22. Markisz JA, Knowles RJR, Altchek DW, Schneider R, Whalen JP, Cahill PT. Segmental patterns of avascular necrosis of the femoral heads: early detection with MRI. *Radiology* 1987;162:717–720.
23. Beltran J, Herman LJ, Burk JM, et al. Femoral head avascular necrosis: MRI with clinical-pathologic and radionuclide correlation. *Radiology* 1988;166:215–220.
24. Glickstein MF, Burk DL Jr, Schiebler ML, et al. Avascular necrosis versus other diseases of the hip: sensitivity of MRI. *Radiology* 1988;169: 213–215.
25. Collier BD Jr, Hellman RS, Krasnow AZ. Bone SPECT. *Semin Nucl Med* 1987;17:247–266.
26. D'Ambrosia RD, Shoji H, Riggnis RS, Stadalnik RC, DeNardo GL. Scintigraphy in the diagnosis of osteonecrosis. *Clin Orthop* 1978;130:139–143.
27. Davidson JK, Tsakiris D, Briggs JD, Junor BJR. Osteonecrosis and fractures following renal transplantation. *Clin Radiology* 1985;36:27–35.
28. Burt RW, Matthew TJ. Aseptic necrosis of the knee: bone scintigraphy. *AJR* 1983;138:571–573.
29. Siddiqui AR, Cohen M, Moran DP. Abdominal masses in children: multiorgan imaging with ^{99m}Tc methylene disphosphonate. *AJR* 1982;139:35–38.

SELF-STUDY TEST

Gastrointestinal Nuclear Medicine

Questions are taken from the *Nuclear Medicine Self-Study Program 1*, published by The Society of Nuclear Medicine

DIRECTIONS

The following items consist of a heading followed by lettered options related to that heading. Select the one lettered option that is best for each item. Answers may be found below.

Drugs that typically slow gastric emptying include which of the following?

1. nicotine
2. verapamil
3. isoproterenol
4. levodopa
5. metoclopramide
6. domperidone

True statements concerning Barrett's esophagus include which of the following?

7. More than half of patients with Barrett's esophagus will develop squamous cell cancer of the esophagus.
8. The radiologic appearance on upper gastrointestinal radiography is diagnostic in most patients.
9. In patients with gastroesophageal reflux, an increase in symptoms suggests development of Barrett's esophagus.
10. Sequential ^{99m}Tc pertechnetate imaging in patients with Barrett's esophagus is helpful in determining which patients will develop malignancy.

True statements concerning scintigraphic evaluation of peritoneovenous shunt patency include which of the following?

11. Because of its low specificity, it is not helpful in most cases.
12. When ^{99m}Tc MAA is injected intraperitoneally, nonvisualization of the efferent limb of the shunt indicates shunt malfunction.
13. The afferent portion of the shunt is the most frequent site of shunt malfunction.
14. Congestive heart failure occasionally causes false-positive studies.
15. Direct puncture of the efferent limb of the shunt occasionally is necessary to precisely locate the site of malfunction.

SELF-STUDY TEST

Gastrointestinal Nuclear Medicine

ANSWERS

Items 1-6: Effect of Drugs on Gastric Emptying

Answers: 1, T; 2, T; 3, T; 4, T; 5, F; 6, F

Many drugs have been shown to slow gastric emptying,and their effects must be considered in reporting the results of gastric emptying studies. The nicotine associated with cigarette smoking has been shown to slow gastric emptying. In addition, calcium channel blockers have been shown to decrease the amplitude and duration of contractions of smooth muscle throughout the gastrointestinal tract. Calcium channel blockers either decrease the number of calcium channels nifedipine, verapamil, diltiazem and/or decrease the rate of calcium transport in the remaining channels verapamil, diltiazem. Adrenergic agonists, especially beta agonists such as isoproterenol, all tend to delay gastric emptying. Dopamine is a neural transmitter, which appears to be involved primarily in gastric relaxation. Dopamine agonists, such as levodopa, will slow gastric emptying. The D-receptor antagonist metoclopramide stimulates gastric contractions and, thus, increases the rate of gastric emptying. It is also felt to have a central antiemetic effect. Domperidone is another dopaminergic antagonist, which also accelerates gastric emptying and has been shown to increase gastric antral contractions.

