endocrine system. Differentiated tumors (papillary or follicular) are highly treatable and usually curable. Poorly differentiated cancers (medullary or anaplastic) are much less common but aggressive, metastasize early, and have a much poorer prognosis. The incidence of this malignancy has been increasing over the last decade. The prognosis for differentiated carcinoma is better for patients younger than 40 y and who have no extracapsular extension or vascular invasion. Age appears to be the single most important prognostic factor. Thyroid cancer commonly presents as a cold nodule within the thyroid gland. The overall incidence of cancer in a cold nodule is 12%–15% but is higher in patients younger than 40 y.

Case Example. A 62-y-old patient underwent surgery of the left thyroid for thyroid cancer. Routine yearly monitoring revealed elevated blood levels of calcitonin. A CT scan was ordered and was normal. An FDG PET scan revealed increased FDG accumulation in the neck (Fig. 18, arrows), which was confirmed by biopsy to be residual thyroid cancer.

Why Did FDG PET Help? FDG PET identified the source of the rising tumor marker and thereby allowed removal of residual thyroid cancer.

Key Management Issues.

- Further evaluation when whole-body ^{131}I scan is negative but thyroglobulin (Tg) levels are rising in a patient with known differentiated thyroid cancer
- Further evaluation for medullary thyroid cancer when rising calcitonin level and initial imaging with dimercaptosuccinic acid V, octreoscan, or metaiodobenzylguanidine is negative.

Summary of Evidence for FDG PET in Thyroid Cancer. For staging: An estimated 22% change was noted in management effect, based on 60 patient studies (Table 17).

For diagnosis/staging: An estimated 9% change was noted in management effect, based on 58 patient studies (Table 17).

For recurrence: An estimated 53% change was noted in management effect, based on 21 patient studies (Table 17).

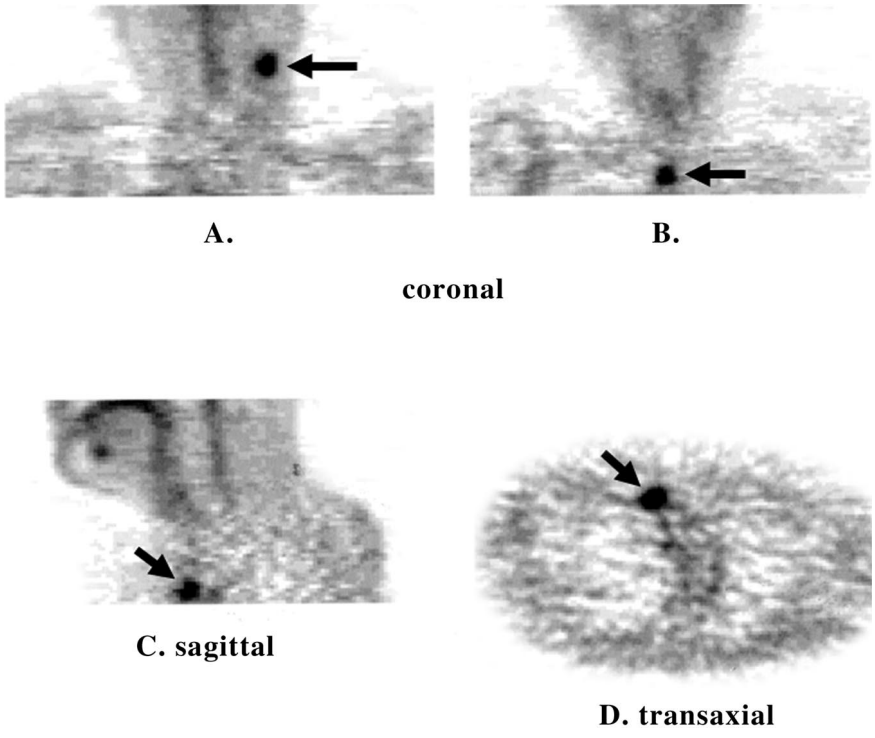


FIGURE 18. Case example, thyroid cancer. Reproduced, with permission, from Maisey et al. *Atlas of Clinical Positron Emission Tomography.* London, UK: Arnold, Hodder Headline Group; 1999.

TABLE 17
FDG PET in Thyroid Cancer: Results of Literature Search

THYROID CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
No articles																		
Staging																		
Brandt-Mainz, 2000	RA	follow-up/MTC/elev calcit/overall	20	18			76										histol/CT/venous cathet	
		neck mets			14		86											
		mediastinal mets			8		86											
		pulm mets			3		100											
		bone mets			2		100											
Kurtaran, 2000[1]	A	recurrent medullary thyroid carcin	20	20			32										CT/US/MRI/histol	
Shanker, 2000[2]	A	follow-up/iodine-neg thyroid ca	23	27			89		88						89		serum thyroglob&antibod/neck US&MRI	
Hoda, 2000[3]	A	detect recurr/met papillary thyrd ca	11	11			91										IWBS/serum Tg assay	
Liu, 2000	A	detect recur & mets/thyroid ca	19	19			79										clin/path follow-up	
Wang, 1999	RA	resid thyrd ca/131I-/elev tg	37														all imaging/serological study/biopsy	51
		hi Tg		18			71				92							
		lo Tg		19			67		81		40		93					
Jacobson, 1999	A	dx recurr/thyrd/elev markers	60	26			35										radiol exam/histopath	
Grünwald, 1999	RA	differentiate thyroid carcinoma	222	222			75		90		88		79		83		histol/cytol/thyroglob/US/CT/clin	
Schluter, 1998[4]	RA	early surg/131I- differen thyrd carcin	60	60													surg	22
Dietlein, 1998	RA	follow-up/differen thyrd ca/all mets	50	50			50										MIBI-scintig/MRI/lung CT	
		LN mets		50			60										histol/iodine-uptake	
		local recurrence		50			100										histol/morphol imaging	
		pulm mets <1cm		50			0										spiral-CT/rising Tg-levels	
	Summary	**by patients**	**522**	**640**			**69**		**89**		**85**		**80**		**84**			**22**
		by lesions			**27**													
Dx/Staging																		
Dietlein, 1997[5]	RA	dx/staging/follow-up to trtmt	58	58			50										histol/anatom imag/nod dissect	9
		subgp/incr Tg level/neg WBS		58			82											
		LN mets			41		49											
Bloom, 1993[6]	RA	Dx/eval thyroid nodules	19	19											100		surg	
Adler, 1993[7]	RA	Dx/susp thyrd nodule/pre-op	9	9			100		67								surg excis	
	Summary	**by patients**	**86**	**144**			**68**		**67**						**100**			**9**
		by lesions			**41**		**49**											

TABLE 17 (*Continued*)

THYROID CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Recurrence																		
Alnafisi, 2000[8]	RA	recurr or met 131I neg papill thyrd ca	11	11							64						CT/sonog/biop nk lesions	64
Kurtaran, 2000[9]	A	recurrent medullary thyroid carcin	20	20			32										CT/US/MRI/histol	
Shanker, 2000[10]	A	follow-up/iodine-neg thyroid ca	23	27			89		88						89		serum thyroglob&antibod/neck US&MRI	
Hoda, 2000[11]	A	detect recurr/met papillary thyrd ca	11	11			91										IWBS/serum Tg assay	
Liu, 2000	A	detect recur & mets/thyroid ca	19	19			79										clin/pathol follow-up	
Chung, 1999	RA	athyrotic papill thyrd ca/131 I -	54	54			94		95		97		91		94		pathol/other imag/clin crse/dissect	
Jacobson, 1999	A	dx recurr/thyrd/elev markers	60	26			35										radiol exam/histopath	
Grünwald, 1999	RA	differentiate thyroid carcinoma	222	222			75		90		88		79		83		histol/cytol/thyroglob/US/CT/clin	
Stokkel, 1999	RA	recurr/rising Tg level/neg I-131 WBS	11	11		yes	100		100						100		US/CT/MRI/FNA cytol	
Jadvar, 1998[12]	RA	eval susp recurr papill thyrd carcin	10	10			100		80		83		100		90		US/CT/MRI/FNA/nk LN dissect	40
Altenvoerde, 1998[13]	RA	differen thyrd carcin/elev tg/-I 131	32	12							50						CT/MRI	
Grunwald, 1997[14]	RA	differen thyrd carcin/versus WBS	54		66		73		86		81		79		80		hist/cytol/Tg/US/CT/MRI/follow-up	
Feine, 1996[15]	RA	detect recurr	41	41			89										131-I-WB gamma cam/nk&abd US	
																	CT/hTg levels	
Grünwald, 1996[16]	RA	susp recur/incr Tg level/131-IWBS	33	33			83										histol/cytol/tg level/sonog/CT/MRI/clin	
	Summary	**by patients**	**601**	**497**			**77**		**91**		**87**		**82**		**86**			**53**
		by lesions			**66**		**73**		**86**		**81**		**79**		**80**			
Monitoring Response																		
No articles																		
Other																		
No articles																		

[1] sens=6/13=.32 1FP discovered from histol which reduced 7 TP to 6 TP. And 13 FN. 20 pts. Conclus:PET has lo sens in localizing recurr/metast MTC lesions. Should not be performed routinely.

[2] 23 pts/27 scans. Spec actually rounds up to .89.

[3] Not clear from abstr if there was 1 FN or 1 TN. If FN, then sens=10/11 for PET.

[4] 13/60=22% operated on after positive PET findings.

[5] Chge in mgmt=5/58=9% sent to surg from +PET where -I uptke for LN met pts.

[6] 19 pre-op pts. 12 pts w solitary thyrd nodules. 7 multinodular goiters. 4 w malig had FDG>8.5. 15 benign w FDG <7.6. Acc=19/19=100.

[7] Mean FDG DUR for 3 malig lesions signif > 6 benign lesions. 3 malig and 4/6 benign lesions w incr FDG uptake.

[8] PET redirected trtmt in 7/11 pts=.64.

[9] sens=6/13=.32. 1FP discovered from histol which reduced 7 TP to 6 TP. And 13 FN. 20 pts. Conclus:PET has lo sens in localizing recurr/metast MTC lesions. Should not be performed routinely.

[10] 23 pts/27 scans. Spec actually rounds up to .89.

[11] Not clear from abstr if there was 1 FN or 1 TN. If FN, then sens=10/11 for PET.

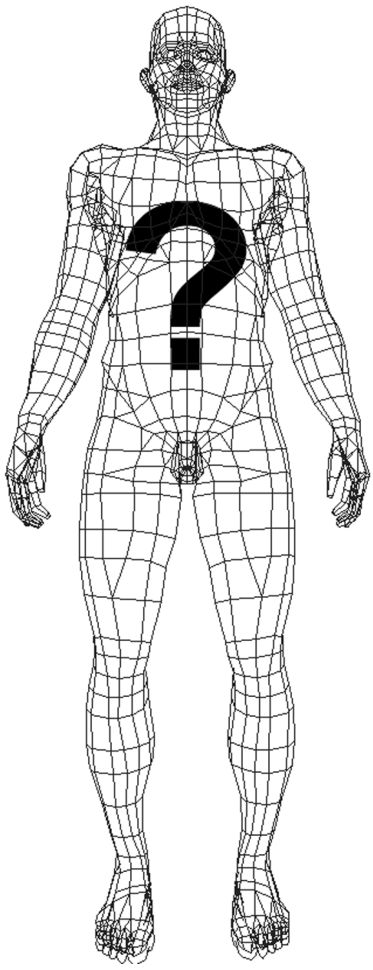
[12] FDG PET provided additional info in 4/10=40% pts affecting their clinical mgmt.

[13] 500 pts w diff thyrd carc. Subgp of 32 pts w elev hTg,- I 131, neg US and chest xray. 12 pts w PET scans.

[14] Based on Table 2 results:22TP/5FP/8FN/31TN.

[15] Referred to in Stokkel '99 discussion.

[16] Referred to in Stokkel '99 as sens=83. From abst, sens=82=14/17.



Disease Background. Detection of the unknown primary lesion is very difficult. In many cases, patients present with obvious metastatic disease, often adenocarcinoma, in which the location of the primary lesion may never be found. In some cases, knowledge of the primary site is important, because the type of treatment may vary (e.g., breast cancers are more responsive to some treatments than are renal cancers). This knowledge also can be helpful in resection or treatment for cure of the primary lesion and metastases (e.g., head and neck cancers). FDG PET is useful in locating primary tumors after metastatic disease has appeared in regional lymph nodes. FDG PET is being applied increasingly in the search for unknown primary lesions. This application is still in evolution, but FDG PET should be considered strongly in the work-up of the unknown primary.

Case Example. A 49-y-old woman presented with lymph node enlargement in the neck. Physical examination, CT, and mammography performed twice all failed to reveal the source of the primary cancer. An FDG PET study showed that the primary cancer was in the left breast (nonpalpable). The lymph node involvement was not seen in the sections shown in Figure 19.

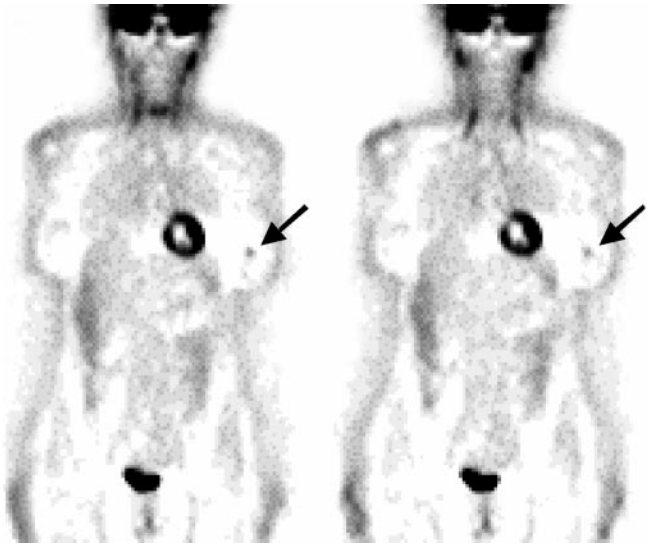


FIGURE 19. Case example, unknown primary tumor.

Why Did FDG PET Help? FDG PET identified the source of the patient's cancer when no other study could do so, thereby allowing the patient to be treated appropriately for breast cancer with spread to the lymph nodes.

Key Management Issues.

- Identifying primary site to determine treatment and evaluate for possible resection

Summary of Evidence for FDG PET in Unknown Primary Cancer. For staging: An estimated 29% change was noted in management effect, based on 285 patient studies (Table 18). (See Table 19 for the results of the literature search on FDG PET in miscellaneous tumors.)

Summary

Table 20 is a summary of results from the literature search on FDG PET in cancer.

TABLE 18

FDG PET in Unknown Primary Cancer: Results of Literature Search

UKNOWN PRIMARY CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Diagnosis																		
No articles																		
Staging																		
Bohuslavizki, 2000[1]	RA	detect of unk prim/overall	53	52			100		81		77		100		88		clin/surg/histopath	
Haase, 2000[2]	A	detect unk prim/overall	32	32		yes	80										biop/CT/MRI/OPET follow-up	38
Kuehnel, 2000[3]	A	detect unk prim	34	34							75						histol/clin course	44
Lassen, 1999[4]	RA	detect unk prim	20	20							69						histol/clin course	15
		detect mets		20			100											
Safa, 1999[5]	RA	detect of unk prim/hd & nk	14	14			75	33	80	64	60	20	89	78	79	57	clin/CT/histopath	21
Hanasono, 1999[6]	RA	detect of unk prim/hd & nk	84	20			70		60		64		67		65		CT/MRI	35
Greven, 1999[7]	RA	detect of unk prim/hd & nk	13	13			50		45		14		83		46		biop/panendoscopy	8
AAssar, 1999[8]	RA	detect of unk prim/hd & nk	17	15			100		63		70		100		80		surg/clin/histopath	53
Lang, 1999	A	detect of unk prim	40	40														28
Klutmann, 1999[9]	A	detect of unk prim/cerv mets	28	28							60						histol/subseq conv imag	32
Yang, 1999[10]	A	detect of unk prim/cerv mets	8	8			80										physical ex/chest x-ray/CT/histol	50
Kole, 1998[11]	RA	detect of unk prim	29	29			70										clin follow-up/addit dx study	10
Braams, 1997[12]	RA	detect of unk prim/H&N	13	13			80										biop/endosc/histol	30
Kole, 1995[13]	A	detect of unk prim	19	19			67										histol/clin follow-up 2-30 mos	21
Hubner, 1995	RA	charact prim unk lung masses	54	23	24		100		67		90		100				histol/surv/SUV vs DNA prolif index	
		recurr lung carcin/lymphoma		13	19		83		80		63		91					
		extrathor/susp pulm mets		18	21		87		83		93		71					
	Summary	**by patients**	**458**	**411**			**82**	**33**	**71**	**64**	**66**	**20**	**91**	**78**	**77**	**57**		**29**
		by lesions			**64**		**91**		**76**		**83**		**88**					
Dx/Staging																		
No articles																		
Recurrence																		
No articles																		

TABLE 18 (*Continued*)

UKNOWN PRIMARY CANCER	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Monitoring Response																		
No articles																		
Other																		
No articles																		

[1] 1 pt denied further workup, so analysis based on 52 pts.20TP,6FP,26TN.44pts had cerv mets/9extracerv mets.

[2] Sens=12/15=.80 based on calling 14 pts w nothing found as TNs. In reality, they may have CUP, but no imaging can find it. Assumption is that for calcs, if isn't found, is considered as TN.

Chge in mgmt determined from % pts w discovered unk prim as this affects trtmt given 12/32=38%.

[3] PET influenced trtmt in 15/34 pts=44%. Data given as 15 TP and 5 FP for PET. So calc'd PPV and not sens, as no results re FNs. And assuming as above,that anything not found is TN.

[4] In 13 pts, PET suggested prim tum which was verified in 9. TP=9/FP=4. Also 2 FN/1TN/4 not confirmed. PET directed therapy change in 3/20=15%.

[5] Have listed what is in Table 2 as ratios. Abst agrees w 1 FN. Art also states that 9 pre-trtmt PET negs had neg mdm biops(which would be 9 TNs). But 1 found to be FN in post-trtmt PET scan and this is in Table.

[6] Chge in mgmt=7/20=35% from detecting unk prim correctly in 7 pts. Art also reports this as detection and sens rte. But states that 10 prims ultimately proven histologically in these 20 pts.

So if use 7TPs, 3FNs,4FPs, and 6 TNs which agree w Table 1, would get sens=7/10=.70.

[7] Chge in mgmt=1/13=8% for discovered unk prim. 3 occult prims proven. PET had 1TP,1FN, 1FP that it picked up in site other than actual location.

[8] 2 lung prims discovered and excluded from rest of analysis. 2x2 based on remaining 15 H&N pts. 7 TP,3FP, 5TN. Chge in mgmt=9/17=53% (9pts total w lung(2) and H&N(7)prims discovered).

They used same assumptions as above; the 8 pts they consider to still have occult prim disease are still listed as FPs and TNs.

[9] Of 16 PET+, 9 TP, 6FP, and 1 refused further cnfrm. PPV=9/15=.60 . Chge in mgmt=9/28=32%. 12 PET-, but no info on FN vs TN w LT follow-up.

[10] PET tst results reported for 7 pre-surg PET; 1 post-surg PET no rslt . Sens=4/5=.80 based on 4 TP, 2TN, 1FN for 7 pts. Chge in mgmt=4/8=50% for discovered prim tumors.

[11] They report chge in mgmt for 3 pts and 3/29=10%. For other unk prim studies, #prim discov/tot pts = chge in mgmt as potent for trtmt specific chges. Also, they report sens rte= detect rate=7/29=24%.

From 2x2, 7 TP,3 FN,19 TN, and sens=7/10=.70.

[12] PET results reported are 4 TP,1 FN, 8 TN. Technically, sens=4/5=.80. Again, they report detection rate of 4/13=30% which is sens if you consider all 13 as 'known' prims to be detected.

But we rpt 2x2 as if assumption is none may ever be found (see other footnotes above).

[13] 19pts. 4TP,2 FN, 13 TN for primary tumor detection. Chge in clin mgmt=4/19=21%. 2x2 sens=4/6=.67. In this example, the 4 pts w chge in mgmt were not all the same 4 that were discovered primaries.

TABLE 19

FDG PET in Miscellaneous Tumors: Results of Literature Search

Miscellaneous Tumors	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Total Lesions	Non-Ded PET	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Kunkel, 2000[1]	RA	verification of oral cancer recurr	44	23	26		88										morphological correlative	
		screening for oral cancer recurr		27	10		90											
Turlakow, 2000[2]	A	detection of peritoneal carcinomatosis	92	16			44										biopsy	
Kluge, 2000	A	detection of perihilar cholangiocarcinoma	29	29			90		88		95		78		90		MRI/histol/control gp PET	
		staging regional lymph nodes		8			13											
		staging distant mets		6			100											
De Winter, 2000[3]	A	dx of chronic osteomyelitis	37	33			100		91						94		invasive/clinical	
		vertebral osteomyelitis		16			100		100						100			
Forster, 2000	A	mon ther rspnse/preop irrad/oral cancer	30	30					88		94						histology	
Bongers, 2000[4]	A	detection of recurrent laryngeal cancer	75	75		yes	100		80		88		100		92		dx endoscopy/biop	
Kato, 2000	A	dx/biliary carcinoma	13	13			70	80	67	67	88	89	40	50	69	77	histopath/clin/abdom CT	
Beuthien-Baumann, 2000	A	dx/oral mucosa carcinoma	39	39			95	72									histology	
		lymph node mets			70		93		87		56		98		86			
		lymph node mets			59			29		94		36		79		71		
Shulkin, 1999[5]	RA	assess sens/pheochromocytomas	29	29			88		42		68		71		69		bne scn/MRI/MIBG	
Lowe, 1999[6]	RA	identify early stge prim & recur laryngeal ca	12	12			92										biop/CT	
Myers, 1998	RA	eval N0 nk/squamous cell carcin/oral cavity	11	11			100	40	100	88	100	67	100	70	100	69	neck dissection	
Schirrmeister, 1998[7]	A	RNB/bne imag/osteoblastic & osteolytic mets	44	44											97		MRI/131-I scint/xray/CT	
Musholt, 1997[8]	RA	recur or persist MTC & pheochromocytoma	10		30		62										surg/pathol	
					27			23										
Shulkin, 1995[9]	RA	assess FDG uptake in pediatric neoplasms	22	22			81		100		100		20		86		surg/bne scn/CT	
Patz, 1995	RA	bronchogenic ca/overall thor nodal staging	42	42	62		83	43	82	85	73	63	89	72	82	69	pathol/CT	
		hilar/lobar lymph nodes			40		73	27	76	86	53	43	88	76	75	70		
		mediastinal node			22		92	58	100	80	100	78	91	62	95	68		
Austin, 1995	RA	dx residual laryngeal carcinoma	10	10			67		57		67		80		60		biopsy/ clin follow-up	
Greven, 1994	RA	recurr vs irrad sequelae/carcin larynx	11	11			100		80		86		100		91		laryngectomy/CT/pathol	
	Summary	**by patients**	**550**	**496**			**88**	**58**	**81**	**82**	**86**	**69**	**79**	**67**	**88**	**71**		
		by lesions			**346**		**83**	**35**	**85**	**88**	**66**	**52**	**92**	**74**	**83**	**79**		

[1] 44 pts. 50 scans. 23 scans in Gp A/susp recurr. 27 scans in Gp B/screening.

[2] Pts included stomach,ovarian,adrenal cancers, and mesothelioma.

