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Rare cystic liver lesions: A diagnostic and managing challenge

Bakoyiannis A *et al*. Rare cystic liver lesions

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**Abstract**

Cystic formations within the liver are a frequent finding among population. Besides the common cystic lesions, like simple liver cysts, rare cystic liver lesions like cystadenocarcinoma should also be considered in the differential diagnosis. Thorough knowledge of each entity’s nature and course are key elements to successful treatment. Detailed search in PubMed, Cochrane Database and international published literature regarding rare cystic liver lesions is carried out. In our research are included not only primary rare lesions like cystadenoma, hydatid cyst, polycystic liver disease etc. but also secondary ones like metastasis from gastrointestinal stromal tumors lesions. Up-to date knowledge regarding diagnosis and management of rare cystic liver lesions is provided. A diagnostic and therapeutic algorithm is also proposed. The need of a multidisciplinary approach by a team including radiologists and surgeons familiar with liver cystic entities, diagnostic tools and treatment modalities is stressed out. Patients with cystic liver lesions must be carefully evaluated by a multidisciplinary team, in order to receive the most appropriate treatment since many cystic liver lesions have a malignant potential and evolution.

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**Key words**: Liver cyst; cystic tumour; Hepatic lesion; Gastrointestinal stromal tumors; Metastases; Cystadenoma; Cystadenocarcinoma; Hydatid cyst; Polycycstic liver disease; Caroli; Echinococcus

**Core tip**: This paper reviews diagnosis differential diagnosis and management of rare cystic liver lesions which should be considered when a cystic hepatic lesion is identified. A diagnostic and therapeutic algorithm is provided. Patients with cystic liver lesions must be carefully evaluated by a multidisciplinary team, in order to receive the most appropriate treatment since many cystic liver lesions have a malignant potential and evolution.

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**INTRODUCTION**

Cystic lesions within the liver have been reported to occur in up to 5% of the population[1]. Most of them are common and benign, but it should not be overlooked the possibility for a cystic liver lesion to be a rare entity like Cystadenoma (HC) or cystadenocarcinoma (HCa). They can present with general or specific symptoms depending of the nature of the lesion, or they can be silent and discovered accidentally[2]. In fact, most are found incidentally on imaging studies and tend to have a benign course, but a minority may cause symptoms, and rarely may be associated with serious morbidity and mortality[2]. The aim of our review is to focus upon the diagnostic and therapeutic algorithm of rare cystic lesions including cystadenomas-cystadenocarcinomas, hydatid disease, polycystic liver disease and metastatic neoplasms from the view of surgeons specialized in hepatobiliary surgery.

**CYSTADENOMA AND CYSTADENOCARCINOMA**

It is estimated that cystic neoplasms constitute approximately 5% of liver cysts among which the malignancy is about 5%[2,3]. The overall incidence among hepatic malignant tumors is lower than 0.41%[2,3]. About 200 cases of hepatobiliary cystadenomas (HC) and a little more than half as many hepatobiliary cystadenocarcinomas (HCa) have been reported in the literature[4].

More than 85% of HC are reported in women and typically in middle aged persons in the fifth decade of life. HC is an unusual cystic lesion accounting for less than 5% of all biliary neoplasms[2,4]. The incidence of hepatobiliary cystadenocarcinoma is approximately 1 per 10 million patients. Malignant transformation is known to occur from HC to HCa. Older patients, in the sixth decade of life, are more likely to present with malignant tumors[2,4].

The histogenesis of HC is unknown, although a congenital origin is generally favoured. A reactive process to some focal injury is still debated[5,6]. Pathologically, HC are multiloculated cysts with a stratified or pseudo-stratified non-ciliated columnar or cuboidal epithelium that contains mucous-producing cells. Papillary infolding is frequently present, and the mesenchyma underlying the tumour is usually hyper cellular, often with ovarian-appearing cells (85%-90%)[7-9]. The pre-malignant progression of HC is based on the histologic presence of intestinal metaplasia (IM), characterised by the presence of numerous goblet cells[10,11]. HC can easily be distinguished histologically from HCa in which, a loss of epithelial nuclear stratification and a tubulo-papillary architecture with nuclear pleomorphism and atypia, predominates. The malignant epithelium is multilayered with numerous papillary projections and the confirmation of an invasion of the stroma, confirms the diagnosis of HCa.

Regardless of the various diagnostic modalities, such a lesion (HC) may be difficult to distinguish preoperatively from an HCa[12].

The majority HC is asymptomatic, discovered incidentally during radiographic studies, or they can present with symptoms related to tumour compression of adjacent organs due to their large size[2]. Patients presenting with symptoms generally complain of abdominal pain, abdominal distension or a palpable mass. Less common presentations include intra-cystic haemorrhage, rupture and fever from secondary bacterial infection. Any patient presenting with recurrence of liver cysts after treatment should be suspected of having a neoplastic cyst until proven otherwise[12].

Cystadenoma (HC) and cystadenocarcinoma (HCa) should be differentiated from benign cystic hepatic lesions, including simple hepatic cyst, hepatic abscess, and echinococcal (hydatid) cyst. Simple hepatic cysts usually lack septa. Though hepatic abscesses and echinococcal cysts may appear similar to cystadenocarcinoma on diagnostic imaging, both infectious diseases are easily diagnosed through clinical and laboratory findings. Improvements in imaging techniques have helped to identify HC and HCa.

Ultrasound is an excellent modality that may delineate a simple cyst from other cystic lesions. Additionally, needle aspirates can be performed under ultrasound guidance. Simple cysts appear as anechoic uni-locular fluid-filled space with imperceptible walls, and with posterior acoustic enhancement. A simple cyst is defined as a well-demarcated water attenuation lesion that does not enhance after the administration of intravenous contrast[2,4].

Contrast enhanced ultrasound (CEUS) is useful in assessing the vascularity of a mural nodule and making a distinction between a mural or septal nodule and intracystic debris[13]. In conventional ultrasound cystic lesions with solid components (septa, wall, mural nodule) represent a wide range of rare entities like HC and HCa, as well as more common entities like simple liver cysts (after bleeding or with cell detritus) or liver abscesses or necrotic liver tumors[13]. CEUS can be informative regarding the vascularity of solid parts of a cystic lesion. Simple cysts, which are unclear in conventional ultrasound, might be identified in CEUS[13]. A cystic liver lesion without vascularization is most probably benign. CEUS is helpful in evaluating nodule vascularity and facilitates the final diagnosis[13].

