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# The surgical management of congenital liver cysts

## The need for a tailored approach with appropriate patient selection and proper surgical technique

**J.-F. Gigot,[1] S. Metairie,[1] J. Etienne,[1] Y. Horsmans,[2] B. E. van Beers,[3] C. Sempoux,[4] P. Deprez,[3] R. Materne,[2] A. Geubel,[2] D. Glineur,[1] P. Gianello[1]**

[1] Department of Digestive Surgery, Saint-Luc University Hospital, Université Catholique de Louvain (UCL), Hippocrate Avenue, 10, B-1200 Brussels, Belgium
[2] Department of Gastroenterology, Saint-Luc University Hospital, Université Catholique de Louvain (UCL), Hippocrate Avenue, 10, B-1200 Brussels, Belgium
[3] Department of Medical Imaging, Saint-Luc University Hospital, Université Catholique de Louvain (UCL), Hippocrate Avenue, 10, B-1200 Brussels, Belgium
[4] Department of Pathology, Saint-Luc University Hospital, Université Catholique de Louvain (UCL), Hippocrate Avenue, 10, B-1200 Brussels, Belgium

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**Abstract**
*Background:* Most series that report the results of surgical treatment for congenital liver cysts focus more on the technical aspects of the operation than on the late outcome of these patients. In this paper, we emphasize the importance of appropriate patient selection and adequate surgical technique for successful long-term outcome.
*Methods:* Twenty-four consecutive patients with congenital liver cysts were selected for surgical treatment. According to our own classification, 13 patients had simple liver cysts, nine had multicystic liver disease, and two had type I polycystic liver disease. All of these patients were treated by the fenestration technique. An open approach was used for five patients (group 1) treated between 1984 and 1990. In 19 patients (group 2) treated since 1991, a laparoscopic approach was used. The incidence of complicated liver cysts was 40% in group 1 and 68% in group 2.
*Results:* There were no treatment-related deaths in this series. The mean postoperative hospital stay was significantly shorter for patients who underwent successful laparoscopic fenestration ($p < 0.05$). In the open group (group 1), there were no postoperative complications, and all patients were alive and free of symptoms during a mean follow-up of 130 months, without any sign of cyst recurrence. In the laparoscopic group (group 2), four patients were converted to open surgery. One of these patients had an inaccessible posterior cyst; another had bile within the cystic cavity. A further two cases had complicated liver cysts with an uncertain diagnosis between congenital and neoplastic cysts. Four patients (21%) developed peri- or postoperative complications. During a mean follow-up time of 38.5 months, none of the patients with simple liver cysts incurred late symptoms or signs of cyst recurrence. In the six patients with multicystic liver disease, one developed disease-related cyst progression (17%) and required reoperation. One of the two patients with type I polycystic liver disease (50%) developed asymptomatic disease-related cyst progression.
*Conclusions:* When patients are carefully selected and a proper surgical technique is employed, excellent long-term results with a low morbidity rate can be achieved in patients with congenital liver cysts. Patients with multicystic liver disease or type I polycystic liver disease are more prone to late cyst recurrence. A tailored approach is thus indicated for patients with congenital liver cystic disease. However, the laparoscopic approach appears to be the gold standard for the treatment of highly symptomatic or complicated simple liver cysts.

**Key words:** Congenital liver cyst — Laparoscopy — Fenestration — Liver

Reports of the use of laparoscopic surgery for the treatment of hepatic cysts have been increasing [6, 9, 10, 15, 18, 21, 24, 27, 28, 29, 35, 39]. Most cases include congenital liver cysts, but the laparoscopic treatment of parasitic liver cysts has also been described [15, 16]. First of all, it is essential to differentiate between congenital and neoplastic liver cysts because treatment options vary from the fenestration