[3] From 2x2, sp=.90 but is reported as .91. 33pts:13TP,2FP,18TN.

[3] 16 pts w vert osteo. 5TP,11TN.

[4] 75 pts:45TP,6FP,24TN. Counted init PET+ readings as TP where for 16 pts biop was init neg and became + w LT follow-up.

[5] Ratios based on 29pts:15TP,7FP,2FN,5TN.

[6] 12pts:7ND,5Recur. PET:11TP,1FN. CT:2TP,7FN.

[7] 44 patients with thyroid, lung, or prostate cancer.

[8] #PET+=tot identified-#not resected. FNs determined by surg/follow-up. No info on TNs.PET:16TP,4FP,10FN. CT:6TP,1FP,20FN.

[9] Cases included neuroblastoma,ewing sarcoma,lymphoma,other malignancies.

TABLE 20

FDG PET in Cancer: Summary of Results of Literature Search

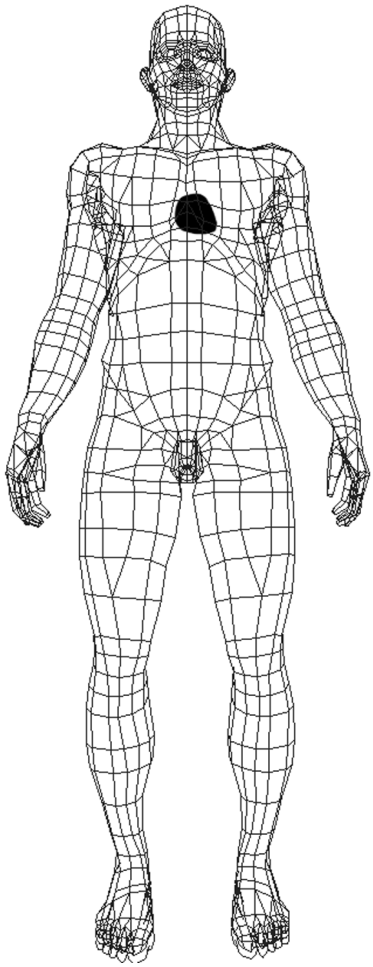
CANCER	PURPOSE	Total Pt. Studies	Total Lesions	SENS PET (%)	Total Pt. Studies	Total Lesions	SPEC PET (%)	Total Pt. Studies	Total Lesions	ACC PET (%)	Total Pt. Studies	Total Lesions	MGMT EFFECT (%)
Bladder	Staging	136		76	98		87	98		83	12		17
	Dx/Staging	52		93	26		86	26		88			
	Recurrence	12		60							12		17
Brain	Dx	36		91									
	Staging	31		86									
	Recurrence	258		79	213		77	161		76	89		31
	Mon Respons	17		82	17		83						
	Other	34		93	19		67	19		84			
Breast	Dx	202		91	97		93	105		95	6		100
			140	90		140	92		105	88			
	Staging	1407		91	1373		88	1328		90	111		24
			242	95		53	88		33	88			
	Dx/Staging	65		75	9		83	52		83			
	Recurrence	414		80	414		85	268		82	23		40
			41	85		41	79						
	Mon Respons	206		81	174		96	84		92			
			31	90		31	74						
Colorectal	Staging										236		36
			24	96									
	Dx/Staging	101		85	87		71	87		94			
	Recurrence	1426		94	1166		87	418		94	915		32
			981	93		912	96		331	87			
	Mon Response												
			34	100		23	90		11	100			
Gastro-Esoph	Dx	120		96				48		98	99		14
			276	80		276	95		276	86			
	Staging	545		73	302		90	245		83	229		20
			15	93									
	Dx/Staging	109		80	109		95	109		86	109		14
	Recurrence	41		100	41		43	41		73			
	Mon Respons	13		100				13		46			
Head&Neck	Dx	129		93	36		70	61		87			
			311	84		267	83		267	85			
	Staging	363		87	279		89	301		88			
			2020	84		1999	95		596	94			
	Dx/Staging	296		88	249		83	184		88	15		33
			179	83		151	94		158	89			
	Recurrence	342		93	271		83	283		87	15		33
			278	84		241	92		241	90			
	Mon Respons	128		84	122		95	81		96			
			16	44									
Hepatocellular	Staging	292		77	249		97	249		93	20		60
	Dx/Staging	22		64									
	Recurrence		9	88									
Lung	Dx	919		96	797		73	719		90			
			278	91		259	68		101	82			
	Staging	1867		83	1495		91	1272		82	1565		37
			1721	83		1553	92		1478	90			
	Recurrence	209		98	193		92	180		96			
			39	100		39	62		39	87			
	Mon Respons	161		94	161		90	126		96			
	Other	101		83									
Lymphoma	Dx	11		100									
	Staging	1179		90	826		93	158		88	407		21
			1156	91		58	100		32	95			
	Dx/Staging	254		92	177		93				62		5
	Recurrence	557		87	453		93	155		88	158		10
			114	100									
	Mon Respons	257		90	279		93	13		69			
									32	95			
Melanoma	Staging	888		83	863		91	125		91	283		26
			899	87		461	68		83	84			

TABLE 20 (*Continued*)

CANCER	PURPOSE	Total Pt. Studies	Total Lesions	SENS PET (%)	Total Pt. Studies	Total Lesions	SPEC PET (%)	Total Pt. Studies	Total Lesions	ACC PET (%)	Total Pt. Studies	Total Lesions	MGMT EFFECT (%)
(cont.)													
Muscle&Conn	Dx	274		94	250		72	139		85			
	Staging	84		91	56		85						
	Dx/Staging	55		90	55		98						
	Recurrence	393		66	360		95	346		89			
	Mon Respons	40		86				19		89			
Ovar/Uter/Cerv	Dx	274		66	238		77	153		77			
	Staging	331		54	119		96						
	Dx/Staging	112		86	58		82	73		87			
	Recurrence	359		88	327		90	220		87	30		17
	Mon Respons	11		100				11		100			
Pancreas	Dx	293		94	281		90	259		92	26		50
			51	90		51	91		51	90			
	Dx/Staging	404		83	360		82	368		81	65		43
			17	76									
	Staging	182		70	182		93	182		91	33		36
			66	67									
	Recurrence										19		53
	Mon Respons	45		92	14		100				19		16
Prostate	Staging	196		57	49		100						
			202	65									
	Recurrence	100		26									
	Mon Respons	43		86									
Renal	Dx	11		89									
	Staging	97		76	22		100	4		100			
Testicular	Staging	129		82	129		94	37		92	27		22
	Recurrence										53		51
	Other	133		80	133		92	133		87			
Thyroid	Staging	430		69	268		89	249		84	60		22
	Dx/Staging	125		68	9		67	19		100	58		9
			41	49									
	Recurrence	474		77	324		91	324		86	21		53
			66	73		66	86		66	80			
Unknown Prim	Staging	235		82	114		71	114		77	285		29
			64	91		64	76						
Misc Tumors		372		88	321		81	335		88			
			260	83		194	85		194	83			
Total Pt. Studies		**18402**		**84**	**14264**		**88**	**9994**		**87**	**5062**		**30**
Total Lesions			**9571**	**86**		**6879**	**90**		**4094**	**89**			

CARDIAC APPLICATIONS

Myocardial Viability



Disease Background. A key issue for imaging is to determine whether a given portion of the heart is viable. This means looking at areas of the heart that are not functioning properly and determining whether tissue is still alive and can recover if the blood supply is restored by revascularization. This is a biochemical question. Biochemists and biologists have shown that glucose is a protective substrate to the heart when blood flow is limited. FDG PET helps to determine viability, because those areas of the myocardium that are viable will have glucose metabolism. On the other hand if the myocardial muscle is dead, it will not have any glucose metabolism. The patient whose myocardial muscle demonstrates no glucose metabolism will not benefit from having blood supply re-established to the muscle. Such a patient would need medical therapy or a heart transplant. About 35% of coronary artery disease patients who receive bypass surgery or angioplasty to revascularize the heart do not show improvement in cardiac function because the affected tissue is not reversible (i.e., is dead).

Case Example. A 57-y-old patient with a previous heart attack was evaluated by echocardiography (echo), which showed that the patient's left ventricular ejection fraction (percentage of blood ejected from the heart during cardiac cycle) was compromised at 35% (normal >55%) and that wall motion was abnormal. An FDG PET cardiac study was requested to evaluate for viable, reversible myocardium. The PET image on the left in Figure 20 was obtained by using ^{13}N ammonia in a study of blood perfusion to the heart. ^{13}N ammonia has been approved by the U.S. Food and Drug Administration for imaging blood flow in the heart. The donut-like structure is the heart muscle, and the chamber it encloses is the left ventricle. The defect (arrow) seen toward the right side of the donut is an area of compromised blood flow. The image on the right in Figure 20 is the FDG PET glucose metabolism study, and it clearly shows FDG metabolism in the same area that is compromised with regard to blood flow. This patient, therefore, would be likely to benefit from revascularization (bypass surgery to restore blood to a portion of the heart). This is referred to as a mismatch pattern (i.e., low blood flow with high glucose metabolism).

Why Did FDG PET Help? FDG PET showed that the patient had viable myocardial tissue, which, if blood flow could be restored, could return the function of the heart closer to normal. The patient, therefore, could avoid a heart transplant by undergoing bypass surgery instead. This patient underwent bypass surgery. The ejection fraction returned to 50% and the wall motion to normal levels.

Key Management Issues.

- Determine whether patients with ischemic heart disease and symptoms of congestive heart failure are best treated with coronary artery bypass surgery, cardiac transplantation, or conservative medical therapy

Summary of Evidence for FDG PET in Myocardial Viability Assessment. Myocardial viability studies with FDG PET should be performed in patients with ischemic heart disease and impaired left ventricular function who are potential candidates for coronary revascularization (Table 21).

Presence of myocardial viability as determined by FDG PET predicts functional improvement, improved daily life activity levels, and improved survival after revascularization.

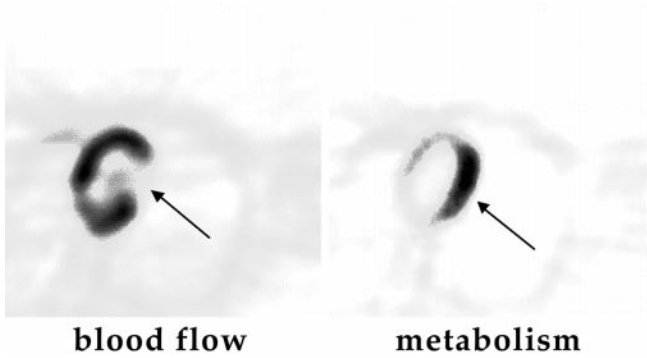


FIGURE 20. Case example, myocardial viability.

TABLE 21
FDG PET in Myocardial Viability: Results of Literature Search

MYOCARDIAL VIABILITY	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Viability																
Inubushi, 2000	A	assess viable myocardium	6	6					77		85				functional improvement	
Schöder, 1999	RA	assess viable myocardium	40	40	93		82								functional improvement	
Maes, 1997	RA	assess viable myocardium	30	30	83		91		91		83		87		functional improvement	
Baer, 1996	RA	assess viable myocardium	121	42	96		69		83		92		86		functional improvement	
Gerber, 1996	RA	assess viable myocardium	39	39	75		67		78		63		72		functional improvement	
Tamaki, 1995	RA	assess viable myocardium	61	43	88		82		76		92		85		functional improvement	
Knuuti, 1994	RA	assess viable myocardium	48	48	100		63		54		100		74		functional improvement	
Gropler, 1993	RA	assess viable myocardium	34	34	83		50		52		81		63		functional improvement	
Lucignani, 1992	RA	assess viable myocardium	14	14	93		80		95		80		91		functional improvement	
Tamaki, 1989	RA	assess viable myocardium	22	22	78		78		78		78		78		functional improvement	
Tillisch, 1986	RA	assess viable myocardium	17	17	95		80		85		92		88		functional improvement	
Summary		**by patients**	**432**	**335**	**89**		**73**		**74**		**86**		**79**			

NEUROLOGICAL APPLICATIONS

Dementia Work-Up

Disease Background. Dementia is defined as loss of memory and at least one other area of complex behavior sufficient to interfere with day-to-day function. The magnitude of the problem is increasing, and it is estimated that 5% of the population older than 65 y and up to 25% of the population older than 80 y has some form of dementia. Causes of dementia include degenerative changes (e.g., Alzheimer's disease, Pick's disease, Parkinson's disease, Huntington's disease), vascular insufficiency, trauma, endocrine changes, and other causes. Metabolic changes in the brain have been shown to precede structural changes by at least 5 y. Treatment for the degenerative forms of dementia, such as Alzheimer's, is improving with the use of cholinesterase inhibitors and treatment options continue to grow. The diagnosis of early Alzheimer's disease and its differential diagnosis from other organic dementias or the benign effects of aging remain clinically difficult today. PET with FDG has been shown to provide an accurate and positive differential diagnosis of Alzheimer's and of other forms of organic dementias. In some ways, the diagnosis of dementia

is similar to that for cancer in the separation of benign from malignant disease. In the case of dementia, it is the separation of benign from organic degenerative disease.

Case Example. A 67-y-old man presented with a 3-y history of progressive loss of memory and day-to-day function and a clinical diagnosis of possible Alzheimer's. A brain MR image showed no anatomic indications of disease. An FDG PET scan was ordered to evaluate for possible Alzheimer's disease. Shown in the left column in Figure 21 is a normal FDG PET scan from a 64-y-old man. In the right column is the FDG PET scan from the patient in this case. Two representative slices are shown from each individual. The right column clearly shows low FDG metabolism in the back portion of the brain (arrows) in the parietal and temporal regions. This hypometabolism pattern is consistent with Alzheimer's disease.

Why Did FDG PET Help? FDG PET established with a high degree of accuracy that the patient's symptoms were the result of Alzheimer's disease and not other causes of dementia. The diagnosis of Alzheimer's disease was confirmed 6 y later at autopsy.

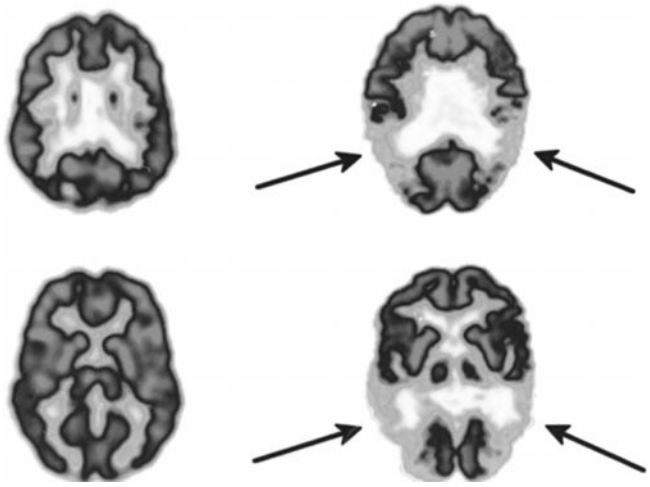


FIGURE 21. Case example, dementia.

Key Management Issues.

- Early diagnosis of dementia versus benign memory loss
- Differential diagnosis of dementia from frontotemporal disease, diffuse Lewy bodies, or cerebrovascular diseases
- Differentiation from pseudodementia/depression (This is a dementia-like state that is caused by depression and not Alzheimer's disease.)

Summary of Evidence for FDG PET in Dementia Work-Up. Primary neurodegeneration is the most common process underlying dementia, and Alzheimer's disease alone accounts for approximately two-thirds of cases. Regional cerebral metabolic patterns reflect pathophysiologic changes in brain that will lead to Alzheimer's disease, even before they give rise to symptoms. In addition to the diagnostic value FDG PET may have in evaluation of dementia, it can also serve as a prognostic tool to determine the likelihood of deterioration of mental status during the years after scanning, thereby facilitating planning by the patient and family members. Although results have varied, depending in part on the severity and diagnostic mix of patients, nearly all studies designed to assess the accuracy of FDG PET in the diagnosis of dementia have found sensitivity for Alzheimer's disease to be >90%, with specificity typically approximating 75% (range, 67%–97%). Meeting the challenge of accurately identifying minimally affected patients to allow them to reap the greatest potential therapeutic benefits requires making the diagnosis with a high degree of sensitivity and overall accuracy at the earliest possible stage of disease. The consistently high sensitivity of FDG PET in patients with even mild impairment makes it well suited for assisting with that task (Table 22).

TABLE 22

FDG PET in Dementia Work-Up: Results of Literature Search

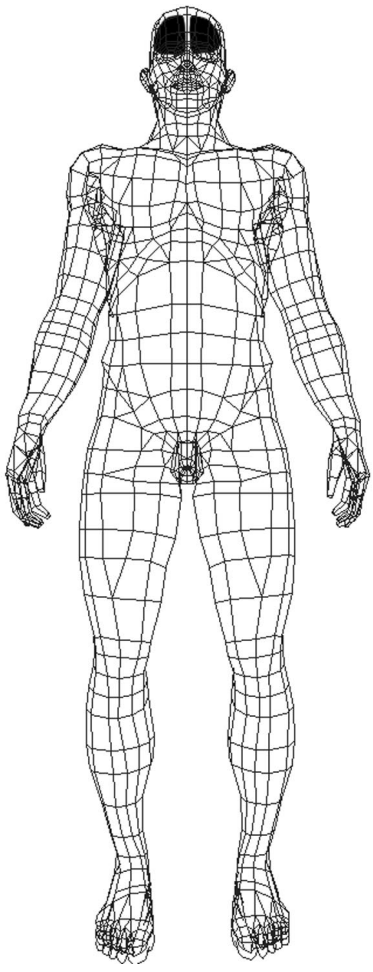
DEMENTIA WORKUP	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	SENS PET (%)	SENS CT (%)	SPEC PET (%)	SPEC CT (%)	PPV PET (%)	PPV CT (%)	NPV PET (%)	NPV CT (%)	ACC PET (%)	ACC CT (%)	GOLD STD	MGMT(%) EFFECT
Silverman, 2000[1]	A	eval of neurodeg dem dis/PND	70	70	93		92						93		autopsy	
		eval of alzheimer's		70	96		67						87		autopsy	
Silverman, 2000[2]	A	eval of ACT effect/PET in dem pts	128	128	90		76		82		86		84		follow-up	
Hoffman, 2000[3]	RA	dx for possible & probable AD	22	22	93		75		87		86		86		pathology	
Silverman, 1999	A	cognit or behav change	88	88	93		74		80		91		84		follow-up 3 y	
Mielke, 1998	RA	normal and impaired	45	45									90		clin eval nr time of scan	
Tedeschi, 1995; Salmon, 1994; Mielke, 1996	RA	cognitively impaired	20	20	92		71						85		histopathology	
Salmon, 1994[4]	RA	cognitively impaired	104	104	93		80						79		clin eval nr time of scan	
Mielke, 1994	RA	normal/probable AD/vasc dem	45	45	(ROC)		(ROC)						90		clin eval nr time of scan	
Herholz, 1993	RA	normal and probable AD	71	71	95		97						96		clin eval nr time of scan	
Szelies, 1992	RA	normal and probable AD	57	57									87		clin eval nr time of scan	
	Summary	**By Patients**	**650**	**720**	**93**		**80**		**82**		**88**		**87**			

[1] PND- Progressive Neurodegenerative Disease.

[2] ACT- Anticholinesterase Therapy.

[3] AD- Alzheimer's Disease.

[4] Note the value of specificity of .80 in the study [Salmon, 1994] is based on all patients with clinical evaluation as gold standard excepting those with Parkinson's disease dementia.



Disease Background. Epilepsy is a common condition, with a prevalence in the population of about 1 in 200 people. Several abnormalities within the brain can lead to abnormal "synchronous firing" of neurons, causing a seizure. Depending on which part of the brain is epileptogenic, seizures will have different outward appearances. In a grand mal seizure, all extremities move as a result of abnormal neuronal firing, which spreads within the brain to cause a diffuse motor seizure. Imaging of all types helps to locate abnormalities within the brain, and, when coupled with electroencephalography (EEG, scalp electrical signal monitoring), can help to manage epilepsy patients. Many patients can be controlled well on medications. Patients who have seizures despite having tried several medications are referred to as patients with intractable seizures. In these patients, identifying the source of the seizure within the brain often can lead to surgery that can stop or reduce the seizures. Imaging, including FDG PET, can play an important role in determining whether a patient is a candidate to be operated on for seizure control. The alternative (invasive electronic monitoring) requires putting electrodes into the brain parenchyma or meninges, with attending morbidity and mortality.

Case Example. An 11-y-old boy, diagnosed with epilepsy at age 7, had been treated with medications for 4 y. During the last year, he had continued to have seizures, even with a change in antiseizure medications. An FDG PET scan was ordered to evaluate for the possible source of the seizure. MRI showed no structural abnormality. The FDG PET scan (Fig. 22) showed moderate-to-severe hypometabolism (lower than normal glucose utilization) in the right parietal, posterior, frontal, occipital, and temporal lobes (arrows) in the interictal period (i.e., between seizures).

Why Did FDG PET Help? PET showed eleptogenic tissue in the localized brain. Surgery was performed to resect the dysfunctional tissue. The child, after surgery, was seizure free.

Key Management Issues.

- Diagnosis of partial epilepsy (MRI negative)
- Localization of seizure focus
- Prediction of surgical outcome (prognosis)

Summary of Evidence for FDG PET in Seizure Work-Up. In patients who have medically intractable epilepsy, neurosurgery to resect epileptogenic foci can decrease or eliminate seizure episodes and reduce neurologic impairment resulting from recurrent seizures and/or high doses of anticonvulsants. Patients with complex partial seizures, particularly those who have EEG evidence of a temporal lobe focus but inconclusive findings on MRI, often are referred for functional brain imaging to assess interictal metabolism. PET with FDG can identify epileptogenic zones through localization of hypometabolic brain tissue interictally. Interictal FDG PET has been demonstrated to be as useful for presurgical planning in most patients with temporal lobe epilepsy as the more logistically cumbersome ictal SPECT or more invasive EEG monitoring with depth electrodes. Patients with unilateral foci of hypometabolism identified by PET have been found in numerous studies to have a high likelihood of benefiting from neurosurgery, regardless of whether invasive electrode monitoring is also undertaken. Patients can thus be saved risks and costs otherwise incurred with invasive monitoring. Further study is needed to define more specifically the role of depth electrodes and surgical therapy in patients with findings of bilateral hypometabolism (Table 23).

SUMMARY

For a summary of all FDG PET literature searched, see Table 24.

