Splenic Cysts
Mark Berner Hansen and Anne Claudi Møller

Abstract: The treatment of splenic cysts is a difficult challenge to surgeons and physicians. This paper reviews the literature on splenic cysts, with special attention to the pathogenesis, diagnosis, and various options of surgical treatment. Splenic cysts are classified as primary or secondary cysts, according to the presence of an epithelial lining. The primary cysts are further subdivided as parasitic or non-parasitic. Secondary cysts are in most cases posttraumatic. Symptoms are usually correlated to the size of the cyst. Prior to surgery, imaging with ultrasound and computer tomography or magnetic resonance should be performed. A cyst puncture should be conducted for diagnostic purposes (amylase and bacteria) as well as to reduce the size of the cyst. Furthermore, the titer of Echinococcus and other biomarkers can be measured. Surgeons should make every possible effort to preserve splenic tissue and spleen-saving techniques with laparoscopic techniques are recommended.

Key Words: case story, computer tomography, fenestration, laparoscopic, magnetic resonance, marsupialization, pathogenesis, review, serum carbohydrate antigen 19-9, ultrasound, splenic cyst, splenectomy, surgery

(Surg Laparosc Endosc Percutan Tech 2004;14:316–322)

The treatment of splenic cyst is a difficult challenge to physicians and surgeons. The number of diagnosed symptomatic and especially nonsymptomatic splenic cysts seems to rise because of the increased use of abdominal imaging such as ultrasound (US), computer tomography (CT), and magnetic resonance (MR). Nonoperative treatment of splenic injuries as well as spleen preserving operation, creating iatrogenic hematomas, are other proposed reasons to the increased numbers of splenic pseudocysts.1,2

The pathogenesis and the treatment of splenic cysts have been controversial. However, now there seems to be an agreement in the literature. In this review article, the pathogenesis, symptoms, diagnosis, and surgical treatment of splenic cysts are presented as a summarized reflection of current practice in referral centers.

CASE REPORT
A 65-year-old man was examined at the Department of Surgical Gastroenterology D, Glostrup University Hospital of Copenhagen, Denmark, for back pain. Except for an uncomplicated inguinal hernia and nephrolithiasis previously, the patient's history was unexceptional. Especially, there was no history of trauma or infections. The physical examination revealed normal findings except for hypertension (220/120 mm Hg) and a palpable mass in the left hypochondria. US- and CT-scan revealed a big 11 × 12 × 15 cm, smooth walled, homogeneous splenic cyst with a possible relation to the pancreas (Fig. 4). Furthermore, several cysts were found in the liver, the suprarenal gland, and the left kidney. The wall of the cyst was calcified and a few mm thick. The surrounding organs were, because of the size of the cyst, dislocated from their normal position. MR scan combined with MR-choledocho-pancreaticography did not show a communication between the cyst and the pancreas (Fig. 5). Echinococcus—antibody titer was negative. Also plasma-aldosterone and other blood samples showed normal levels. After a US-guided aspiration emptying of 1300 mL of yellow-white liquid from the cyst, the patient was without symptoms. A cytologic- and microbiological examination of the cyst liquid revealed sterile conditions without any content of amylase. The histologic diagnosis was hemorrhagic liquid. A US scan was carried out 2 and 8 months later and demonstrated redevelopment of the cyst. The patient refused operation treatment.3

Search Strategy and Selection of Data
The review paper is based on a Pub-Medline search (1960–2004) we did of reports published in English, with the keywords: splenic cysts. We reviewed the available literature with respect to the pathogenesis, diagnosis, and various options of treatment. As no prospective randomized clinical trials exist for the diagnosis and treatment of splenic cysts, we selectively used data from series of cases and other anecdotal reports to suggest algorithms for the diagnosis and surgical treatment.

Pathogenesis
Splenic cysts are classified as either primary or secondary cysts, according to the presence or absence of an epithelial lining of the lumen.4,5,6

Primary Cysts
The primary cysts are subdivided into parasitic and non-parasitic.1,5,7,8 A suggested algorithm of the splenic cyst classification is depicted in Figure 1.

