OBJECTIVE. Few abdominal or pelvic cystic lesions come to the attention of the interventional radiologist, and those that do are symptomatic. Differentiation of cysts from cystic-appearing masses is not difficult when a multitechnique imaging approach is used. Our objective is to summarize the principles and specifics for management of symptomatic cysts through percutaneous catheter techniques.

CONCLUSION. Percutaneous aspiration of cysts can relieve symptoms without the need for surgery. A sound knowledge of the various types of cysts that may be found in the abdomen and pelvis enables the radiologist to select those patients who will benefit the most from percutaneous management.

Pericatheter drainage of abdominal abscesses and fluid collections has been an established component of radiologic practice for nearly 2 decades. Appropriately, the clinical and technical focus of interventional radiologists has been on pyogenic abscesses because of their potentially lethal course. Nonetheless, percutaneous needle and catheter treatment methods for managing symptomatic abdominal and pelvic cysts have proven nearly equally valuable in selected patients. Modern cross-sectional imaging techniques frequently show small asymptomatic intraparenchymal cysts in many organs such as the liver, kidneys, and ovaries among others, but symptomatic cystic collections in many organs can be managed effectively by percutaneous catheter techniques. This article provides a summary of principles and specific therapeutic techniques.

Cystic Lesions
Cysts in the solid parenchymal organs of the abdomen may be categorized histologically as true cysts or pseudocysts. A more practical classification categorizes cysts as congenital or acquired types. Congenital cysts usually occur sporadically but may occur in congenital cystic diseases such as autosomal dominant polycystic kidney disease, von Hippel-Lindau disease, and cystic fibrosis. These cysts most commonly occur in the liver, kidneys, and pancreas. Acquired cysts of the abdomen are most commonly caused by infection with *Echinococcus granulosus*. Pseudocysts usually result from prior trauma or infection. These are the most frequently encountered cystic masses in the pancreas, spleen, and adrenal glands.

Cystic masses may also be found in the abdomen and pelvis after surgery. Such lesions include lymphocele, seroma, hematoma, peritoneal inclusion cyst, urinoma, or biloma. Many lesions may mimic cysts on any single imaging technique; however, these lesions may be distinguished from simple cysts both on clinical grounds and by further imaging. Such lesions include abscesses and cystic tumors. The management of these more complex “cystic” masses is outside the scope of this article, which focuses on simple cystic masses.

Of the many and varied cysts that occur within the abdomen and pelvis, only symptomatic cysts come to the attention of the interventional radiologist. The most frequently encountered cysts include cysts in the liver and kidney, pancreatic cysts, echinococcal cysts, lymphoceles, and ovarian cysts.

Principles of Drainage

Indications
Only symptomatic cysts require intervention. A cyst may become symptomatic after hemorrhage into the cyst or superinfection, or the symptom of abdominal pain may be related to the size of the cyst. The traditional management of cysts in solid parenchymal
Management of Abdominal and Pelvic Cysts

organs is surgical marsupialization, either as an open procedure [1, 2] or, more recently, laparoscopically [3, 4]. These procedures, although relatively straightforward, are associated with the risks of surgery and general anesthesia. Because these cysts represent benign disease, alternative, less invasive methods for management are desirable. In addition, less invasive methods are preferred in patients who have comorbidities that may increase the risk of surgery.

**Imaging Guidance**

Most symptomatic cysts requiring drainage are large and, because of their fluid content, are ideally approached using sonographic guidance. The advantages of sonography include speed and versatility, lack of ionizing radiation, real-time guidance, and the ability to clearly identify vessels. If the cyst is located deep within the body and a clear access route is not achievable by sonography, CT guidance may be required.

**Puncture**

A preliminary sonogram should be performed to plan a safe access route to the cyst. For hepatic or splenic cysts, a subcostal route is preferable to an intercostal route, because the former will reduce the possibility of transgressing the pleural space, which may result in a pneumothorax or empyema. One of the many advantages of using sonographic guidance over CT guidance is the real-time ability of sonography to create a subcostal window to a cyst in a craniocaudal plane that is not available with CT guidance. Using an angled gantry with CT will create a craniocaudal angulation but only in the axial plane. Sonography allows real-time creation of an access route in three dimensions.

If a subcostal route is not available, an intercostal route may be used. Because this route usually involves transgressing the pleura, the risks of pneumothorax or empyema are increased. This increased risk should be explained to both the patient and the referring physician before the procedure, and the lowest available intercostal route should be chosen.