APPENDIX A. LITERATURE SEARCH CRITERIA AND DATA ANALYSIS METHODS

Literature Search Criteria

The literature search was performed using the databases Medline/Healthstar 1993–2000 and Biosis Previews 1993–

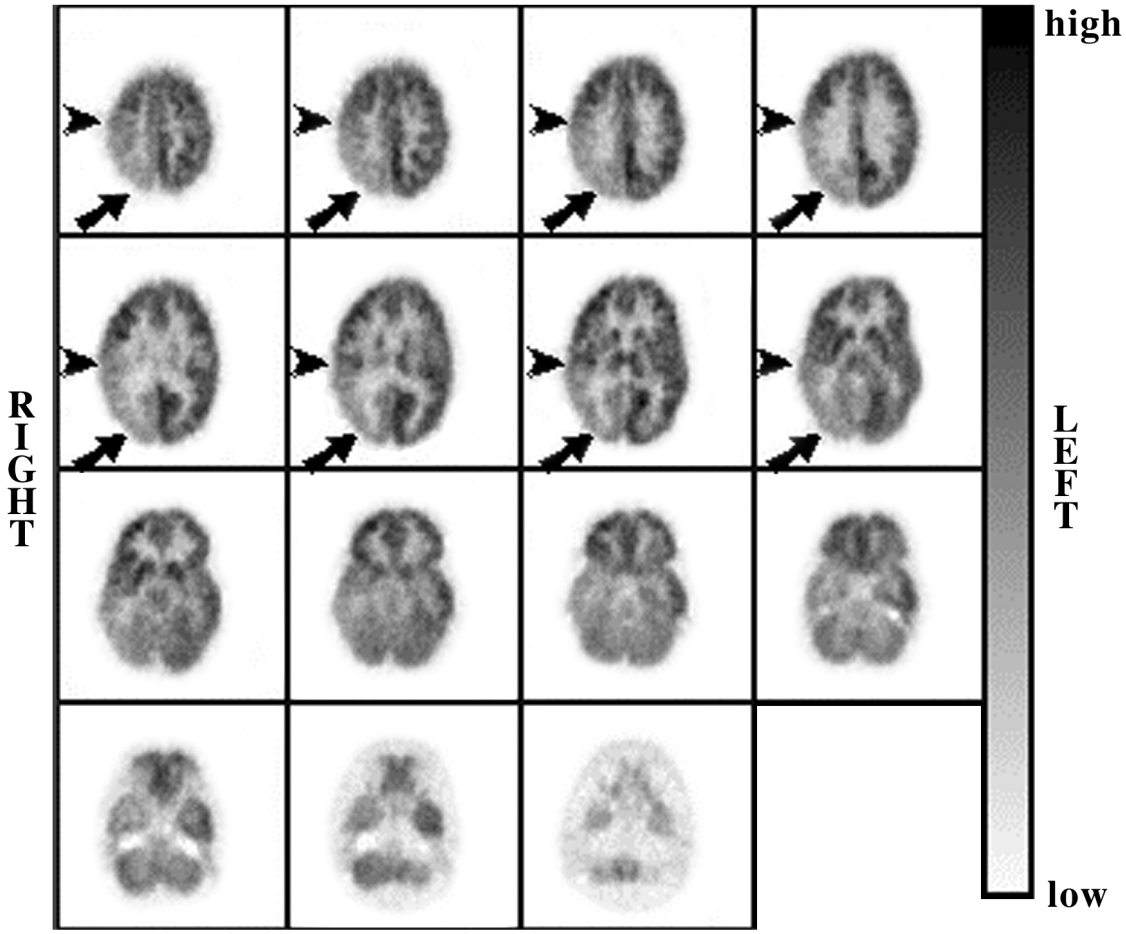


FIGURE 22. Case example, seizure.

2000 for articles and abstracts published from January 1993–June 2000. All key word combinations, including FDG PET, PET, and specific oncologic, neurologic, and cardiac applications were searched. Printed copies of *The Journal of Clinical Positron Imaging* (1998–2000) and *The Journal of Nuclear Medicine* abstracts (1996–2000) also were used. Only articles/abstracts in English were used, with the exception of a few English abstracts of non-English-language articles that provided complete information. Both dedicated PET and newer low-cost PET technology (for example, coincidence imaging) studies were included.

The only exceptions to our search time period occurred in the neurological and cardiac application categories. Specifically for myocardial applications, the Medline search extended back to 1986, with a focus on literature assessing viable myocardium. For dementia and seizure workup, the Medline search extended back to 1980, with respective foci on literature assessing accuracy in diagnosing individual patients with dementia and on literature assessing PET performance with respect to evaluating potential candidates for neurosurgery.

All literature that was not clear with respect to methods and/or reporting was excluded. Furthermore, any article/abstract that reported on a study with five or fewer individuals also was excluded. A total of 775 articles/abstracts were retrieved from the literature for our review. Approximately 8 articles could not be obtained from interlibrary requests to outside libraries. The data analysis used 473 unique articles/abstracts (specifically 151 abstracts and 322 articles), and 302 were excluded as per the inclusion/exclusion criteria. The spreadsheets listed a total of 561 article/abstract entries, of which 17 were repeated across several spreadsheets to which they were applicable and 71 were repeated within spreadsheets in multiple applications.

Inclusion Criteria. (1) Abstracts and articles reporting data within which sensitivity (sens), specificity (spec), positive predictive value (ppv), negative predictive value (npv), accuracy (acc), and management change (mgmt) values were either partially or fully listed or could be partially or fully derived for FDG PET imaging in the 22 different oncologic areas, cardiac viability area, and dementia and seizure work-up areas. In addition, some studies (e.g., seizure) were listed with FDG PET contributions to clinical issues without accompanying accuracy data. Only data with stated or derived total patient studies or total lesions were incorporated into the weighted averages. In those instances in which CT data were found in the PET literature satisfying the inclusion criteria, these were also listed.

TABLE 23

FDG PET in Seizure Work-Up: Results of Literature Search

SEIZURE WORKUP	ARTICLE TYPE	PURPOSE	Total No. Patients	Total Pt. Studies	Comments	PET HELPS
Salanova, 1999	RA	presurg eval/ outcome/temp lobe	22	14	PET suggested that focal functional deficits appear early in pts w medically refractory TLE which may help in early ident.	yes
Akimura, 1999	RA	clarify imprvemt from epil surg	9	9	4/9 pts showed improved glucose metabolism in formerly hypometabolic zones.	yes
Barrington, 1998	RA	determine if routine EEG justified	236	6	PET scan interpretation w single seizure occurrence not influenced by CSEEG recordings. The value of routine CSEEG in outpts treated w medication should be reappraised w pot cost savings.	yes
Kraemer, 1998	RA	eval lesionectomy outcome	15	15	PET can be part of careful pt selection where lesionectomy is procedure of choice for occult vascular malformations.	yes
Blum, 1998	RA	predict good surg outcome/ident UTH	10% Instit PET scns	10% Instit PET scns	PET has proven useful in epilepsy surg to ID unilateral temporal hypometabolism (UTH). Pts w BTH have a worse prognosis for seizure remission after surg.	yes
Mukahira, 1998	RA	surg/intractible childhood epilepsy	14	14	PET revealed abnormalities providing crucial information regarding the epileptic focus.	yes
Salanova, 1998	RA	predict outcome/TLE surg	38	38	PET scans found complementary to head MRIs. Concordance between PET temporal hypometabolism and MRI hippocampal sclerosis correlated w better outcome.	yes
Achten, 1998	RA	lateralization/refrac TLE	29	29	Proton MR spectroscopy more sensitive in depicting metabolic abnormalities than PET for TLE. Pts w neg PET will benefit from MR spect for lateralization.	no
Da silva, 1997	RA	eval Landau-Kleffner syndrome	17	17	PET enabled study of pathophysiology of syndrome. Suggested importance of temporal lobe structures, and revealed cortical abnormalities indicating common extensive brain functional disturbance.	yes
Markand, 1997	RA	localize epilept focus/MI-CPS	67	36	Interictal PET equally sensitive to ictal SPECT. Both play critical role providing localization in MRI neg pts allowing surg wout addit invas electrographic monitoring.	yes
Duncan, 1997	RA	presurg PET mapping/eloq brain	15	15	Suggested noninvasive presurgical PET brain mapping has potential to reduce risk and improve neurologic outcome.	yes
Holopainen, 1997	RA	verify ext hypometabolic area	5	5	PET can be used in conjunction w proton magnetic resonance spectroscopy for clinical assessment of children w intractable TLE.	yes
Theodore, 1997	RA	seizure focus detection	46	46	PET provides valuable data in pts w unlocalized surface ictal EEG and can reduce the number of pts who require IEEG studies.	yes
Tanaka, 1997	RA	presurg ident of epileptic foci	10	10	BP images delineated the epileptic foci more precisely than either PET or ictal perfusion SPET.	no
Rintahaka, 1997	RA	tuberous sclerosis complex	23	23	PET provides addit localizing info to CT and MRI in pts w tuberous sclerosis complex. If EEG, CT, and MRI are unifocal or unilateral, and surg is considered, more detailed eval w PET may help to determine if contralat tubers present and eval the functional integrity of brain as a whole.	yes
Lucignani, 1996	RA	SEEG&PET/severe part epilepsy	16	16	PET consistently allowed localization of temporal hypometabolism, but is not specifically related to SEEG patterns.	no
Helveston, 1996	RA	comparison w MRI/Intract TLE	16	16	Ea imag technique yields useful info for sz lateraliz in TLE w hippocamp formation volumetric assessmt (HV MR) yielding more than QPETorQMR.	yes
Ferrie, 1996	RA	epileptic encephalopathies	32	32	PET suggests that some children w epil encephalopathies previously thought to have prim generalized seizures due to multifocal pathology may have unifocal cortical origin which may be amen to surg.	yes
Delbeke, 1996	RA	postsurg outcome/uncontrol part sz	38	38	A focus of interictal temporal hypometabolism on PET is associated w marked improvement of seizure control after surg in 94% of pts.	yes
Snead, 1996	RA	pediatric epil surg	100	56	Found insuffic correl of interict hypometab area on PET and epilept zone in terms of anat locat & size to justify foregoing chronic invasive intracran monitoring in children w intract part sz in eval for surg unless absolute concord of all neuroimaging,clin,&video-electroenceph data.	no
Fois, 1995	RA	intract childhood epil/surg correl	30	30	Functional imaging w SEEGs appears superior to only CT and MRI for selecting children w epil for surg espec w CPS resistant to therapy.	yes
De Reuck, 1995	RA	late onset/cryptogenic symp sz	10	10	Suggested that late-onset seizures could be premonitory signs of progressive encephalopathy of unknown origin.	yes
Heinz, 1994	RA	compare PET and MRI w histol	27	27	PET sens for mesial temporal sclerosis=12/15(.80). MRI sens=13/15(.87).	yes
		compare PET/MRI/PET+MRI w outcome	27	27	PET sens for good outcome=17/24=.71, incl 3/4 pts missed by MRI.	yes
Shih, 1994	RA	PETvsSPECT/MRIvsCT/c/w ECoG&outcome	30	30	FDG-PET more accurate than SPECT. MRI more sens than CT.	yes
Savic, 1993	RA	compare PET w intra- & extra-cranial EEG	8	8	FDG laterality agreed w EEG in 5/8. [C-11]flumazenil-PET laterality agreed w EEG in 8/8.	yes
Leiderman, 1992	RA	compare FDG-PET w [O-15]water-PET	28	28	FDG-PET more specific for localization of epileptic zones.	yes
Engel, 1990	RA	compare depth-SEEG w PET+ictal surf EEG	153	153	Concordant PET and ictal surface EEG studies generally obviate the need for SEEG.	yes
Pawlik, 1990	RA	retrosp rev of exper w 213 PET studies	124	124	PET had sens of >.90, and was superior to other diagnostic methods in typical TLE.	yes
Swartz, 1989	RA	compare CT/MRI/PET in frontal lobe epil	22	22	Sens of CT=.32;MRI=.45;PET=.64. Frontal hypometab signif correlated w ictal semiology.	yes
Chugani, 1988	RA	compare PET to outcome & neuropathol	8	8	In the 4 pts with outcome data, all were correctly classified; PET more sens than CT and MRI.	yes
Stefan, 1987	RA	compare PET/SPECT/MRI/CT w EEG	10	10	PET was the best imaging modality for definition of epileptic focus.	yes
Theodore, 1986	RA	compare PET/CT/MRI w EEG	36	36	PET more sensitive than CT or MRI.	yes
		Summary	**1261**	**948**		

TABLE 24

Summary of Results of FDG PET Literature Search

CANCER	PURPOSE	Total Pt. Studies	Total Lesions	SENS PET (%)	Total Pt. Studies	Total Lesions	SPEC PET (%)	Total Pt. Studies	Total Lesions	ACC PET (%)	Total Pt. Studies	Total Lesions	MGMT EFFECT (%)
Bladder	Staging	136		76	98		87	98		83	12		17
	Dx/Staging	52		93	26		86	26		88			
	Recurrence	12		60							12		17
Brain	Dx	36		91									
	Staging	31		86									
	Recurrence	258		79	213		77	161		76	89		31
	Mon Response	17		82	17		83						
	Other	34		93	19		67	19		84			
Breast	Dx	202		91	97		93	105		95	6		100
			140	90		140	92		105	88			
	Staging	1407		91	1373		88	1328		90	111		24
			242	95		53	88		33	88			
	Dx/Staging	65		75	9		83	52		83			
	Recurrence	414		80	414		85	268		82	23		40
			41	85		41	79						
	Mon Response	206		81	174		96	84		92			
			31	90		31	74						
Colorectal	Staging										236		36
			24	96									
	Dx/Staging	101		85	87		71	87		94			
	Recurrence	1426		94	1166		87	418		94	915		32
			981	93		912	96		331	87			
	Mon Response												
			34	100		23	90		11	100			
Gastro-Esoph	Dx	120		96				48		98	99		14
			276	80		276	95		276	86			
	Staging	545		73	302		90	245		83	229		20
			15	93									
	Dx/Staging	109		80	109		95	109		86	109		14
	Recurrence	41		100	41		43	41		73			
	Mon Response	13		100				13		46			
Head&Neck	Dx	129		93	36		70	61		87			
			311	84		267	83		267	85			
	Staging	363		87	279		89	301		88			
			2020	84		1999	95		596	94			
	Dx/Staging	296		88	249		83	184		88	15		33
			179	83		151	94		158	89			
	Recurrence	342		93	271		83	283		87	15		33
			278	84		241	92		241	90			
	Mon Response	128		84	122		95	81		96			
			16	44									
Hepatocellular	Staging	292		77	249		97	249		93	20		60
	Dx/Staging	22		64									
	Recurrence		9	88									
Lung	Dx	919		96	797		73	719		90			
			278	91		259	68		101	82			
	Staging	1867		83	1495		91	1272		82	1565		37
			1721	83		1553	92		1478	90			
	Recurrence	209		98	193		92	180		96			
			39	100		39	62		39	87			
	Mon Response	161		94	161		90	126		96			
	Other	101		83									
Lymphoma	Dx	11		100									
	Staging	1179		90	826		93	158		88	407		21
			1156	91		58	100		32	95			
	Dx/Staging	254		92	177		93				62		5
	Recurrence	557		87	453		93	155		88	158		10
			114	100									
	Mon Response	257		90	279		93	13		69			
									32	95			
Melanoma	Staging	888		83	863		91	125		91	283		26
			899	87		461	68		83	84			

TABLE 24 (*Continued*)

CANCER	PURPOSE	Total Pt. Studies	Total Lesions	SENS PET (%)	Total Pt. Studies	Total Lesions	SPEC PET (%)	Total Pt. Studies	Total Lesions	ACC PET (%)	Total Pt. Studies	Total Lesions	MGMT EFFECT (%)
(cont.)													
Ovar/Uter/Cerv	Dx	274		66	238		77	153		77			
	Staging	331		54	119		96						
	Dx/Staging	112		86	58		82	73		87			
	Recurrence	359		88	327		90	220		87	30		17
	Mon Response	11		100				11		100			
Pancreas	Dx	293		94	281		90	259		92	26		50
			51	90		51	91		51	90			
	Dx/Staging	404		83	360		82	368		81	65		43
			17	76									
	Staging	182		70	182		93	182		91	33		36
			66	67									
	Recurrence										19		53
	Mon Response	45		92	14		100				19		16
Prostate	Staging	196		57	49		100						
			202	65									
	Recurrence	100		26									
	Mon Response	43		86									
Renal	Dx	11		89									
	Staging	97		76	22		100	4		100			
Testicular	Staging	129		82	129		94	37		92	27		22
	Recurrence										53		51
	Other	133		80	133		92	133		87			
Thyroid	Staging	430		69	268		89	249		84	60		22
	Dx/Staging	125		68	9		67	19		100	58		9
			41	49									
	Recurrence	474		77	324		91	324		86	21		53
			66	73		66	86		66	80			
Unknown Prim	Staging	235		82	114		71	114		77	285		29
			64	91		64	76						
Misc Tumors		372		88	321		81	335		88			
			260	83		194	85		194	83			
Total Pt. Studies		**18402**		**84**	**14264**		**88**	**9994**		**87**	**5062**		**30**
Total Lesions			**9571**	**86**		**6879**	**90**		**4094**	**89**			
CARDIAC	Viability	**329**		**89**	**329**		**73**	**289**		**79**			
DEMENTIA	Workup	**573**		**93**	**573**		**80**	**720**		**87**			
SEIZURE	Workup	**948**											

(2) Oncologic studies drawn from the period January 1993–June 2000; dementia and seizure studies from January 1980–June 2000; and cardiac studies from January 1986–June 2000.

(3) Response-to-treatment articles were included in the spreadsheets where a 2 × 2 table could be created from the reported data for: responders/nonresponders versus increased FDG/decreased FDG. In those instances in which a 2 × 2 table could not be formulated, the article was excluded.

Note that three articles were also included that provided no numerical information about FDG PET accuracy but had some useful features, which are described in the comments field. These articles, therefore, have no bearing on the weighted averages summarizing all the literature data. These studies by Bischoff et al. (*46*), Holthoff et al. (*197*), and Rozental et al. (*354*) were all part of the monitoring response application.

Exclusion Criteria. (1) Case reports, review/tutorial articles, and studies with 5 or fewer patients.

(2) Articles not in English. However, abstracts in English of articles not in English but with relevant information were included.

Data Analysis

Data analysis was performed using simple weighted averages. Therefore, studies with more patients were weighted more than studies with fewer patients to arrive at estimates

of the sensitivity, specificity, and, when possible, management changes. Weighting is the easiest method to use on such a large number of studies, each of which may or may not present a full 2 × 2 table of outcomes. No attempt was made to perform a formal meta-analysis.

In instances in which articles and abstracts included data for multiple categories (e.g., diagnosis/staging/recurrence), the entire article entry was listed in each of the three individual categories (diagnosis, staging, and recurrence) to preserve the entirety of a study's reporting and to represent that study's contribution to data for that category for both this report and possible future analyses that might be looking for all references including data for a given category (e.g., specifically for recurrence.) Only data relevant to a specific category was used in the weighted average for that category (e.g., in calculating the weighted average in the recurrence category, only the recurrence portion of the article's data was used, even though data for diagnosis also may have been listed).

The number in the total patient studies column sometimes exceeded that in the total number of patients column for a given entry line (e.g., in instances in which patients may have had multiple FDG PET scans). For each line entry of data, the total patient studies or total lesions were listed upon which the 2 × 2 table was based for calculating a given line of data (e.g., if 58 patients had 62 scans from which the true positive (TP), true negative (TN), false positive (FP), and false negative (FN) values were counted, 62 was listed for total patient studies).

In those instances in which articles/abstracts had data broken down for various reported subgroups (e.g., mediastinal and hilar lymph nodes or lymph nodes <1 cm), total patient studies for each subgroup would be listed (as explained above), but often these subgroups would have overlapping patients. In terms of the data analysis, when a given study provided overall values in addition to listing various subgroup values, the overall value was used in the weighted average. When an overall value was not listed, the subgroup data was weighted in by the total patient studies value from which it was generated (or by total lesions, if listed by lesions). The only exceptions occurred in the lung cancer spreadsheet/staging section in the four articles by Baum et al. (*36*), Tatsumi et al. (*424*), Ryu et al. (*356*), and Marom et al. (*290*). When these studies reported subgroup values for the full patient study count multiple times, the subgroup values were averaged and weighted into the weighted average formula by the total patient studies for one group only.

APPENDIX B. DATA ANALYSIS SUMMARY

Because the default analysis (analysis 1) of our 22 spreadsheets listed all the literature values used that included multiple listings of abstracts/articles both within spreadsheets (e.g., both in the diagnosis/staging and staging applications of a particular cancer) and across spreadsheets, some overlapping of patient studies occurred. To analyze the effects of listing the broad view of the literature values used we performed 5 additional data analyses to study the effects on PET sens/spec/acc by selecting out certain studies according to the following criteria:

(1) Analysis 1 (default analysis): Included all literature used that had some overlap of total patient studies within and across spreadsheets.

(2) Analysis 2: Used data from only those studies that reported jointly the sensitivity and specificity values for PET and PET accuracy values that included one other PET statistical ratio column (e.g., reported PET accuracy and also PET sensitivity).

(3) Analysis 3: Repeated the default analysis, including data from only full research articles. All abstracts were specifically excluded.

(4) Analysis 4: Repeated analysis 2, including data from only full research articles. All abstracts were excluded.

(5) Analysis 5: Pooled sens/spec/acc values for PET across all available studies that provided TP/TN/FP/FN values for each cancer and for all cancers together. This is a formal pooling analysis, using data from each study to construct a large 2 × 2 table. Note that all four cells (TP/TN/FP/FN) must be available, that is, information for patients both with and without disease is required. Therefore, some studies used in some of the weighted averaging subanalysis formulations (e.g., reporting sens only) could not be included in the pooling subanalysis, and thus slight discrepancies exist between the article subsets used in the weighted averages and those used in the pooling.

(6) Analysis 6: Repeated the default analysis excluding all data from nondedicated PET machines (e.g., coincidence imaging).

Results are provided in Table 25.