The parasitic cysts occur after infection by the Tenia Echinococcus, most often Echinococcus granulosus. The most common organ infected by the parasite is the liver followed by the spleen and the lungs.5,9,10
FIGURE 1. An algorithm for the classification of splenic cysts is suggested as presented. Splenic cysts are classified as primary if they have an epithelial lining toward the cystic lumen or secondary if they are without an epithelial lining. Primary cysts are either parasitic or non-parasitic. The non-parasitic cysts are subdivided into congenital or neoplastic. The congenital cysts are further classified as epidermoid cysts, dermoid cysts, or simple cysts. Secondary cysts are mostly posttraumatic.

The nonparasitic cysts are either congenital or neoplastic. The congenital cysts are originally divided into epidermoid, dermoid, and endodermoid cysts. The epidermoid cysts can result from either embryonic inclusion of epithelial cells from adjacent structures followed by cystic dilatation, or be the result of an invagination of the capsular surface mesothelium. Epidermoid cysts can also follow trauma with metaplasia within mesothelial cysts. Epidermoid cysts should be classified as primary, as they are mesothelial in origin and have focal squamous metaplasia. The cystic wall of the epidermoid type appears to be fibrotic with a variety of trabecular architecture, probably due to reorganization of stromal/luminal bleeding with a content of yellow proteinous liquid (Table 1). Dermoid cysts are extremely rare. They are considered to be cystic teratomas and contain structures derived from the three germ layers. The endodermoid cysts are not true cysts, but are rather a cystic vascular lesion composed of several ectatic vessels. They should be classified as a lymphangioma or a hemangioma. Cystic neoplastic tumors can, in addition to parasitic and congenital splenic cysts, be found in the spleen. The epidermoid subtype accounts for 90% of the primary non-parasitic cysts, while the dermoid cysts accounts for most of the remaining cases.

Secondary Cysts

The spleen is the most commonly injured intraperitoneal organ following abdominal trauma. According to the type and intensity of the trauma, the site of the vascular injury in the parenchyma, the blood coagulation pattern and an intact splenic capsule, an intraparenchymal or subcapsular hematoma may result. Organization, liquefaction, resorption, and encapsulation may lead to the formation of a pseudocyst. Apparently posttraumatic cysts account for 75% of all non-parasitic splenic cysts, although 30% of patients do not recall any trauma. Secondary cysts might also develop because of splenic infarcts or infections (eg, mononucleosis, tuberculosis, or malaria), which enlarges and makes the spleen more vulnerable.

The pseudocyst contains a liquid mixture of blood and necrotic debris. The wall of the posttraumatic cyst does not have an epithelial lining and deposited hemosiderin is often detected microscopically (Table 1). However, hemorrhage may also occur in the case of primary cysts. Furthermore, the epithelial lining of the primary cyst can be atrophic, which some times make the primary cysts difficult to be distinguished from secondary cysts.

Clinically it is not possible to distinguish between primary and secondary cysts, although adhesions are reported to be associated with secondary cysts. Additionally the parasitic cysts are more frequently multilocular, whereas the nonparasitic cysts most often appear to be unilocular.

Incidence

The incidence of splenic cysts is low. Only 800 cases have been reported and in small series. The primary nonparasitic congenital cysts are seen predominantly in children and young adults. The primary parasitic cysts appear to be endemic in South America and the Mediterranean area. The parasite is rare in the Western world, yet this group of cysts probably accounts for most splenic cysts worldwide.

The age group covering most of the secondary cysts are young and middle aged adults, with 60% being women in the

