Review Article

Narrative review of laparoscopic management of hepatic cysts

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Abstract: Hepatic cysts are a common and often asymptomatic finding. In this review we will discuss the diagnosis and treatment of hepatic cysts with a specific focus on minimally invasive surgical approaches. Most simple cysts are asymptomatic and do not require intervention. As cysts increase in size they may cause a range of symptoms including satiety, fullness, a palpable mass, and rarely bleeding or secondary infection. Surgical approaches are reserved for symptomatic lesions, and hydatid disease. It is important to rule out bacterial infection (abscess) and neoplasm in the work up of hepatic cysts. While cysts are often detected by ultrasound, Computed tomography and Magnetic Resonance Imaging are the primary modes of assessment for these lesions. Most cysts can be managed by unroofing or marsupialization alone, with formal liver resection rarely required. Minimally invasive surgery (MIS) techniques have been described for many years including laparoscopic and recently, robotic approaches. Hydatid cysts require special attention to control of contents to avoid anaphylaxis but can also be managed laparoscopically. Laparoscopic and/or robotic surgery can be performed safely and is effective in the treatment of cystic disease of the liver. Mortality should be below 1%, and overall morbidity less than 10%. Recurrence rates for simple cysts are generally below 10%, however polycystic liver disease (PLD) does have a higher recurrence rate after marsupialization than simple cysts.

Keywords: Liver cyst; laparoscopic surgery; robotic surgery; hydatid cyst

Received: 15 February 2020; Accepted: 04 January 2021; Published: 25 April 2021.

doi: 10.21037/ls-20-36

View this article at: http://dx.doi.org/10.21037/ls-20-36

Background

Cystic lesions of the liver are a diverse group of conditions with a range of clinical presentations. The majority of liver cysts are benign and asymptomatic. They are usually discovered incidentally during abdominal imaging. There are two major classes of hepatic cysts, summarized in *Figure 1*. The term hepatic cyst typically refers to a solitary non-parasitic simple cyst of the liver. The different cysts can usually be determined by the clinical presentation and imaging characteristics. The indications for intervention are determined primarily by the type of cyst, and symptoms. Choledochal cysts and Caroli's disease are lesions of the biliary tree with a different management algorithm that will not be covered in this chapter. Most simple cysts are asymptomatic and can be observed alone. This review is undertaken to summarize the current status of minimally invasive surgery (MIS) for the treatment of hepatic cysts. Manuscripts representing single institution case series as well as long term follow up for selected procedures were identified, as well as publications covering new technology introduction. I present the following article in accordance with the Narrative Review reporting checklist (available at http://dx.doi.org/10.21037/ls-20-36).

Symptoms and indications for intervention

Infectious and neoplastic cysts always require treatment (1,2). Most congenital cysts which are discovered incidentally are asymptomatic. Simple cysts under 5 cm in size do not need surveillance. However, symptoms related to hepatic cysts include a broad range including pain, nausea, anorexia, early satiety, weight loss, dyspnea,

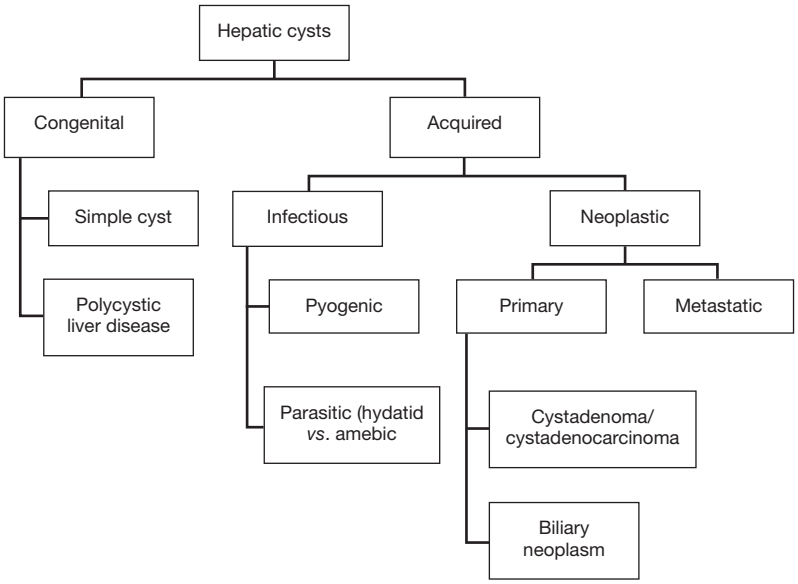

Figure 1 Classification of hepatic cysts.