TABLE 25
Data Analysis Summary

	Total Patient Studies	Total Lesions	Sens (%) PET	Total Patient Studies	Total Lesions	Spec (%) PET	Total Patient Studies	Total Lesions	Acc (%) PET
Analysis 1*	18402		84	14264		88	9994		87
[*Default]		9571	86		6879	90		4094	89
Analysis 2	14212		86	14212		88	8892		88
		6879	85		6879	90		3934	89
Analysis 3	12004		86	9823		88	7313		89
		7397	86		5385	91		2806	90
Analysis 4	9801		86	9801		88	6850		89
		5385	86		5385	91		2795	90
Analysis 5	14458		85	14458		91	14458		88
		8187	85		8187	93		8187	90
Analysis 6	17783		84	13954		88	9663		88
		9244	87		6607	90		3666	89

APPENDIX C. ABBREVIATIONS LEGEND

Abdom: abdominal
Abst: abstract
Acc: accuracy
Activ: activity
Addit: additional
Adenocarc: adenocarcinoma
Adjuv: adjuvant
Adrenalect: adrenalectomy
Adv: advanced
AFP: serum alpha-fetoprotein level
AIDS: acquired immunodeficiency syndrome
ALNDs: axillary lymph node dissections
Amen: amenable
Amput: amputations
Anat: anatomical
Andro: androgen
Antibod: antibodies
Antiestr: antiestrogen
Art: article
Aspir: aspirate
Assessmt: assessment
Asymp: asymptomatic
Autop: autopsy
Av: average
Avdmajsurg: avoid major surgery
BCNU: carmustine
Behav: behavioural
Biochem: biochemical
Biop: biopsy
Bne: bone
BPH: benign prostatic hyperplasia
Br: brain
Brst: breast
BS: bone scintigraphy
BTH: bilateral temporal hypometabolism
B/w: between
C: calcitonin
Ca: cancer
Calcit: calcitonin
Calcs: calculates
Cam: camera
Carcin: carcinoma
Cathet: catheterization
CDM: conventional diagnostic methods
CEA: carcino-embryonic antigen
Cerv: cervical
Chem: chemistry
Chemo: chemotherapy
Chemohormonother: chemohormonotherapy
Chemoradio: chemoradiotherapy
Chge: change
CHOL: 11C choline
Cholang: cholangio-pancreaticography
CI: conventional imaging
Classif: classification
Clin: clinical
Clinstge: clinical stage
Cm: centimeter
Cnfrm: confirmation
CNS: central nervous system
CoDe-PET: coincidence detection PET
Cognit: cognitive
Colonosc: colonoscopy
Compar: comparison
Concom: concomitant
Concord: concordance
Conn: connective
Cont: continued
Contrad: contradictory
Conv: conventional
Corr: correctly
Correl: correlation
CR: complete response
Craniot: craniotomy
Crse: course
CT: computed tomography
CUP: cancer of unknown primary
Cur: curative
CYT-356: capromab pendetide
Cytol: cytology
Cytopath: cytopathology

DAR: differential absorption ratio
Decis: decision
Decr: decrease
DedPET: dedicated PET
Def: definite
Degen: degenerative
Dem: dementia
Detect: detect
Diff: different
Differen: differentiated
Dimens: dimensions
Dis: disease
Discrep: discrepancy
Dissect: dissection
Dissem: disseminated
Dist: distant
Ds: days
DUR: dose uptake ratio
Dwnstge: downstage
Dx: diagnosis
Ea: each
EEG: electroencephalographic
E.g.: for example
Elev: elevation
Endos: endosonography
Endosc: endoscopic examination
Entero: enteroclysis
Epil: epilepsy
Epilept: epileptogenic
Equiv: equivocal
ER+: biopsy-proved estrogen receptor-positive
Esoph: esophageal
Eval: evaluate
Evid: evidence
Ex: exam
Excis: excisional
Exp: experience
Explor: exploratory
Ext: extension
Extrathor: extrathoracic
Fav: favorable
Fd: found
FDG: 2-[F-18]Fluoro-2-Deoxy-D-Glucose
Fm: from
FN: false negative
Fn: function
FNA: fine-needle aspiration
FNAB: fine needle aspiration biopsy
FP: false positive
Ga: gallium
Gastro: gastroesophageal
Gastros: gastroscopy
GCI: gamma camera coincidence imaging
Gde: grade
Gluc: glucose
Gp: group
GRD: gross residual disease
Gynecol: gynecological
H&N: head and neck
HCC: hepatocellular carcinoma
HD: hodgkin's disease
Hep: hepatic
Hepatocell: hepatocellular
Hi: high
Hippocamp: hippocampal
Hist: history
Histol: histology
Histopath: histopathology
Horm: hormone
Hypertherm: hyperthermic
Hypometab: hypometabolic
Hypopharyng: hypopharyngeal
Ident: identify
Imag: imaging
IMLN: internal mammary lymph node
Immed: immediate
Imprvemt: improvement
IMT: 123I-Iodo-alpha-methyltyrosine
Inconclus: inconclusive
Incorr: incorrectly
Incr: increased
Indeterm: indeterminate
Indic: indicative
Individ: individual
Info: information
Init: initiate; initial
Insuffic: insufficient
Interict: interictal
Intracran: intracranial
Intract: intractable
Involv: involvement
IORT: intraoperative radiation therapy
Irrad: irradiated
IS: immunoscintigraphy
Isol: isolated
Kn: known
Lapar: laporatory
Laparat: laparotomy
Laryng: laryngeal
Lateraliz: lateralization
Les: lesion
Lft: left
LN: lymph node
Lo: low
Loc: local
Locat: location
Locoreg: locoregional
Lowabd: lower abdomen
LT: long term
Lumpect: lumpectomy
Lymphad: lymphadenectomy
Majdwn: major downstaging

Majmgmt: major management
Majupstg: major upstaging
Malig: malignancy
MALT: mucosa-associated lymphoid tissue
Mar: marrow
Mastect: mastectomy
Meas: measurable
Mediast: mediastinal
Mediastinos: mediastinoscopy
Melan: melanoma
MET: 11-Cmethionine
Met: metastatic
Metab: metabolism
Mets: metastases
Mgmt: management
MH: M. Hodgkin
MIBG: metaiodo-benzylguanidine
MIBI: 99mTc-Methoxyisobutylisonitrile
MI-CPS: medically intractable complex partial seizures
Mindwn: minor downstaging
Minmgmt: minor management
Minupstg: minor upstaging
Misc: miscellaneous
MM: mammography
Mo: month
Mod: moderately
Modals: modalities
Mon: monitor
Morphol: morphologic
MR: magnetic resonance
MRD: minimal residual disease
MRI: magnetic resonance imaging
MTC: medullary thyroid cancer
N: total number of patient studies or lesions
N staging: nodal staging
NC: no change
ND: new disease
Necros: necrosis
NED: no evidence of disease
Neg: negative
Neurodeg: neurodegenerative
NHL: non-Hodgkin's lymphoma
Nk: neck
No: number
Nochge: no change
Noneupstg: none upstaged
NPV: negative predictive value
Nr: near
Nsclc: non-small cell lung cancer
Nt: not
Observ: observation
Occ: occupying
Oper: operable
OPET: other PET
Ophthal: opthalmologic
Osteo: osteomyelitis
Otolaryn: otolaryngologic
Ovar: ovarian
Overstgd: overstaged
P53: p53 protein expression of HCC
Pancr: pancreatic
Papill: papillary
Paramalig: paramalignant
Part: partial
Pathol: pathology
Pblms: problems
Pca: prostate cancer
PCS: positron coincidence scintigraphy
PD: progressed disease
Pelv: pelvic
Perfsurg: perform surgery
Perfus: perfusion
Persist: persistent
PET: positron emission tomography
Phys: physical
Polychemo: polychemotherapy
Poor: poorly
Potent: potentially
PPV: positive predictive value
PR: partial response
Preop: preoperative
Prim: primary
Prob: probably
Proced: procedure
Progress: progressing metastases; progression
Prolif: proliferative
Prost: prostate
PSA: prostate specific antigen
Pt: patient
Pt gp: patient group
Pts: patients
Pulm: pulmonary
RA: research article
Rad: radiation
Rad lymphad: radical lymphadenectomy
Radiog: radiography; radiographic
Radiol: radiological
Recur: recurring
Recurr: recurrence
Ref: reference
Refrac: refractory
Relap: relapsed
Resect: resectable
Resid: residual
Resis: resistant
Restage: restaging
Retroper: retroperitoneal
Retrosp: retrospective
Rev: review
RIT: radioimmunotherapy
RNB: radionuclide bone scintigraphy
Rpts: reports

Rspnse: response
Scint: scintigraphy
Sclc: small cell lung cancer
Scn: scan
SEEG: stereo-EEG
Sens: sensitivity
Ser: serial
Signif: significantly
Simult: simultaneously
Sites: lesion sites
Sl: slight
Smplg: sampling
SNB: sentinel node biopsy
Sonog: sonography
Sp: space
Spdsht: spreadsheet
Spec: specificity
SPECT: single-photon emission CT
SPET: single photon emission tomography
SPN: solitary pulmonary nodule
S.t.: short-term
Std: standard
Stereo biop: stereotactic biopsy
Stg: stage
Strat: strategy
STS: soft tissue sarcomas
Subclin: subclinical
Subgps: subgroups
SUR: standardized uptake ratio
Surf: surface
Surg: surgery
Susp: suspected
Suspic: suspicious
SUV: standardized uptake values
Symp: symptom
Sys: system
Sz: seizure
TCB: trucut biopsy
Temp: temporal
Tg: thyroglobulin
Theor: theoretical
Ther: therapy
Therap: therapeutic
Thor: thoracic
Thorac: thoracotomy
Thyrd: thyroid
Thyroglob: thyroglobulin
Tiss: tissue
T: L ratio:tumor-to-normal liver ratio
TLE: temporal lobe epilepsy
TN: true negative
Tot: total
TP: true positive
Trtmt: treatment
TTNA: transthoracic needle aspiration
Tum: tumor
Ultim: ultimately
Understgd: understaged
Unil: unilateral
Unk Prim: unknown primary
Unnecess: unnecessary
Upstge: upstage
Uptke: uptake
US: ultrasonography
Uter: uterine
UTH: unilateral temporal hypometabolism
Util: utilization
Vasc: vascular
Vert: vertebral
Vs: versus
W: with
WB: whole body
WBS: whole-body scintigraphy
Wd: would
With: withdrawal
Wks: weeks
Wt: weight
WW: watchful waiting
Y: year
131-I: 131-Iodine
2x2: two by two table of true/false positive values and true/false negative values
18F-FDG: 18F-fluorodeoxyglucose
201Tl SPET: 201Tl single photon emission tomography
201Tl SPECT: 201 Tl chloride single-photon emission CT
#: number
+: positive
−: negative
<: less than
>: greater than

REFERENCES

1. AAssar OS, Fischbein NJ, Caputo GR, et al. Metastatic head and neck cancer: role and usefulness of FDG PET in locating occult primary tumors. *Radiology*. 1999;210:177–181.
2. Abdel-Nabi H, Abou-Zied MM, Doerr RJ. Preoperative evaluation of patients with suspected liver metastases with positron emission tomography with F-18 FDG [abstract]. *J Nucl Med*. 1999;40:241P.
3. Abdel-Nabi H, Doerr RJ, Lamonica DM, et al. Staging of primary colorectal carcinomas with fluorine-18 fluorodeoxyglucose whole-body PET: correlation with histopathologic and CT findings. *Radiology*. 1998;206:755–760.
4. Achten E, Santens P, Boon P, et al. Single-voxel proton MR spectroscopy and positron emission tomography for lateralization of refractory temporal lobe epilepsy. *Am J Neuroradiol*. 1998;19:1–8.
5. Acland KM, O'Doherty MJ, Russell-Jones R. The value of positron emission tomography scanning in the detection of subclinical metastatic melanoma. *J Am Acad Dermatol*. 2000;42:606–611.
6. Adams S, Baum R, Stuckensen T, Bitter K, Hör G. Prospective comparison of 18F-FDG PET with conventional imaging modalities (CT, MRI, US) in lymph node staging of head and neck cancer. *Eur J Nucl Med*. 1998;25:1255–1260.
7. Adler L, Crowe J, al-Kaisi N, Sunshine J. Evaluation of breast masses and axillary lymph nodes with [F-18] 2 deoxy-2-fluoro-D-glucose PET. *Radiology*. 1993;187:743–750.
8. Adler L, Faulhaber P, Schnur K, Al-Kasai N, Shenk R. Axillary lymph node metastases: screening with [F-18]2 deoxy-2-D-glucose (FDG) PET. *Radiology*. 1997;203:323–327.
9. Adler LP, Bloom AD. Positron emission tomography of thyroid masses. *Thyroid*. 1993;3:195–200.

10. Akimura T, Yeh HS, Mantil JC, Privitera MD, Gartner M, Tomsick TA. Cerebral metabolism of the remote area after epilepsy surgery. *Neurol Medico-Chirurg*. 1999;39:16–27.
11. Al-Sugair AS, Coleman RE. Relative diagnostic efficacy of F-18 FDG PET and bone scintigraphy for detection of osseous metastases in primary or secondary lung cancer [abstract]. *J Nucl Med*. 1999;40:20P.
12. Albers P, Bender H, Yilmaz H, Schoeneich G, Biersack HJ, Mueller SC. Positron emission tomography in the clinical staging of patients with stage I and II testicular germ cell tumors. *Urology*. 1999;53:808–811.
13. Albes JM, Lietzenmayer R, Schott U, Schülen E, Wehrmann M, Ziemer G. Improvement of non-small-cell lung cancer staging by means of positron emission tomography. *Thoracic Cardiovasc Surgeon*. 1999;47:42–47.
14. Alnafisi NS, Driedger AA, Coates G, Moote DJ, Raphael SJ. FDG PET of recurrent or metastatic 131I-negative papillary thyroid carcinoma. *J Nucl Med*. 2000;41:1010–1015.
15. Altenvoerde G, Lerch H, Kuwert T, Matheja P, Schäfers M, Schober O. Positron emission tomography with F-18-deoxyglucose in patients with differentiated thyroid carcinoma, elevated thyroglobulin levels, and negative iodine scans. *Langenbecks Arch Surg*. 1998;383:160–163.
16. Amthauer H, Hosten N, Mueller-York A, et al. Whole body FDG-PET before laser-induced thermo-therapy (LITT) in patients with hepatic metastases of colorectal cancer [abstract]. *J Nucl Med*. 2000;41:35P.
17. Anzai Y, Carroll WR, Quint DJ, et al. Recurrence of head and neck cancer after surgery or irradiation: prospective comparison of 2-deoxy-2-[F-18]fluoro-D-glucose PET and MR imaging diagnoses. *Radiology*. 1996;200:135–141.
18. Austin JR, Wong FC, Kim EE. Positron emission tomography in the detection of residual laryngeal carcinoma. *Otolaryngol Head Neck Surg*. 1995;113:404–407.
19. Avril N, Dose J, Jänicke F, et al. Metabolic characterization of breast tumors with positron emission tomography using F-18 fluorodeoxyglucose. *J Clin Oncol*. 1996;14:1848–1857.
20. Avril N, Schelling M, Naehrig J, et al. Monitoring primary chemotherapy in advanced breast cancer using FDG-PET [abstract]. *J Nucl Med*. 2000;41:112P–113P.
21. Bachor R, Kocher F, Gropengiesser F, Reske SN, Hautmann RE. Positron emission tomography: introduction of a new imaging technique for urological tumors and initial clinical results [in German]. *Urologe Ausgabe A*. 1995;34:138–142.
22. Bachor R, Kotzerke J, Gottfried HW, Braendle E, Reske SN, Hautmann R. Positron emission tomography (PET) for diagnosis of renal cell carcinoma (RCC) [in German]. *Urologe Ausgabe A*. 1996;35:146–150.
23. Bachor R, Kotzerke J, Reske SN, Hautmann R. Lymph node staging for urinary bladder carcinoma with positron emission tomography (PET) [in German]. *Urologe Ausgabe A*. 1999;38:46–50.
24. Bader JB, Samnick S, Schaefer A, et al. Contribution of nuclear medicine to the diagnosis of recurrent brain tumors and cerebral radionecrosis [in German]. *Radiologe*. 1998;38:924–929.
25. Bader JB, Siebert S, Schaefer A, et al. Diagnostic efficiency in the detection of brain tumor recurrence at follow-up by 123I alpha-methyltyrosine-SPECT and 18FDG-PET [abstract]. *J Nucl Med*. 1997;38:239P.
26. Baehre MH, Markert U, Meller B, et al. Oncologic information provided by immunoscintigraphy with 99mTc Fab' fragments compared with (18F)FDG PET in colorectal cancer [abstract]. *J Nucl Med*. 2000;41:141P.
27. Baer F, Voth E, Deutsch H. Predictive value of low-dose dobutamine transesophageal echocardiography and fluorine-18 fluorodeoxyglucose positron emission tomography for recovery of left ventricular function after successful revascularization. *J Am Coll Cardiol*. 1996;28:60–69.
28. Bangerter M, Kotzerke J, Griesshammer M, Elsner K, Reske SN, Bergmann L. Positron emission tomography with 18-fluorodeoxyglucose in the staging and follow-up of lymphoma in the chest. *Acta Oncologica (Stockholm)*. 1999;38:799–804.
29. Bangerter M, Moog F, Buchman I, et al. Whole-body 2-[18F]-fluoro-2-deoxy-D-glucose positron emission tomography FDG-PET for accurate staging of Hodgkin's disease. *Ann Oncol*. 1998;9:1117–1122.
30. Bares R, Dohmen B, Cremerius U, Fass J, Teusch M, Buell U. Results of positron emission tomography with fluorine-18-labeled fluorodeoxyglucose in differential diagnosis and staging of pancreatic carcinoma [in German]. *Radiologe*. 1996;36:435–440.
31. Bares R, Galonska P, Dempke W, Handt S, Büll U, Osieka R. Somatostatin receptor scintigraphy in malignant lymphoma: first results and comparison with glucose metabolism measured by positron emission tomography. *Horm Metab Res.* 1993;27(suppl):56–58.
32. Bares R, Klever P, Hauptmann S, et al. F-18 fluorodeoxyglucose PET in vivo evaluation of pancreatic glucose metabolism for detection of pancreatic cancer. *Radiology*. 1994;192:79–86.
33. Bares R, Klever P, Hellwig D, et al. Pancreatic cancer detected by positron emission tomography with 18F-labelled deoxyglucose: method and first results. *Nucl Med Commun*. 1993;14:596–601.
34. Barrington SF, Koutroumanidis M, Agathonikou A, et al. Clinical value of "ictal" FDG-positron emission tomography and the routine use of simultaneous scalp EEG studies in patients with intractable partial epilepsies. *Epilepsia*. 1998;39:753–766.
35. Bassa P, Kim EE, Inoue T, et al. Evaluation of preoperative chemotherapy using PET with fluorine-18-fluorodeoxyglucose in breast cancer. *J Nucl Med*. 1996;37:931–938.
36. Baum RP, Schmuecking M, Plichta K, et al. Staging of non-small cell lung cancer (NSCLC): is PET really clinically important or just a research tool [abstract]? *J Nucl Med*. 2000;41:293P–294P.
37. Beets G, Pennickx F, Schiepers C, et al. Clinical value of whole-body positron emission tomography with [18F] fluorodeoxyglucose in recurrent colorectal cancer. *Br J. Surg.* 1994;81:1666–1670.
38. Bellon JR, Mankoff DA, Eubank WB, et al. Evaluation of the internal mammary (IM) lymph node (LN) chain by PET in locally advanced breast cancer (LABC) [abstract]. *J Nucl Med*. 2000;41:145P.
39. Benchaou M, Lehmann W, Slosman DO, et al. The role of FDG-PET in the preoperative assessment of N-staging in head and neck cancer. *Acta Otolaryngol*. 1996;116:332–335.
40. Bender H, Bangard N, Metten N, et al. Possible role of FDG-PET in the early prediction of therapy outcome in liver metastases of colorectal cancer. *Hybridoma*. 1999;18:87–91.
41. Bender H, Kirst J, Palmedo H, et al. Value of 18-fluorodeoxyglucose positron emission tomography in the staging of recurrent breast carcinoma. *Anticancer Res*. 1997;17:1687–1692.
42. Berlangieri SU, Brizel DM, Scher RL, et al. Pilot study of positron emission tomography in patients with advanced head and neck cancer receiving radiotherapy and chemotherapy. *Head Neck*. 1994;16:340–346.
43. Bernstein V, Jones A, Mankoff DA, Davis N. Assessment of internal mammary lymph nodes by fluorodeoxyglucose positron emission tomography (FDG-PET) in medial hemisphere breast cancer [abstract]. *J Nucl Med*. 2000;41:289P.
44. Berry WAC, Molloy PT, Alavi A, Vaughan SN. Neuroimaging in the evaluation of suspected brain tumor recurrence in the pediatric population, the critical role of fluorodeoxyglucose (18-FDG) positron emission tomography (PET) studies [abstract]. *J Nucl Med*. 1997;38:12P–13P.
45. Beuthien-Baumann B, Bredow J, Eckelt U, Franke WG, Hlawitschka M, Neise E. Diagnostic value of 18F-FDG PET in detecting carcinoma of the oral mucosa in comparison with MRI, CT, and ultrasound (US) [abstract]. *J Nucl Med*. 2000;41:301P.
46. Bischoff HG, Knopp MV, Rimac A, Manegold C, Drings P, Van Kaick G. Chemotherapy response monitoring with FDG positron emission tomography of patients with small cell lung cancer [abstract]. *Ann Hematol*. 1996;73:A99.
47. Bleckmann C, Dose J, Bohuslavizki KH, et al. Effect of attenuation correction on lesion detectability in FDG PET of breast cancer [see comments]. *J Nucl Med*. 1999;40:2021–2024.
48. Blessing C, Feine U, Geiger L, Carl M, Rassner G, Fierlbeck G. Positron emission tomography and ultrasonography. A comparative retrospective study assessing the diagnostic validity in lymph node metastases of malignant melanoma [see comments]. *Arch Dermatol*. 1995;131:1394–1398.
49. Block M, Patterson G, Sundaresan R, et al. Improvement in staging of esophageal cancer with addition of positron emission tomography. *Ann Thorac Surg*. 1997;64:770–776.
50. Bloom AD, Adler LP, Shuck JM. Determination of malignancy of thyroid nodules with positron emission tomography. *Surgery*. 1993;114:728–735.
51. Blum DE, Ehsan T, Dungan D, Karis JP, Fisher RS. Bilateral temporal hypometabolism in epilepsy. *Epilepsia*. 1998;39:651–659.
52. Bohdiewicz PJ, Scott GC, Juni JE, et al. Indium-111 OncoScint CR/OV and F-18 FDG in colorectal and ovarian carcinoma recurrences. Early observations. *Clin Nucl Med.* 1995;20:230–236.
53. Bohuslavizki KH, de Wit M, Buchert R, et al. Post-treatment 18F-FDG-PET as predictor for disease-free survival in Hodgkin's lymphoma [abstract]. *J Nucl Med*. 2000;41:275P.
54. Bohuslavizki KH, Klutmann S, Kröger S, et al. FDG PET detection of unknown primary tumors. *J Nucl Med*. 2000;41:816–822.
55. Bohuslavizki KH, Klutmann S, Neuber K, et al. Correlation of 18F FDG-PET and histological findings in patients with malignant melanoma [abstract]. *J Nucl Med*. 2000;41:302P.
56. Bombardieri E, Crippa F, Agresti R, et al. FDG-PET in the assessment of axillary metastases in breast cancer. Clinical application and economic implications [abstract]. *J Nucl Med*. 1998;39:254P.