*Correspondence to:* J.-F. Gigot

technique to radical liver resection. It is also important to keep in mind that most congenital liver cysts are silent in asymptomatic patients and thus do not require any kind of treatment, even if they are large. All cysts should have a large volume (except if strategically situated) and there should be severe and specific cyst-related symptoms before the surgeon considers the indications for treatment [9]. However, the clinical presentation of congenital liver cysts can be complicated, with acute intracystic hemorrhage, rupture, infection, or compression of adjacent structures. In patients with highly symptomatic or complicated congenital liver cysts, the treatment options for minimally invasive therapy include laparoscopic treatment and alcohol sclerotherapy [26, 33, 34]. The aim of this paper is not to compare the results of these two methods for treating such patients, but to emphasize the importance of appropriate patient selection and adequate surgical technique for successful long-term outcome.

## Materials and methods

During a 15-year period from 1984 to 1999, 41 consecutive patients with nonparasitic cystic liver disease were selected for surgical treatment at a single academic hospital. Two of these patients had a neoplastic liver cyst, 17 had true inherited polycystic liver disease (PLD), and 22 were presumed to have a congenital liver cyst. Among these 22 patients, 13 presented with a simple congenital liver cyst (SCLC) and nine presented with multicystic liver disease (MLD). During the study period, 12 other patients suffering from congenital liver cysts and seven suffering from PLD were excluded from treatment due to the absence of symptoms or the presence of aspecific nonrelated symptoms.

Congenital liver cyst (CLC) was defined as an anechoic or hypodense lesion with a thin cystic wall and no nodularity or septation. Intracystic hemorrhage was suggested in patients with a previous or current history of acute abdominal pain associated with heterogenous, hyperdense, or hyperintense cyst content on imaging studies. Simple congenital liver cyst (SCLC) was defined as a solitary or multiple liver cyst, including a predominant cyst with fewer than four associated smaller cysts. Multicystic liver disease (MLD) was defined as the presence of a predominant liver cyst associated with multiple (more than four) liver cysts of various sizes and a normal liver volume. Patients with polycystic liver disease (PLD) suffered from polycystic hepatomegaly, which was associated with polycystic kidney disease in most patients. Patients with PLD were classified into three groups, according to the number and size of liver cysts and the amount of remaining liver parenchyma [8]. Type I PLD included patients with a limited number (<10) of large (>10 cm) liver cysts. Type II PLD was represented by diffuse involvement of liver parenchyma by multiple medium-sized cysts with remaining large areas of noncystic liver parenchyma on preoperative computed tomography. Type III PLD patients suffered from a severe form of PLD with massive diffuse involvement of liver parenchyma by multiple small and medium-sized cysts, with only a few areas of normal liver parenchyma between the cysts.

From these 41 initial patients, two previously reported patients with a preoperatively diagnosed neoplastic cyst were excluded from this series [11, 12]. Two patients with a type I polycystic liver disease were included in this series due to the morphologic similarity of this type of PLD to congenital liver cysts. On the other hand, 15 patients with types II and III PLD were not excluded from this series because these diffuse forms of PLD are completely different clinical entities that require more aggressive forms of treatment in most patients. Finally, the homogeneous group of 24 remaining patients with a benign nonparasitic congenital cystic liver disease comprise the subject of this analysis.

There was a female predominance in these patients, with only one male patient. Their mean age was 54 years (range, 28–76). One patient was classified as high risk—namely, ASA III according to the classification of the American Society of Anesthesiologists [1].

Details of the clinical presentation of the patients are shown in Table 1. A complicated presentation was encountered in 15 patients (62%), including intracystic hemorrhage in 11 patients, hemorrhage with cyst rupture in two patients, spontaneous superinfection in one patient, and biliary compression with transient jaundice in one patient. In three of the eight patients who complained of abdominal pain, the specificity of cyst-related abdominal pain was confirmed by a percutaneous cyst aspiration test under local anesthesia. Complete resolution of the pain was achieved with cyst volume reduction. Subsequent recurrent abdominal pain was correlated with cyst recurrence on imaging studies. Previous cyst treatment had been attempted in five patients (21%), including cyst aspiration in two patients, alcohol sclerotherapy in two patients, laparoscopic fenestration in one patient, and percutaneous cyst drainage in one patient with acute pain and pulmonary atelectasis due to a huge liver cyst with intracystic tension hemorrhage.