and bleeding (3-5), Modern imaging studies are usually adequate to distinguish between the various etiologies. When intervention is required for symptoms, unroofing or marsupialization is usually adequate. Adult polycystic liver disease (APLD) may require either fenestration or liver resection based on type. Hydatid cysts can be managed with either percutaneous or surgical approaches with pre- and post-medication with anti-parasitic agents. Neoplastic cysts will usually require either segmental or non-anatomical liver resection. Minimally invasive techniques including laparoscopic and robotic surgery have now been well described for every liver operation including formal hepatectomy with excellent outcomes both short and long term.

Congenital hepatic cysts

The most common form of liver cyst, believed to arise from malformation of the ductal plate during embryological development. They are typically lined with biliary epithelium and contain either clear or murky fluid chemically similar to plasma. The epithelial lining will secrete the fluid, so aspiration alone is not likely to be effective. Aspiration with sclerotherapy is an effective treatment option. They can grow overtime and when they grow, they compress the surrounding liver tissue. Even massive cysts (>15 cm) will typically not impact liver function, although there have been rare reports of biliary obstruction. Biliary ductal compression is also rare. Symptoms are usually caused by compression of adjacent organs, typically gastric, but also diaphragm, resulting in satiety, gastroesophageal reflux disease (GERD), abdominal pain or dyspnea. They can occasionally grow large enough to be externally visible, or palpable (*Figure 2*).

Ultrasound or CT examination will find asymptomatic hepatic cysts in 2–15% of the population. The majority of these are small (<5 cm) at the time of diagnosis and no intervention or follow up is needed for these. Cysts that are larger than 5 cm can be followed for evolution. Sonography is usually adequate for most cysts. Some may require either CT or MRI based on location and/or displacement of adjacent structures. Symptomatic cysts are usually large (>5 cm), often giant (>10 cm) and can be treated entirely with minimally invasive techniques (6-8).

APLD

Polycystic liver disease (PLD) is usually associated with the autosomal dominant polycystic kidney disease (AD-PKD) which is associated with mutations in PKD1 and PKD2. While many of these patients may develop renal insufficiency over time from the kidney cysts, there is rarely ever an impact on liver function although there have been rare reports of hepatic fibrosis and liver failure. The pattern of PKD dominates the clinical presentation. Intervention for the liver cysts is usually only necessary for size and

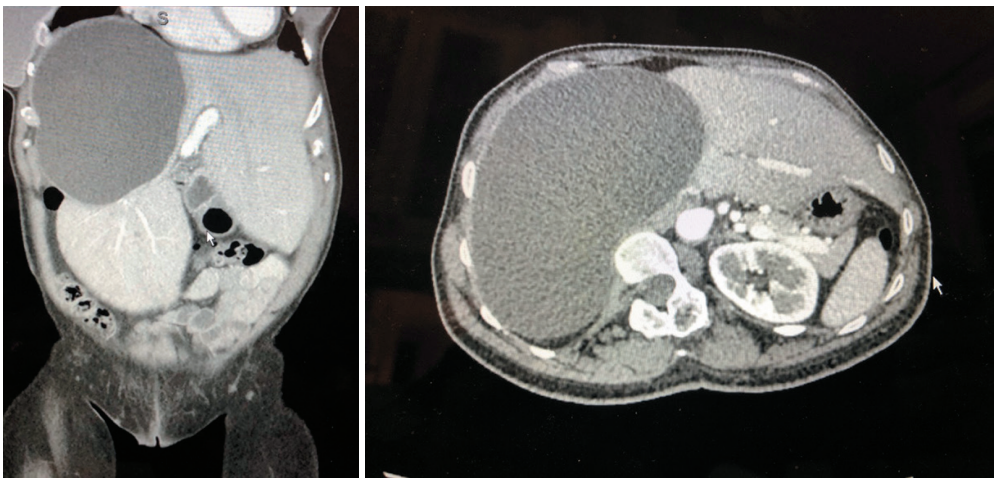

Figure 2 Congenital cyst—symptomatic with pain.