On conventional ultrasound, a HC typically appears hypo-echoic with thickened irregular walls and occasional internal echoes. Xu *et al*[13],Lin *et al*[14] and Anderson *et al*[15] describe it as a well-defined unilocular or more typically multilocular cystic mass with mural or septal nodules in rare cases. On CEUS, a HC presents with septa enhancement during the arterial phase and hypo-enhancement during the portal and late phases[13,14]. Cystadenocarcinoma on the other hand appears as a multilocular cystic mass with mural or septal nodules with thick and coarse calcifications on the septa on conventional ultrasound, while on CEUS appears with septa enhancement during the arterial phase, mural or septal nodules enhancement and hypo-enhancement during the portal or late phase[13,14]. Xu *et al*[13] reported that on CEUS, there is no significant difference between cystadenoma and cystadenocarcinoma regarding enhancement pattern and extent. Simple cysts unlike HC are virtually never septated[2,4]. Ultrasonography is a very useful initial investigation in these patients as it demonstrates cystic lesions with thin internal septations, debris, projections or mural nodes and it can in most cases accurately distinguish simple from neoplastic cysts (Figure 1A).

The differential diagnosis between HC and HCa is difficult. Although the presence of mural nodularity is not pathognomonic for cystadenocarcinoma, the absence of mural nodularity is suggestive of cystadenoma[15,16]. The diameter of the mural nodule(when exists) in cystadenomas is much smaller (less than 1.0 cm), than mural or septal nodules in cystadenocarcinomas (larger than 1.0 cm)[13]. It seems that the presence of the internal septations and a mural or septal nodule, as well as the nodule diameter, might be diagnostic clues for differentiation between cystadenoma and cystadenocarcinoma[13]. The other differential-diagnostic characteristic between HC and HCa is that cystadenomas are more typically multilocular cystic lesions and cystadenocarcinomas more typically unilocular cystic or solid lesions[13].

Computed tomography (CT) is another useful modality to evaluate cystic lesion of the liver. On a CT scan, a Cystadenoma may be uni- or multi-locular or may have septations. In a study from Vogt et al[3], all patients demonstrated septations within the cyst at the CT scan. The cyst wall is usually thickened or irregular, in contrast to a simple cyst. A Cystadenoma may also have a smooth external surface and a thin wall (Figure 2A).

Magnetic resonance imaging (MRI) is very useful, as it demonstrates a well-defined lesion that does not enhance after the administration of intravenous gadolinium. On T1 images, the cyst shows a low signal; conversely on T2 weighted images, a very high intensity signal is observed. However, no specific information is gained towards pseudo-ovarian stroma detection[17].

Despite the various diagnostic modalities, it remains difficult to distinguish HCs from HCa on preoperative imaging; however, a significant solid component on the cystic wall suggests invasive malignant disease. Furthermore, HC can evolve into HCa after long periods lasting more than 10 years[18,19].

Liver enzymes and bilirubin, are usually normal unless the biliary tree is compressed. The elevation of alkaline phosphate and bilirubin occurs in cases of bile duct obstruction. Carbohydrate antigen 19-9 may be elevated but CEA and a-Fetoprotein are usually normal[3,20]. It has been reported that most patients with cystadenocarcinoma have normal serum concentrations of CEA and CA 19-9. Moreover, the serum concentrations of these tumour markers can be elevated in patients with HC as well. Therefore, these serum tumour markers cannot distinguish HCa from HC.

Some authors have reported that fine needle aspiration cytology of the cyst contents is a good method for diagnosing cystic lesions[5,16]. In many studies, however, no malignant cells were recovered in patients with HCa who underwent intraoperative cytology examination. Thus, this procedure rarely generates a definitive diagnosis and carries the risk of pleural or peritoneal dissemination and should be avoided, especially when surgery is planned. The fluid of the cystic cavity often consists of a high-molecular-weight glycoprotein called mucin. However, hemorrhagic, bilious, clear and mixed fluid contents have also been observed[5,16]. Aspiration and cyst fluid analysis for CEA and Ca 19-9 has been proved more useful than serum analysis[5,16]. Cyst fluid demonstrates marked but variable elevation in Ca 19-9 and moderate elevation of CEA[5,16]. Elevation of these cyst fluid tumour markers has high specificity and sensitivity in distinguishing HC from simple cyst and echinococcal cyst.

HC has been treated by marsupialization, internal Roux-en-Y drainage, repeated needle aspirations, fenestration or partial resection. All these methods have been associated with high rates of recurrence and complications including sepsis, continued growth and progress to malignancy. Although the rate of malignant transformation is relatively low (5%-10%) all suspected HCs must be excised[16,21]. Liver resection with clear margins is strongly indicated due to the possibility of synchronous appearance of HCa at the borders of the cyst[16,21]. Enucleation though is also acceptable. Reports supporting resection, cite the low associated mortality of the procedure and the permanent relief of symptoms[16,21].

The majority of HC can be completely and safely excised by enucleation, including those that are centrally located. Once the cyst has been decompressed and the proper plane identified, enucleation can proceed without significant blood loss. If due to adjacent major venous vascular structures the possibility of haemorrhage is high, then enucleation can be completed with either inflow occlusion (Pringle maneuverer) or total vascular exclusion. In the era of laparoscopic surgery a laparoscopic frozen section biopsy of the cyst wall is feasible. If the frozen section is consistent with a simple, benign cyst, laparoscopic partial excision is adequate. If the biopsy demonstrates HC, then complete excision is necessary. However, frozen section biopsies are not always accurate due to inconsistency and discontinuity of pathological epithelium[3,7,22]. Frozen section cannot definitely exclude or confirm the diagnosis of HC especially in the case of HCa[3,7].

The only potentially curative treatment for HCa is complete removal, usually by a major liver resection with 1-cm margins. Reported survival rates for HCa range from 25% to 100% (87% disease free) at 5 years[4]. It has been reported that patients with HCa who have invasion of the liver parenchyma or neighbouring organs have a poor prognosis[4]. Asahara et al. have reported that the prognosis of patients with HCa is poor when the tumour lacks mesenchymal stroma[2,4]. Absence of mesenchymal stroma in HCa appears to be associated with aggressive disease behaviour, *i.e.,* rapid dissemination or distant metastasis[2,4].

**HYDATID DISEASE**

Human cystic echinococcosis, or hydatid cyst disease, is a zoonosis caused by the larval cestode *Echinococcus granulosus,* *Echinococcus multilocularis, or Echinococcus vogeli.* E. granulosus produces unilocular cystic lesions, whereas E. multilocularis and E. vogeli produce multilocular alveolar cysts[23,24]. Dogs are the definitive hosts for *E. granulosus* and sheep the major intermediate host (yaks, goats, and camels are other relevant intermediate hosts). Man is only incidentally infected when ingesting tapeworm eggs[24]. The eggs penetrate the intestinal wall and the larvae reach the blood and lymphatic circulation and through the portal vein into the liver, lungs, and other tissues, and develop into a hydatid cyst[25,26].

The liver is the most frequent site for the cystic lesions (52%-77%) seen in hydatid disease, followed by the lung (10%-40%), brain, and other viscera[24,26,27]. The disease may remain silent for many years before coming into medical attention as an incidental imaging finding, or it may present with complications.