Preparation before drainage includes obtaining written informed consent from the patient and assessing bleeding parameters. The platelet count, prothrombin time, and activated partial thromboplastin time should be reviewed and corrected when necessary. The minimum platelet level acceptable is 50,000 platelets per milliliter, and the acceptable range for prothrombin time is 11.5–15 sec. This approximates an international normalized ratio of less than 1.3. An elevated international normalized ratio may be corrected using fresh, frozen plasma if required. Two units of fresh, frozen plasma are required for each 0.1 unit that the international normalized ratio is over 1.3. Sufficient platelets should be given to result in a platelet count of more than 50,000 per milliliter before the procedure. Percutaneous cyst aspiration is an elective procedure and should be undertaken cautiously in patients with coagulopathy requiring correction.

For catheter placement, conscious sedation consisting of IV midazolam hydrochloride (Versed, Roche Laboratories) and fentanyl citrate may be used at the discretion of the interventional radiologist performing the procedure. This sedation frequently is not required, however, because the cysts are usually large and permit superficial access.

The overlying skin is cleaned, prepared, and draped. Local anesthetic is given subcutaneously. Under direct sonographic guidance, a 19- to 22-gauge needle or an 8- to 10-French pigtail locking catheter is inserted into the cyst by a single-thrust (trocar) technique [5]. The size of the needle or catheter is at the discretion of the radiologist performing the procedure. Small cysts (< 50 mL) may be aspirated directly using a single-stick needle technique. Although this method is seldom effective for large cysts within the parenchymal organs, it may suffice when a cyst is in an anatomic location that will cause symptoms even when the cyst is small, such as a lymphocele in the inguinal region.

The Seldinger technique may be used if desired. The choice of the trocar or Seldinger technique is at the discretion of the interventional radiologist performing the procedure. The Seldinger technique has the theoretic advantage of increased safety; however, because these symptomatic cysts usually are large and superficial, the technique offers little benefit, whereas the trocar technique offers a quicker and simpler approach.

**Catheter Drainage**

Large cysts are drained more efficiently and rapidly by placement of an indwelling catheter. Large, symptomatic cysts may contain a liter of fluid or more (Fig. 1).

Once the catheter has been placed within the cyst, the contents of the cyst are evacuated. Connecting tubing is attached to the catheter via a three-way stopcock. Cysts of intermediate size may be evacuated by hand using a 60-mL syringe. Larger cysts may drain more efficiently by attachment of the connecting tubing to a vacuum bottle. Before the stopcock is turned to the open position, samples of the fluid should be obtained from the third port of the stopcock. These samples may be sent for culture and for sensitivity, cytology, or biochemical analysis, including amylase, bilirubin, creatinine, or triglycerides, as clinically indicated. After the sampling, a 10-mL syringe may be attached to the third port of the stopcock and filled with saline to serve as a reservoir. The stopcock is then opened to the vacuum bottle and the cyst contents rapidly evacuated. If the rate of fluid return decreases, two maneuvers may be used to ensure complete drainage. First, saline from the reservoir may be injected to clear the catheter of viscous debris. If this fails, the catheter is then manipulated by both rotation and slight withdrawal. This maneuver is useful when the cyst wall collapses around the side holes of the catheter. The catheter may be withdrawn under direct sonographic guidance to ensure that it remains within the cyst. If fluid remains within the cyst once the catheter is rotated and withdrawn, drainage is continued. Once complete collapse of the cyst has been confirmed on imaging and no more fluid can be aspirated, the catheter is removed. Postprocedural images should always be obtained (Fig. 2). The patient should be observed for up to 4 hr after the procedure, with heart rate and blood pressure recorded.

**Recurrence**

Because percutaneous drainage alone does not address the underlying causes of fluid accumulation, two additional points are noteworthy. First, cyst drainage is not only therapeutic but also diagnostic, because symptoms that resolve after cyst drainage and return with reaccumulation ensure that the cyst is indeed their cause [6]. Conversely, if the patient’s symptoms are not relieved by cyst aspiration, another cause for the symptoms should be sought. Second, simple needle aspiration alone is not an effective treatment for large, symptomatic cysts, particularly hepatic and renal cysts, and recurrence is common [1, 6]. If a recurrent cyst is small and asymptomatic, it may require no further intervention. However, after symptomatic recurrence, repeated drainage with sclerosis or formal surgical removal of the roof of the cyst is required.