57. Bongers V, Terhaard CJ, van Isselt JW, Hordijk GJ, van Rijk PP. Dual-head FDG-PET for the detection of recurrent laryngeal cancer compared with histopathological biopsy results and minimally 1-year clinical follow-up [abstract]. *J Nucl Med*. 2000;41:287P.
58. Böni R, Böni RA, Steinert H, et al. Staging of metastatic melanoma by whole-body positron emission tomography using 2-fluorine-18-fluoro-2-deoxy-D-glucose. *Br J Dermatol*. 1995;132:556–562.
59. Both SA, Schaeffer U, Schlenger KH, et al. 18F FDG-PET in clinical assessment of primary uterine cervical carcinoma: detection and correlation with tumor oxygen partial pressure [abstract]. *J Nucl Med*. 2000;41:116P.
60. Braams J, Pruim J, Freling N, et al. Detection of lymph node metastases of squamous cell cancer of the head and neck with FDG-PET and MRI. *J Nucl Med*. 1995;36:211–216.
61. Braams JW, Pruim J, Kole AC, et al. Detection of unknown primary head and neck tumors by positron emission tomography. *Int J Oral Maxillofac Surg*. 1997;26:112–115.
62. Brandt-Mainz K, Müller SP, Görges R, Saller B, Bockisch A. The value of fluorine-18 fluorodeoxyglucose PET in patients with medullary thyroid cancer. *Euro J Nucl Med*. 2000;27:490–496.
63. Bury T, Corhay JL, Duysinx B, et al. Value of FDG-PET in detecting residual or recurrent nonsmall cell lung cancer. *Eur Respir J*. 1999;14:1376–1380.
64. Bury T, Dowlati A, Paulus P, et al. Evaluation of the solitary pulmonary nodule by positron emission tomography imaging. *Eur Respir J*. 1996;9:410–414.
65. Bury T, Paulus P, Dowlati A, et al. Staging of the mediastinum: value of positron emission tomography imaging in non-small cell lung cancer. *Eur Respir J*. 1996;9:2560–2564.
66. Cambier JPR, Flamen P, Maes A, Van Cutsem E, Lerut T, Mortelmans L. FDG-PET for staging recurrent esophageal cancer (EC) [abstract]. *J Nucl Med*. 2000;41:32P.
67. Caputo GR, Budinger T, Price D, Schreck C, Hawkins R. Evaluation of prostate cancer using high-resolution FDG PET imaging [abstract]. *J Nucl Med*. 1997; 38:128P.
68. Carr R, Barrington SF, Madan B, et al. Detection of lymphoma in bone marrow by whole-body positron emission tomography. *Blood*. 1998;91:3340–3346.
69. Casey MJ, Gupta NC, Muths CK. Experience with positron emission tomography (PET) scans in patients with ovarian cancer. *Gynecol Oncol*. 1994;53:331–338.
70. Chaiken L, Rege S, Hoh C, et al. Positron emission tomography with fluorodeoxyglucose to evaluate tumor response and control after radiation therapy. *Int J Radiat Oncol Biol Phys*. 1993;27:455–464.
71. Cheon G, Chung J, So Y, et al. Diagnostic accuracy of F-18 FDG-PET in the assessment of post-therapeutic recurrence of head and neck cancer. *Clin Positron Imaging*. 1999;2:197–204.
72. Chierichetti F, Rubello D, Pedrazzoli S, et al. FDG PET role in differential diagnosis of pancreatic and peri-pancreatic masses [abstract]. *J Nucl Med*. 1997;38:51P.
73. Chin R Jr, Ward R, Keyes JW, et al. Mediastinal staging of non-small-cell lung cancer with positron emission tomography. *Am J Respir Crit Care Med*. 1995; 152:2090–2096.
74. Chisin R, Klein M, Freedman N, et al. PET and lymphoscintigraphic evaluation of malignant melanomas: the Hadassah Hospital experience [abstract]. *Clin Positron Imaging*. 1998;1:252.
75. Choi JY, Lee KH, Shim YM, et al. Improved detection of individual nodal involvement in squamous cell carcinoma of the esophagus by FDG PET. *J Nucl Med*. 2000;41:808–815.
76. Chugani HT, Shewmon DA, Peacock WJ, Shields WD, Mazziotta JC, Phelps ME. Surgical treatment of intractable neonatal-onset seizures: the role of positron emission tomography. *Neurology*. 1988;38:1178–1188.
77. Chung JK, So Y, Lee JS, et al. Value of FDG PET in papillary thyroid carcinoma with negative 131I whole-body scan [see comments]. *J Nucl Med*. 1999;40:986–992.
78. Collins BT, Gardner LJ, Verma AK, Lowe VJ, Dunphy FR, Boyd JH. Correlation of fine needle aspiration biopsy and fluoride-18 fluorodeoxyglucose positron emission tomography in the assessment of locally recurrent and metastatic head and neck neoplasia. *Acta Cytol*. 1998;42:1325–1329.
79. Conti P, Durski J, Bacqai F, Grafton S, Singer P. Imaging of locally recurrent and metastatic thyroid cancer with positron emission tomography. *Thyroid*. 1999;9:797–804.
80. Cortes-Blanco A, Meyer PT, Martinez-Lazaro R, Desiderio LM, Molloy PT, Alavi AA. Discrepant performance of FDG-PET and magnetic resonance imaging (MRI) and spectroscopy (MRS) for the detection of brain tumor recurrence between adults and children [abstract]. *J Nucl Med*. 2000;41:225P.
81. Couper GW, McAteer D, Wallis F, et al. Detection of response to chemotherapy using positron emission tomography in patients with oesophageal and gastric cancer. *Br J Surg*. 1998;85:1403–1406.
82. Cremerius U, Fabry U, Neuerburg J, Zimny M, Osieka R, Buell U. Positron emission tomography with 18F-FDG to detect residual disease after therapy for malignant lymphoma. *Nucl Med Commun*. 1998;19:1055–1063.
83. Cremerius U, Wildberger H, Zimny M, Jaksy G, Gunther R, Buell U. Does positron emission tomography using 18-fluoro-2-deoxyglucose improve clinical staging of testicular cancer? Results of a study in 50 patients. *Urology*. 1999; 54:900–904.
84. Crespo-Jara AA, Garcia MJ, Gimenez M, et al. Skeletal metastases in lung cancer: accuracy of 18FDG-PET in correlation with bone scintigraphy [abstract]. *J Nucl Med*. 1999;40:258P.
85. Crespo-Jara AA, Gimenez M, Villar LM, et al. Evaluation of adrenal masses in lung cancer using 18FDG PET. *J Nucl Med*. 2000;41:293P.
86. Crippa F, Agresti R, Donne VD, et al. The contribution of positron emission tomography (PET) with 18F-fluorodeoxyglucose (FDG) in the preoperative detection of axillary metastases of breast cancer: the experience of the National Cancer Institute of Milan [in Italian]. *Tumori*. 1997;83:542–543.
87. Crippa F, Agresti R, Seregni E, et al. Prospective evaluation of fluorine-18 FDG PET in presurgical staging of the axilla in breast cancer. *J Nucl Med*. 1998;39:4–8.
88. Crowe J, Adler L, Shenk R, Sunshine J. Positron emission tomography and breast masses: comparison with clinical, mammographic, and pathological findings. *Ann Surg Oncol*. 1994;1:132–140.
89. da Silva EA, Chugani DC, Muzik O, Chugani HT. Landau-Kleffner syndrome: metabolic abnormalities in temporal lobe are a common feature. *J Child Neurol*. 1997;12:489–495.
90. Damian DL, Fulham MJ, Thompson E, Thompson JF. Positron emission tomography in the detection and management of metastatic melanoma. *Melanoma Res*. 1996;6:325–329.
91. De Reuck J, Santens P, Decoo D, et al. Positron emission tomographic study of late-onset cryptogenic symptomatic seizures. *Clin Neurol Neurosurg*. 1995;97: 208–212.
92. De Winter F, Van de Wiele C, Vogelaers D, et al. FDG PET is highly accurate in the diagnosis of chronic osteomyelitis in the central skeleton [abstract]. *J Nucl Med*. 2000;41:15P.
93. de Wit M, Bender H, Dohmen BM, et al. Germ cell tumor: staging with FDG-PET. Pilot phase of the German multicenter trial [abstract]. *J Nucl Med*. 1999;40:256P.
94. de Wit M, Bumann D, Beyer W, Herbst K, Clausen M, Hossfeld DK. Whole-body positron emission tomography (PET) for diagnosis of residual mass in patients with lymphoma. *Ann Oncol*. 1997;8(suppl 1):57–60.
95. Dehdashti F, Flanagan FL, Mortimer JE, Katzenellenbogen JA, Welch MJ, Siegel BA. Positron emission tomographic assessment of "metabolic flare" to predict response of metastatic breast cancer to antiestrogen therapy. *Eur J Nucl Med*. 1999;26:51–56.
96. Delbeke D, Lawrence SK, Abou-Khalil BW, Blumenkopf B, Kessler RM. Postsurgical outcome of patients with uncontrolled complex partial seizures and temporal lobe hypometabolism on 18FDG-positron emission tomography. *Invest Radiol*. 1996;31:261–266.
97. Delbeke D, Martin WH, Sandler MP, Chapman WC, Wright JK Jr, Pinson CW. Evaluation of benign vs malignant hepatic lesions with positron emission tomography. *Arch Surg*. 1998;133:510–516.
98. Delbeke D, Morgan DS, Kovalsky E, et al. 18F-fluorodeoxyglucose imaging with positron emission tomography in the follow-up of patients with lymphoma [abstract]. *J Nucl Med*. 2000;41:70P.
99. Delbeke D, Morgan DS, Kovalsky E, et al. 18F-fluorodeoxyglucose imaging with positron emission tomography for initial staging of Hodgkin's disease and lymphoma [abstract]. *J Nucl Med*. 2000;41:275P.
100. Delbeke D, Rose D, Chapman W, et al. Optimal interpretation of FDG PET in the diagnosis, staging and management of pancreatic carcinoma. *J Nucl Med*. 1999;40:1784–1791.
101. Delbeke D, Vitola JV, Sandler MP, et al. Staging recurrent metastatic colorectal carcinoma with PET. *J Nucl Med*. 1997;38:1196–1201.
102. Deshmukh A, Scott JA, Palmer EL, Hochberg FH, Gruber M, Fischman AJ. Impact of fluorodeoxyglucose positron emission tomography on the clinical management of patients with glioma. *Clin Nucl Med*. 1996;21:720–725.
103. Dewan NA, Gupta NC, Redepenning LS, Phalen JJ, Frick MP. Diagnostic efficacy of PET-FDG imaging in solitary pulmonary nodules. Potential role in evaluation and management. *Chest*. 1993;104:997–1002.
104. Dewan NA, Reeb SD, Gupta NC, Gobar LS, Scott WJ. PET-FDG imaging and transthoracic needle lung aspiration biopsy in evaluation of pulmonary lesions. A comparative risk-benefit analysis. *Chest*. 1995;108:441–446.
105. Di Martino E, Nowak B, Krombach GA, et al. Results of pretherapeutic lymph node diagnosis in head and neck tumors. Clinical value of 18-FDG positron emission tomography (PET). *Laryngo-Rhino-Otologie*. 2000;79: 201–206.

106. Dietlein M, Scheidhauer K, Voth E, Theissen P, Schicha H. Fluorine-18 fluorodeoxyglucose positron emission tomography and iodine-131 whole-body scintigraphy in the follow-up of differentiated thyroid cancer. *Eur J Nucl Med*. 1997;24:1342–1348.
107. Dietlein M, Scheidhauer K, Voth E, Theissen P, Schicha H. Follow-up of differentiated thyroid cancer: what is the value of FDG and sestamibi in the diagnostic algorithm? *Nuklearmedizin*. 1998;37:12–17.
108. Dimitrakopoulou-Strauss A, Heichel T, Lehner B, Strauss LG. Positron emission tomography (PET) with 18F-deoxyglucose (FDG) in tumors of the skeleton system [abstract]. *J Nucl Med*. 2000;41:304P.
109. Dimitrakopoulou-Strauss A, Schwarzbach M, Willeke F, Strauss LG. PET with FDG in soft tissue sarcomas [abstract]. *J Nucl Med*. 2000;41:303P.
110. Dimitrakopoulou-Strauss A, Strauss LS, Goldschmidt H, Lorenz WJ, Maier-Borst W, van Kaick G. Evaluation of tumour metabolism and multidrug resistance in patients with treated malignant lymphomas. *Eur J Nucl Med*. 1995;22: 434–442.
111. Dittmann H, Dohmen BM, Soekler M, Kanz L, Bares R. Therapeutic relevance of FDG-PET in untreated Hodgkin's disease and high-grade non-Hodgkin lymphoma [abstract]. *J Nucl Med*. 2000;41:71P.
112. Duhaylongsod FG, Lowe VJ, Patz EF Jr, Vaughn AL, Coleman RE, Wolfe WG. Detection of primary and recurrent lung cancer by means of F-18 fluorodeoxyglucose positron emission tomography (FDG PET). *J Thorac Cardiovasc Surg*. 1995;110:130–140.
113. Duhaylongsod FG, Lowe VJ, Patz EF Jr, Vaughn AL, Coleman RE, Wolfe WG. Lung tumor growth correlates with glucose metabolism measured by fluoride-18 fluorodeoxyglucose positron emission tomography. *Ann Thorac Surg*. 1995;60: 1348–1352.
114. Duncan JD, Moss SD, Bandy DJ, et al. Use of positron emission tomography for presurgical localization of eloquent brain areas in children with seizures. *Pediatr Neurosurg*. 1997;26:144–156.
115. Eigtved A, Andersson AP, Dahlstrøm K, et al. Use of fluorine-18 fluorodeoxyglucose positron emission tomography in the detection of silent metastases from malignant melanoma. *Eur J Nucl Med*. 2000;27:70–75.
116. Engel J Jr, Henry TR, Risinger MW, et al. Presurgical evaluation for partial epilepsy: relative contributions of chronic depth-electrode recordings versus FDG-PET and scalp-sphenoidal ictal EEG. *Neurology*. 1990;40:1670–1677.
117. Ericson K, Kihlström L, Mogard J, et al. Positron emission tomography using 18F-fluorodeoxyglucose in patients with stereotactically irradiated brain metastases. *Stereotact Funct Neurosurg*. 1996;66(suppl 1):214–224.
118. Eubank WB, Mankoff DA, Shanley TJ, et al. Assessment of mediastinal lymph node metastasis in advanced breast cancer: comparison of FDG PET with CT [abstract]. *J Nucl Med*. 1999;40:17P–18P.
119. Farber L, Benard F, Machtay M, et al. Detection of recurrent head and neck squamous cell carcinomas after radiation therapy with 2-18F-fluoro-2-deoxy-D-glucose positron emission tomography. *Laryngoscope*. 1999;109: 970–975.
120. Feine U, Lietzenmayer R, Hanke JP, Held J, Wöhrle H, Müller-Schauenburg W. Fluorine-18-FDG and iodine-131-iodide uptake in thyroid cancer. *J Nucl Med*. 1996;37:1468–1472.
121. Fenchel S, Kotzerke J, Stöhr I, et al. Preoperative assessment of asymptomatic adnexal tumors by positron emission tomography and F-18 fluorodeoxyglucose. *Nuklearmedizin*. 1999;38:101–107.
122. Ferrie CD, Maisey M, Cox T, et al. Focal abnormalities detected by 18FDG PET in epileptic encephalopathies [see comments]. *Arch Dis Child*. 1996;75:102–107.
123. Findlay M, Young H, Cunningham D, et al. Noninvasive monitoring of tumor metabolism using fluorodeoxyglucose and positron emission tomography in colorectal cancer liver metastases: correlation with tumor response to fluorouracil [see comments]. *J Clin Oncol*. 1996;14:700–708.
124. Finke J, Buchmann I, Bares R, et al. (F-18)-FDG-PET in primary staging of malignant lymphoma: first results of a multicenter study [abstract]. *J Nucl Med*. 1999;40:61P.
125. Fischbein NJ, AAssar OS, Caputo GR, et al. Clinical utility of positron emission tomography with 18F-fluoro-deoxy glucose in detecting residual/recurrent squamous cell carcinoma of the head and neck [see comments]. *Am J Neuroradiol*. 1998;19:1189–1196.
126. Flamen P, Stroobants S, Dupont P, et al. Additional value of positron emission tomography (PET) with fluorodeoxyglucose (FDG) in recurrent colorectal cancer: a study in 103 patients [abstract]. *J Nucl Med*. 1998;39:134P.
127. Flamen P, Stroobants S, Van Cutsem E, et al. Additional value of whole-body positron emission tomography with fluorine-18-2-fluoro-2-deoxy-D-glucose in recurrent colorectal cancer. *J Clin Oncol*. 1999;17:894–901.
128. Flanagan F, Dedashti F, Siegel B, et al. Staging of esophageal cancer with 18F-fluorodeoxyglucose positron emission tomography. *AJR*. 1997;168:417–424.
129. Flanagan FL, Dehdashti F, Ogunbiyi OA, Kodner IJ, Siegel BA. Utility of FDG-PET for investigating unexplained plasma CEA elevation in patients with colorectal cancer. *Ann Surg*. 1998;227:319–323.
130. Fois A, Farnetani MA, Balestri P, et al. EEG, PET, SPET and MRI in intractable childhood epilepsies: possible surgical correlations. *Child Nerv Syst*. 1995;11: 672–678.
131. Forster GJ, Kunkel M, Kutzner J, et al. Early monitoring of treatment response by (18F)FDG-PET in preoperatively irradiated advanced oral cancer [abstract]. *J Nucl Med*. 2000;41:113P.
132. Franke C, Klapdor R, Meyerhoff K, Schauman M. 18-FDG positron emission tomography of the pancreas: diagnostic benefit in the follow-up of pancreatic carcinoma. *Anticancer Res*. 1999;19:2437–2442.
133. Friess H, Langhans J, Ebert M, et al. Diagnosis of pancreatic cancer by 2[18F]-fluoro-2-deoxy-D-glucose positron emission tomoraphy. *Gut*. 1995;36: 771–777.
134. Fröhlich A, Diederichs C, Staib L, Vogel J, Beger H, Reske S. Detection of liver metastases from pancreatic cancer using FDG PET. *J Nucl Med*. 1999;40:250–255.
135. Fujii H, Yasuda S, Ide M, et al. The usefulness of breast cancer screening using 18F FDG PET [abstract]. *J Nucl Med*. 2000;41:291P.
136. Fukunaga T, Okazumi S, Koide Y, Isono K, Imazeki K. Evaluation of esophageal cancers using fluorine-18-fluorodeoxyglucose PET. *J Nucl Med*. 1998;39: 1002–1007.
137. Gamez C, Garcia-Velloso MJ, Villar LM, et al. 18F-FDG and 11C-methionine PET for evaluation of suspected recurrent colorectal cancer [abstract]. *J Nucl Med*. 2000;41:141P.
138. Gauthier H, Levy E, Merlet P, Thirion P, Syrota A, Meignan M. High negative predictive value of FDG-PET for assessment of progressive disease in patients with soft tissue sarcoma [abstract]. *J Nucl Med*. 1999;40:259P.
139. Gerber B, Vanoverschelde J, Bol A. Myocardial blood flow, glucose uptake, and recruitment of inotropic reserve in chronic left ventricular ischemic dysfunction: implications for the pathophysiology of chronic myocardial hibernation. *Circulation*. 1996;94:651–659.
140. Gimenez M, Crespo-Jara AA, Villar L, et al. Preoperative and intraoperative uptake of 18FDG-PET in axillary metastases of breast cancer. A pathological correlation [abstract]. *J Nucl Med*. 1999;40:138P.
141. Gliem I, Leutz M, Hellwig D, et al. Evaluation of malignancy-related pleural disease with FDG-positron emission tomography (PET) [abstract]. *Eur Respir J*. 1998;12:392S.
142. Goldberg MA, Lee MJ, Fischman AJ, Mueller PR, Alpert NM, Thrall JH. Fluorodeoxyglucose PET of abdominal and pelvic neoplasms: potential role in oncologic imaging. *RadioGraphics*. 1993;13:1047–1062.
143. Grab D, Flock F, Stöhr I, et al. Classification of asymptomatic adnexal masses by ultrasound, magnetic resonance imaging, and positron emission tomography. *Gynecol Oncol*. 2000;77:454–459.
144. Greven KM, Keyes JW Jr, Williams DW III, McGuirt WF, Joyce WT III. Occult primary tumors of the head and neck: lack of benefit from positron emission tomography imaging with 2-[F-18]fluoro-2-deoxy-D-glucose. *Cancer*. 1999;86: 114–118.
145. Greven KM, Williams DW III, Keyes JW Jr, et al. Distinguishing tumor recurrence from irradiation sequelae with positron emission tomography in patients treated for larynx cancer. *Int J Radiat Oncol Biol Phys*. 1994;29:841–845.
146. Greven KM, Williams DW III, Keyes JW Jr, et al. Positron emission tomography of patients with head and neck carcinoma before and after high dose irradiation [see comments]. *Cancer*. 1994;74:1355–1359.
147. Grigsby PW, Dehdashti F, Elbendary AA, et al. FDG-PET evaluation of primary carcinoma of the cervix. *Gynecol Oncol*. 1999;72:457–458.
148. Gritters LS, Francis IR, Zasadny KR, Wahl RL. Initial assessment of positron emission tomography using 2-fluorine-18-fluoro-2-deoxy-D-glucose in the imaging of malignant melanoma. *J Nucl Med*. 1993;34:1420–1427.
149. Gropler R, Geltman E, Sampathkurmaran K. Comparison of carbon-11-acetate with fluorine-18-fluorodeoxyglucose for delineating viable myocardium by positron emission tomography. *J Am Coll Cardiol*. 1993;22:1587–1597.
150. Grünwald F, Kälicke T, Feine U, et al. Fluorine-18 fluorodeoxyglucose positron emission tomography in thyroid cancer: results of a multicentre study. *Eur J Nucl Med*. 1999;26:1547–1552.
151. Grünwald F, Menzel C, Bender H, et al. Comparison of 18FDG-PET with 131I and 99mTc-sestamibi scintigraphy in differentiated thyroid cancer. *Thyroid*. 1997;7:327–335.
152. Grünwald F, Schomburg A, Bender H, et al. Fluorine-18 fluorodeoxyglucose positron emission tomography in the follow-up of differentiated thyroid cancer. *Eur J Nucl Med*. 1996;23:312–319.
153. Guhlmann A, Storck M, Kotzerke J, Moog F, Sunder-Plassmann L, Reske SN.