Preoperative liver work-up included ultrasonography (US) and computed tomography (CT) in all patients. Magnetic resonance imaging (MRI) was performed in 14 patients (54%). The mean size of the dominant liver cyst was 10 cm (range, 7–17) in group 7 and 13 cm (range, 8–30) in group 2 (not significant). The intrahepatic distribution of the liver cysts according to Couinaud's segmental classification is shown in Table 2. Hepatic cysts were located in the left part of the liver in 38% of the patients and in the right part of the liver in 54%; they were bilobar in 8%. The mean number of hepatic cyst was two (range, one to four) in patients with SCLC, eight (range, four to 12) in patients with MLD, and eight (range, five to 15) in patients with PLD.

Wide deroofing of the cyst roof was performed according to the fenestration technique reported by Lin et al. [22]. Careful attention was given

**Table 1.** Demographic and clinical data of patients with congenital liver cysts

| | Group 1 (open) | Group 2 (laparoscopic) |
|---|---|---|
| *Patients*: | 5 | 19 |
| *Mean age* (yr) | 45 | 57 |
| (range) | (28–63) | (40–76) |
| *Sex ratio* (F/M) | 5/0 | 18/1 |
| *ASA classification*: | | |
| ASA I, II | 5 | 18 |
| ASA III | 0 | 1 |
| *Clinical presentation* | | |
| abdominal pain | 2 | 6 |
| hemorrhage | 2 (40%) | 9 |
| hemorrhage + cyst rupture | 0 | 2 — 68.4% |
| superinfection | 0 | 1 |
| biliary compression | 0 | 1 |
| incidental | 1 | — |

**Table 2.** Characteristics of congenital liver cysts

| | Open fenestration (group 1) | Laparoscopic fenestration (group 2) |
|---|---|---|
| *Number of hepatic cysts* | | |
| simple liver cysts | 3 | 10 |
| multicystic liver disease | 2 | 6 |
| multilocular liver cyst | — | 1 |
| polycystic liver disease | — | 2 |
| *Mean size of the dominant hepatic cyst* (cm) (range) | 10 (7–17) | 13 (8–30) |
| *Location within the liver:* | | |
| right lobe | 1 | 12 |
| left lobe | 4 | 5 |
| bilobar | 0 | 2 |
| *Location according to Couinaud's* classification[a] | | |
| segment II | 1 | 3 |
| III | 1 | 2 |
| IV | 3 | 9 |
| V | 1 | 8 |
| VI | 1 | 1 |
| VII | 0 | 3 |
| VIII | 1 | 11 |