The diagnosis of uncomplicated hepatic hydatid disease is based on clinical suspicion with special attention to factors such as the patient’s residence or place of origin and occupation in order to identify high-risk patients. The symptoms depend on the size, location and stage of development of the cyst[26,28]. Pain in the right upper quadrant or the epigastrium is the most common symptom, whereas hepatomegaly and a palpable mass are the most common signs. Nonspecific symptoms such as fatigue, fever, nausea, or dyspepsia may also be present. Patients with complicated hepatic hydatid disease may present with fever, jaundice, or anaphylactic symptoms, depending on the complication[26,29].

Acute cholangitis is the most common syndrome when the hydatid cysts rupture in the biliary tract. Rupture of a cyst may produce fever, pruritus, eosinophilia or fatal anaphylaxis[23]. Lower chest pain, a productive cough, and hemoptysis are the most frequent symptoms when there is thoracic involvement. Bilioptysis is diagnostic of a biliobroncheal fistula[25].

General blood tests are not specific except in complicated disease, whereas a high white blood cell count with eosinophilia are possible findings. Hepatic parameters are normal except in the case of biliary compression[30]. Serologic tests such as hemagglutination, latex agglutination and enzyme-linked immunosorbent assay (ELISA), are associated with a high incidence of false-negative and false-positive results[28]. Nevertheless, the detection of specific antigens and immune complexes of the cyst with ELISA yields a positive result in more than 90% of patients. Specific IgE antibodies are demonstrated with ELISA and the radioallergosorbent test (RAST) is positive in the presence of active disease. Confirmatory tests such as arc-5 immunoelectrophoresis and immunoblotting use parasite-specific antigens. The positivity rate with arc-5 immunoelectrophoresis is as high as 91.1%[26,29]. The Casoni and Weinberg tests are no longer used for the diagnostic workup mainly due to their low sensitivity[29].

The indirect immunofluorescence assay (IFA) first reported by Coudert et al. is specific and sensitive, especially in cases of hepatic cystic hydatidosis. This easy-to-do assay can be achieved in less than 2.5 h and it is the most sensitive test in more than 95% of patients with hepatic cystic hydatidosis[30]. The diagnosis of hydatidosis by molecular biology is based on the polymerase chain reaction and the technique needs to be evaluated. Based on the choice of primers and probes, molecular biology can differentiate *E. granulosus* from *E. multilocularis* in clinical samples[30].

False-positive results have been described in some patients with tumors, but there is no explanation for that whereas false-negative results are observed when cysts are calcified, even if fertile and they correspond to the lack of antigenic stimulation. Serologic tests do not supplant clinical or imaging investigations but they can, however, confirm the hydatic origin of a cyst. Specific antibodies increase 4 to 6 wk after surgery, after which they decrease slowly for the next 12 to 18 mo. The decrease in specific antibodies is too irregular to be a good witness of recovery or relapse, however. Persistently high specific antibody titers or a secondary increase in the antibody titers 6 to 12 mo after surgery indicate a relapse[30].

Standard chest and abdomen radiographs may reveal an elevated diaphragm and concentric calcifications in the cyst wall. Liver scanning was an important diagnostic tool during the 1970s. Since then, ultrasonography (US) and computed tomography (CT) have replaced scanning and are considered the first choice in the diagnostic armamentarium. These methods are helpful for determining the complications as well[29].Magnetic resonance imaging (MRI) and endoscopic retrograde cholangiopancreatography (ERCP) can be proved helpful during the diagnostic approach.

Ultrasonography, a noninvasive, readily available, sensitive, cost-effective imaging technique, should be the diagnostic method of choice. Ultrasonography is helpful for defining the internal structure, number, and location of the cysts and the presence of complications (Figure 1B). The specificity of ultrasonography is in the range of 90%. Several authors have proposed an ultrasonographic classification of hepatic hydatid disease (Table 1)[26,31]. Classification was standardized by the World Health Organization–Informal Working Group on Echinococcosis (WHO-IWGE) in 2001 (Table 2)[26]. According to the five categories noted in the classification of Gharbi types II and III are characteristic of hydatid cysts, types I and V are suggestive of hydatid cysts in endemic areas, and type IV simulates a pseudotumor[25].

CT is a helpful tool for confirming the diagnosis, essentially when an ultrasound examination shows a type IV sonographic pattern[25]. It provides information equivalent to that derived by US, but it shows the location and depth of the cyst within the liver more accurately (Figure 2B, C)**.** Moreover it can reveal calcified cystic walls[28], daughter cysts and exogenous cysts and evaluate their volume and density. CT is essential for planning the surgical treatment, especially when a minimally invasive approach is to be used[26,29]. Imaging findings on CT depend on the stage of cyst growth and the Echinococcus specie involved. Hepatic involvement by E. multilocularis is characterized by a different appearance than E. granulosus, consisting of infiltrating solid mass composed of multiple cysts and indistinct margins. Infection by E. granulosus usually forms a single cyst, with or without daughter cysts[23].

Although MRI can be helpful for demonstrating the lesion in the liver (Figure 3), it does not provide additional information in hepatic lesions and it is not cost-effective when compared with either US or CT[26,29]. However, both CT and MRI have high specificity and sensitivity in the detection and differential diagnosis of hepatic cysts and extracapsular (satellite) cysts[28].

The ideal treatment for hepatic hydatid disease should completely eliminate the parasite and prevent recurrence of the disease with minimum morbidity and mortality. There are three available therapeutic modalities for hepatic hydatid cysts; systemic chemotherapy, surgery, and the treatment known as “puncture, aspiration, injection, reaspiration” (PAIR). Chemotherapy and PAIR are recommended as alternatives to surgery, especially for patients who cannot tolerate or refuse surgery. However, surgery is still the first choice of treatment for hepatic hydatid cysts. Selection of the most appropriate treatment for hepatic hydatid cysts depends on the patient’s health status, the nature of the cyst(s) considering number, size, location, and presence of complications, and the available resources and expertise[26].

Mebendazole (MBZ) was the first benzimidazole carbamate agent found to have *in vivo* activity in hydatid disease. The drug interferes with mechanisms of glucose absorption through the wall of the parasite leading to glycogen depletion and subsequent degenerative changes in the mitochondria and endoplasmic reticulum of the germinal cells[32]. Albendazole (ABZ) is more active *in vitro* than mebendazole and has improved gastrointestinal absorption and bioavailability, as well as reports of better clinical results[32]. Although orally administered, albendazole results in high serum concentrations and penetration into cyst contents is erratic. For now, albendazole chemotherapy as the primary treatment may be considered for patients who are not acceptable candidates for surgery, those with inoperable, recurrent, peritoneal or multiple liver cysts within the whole liver, those with multiple cysts in several organs, those who refuse surgery or percutaneous drainage, and perhaps, for asymptomatic individuals[32].