Lymph node staging in non-small cell lung cancer: evaluation by (18F)FDG positron emission tomography (PET). *Thorax*. 1997;52:438–441.
154. Gupta NC, Bishop HA. Long-term outcome of patients with indeterminate lung nodules following management based on PET-FDG results [abstract]. *J Nucl Med*. 2000;41:76P.
155. Gupta NC, Bishop HA, Graeber GM. Incidence and characteristics of falsely positive and negative lymph node on PET and CT in lung cancer staging [abstract]. *J Nucl Med*. 1999;40:57P.
156. Gupta NC, Graeber G, Rogers J, Koay T, Bishop H. Relative utility of PET-FDG and CT scanning in preoperative TNM staging of lung cancer patients [abstract]. *J Nucl Med*. 1998;39:80P.
157. Gupta NC, Graeber GM, Bishop HA, Raylman RR. Improved pre-operative staging of primary lung cancer by PET-FDG imaging [abstract]. *J Nucl Med*. 1997;38:243P–244P.
158. Gupta NC, Graeber GM, Bishop HA, Stephens TS. Comparative efficacy of FDG-PET in evaluation of small (less than 3 cm) and large (greater than 3 cm) pulmonary (PUL) and lymph node (LN) lesions [abstract]. *J Nucl Med*. 1997; 38:79P.
159. Gupta NC, Maloof J, Gunel E. Probability of malignancy in solitary pulmonary nodules using fluorine-18-FDG and PET [see comments]. *J Nucl Med*. 1996; 37:943–948.
160. Gupta NC, Nicholson P, Bloomfield SM. FDG-PET in the staging work-up of patients with suspected intracranial metastatic tumors. *Ann Surg*. 1999;230:202–206.
161. Gupta NC, Tamim WZ, Bishop HA. Is there any incremental value of routine lymph node sampling using mediastinoscopy and/or thoracotomy or open biopsy for management of lung cancer patients following whole body PET [abstract]? *J Nucl Med*. 2000;41:76P.
162. Gupta-Burt S, Marcus E, Coon J, et al. The role of positron-emission tomography (PET) in the assessment of pathologic response to neoadjuvant chemotherapy with doxorubicin and docetaxel in patients with locally advanced breast cancer [abstract]. *Eur J Cancer*. 1999;35:S316.
163. Haase A, Lauer I, Meller B, Richter E, Baehre MH. Feasibility of detecting unknown primary tumors with gamma camera coincidence PET [abstract]. *J Nucl Med*. 2000;41:296P.
164. Haberkorn U, Strauss LG, Dimitrakopoulou A, et al. Fluorodeoxyglucose imaging of advanced head and neck cancer after chemotherapy. *J Nucl Med*. 1993;34:12–17.
165. Haenggeli CA, Dulguerov P, Slosman D, et al. Value of positron emission tomography with 18-fluorodeoxyglucose (FDG-PET) in early detection of residual tumor in oro-pharyngeal-laryngeal carcinoma [in German]. *Schweiz Med Wochenschr*. 2000;116(suppl):8S–11S.
166. Hagberg RC, Segall GM, Stark P, Burdon TA, Pompili MF. Characterization of pulmonary nodules and mediastinal staging of bronchogenic carcinoma with F-18 fluorodeoxyglucose positron emission tomography. *Eur J Cardiothorac Surg*. 1997;12:92–97.
167. Hain SF, O'Doherty MJ, Huddart RA, Leslie MD, Timothy AR, Harper PG. The value of FDG-PET in recurrent testicular carcinoma [abstract]. *J Nucl Med*. 1999;40:105P.
168. Hain SF, O'Doherty MJ, Leslie MD, Timothy AR. Staging of testicular carcinoma with FDG-PET [abstract]. *J Nucl Med*. 1999;40:256P.
169. Hain SF, O'Doherty MJ, Lucas JD, Smith MA. Fluorodeoxyglucose PET in the evaluation of amputations for soft tissue sarcoma. *Nucl Med Commun*. 1999; 20:845–848.
170. Hanasono MM, Kunda LD, Segall GM, Ku GH, Terris DJ. Uses and limitations of FDG positron emission tomography in patients with head and neck cancer. *Laryngoscope*. 1999;109:880–885.
171. Hara T, Kosaka N, Kishi H. PET imaging of prostate cancer using carbon-11-choline. *J Nucl Med*. 1998;39:990–995.
172. Harms W, Bares R, Kamps H, Gronimus R, Boeckmann W, Jake G. Therapy control of metastatic testicular carcinoma with F18-DOG PET [abstract]. *J Nucl Med*. 1995;36:198P.
173. Harrison J, Ali A, Bonomi P, Prinz R. The role of positron emission tomography in selecting patients with metastatic cancer for adrenalectomy. *Am Surg*. 2000; 66:432–437.
174. Haseman MK, Reed NL, Rosenthal SA. Monoclonal antibody imaging of occult prostate cancer in patients with elevated prostate-specific antigen positron emission tomography and biopsy correlation. *Clin Nucl Med*. 1996; 21:704–713.
175. Hathaway PB, Mankoff DA, Maravilla KR, et al. Value of combined FDG PET and MR imaging in the evaluation of suspected recurrent local-regional breast cancer: preliminary experience. *Radiology*. 1999;210:807–814.
176. Heicappell R, Mueller-Mattheis V, Reinhardt M, et al. Staging of pelvic lymph nodes in neoplasms of the bladder and prostate by positron emission tomography with 2-(18F)-2-deoxy-D-glucose. *Eur Urol*. 1999;36:582–587.
177. Heinz R, Ferris N, Lee EK, et al. MR and positron emission tomography in the diagnosis of surgically correctable temporal lobe epilepsy. *Am J Neuroradiol*. 1994;15:1341–1348.
178. Helveston W, Gilmore R, Roper S, et al. Intractable temporal lobe epilepsy: comparison of positron emission tomography with qualitative and quantitative MR. *Am J Neuroradiol*. 1996;17:1515–1521.
179. Henze M, Brix G, Knopp M, et al. Functional breast imaging: comparison of 18F-fluorodeoxyglucose (FDG) PET and pharmacokinetic MR mapping (DMRI) [abstract]. *J Nucl Med*. 2000;41:290P.
180. Henze M, Mohammed A, Mier W, et al. Pretreatment studies of 18F-fluorodeoxyglucose (FDG), 123I-[alpha]-methlytyrosine (IMT) and 99mTc-sestamibi uptake in hypopharynx-larynx-carcinomas [abstract]. *J Nucl Med*. 2000;41: 142P.
181. Herholz K, Perani D, Salmon E, et al. Comparability of FDG PET studies in probable Alzheimer's disease. *J Nucl Med*. 1993;34:1460–1466.
182. Hicks RJ, Binns D, Kalff V, et al. The utility of flourine-18 fluorodeoxyglucose (FDG) positron emission tomography (PET) for restaging of non-small cell lung cancer (NSCLC): Analysis of management change and survival in 63 consecutive patients [abstract]. *J Nucl Med*. 2000;41:75P.
183. Higashi K, Nishikawa T, Seki H, et al. Comparison of fluorine-18-FDG PET and thallium-201 SPECT in evaluation of lung cancer. *J Nucl Med*. 1998;39:9–15.
184. Higashi K, Ueda Y, Kodama Y, et al. Comparison of 18F FDG PET and 201Tl SPECT in evaluation of pulmonary nodules [abstract]. *J Nucl Med*. 2000;41: 297P.
185. Higashi T, Sakahara H, Torizuka T, et al. Evaluation of intraoperative radiation therapy for unresectable pancreatic cancer with FDG PET. *J Nucl Med*. 1999; 40:1424–1433.
186. Hoda S, Ardakani N, Hawkins RA. Significance of PET-FDG in comparison with 131I WBS and serum Tg in detection of recurrent and metastatic papillary thyroid carcinoma [abstract]. *J Nucl Med*. 2000;41:312P.
187. Hoffman J, Welsh-Bohmer K, Hanson M, et al. FDG-PET imaging in pathologically verified dementia. *J Nucl Med*. 2000;41:1920–1928.
188. Hoffman JM, Waskin HA, Schifter T, et al. FDG-PET in differentiating lymphoma from nonmalignant central nervous system lesions in patients with AIDS. *J Nucl Med*. 1993;34:567–575.
189. Hoffmann M, Kletter K, Diemling M, et al. Positron emission tomography with fluorine-18-2-fluoro-2-deoxy-D-glucose (F18-FDG) does not visualize extranodal B-cell lymphoma of the mucosa-associated lymphoid tissue (MALT)-type. *Ann Oncol*. 1999;10:1185–1189.
190. Hoh C, Glaspy J, Rosen P, et al. Whole-body FDG-PET imaging for staging of Hodgkin's disease and lymphoma. *J Nucl Med*. 1997;38:343–348.
191. Hoh CK, Chap L, Glaspy JA, Bui S, Czernin J, Phelps ME. Prognostic value of whole body FDG PET in breast cancer patients undergoing chemotherapy [abstract]. *J Nucl Med*. 1998;39:254P.
192. Hoh CK, Figlin RA, Belldegrun A, et al. Evaluation of renal cell carcinoma with whole body FDG PET [abstract]. *J Nucl Med*. 1996;37:141P.
193. Hoh CK, Hawkins RA, Glaspy JA, et al. Cancer detection with whole-body PET using 2-[18F]fluoro-2-deoxy-D-glucose. *J Comput Assist Tomogr*. 1993;17: 582–589.
194. Hoh CK, Rosen PJ, Belldegrun A, Moon DH, Maddahi J, Phelps ME. Quantitative and whole-body FDG PET in the evaluation of suramin therapy in patients with metastatic prostate cancer [abstract]. *J Nucl Med*. 1996;37:267P.
195. Holder WD Jr, White RL Jr, Zuger JH, Easton EJ Jr, Greene FL. Effectiveness of positron emission tomography for the detection of melanoma metastases. *Ann Surg*. 1998;227:764–771.
196. Holopainen IE, Lundbom NM, Metsähonkala EL, et al. Temporal lobe pathology in epilepsy: proton magnetic resonance spectroscopy and positron emission tomography study. *Pediatr Neurol*. 1997;16:98–104.
197. Holthoff VA, Herholz K, Berthold F, et al. In vivo metabolism of childhood posterior fossa tumors and primitive neuroectodermal tumors before and after treatment. *Cancer*. 1993;72:1394–1403.
198. Hölzer T, Herholz K, Jeske J, Heiss WD. FDG-PET as a prognostic indicator in radiochemotherapy of glioblastoma. *J Comput Assist Tomogr*. 1993;17:681–687.
199. Hsueh EC, Gupta RK, Glass EC, Yee R, Qi K, Morton DL. Positron emission tomography plus serum TA90 immune complex assay for detection of occult metastatic melanoma. *J Am Coll Surg*. 1998;187:191–197.
200. Hübner K, McDonald T, Niethammer J, Smith G, Gould H, Buonocore E. Assessment of primary and metastatic ovarian cancer by positron emission tomography (PET) using (2-[18F]FDG). *Gynecol Oncol*. 1993;51:197–204.
201. Hübner KF, Buonocore E, Gould HR, et al. Differentiating benign from malig-

nant lung lesions using "quantitative" parameters of FDG PET images. *Clin Nucl Med*. 1996;21:941–949.
202. Hübner KF, Buonocore E, Singh SK, Gould HR, Cotten DW. Characterization of chest masses by FDG positron emission tomography. *Clin Nucl Med.* 1995; 20:293–298.
203. Hustinx R, Smith RJ, Benard F, Bhatnagar A, Alavi A. Can the standardized uptake value characterize primary brain tumors on FDG-PET? *Eur J Nucl Med*. 1999;26:1501–1509.
204. Hwang KH, Park CH, Kim HC, Kim HS, Yoon SN, Kim S. Imaging of malignant lymphomas with 18F-FDG coincidence detection PET (CoDe-PET) [abstract]. *J Nucl Med*. 2000;41:278P.
205. Imdahl A, Nitzsche E, Krautmann F, et al. Evaluation of positron emission tomography with 2-[18F]fluoro-2-deoxy-D-glucose for the differentiation of chronic pancreatitis and pancreatic cancer. *Br J Surg*. 1999;86:194–199.
206. Imdahl A, Reinhardt MJ, Nitzsche EU, et al. Impact of 18F-FDG-positron emission tomography for decision making in colorectal cancer recurrences. *Langenbecks Arch Surg*. 2000;385:129–134.
207. Inagaki K, Morita T, Fujii K, Kosaka N, Hara T. Mediastinal lymph node staging in non-small cell lung cancer using PET with C-11 choline and F-18 FDG [abstract]. *J Nucl Med*. 1999;40:59P–60P.
208. Inokuma T, Tamaki N, Torizuka T, et al. Evaluation of pancreatic tumors with positron emission tomography and F-18 fluorodeoxyglucose: comparison with CT and US. *Radiology*. 1995;195:345–352.
209. Inoue T, Kim EE, Komaki R, et al. Detecting recurrent or residual lung cancer with FDG-PET. *J Nucl Med*. 1995;36:788–793.
210. Inubushi M, Ishida Y, Fukuchi K, Fukushima K, Sasako K. Myocardial viability assessment using 18F FDG gated PET [abstract]. *J Nucl Med*. 2000;41:157P.
211. Israel O, Yefremov N, Mor M, et al. 67Ga scintigraphy and 18F FDG coincidence imaging in the evaluation of lymphoma [abstract]. *J Nucl Med*. 2000;41: 141P.
212. Jacobson AF, Maisey MN, Fogelman I. Yield of FDG-PET scans for identifying active malignancy in patients with elevated tumour markers [abstract]. *J Nucl Med*. 1999;40:101P–102P.
213. Jacobson AF, Maisey MN, Fogelman I, Kuhn D. Yield of FDG-PET scanning as a routine follow-up exam in patients with malignancy [abstract]. *J Nucl Med*. 2000;41:304P.
214. Jadvar H, Fischman AJ. Clinical impact of FDG PET on the management of patients with pancreatic carcinoma: comparison with CT and CA19-9 serology [abstract]. *J Nucl Med*. 1999;40:104P.
215. Jadvar H, Johnson DL, Segall GM. The effect of fluorine-18 fluorodeoxyglucose positron emission tomography on the management of cutaneous malignant melanoma. *Clin Nucl Med*. 2000;25:48–51.
216. Jadvar H, McDougall IR, Segall GM. Evaluation of suspected recurrent papillary thyroid carcinoma with [18F]fluorodeoxyglucose positron emission tomography. *Nucl Med Commun*. 1998;19:547–554.
217. Jansson T, Westlin JE, Ahlström H, Lilja A, Långström B, Bergh J. Positron emission tomography studies in patients with locally advanced and/or metastatic breast cancer: a method for early therapy evaluation? *J Clin Oncol*. 1995;13: 1470–1477.
218. Janus TJ, Kim EE, Tilbury R, Bruner JM, Yung WK. Use of [18F]fluorodeoxyglucose positron emission tomography in patients with primary malignant brain tumors. *Ann Neurol*. 1993;33:540–548.
219. Jerusalem G, Beguin Y, Fasotte M, et al. Whole body positron emission tomography using 18F-fluorodeoxyglucose for posttreatment evaluation in Hodgkin's disease and non-Hodgkin's lymphoma has higher diagnostic and prognostic value than classical computed tomography scan imaging. *Blood*. 1999;94:429–433.
220. Jerusalem G, Beguin Y, Fassotte MF, et al. Persistent tumor 18F-FDG uptake after a few cycles of polychemotherapy is predictive of treatment failure in non-Hodgkin's lymphoma. *Haematologica*. 2000;85:613–618.
221. Jerusalem G, Warland V, Najjar F, et al. Whole-body 18F-FDG PET for the evaluation of patients with Hodgkin's disease and non-Hodgkin's lymphoma. *Nucl Med Commun*. 1999;20:13–20.
222. Kahn D, Follett KA, Bushnell DL, et al. Diagnosis of recurrent brain tumor: value of 201Tl SPECT vs 18F-fluorodeoxyglucose PET. *AJR*. 1994;163:1459–1465.
223. Kalff V, Hicks RJ, McManus M, et al. The clinical impact of PET scanning in patients with lung cancer: a prospective [abstract]. *J Nucl Med*. 1998;39:249P.
224. Karlan BY, Hawkins R, Hoh C, et al. Whole-body positron emission tomography with 2-(18F)-fluoro-2-deoxy-D-glucose can detect recurrent ovarian carcinoma. *Gynecol Oncol*. 1993;51:175–181.
225. Kato T, Tsukamoto E, Shiga T, et al. Preliminary results of whole body FDG-PET in biliary carcinoma [abstract]. *J Nucl Med*. 2000;41:298P.
226. Keogan MT, Lowe VJ, Baker ME, McDermott VG, Lyerly HK, Coleman RE. Local recurrence of rectal cancer: evaluation of F-18 fluorodeoxyglucose PET imaging. *Abdom Imaging*. 1997;22:332–337.
227. Kerrou K, Montravers F, Grahek D, Younsi N, de Beco V, Talbot JN. Follow-up of ovarian cancer using (18F)-FDG scan with a dual-head coincidence gamma camera (CDET) [abstract]. *J Nucl Med*. 2000;41:302P.
228. Keyes JW Jr, Chen MY, Watson NE Jr, Greven KM, McGuirt WF, Williams DW III. FDG PET evaluation of head and neck cancer: value of imaging the thorax. *Head Neck*. 2000;22:105–110.
229. Kim DG, Kim CY, Paek SH, et al. Whole-body [18F]FDG PET in the management of metastatic brain tumours. *Acta Neurochirurg*. 1998;140:665–684.
230. Kim JH, Choi CW, Kim BG, et al. FDG-PET in patients with cervical cancer of uterus: experience in patients with clinically no evidence of disease [abstract]. *J Nucl Med*. 2000;41:300P.
231. Kim S, Park CH, Han MH, et al. How useful is 18F-FDG coincidence detection positron emission tomography in the staging of lung cancer? *J Nucl Med*. 2000;41:296P–297P.
232. Kincaid PK, El-Saden SM, Park SH, Goy BW. Cerebral gangliogliomas: preoperative grading using FDG-PET and 201Tl-SPECT [see comments]. *Am J Neuroradiol*. 1998;19:801–806.
233. Kluge R, Berr F, Schmidt F, et al. Value of 18F-FDG PET in detection and staging of perihilar cholangiocarcinoma [abstract]. *J Nucl Med*. 2000;41:36P.
234. Klutmann S, Bohuslavizki KH, Buchert R, et al. Impact of 18F-FDG-PET in patients with cancer of unknown primary [abstract]. *J Nucl Med*. 1999;40:259P.
235. Knight SB, Delbeke D, Stewart JR, Sandler MP. Evaluation of pulmonary lesions with FDG-PET. Comparison of findings in patients with and without a history of prior malignancy. *Chest*. 1996;109:982–988.
236. Knuuti M, Saraste M, Nuutila P. Myocardial viability: fluorine-18-deoxyglucose positron emission tomography in prediction of wall motion recovery after revascularization. *Am Heart J*. 1994;127:785–796.
237. Kole A, Plukker J, Nieweg O, Vaalburg W. Positron emission tomography for staging of gastroesophageal malignancy. *Br J Cancer*. 1998;78:521–527.
238. Kole AC, Nieweg OE, Pruim J, et al. Detection of unknown occult primary tumors using positron emission tomography. *Cancer*. 1998;82:1160–1166.
239. Kole AC, Nieweg OE, Pruim J, et al. Whole-body PET with FDG: detection of unknown primary tumors [abstract]. *J Nucl Med*. 1995;36:57P.
240. Kole AC, Nieweg OE, van Ginkel RJ, et al. Detection of local recurrence of soft-tissue sarcoma with positron emission tomography using [18F]fluorodeoxyglucose. *Ann Surg Oncol*. 1997;4:57–63.
241. Kostakoglu L, Leonard JP, Coleman M, Kuji I, Vallabhajosula S, Goldsmith SJ. Evaluation of FDG-PET in the detection of bone marrow involvement in lymphoma [abstract]. *J Nucl Med*. 2000;41:71P.
242. Kostakoglu L, Leonard JP, Coleman M, Kuji I, Vallabhajosula S, Goldsmith SJ. Comparison of FDG-PET and 67Ga SPECT in the staging of lymphoma [abstract]. *J Nucl Med*. 2000;41:118P.
243. Kosuda S, Grossman HB, Kison PV, Wahl RL. Preliminary FDG-PET study in patients with bladder cancer [abstract]. *J Nucl Med*. 1996;37:260P.
244. Kraemer DLA, Griebel ML, Lee N, Friedman AH, Radtke RA. Surgical outcome in patients with epilepsy with occult vascular malformations treated with lesionectomy. *Epilepsia*. 1998;39:600–607.
245. Kubik-Huch RA, Dörffler W, von Schulthess GK, et al. Value of (18F)-FDG positron emission tomography, computed tomography, and magnetic resonance imaging in diagnosing primary and recurrent ovarian carcinoma. *Eur Radiol*. 2000;10:761–767.
246. Kuehnel G, Rades D, Wildfang I, et al. Whole-body positron emission tomography (PET) with 18F-FDG in patients with cancer of unknown primary [abstract]. *J Nucl Med*. 2000;41:300P.
247. Kunkel M, Kuffner HD, Reichert TE, Benz P, Förster GJ, Wagner W. (18F)-2-fluorodeoxyglucose PET. Prospects for secondary prevention of mouth cavity carcinoma [in German]. *Mund Kiefer Gesichtschirurg*. 2000;4:105–110.
248. Kurtaran A, Becherer A, Poetzi C, et al. Limited value of (18F)FDG-PET in localizing of recurrent/metastatic medullary thyroid carcinoma (MTC) [abstract]. *J Nucl Med*. 2000;41:308P.
249. Kutlu CA, Pastorino U, Maisey M, Goldstraw P. Selective use of PET scan in the preoperative staging of NSCLC. *Lung Cancer*. 1998;21:177–184.
250. Lai DT, Fulham M, Stephen MS, et al. The role of whole-body positron emission tomography with [18F] fluorodeoxyglucose in identifying operable colorectal cancer metastases to the liver. *Arch Surg*. 1996;131:703–707.
251. Lang O, Bihl H. Carcinoma of unknown primary (CUP): value of whole-body F-18-FDG-PET for detection of the primary tumor [abstract]. *J Nucl Med*. 1999;40:259P.
252. Lang O, Brouwers AH, Mergenthaler HG, Doerr U, Bihl H. Value of whole-body 18F-FDG-PET in metastatic renal cell carcinoma: correlation with tumor aggressiveness [abstract]? *J Nucl Med*. 2000;41:117P.
253. Lang O, Doerr U, Merkle P, Bihl H. Whole-body 18F-FDG-PET in patients with