TABLE 1. Case Reports

<table>
<thead>
<tr>
<th>Sex/Age</th>
<th>Pathogenesis</th>
<th>Symptoms</th>
<th>Size</th>
<th>Preoperative Examination</th>
<th>Calcification of the Cyst</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/62</td>
<td>Traumatic</td>
<td>None</td>
<td>B</td>
<td>US, CT, MR, MRCP NBV</td>
<td>Yes</td>
<td>Patient refused</td>
</tr>
<tr>
<td>Female/11</td>
<td>Congenital?</td>
<td>Abdominal pain</td>
<td>S</td>
<td>US, MR, NBV</td>
<td>None</td>
<td>Conservative</td>
</tr>
<tr>
<td>Male/22</td>
<td>?</td>
<td>Left-sided flank and groin pain</td>
<td>S</td>
<td>US, CT, NBV</td>
<td>Spleen hilus</td>
<td>Conservative</td>
</tr>
<tr>
<td>Female/36</td>
<td>Traumatic</td>
<td>Left-sided flank pain radiating to left shoulder</td>
<td>M</td>
<td>USGCP, CT, NBV</td>
<td>None</td>
<td>Conservative</td>
</tr>
<tr>
<td>Female/27</td>
<td>?</td>
<td>None</td>
<td>S</td>
<td>US, CT, NBV</td>
<td>None</td>
<td>Conservative</td>
</tr>
<tr>
<td>Male/33</td>
<td>Traumatic</td>
<td>Left-sided flank pain Relief at meals</td>
<td>M</td>
<td>US, CT, NBV</td>
<td>None</td>
<td>Conservative</td>
</tr>
</tbody>
</table>
fertile age. The reason for this female prevalence is unknown. Hormonal influences causing splenic infarction, and micro-trauma to the more vulnerable spleen in pregnant women have been suggested as possible causes.

**Symptoms**

More than 70% of patients with a splenic cyst do have symptoms, and more than half of the asymptomatic cysts can be detected by a physical examination (see case report, Table 1). A painless abdominal mass as well as typical splenomegaly, early satiety, nausea, vomiting, flatus, and weight loss are frequently present (Table 1).

Some patients present with continuous or inconsistent left-sided abdominal or epigastric pain, as well as radiating left shoulder pain, or involving the abdomen like a "tight belt." The pain is due to distension of the capsule, or the mass effect of the cyst, such as dislocation and compression of the adjacent organs (see case report, Table 1). If the left kidney is affected, the result might be proteinuria and hypertension.

Thrombocytopenia, granulocytopenia and anemia might appear as a result of the relation of the spleen to the blood circulation. Cough and dyspnea may occur as well as pleural exudates and empyema due to a transdiaphragmatic and bronchial fistula.

**Diagnostic Methods**

When a splenic mass has been identified, several follow-up examinations should be carried out before the choice of treatment is taken. X-ray with contrast of the stomach can be useful to exclude a fistula to the gastrointestinal tract. Preoperative US and CT scan and/or MR are helpful in determining whether the cyst is multi- or unilocular, the location in the spleen, and its relationship to the surrounding structures. Furthermore, these imaging modalities can help plan the optimal operative approach, especially if a laparoscopic approach is being considered.

**Ultrasound**

With abdominal or laparoscopic US, the typical splenic cyst appears as a round homogeneous, anechoic area with marked echo enhancement and with a smooth, thin wall. However, sometimes thin septations, irregular cyst wall, and a mixed pattern of echogenicity from internal debris or hemorrhage, as well as peripheral brightly echogenic foci with distal shadowing due to cyst wall calcifications may contribute to a more complex picture.

**Computed Tomography**

At CT, with helical scanning after bolus contrast material administration, splenic cysts are typically spherical, well-defined lesions with attenuation near water and a thin or imperceptible wall and no rim enhancement. Cyst wall calcifications and septations are well demonstrated.

**Magnetic Resonance**

On both T1- and T2-weighted MR images, splenic cysts typically have a signal intensity equal to that of water; however, depending on the composition of the cystic fluid (eg, serous or hemorrhagic), the signal intensity on T1-weighted images may be increased, whereas the signal intensity on T2-weighted images remains high. MR is also useful to achieve a view of the relationship between the cyst, the spleen, and the surrounding organs.

**Doppler Ultrasound/Angiography**

Doppler US is helpful in deciding if it is a pulsatile tumor. An angiography is an important preoperative examination if partial splenectomy is considered, due to the extremely variable anatomy of the splenic vessels.

**Cystic Puncture/Blood Samples**

When a splenic cyst is considered to be clinically benign, especially according to imaging diagnostic findings, US-guided percutaneous cyst puncture has proven extremely useful, not only for establishing the diagnosis (bacteria, amylase), but also to reduce the size of the cyst. However, the theoretical risk of seeding malignant cells into the peritoneum or along the needle tract should be kept in mind, although this risk is minimal. Furthermore, a cyst aspiration is performed to exclude a neoplasm (eg, a communicating mucinous cystadenocarcinoma from the pancreas). Preoperatively, it is of great importance to exclude the presence of Echinococcus to avoid spread as well as anaphylactic shock. Therefore, blood samples for determination of parasite antibodies (titer) should always be taken although these tests are nonspecific and therefore unreliable.

