Duodenal Diverticula Mimicking Cystic Neoplasms of the Pancreas: CT and MR Imaging Findings in Seven Patients

OBJECTIVE. Duodenal diverticula are common and are typically asymptomatic. When filled with gas or a combination of fluid and gas, duodenal diverticula are easily recognized on CT or MR imaging. However, a duodenal diverticulum that is entirely filled with fluid may mimic a cystic neoplasm arising from the head of the pancreas. We present seven cases of patients with duodenal diverticula in whom initial findings on CT or MR imaging were suggestive of a cystic neoplasm in the head of the pancreas. In all patients, this structure was ultimately proven to be a duodenal diverticulum.

CONCLUSION. When filled with only fluid, a duodenal diverticulum may mimic a cystic neoplasm in the head of the pancreas. Recognizing the location in which this entity characteristically arises and identifying small amounts of intradiverticular gas when it is present may aid in establishing the correct diagnosis in patients with duodenal diverticula.

After the colon, the duodenum is the most common location for gastrointestinal diverticula [1]. These diverticula typically occur in the periampullary region, along the medial aspect of the second and third portions of the duodenum [2]. They are easily recognized on upper gastrointestinal barium examinations, and they are usually depicted well on CT or MR imaging if they are filled with fluid and air and located in the characteristic periampullary region [3].

Most patients with duodenal diverticula are asymptomatic. Perforation and bleeding are the most frequently reported complications [1–3]. Duodenal diverticula present a major source of failure for endoscopic retrograde cholangiopancreatography (ERCP) if the common bile duct drains directly into a periampullary diverticulum, obscuring the orifice of the ampulla of Vater. In rare cases, a duodenal diverticulum may become obstructed, resulting in associated duodenal diverticulitis.

We describe the imaging findings of seven patients in whom initial CT or MR imaging findings were suggestive of a cystic pancreatic mass. In all patients, the lesion ultimately proved to be a duodenal diverticulum. In three patients, clues to the correct diagnosis of a duodenal diverticulum were present but unrecognized on the initial imaging examination. However, in the remaining four patients, the presence of a cystic pancreatic neoplasm could not be excluded, even in a retrospective review. A duodenal diverticulum should be considered in the differential diagnosis if a cystic process is identified between the duodenum and the head of the pancreas on CT or MR imaging.

Materials and Methods

Patients

From January 1997 to February 2002, we made an initial imaging diagnosis of cystic pancreatic neoplasm for seven patients at our institution. Subsequently, follow-up or previously acquired images for
all seven patients showed that the imaging finding initially thought to represent a cystic pancreatic neoplasm was a duodenal diverticulum. The patient group consisted of four men and three women whose ages ranged from 45 to 83 years (mean age, 66 years).

Cases were retrospectively identified by an abdominal radiologist who interpreted the follow-up imaging examinations or reviewed images obtained previously at outside institutions. In all cases in which the second imaging examination revealed findings typical of a periampullary duodenal diverticulum, the original imaging examination was retrieved and analyzed by a single abdominal radiologist for the imaging features that were suggestive of cystic pancreatic neoplasm and for findings that might have led to an accurate initial diagnosis. In addition, the initial imaging reports and clinical indications for performing the studies were obtained.

Imaging Technique

CT.—All CT scans were performed with one of two protocols using a HiSpeed Advantage or CT/i scanner (General Electric Medical Systems, Milwaukee, WI). Protocol 1 parameters, used for patients undergoing routine abdominal CT, consisted of a 7-mm collimation, table speed range of 7–10 mm/sec, pitch range of 1.0–1.4, 120 kV, and 210–260 mAs. Patients began ingesting 800 mL of barium sulfate suspension of 2.1% weight/volume (Readi-Cat 2; E-Z-EM, Westbury, NY) or diluted (2%) water-soluble contrast material (Gastrografin [meglumine diatrizoate]; Bristol-Myers Squibb, Wallingford, CT) approximately 1 hr before scanning was performed. One hundred fifty mL of nonionic IV contrast material (Ultravist [iohexol], 300 mg I/mL; Berlex Laboratories, Wayne, NJ) was administered via a 22-gauge catheter inserted into an antecubital vein at a rate of 2 mL/sec using a power injector (Envision CT injector; Medrad, Pittsburgh, PA). Acquisition of CT data was begun 70 sec after the initiation of the injection.