**Sclerotherapy**

Bean was the first to report successful sclerosis of symptomatic renal cysts by alcohol injection [7]. Subsequent authors have evaluated other agents such as povidone-iodine [8,
tetracycline [10], bleomycin [11], iophendylate [12], glucose [13], phenol [14], iophendylate [15], urea chlorhydrrolactate [16], and, more recently, n-butyl cyanoacrylate with iodized oil [17]. However, many of these agents have proven inadequate for effective cyst sclerosis or are highly toxic. Alcohol sclerosis is easy, well tolerated, and widely available and yields excellent results. For these reasons, alcohol is the most widely used sclerosing agent for simple cysts of the abdomen and pelvis [18–20].

Given that cysts selected for sclerotherapy are usually large, the procedure is readily performed under sonographic guidance with an 8- to 10-French catheter, placed as described previously. Dilute iodinated contrast material is then injected into the cyst, and either fluoroscopy or CT is performed to exclude spillage into the peritoneal cavity or communication with the renal collecting system, vessels, or biliary tree. If contrast material leaks into vital structures such as vessels, bowel, or the urinary tract, alcohol sclerotherapy is contraindicated.

Once the cyst has been drained and no contrast leak is detected, approximately 50% of the aspirated fluid volume is replaced with 95% ethyl alcohol. A maximum of 100 mL of alcohol generally should be used. This limitation is to avoid potential alcohol toxicity from systemically absorbed alcohol, although the total volume of alcohol used is at the discretion of the radiologist performing the procedure and may be increased carefully as long as the patient tolerates the procedure. With the use of large volumes of alcohol, the patient’s blood

Fig. 1—44-year-old man with symptomatic liver cyst.
A, Diagnostic CT image showing large liver cyst.
B, Preprocedural sonographic image showing lesion with characteristic imaging features of simple cyst.
C, Sonographic image showing catheter tip in cyst (arrow).
D, Sonographic image showing collapse of cyst after aspiration.
alcohol level may rise shortly after the procedure, peaking at about 20 min and decreasing by 60 min [21]. Symptoms of inebriation from systemic alcohol absorption are uncommon.

The mechanism of alcohol sclerotherapy involves protein denaturation, cell death, and fibrous scarring. Hence, the intent of therapy is to ensure that the alcohol contacts the entire cyst wall without creating excessive pressure that might result in intravasation. The alcohol is left in the cavity for between 20 and 30 min. The total time depends on the size of the cyst being treated. During this time, the patient is placed in the prone, right and left lateral decubitus, and supine positions for approximately 5–10 min each to ensure that the alcohol contacts all surfaces in the cavity. Should greater than 100 mL of alcohol be injected into the cyst, the dwelling time of the alcohol should be reduced accordingly. Small cysts may be treated over a shorter time; however, the success rate of alcohol sclerosis is related to the time for which the lining of the cyst is exposed to the alcohol. Even for small cysts containing 20 mL of fluid or less, the alcohol should be left in situ for a minimum of 20 min. After this treatment, all the alcohol is aspirated. Sonography or CT verifies complete emptying of the cyst cavity, and the catheter is removed.

Aside from the standard risks of bleeding, infection, and damage to adjacent organs, complications of cyst sclerosis include severe pain [21]. This is usually due to leaking of a small volume of the alcohol into the peritoneal cavity and may very rarely necessitate termination of the procedure. Minor, transient pain from the infusion of alcohol may be relieved by local instillation of lidocaine (5–15 mL of a 1% or 2% solution) or IV analgesia, usually fentanyl citrate. A transient elevation of body temperature may also be seen during or after the procedure [7, 21]. Termination of the procedure prematurely because of severe pain does not preclude another attempt later [21].

Follow-up imaging is performed 3 months after the procedure to evaluate for recurrence. Occasionally, a second aspiration and sclerosis may be required, especially with larger cysts.