**Biomarkers**

Serum carbohydrate antigen 19-9 (CA 19-9) level of the epidermoid cysts content has often proven to be elevated. The subsequent immunohistological examination often reveals that the stratified squamous epithelium is positive for CA 19-9. This finding suggests that CA19-9 is secreted from the epidermoid cyst epithelium into the blood flow. Postoperatively, the patient's serum CA 19-9 level returns to normal levels. Thus, CA 19-9 should be measured preoperatively to support the histologic diagnosis, as well as three months later to exclude recurrence. However, CA 19-9 and carcinoembryonic antigen (CEA) are also sensitive tumor markers in differentiating benign pseudocyst from mucinous cystic neoplasm of the pancreas, although the specificity is low. Furthermore, the CA 72-4 tumor marker can be used to detect mucinous pancreatic tumors as it has both a high sensitivity and specificity. This is interesting due to the possible splenic pseudocyst communication of the pancreas.

**DIFFERENTIAL DIAGNOSIS TO SPLENIC CYSTS**

Numerous differential diagnoses are possible. Splenomegaly is the most frequent, but is not a specific entity, only a manifestation of a systemic disorder. Mild splenomegaly could be due to infections such as mononucleosis, tuberculosis, congenital lues, histoplasmosis, and sepsis. Moderate splenomegaly occurs in hematological diseases (eg, congenital hemolytic anemia, lymphoma, and portal hypertension). Severe splenomegaly can result from leukemia, primary tumors (such as hemangioma and lymphangiomata), and infection with malaria. Miscellaneous other reasons could be cysts, abscesses, and tumors in the surrounding organs.
surg laparosc endosc percutan tech • volume 14, number 6, december 2004

splenic cysts

TABLE 2. Options for Treatment
1. Conservative
2. Percutaneous drainage
3. Complete or partial splenectomy
4. Marsupialization
5. Fenestration

such as a pancreatic pseudocyst extending into the splenic parenchyma.15,16,21 Calcifications of both the primary and secondary cysts are frequently found, which are useful in diagnosing cysts from causes other than splenomegaly.9,13

TREATMENT

TREATMENT OF SPLENIC CYSTS HAS PREVIOUSLY BEEN BASED UPON PERSONAL EXPERIENCE. HOWEVER, THE NUMBER OF REPORTED CASES IS NOW OF A MAGNITUDE TO MAKE IT POSSIBLE TO DRAW GENERAL CONCLUSIONS WITH RESPECT TO THE CHOICE OF TREATMENT. THE PROCEDURES OF CHOICE FOR A PATIENT WITH A SPLENIC CYST ARE POTENTIALLY MANY (TABLE 2). IN FIGURE 2 WE SUGGEST AN ALGORITHM FOR THE TREATMENT OF SPLENIC CYSTS.

NONOPERATIVE TREATMENT

A NONOPERATIVE APPROACH IS THE GENERALLY ACCEPTED TREATMENT OF CHOICE IF THE DIAMETER OF THE CYST IS LESS THAN 5 CM, BECAUSE THESE CYSTS OFTEN RESOLVE.4,6,8 IF THE CYST IS LARGER THAN 5 CM IN DIAMETER OR SYMPTOMATIC, IT IS GENERALLY ACCEPTED THAT A SURGICAL INTERVENTION SHOULD BE PERFORMED.1,4,7,16,22 HOWEVER, THE EVIDENCE FOR CHOOSING SIZE AS A CUTOFF LIMIT SEEMS POOR.