suspected recurrence of colorectal cancer: a comparison with CT and MRI [abstract]. *J Nucl Med*. 2000;41:35P.
254. Lang O, Doerr U, Schneider K, Hagen R, Bihl H. Cervical lymph node staging in patients with head and neck cancer: a comparison between 18F-FDG-PET and ultrasound [abstract]. *J Nucl Med*. 2000;41:32P.
255. Laningham FH, Smith GT, Hanna WT, Hubner KF. The impact of whole body FDG PET on the management of patients with malignant melanoma [abstract]. *Clin Positron Imaging*. 1998;1:262.
256. Lapela M, Eigtved A, Jyrkkiö S, et al. Experience in qualitative and quantitative FDG PET in follow-up of patients with suspected recurrence from head and neck cancer. *Eur J Cancer*. 2000;36:858–867.
257. Lapela M, Grénman R, Kurki T, et al. Head and neck cancer: detection of recurrence with PET and 2-[F-18]fluoro-2-deoxy-D-glucose. *Radiology*. 1995; 197:205–211.
258. Lassen U, Daugaard G, Eigtved A, Damgaard K, Friberg L. 18F-FDG whole body positron emission tomography (PET) in patients with unknown primary tumours (UPT). *Eur J Cancer*. 1999;35:1076–1082.
259. Leiderman DB, Balish M, Sato S, et al. Comparison of PET measurements of cerebral blood flow and glucose metabolism for the localization of human epileptic foci. *Epilepsy Res*. 1992;13:153–157.
260. Lenzo NP, Shulkin B, Castle VP, Hutchinson RJ. FDG PET in childhood soft tissue sarcoma [abstract]. *J Nucl Med*. 2000;41:96P.
261. Lewis P, Griffin S, Marsden P, et al. Whole-body 18F-fluorodeoxyglucose positron emission tomography in preoperative evaluation of lung cancer. *Lancet*. 1994;344:1265–1266.
262. Li PY, Mozley PD, Zhuang HM, et al. Effectiveness of FDG PET in the detection of recurrent squamous cell carcinoma of the head and neck [abstract]. *J Nucl Med*. 2000;41:32P.
263. Lin PC, Chu J, Pocock N. 18F fluorodeoxyglucose imaging with coincidence dual-head gamma camera (hybrid FDG-PET) for staging of lymphoma: comparison with 67Ga scintigraphy [abstract]. *J Nucl Med*. 2000;41:118P.
264. Lin PC, Chu J, Pocock N, Quach T, Sorensen B. F-18 FDG imaging with coincidence dual-head gamma camera (co-PET) in staging of lymphoma: comparison with CT and gallium scans [abstract]. *J Nucl Med*. 1999;40:62P.
265. Lindholm P, Leskinen-Kallio S, Minn H, et al. Comparison of fluorine-18-fluorodeoxyglucose and carbon-11-methionine in head and neck cancer. *J Nucl Med*. 1993;34:1711–1716.
266. Liu RS, Chu LS, Lee CH, et al. Limited usefulness of (11C)acetate whole body PET in patients with thyroid cancer [abstract]. *J Nucl Med*. 2000;41: 310P.
267. Lodge MA, Lucas JD, Marsden PK, Cronin BF, O'Doherty MJ. A six-hour study of soft tissue masses using FDG PET [abstract]. *J Nucl Med*. 1998;39: 255P.
268. Lodge MA, Lucas JD, Marsden PK, Cronin BF, O'Doherty MJ, Smith MA. A PET study of 18FDG uptake in soft tissue masses. *Eur J Nucl Med*. 1999;26: 22–30.
269. Lonneux M, Borbath I, Bausart R, Pauwels S. The role of PET-18FDG in detecting distant recurrence of breast cancer [abstract]. *J Nucl Med*. 1999;40: 250P.
270. Lonneux M, Delval D, Bausart R, et al. Can dual-headed 18F-FDG SPET imaging reliably supersede PET in clinical oncology? A comparative study in lung and gastrointestinal tract cancer. *Nucl Med Commun*. 1998;19:1047–1054.
271. Lowe V, Boyd J, Dunphy F, et al. Surveillance for recurrent head and neck cancer using positron emission tomography. *J Clin Oncol*. 2000;18:651–658.
272. Lowe V, Dunphy F, Varvares M, et al. Evaluation of chemotherapeutic response in patients with advanced head and neck cancer using [F-18] fluorodeoxyglucose positron emission tomography. *Head Neck*. 1997;19:666–674.
273. Lowe VJ, Fletcher JW, Gobar L, et al. Prospective investigation of positron emission tomography in lung nodules. *J Clin Oncol*. 1998;16:1075–1084.
274. Lowe VJ, Kim H, Boyd JH, Eisenbeis JF, Dunphy FR, Fletcher JW. Primary and recurrent early stage laryngeal cancer: preliminary results of 2-[fluorine 18]fluoro-2-deoxy-D-glucose PET imaging. *Radiology*. 1999;212:799–802.
275. Lowe VJ, Naunheim KS, Dunphy FR, Kim HJ, Fletcher JW. Evaluation of diagnostic testing discrepancies in the management of lung cancer: a review incorporating (F-18)FDG-PET imaging [abstract]. *J Nucl Med*. 1998;39:248P.
276. Lucas JD, O'Doherty MJ, Cronin BF, et al. Prospective evaluation of soft tissue masses and sarcomas using fluorodeoxyglucose positron emission tomography. *Br J Surg*. 1999;86:550–556.
277. Lucas JD, O'Doherty MJ, Wong JC, et al. Evaluation of fluorodeoxyglucose positron emission tomography in the management of soft-tissue sarcomas. *J Bone Joint Surg. [British volume]*. 1998;80:441–447.
278. Lucignani G, Paolini G, Landoni C. Presurgical identification of hibernating myocardium by combined use of technetium-99m hexakis 2-methoxybutylisonitrile single photon emission tomography and fluorine-18 fluoro-2-deoxy-D-glucose positron emission tomography in patients with coronary artery disease. *Eur J Nucl Med*. 1992;19:874–881.
279. Lucignani G, Tassi L, Fazio F, et al. Double-blind stereo-EEG and FDG PET study in severe partial epilepsies: are the electric and metabolic findings related? *Eur J Nucl Med*. 1996;23:1498–1507.
280. Luketich JD, Friedman DM, Weigel TL, et al. Evaluation of distant metastases in esophageal cancer: 100 consecutive positron emission tomography scans. *Ann Thorac Surg*. 1999;68:1133–1137.
281. Luketich JD, Schauer PR, Meltzer CC, et al. Role of positron emission tomography in staging esophageal cancer. *Ann Thorac Surg*. 1997;64:765–769.
282. Macfarlane DJ, Sondak V, Johnson T, Wahl RL. Prospective evaluation of 2-[18F]-2-deoxy-D-glucose positron emission tomography in staging of regional lymph nodes in patients with cutaneous malignant melanoma. *J Clin Oncol*. 1998;16:1770–1776.
283. Maes A, Borgers M, Flameng W. Assessment of myocardial viability in chronic coronary artery disease using technetium-99m sestamibi SPECT: correlation with histologic and positron emission tomographic studies and functional follow up. *J Am Coll Cardiol*. 1997;29:62–68.
284. Magnani P, Carretta A, Rizzo G, et al. FDG/PET and spiral CT image fusion for mediastinal lymph node assessment of non-small cell lung cancer patients. *J Cardiovasc Surg*. 1999;40:741–748.
285. Maisey M, Wahl R, Barrington S. *Atlas of Clinical Positron Emission Tomography*. London, UK: Arnold, Hodder Headline Group; 1999.
286. Maisey NR, Hill ME, Webb A, et al. Are 18-fluorodeoxyglucose positron emission tomography and magnetic resonance imaging useful in the prediction of relapse in lymphoma residual masses? *Eur J Cancer*. 2000;36:200–206.
287. Maldonado A, Sancho F, Calvo F, et al. The role of FDG-PET in diagnosing suspected tumor recurrence based on increased levels of plasma markers [abstract]. *Clin Positron Imaging*. 1998;1:246.
288. Manolidis S, Donald PJ, Volk P, Pounds TR. The use of positron emission tomography scanning in occult and recurrent head and neck cancer. *Acta Otolaryngol*. 1998;534(suppl):1–11.
289. Markand ON, Salanova V, Worth R, Park HM, Wellman HN. Comparative study of interictal PET and ictal SPECT in complex partial seizures. *Acta Neurol Scand*. 1997;95:129–136.
290. Marom EM, McAdams HP, Erasmus JJ, et al. Staging non-small cell lung cancer with whole-body PET. *Radiology*. 1999;212:803–809.
291. Martin L, Fazel A, Burton F, Fletcher JW. Performance of dedicated, non-attenuation corrected FDG-PET in diagnosis and staging of pancreatic cancer (PCa) [abstract]. *J Nucl Med*. 2000;41:35P–36P.
292. Martinez-Lazaro R, Cortes-Blanco A, Zhuang HM, Alavi AA. Diagnostic performance of whole-body FDG-PET and CT imaging in malignant lymphomas [abstract]. *J Nucl Med*. 2000;41:277P.
293. Matthies A, Smith RJ, Cuchiara AJ, Alavi AA. Dual time point 18FDG-PET imaging for the differentiation between benign and malignant pulmonary nodules [abstract]. *J Nucl Med*. 2000;41:293P.
294. Melchior SW, Fichtner J, Jones J, et al. Changes in fluorodeoxyglucose (FDG) uptake measured by positron emission tomography (PET) in prostate cancer (CaP) patients following androgen withdrawal [abstract]. *J Urol*. 1999;161:297.
295. Meltzer CC, Luketich JD, Friedman D, et al. Whole-body FDG positron emission tomographic imaging for staging esophageal cancer. Comparison with computed tomography. *Clin Nucl Med*. 2000;25:882–887.
296. Menda Y, Bushnell DL, Madsen MT, Kernstine KH, McLaughlin K, Hichwa RD. Retrospective analysis of standardized uptake values of lung masses with 18F FDG PET [abstract]. *J Nucl Med*. 2000;41:295P.
297. Meta J, Valk P, Ariannejad M, et al. Impact of FDG-PET on management of patients with colorectal cancer [abstract]. *J Nucl Med*. 2000;41:299P.
298. Mielke R, Heiss WD. Positron emission tomography for diagnosis of Alzheimer's disease and vascular dementia. *J Neural Transm*. 1998;53:237–250.
299. Mielke R, Pietrzyk U, Jacobs A, et al. HMPAO SPET and FDG PET in Alzheimer's disease and vascular dementia: comparison of perfusion and metabolic pattern [see comments]. *Eur J Nucl Med*. 1994;21:1052–1060.
300. Mielke R, Schroeder R, Fink GR, Kessler J, Herholz K, Heiss WD. Regional cerebral glucose metabolism and postmortem pathology in Alzheimer's disease. *Acta Neuropathol*. 1996;91:174–179.
301. Mikhaeel NG, Timothy AR, Hain SF, O'Doherty MJ. 18-FDG-PET for the assessment of residual masses on CT following treatment of lymphomas. *Ann Oncol*. 2000;11(suppl 1):147–150.
302. Montravers F, Grahek D, Kerrou K, de Beco V, Younsi N, Talbot JN. Comparison of FDG scan on a dual-head coincidence gamma camera (CDET) and conventional imaging for the diagnosis of recurrence of colorectal cancer [abstract]. *J Nucl Med*. 2000;41:300P.
303. Moog F, Bangerter M, Diederichs CG, et al. Lymphoma: role of whole-body

2-deoxy-2-[F-18]fluoro-D-glucose (FDG) PET in nodal staging. *Radiology*. 1997;203:795–800.
304. Moog F, Bangerter M, Diederichs CG, et al. Extranodal malignant lymphoma: detection with FDG PET versus CT. *Radiology*. 1998;206:475–481.
305. Moog F, Kotzerke J, Reske SN. FDG PET can replace bone scintigraphy in primary staging of malignant lymphoma. *J Nucl Med*. 1999;40:1407–1413.
306. Moon D, Maddahi J, Silverman D, Glaspy J, Phelps M, Hoh C. Accuracy of whole body fluorine-18-FDG PET for the detection of recurrent or metastatic breast carcinoma. *J Nucl Med*. 1998;39:431–435.
307. Mruck S, Baum RP, Rinne D, Hoer G. Diagnostic accuracy and predictive value of the tumor-associated antigen S100 in malignant melanomas: validation by whole body FDG-PET and conventional diagnostics. *Anticancer Res*. 1999;19: 2685–2690.
308. Mueller SP, Goerges R, Brandt-Mainz K, Bockisch A. The role of FDG-PET and 201Tl imaging as a preoperative diagnostic tool in recurrent Hürthle cell carcinoma of the thyroid [abstract]. *J Nucl Med*. 2000;41:306P.
309. Mukahira K, Oguni H, Awaya Y, et al. Study on surgical treatment of intractable childhood epilepsy. *Brain Dev*. 1998;20:154–164.
310. Musholt TJ, Musholt PB, Dehdashti F, Moley JF. Evaluation of fluorodeoxyglucose-positron emission tomographic scanning and its association with glucose transporter expression in medullary thyroid carcinoma and pheochromocytoma: a clinical and molecular study. *Surgery (St. Louis)*. 1997;122:1049–1061.
311. Myers LL, Wax MK. Positron emission tomography in the evaluation of the negative neck in patients with oral cavity cancer. *J Otolaryngol*. 1998;27:342–347.
312. Nakamoto Y, Higashi T, Sakahara H, et al. Contribution of PET in the detection of liver metastases from pancreatic tumours. *Clin Radiol*. 1999;54:248–252.
313. Nakamoto Y, Saga T, Ishimori T, et al. Clinical contribution of FDG-PET for follow-up patients with gynecological malignancies [abstract]. *J Nucl Med*. 2000;41:301P.
314. Nettelbladt OS, Sundin AE, Valind SO, et al. Combined fluorine-18-FDG and carbon-11-methionine PET for diagnosis of tumors in lung and mediastinum. *J Nucl Med*. 1998;39:640–647.
315. Newman JS, Francis IR, Kaminski MS, Wahl RL. Imaging of lymphoma with PET with 2-[F-18]-fluoro-2-deoxy-D-glucose: correlation with CT. *Radiology*. 1994;190:111–116.
316. Nguyen A, Akhurst T, Larson S, Coit D, Brady M. PET Scanning with 18F2-fluoro-2-deoxy-D-glucose(FDG) in patients with melanoma: benefits and limitations. *Clin Positron Imaging*. 1999;2:93–98.
317. Nieweg O, Kim E, Wong W, et al. Positron emission tomography with fluorine-18-deoxyglucose in the detection and staging of breast cancer. *Cancer*. 1993; 71:3920–3925.
318. Nieweg OE, Pruim J, van Ginkel RJ, et al. Fluorine-18-fluorodeoxyglucose PET imaging of soft-tissue sarcoma. *J Nucl Med*. 1996;37:257–261.
319. Nitzsche EU, Hoh CK, Dalbohm NM, et al. Whole body positron emission tomography in breast cancer [in German]. *Rofo Fortschr Geb Rontgenstr*. 1993;158:293–298.
320. Nitzsche EU, Simon GH, Krautmann F, et al. Is FDG PET indicated when cancer disease of the pancreas is diagnosed based on CT [abstract]? *J Nucl Med*. 1997;38:144P.
321. Noh D, Yun I, Kim J, et al. Diagnostic value of positron emission tomography for detecting breast cancer. *World J Surg.* 1998;22:223–228.
322. Noh DY, Yun IJ, Kang HS, et al. Detection of cancer in augmented breasts by positron emission tomography. *Euro J Surg.* 1999;165:847–851.
323. Nowak B, Di Martino E, Jänicke S, et al. Diagnostic evaluation of malignant head and neck cancer by F-18-FDG PET compared to CT/MRI. *Nuklearmedizin*. 1999;38:312–318.
324. Nunez RF, Yeung HW, Macapinlac HA, Larson SM. Does post radiation therapy change in the lung affect the accuracy of FDG-PET in the evaluation of tumor recurrence in lung cancer [abstract]? *J Nucl Med*. 1999;40:234P.
325. Nuutinen J, Leskinen S, Elomaa I, et al. FDG-PET imaging of residual testicular cancer after chemotherapy [abstract]. *J Nucl Med*. 1996;37:256P.
326. Ogunbiyi OA, Flanagan FL, Dehdashti F, et al. Detection of recurrent and metastatic colorectal cancer: comparison of positron emission tomography and computed tomography. *Ann Surg Oncol*. 1997;4:613–620.
327. Orino K, Kawamura M, Hatazawa J, Suzuki I, Sazawa Y. Efficacy of F-18 fluorodeoxyglucose positron emission tomography (FDG-PET) scans in diagnosis of pulmonary nodules [in Japanese]. *Jpn J Thorac Cardiovasc Surg*. 1998;46:1267–1274.
328. Oriuchi N, Ichikawa A, Koyama K, et al. Clinical significance of L-(3-18F)-alpha-methyl tyrosine PET studies in intracranial and intrathoracic tumor: a comparative study with 18F-FDG PET [abstract]. *J Nucl Med*. 2000;41:291P–292P.
329. Oyama N, Akino H, Suzuki Y, et al. The increased accumulation of [18F]fluorodeoxyglucose in untreated prostate cancer. *Jpn J Clin Oncol*. 1999;29:623–629.
330. Oyama N, Akino H, Suzuki Y, et al. FDG-PET for evaluating the effectiveness of endocrine therapy for prostate cancer [abstract]. *J Nucl Med*. 1999;40:256P–257P.
331. Oyen WJ, Neeleman N, Ruers TJ, Jager GJ, Wobbes T, Corstens FH. FDG-PET in metastasized colorectal carcinoma [abstract]. *J Nucl Med.* 2000;41:35P.
332. Pai M, Park CH, Suh JH, Koh JH. Fluorine-18 fluorodeoxyglucose imaging using dual-head coincidence positron emission tomography without attenuation correction in patients with head and neck cancer. *Clin Nucl Med*. 1999;24:495–500.
333. Palmedo H, Bender H, Grünwald F, Mallmann P, Krebs D, Biersack H. Comparison of fluorine-18 fluorodeoxyglucose positron emission tomography and technetium-99m methoxyisobutylisonitrile scintimammography in the detection of breast tumors. *Eur J Nucl Med*. 1997;24:1138–1145.
334. Paquet P, Henry F, Belhocine T, et al. An appraisal of 18-fluorodeoxyglucose positron emission tomography for melanoma staging. *Dermatology*. 2000;200: 167–169.
335. Patz EF Jr, Lowe VJ, Goodman PC, Herndon J. Thoracic nodal staging with PET imaging with 18FDG in patients with bronchogenic carcinoma. *Chest*. 1995;108:1617–1621.
336. Patz EF Jr, Lowe VJ, Hoffman JM, et al. Focal pulmonary abnormalities: evaluation with F-18 fluorodeoxyglucose PET scanning. *Radiology*. 1993;188: 487–490.
337. Patz EF, Lowe VJ, Hoffman JM, Paine SS, Harris LK, Goodman PC. Persistent or recurrent bronchogenic carcinoma: detection with PET and 2-(F-18)-12-deoxy-D-glucose. *Radiology*. 1994;191:379–382.
338. Paulus P, Sambon A, Vivegnis D, et al. 18FDG PET for the assessment of primary head and neck tumors: clinical, computed tomography, and histopathological correlation in 38 patients. *Laryngoscope*. 1998;108:1578–1583.
339. Pawlik G, Holthoff VA, Kessler J, et al. Positron emission tomography findings relevant to neurosurgery for epilepsy. *Acta Neurochirurg.* 1990;50 (suppl):84–87.
340. Peterson LM, Graham MM, Hayward RM, Yeung RS, Hansen PD. FDG PET identify residual or recurrent disease following local ablation of liver metastases [abstract]. *J Nucl Med*. 2000;41:287P.
341. Präuer HW, Weber WA, Römer W, Treumann T, Ziegler SI, Schwaiger M. Controlled prospective study of positron emission tomography using the glucose analogue [18F]fluorodeoxyglucose in the evaluation of pulmonary nodules. *Br J Surg*. 1998;85:1506–1511.
342. Que TH, Plukker JT, Vaalburg W. Staging of gastroesophageal cancer with PET using 11C choline and 18F FDG [abstract]. *J Nucl Med*. 2000;41:141P.
343. Raja S, Fernandez-Vicioso E, Suh JH, et al. Brain tumor recurrence versus radiation necrosis: role of Tc-99m MIBI compared to FDG PET [abstract]. *J Nucl Med*. 1997;38:153P.
344. Rakotonirina H, Delahaye N, Crestani B, et al. Preoperative staging of patients (PTS) with non-small cell lung cancer (NSCLC) using 18FDG imaging: comparison of dual-head coincidence (DHC) gamma-camera versus dedicated PET [abstract]. *J Nucl Med*. 2000;41:292P.
345. Rankin SC, Taylor H, Cook GJ, Mason R. Computed tomography and positron emission tomography in the pre-operative staging of oesophageal carcinoma. *Clin Radiol*. 1998;53:659–665.
346. Rege S, Maass A, Chaiken L, et al. Use of positron emission tomography with fluorodeoxyglucose in patients with extracranial head and neck cancers. *Cancer*. 1994;73:3047–3058.
347. Rege SD, Hoh CK, Glaspy JA, et al. Imaging of pulmonary mass lesions with whole-body positron emission tomography and fluorodeoxyglucose. *Cancer*. 1993;72:82–90.
348. Richter J, Garcia-Velloso M, Perez-Equiza C, et al. PET-FDG versus CT in the staging and detection of relapse in patients with Hodgkin's disease or non-Hodgkin lymphoma: two years experience [abstract]. *Clin Positron Imaging*. 1998;1:248.
349. Rinne D, Baum RP, Hör G, Kaufmann R. Primary staging and follow-up of high risk melanoma patients with whole-body 18F-fluorodeoxyglucose positron emission tomography: results of a prospective study of 100 patients. *Cancer*. 1998;82:1664–1671.
350. Rintahaka PJ, Chugani HT. Clinical role of positron emission tomography in children with tuberous sclerosis complex. *J Child Neurol*. 1997;12:42–52.
351. Römer W, Avril N, Dose J, et al. Metabolic characterization of ovarian tumors with positron emission tomography and F-18 fluorodeoxyglucose. *Rofo Fortschr Geb Rontgenstr*. 1997;166:62–68.
352. Rose PG, Adler LP, Rodriguez M, Faulhaber PF, Abdul-Karim FW, Miraldi F. Positron emission tomography for evaluating para-aortic nodal metastasis in locally advanced cervical cancer before surgical staging: a surgicopathologic study. *J Clin Oncol*. 1999;17:41–45.

