The Value of Bowel Preparation in Ga-67 Citrate Scanning: Concise Communication

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In order to assess the value of bowel preparation in Ga-67 citrate scanning, we retrospectively analyzed 156 randomly selected 72-hr Ga-67 scans and compared the extent of bowel activity in two groups of patients: those receiving a vigorous 3-day bowel preparation and those receiving no preparation. The populations were studied with regard to age, sex, and bowel preparation. A three-way analysis of variance (prep $\times$ sex $\times$ age) revealed no influence of these parameters on the degree of colonic gallium activity. We conclude that bowel preparation as used at our institution did not seem to reduce colonic gallium content significantly ($p > 0.10$).

Since the introduction of Ga-67 citrate in 1969, its ability to localize inflammatory and neoplastic lesions has been well documented (1–3). Colonic gallium activity has interposed an obstacle in the interpretation of the 72-hr scan in the abdominal and pelvic regions. Previous studies have reported anywhere from 9% to 15% excretion of gallium in the feces (4,5). The presence of colonic radioactivity has prompted the use of various combinations of cathartics to cleanse the bowel of gallium activity. Vigorous bowel preparation may be extremely inconvenient and somewhat traumatic for the patient, as well as being contraindicated in certain abdominal conditions. This project was undertaken to evaluate the practice of bowel cleansing in preparing the patient for the 72-hr gallium scan.

METHODS

From 1973 to 1975 approximately 1400 gallium scans were performed at two neighboring hospitals in Chicago, Illinois. Suspicion of a neoplastic or inflammatory process was usually the indication for scanning. Scanning was performed 3 days after intravenous administration of 3–5 mCi of Ga-67 citrate, on a dual-probe total-body rectilinear scanner with either 1:2 or 1:5 minification. Energy selection included the lower two or three photopeaks of Ga-67. Bowel preparation (PREP) consisted of three 5-mg bisacodyl* tablets on each of three nights between gallium injection and scanning, and 360 ml of magnesium citrate orally on the night before scanning.

Patients without bowel preparation (NOPREP) were obtained by discontinuing bowel preparation orders at one institution for all 72-hr total-body gallium examinations until more than 100 consecutive NOPREP studies were accumulated. There was no prospective criterion for selection of NOPREP patients. It was then necessary to select a comparable group of patients who had undergone the routine bowel preparation before gallium scanning. To accomplish this comparison NOPREP patients were divided into six groups (data cells) on the basis of age (young: 21–40 years, middle age: 41–60 years, and old: 61–80 years) and sex (M,F). This grouping was instituted because we felt that age or sex—particularly in the older age group—might demonstrate a significant difference in colonic activity. There was no classification according to disease, except that patients with bowel disease such as ulcerative colitis were excluded from the analysis since marked gallium activity may occur at a site of intestinal abnormality.

To analyze the data conveniently, it was desirable

to have equal numbers of usable scans in each data cell. Usable scans were defined as those that could be assigned a rating with regard to colonic activity. At the time the analysis of colonic activity was performed, enough NOPREP patients were available to place 13 usable scans in each of the six data cells. It should be noted that each cell contained more than 13 patients, but several examinations in each cell could not be analyzed for colonic activity and were classed as indeterminate, meaning that the degree of colonic activity was uncertain because of technical defects, anatomic variation, or abdominal disease. Twenty-two percent of the total examinations were classified as indeterminate. Thirteen determinate cases (i.e., colonic activity of Ga-67 could be estimated) for each data cell were randomly chosen from the NOPREP group of approximately 1,300 scans.

The scans were evaluated for gallium activity in the colon on a four-point scale (Table 1, Fig. 1). A three-way analysis of variance was employed to evaluate the results statistically. This method was used because it lends itself especially to the comparison of two sample populations, each of which had subgroups. The means of the subgroups and all combinations thereof were compared, as well as the larger populations under study.