Protocol 2 was used to evaluate patients in whom pancreatic disease was suspected. This protocol consisted of initially scanning the pancreas using the parameters of 3-mm collimation, a table speed of 6 mm/sec, a pitch of 2, 120 kV, and 210–260 mAs. Water was used as an oral contrast agent, and the IV contrast material was 150 mL iopamidol (Ultravist, 300 mg I/mL) was administered via a 20-gauge catheter inserted into an antecubital vein at a rate of 4 mL/sec using a power injector (Envision CT injector). Acquisition of CT data of the pancreas was begun 40 sec after the initiation of the injection. Then the portal venous phase acquisition of the abdomen was performed in the same fashion described in protocol 1.

MR imaging.—MR imaging was performed in five patients at 1.5 T (Vision or Symphony; Siemens, Erlangen, Germany) using a torso phased array coil. In four patients with a suspected right upper quadrant process, axial breath-hold T2-weighted short tau inversion recovery (STIR) turbo spin-echo MR imaging (TR/TE range, 4200/76; flip angle, 180°) and T1-weighted in-phase and opposed-phase gradient-echo MR imaging (TR/TE range, 180/2.7–5.3; flip angle, 90°) of the abdomen was performed. In addition, axial and coronal breath-hold T2-weighted MR imaging using a half-Fourier single-shot turbo spin-echo (HASTE) sequence (infinite/67; flip angle, 150°) was performed. Finally, a breath-hold three-dimensional T1-weighted fat-suppressed spoiled gradient-echo sequence (4.5/1.9; flip angle, 12°) was performed before and after administration of IV contrast material during the hepatic arterial, portal venous, and equilibrium phases of enhancement.

A fifth patient, who was being evaluated for renal artery stenosis, underwent T1-weighted in- and opposed-phase gradient-echo MR imaging (TR/TE range, 180/2.7–5.3; flip angle, 90°) of the kidneys and breath-hold three-dimensional T1-weighted fat-suppressed spoiled gradient-echo MR imaging (4.5/1.9; flip angle, 30°) before and after administration of IV contrast material during the arterial and nephrographic phases of enhancement.

Results

Of our seven patients, two underwent an initial evaluation with CT and five, with MR imaging. The initial clinical history in the patients who had CT as the first examination was abdominal pain in one patient and lymphoma in the second patient. In patients who had MR imaging as the initial examination, the clinical history was biliary dilatation in two patients, suspected liver lesion in two patients, and renal artery stenosis in one patient. Protocol 1 was used in the two patients with initial CT examinations. Protocol 2 was used for follow-up CT examinations at our institution in four patients. In one patient, prior imaging performed at our institution had been obtained with protocol 1, and in one patient, an imaging examination performed at an outside institution had been obtained with a technique similar to that of protocol 1.

The mean size of the seven cystic lesions identified was 15.7 mm (range, 10–25 mm). The initial imaging diagnoses were intraductal papillary mucinous neoplasm (n = 3), mucinous cystic tumor of the pancreas (n = 1), and nonspecific cystic tumor (n = 3). Because of the size of the cystic lesions identified on the initial imaging study, six of seven patients did not undergo surgery. Follow-up imaging to document stability or change in the lesion was recommended for these patients by the radiol-
ogist who interpreted the initial examinations. One patient underwent pancreaticoduodenectomy, which confirmed the presence of a duodenal diverticulum.

In four patients, confirmation of the diagnosis of duodenal diverticulum was made when follow-up CT revealed intradiverticular gas in what had been thought to be the cystic tumor (Figs. 1–4). In another two patients, prior imaging studies were found that showed the cystic lesion to be a duodenal diverticulum. In one of these patients, previous CT scans performed with oral and IV contrast materials at our institution showed intradiverticular gas in what had originally been thought to be the cystic pancreatic neoplasm (Fig. 5). In the second patient, prior CT scans performed with oral and IV contrast materials at an outside institution showed a combination of gas and barium in what had originally been thought to be the cystic pancreatic neoplasm. In the seventh patient, a follow-up upper gastrointestinal barium examination showed a typical periampullary diverticulum in the location in which previously obtained MR imaging showed the cystic lesion.

Discussion

Duodenal diverticula are common and are incidentally discovered on upper gastrointestinal barium examinations in as many as 14.5% of patients and at autopsy in 22% of cadavers [1, 2, 4]. Most duodenal diverticula are acquired, rather than congenital, abnormalities. They are easily recognized on upper gastrointestinal barium examinations as collections of gas and barium in round or oval sacklike protrusions that usually arise from the medial aspect of the periampullary duodenum. The typical CT appearance of a duodenal diverticulum has been described as a thin-walled rounded collection of gas and oral contrast material situated along the medial border of the junction of the second and third portions of the duodenum [2]. On T2-weighted MR imaging, duodenal diverticulum may contain both high-signal-intensity areas (related to the presence of fluid) and low-signal-intensity areas (related to the presence of gas).