Table 1 Gigot classification of polycystic liver disease (PLD) (9)

Type	Description
I	Presence of less than 10 large hepatic cysts measuring more than 10 cm in maximum diameter
II	Diffuse involvement of liver parenchyma by multiple cysts with remaining large areas of non-cystic (normal appearing) liver parenchyma
III	Presence of diffuse involvement of liver parenchyma by small and medium sized cysts with only a few areas of normal liver parenchyma

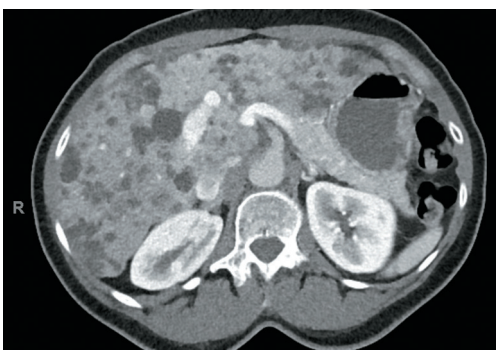

Figure 3 Polycystic liver type III.

related compression. These cysts can be symptomatic from compression and often present with satiety, weight loss, pain, and rarely bleeding. The classification system for PLD proposed by Gigot (*Table 1*) can help guide treatment options. Patients with type III PLD (*Figure 3*) are least likely to benefit from cyst directed therapy and maybe better served with formal resection or even transplant. Type I and II PLD can often be well served by fenestration and decompression (*Figure 4*) (10-12).

Hydatid cyst

Hydatid cysts are caused by infection of the parasite Ecchinococcus granulosum which is typically found in regions of large animal farming, but is reported worldwide. The adult tapeworm lives in the GI tract of carnivores, and the eggs are excreted and ingested. The larvae are then absorbed in the GI tract of the intermediate host, and are transported to the liver, where they become encysted and grow. The cysts have an outer inflammatory wall and an inner germinal wall from which daughter cysts can bud and grow (*Figure 5*). Appropriate management of these cysts with anti-parasitic agents, control of contents and spillage is critical to avoid potentially life-threatening complications of anaphylaxis. Type I cysts can mimic a congenital hepatic cyst, so careful pre-op assessment is

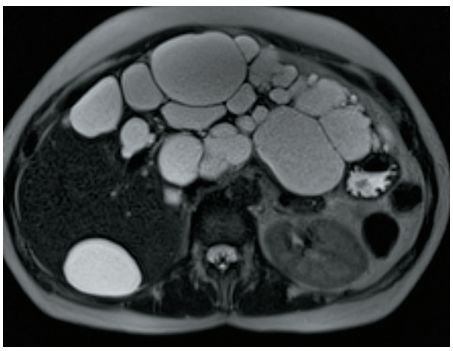

Figure 4 Polycystic liver type II.

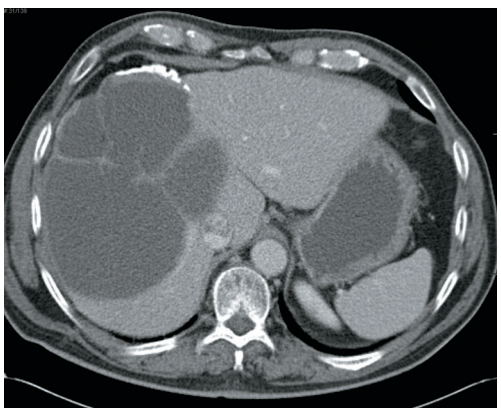

Figure 5 Echinococcal cyst—with daughter cysts and calcification.

Table 2 Gharbi classification of hydatid cysts (13)Top of Form

Type	Description
I	Pure fluid collection
II	Fluid collection with a detached membrane
III	Fluid collection with multiple septae and/or daughter cysts
IV	Hyperechoic with internal echoes
V	Cyst with reflecting, calcified, thick wall

critical (*Table 2*).

Hepatic abscess

It is important to rule out a bacterial hepatic abscess early in the work up of a cystic lesion. They will typically manifest with fever and transaminase elevations. These should be