Both drugs may decrease the size of hydatid cysts and may lead to the sterilization of cyst contents in some case; however, without concomitant drainage clinical and radiographic resolution is unpredictable and occurs in less than half of treated patients[24]. Hepatic and hematologic toxicities are the most frequent serious adverse effects of albendazole and mebendazole. Treatment of hepatic cystic echinococcosis with mebendazole or albendazole alone is not as effective as a combined chemotherapy–drainage approach[24,33]. Clinical and radiographic improvement (in most studies defined as > 25% reduction in cyst size, membrane separation, or cyst calcification) is seen frequently, but complete cure (*i.e.*, cyst disappearance) generally occurs in less than half of patients treated with anti-parasitic monotherapy[24,33].

According to the WHO guidelines, chemotherapy is indicated for inoperable primary liver or lung echinococcosis and for patients with multiple cysts in two or more organs and peritoneal cysts. Another important indication for chemotherapy is the prevention of secondary echinococcosis. Preoperative use of ABZ or MBZ can reduce the risk of recurrence of cystic echinococcosis and facilitate the operation. Concomitant chemotherapy is also recommended for PAIR. Chemotherapy is contraindicated for large cysts that are at risk of rupture (superficially situated, infected cysts) and for inactive or calcified cysts[34].

The usually recommended oral dosage of ABZ is 10 to 15 mg/kg per day in two divided doses for several 1-month courses separated by 14-day intervals. The usual oral dosage of MBZ is given as 500 mg tablets in daily doses of 40 to 50 mg/kg (in three divided doses) for at least 3 to 6 mo. Better intestinal absorption of benzimidazole compounds is gained by administering it with a fat-rich meal or by combining it with cimetidine. Medical and laboratory examinations for adverse reactions are initially necessary every 2 wk and then monthly[35].

A third antiparasitic agent, praziquantel, has had limited use in the treatment of hydatid cysts of the liver. The drug increases the permeability of the parasite's cell membrane to calcium, resulting in strong contractions and paralysis of the musculature leading to detachment from host tissue. In humans, it has favorable pharmacokinetics when given in a dose of 50 mg/kg either once weekly or every two weeks. There are few clinical studies documenting the efficacy of praziquantel in humans, however, several of these have suggested that the use of praziquantel in combination with mebendazoleor albendazole is more effective and perhaps, more rapid than with the benzimidazoles alone (47.4% *vs* 36.4%). after only 2–6 mo of drug therapy[24].

Surgery was defined as the only definitive and curative modality by the WHO-IWGE in 1996[33]. The goals of surgery in hydatid disease are to inactivate the cestode parasites, evacuate the cyst cavity, remove the germinal layer, and obliterate the residual cavity. Surgical interventions consist of open conservative or radical, and laparoscopic approaches[24]. Conservative techniques involve drainage, marsupialization, capitonnage, deroofing, partial simple cystectomy and open or closed total cystectomy with or without omentoplasty[24].The conservative procedures are safer and easier to perform[25]. Radical procedures include total pericystectomy, partial hepatectomy, or lobectomy[24]. Although it seems logical that radical operations would be associated with higher intra- and postoperative morbidity but less frequent recurrence, recent studies have shown that radical surgery is not associated with a high complication rate[26].

Laparoscopic drainage of hepatic hydatid cysts is a ‘minimally invasive’ surgical technique that appears safe and effective. It has the theoretic advantages of a shorter hospital stay, lower incidence of wound infection, less postoperative pain and the disadvantages of difficult accessibility to the various locations, increased risk of spillage of the cyst content, and the difficulty of aspirating the cyst content of the thick, degenerated cyst contents, especially in some WHO-IWGE CE3 and CE4 cysts. Thus, choosing the best candidates for the laparoscopic approach requires careful evaluation of the cystic disease[25,26]. Whichever technique is used, a benzimidazole agent is best used before any surgery in an attempt to sterilize the cyst contents and reduce the risk of anaphylaxis and dissemination[24].

Meticulous packing of the operative field is necessary irrespective of the surgical technique employed, as is the use of solutions that kill the infective scoleces and protoscolices of the parasite residing within the hydatid cyst, or potentially leaking from the cyst during surgical manipulation. Various scolicidal solutions used in surgical (and percutaneous) approaches include: hypertonic saline (3%-20%), povidone iodine, hydrogen peroxide, iodine, formalin, silver nitrate, ethyl alkohol and albendazole. These scolicides can be used alone or in combination[24].

Potential major complications associated with the surgical treatment of hepatic hydatid cysts include postoperative hemorrhage, bile exudation from the residual cyst cavity, incisional fistula formation, cholangitis, wound infection, sepsis, incisional fistulae, pulmonary complications such as pneumonia and pulmonary embolization, complications of anesthesia, and death[24].

Endoscopic retrograde cholangiopancreatography (ERCP) is used as a diagnostic and therapeutic tool in the management of biliary tract-complicated hepatic hydatid cysts. Preoperatively, ERCP defines the biliary tract-related complication and allows the assessment and management of acute conditions, including acute cholangitis and biliary obstruction, so that elective surgery can be performed later. When combined with sphincterotomy, drains the cyst cavity and help prevent postoperative biliary fistula. Postoperatively, ERCP allows visualization of the distorted anatomy in recurrent cases, helps clarify the etiology of ongoing or recurrent biliopancreatic symptoms and biochemical abnormalities, allows endoscopic management of a biliary fistula and enables treatment of secondary biliary strictures by stenting[26].

The treatment modality that we prefer using in our department with optimal results is the evacuation of the cavity with careful removal of the laminated membrane and the daughter cysts in order to avoid spillage. The cyst cavity is obliterated by omentoplasty or capitonnage and the site is drained externally by suction catheter. Partial cystectomy and internal drainage with a Roux-en-Y intracystic hepaticojejunostomy is performed when large ducts had been disrupted because of large cysts. Preoparative ERCP is performed when communication between cyst cavity and biliary tree is suspected and endoscopic sphincterotomy is performed in cases of obstruction.

The minimally invasive technique of puncture, aspiration of cyst, injection of hypertonic saline and/or absolute alcohol and re-aspiration (PAIR), described initially by Voros *et al[*28] and Falagas *et al*[33] is an alternative to major interventional procedures. PAIR treatment satisfies all the goals of surgery in hydatid disease but substitutes germinal membrane sclerosing and separation using scolicides for surgical removal. PAIR drainage is best performed under continuous ultrasonographic or CT guidance.

Patients undergoing PAIR typically receive oral albendazole that is administered 24 to 4 h before intervention and 15 to 30 d after intervention according to cyst size[34]. Different scolicidal solutions can be used in PAIR, although hypertonic saline is most commonly employed. Hypertonic saline (in 5%–30% concentrations) exerts its scolicidal effect by creating a strong osmotic gradient across the outer cuticular membrane of the protoscolex, which causes its lysis. For multiseptate Type III cysts or large cysts over 6 cm in size, some authors advocate the use of absolute alcohol because it is a more sclerosing agent than hypertonic saline and may destroy daughter cysts not killed by saline and may also result in a more rapid involution of the cyst cavity. Alcohol should not be used, however, if pre-existing biliary communication is suspected or documented because the agent may cause a chemical cholangitis[33].