RESULTS

The means of the individual cells are presented in Table 2, and they fail to show any clear differences. The data were then analyzed by the three-way analysis of variance. The sums of squares, mean squares, F values, and P values are generated by comparing the individual cell means. As can be seen from Table 3, no significant differences were found in the degree of colonic radioactivity in the young, middle-aged, old-age, male, female, PREP, and NOPREP groups (p > 0.10). There was slightly less colonic gallium activity in the PREP group ($\bar{x}_{PREP} = 0.75$) than in the NOPREP group
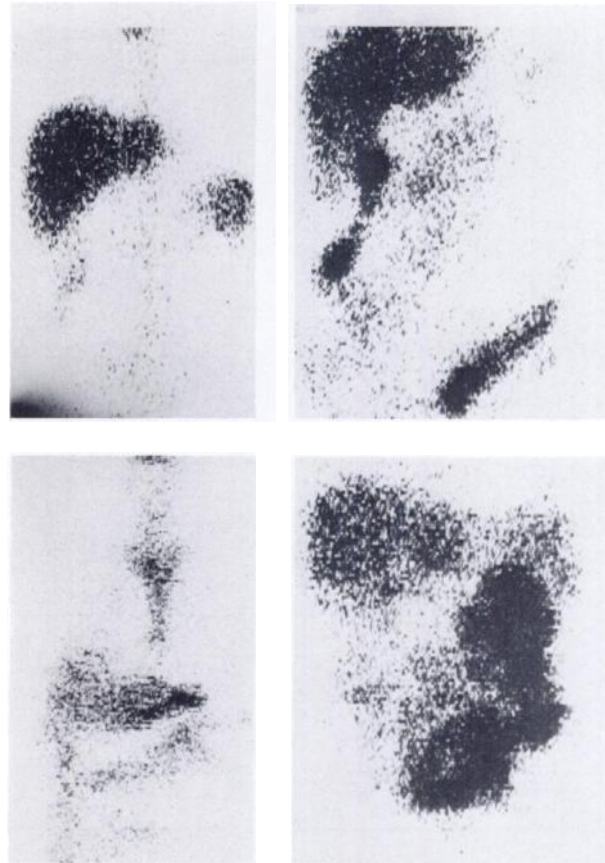

FIG. 1. Examples of colonic activity ratings. Upper left, 1; upper right, 2; lower left, 2; lower right, 3.

($\bar{x}_{NOPREP} = 0.83$), but this was not statistically significant at the 0.10 level.

The incidence of various diseases is presented in Table 4. The populations were generally similar with regard to disease. Hodgkin's disease and lymphoma represented the most prevalent diagnosis. Suspected occult carcinoma, metastatic disease, or abscess were other common diagnoses at the time of scanning.

DISCUSSION

The data presented indicate that our vigorous bowel preparation only marginally decreased the amount of colonic radioactivity on the 72-hr Ga-67 scan. In addition, neither sex nor age influenced gallium activity in the colon. In a previous study (4) it was shown that gallium distribution in man is not influenced by age, sex, nutritional status, or the presence of inflammatory or neoplastic disease. We chose to look at the effect of age and sex on colonic activity as a check on our data.

A very significant point that the data processing assumes is that distant sites of disease do not divert significant amounts of gallium so as to alter its distribution. Reference 4 stated this concept. Because

TABLE 1. RATING SCALE FOR GALLIUM BOWEL ACTIVITY

(0) No detectable bowel activity

(1) Activity less than that of liver in one segment of bowel

(2) Activity equal to that of liver in one segment of bowel or activity less than that of liver in two segments of bowel

(3) Activity greater than or equal to that of liver in two segments of bowel or less than that of liver in three segments of bowel

(i) Indeterminate category

Note: A segment is defined as 50% of the length of the ascending, transverse, or descending colon.

TABLE 2. ORIGINAL DATA

Males

	21–40 yr	41–60 yr	61–80 yr	
PREP	(1,2,2,1,0,1,0,1,1,2,1,2,1) $\bar{x} = 1.15$, n = 13, and 5 indet.	(0,2,0,0,0,0,1,0,0,0,3,0) $\bar{x} = 0.46$, n = 13, and 2 indet.	(0,1,1,0,0,0,0,3,0,2,3,1) $\bar{x} = 0.85$, n = 13, and 5 indet.	
NOPREP	(2,0,0,2,1,0,1,1,0,0,3,0,0) $\bar{x} = 0.77$, n = 13, and 4 indet.	(0,3,2,0,2,0,1,0,1,2,0,2,1) $\bar{x} = 1.08$, n = 13, and 2 indet.	(0,1,3,2,0,0,0,0,2,2,0,0,2) $\bar{x} = 0.92$, n = 13, and 2 indet.	