Duodenal diverticula are rarely symptomatic, although they may make cannulation of the common bile duct difficult during an ERCP or may become impacted with debris, leading to duodenal diverticulitis [2]. Complications of hemorrhage and increased prevalence of cholecodocholithiasis have been described [1, 2]. Misinterpretation of a duodenal diverticulum on CT as a pancreatic tumor, metastatic lymph node, pancreatic pseudocyst, or pancreatic abscess has been reported [3–7]. One may be unable to distinguish duodenal diverticulum on CT or MR imaging if their content is purely fluid.

The differential diagnosis of a cystic lesion in the region of the head of the pancreas includes cystic pancreatic neoplasms, inflammatory processes (such as pseudocysts), and duodenal di-

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Fig. 2.—Duodenal diverticulum in 85-year-old man.
A, Axial CT scan obtained with IV and oral contrast materials at level of pancreatic head shows 15-mm fluid-filled cystic process (long arrow) that was initially thought to represent nonspecific cystic pancreatic tumor. Short arrow identifies duodenum.
B, Follow-up axial CT scan obtained at similar level as A 6 months later shows complete filling of diverticulum with gas (arrow), confirming diagnosis of duodenal diverticulum.

Fig. 3.—Duodenal diverticulum in 75-year-old man.
A, Axial T2-weighted MR image obtained with HASTE sequence (TR/TE, infinite/67; flip angle, 150°) shows 25-mm cystic process (long arrow) in region of pancreatic head. Along ventral aspect of cystic process is focus of low signal intensity (arrowhead) that likely represents small amount of gas but was not identified as such. Note dilated pancreatic duct (short arrow) resulting from incidental polyp (not visualized) in distal common bile duct. Duodenal diverticulum was initially thought to represent mucinous cystic tumor.
B, Axial CT scan obtained at same level as A 1 week later shows filling of diverticulum with gas and fluid (arrow), confirming diagnosis of duodenal diverticulum.
verticula. Three cystic tumors are relatively common pancreatic neoplasms—an intraductal papillary mucinous neoplasm, mucinous cystic neoplasm, and serous cystic neoplasm [8].

The exact treatment and workup for a patient with a suspected cystic neoplasm of the pancreas are controversial. In our series, all the lesions were small, with a mean size of 15.7 mm. Clinical observation was chosen as the management for six patients on the basis of the initial imaging examination. In one patient (Fig. 3), surgical resection was recommended because of the imaging appearance of the cystic lesion as well as associated bile and pancreatic duct dilatation. In this patient, CT performed 1 week showed a duodenal diverticulum and bile and pancreatic duct dilatation. This patient underwent pancreaticoduodenectomy. This procedure revealed an obstructing polyp in the distal common bile duct in addition to the duodenal diverticulum.

Although the imaging features in the patients’ initial imaging examinations were suggestive of cystic pancreatic neoplasm, three patients had imaging findings present that, although subtle, might have led to an earlier establishment of the correct diagnosis. In two of the MR imaging examinations, subtle areas of decreased signal intensity were visible (Figs. 3 and 4). These areas likely represented small amounts of intradiverticular gas. Visualization of decreased signal intensity or susceptibility artifact (blooming of low signal) on MR imaging sequences performed with increasing echo times in a periampullary cystic process supports the diagnosis of duodenal diverticulum. On the imaging examinations in the third patient, a curvilinear area of increased attenuation was visible around the periphery of the cystic lesion. This feature was initially thought to represent peripheral calcification but likely represented residual barium (Fig. 1).

A limitation of our study was that surgical proof of duodenal diverticulum was not obtained in six patients. In one patient, surgical proof was obtained, and in two patients, an
upper gastrointestinal barium series confirmed the presence of duodenal diverticulum. In the remaining four patients, the appearance of the lesion on follow-up CT was characteristic of a periampullary duodenal diverticulum [2]. A second limitation is that we do not know how frequently duodenal diverticula are misclassified as cystic tumors of the pancreas. We have attempted to retrospectively document cases in which an initial imaging diagnosis suggested cystic pancreatic neoplasm. It is likely that other cases may have been misclassified as cystic tumors.

In conclusion, a cystic process seen on CT or MR imaging as adjacent to the head of the pancreas and the second portion of the duodenum should lead to consideration of a number of conditions in the differential diagnosis. These include cystic pancreatic neoplasms, pseudocysts, and fluid-filled duodenal diverticula. Careful scrutiny of images for evidence of small amounts of gas or air–fluid levels should be made, especially on MR imaging. If the diagnosis is in doubt, follow-up imaging or an upper gastrointestinal barium examination should be considered to confirm the presence of a duodenal diverticulum.

References