With PAIR, cyst fluid or operative tissue specimens are immediately subjected to cytologic, histopathologic, and parasitologic examinations after aspiration or catheter drainage in order to confirm the diagnosis and assess success of the drainage procedure.

Complications after PAIR therapy, like infections, are generally well tolerated and can be managed with systemic antimicrobial therapy. Leakage during drainage may lead to fever, urticaria, transient hypotension, or anaphylaxis but these can be anticipated and effectively managed with antipyretics, *iv* fluids, antihistamines, and subcutaneous epinephrine. Cyst-biliary communications (biliary rupture and fistula formation) developing after PAIR and caused by cyst decompression, can usually be managed endoscopically[24]. For patients who underwent PAIR as a primary procedure it has been reported a total complication rate of 14.7% and a recurrence rate of 1.57%[28].

In conclusion, compared to patients undergoing surgical intervention for cystic hepatic echinococcosis, PAIR plus albendazole is associated with greater clinical and parasitologic efficacy, less major and minor morbidity whenever is indicated i.e for non-echoic lesion ≥ 5 cm in diameter (CE1), cysts with daughter cysts (CE2), and/or with detachment of membranes (CE3). Surgery may be reserved for patients with hydatid cysts refractory to PAIR because of secondary bacterial infection or with difficult-to-manage cyst-biliary communication or obstruction[24,34].

**POLYCYSTIC LIVER DISEASE**

Polycystic liver disease (PLD) is inherited as an autosomal dominant trait presenting in adulthood and is more common in women[36]. Autosomal dominant polycystic disease is genetically heterogeneous with mutations in two distinct genes predisposing to the combination of renal and liver cysts (AD-PKD1 and AD-PKD2)[36,37]. PLD is genetically linked to protein kinase C substrate 80K-H (PRKCSH) and SEC63[38]. The cysts in PLD can also increase in size and number during pregnancy or simultaneously with the use of exogenous female steroid hormones[39].

Most patients are asymptomatic and do not require treatment. Some patients develop massive hepatic cystic disease and become clinically symptomatic associated with the increased liver volume and the adjacent visceral compression. Usually patients suffer from chronic dull abdominal pain, satiety, weight loss, dyspnea, physical disability and descensus[36,40]. Liver function tests are usually normal except mild elevation in ALP or γ-GT[36,40]. Liver failure or complications of advanced liver disease, such as infection or intracystic hemorrhage are rare. Less than 5% of patients have acute medical complications. These consist of cyst hemorrhage, rupture, infection, uterine prolapse due to displacement, obstructive jaundice, portal hypertension, ascites and Budd-Chiari syndrome[19,36,40-42]. Even with marked hepato-splenomegaly and portal hypertension, liver function is well preserved in PLD. Ascites may be present and it usually results from hepatic venous flow obstruction. Diagnosis is confirmed with U/S and CT imaging (Figure 2D), which along with MRI provide the surgeon with valuable preoperative information, such as the location of infected or hemorrhagic cysts that may be responsible for symptoms[40] (Figure 4). Treatment should be considered in case of persistent symptoms or associated complications.

Cyst aspiration with sclerosis, open or laparoscopic cyst fenestration, combined hepatic resection and fenestration, liver transplantation and recently medical treatment with somatostatine analogues are possible therapeutic options based on type of PLD[19,36,40,42, 43-46]. Aspiration combined with ethanol instillation to induce sclerosis of the cyst lining epithelium can be effective in patients with a few dominant cysts (Type I PLD - few large cysts greater than 7 cm). Open or laparoscopic cyst fenestration with omentoplasty is another modality of treatment that can be performed in patients with more diffuse PLD (Type II-multiple medium cysts 5- 7 cm in diameter). Patients with small cysts throughout the liver have a greater risk of persistence and/or recurrence of symptoms[19,42]. Postoperative morbidity consists of temporary ascites, pleural effusion and rarely biliary leakage[40].

Combined hepatic resection and fenestration is more effective for reducing the hepatic mass and relieves gastric compression. This procedure has an advantage in the case of massive hepatomegaly with associated gastric compression[40,47,48]. Resection addresses the problem of liver mass, but poses significant risk of bile duct injury, vascular compromise, and liver insufficiency because cysts markedly distort intrahepatic anatomy. In particular, ascites has been troublesome due to continued cyst secretion from residual fenestrated cysts, disruption of intrahepatic lymphatics and partial venous outflow obstruction. Candidates for combined resection/fenestration should have at least two adjacent liver segments not involved by cysts and normal liver function. Furthermore, these patients should be managed by experienced hepatobiliary surgeons at institutions with advanced intensive care and interventional radiological and gastroenterology support.

Liver transplantation has been performed in rare cases, especially when the above-mentioned interventions are not an option. In patients who harbour diffuse PLD, orthotopic liver transplantation (OLT) is effective, but inherently assumes the risks of long-term immunosuppression and rejection. OLT is indicated for patients with progressive PLD after resection/fenestration, patients with concurrent liver dysfunction and renal failure, and patients with diffuse PLD without segmental sparing. Although symptomatic relief from hepatomegaly occurred in all surviving patients, long term follow up addressing quality of life, hepato-renal function, immunosuppressive complications and survival is limited[42,49].

Regarding the results of invasive methods, in case series is noted that aspiration and sclerosis of individual liver cysts reduced liver volume by 19% in patients with 1 or more large dominant liver cysts[50]. Reduction of liver volume is reported to be as high as 12.5% when laparoscopic fenestration is used, but the complication rate reported is also high(0%–33%)[51,52-55].

The drawbacks of invasive procedures in treating PLD are their partial effectiveness, their related morbidity and mortality and most importantly, the fact that they do not change the natural course of the disease as symptoms recur due to growth of new cysts or re-growth of treated ones[41].

Several studies have reported the positive effects of somatostatin analogues in decreasing liver and kidney growth in PKD and ADPLD over a treatment period of minimum 6 mo[43-46].

Somatostatin may reduce cyst development through several mechanisms[45]: (1) by inhibiting secretin release from the pancreas[56]; (2) by inhibiting secretin-induced cAMP generation and fluid secretion in cholangiocytes[57-59]; (3)by vasopressin-induced cAMP generation and water permeability in collecting ducts[60-63] by its effects on Gi protein-coupled receptors; and (4) by suppressing the expression of IGF-1, vascular endothelial growth factor, and other cystogenic growth factors and downstreaming signaling from their receptors[60-64].

Ruggenenti *et al*[43], in 2005 showed that kidney volume increased by 2.2% - 3.7% during active treatment with octreotide LAR compared with 5.9% - 5.4% (*P* < 0.01) while on placebo. Octreotide LAR (40 mg intramuscularly every 4 wk) was given for 6 mo in 12 ADPKD patients with advanced renal disease (mean total kidney volume 2435 mL, mean serum creatinine 1.9 mg/dL)[43].