THE MOST FEARED COMPLICATION OF SPLENIC CYSTS IS RUPTURE. HOWEVER, A LITERATURE SEARCH DEMONSTRATED ONLY 3 CASE HISTORIES DESCRIBING RUPTURE, AND ONLY 1 CASE WITH INFECTION OF THE CYST.21,25 IN THE CASE OF CYSTIC HEMANGIOMA OF THE SPLEEN, QURESHI AND HAFNER DEMONSTRATED A 25% RATE OF SPONTANEOUS RUPTURE WITH A MORTALITY RATE OF 20% TO 25%.26 HOWEVER, THE TRUE INCIDENCE OF RUPTURE OF PRIMARY AND SECONDARY SPLENIC CYSTS IS UNKNOWN.4 HEMOPEROITONEUM, PERITONITIS, ABSCESSES, ANAPHYLACTIC SHOCK, AND ENEMPYEMA ARE SOME OF THE COMPLICATIONS TO A RUPTURE.5,7 IN SUMMARY, RUPTURE AND INFECTION MUST BE VIEWED UPON AS BEING DANGEROUS BUT RARE COMPLICATIONS.

PERCUTANEOUS DRAINAGE

PERCUTANEOUS DRAINAGE OF THE CYST, WITH OR WITHOUT SCLEROSEING, IS FOLLOWED BY A HIGH INCIDENCE OF RECURRENCE.1,4,6,15 FURTHERMORE, IT MAY RESULT IN ADEHERENCES TO THE SURROUNDING ORGANS. A DENSE INFLAMMATORY RESPONSE AROUND THE SPLEEN IS ANOTHER COMPLICATION, RENDERING ANY SUBSEQUENT OPERATION DIFFICULT.6,16

OPERATIVE TREATMENT

HISTORICALLY, THE OPEN SURGICAL APPROACH TO SPLENIC CYSTS HAS BEEN OPEN COMPLETE SPLENECTOMY.4 TODAY, A SPLEEN-PRESERVING MINIMALLY INVASIVE APPROACH IS RECOMMENDED DUE TO THE FACT THAT THE SPLEEN PLAYS AN IMPORTANT ROLE IN SEVERAL FUNCTIONS: REGULATION OF THE CIRCULATING BLOOD VOLUME, HEMATOPOIESIS, IMMUNITY, AND PROTECTION AGAINST INFECTIONS AND MALIGNANCIES.1,11,16,27

THE RISK OF DEVELOPING AN OVERWHELMING POSTSPLENECTOMY INFECTION IS MULTIPLIED BY 200 IF THE SPLEEN IS REMOVED, COMPARED WITH THE BACKGROUND POPULATION, ALTHOUGH THE INCIDENCE IS STILL LOW (0.3%–0.7%).1,4,16,28 THE ORGANISMS MOST FREQUENTLY ISOLATED IN POSTSPLENECTOMY PATIENTS ARE STREPTOCOCCUS PNEUMONIA, NEISSERIA MENINGITIS, HEMOPHILUS INFLUENZAE, AND ESCHERICHIA COLI.27 VACCINES COVERING THE FIRST THREE BACTERIA SPECIES ARE AVAILABLE IN CASE A COMPLETE SPLENECTOMY IS UNAVOIDABLE.4

SOMETIMES IT IS NECESSARY TO PERFORM COMPLETE SPLENECTOMY. THIS TECHNIQUE IS RECOMMENDED IN POLYCYSTIC CASES, WHERE THE CYSTS ARE INACCESSIBLE FOR FENESTRATION OR MARSUPIALIZATION (SEE BELOW). A PARTIAL SPLENECTOMY WOULD BE TECHNICALLY DIFFICULT TO PERFORM IF THE CYST IS VERY LARGE AND ALMOST COMPLETELY COVERED BY SPLENIC PARENCHYMA. IN THESE CASES A COMPLETE SPLENECTOMY IS RECOMMENDED BECAUSE OF THE RISK OF INTRACTABLE BLEEDING FROM THE SPLEEN. IF ANOTHER SURGICAL APPROACH IS CARRIED OUT, FOR EXAMPLE FENESTRATION OF THE CYST, AND THE INTRAOPERATIVE BLEEDING BECOMES UNCONTROLABLE, ONE HAS TO CONVERT TO TOTAL SPLENECTOMY WITH NO HESITATION.