Fig. 2—52-year-old man with cyst that was compressing renal artery and thought to be contributing to patient's hypertension.
A, Sonographic image showing large renal parapelvic cyst.
B, Sonographic image showing renal cyst containing catheter, which was placed using trocar technique.
C, Sonographic image showing catheter deployed within cyst.
Polycystic Diseases

This is a group of diseases resulting in multiple cysts in one or more organs. The most frequently encountered is autosomal dominant polycystic kidney disease. Other polycystic diseases include isolated polycystic liver disease, von Hippel-Lindau disease, and cystic fibrosis, in addition to a number of rare inherited polycystic syndromes. In patients with autosomal dominant polycystic kidney disease, multiple cysts are present in the kidneys. Associated multiple liver cysts are found in up to 30% of patients, and pancreatic cysts in approximately 5%. The renal and liver cysts are often large and may become symptomatic. The most common cause of symptoms is hemorrhage into a cyst. Superinfection may also result in symptoms. Large cysts may cause compressive symptoms on surrounding structures or lead to abdominal pain. These cysts are amenable to percutaneous aspiration as described previously.

Should the cyst again become symptomatic after aspiration, sclerosis with alcohol is the treatment of choice. The technique is identical to that described previously. One advantage to percutaneous management of symptomatic cysts in this group of patients is that, given the multiplicity of cysts, more than one cyst may become large enough to become symptomatic. Each cyst may be treated with alcohol sclerosis in turn, thus obviating repeated surgical intervention.

Pancreatic Cysts

Pseudocysts are the most common cystic lesions of the pancreas and result from a prior episode of acute pancreatitis. The natural history of at least 50% of pseudocysts is resolution [22, 23]. Asymptomatic pseudocysts require no intervention. Pseudocysts larger than 5 cm may cause symptoms of compression on adjacent structures and require treatment. Percutaneous drainage of pseudocysts is a safe and effective form of therapy [24–26]. Approximately 50% of pseudocysts do not communicate with the pancreatic duct, and these drain readily and are unlikely to recur [27]. Once drained, pseudocysts that communicate with the pancreatic duct system can be documented with a fluoroscopically guided injection of contrast material. These pseudocysts are likely to recur if the catheter is removed prematurely. Successfully percutaneous management usually requires long-term placement of the catheter to allow healing of the communication with the duct before removal of the catheter. To help speed this process, octreotide may be given IV to decrease the volume of pancreatic secretions produced [27–30]. Once contrast injection has shown healing of the communication with the pancreatic duct, the catheter may be removed.

Simple cysts of the pancreas are uncommon and usually occur in patients with polycystic syndromes. These cysts, like simple cysts in the other parenchymal organs, become symptomatic when large enough to cause compressive symptoms or after infection or hemorrhage into the cyst. Symptomatic cysts may be drained percutaneously. Should the cyst become recurrently symptomatic, more definitive therapy is required. Given the risks involved with accessing the pancreatic bed surgically, alcohol sclerosis using the technique described above should be considered.

In these cases, it is imperative that lack of communication between the cyst and the pancreatic duct be documented on prior fluoroscopy or CT with a contrast injection, before the alcohol is injected into the cyst cavity.

Cystic neoplasms of the pancreas may be classified loosely as microcystic adenoma, mucinous cystic tumor, or intraductal papillary mucinous tumor. The diagnosis of these and their subsequent management are outside the scope of this article and are discussed elsewhere [31].

Hydatid Cysts

Hydatid disease produces true cysts resulting from infection with the tapeworm Echinococcus granulosus. In primary hydatid disease, larval cysts may develop in any organ. Most patients (up to 80%), however, have only single-organ involvement—most commonly the liver. The right lobe is affected more frequently than the left lobe. After an undefined incubation period, infections may become symptomatic if cysts are actively growing and press on adjacent tissues. Spontaneous or traumatic rupture of the cyst may lead to a sudden onset of symptoms, including death from anaphylaxis due to release of antigenic intracyst protein debris. Other reported complications of untreated hydatid disease include rupture of a longstanding hydatid cyst into the bronchial tree [32, 33] and formation of a fistula between the hydatid cyst and the colon [34].

Diagnosis is made through serology once the disease is suspected. Imaging findings may support the diagnosis or in some instances first suggest the diagnosis when the classic imaging findings are present. Early sonographic findings include a cystic mass with peripheral calcification. As the cyst ages, although it remains well defined, the wall may appear to split and a fragment of the wall may appear to float inside the cyst, producing the so-called water-lily sign. Daughter cysts may be seen within the cyst, resulting in a seapted, almost honeycomb, appearance. A mature, essentially dead cyst appears as a densely calcified mass with posterior acoustic shadowing.