In 2009, Van Keimpema et al.,tested lanreotide for treating PLD (120 mg subcutaneously every 4 wk) for 6 mo in 54 patients with PLD (32 ADPKD and 22 ADPLD)[44]. He concluded that liver volume decreased 2.9%, from 4606 to 4471 mL, in the lanreotide group, whereas it increased 1.6%, from 4689 to 4895 mL, in the placebo group (*P* < 0.01)[44]. In the 32 patients with ADPKD, total kidney volume decreased 1.5%, from 1000 to 983 mL in the lanreotide group, whereas it increased 3.4%, from 1115 to 1165 mL, in the placebo group (*P* < 0.02)[44].

The results of the clinical trial reported in 2010 by Hogan *et al*[45], showed that administration of octreotide LAR for 1 year induced a moderate but significant reduction in liver volume, inhibited the growth of polycystic kidneys, and improved quality of life in patients with ADPKD and/or ADPLD, with low toxicity and few side effects.

In 2012 Hogan *et al*[46] reported his results in treating patients with PLD with Octreotide LAR for 2 years. He concluded that his study further substantiates the positive effects of somatostatin analogs in reducing TLV (6.08% overall reduction in TLV in the first year), demonstrating they are safe and efficacious over a 2-year period in individuals with ADPKD or ADPLD, many of whom had chronic renal insufficiency[46]. While OctLAR inhibited renal enlargement within the first year of treatment, it appeared to lose effectiveness during Year 2. While the results of OctLAR therapy on TLV were clearly positive and results on TKV may show some benefit, he did not detect any positive effect of OctLAR on GFR[46].

The administration of octreotide or lanreotide has been generally well tolerated in all studies, with mostly mild, predictable, and dose-dependent gastrointestinal side effects. Patients undergoing longterm octreotide treatment should be monitored for cholelithiasis symptoms or signs because this is a known complication[45,65]. Alopecia,symptomatic bradycardia and steatorrhea are other known adverse events associated with somatostatin analogues treatment[66-73].

**CYSTIC METASTASES (GIST)**

Many cystic tumors may metastasize to the liver e.g. pancreatic or ovary cystadenocarcinomas (Figure 2E). Other liver metastatic lesions which can appear cystic usually originate from rapidly growing hypervascular tumors (sarcoma, melanoma, neuroendocrine tumors) and appear so due to necrosis and cystic degeneration[74]. Despite the fact that these metastatic sites often show cystic characteristics, in most of the cases the differential diagnosis between them and benign liver cysts is easily made with the contribution of computed tomography.

Of particular interest are the liver metastases from gastrointestinal stromal tumors (GIST) that may appear cystic even before treatment (Figure 2F).

GIST is the most common mesenchymal tumour of the gastrointestinal tract, accounting for 1%-3% of all gastrointestinal malignancies[75-77]. GIST can arise anywhere along the GI tract but it is most common in the stomach (50%-70%) and small bowel (25%-35%)[78].

Despite its less aggressive pathologic nature, GIST can metastasize after a long remission period. When GIST originates in the small bowel it behaves in a more aggressive manner. The most common site for metastases is the liver and the peritoneal cavity[76,77,79], but it can also occur in bones, lungs, skin and lymph nodes. Data from the MD Anderson Cancer Center (MDACC) report 18% patients presenting with metastatic disease[80]. Liver metastases are commonly multiple and distributed in both lobes and more frequently detected synchronously with the primary tumour than metachronously. Case reports showed further metachronous liver metastases being detected after more than 10 years (13 years after gastrectomy for gastric GIST, 17 years after resection for retroperitoneum GIST, and 12 years after surgery for rectal GIST)[77].

GIST mostly affects males between the ages 40 and 70 and are usually found incidentally. Features at clinical presentation depend on tumour size. Large or advanced lesions may present with a variety of clinical findings including bleeding, abdominal pain, early satiety, bowel obstruction or perforation. Bowel obstruction is reported in up to 30% of clinical series but accounts for less than 10% of presentations in most reports[81].

The initial workup should include history and physical examination, appropriate imaging [*i.e.,* chest, abdominal and pelvic computed tomography (CT) with contrast and/or magnetic resonance imaging (MRI)], endoscopy in selected cases of primary gastric mass, endoscopic ultrasound, liver function tests, full blood counts, and surgical assessment of tumour resectability. On CT scans, metastases within the liver developed lower attenuation than that of the normal surrounding parenchyma. Liver metastases are hypervascular in 92% of patients and rapidly become cystic following therapy with Imatinib (IM).

GIST and GIST liver metastases are soft and fragile and biopsy may cause tumour haemorrhage or dissemination. The decision to obtain a biopsy should be based on data regarding the stage of the disease and the clinician’s suspicion of other malignancies. If the diagnosis is in doubt, or neo-adjuvant therapy using Imatinib mesylate (IM) is under consideration, or if there is synchronous metastatic disease, then biopsy is essential[77].

Before 2001, the only effective therapy was surgery alone. The development of clinically effective inhibitors targeting the trans-membrane receptor tyrosine kinase KIT radically changed the management of advanced (locally advanced and metastatic) disease. Imatinib mesylate (IM), a selective inhibitor of tyrosine kinase, has revolutionized the management of this disease in recent years. Laboratory studies revealed significant molecular heterogeneity among GIST[82-84]. In 2010 in a meta-analyses was shown that most patients with different genotypes of GIST and KIT exon 11-mutant will benefit from the individualized treatment of Imatinib[85].

Imatinib has become the first line of treatment for recurrent and/or metastatic disease[79]. Another meta-analyses comparing the efficacy of imatinib given either once (400 mg) or twice daily, revealed that the higher dose offers a progression-free survival advantage among patients with exon 9 mutations[86] but the overall survival is the same in the two groups of patients.

Nowadays imatinibe therapy and surgical intervention are combined to give patients better disease free and survival rates. Surgical intervention in patients responding to medical therapy may provide complete cure[87,88]. Complete pathological response to imatinibe alone occurs in less than 5% of patients[87,88]. Surgery has the best results when offered to patients with lesions responsive to 6 month imatinib therapy. CT with or without PET can be used to assess the therapeutic effect. In a study by MSKCC patients who had lesions responsive to Imatinib had a 2-year progression free survival of 61% and 2-year overall survival 100% after surgical resection. In contrast, the 2-year survival was 36% in patients resistant to Imatinib therapy[89]. Raut et al has also reported that debulking surgery may prolong survival in patients who are either responsive to imatinib or have limited radiographic progression, but has poor or no result in patients with progressive metastatic disease[90]. Gronchi *et al*[91] reported in 2007 that surgery may be of value to patients who develop responsive or stable disease while on preoperative Imatinib therapy.