FIGURE 2. AN ALGORITHM FOR THE TREATMENT OF SPLENIC CYSTS IS SUGGESTED AS PRESENTED. THE TREATMENT OF SPLENIC CYSTS VARIES ACCORDING TO SIZE, NUMBER, PATHOGENESIS, AND LOCATION.
The surgeon must carefully avoid contact between the cystic contents and the circulation, because anaphylactic shock can develop.\textsuperscript{10} In case of multiple splenic hydatid cysts, it is recommended that parasitic cysts are not to be considered as suitable for surgical treatment.\textsuperscript{5,29} However, one group has found that chemical sterilization followed by laparoscopic complete splenectomy is successful in these patients and the recurrence rate is low (4\%). However, if there exists a single or only a few cysts caused by the parasite, medical treatment and cyst evacuation is recommended to achieve splenic salvage.\textsuperscript{10} Centrimide (cetyltrimethylammonium bromide) 0.1\% is the potent chemical agent used to ensure the death of all viable scolices. It is used to fill in the cavity and left in place for 10 minutes, followed by aspiration and opening of the cyst. A known complication to this drug is methemoglobinemia and peritoneal irritation. Methemoglobinemia is easily treated by intravenous methylene blue, and peritoneal irritation is tested by a saline wash of the abdomen after treatment.\textsuperscript{5}

**Open Versus Laparoscopic Approach**

Comparing the laparoscopic treatment of splenic cysts to open operation, the former approach seems to offer the benefits of minimally invasive surgery: reduced morbidity and mortality, a shorter hospital stay, faster recovery, less postoperative pain, preserved sufficient splenic function, a more satisfying cosmetic outcome, and fewer wound-related complications.\textsuperscript{5,10} However only the peripherally (most frequently secondary) located cysts seem appropriate for laparoscopic treatment as compared with the centrally and deeply located ones, which are most frequently primary cysts.\textsuperscript{30}

**Complete Splenectomy**

Complete splenectomy can be performed safely laparoscopically (eg, with “hand-assistance”), even for huge splenic cysts.\textsuperscript{21} Sakamoto et al advise the use of the harmonic scalpel. This instrument is able to perform adequate dissection of the hilar tissue followed by ligation/stapling of the hilar vessels. This procedure results in minimal intraoperative blood loss from the hilar vessels.\textsuperscript{11}

**Partial Splenectomy**

It is estimated that 25\% of the splenic parenchyma, if irrigated by splenic vessels, is sufficient to achieve immunologic protection. Partial splenectomy satisfies this goal and has proven to be better in outcome compared with splenic auto-transplantation.\textsuperscript{7} Partial splenectomy is recommended if the cyst cavity is deep due to the higher risk of recurrence.\textsuperscript{5} If the cyst is localized at the upper or lower pole of the spleen, the surgical approach could also be laparoscopic partial splenectomy.\textsuperscript{1,4}

Partial splenectomy can be performed with low risk.\textsuperscript{7} In performing partial splenectomy, the vessels supporting the region of the cyst need to be controlled. A harmonic scalpel is recommended to incise the capsule of the spleen on the ischemic cystic side. The communicating branches between the nearly avascular cyst area and the viable portion of the spleen are divided and controlled. Complete hemostasis cannot be accomplished with the use of an ultrasonically activated instrument only. An Argon Beam Coagulator is recommended to prevent oozing from the freshly divided surface and to achieve complete hemostasis using gauze, with oxidized cellulose, by sustaining compression for 10 minutes.\textsuperscript{1,4}

**Marsupialization**

Laparoscopic marsupialization is recommended by various authors when the cyst is superficially located. The technique is simple, safe and carries no risk of recurrence as compared with other splenic conservation procedures. The approach also reduces the duration of operation and can be performed safely in children.\textsuperscript{5,10}

Diathermia and suture machines are used to separate the cystic wall from the splenic parenchyma and to control bleeding. Ultrasonically activated dissection instruments have proven to be of great help for this.\textsuperscript{5} Recent reports have also described the use of “needlescopic” operation technique, which provides the advantage of minimal access, to be safe. The technique is successfully used in incising the cystic wall using the electrocautery or laparoscopic coagulating shears.\textsuperscript{5,11} Whether this technique is superior to the other ones is yet unclear.