Surgery had been the only treatment available before the introduction of antihelminthic drugs. Surgical therapy includes cyst lavage followed by cystectomy or partial hepatectomy. It still is considered the first-choice treatment but is associated with considerable mortality, morbidity, and recurrence. Relative contraindications to surgery include the presence of multiple cysts, cysts that are difficult to access, dead cysts, and small cysts that are asymptomatic [35]. The benefit of surgery is immediate and total cure. The surgery does, however, carry risks in excess of those generally associated with surgery. These include secondary echinococcosis due to spillage (in 2% to 21% of cases [36]) and a reported operative mortality of 0.5% to 4% [36, 37]. In addition, recurrence is possible if other cysts are present but not resected.

Intraoperatively, instilling hypertonic saline or 0.5% silver nitrate solution into the cysts before opening the cavities destroys the daughter cysts and therefore prevents secondary seeding of the peritoneal cavity or anaphylactic reaction. Treatment with albendazole is usually given for at least 4 days before the surgery and continued for 1 month after surgery and is believed to reduce the risk of secondary echinococcosis [34]. Mebendazole is an alternative antihelminthic agent; however, recent studies have shown that albendazole is significantly more effective than mebendazole in the treatment of whole hydatid cysts (77.9% vs 50.6%, respectively) [38, 39].

Medical management with antihelminthic agents alone has yielded some success, with between 30% and 50% of patients treated showing some improvement in the radiologic appearance of the cysts. However, cure should not be expected with the currently available medications alone. The failure rate for medical management alone approaches 25%, with most cases of relapse occurring within 2 years of cessation of therapy.

Sclerosis—Given the risks associated with surgery and the poor results for oral antihelminthic medication, less invasive methods of treating hydatid cysts have been sought. Traditionally, there has been reluctance to drain
Management of Abdominal and Pelvic Cysts

hydatid cysts percutaneously, reflecting the concern that the lack of control of cyst contents during percutaneous drainage could lead to anaphylaxis or spillage of the contents and result in secondary echinococcosis. However, in the early 1980s, reports of the puncture and aspiration of hydatid cysts began increasing, at first accidentally and then deliberately by Mueller et al. [40]. Contemporaneously, Ben Amor and coworkers [41] percutaneously drained hydatid cysts in sheep, thus encouraging radiologists to drain hydatid cysts in humans.

Percutaneous sclerotherapy of hydatid cysts is now widely used. This procedure is a simple derivative of alcohol ablation of non-parasitic cysts, although several additional measures are required. The technique has been described succinctly by the acronym PAIR—puncture, aspiration, injection, and reaspiration [35] (Fig. 3).

Once the diagnosis is confirmed with serology and imaging, the patient should be pre-treated, as before surgical cystectomy, with albendazole for 4 days, and the treatment should continue for up to 1 month after the procedure. If the cyst is less than 6 cm in diameter, 2 weeks of postprocedural therapy is deemed sufficient [35]. The presence of anesthesiologist is advisable to ensure prompt treatment in the unlikely event that an anaphylactic reaction occurs.

The cyst is punctured under sonographic guidance. A small catheter is placed and the cyst contents aspirated. The first 10–15 mL of cyst fluid is sent for parasitic and biochemical evaluation. Low levels of sodium and chloride have been reported, with elevated levels of potassium in active cysts [42]. If protocolscicles are present and viable, the cyst fluid is aspirated completely, iodinated contrast material is then injected and the catheter is clamped. The integrity of the cyst is checked on the next day with fluoroscopy or CT. A communication may not become evident on cystography for up to 24 hr after drainage of the cyst contents. If a communication with the biliary tree is present, no alcohol is injected. Provided lack of a biliary communication has been confirmed, 95% ethanol is injected into the cyst. Hypertonic saline may be used as an alternative. The volume of alcohol used is approximately one third to one half the volume of fluid aspirated. After 15–20 min, the alcohol is reaspirated. Images are obtained to show resolution of the cyst. The fluid is again checked for viable protocolscicles. If these are present, a second volume of alcohol is injected into the catheter and the process is repeated. If no viable protocolscicles are identified, the catheter is removed. In addition to routine postprocedural observation, these patients should be followed up closely with serology and sonography every week for the first month, every other month for 6 months, and every year for 5 years [36].