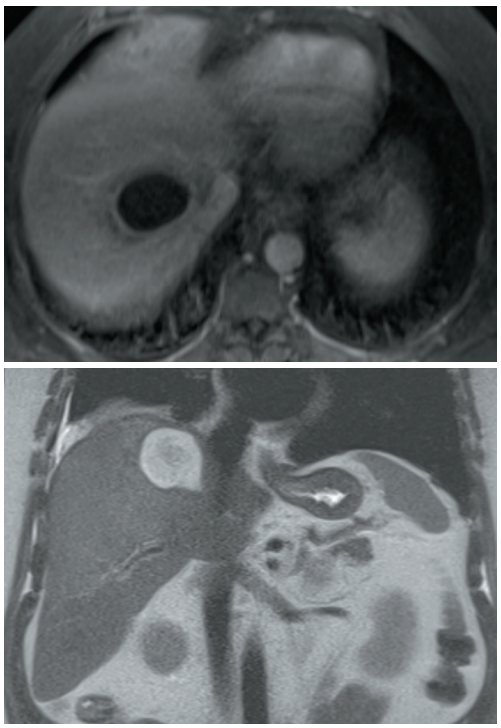

Figure 6 Amebic abscess.

treated with intravenous antibiotics and percutaneous drainage where needed. Surgical drainage and debridement is rarely needed and reserved for those cases where percutaneous drainage has failed (*Figure 6*) (14).

Neoplastic cysts

Biliary cystadenoma are true neoplastic lesions of the liver lined by cuboidal biliary epithelium which can progress to carcinoma with invasion of the basement membrane. These are rare and would be treated with formal hepatic resection as in hepatocellular carcinoma (*Figure 7*) (15,16).

Imaging

While many asymptomatic cysts are discovered incidentally on sonography, if intervention is planned, additional cross-sectional imaging is critical. Either CT or MRI can identify segment, displacement, relationship to critical structures, etc. Sometimes they are necessary for the differential diagnosis as well. CT and MRI can help distinguish between simple cysts and PLD, as well as type I hydatid cysts. Evidence of intracavitary bleeding can often be seen as well.

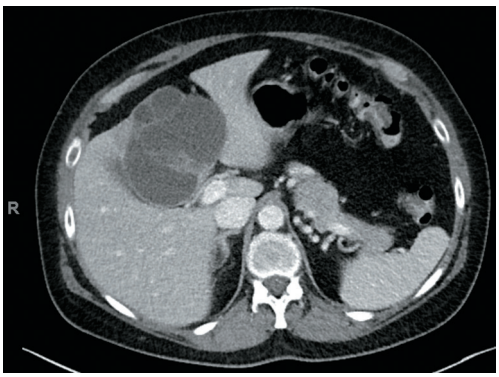

Figure 7 Biliary cystadenoma (surgically resected).

Technical considerations

Access

A standard laparoscopic preparation is appropriate. There should be very rare need for a laparotomy, even in patients with prior abdominal surgery, as the upper abdomen is usually spared once safe pneumoperitoneum can be achieved. We typically use the supine position as most of these cysts will be in the anterior liver. For cysts in the posterior segment, we will consider a lateral decubitus approach to facilitate access and liver mobilization. We generally tuck the left arm, or both arms if needed based on body habitus and approach. Laparoscopic access can be achieved in a variety of methods: Hasson, direct entry, Veress, SILS, etc.

Marsupialization (de-roofing)

This technique can be applied to large simple cysts in the liver, and to multiple simple cysts simultaneously. Once the cyst is identified, we will usually aspirate with a large needle attached to suction, or perforate the cyst and place a laparoscopic suction inside to decompress. Resection of a large section of the cyst wall is critical to prevent recurrence (8,17). While monopolar cautery is usually sufficient for most of the dissection, we prefer an advanced energy device such as ultrasonic shears or advanced bipolar vessel sealer for better hemostasis. If the cyst has a small surface component, then a peri-cystectomy along the cyst wall can be performed to ensure that adequate lateral resection is done. A key aspect to the de-roofing is the resection of the outer wall of the cyst without crossing into the normal liver parenchyma. We use a 1 cm margin to the edge of the cyst. There are often trabeculations within the cyst wall, and sometimes debris or heterogenous material from prior hemorrhage, all of this is evacuated (18,19).

Laparoscopic ultrasound is often a useful adjunct. While most cysts are fairly obvious, if there are multiple cysts, or there is proximity to portal or hepatic branches, intra-operative mapping with ultrasound is very helpful.

Other maneuvers

Other techniques have been developed in an effort to reduce recurrence. Many authors have described fulguration or ablation of the cyst lining with standard cautery or argon beam coagulation. This is thought to reduce the risk of recurrence by minimizing the residual secretory capacity of the epithelial lining. Omentopexy into the cyst has also been advocated, especially in cysts that are located more superiorly where the diaphragm may act as a new roof after desufflation (20).