**Fenestration**

Fenestration is a simple method of managing superficially placed cysts. The use of laparoscopic ultrasound enables the surgeon to determine the precise size and morphology of the cyst and to decide the thinnest part of the cyst wall for resection (Fig. 3).\textsuperscript{32} A portion of the cyst wall is resected to create a permanent opening into the peritoneum. Whether the approach is open or laparoscopic, the risk of recurrence of the cyst is the same. However, to reduce the risk of reappearance of the cyst, the surgeon should remove a sufficiently large section of the cystic wall and attach the omentum over the resulting parenchyma defect.\textsuperscript{6,29}

**FIGURE 3.** A splenic cyst identified during laparoscopy and characterized with laparoscopic US in a 36-year-old female is presented. The wall of the cyst is 16 mm thick wall and consists of splenic parenchyma. Laparoscopic fenestration was performed without significant recurrence of the cyst. Reproduced with permission.\textsuperscript{3}
TABLE 3. Complications to Laparoscopic Treatment

1. Perforation of hollow organs when establishing the pneumoperitoneum.
2. Bleeding from the major vessel caused by puncture from the Veress needle or laparoscopic/camera trocar.
3. Thermal damage to the intestine from electrocautery resulting in early or late perforation.
4. Bleeding from the spleen.
5. Subcutaneous emphysema.
6. Wound infection.
7. Undetected injury to the colon accompanied by abscess and peritonitis.
8. Thrombosis or embolism.

For further details on preparations such as anesthesia, positioning of the patient as well as step-by-step procedure please see other recent publications. For details on intra- and postoperative complications as well as contraindications to operation (Tables 3 and 4).

Postoperative Treatment and Follow-up

It might take the remaining spleen months to regain an adequate level of immune competence. For those patients not vaccinated preoperatively, some authors recommend the prophylactic use of antibiotics during the first 3 postoperative months or until a scintigraphy has detected satisfying splenic function. However, to avoid the high risk of multiresistant bacteria, a more modest use of antibiotics seems appropriate. Strict follow-up of nonoperatively treated patients is required to evaluate whether the cyst has progressed. One might propose an ultrasound-examination once a year for the following 5 years to monitor the size of the cyst, as well as a postoperative (eg, 3-month) examination on surgically treated patients to exclude reappearance of the cyst. Furthermore a measure of CA 19-9 and CA 72-4 is proposed to exclude the reappearance of the congenital epidermoid cyst 3 months after operation as well as the spread of a potentially pancreatic mucinous adenocarcinoma.

CONCLUSIONS

The preferable imaging modalities for diagnosing splenic cysts are US, CT, and MR scans. Preoperatively, blood samples (parasite titer, serum CA 19-9) and a US-guided splenic cyst puncture should be performed for diagnostic purposes (amylase, bacteria, CA 72-4) as well as to reduce the size of the cyst. High serum values of CA 19-9 and high CA 72-4 fluid levels indicate that the splenic cyst could be a mucinous cystic neoplasm of pancreatic origin. Non-symptomatic cysts less than 5 cm in diameter can be treated non-operatively. Cysts larger than 5 cm in diameter or symptomatic ones should be treated surgically. The surgeon should attempt to preserve as much of spleen parenchyma as possible. Compared with the open approach, laparoscopic treatment, assisted by laparoscopic US, seems to offer safety and all the benefits of minimally invasive procedures and should therefore be the choice of the surgical approach. If the

TABLE 4. Contraindications for Laparoscopic Treatment

1. Coagulopathy.
2. Infection (abscess).
3. Demonstrated or suspected neoplastic cyst.
4. Perisplenitis or other disorders with extensive, broad adhesions.
cyst is superficial, the approach should be fenestration or marsupialization. If the cyst is placed in one of the poles or deeply within the splenic parenchyma, the treatment of choice is partial splenectomy performed after angiography.

In case of a congenital cyst a measure of the CA 19-9 serum level should be performed 3 months after operation to exclude reappearance. A US scan followup once a year for 5 years should be performed to make sure the cysts do not progress.

ACKNOWLEDGMENTS

The authors thank René Jensen, MD, Department of Radiology, the Department of Surgical Gastroenterology D at Glostrup University Hospital of Copenhagen, and Henrik Loft Jacobsen, MD, and colleagues, Denmark, for providing help with cases and imaging material.

REFERENCES


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