Not all hydatid cysts should be drained percutaneously. Treatment with PAIR is successful less often for cysts that, on sonography, appear predominantly solid and for multiseptated cysts that contain multiple daughter cysts. These cysts may be treated better surgically, although some centers are reporting some short-term success with radiofrequency ablation of these cysts.

Results—Alcohol sclerosis of hydatid cysts has proven a safe and effective therapeutic option. Percent reduction of cyst size has been reported at between 73% and 99% [35, 43]. In a series of 61 hydatid cysts treated percutaneously, only one cyst showed recurrence at 4 years [35]. This was successfully treated with a second percutaneous procedure. A second large study of 57 hydatid cysts of the liver treated percutaneously had a recurrence rate of 2% [43], with one cyst recurring after 11 months. This cyst was successfully treated with a second percutaneous procedure.

Of the more than 1,700 reported procedures involving percutaneous drainage of hydatid cysts, only one reversible episode of anaphylaxis has been reported [35, 44]. The 34 minor complications reported in that series included urticaria, pruritus, tachycardia, and tachypnea. One case resulted in a fistula (which was surgically corrected) between the cyst and the gallbladder. These figures suggest that the risk of anaphylaxis when draining hydatid cysts is low if the described precautions are taken.

Lymphoceles

A lymphocele or lymphocyst is a collection of lymphatic fluid in a nonepithelialized cavity lined with fibromembranous tissue. Lymphoceles occur after pelvic surgery in up to 40% of patients undergoing hysterectomy or lymphadenectomy with or without radical prostatectomy [45] and in up to 41% of patients after renal transplantation [46]. Lymphoceles are usually asymptomatic unless they are infected, become hemorrhagic, or are large enough to cause compressive symptoms.

Treatment options for symptomatic lymphoceles, although traditionally surgical, now include percutaneous aspiration, with sclerosis for recurrent lymphoceles (Fig. 4). Alcohol sclerotherapy is an effective treatment method with a high technical success rate, a low rate of recurrence, and an acceptable complication rate and is a less invasive alternative to surgical methods [18].

Lymphoceles are generally more complex than simple cysts of the solid parenchymal organs such as the liver or kidney. They have more septations and contain more debris, potentially making aspiration more difficult, particularly if the septations result in a loculated collection in which the locules do not communicate. In this case, each individual locule must be treated as a separate cyst. Each must be punctured and aspirated separately and each sclerosed in turn.

The technique for draining and sclerosing lymphoceles is similar to that already described (Figs. 5 and 6). Different routes of drainage are used, depending on the location of the lymphocele. Lymphoceles may occur at a surgical incision in the anterior abdominal wall; however, sclerotherapy is best avoided in patients with surgical meshes in place.

Although a transabdominal approach is most often used, a transgluteal approach may be applied for deep pelvic collections. Sonographic guidance is most commonly chosen, although CT may be used for deeply located lymphoceles. Often, a combined sonographic and CT approach is used for lymphoceles, because lymphoceles differ from simple parenchymal cysts in that they are not surrounded by normal solid tissue. As a result, the boundaries of lymphoceles may be less clearly defined on the diagnostic imaging study. Given their location and post-surgical origin, lymphoceles have more potential to communicate with other organs. Injecting alcohol, a sclerosing agent, into any body cavity; into the urinary, biliary, or gastrointestinal tract; or into the peritoneum or a vessel is contraindicated. To prevent inadvertent injection of alcohol into a space other than the lymphocele should there be any doubt about possible communication, dilute contrast material may be injected into the lymphocele after aspiration of the contents to exclude spillage into the peritoneal cavity or communication with the renal collecting system, vessels, or bowel. This contrast material may be injected under sonographic guidance, after which a limited CT scan of the area is obtained to evaluate for a contrast spill. The contrast material used should be a dilute solution (1–2%) of a low-osmolar, nonionic agent. If spillage of the contrast material outside the lymphocele is detected, then no alcohol is injected. The
contrast material should be aspirated and imaging obtained showing complete resolution of the lymphocele.

If the contrast material is confined entirely to the cavity of the lymphocele, then the contrast material is aspirated and alcohol injected. The patient is rotated with the alcohol in the lymphocele as before, to ensure that the entire surface of the lymphocele comes into contact with the alcohol. After approximately 20–30 min, the alcohol is aspirated, as confirmed by imaging. The catheter is then removed, the skin cleaned, and a dressing applied. The patient is monitored in the recovery area for 3–4 hr before being discharged to home.