References

1. Berkowitz DM, McCallum RW. Interaction of levodopa and metoclopramide on gastric emptying. *Clin Pharmacol Ther* 1980;27:414-420.
2. Broekaert A. Effect of domperidone on gastric emptying and secretion. *Postgrad Med J* 1979;55:11-14.
3. Jacob H, Brandt LJ, Farkas P, Frishman W. Beta-adrenergic blockade and the gastrointestinal system. *Am J Med* 1983;74:1042-1051.

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REFERENCES

1. Go RT, MacIntyre WJ, King JL, et al. Thallium-201 SPECT myocardial imaging: analysis of indications for referral and its effect on the frequency of subsequent coronary angiography [Abstract]. *J Nucl Med* 1988;29:946.
2. Go RT, Marwick TH, MacIntyre WJ, et al. A prospective comparison of rubidium-82 PET and thallium-201 SPECT myocardial perfusion imaging utilizing a single dipyridamole stress in the diagnosis of coronary artery disease. *J Nucl Med* 1990;31:1899–1905.
3. Marwick TH, Go RT, MacIntyre WJ, et al. Myocardial perfusion imaging with positron tomography and single photon emission computed tomography: frequency and causes of disparate results. *Eur Heart J* 1991;12: 1064–1069.
4. Brown BG, Josephson MA, Petersen RB, et al. Intravenous dipyridamole combined with isometric handgrip for near maximal acute increase in coronary flow in patients with coronary artery disease. *Am J Cardiol* 1981;48:1077–1085.
5. Go RT, MacIntyre WJ. Myocardial perfusion imaging. In: Yeh SDJ, Chen DCP, eds. *Nuclear medicine update 1988*. Taipei: The Society of Nuclear Medicine ROC; 1988:152–164.
6. MacIntyre WJ, Go RT, Houser TS. Cardiac tomography: techniques and applications. In: Spencer RP, ed., *New procedures in nuclear medicine*. Boca Raton: CRC Press; 1989:129–142.
7. Go RT, MacIntyre WJ, King JL, et al. Effect of thallium-201 myocardial imaging on frequency of subsequent coronary artery angiography related to category of referrals. *Eur J Nucl Med* 1988;14:261.
8. DePasquale EE, Nody AC, DePuey EG, et al. Quantitative rotational Tl-201 tomography for identifying and localizing coronary artery disease. *Circulation* 1988;77:316–327.
9. Iskandrian AS, Heo J, Kong B, et al. Use of technetium-99m isonitrile (RP-30A) in assessing left ventricular perfusion and function at rest and during exercise in coronary artery disease, and comparison with coronary arteriography and exercise thallium-201 SPECT imaging. *Am J Cardiol* 1989;64:270–275.
10. Van Train KR, Maddahi J, Berman DS, et al. Quantitative analysis of tomographic stress thallium-201 myocardial scintigrams: a multicenter trial. *J Nucl Med* 1990;31:1168–1179.
11. Go RT, MacIntyre WJ, Cook SA, et al. Myocardial perfusion imaging in the diagnosis of coronary artery disease and its role in the interventional laboratory. *Curr Opin Radiol* 1992;4:23–32.

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ANSWERS *(continued)*

4. Nowak A, Jonderko K, Kaczor R, Nowak S, Skrzypek D. Cigarette smoking delays gastric emptying of radiolabeled solid food in healthy smokers. *Scand J Gastroenterol* 1987;22:54-58.
5. Pinder RM, Brogden RN, Sawyer PR, Speight TM, Avery GS. Metoclopramide: a review of its pharmacological properties and clinical use. *Drugs* 1976;12:81-131.
6. Valenzuela JE. Dopamine as a possible neuro-transmitter in gastric relaxation. *Gastroenterology* 1976;71:1019-1022.