Recent developments in the use of indocyanine green (ICG) with near infra-red imaging have facilitated the assessment of both perfusion and bile duct communication in these cysts. We have adopted routine use of ICG in all liver resections for the benefits of improved visualization intra-operatively (*Video 1*). Some early single center reports have suggested a lower rate of missed bile leak with ICG detection of exposed biliary radicals (21-24).

Hydatid cysts

Hydatid cysts may often present with biliary compression, altered hepatic enzymes as well as compression related symptoms. Pre-operative treatment with a scolicidal agent such as albendazole for at least 7 days is necessary. Controlled aspiration and inactivation of the cyst contents with 20% hypertonic saline is critical to the management of these cysts. Most surgeons will surround the liver and planned resection bed with sponges or gauze soaked in hypertonic saline or betadine prior to drainage of the cyst. Early reports suggested that only type I and II cysts were safe to approach laparoscopically, but as international experience has grown, it is clear that all LHC can be safely handled with MIS techniques and in fact type III lesions are arguable best handled via a MIS surgical approach (5,25,26). Special consideration to those cysts located deep or posterior in the right lobe must be taken as control of spillage may be difficult. Complete cystectomy is not necessary for most hydatid cysts, and is associated with higher rates of bile leak and bleeding postoperatively. For simple type I cysts, the percutaneous aspiration injection and re-aspiration (PAIR) technique has been demonstrated to have excellent results with low morbidity and low recurrence rates (27,28).

Table 3 From Bernts *et al*. clinical response after laparoscopic fenestration of symptomatic hepatic cysts: a systematic review and meta-analysis surgical endoscopy

Response	Overall, %	PLD, %
Recurrence	9.6	33.7
Reintervention	7.1	26.4
Complications (all)	10.8	29.3
Major	3.3	7.2
Mortality	1.0	2.3

Outcomes

Reports of laparoscopic treatment of hepatic cysts date back to the early 1990's, shortly after the adoption of laparoscopic cholecystectomy. Over the subsequent 30+ years, many small and large series have been published all over the world demonstrating that all cysts can be safely addressed with MIS techniques with outcomes that are comparable or superior to traditional laparotomy (27,29,30). The key outcome measures include peri-operative outcomes including morbidity and mortality, as well as conversion, endoscopic band ligation (EBL) and symptomatic recurrence. A recent meta-analysis (*Table 3*) reviewed 62 studies representing 1,314 patients (31). Symptomatic relief was achieved in 90.2%. Symptomatic recurrence in 9.6%, with re-intervention rates of 7.1%. Overall complication rates were 10.8% with major complications (Clavien-Dindo 3–4) of 3.3%. Mortality across these 62 studies was 1%. Most studies of MIS hepatic cyst surgery have reported mortality of 0%. The outcomes with PLD are notably different from simple cysts. The recurrence rate was substantially higher at 33.7% with a reintervention rate of 26.4%. The overall complication rate was also higher at 29.3%. In this meta-analysis, there were no benefits to omentopexy in reducing recurrence rates. There have been no randomized prospective trials performed to assess the specific benefits of the various approaches or component steps including argon beam coagulation, sclerotherapy, etc. so no specific recommendations can be made, although many single center series have reported improved outcomes with individual components (32).

Summary

Cystic disease of the liver is a complex entity with varied presentation. Congenital cystic disease is not usually symptomatic but when it is, it can be safely and effectively treated with minimally invasive techniques including laparoscopic and robotic surgery. Parasitic cysts can also be safely treated laparoscopically with similar marsupialization.

Acknowledgments

The author is grateful to Ms. Marie Desdunes for assistance with the manuscript and process.
Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editor (H. Leon Pachter) for the series "Laparoscopic Surgery of the Liver and Spleen" published in *Laparoscopic Surgery*. The article has undergone external peer review.

Reporting Checklist: The author has completed the Narrative Review reporting checklist. Available at http://dx.doi.org/10.21037/ls-20-36

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/ls-20-36). The series "*Laparoscopic Surgery* of the Liver and Spleen" was commissioned by the editorial office without any funding or sponsorship. Dr. PCS reports personal fees from Intuitive Surgical, personal fees from Stryker, other from CareCentra, outside the submitted work.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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doi: 10.21037/ls-20-36
Cite this article as: Shah PC. Narrative review of laparoscopic management of hepatic cysts. Laparosc Surg 2021;5:19.