Regarding the timing of surgical resection, Suzuki *et al*[92] have reported a complete resection rate of 31.4% after IM therapy for a period of 6.9-37.5 mo (mean 10 mo). They also emphasized that surgical resection for IM- responsive recurrent or metastatic disease should be considered as early as possible before the development of progression and secondary resistance to IM[92]. Surgical resection 6-12 mo after the start of IM treatment is recommended among responders[79]. However a large tumour may prohibit resection because of the risk of postoperative liver failure. An option to counteract this phenomenon is the use of portal vein embolization (PVE). In general, the median time for detection of further metastases following resection of liver metastases, is 12 mo after the initial hepatectomy[77,79]. Therefore, careful evaluation of the liver is critical during the first year post-hepatectomy.

Radio-frequency ablation, microwave ablation and hepatic artery embolization are other treatment modalities that can be used usually in patients with unresectable disease or in patients who cannot undergo surgical excision due to co-morbidities.

**CYSTIC HEPATOCELLULAR CARCINOMA**

Rarely hepatocellular carcinoma (HCC) can have a cystic appearance, due to necrosis and cystic degeneration in case of rapid growing tumors. Co-existing liver cirrhosis and specific HCC imaging characteristics such as hypervascularity of solid components and tumor invasion of the portal and hepatic veins can help to reach the correct diagnosis[74]. Typically the conventional ultrasound would reveal a heterogeneous echogenic lesion with hypoechoic rim and peripheral or internal arterial flow signals in a liver cirrhosis background. The CEUS would reveal a heterogenous hyper-enhancement during the arterial phase and hypo-enhancement during the portal and late phases[14].

**CAROLI’S DISEASE**

Caroli’s disease (CD) is a benign congenital disorder, characterized by unilobar or bilobar segmental cystic dilatation of the intrahepatic biliary tract. The first report was by Todd in 1818 but Jaques Caroli in 1958 defined the disease precisely with its different types[93]. The estimated incidence of Caroli’s disease is 1 in 1000000 population with males and females being equally affected and more than 80% of patients present before 30 years of age[94].

There are two forms of the disease, one associated with congenital hepatic fibrosis, also called Caroli’s syndrome, and the other a simple form occurring alone. Recent studies suggest that the simple form may be as common as that with congenital hepatic fibrosis[95,96]. It is characterized by segmental cystic dilatation of the intrahepatic ducts, increased incidence of biliary lithiasis, cholangitis and liver abscesses. Absence of cirrhosis and portal hypertension is typical[94]. Various renal disorders have been described in association with this liver disease, including autosomal polycystic kidney disease, medullary sponge kidney and medullary cystic disease[93,95].

Mode of inheritance is still unclear but in the majority of cases it is transmitted in autosomal recessive fashion[93]. Caroli's disease is associated with increased risk of cholangiocarcinoma with the reported incidence of malignancy ranging from 5% to 10%.The estimated risk is 100 times greater than that of the general population and is triggered by long-standing inflammation and chronic injury of the biliary epithelium[94,97]. Although present from birth, the disease usually remains asymptomatic during the first 20 years, and may also remain so throughout life[94]. However when symptomatic, a significant number of these patients present significant loss in their quality of life and their clinical course.

The disease is frequently noted by recurrent fever, jaundice and/or pain in the right hypochondrium[97]. A literature review found recurrent acute cholangitis as the main mode of presentation in 64% of the patients[94] and the most life-threatening complication of CD. Usually caused by Gram-negative bacilli, it has a recurrent course and despite different antibiotic associations the medical treatment is often not satisfactory[93]. Patients with Caroli's syndrome, on the other hand, usually present early in life, with complications of portal hypertension, mainly variceal bleeding, hypersplenism or portal hypertension in 20% to 50% of cases[97].

Laboratory studies typically show an elevation of serum alkaline phosphatase, direct bilirubin and a leucocytosis with a predominance of neutrophils. Hepatic synthetic function is well-preserved initially, but may be affected by progressive liver damage due to recurrent cholangitis and biliary obstruction. Coagulopathy from vitamin K malabsorbtion may occur in cholestatic patients[94].

Histologically, the main macroscopic and microscopic features of CD are: non-obstructive, localized dilatation of the bile ducts, intraluminal bulbar protrusions of the ductal wall and intra ductal vascular tracts containing patent portal venous and hepatic arterial channels that traverse the true lumen and terminate within the lumen[94]. The diagnosis of CD therefore rests on demonstrating that the cystic lesions are in continuity with the biliary tree. It can be done by imaging studies such as isotope scan, magnetic resonance cholangiopancreatography (MRCP), CT scan, ultrasonography (u/s), endoscopic retrograde cholangiopancreatography (ERCP) and percutaneous transhepatic cholangiography (PTC).

The classical finding of CD is finding of a cold area on 99 m TC sulphur colloid scan becoming hot on 99 m Tc DISIDA scan[94]. MRCP presents advantages to depict the entire biliary tree. Three main patterns of CD are identified in MRCP: (1) multiple cystic ectasias connected with fusiform dilatations; (2) isolated fusiform dilatations with multiple calculi; and (3) solitary dilatation of the left bile ducts with cysts and multiple calculi[93] (Figure 5).

CT scan shows central dot signs in CD patients. The fibrovascular bundles containing portal vein radical and a branch of hepatic artery bridging the saccule appear as central dots or linear streak. This central dot sign described on CT scan is suggested as a pathognomonic finding in CD and it can also be demonstrated on U/S[94]. ERCP is the method with the highest sensitivity in the diagnosis of CD. The cholangiographic features of Caroli’s disease are well established as saccular or fusiform dilatation of the intrahepatic bile ducts. Irregular bile duct walls, strictures and stones may be present. Therefore, direct cholangiography is considered the method of choice for an accurate diagnosis of Caroli’s disease[94]. With PTC, the diagnosis can be made confidently when the large intrahepatic branches have focal or segmental involvement with cystic outpouchings in which the contrast medium collects. False-positive findings are rare when PTC is used[93].

The treatment of CD depends on the clinical features and the location of the biliary abnormalities. It seems more than justified to advocate a rather aggressive surgical strategy in symptomatic patients who have had several futile conservative treatment attempts[98]. The localized forms, which involve the whole of the left half of the liver, or the right half of the liver, are curable by surgery. They should be treated by hemi-hepatectomy, left or right, with associated treatment of any problem affecting the common duct[94]. The procedure is associated with low morbidity and virtual no mortality. There is no report of malignant tumors arising after surgical resection[98].

Diffuse involvement of both lobes can be treated with conservative management in asymptomatic patients, with appropriate antibiotics for cholangitis and ursodeoxycolic acid therapy for litholysis in case of intrahepatic cholelithiasis, endoscopic therapy (sphincterotomy for clearance of intrahepatic stones) and internal biliary bypass procedure[94]. These patients in whom there is no indication for liver resection or transplantation should at least be followed up regularly on an outpatient basis to detect any kind of deterioration or malignant transformation as early as possible[98].