The aspirated fluid is sent for chemical analysis (blood urea nitrogen, creatinine, triglycerides, and bilirubin), a cell count, and microbiologic evaluation to confirm the diagnosis of a lymphocele. Creatinine, blood urea nitrogen, and bilirubin levels in lymphoceles are the same as in the serum—a fact that is important in differentiating them from biloma or urinoma. The triglyceride levels are elevated in lymphoceles—the diagnostic criterion that differentiates them from a postsurgical seroma.

Imaging is performed 3 months after the procedure. If a recurrent lymphocele is identified on follow-up imaging, treatment is repeated. Recurrence is more likely with large lymphoceles, which may require more prolonged treatment with catheter insertion and multiple sessions of alcohol sclerotherapy.

**Fig. 3**—64-year-old woman with hydatid cyst within right lobe of liver.

A, CT image from diagnostic scan showing well-defined hydatid cyst.

B, Predrainage sonographic image showing hydatid cyst.

C, CT image showing drainage needle within cyst.

D, Image showing that iodinated contrast material has been injected into cyst to confirm its integrity and ensure no communication between cyst and biliary system. Alcohol has been injected into cyst and is seen floating on contrast material (arrow).
Unilocular Ovarian Cysts

Simple ovarian cysts in pre- and postmenopausal women are usually benign, and almost 25 years of accumulated experience have led to the formulation of conservative treatment and management guidelines for these masses. Most postmenopausal women with unilocular ovarian cysts up to 10 cm in diameter do not require surgery. Simple ovarian cysts can be treated successfully by needle drainage in both pre- and postmenopausal women. Success depends on the size of the cyst and the age of the patient; reaccumulation rates are higher in postmenopausal women. The larger the cyst, the higher the recurrence rate, most likely because of the larger surface area of the fluid-producing inner lining. Cysts larger than 5 cm are generally not suitable for this type of treatment because the recurrence rate is high, around 80%. We drain cysts that are completely anechoic; have no wall thickening (< 3 mm), nodularity, or thick septations (< 3 mm); and have no evidence of abnormal diastolic flow. We insist on a normal carcinoembryonic antigen-125 result before aspiration biopsy.

In premenopausal women, most simple cysts in the pelvis are functional. Therapy may be required if these cysts are larger than 5 cm, because they may undergo torsion or hemorrhage.

Other Pelvic Cystic Lesions

A variety of other cystic lesions may be identified on imaging. These cysts include peritoneal inclusion cysts and paraovarian cysts. Should these cysts become sympto-
matic, drainage and sclerosis may be indicated. The technique for draining and sclerosing these cysts is similar to that for parenchymal cysts. Paraovarian cysts are the most common. They are located in the broad ligament and usually are of paravesicle or mesothelial origin or occasionally originate from mesonephric or wolffian remnants. These cysts occasionally are seen to contain hemorrhage-producing internal septations and solid components on cross-sectional imaging. When they become enlarged, they produce pain and may undergo torsion. Aspiration and sclerotherapy can be offered to this group of patients.

Peritoneal inclusion cysts result from serous fluid collections that become entrapped by adhesions resulting from pelvic surgery or pelvic inflammatory disease. Patients usually have chronic abdominal or pelvic pain. Functioning ovarian tissue must be present for one to make this diagnosis. Fluid released by the ovary becomes entrapped and is usually reabsorbed by the peritoneum, at a rate that is 20% less for scarred peritoneum than for normal peritoneum. If the cyst becomes enlarged, it may produce pain and require drainage and sclerosis.

**Management of Pelvic Cystic Lesions**

Traditionally, surgery was performed. During laparoscopy or laparotomy, the cyst was punctured, drained, and removed. Complications after surgery included pain, hemorrhage, and possible development of pelvic adhesions.

Sonography-guided puncture of large or symptomatic cysts is an alternative to surgery and minimizes the complications, including
adhesions and infertility. Aspiration of the fluid also helps identify the nature of the cyst. The success of the therapy depends on selection of only simple cysts and the accuracy of cytopathologic analysis.