353. Rostom AY, Powe J, Kandil A, et al. Positron emission tomography in breast cancer: a clinicopathological correlation of results. *Br J Radiol*. 1999;72:1064–1068.
354. Rozental JM, Cohen JD, Mehta MP, Levine RL, Hanson JM, Nickles RJ. Acute changes in glucose uptake after treatment: the effects of carmustine (BCNU) on human glioblastoma multiforme. *J Neuro-Oncol*. 1993;15:57–66.
355. Ruhlmann J, Schomburg A, Bender H, et al. Fluorodeoxyglucose whole-body positron emission tomography in colorectal cancer patients studied in routine daily practice. *Dis Colon Rectum*. 1997;40:1195–1204.
356. Ryu JS, Choi NC, Fischman AJ. FDG-PET in evaluating therapeutic effect and restaging of non-small cell lung cancer after neoadjuvant chemoradiotherapy: correlation with histopathology [abstract]. *J Nucl Med*. 1999;40:246P.
357. Safa AA, Tran LM, Rege S, et al. The role of positron emission tomography in occult primary head and neck cancers [see comments]. *Cancer J Sci Am*. 1999;5:214–218.
358. Salanova V, Markand O, Worth R, et al. Presurgical evaluation and surgical outcome of temporal lobe epilepsy. *Pediatr Neurol*. 1999;20:179–184.
359. Salanova V, Markand O, Worth R, et al. FDG-PET and MRI in temporal lobe epilepsy: relationship to febrile seizures, hippocampal sclerosis and outcome. *Acta Neurol Scand*. 1998;97:146–153.
360. Salmon E, Sadzot B, Maquet P, et al. Differential diagnosis of Alzheimer's disease with PET. *J Nucl Med*. 1994;35:391–398.
361. Sanz G, Robles JE, Giménez M, et al. Positron emission tomography with 18-fluorine-labelled deoxyglucose: utility in localized and advanced prostate cancer. *Br J Urol Int*. 1999;84:1028–1031.
362. Sasaki M, Ichiya Y, Kuwabara Y, et al. The usefulness of FDG positron emission tomography for the detection of mediastinal lymph node metastases in patients with non-small cell lung cancer: a comparative study with X-ray computed tomography. *Eur J Nucl Med*. 1996;23:741–747.
363. Saunders CAB, Dussek JE, O'Doherty MJ, Maisey MN. Evaluation of fluorine-18-fluorodeoxyglucose whole body positron emission tomography imaging in the staging of lung cancer. *Ann Thorac Surg*. 1999;67:790–797.
364. Savic I, Ingvar M, Stone-Elander S. Comparison of [11C]flumazenil and [18F]FDG as PET markers of epileptic foci. *J Neurol Neurosurg Psychiatry*. 1993;56:615–621.
365. Sazon DA, Santiago SM, Soo Hoo GW, et al. Fluorodeoxyglucose-positron emission tomography in the detection and staging of lung cancer. *Am J Respir Crit Care Med*. 1996;153:417–421.
366. Scheidhauer K, Scharl A, Pietrzyk U, et al. Qualitative [18F] FDG positron emission tomography in primary breast cancer: clinical relevance and practicability. *Eur J Nucl Med*. 1996;23:618–623.
367. Schelling M, Avril N, Nährig J, et al. Positron emission tomography using [18F]fluorodeoxyglucose for monitoring primary chemotherapy in breast cancer. *J Clin Oncol*. 2000;18:1689–1695.
368. Schiepers C, Meta J, Yap CS, et al. Characterization of solitary pulmonary nodules and lung cancer with FDG-PET [abstract]. *J Nucl Med*. 2000;41:296P.
369. Schiepers C, Penninckx F, De Vadder N, et al. Contribution of PET in the diagnosis of recurrent colorectal cancer: comparison with conventional imaging. *Eur J Surg Oncol*. 1995;21:517–522.
370. Schiepers C, Yap CS, Meta J, et al. Staging of recurrent lung cancer: value of FDG-PET in therapy selection and management of patients [abstract]. *J Nucl Med*. 2000;41:75P.
371. Schiepers C, Yap CS, Silverman DH, et al. Staging of newly diagnosed lung cancer: impact of FDG-PET on patient management [abstract]. *J Nucl Med*. 2000;41:109P.
372. Schirrmeister H, Guhlmann A, Kotzerke J, et al. Early detection and accurate description of extent of metastatic bone disease in breast cancer with fluoride ion and positron emission tomography. *J Clin Oncol*. 1999;17:2381–2389.
373. Schirrmeister H, Guhlmann CA, Diederichs CD, Trager H, Reske SN. Planar bone imaging vs 18F-PET in patients with cancer of the prostate, thyroid and lung [abstract]. *J Nucl Med*. 1998;39:113P–114P.
374. Schirrmeister HH, Kuehn T, Buck AK, Reske SN. FDG-PET in preoperative staging of breast cancer [abstract]. *J Nucl Med*. 2000;41:28P.
375. Schirrmeister HH, Staib L, Buck AK, Guhlmann CA, Reske SS. FDG-PET in patients with suspected recurrence of colorectal cancer. Is there a contribution to surgical decision finding [abstract]? *J Nucl Med*. 2000;41:297P.
376. Schlüter B, Grimm-Riepe C, Beyer W, Lübeck M, Schirren-Bumann K, Clausen M. Histological verification of positive fluorine-18 fluorodeoxyglucose findings in patients with differentiated thyroid cancer. *Langenbecks Arch Surg*. 1998;383:187–189.
377. Schöder H, Campisi R, Ohtake T, et al. Blood flow-metabolism imaging with positron emission tomography in patients with diabetes mellitus for the assessment of reversible left ventricular contractile dysfunction. *J Am Coll Cardiol*. 1999;33:1328–1337.
378. Schoenberger JA, Bergner U, Maag K, Eilles C. Comparison of hybrid PET system and dedicated PET-scanner in patients with colon cancer and indeterminate liver lesion [abstract]. *J Nucl Med*. 2000;41:291P.
379. Schulte M, Brecht-Krauss D, Heymer B, et al. Fluorodeoxyglucose positron emission tomography of soft tissue tumours: is a non-invasive determination of biological activity possible? *Eur J Nucl Med*. 1999;26:599–605.
380. Schwarzbach M, Willeke F, Dimitrakopoulou-Strauss A, et al. Functional imaging and detection of local recurrence in soft tissue sarcomas by positron emission tomography. *Anticancer Res*. 1999;19:1343–1350.
381. Schwarzbach MH, Dimitrakopoulou-Strauss A, Willeke F, et al. Clinical value of [18-F] fluorodeoxyglucose positron emission tomography imaging in soft tissue sarcomas. *Ann Surg*. 2000;231:380–386.
382. Scott WJ, Gobar LS, Terry JD, Dewan NA, Sunderland JJ. Mediastinal lymph node staging of non-small-cell lung cancer: a prospective comparison of computed tomography and positron emission tomography. *J Thorac Cardiovasc Surg*. 1996;111:642–648.
383. Scott WJ, Schwabe JL, Gupta NC, Dewan NA, Reeb SD, Sugimoto JT. Positron emission tomography of lung tumors and mediastinal lymph nodes using [18F]fluorodeoxyglucose. The members of the PET-Lung Tumor Study Group. *Ann Thorac Surg*. 1994;58:698–703.
384. Seltzer MA, Barbaric Z, Belldegrun A, et al. Comparison of helical computerized tomography, positron emission tomography and monoclonal antibody scans for evaluation of lymph node metastases in patients with prostate specific antigen relapse after treatment for localized prostate cancer. *J Urol*. 1999;162:1322–1328.
385. Seltzer MA, Strum SB, Scholz MC, et al. Comparison of whole-body 11C acetate and FDG PET in patients with prostate cancer [abstract]. *J Nucl Med*. 2000;41:142P.
386. Seltzer MA, Valk PE, Wong CS, et al. Prospective survey of referring physicians to determine the impact of whole-body FDG-PET on management of cancer patients [abstract]. *J Nucl Med*. 2000;41:108P.
387. Shah N, Hoskin P, McMillan A, Gibson P, Lowe J, Wong WL. The impact of FDG positron emission tomography imaging on the management of lymphomas. *Br J Radiol*. 2000;73:482–487.
388. Shankar LK, Yamamoto AJ, Alavi AA, Mandel S. The clinical utility of 18FDG PET in the management of iodine-negative thyroid cancer [abstract]. *J Nucl Med*. 2000;41:310P.
389. Shields AF, Ahmed S, Zalupski MM, et al. FDG-PET evaluation of pancreatic cancer treatment [abstract]. *J Nucl Med*. 1999;40:243P.
390. Shih YH, Yiu CH, Su MS, et al. Temporal lobectomy in adults with intractable epilepsy. *J Formosan Med Assoc*. 1994;93:307–313.
391. Shreve P, Grossmann H, Gross M, Wahl R. Metastatic prostate cancer: initial findings of PET with 2-deoxy-2-[F-18] fluoro-D-glucose. *Radiology*. 1996;199:751–756.
392. Shreve PD, Steventon RS, Deters EC, Kison PV, Gross MD, Wahl RL. Oncologic diagnosis with 2-[fluorine-18]fluoro-2-deoxy-D-glucose imaging: dual-head coincidence gamma camera versus positron emission tomographic scanner. *Radiology*. 1998;207:431–437.
393. Shulkin BL, Mitchell DS, Ungar DR, et al. Neoplasms in a pediatric population: 2-(F-18)-fluoro-2-deoxy-D-glucose PET studies. *Radiology*. 1995;194:495–500.
394. Shulkin BL, Thompson NW, Shapiro B, Francis IR, Sisson JC. Pheochromocytomas: imaging with 2-(fluorine-18)fluoro-2-deoxy-D-glucose PET. *Radiology*. 1999;212:35–41.
395. Silverman DH, Chang CY, Cummings JL, et al. Prognostic value of regional brain metabolism in evaluation of dementia: comparison with long-term clinical outcome [abstract]. *J Nucl Med*. 1999;40:71P.
396. Silverman DH, Lu CS, Czernin J, Small GW, Phelps ME. Prognostic value of brain PET in patients with early dementia symptoms, treated or untreated with anticholinesterase therapy [abstract]. *J Nucl Med*. 2000;41:64P.
397. Silverman DH, Small GW, Kung de Aburto MA, et al. Diagnostic accuracy of FDG-PET in evaluation of dementia: international multi-center pooled brain scan and autopsy data [abstract]. *J Nucl Med*. 2000;41:63P.
398. Slosman DO, Spiliopoulos A, Couson F, et al. Satellite PET and lung cancer: a prospective study in surgical patients. *Nucl Med Commun*. 1993;14:955–961.
399. Smith G, Hubner K, McDonald T, Thie J. Avoiding second-look surgery and reducing costs in managing patients with ovarian cancer by applying F-18-FDG PET [abstract]. *Clin Positron Imaging*. 1998;1:263.
400. Smith I, Ogston K, Whitford P, et al. Staging of the axilla in breast cancer: accurate in vivo assessment using positron emission tomography with 2-(fluorine-18)-fluoro-2-deoxy-D-glucose. *Ann Surg*. 1998;228:220–227.
401. Smith IC, Welch A, Chilcott F, et al. 18F-FDG PET may predict the pathological response of breast cancer to primary chemotherapy [abstract]. *J Nucl Med*. 1999;40:137P.

402. Smith IC, Welch AE, Hutcheon AW, et al. Positron emission tomography using [(18)F]-fluorodeoxy-D-glucose to predict the pathologic response of breast cancer to primary chemotherapy. *J Clin Oncol*. 2000;18:1676–1688.
403. Snead OC III, Chen LS, Mitchell WG, et al. Usefulness of [18F]fluorodeoxyglucose positron emission tomography in pediatric epilepsy surgery. *Pediatr Neurol*. 1996;14:98–107.
404. Spaepen K, Stroobants S, Dupont P, et al. Positron emission tomography with fluorodeoxyglucose after first line chemotherapy in non-Hodgkin's lymphoma [abstract]. *J Nucl Med*. 2000;41:70P.
405. Stefan H, Pawlik G, Böcher-Schwarz HG, et al. Functional and morphological abnormalities in temporal lobe epilepsy: a comparison of interictal and ictal EEG, CT, MRI, SPECT and PET. *J Neurol*. 1987;234:377–384.
406. Steinert HC, Hauser M, Allemann F, et al. Non-small cell lung cancer: nodal staging with FDG PET versus CT with correlative lymph node mapping and sampling. *Radiology*. 1997;202:441–446.
407. Steinert HC, Huch Böni RA, Buck A, et al. Malignant melanoma: staging with whole-body positron emission tomography and 2-[F-18]-fluoro-2-deoxy-D-glucose. *Radiology*. 1995;195:705–709.
408. Steinert HC, Voellmy DR, Trachsel C, et al. Planar coincidence scintigraphy and PET in staging malignant melanoma [abstract]. *J Nucl Med*. 1998;39:1892–1897.
409. Steinert HC, Von Schulthess GK, Weder W. Effectiveness of whole-body FDG PET imaging in staging of non-small-cell lung cancer (NSCLC) [abstract]. *J Nucl Med*. 1998;39:80P.
410. Stokkel M, Stevens H, Taphoorn M, Van Rijk P. Differentiation between recurrent brain tumour and post-radiation necrosis: the value of 201Tl SPET versus 18F-FDG PET using a dual-headed coincidence camera. A pilot study. *Nucl Med Commun*. 1999;20:411–417.
411. Stokkel MP, de Klerk JH, Zelissen PM, Koppeschaar HP, van Rijk PP. Fluorine-18 fluorodeoxyglucose dual-head positron emission tomography in the detection of recurrent differentiated thyroid cancer: preliminary results. *Eur J Nucl Med*. 1999;26:1606–1609.
412. Stokkel MP, Terhaard CH, Hordijk GJ, van Rijk PP. The detection of local recurrent head and neck cancer with fluorine-18 fluorodeoxyglucose dual-head positron emission tomography. *Eur J Nucl Med*. 1999;26:767–773.
413. Stollfuss JC, Glatting G, Friess H, Kocher F, Berger HG, Reske SN. 2-(fluorine-18)-fluoro-2-deoxy-D-glucose PET in detection of pancreatic cancer: value of quantitative image interpretation [see comments]. *Radiology*. 1995;195:339–344.
414. Stumpe K, Urbinelli M, Steinert H, Glanzmann C, Buck A, von Schulthess G. Whole-body positron emission tomography using fluorodeoxyglucose for staging of lymphoma: effectiveness and comparison with computed tomography. *Eur J Nucl Med*. 1998;25:721–728.
415. Sugawara Y, Eisbruch A, Kosuda S, Recker BE, Kison PV, Wahl RL. Evaluation of FDG PET in patients with cervical cancer. *J Nucl Med*. 1999;40:1125–1131.
416. Sugawara Y, Wald JJ, McGillicuddy JE, Carlson SM, Wahl RL. FDG-PET in evaluation of brachial plexopathy in patients with previously-treated breast cancer [abstract]. *J Nucl Med*. 1999;40:137P–138P.
417. Swartz BE, Halgren E, Delgado-Escueta AV, et al. Neuroimaging in patients with seizures of probable frontal lobe origin. *Epilepsia*. 1989;30:547–558.
418. Szelies B, Grond M, Herholz K, Kessler J, Wullen T, Heiss WD. Quantitative EEG mapping and PET in Alzheimer's disease. *J Neurol Sci*. 1992;110:46–56.
419. Takeuchi O, Saito N, Koda K, Sarashina H, Nakajima N. Clinical assessment of positron emission tomography for the diagnosis of local recurrence in colorectal cancer. *Br J Surg*. 1999;86:932–937.
420. Tamaki N, Kawamoto M, Tadamura E. Prediction of reversible ischemia after revascularization: perfusion and metabolic studies with positron emission tomography. *Circulation*. 1995;91:1697–1705.
421. Tamaki N, Yoshiharu Y, Yamashita K. Positron emission tomography using fluorine-18 deoxyglucose in evaluation of coronary artery bypass grafting. *Am J Cardiol*. 1989;64:860–865.
422. Tanaka F, Yonekura Y, Ikeda A, et al. Presurgical identification of epileptic foci with iodine-123 iomazenil SPET: comparison with brain perfusion SPET and FDG PET. *Eur J Nucl Med*. 1997;24:27–34.
423. Tatsumi M, Tokita N, Nishimura T. Whole-body hybrid positron emission tomography with 18F-FDG in the staging of non-Hodgkin's lymphoma [abstract]. *J Nucl Med*. 2000;41:292P.
424. Tatsumi M, Yutani K, Watanabe Y, et al. Feasibility of fluorodeoxyglucose dual-head gamma camera coincidence imaging in the evaluation of lung cancer: comparison with FDG PET. *J Nucl Med*. 1999;40:566–573.
425. Tedeschi E, Hasselbalch SG, Waldemar G, et al. Heterogeneous cerebral glucose metabolism in normal pressure hydrocephalus. *J Neurol Neurosurg Psychiatry*. 1995;59:608–615.
426. Theodore WH, Dorwart R, Holmes M, Porter RJ, DiChiro G. Neuroimaging in refractory partial seizures: comparison of PET, CT, and MRI. *Neurology*. 1986;36:750– 759.
427. Theodore WH, Sato S, Kufta CV, Gaillard WD, Kelley K. FDG-positron emission tomography and invasive EEG: seizure focus detection and surgical outcome. *Epilepsia*. 1997;38:81–86.
428. Thompson TP, Lunsford LD, Kondziolka D. Distinguishing recurrent tumor and radiation necrosis with positron emission tomography versus stereotactic biopsy. *Stereotactic Funct Neurosurg*. 1999;73:9–14.
429. Tillisch J, Brunken R, Marshall R. Reversibility of cardiac wall motion abnormalities predicted by positron tomography. *N Engl J Med*. 1986;314:884–888.
430. Tomas MB, Manalili E, Leonidas JC, Karayalcin G, Lipton J, Palestro CJ. 18F-FDG imaging of lymphoma in children using a hybrid PET system: comparison with 67Ga [abstract]. *J Nucl Med*. 2000;41:96P.
431. Torizuka T, Nobezawa S, Nagashima S, et al. Role of whole-body FDG-PET in management of patients with recurrent ovarian cancers [abstract]. *J Nucl Med*. 2000;41:303P.
432. Torizuka T, Zasadny KR, Kison PV, Rommelfanger SG, Kaminski MS, Wahl RL. Metabolic response of non-Hodgkin's lymphoma to 131I-anti-B1 radioimmunotherapy: evaluation with FDG PET. *J Nucl Med*. 2000;41:999–1005.
433. Trieu TC, Littlefield JL, Lowe VJ, Fletcher JW. The efficacy of FDG-PET in the management of non-small cell lung cancer [abstract]. *J Nucl Med*. 1997;38:80P.
434. Trojan J, Schroeder O, Raedle J, et al. Fluorine-18 FDG positron emission tomography for imaging of hepatocellular carcinoma. *Am J Gastroenterol*. 1999;94:3314–3319.
435. Turlakow A, Yeung HW, Macapinlac HA, Nunez RF, Sanchez AF, Larson SM. Peritoneal carcinomatosis: the role of FDG-PET [abstract]. *J Nucl Med*. 2000; 41:36P.
436. Utech C, Young C, Winter P. Prospective evaluation of fluorine-18 fluorodeoxyglucose positron emission tomography in breast cancer for staging of the axilla related to surgery and immunocytochemistry. *Eur J Nucl Med*. 1996;23: 1588–1593.
437. Valk PE, Abella-Columna E, Hasemann MK, et al. Whole-body PET imaging with F-18 fluorodeoxyglucose in management of recurrent colorectal cancer. *Arch Surg*. 1999;134:503–513.
438. Valk PE, Pounds TR, Hopkins DM, et al. Staging non-small cell lung cancer by whole-body positron emission tomographic imaging. *Ann Thorac Surg*. 1995; 60:1573–1581.
439. Van Ginkel RJ, Hoekstra HJ, Pruim J, et al. FDG-PET to evaluate response to hyperthermic isolated limb perfusion for locally advanced soft-tissue sarcoma. *J Nucl Med*. 1996;37:984–990.
440. Vansteenkiste JF, Stroobants SG, De Leyn PR, et al. Mediastinal lymph node staging with FDG-PET scan in patients with potentially operable non-small cell lung cancer. A prospective analysis of 50 cases. *Chest*. 1997;112:1480–1486.
441. Vansteenkiste JF, Stroobants SG, Dupont PJ, et al. FDG-PET scan in potentially operable non-small cell lung cancer: do anatometabolic PET-CT fusion images improve the localisation of regional lymph node metastases? The Leuven Lung Cancer Group. *Eur J Nucl Med*. 1998;25:1495–1501.
442. Vaylet F, Foehrenbach H, De Dreuille O, et al. Fluorodeoxyglucose and bronchopulmonary cancer. Initial French results with positron emission tomography [in French]. *Rev Pneumol Clin*. 1998;54:187–195.
443. Vitola JV, Delbeke D, Sandler MP, et al. Positron emission tomography to stage suspected metastatic colorectal carcinoma to the liver. *Am J Surg*. 1996;171: 21–26.
444. Wagner JD, Schauwecker D, Davidson D, et al. Prospective study of fluorodeoxyglucose-positron emission tomography imaging of lymph node basins in melanoma patients undergoing sentinel node biopsy. *J Clin Oncol*. 1999;17: 1508–1515.
445. Wagner JD, Schauwecker D, Hutchins G, Coleman JJ III. Initial assessment of positron emission tomography for detection of nonpalpable regional lymphatic metastases in melanoma. *J Surg Oncol*. 1997;64:181–189.
446. Wahl RL, Quint LE, Greenough RL, Meyer CR, White RI, Orringer MB. Staging of mediastinal non-small cell lung cancer with FDG PET, CT, and fusion images: preliminary prospective evaluation. *Radiology*. 1994;191:371–377.
447. Wahl RL, Zasadny K, Helvie M, Hutchins GD, Weber B, Cody R. Metabolic monitoring of breast cancer chemohormonotherapy using positron emission tomography: initial evaluation. *J Clin Oncol*. 1993;11:2101–2111.
448. Wang H, Maurea S, Mainolfi C, et al. Tc-99m MIBI imaging in patients with lung cancer: comparison with CT and fluorine-18 FDG PET studies [abstract]. *J Nucl Med*. 1996;37:260P.
449. Wang W, Macapinlac H, Larson SM, et al. [18F]-2-fluoro-2-deoxy-D-glucose positron emission tomography localizes residual thyroid cancer in patients with

negative diagnostic (131)I whole body scans and elevated serum thyroglobulin levels. *J Clin Endocrinol Metab*. 1999;84:2291–2302.
450. Weber W, Bartenstein P, Gross MW, et al. Fluorine-18-FDG PET and iodine-123-IMT SPECT in the evaluation of brain tumors. *J Nucl Med*. 1997;38:802–808.
451. Weber W, Voll B, Treumann T, Watzlowik P, Praeuer H, Schwaiger M. Imaging of lung cancer: comparison of C-11-methionine and F-18-FDG PET [abstract]. *J Nucl Med*. 1998;39:80P.
452. Weder W, Schmid RA, Bruchhaus H, Hillinger S, Von Schulthess GK, Steinert HC. Detection of extrathoracic metastases by positron emission tomography in lung cancer. *Ann Thorac Surg*. 1998;66:886–893.
453. Whiteford MH, Whiteford HM, Yee LF, et al. Usefulness of FDG-PET scan in the assessment of suspected metastatic or recurrent adenocarcinoma of the colon and rectum. *Dis Colon Rectum*. 2000;43:759–770.
454. Wiedmann E, Baican B, Hertel A, et al. Positron emission tomography (PET) for staging and evaluation of response to treatment in patients with Hodgkin's disease. *Leuk Lymphoma*. 1999;34:545–551.
455. Wong CS, Valk P, Ariannejad M, et al. Impact of FDG-PET on management of patients with melanoma [abstract]. *J Nucl Med*. 2000;41:282P.
456. Wong CYO, Pham AN, Welsh RJ, et al. Supra-CT detection of N3 or M1 lesions of NSC lung cancer by 18F FDG PET [abstract]. *J Nucl Med*. 2000;41: 294P.
457. Wong WL, Chevretton E, McGurk M, Croft D. PET-FDG imaging in the clinical evaluation of head and neck cancer. *J Royal Soc Med*. 1995;88:469P–473P.
458. Wong WL, Chevretton EB, McGurk M, et al. A prospective study of PET-FDG imaging for the assessment of head and neck squamous cell carcinoma. *Clin Otolaryngol*. 1997;22:209–214.
459. Yang WI, Choi CW, Lee YS, et al. Whole body (18F) FDG PET in patients with cervical lymph node metastases of unknown primary site [abstract]. *J Nucl Med*. 1999;40:259P–260P.
460. Yap CS, Valk P, Ariannejad M, et al. FDG-PET influences the clinical management of lymphoma patients [abstract]. *J Nucl Med*. 2000;41:70P.
461. Yap CS, Valk P, Ariannejad M, et al. Evaluation of FDG-PET for the clinical management of breast cancer patients [abstract]. *J Nucl Med*. 2000;41:109P.
462. Yasuda S, Makuuchi Y, Sadahiro S, et al. Colorectal cancer recurrence in the liver: detection by PET. *Tokai J Exp Clin Med*. 1998;23:167–171.
463. Yeh SDJ, Imbriaco M, Garza D, et al. Twenty percent of bony metastases of hormone-resistant prostate cancer are detected by PET-FDG whole body scanning [abstract]. *J Nucl Med*. 1995;36:198P.
464. Yeung H, Macapinlac H, Mazumdar M, Bains M, Finn R, Larson S. FDG-PET in esophageal cancer: incremental value over computed tomography. *Clin Positron Imaging*. 1999;2:255–260.
465. Yutani K, Hojo S, Tatsumi M, Shiba E, Noguchi S, Nishimura T. Correlation of F-18-FDG and Tc-99m-MIBI uptake with proliferative activity in breast cancer [abstract]. *J Nucl Med*. 1999;40:16P–17P.
466. Yutani K, Shiba E, Kusuoka H, et al. Comparison of FDG-PET with MIBI-SPECT in the detection of breast cancer and axillary lymph node metastasis. *J Comput Assist Tomogr*. 2000;24:274–280.
467. Yutani K, Tatsumi M, Uehara T, Nishimura T. Effect of patients' being prone during FDG PET for the diagnosis of breast cancer. *AJR*. 1999;173:1337–1339.
468. Yutani K, Uehara T, Nishimura T. Detectability of FDG-PET and MIBI-SPECT to breast tumor [abstract]. *J Nucl Med*. 1997;38:68P.
469. Zeitouni AG, Yamamoto YL, Black M, Gjedde A. Functional imaging of head and neck tumours using positron emission tomography. *J Otolaryngol*. 1994; 23:77–80.
470. Zhuang HM, Sinha P, Pourdehnad M, Duarte PS, Alavi AA. The crucial role of FDG-PET in the evaluation of liver metastasis from colorectal cancer [abstract]. *J Nucl Med*. 2000;41:35P.
471. Zimny M, Bares R, Frass J, et al. Fluorine-18 fluorodeoxyglucose positron emission tomography in the differential diagnosis of pancreatic carcinoma: a report of 106 cases. *Eur J Nucl Med*. 1997;24:678–682.
472. Zimny M, Nowak B, Di Martino E, Jaenicke S, Cremerius U, Buell U. Hybrid PET vs. conventional imaging in the diagnosis of head and neck tumors [abstract]. *J Nucl Med*. 2000;41:292P.
473. Zimny M, Schröder W, Wolters S, Cremerisu U, Rath W, Büll U. 18F-fluorodeoxyglucose PET in ovarian carcinoma: methodology and preliminary results [in German]. *Nuklearmedizin*. 1997;36:228–233.
474. Zinzani P, Magagnoli M, Chierichetti F, et al. The role of positron emission tomography (PET) in the management of lymphoma patients. *Ann Oncol*. 1999;10:1181–1184.