Bilateral disease complicated by recurrent cholangitis, cirrhosis or both, together with symptoms of associated hepatic fibrosis do not find the same solution and is often difficult to manage. Emergency surgery in the presence of acute cholangitis and deteriorating liver function is associated with high mortality (20%-40%) and morbidity (44%-80%)[94].

It seems that liver transplantation or living donor transplantation is an effective therapeutic option and possibly the only and ultimate management option for these patients with end-stage diffuse Caroli's disease providing gratifying long-term results[94,97,98]. Orthotopic liver transplantation has become a therapeutic option which besides the better long-term outcome, can prevent the development of cholangiocarcinoma[96].

**DISCUSSION**

Liver cystic lesions consist of a heterogeneous group of disorders. Rare liver cystic lesions such as cystadenoma, hydatid cyst, polycystic liver disease, Caroli’s disease and cystic liver metastases pose several dilemmas to the practicing surgeon or physician. It is very important that awareness and high index of suspicion for rare diseases just as hepatic Cystadenoma(HC) is high, so the diagnosis would not be missed out. Since our diagnostic tools become more and more powerful and accurate, our adequate knowledge of the nature, evolution, confirmation and treatment of all the possible pathological entities in the differential diagnosis becomes more than ever necessary.

The use of contrast-enhanced ultrasound (CEUS) in diagnosis of liver lesions has shown promising results, providing more accurate images than conventional ultrasound[99-102]. The discrimination between malignant and benign lesions is easier and more accurate than the conventional ultrasound.

Complete non-enhancement throughout three phases of CEUS or sustained enhancement in the portal and late phases is noticed in most benign lesions[14]. Conversely, hypoenhancement in the late phase is seen in malignancies[14]. Real time CEUS improves the capability of discrimination between benign and malignant complex cystic focal liver lesions[14]. It has been shown that CEUS can greatly improve the diagnostic accuracy of focal liver lesions compared with conventional ultrasound[14].

Contrast-enhanced ultrasound, has also been used for diagnostics of the biliary system. In 2009 Xu *et al*[100] has summarized the methodology, the image interpretation, the enhancement pattern, the clinical usefulness, and the indications for CEUS in the biliary system.

The first important step, regarding liver cystic lesions, is to make a definitive diagnosis of the nature of the cystic lesion. The second is determining whether the patient's symptoms are related to the cystic lesion. The third is deciding whether and when to initiate therapy for the lesion. Finally, a number of treatment options are available, leading to the fourth issue, which is deciding the appropriate therapy for the patient.

Ideally the cystic liver lesions should be handled by a multidisciplinary team familiar with liver diseases, consisting of interventional radiologist, interventional gastroenterologist, surgeon, clinical oncologist and pathologist. In our opinion this is the way that even rare entities can be identified and treated promptly. The algorithm used in our department for managing those cystic lesions is provided in Figure 6.

**CONCLUSION**

Cystic liver lesions require accurate pre-treatment diagnosis in order to select the appropriate therapy for each patient, as they can represent benign or malignant formations. It is best that a specialized team deals with cystic liver lesions so that the diagnosis and treatment are accurate and focused. Specifically rare entities require accurate diagnosis and management as they can pose a malignant impact.

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**Figure 1 Ultrasound image.** A: Showing an anechoic mass in the liver (light blue arrow), with a rather thin capsule (cystadenoma); B: Showing two echinococcal cysts. The first-on the right-(grey arrow-right image) appears as an anechoic mass with hydatid sand (type CE1) (white arrow-right image) while in the second (on the left) detached and folded endocyst membrane is obvious (type CE3) (white arrow-left image).

**Figure 2 Computed tomography image.** A: In liver segment IV there is a large cystic lesion (black arrow) causing compression with dilatation of biliary ducts (light blue arrows) in the left liver lobe. Peripheral contrast enhancement (light green arrow) as well as a nodule (pink arrow) is evident in this case of cystadenoma; B: Echinococcal disease evaluated. Two lesions are evident. The first in liver segment I appears as a multilocular cystic lesion (black arrow) and the second in liver segment VI as a calcified mass with irregular margins (white arrow); C Demonstrates direct infiltration of a liver hydatid cyst in the adjacent peritoneal surface and the abdominal wall (light blue arrow); D: A typical case of multicystc disease with liver (light blue arrow) and kidney (pink arrow) involvement were very well depicted; E: Showing two large cystic-appearing liver lesions (light blue arrows), in a case of a metastatic pancreatic cystadenocarcinoma that is also evident (pink arrow); F: A large cystic lesion (light blue arrow) with a small solid component at the periphery (pink arrow), as well as two small hypodense liver lesions (black arrows), are seen on this image, in a case of proven gastrointestinal stromal tumors metastatic lesions.

**Figure 3 Magnetic resonance T1-w image shows an echinococcal cyst as a multiloculated cystic liver lesion, indicative of the presence of daughter cysts (light blue arrow).** A second smaller unilocular lesion with peripheral contrast enhancement is also seen (pink arrow).

**Figure 4 Image.** A: Computed tomography image in a case of multicystic disease, showing two large dominant cysts causing mild intrahepatic biliary dilatation (grey arrows); B: Magnetic resonance cholangiopancreatography image shows multiple hepatic cysts (light blue arrows) while common bile duct seems compressed between the two larger cysts (black arrow).

**Figure 5 A case of Caroli disease.** A: On computed tomography. A large intra-billiary stone (black arrow) is evident in the dilated ducts (red arrows); B: On magnetic resonance imaging. A large intra-billiary stone (pink arrow) is evident in the dilated ducts (blue arrows).

**Figure 6 Liver cystic lesions management algorithm.**

**Table 1 Gharbi’s classification of cystic hydatid disease**

|  |  |
| --- | --- |
| **Type** | **Ultrasonographic features and patterns** |
| I | Pure fluid collection |
| II | Fluid collection with a split wall (water-lily sign) |
| III | Fluid collection with septa (honeycomb sign) |
| IV | Heterogeneous echographic patterns |
| V | Reflecting thick walls |

**Table 2 World Health Organization—Informal Working Group on Echinococcosis**

|  |  |
| --- | --- |
| **Type** | **Ultrasonographic features and patterns** |
| CL | Unilocular cystic lesion with uniform anechoic content, cyst wall not visible |
| CE1 | Unilocular cystic lesion with uniform anechoic content, cyst wall visible, snowflake sign |
| CE2 | Multivesicular, multiseptated cysts, daughter cysts present, honeycomb sign |
| CE3 | Unilocular cyst containing liquid with a floating membrane inside, daughter cysts may be present, water-lily sign |
| CE4 | Cysts with heterogeneous hypoechoic or hyperechoic degenerative contents, no daughter cysts |
| CE5 | Cysts characterized by a thick calcified wall, which is arch-shaped, producing a cone-shaped shadow; degree of  calcification varies from partial to complete |