Items 7-10: Barrett's Esophagus

Answers: 7, F; 8, F; 9, F; 10, F

Much has been written about the clinical presentation and assessment of patients with Barrett's esophagus. Although Barrett's esophagus causes no symptoms per se, the clinical presentation is related to gastroesophageal reflux and covers the spectrum of regurgitation, heartburn, chest and abdominal pain, and dysphagia. It has been suggested that patients with Barrett's esophagus have less severe symptoms than do those with reflux esophagitis without Barrett's epithelium. The five major complications of Barrett's esophagus include: esophagitis, ulceration, stricture, bleeding, and adenocarcinoma (not squamous cell cancer). The frequency of adenocarcinoma of the esophagus in patients with Barrett's esophagus is approximately 10%. The risk of esophageal cancer with Barrett's esophagus is approximately 30 to 40 times greater than that in the general population. Once the diagnosis of Barrett's esophagus has been made on biopsy, periodic endoscopy with biopsy is recommended to monitor for malignant transformation. The radiographic appearance of Barrett's esophagus is not specific and includes gastroesophageal reflux, hiatal hernia, esophageal stricture, ulceration, irregular mucosal folds, granulating reticular mucosal pattern, and intramural pseudodiverticulosis. The findings of a benign-appearing stricture in the proximal esophagus or a deep esophageal ulceration should suggest the diagnosis and prompt endoscopic evaluation. The scintigraphic assessment of Barrett's esophagus has not been widely explored or utilized. The accumulation of ^{99m}Tc pertechnetate in the lower esophagus after intravenous injection of this tracer is considered a positive examination and is related to mucous-secreting cells of Barrett's mucosa. The swallowing of free ^{99m}Tc in saliva and eflux of gastric activity can cause significant problems in scan interpretation, however. Scintigraphy can identify possible areas of Barrett's esophagus, but plays no role in assessment for possible malignancy. Currently, scintigraphy plays no definitive role in the evaluation of patients with suspected Barrett's esophagus. A large prospective study with adequate controls will be necessary to define if any future role for scintigraphy exists.

References

1. Sjogren RW, Johnson LF. Barrett's esophagus: a review. *Am J Med* 1983;7 4:313-321.
2. Spechler SJ, Goyal RK. Barrett's esophagus. *N Engl J Med* 1986;315:362-371.

Items 11-15: Peritoneovenous Shunt Imaging

Answers:11, F; 12, F; 13, T; 14, T; 15, T

Scintigraphic techniques for assessing patency of peritoneovenous shunts utilize tracers injected into the peritoneal cavity and/or directly into the efferent limb of the shunt. These imaging techniques monitor the transit of tracer from the peritoneal cavity through the shunt into the target organs (lung or liver/spleen) of the tracer employed (^{99m}Tc macroaggregated albumin +MAA or ^{99m}Tc sulfur colloid). The most frequent cause of shunt malfunction is obstruction by fibrin deposits of the afferent limb of the shunt. Less frequently, thrombus formation occurs in the efferent portion of the tubing. When ^{99m}Tc MAA is the tracer utilized at high and low flow rates, there may be nonvisualization of the efferent shunt tubing. Hence, direct target organ visualization i.e., tracer accumulation in the lungs should be utilized as the criterion of shunt patency. Disease states that cause elevated right heart pressure, such as congestive heart failure, can cause false-positive studies. Thus, when only the afferent portion of the shunt is visualized, direct puncture of the efferent limb is generally necessary to locate the site of malfunction more precisely. Both the sensitivity and specificity of peritoneovenous shunt scintigraphy appear to be high. In a study of 40 patients, six of whom were evaluated when their shunts appeared to be malfunctioning, no false-positive or false-negative studies were encountered.

References

1. Madeddu G, D'Ovidio G, Casu AR, et al. Evaluation of peritoneovenous shunt patency with Tc-99m-labeled microspheres. *J Nucl Med* 983; 24:302-307.
2. Singh A, Grossman ZD, McAfee JG, Thomas FD. LaVeen shunt patency studies: clarification of scintigraphic finding. *Clin Nucl Med* 1980;5:106-108.
3. Taggart GJ, Sullivan DC, Gusberg RJ, Conn H. Percutaneous transtubal scintigraphic assessment of patency of peritoneovenous shunts. *Clin Nucl Med* 1981;6:70-72.