Cystic lesions in the pelvis pose a special dilemma because they may be inaccessible to percutaneous biopsy and drainage. The urinary bladder and bowel may preclude the use of an anterior approach, whereas the bony pelvis limits lateral and posterior access. Consequently, a transvaginal route may need to be used, depending on the size, location, sonographic characteristics, and clinical presentation of the lesion. Traditional percutaneous access is used only for large, anterior pelvic cystic masses near the abdominal wall. The transvaginal route is effective and safe for draining noninfected cystic lesions but is limited to collections in the central and anterior pelvis. This route does not provide good access to lesions extending to the presacral space or into the ischiorectal fossa.

Other Rare Cystic Lesions

A rare intraabdominal cyst that may cause symptoms is the urachal cyst. A urachal cyst develops when the urachus closes at both the umbilicus and the bladder but remains open in the middle. Urachal cysts vary in size and are usually asymptomatic, unless they become enlarged or superinfected. Infection is the most common complication. The route of infection can be lymphatic, hematogenous, or urinary. Infected urachal cysts require drainage. If not treated, they spontaneously can rupture into the peritoneum, causing peritonitis.

CT and sonography show a thick-walled complex cystic lesion in the midline of the anterior lower abdomen, behind and below the umbilicus and above the bladder. Percutaneous aspiration biopsy and drainage are essential for correct diagnosis. Although definitive treatment of a urachal cyst is surgical, infected cysts may be treated with catheter drainage. Alcohol sclerosis is not a treatment option for urachal cysts because, unlike simple parenchymal or postoperative cysts, they have malignant po-

Fig. 6—63-year-old woman with malignant melanoma. A, Sonographic image showing small inguinal lymphocele, which, because of its location in groin, was symptomatic despite its small size. B, Sonographic image showing draining needle in lymphocele. Echogenic dots in middle of cyst are the needle. C, Postalcohol sclerosis sonographic image showing resolution of lymphocele seen in A.
tential [47]. For this reason, close follow-up is required at intervals and the cyst should be excised if any nodularity of the wall develops.

Many other cysts occur in the abdomen and pelvis, although most rarely come to the attention of the interventional radiologist. These include cysts in the spleen, adrenals, or male reproductive organs; mesenteric or omental duplication cysts; and Gartner’s duct cysts. Cysts at these sites are relatively uncommon and, when they do occur, are rarely symptomatic.

The most common splenic and adrenal cysts are pseudocysts after trauma or infection. True congenital cysts of these organs are rare. Like cysts in the liver or kidney, splenic and adrenal cysts may become symptomatic when infected, bleeding, or large enough to cause compression. The traditional management of these cysts is surgical, and little has been published on their percutaneous management. There is no reason why cysts in these organs should not be treated percutaneously with alcohol sclerosis. Percutaneous intervention on the spleen has been shown to be feasible and safe, and fear of bleeding unwarranted [48].

Cysts of the male reproductive system include prostate cysts, epididymis cysts, and cysts of the seminal vesicles and vas deferens. These, also, are rarely symptomatic. The most common difficulty with these cysts is that they may contribute to male infertility. The role of the interventional radiologist in these cysts is limited. Once diagnosed on endorectal sonography, large cysts may be aspirated under sonographic guidance. In patients with infertility and low semen volume, cysts of the vas deferens containing viable sperm may be aspirated. The contents may be used for successful in vitro fertilization [49]. Although uncommon, this procedure has proven to be of exceptional value to patients in these circumstances.

Mesenteric and omental duplication cysts are frequently detected on CT scans and are commonly small and asymptomatic. When large and causing compressive symptoms, they require intervention. They usually become symptomatic in childhood. The management of these cysts is surgical, and complete excision usually is possible [50]. Interventional radiology does not play a role in these cases.

Gartner’s duct cysts may cause symptoms by obstructing the ureter. The cyst then may be aspirated under sonographic guidance. If the cyst becomes recurrently symptomatic, surgical excision is required.

Summary

Many types of cystic lesions are found in the abdomen and pelvis, few of which come to the attention of the interventional radiologist. Those that do are symptomatic. It is not difficult to differentiate cysts from cystic-appearing masses when a multitechnique imaging approach is used. This review has focused on the percutaneous management of cysts in the abdomen and pelvis. Percutaneous aspiration, either alone or with alcohol sclerosis, is effective, safe, and easy to perform and relieves symptoms without the need for surgery. A sound knowledge of the different cysts that may be found in the abdomen and pelvis enables the radiologist to select those candidates who will benefit the most from percutaneous management.

References

Management of Abdominal and Pelvic Cysts

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