$$\bar{x}_{males} = 0.87$$

Females

	21–40 yr	41–60 yr	61–80 yr	
PREP	(1,0,0,0,1,0,2,0,2,0,2,0,1) $\bar{x} = 0.69$, n = 13, and 2 indet.	(3,1,0,0,1,1,0,0,0,0,3,0,0) $\bar{x} = 0.69$, n = 13, and 2 indet.	(1,1,3,0,0,0,0,3,0,0,0,2,0) $\bar{x} = 0.69$, n = 13, and 4 indet.	$x_{PREP} = 0.75$
NOPREP	(0,0,2,1,0,0,0,2,0,0,2,0,1) $\bar{x} = 0.62$, n = 13, and 4 indet.	(0,0,3,2,2,3,0,0,0,3,0,0,2) $\bar{x} = 1.15$, n = 13, and 6 indet.	(0,0,0,2,0,0,0,0,0,0,0,3,1) $\bar{x} = 0.46$, n = 13, and 6 indet.	$x_{NOPREP} = 0.83$

$$\bar{x}_{females} = 0.72$$

$\bar{x}_{21-40} = 0.81$	$\bar{x}_{41-60} = 0.73$	$\bar{x}_{61-80} = 0.73$

Key:

x = Mean for that cell or subgroup for which it is calculated.

( ) indet. = Number of scans that could not be assigned a rating for a given cell; these are not included in any further calculations.

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of this concept, one need not expect specific disease categories to affect colonic activity.

There have been few studies to date considering the efficacy of bowel preparations in gallium scanning. A combination of milk of magnesia and cascara sagrada was found to give good clearance of bowel activity in 68 of 70 patients with lymphoma (7). There have been no controlled prospective studies comparing a group receiving bowel preparation with a group receiving none. We hope that this study, although retrospective, will provide a stimulus for randomized prospective trials.

The action of cathartics on the bowel wall has been discussed in the gastroenterology literature. Inflammatory change, chemical gastroenteritis and frank sloughing of the intestinal villus tips were noted when the ileum of a rat was exposed to castor oil (8). A study of the rabbit ileum with the scanning electron microscope has shown cleft-like defects at the tips of villi after castor oil exposure (9). One may speculate on the effect that these bowel-wall changes would have on colonic gallium activity in man. Gallium has been reported in isolated cases to be taken up by the diseased, inflammed wall of pseudomembranous enterocolitis (10).

It is our conclusion that further prospective trials of bowel preparation for gallium scanning are needed. Based on our retrospective analysis, no significant difference at the 0.10 level was found be-

TABLE 3. A THREE-WAY ANALYSIS OF VARIANCE

Source of variance between:	df	Sums of squares	Mean squares	F	P
A Prep (PREP, NOPREP)	1	0.22	0.22	0.21	N.S.
B Sex (M,F)	1	0.93	0.93	0.88	N.S.
C Age (Y,M,O)	2	0.36	0.18	0.17	N.S.
AB Prep X Sex	1	0.04	0.04	0.038	N.S.
BC Sex X age	2	1.85	0.93	0.88	N.S.
AC Prep X age	2	4.32	2.16	2.06	N.S.
ABC Prep X Sex X age	2	0.65	0.32	0.31	N.S.
Within	144	151.08	1.05	1	—

TABLE 4. REPRESENTATIVE DISEASES

Condition	NOPREP	PREP
Hodgkin's disease or lymphoma	27/78 = 34%	34/78 = 44%
Abscess	13/78 = 17%	11/78 = 14%
Carcinoma, primary or metastatic	17/78 = 22%	19/78 = 24%
Other	21/78 = 27%	14/78 = 18%

tween a group of patients receiving a 3-day bowel preparation of magnesium citrate and bisacodyl tablets, and a group receiving no preparation. This may signify that bowel preparation is of questionable value in 72-hr gallium citrate scanning.

FOOTNOTE

* Dulcolax®, Boehringer Ingelheim Ltd., Elmsford, New York.

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