[a] Multiple liver segments are usually found in the same patient

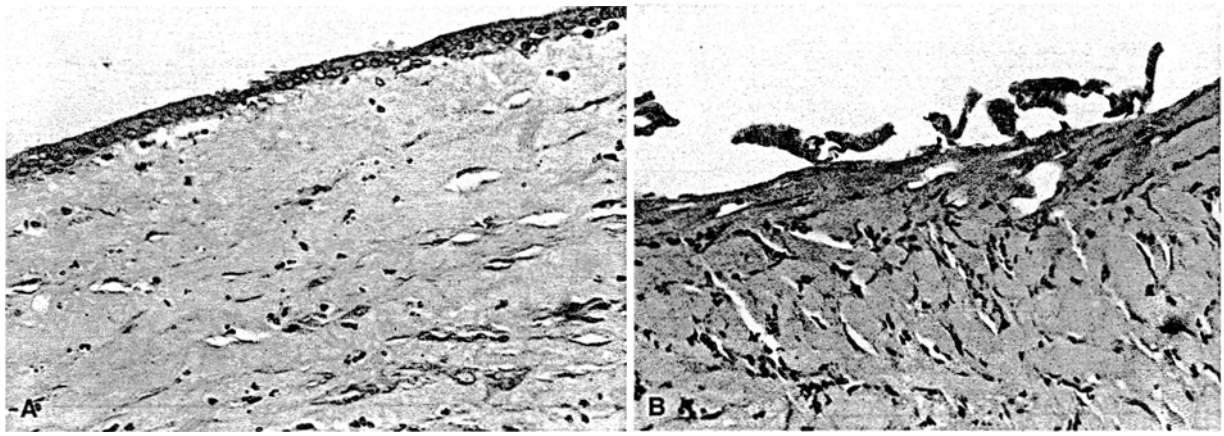


**Fig. 1.** Pathologic examination of the cystic wall after laparoscopic deroofing. **A** Normal aspect of the secreting cystic epithelium before the use of argon beam coagulation. **B** Epithelium destroyed by vaporization with argon beam coagulation.

to achieve hemostasis and bile stasis in the cut edges of the fenestrated residual cystic cavity. Before 1991, patients underwent the fenestration technique through an open approach (group 1, five patients). Following the introduction of laparoscopic surgery in our department in 1991, the 19 remaining patients (group 2) underwent laparoscopic fenestration using a four-trocar technique. Open and laparoscopic intraoperative ultrasonography was used to assess the cysts' location and extent, to determine the biliary and vascular cyst wall relationship, and to access deep-sited liver cysts. Cystic fluid aspiration was performed routinely during surgical exploration for cytologic examination. Electrocautery was used in 20 patients, and harmonic shears were used in four recent patients treated laparoscopically.

After wide deroofing, frozen pathological examination of the cystic wall was also performed routinely to rule out neoplastic cyst. In group 1, in-situ omentoplasty was used in three patients (60%). In group 2 ablation of the cyst lining in the residual fenestrated cystic cavity was achieved with argon beam coagulation in 11 patients (58%) to eliminate epithelial secreting cells and avoid cyst recurrence (Fig. 1). In group 2, two patients underwent associated laparoscopic cholecystectomy, with detection of an occult gallbladder carcinoma in an elderly high-risk patient.

Perioperative and postoperative complications, postoperative hospital stay, and clinical or radiological recurrence during long-term follow-up were recorded in all patients. Complete follow-up was achieved in all patients, including clinical, biochemical, and radiological examinations. Imaging techniques performed during follow-up included US in 10 patients, CT in 18 patients, and MRI in three patients. The mean clinical follow-up period was 130 months (range, 72–175) in group 1 and 38.5 months (range, 3–122) in group 2. In patients with congenital liver cysts, the mean clinical follow-up time was 29 months (range, 3–62) for patients with SLCL, 41 months (range, 2–122) for patients with MLD, and 56 months (range, 12–100) for the two patients with PLD.

Statistic analysis included appropriate use of chi-square test, Fisher's exact test, and Student's *t*-test. A $p$ value of $< 0.05$ was considered significant.

## Results

Age, gender, clinical presentation, and characteristics of the hepatic cysts (number, location, and size of the dominant cyst) were not significantly different between group 1 and group 2 in patients with congenital liver cysts (Tables 1 and 2).

Four patients (21%) in group 2 had to be converted to open surgery. The reasons for conversion include a laparoscopically inaccessible posterior cyst located within the right liver in one patient and the presence of a large biliary fistula discovered during laparoscopic deroofing in another patient who had previously undergone percutaneous alcohol sclerotherapy. Treatment consisted of open fenestration in these cases, as well as closure of a biliary fistula in one of them. The two other converted patients suffered from liver cysts with the presence of a green-brown fluid at cyst aspiration and a thick inflammatory cystic wall at macroscopic inner examination of the cyst. We were unable to rule out liver cystadenoma on repeated frozen-section examinations. These two patients underwent liver resection—namely, removal of segment IV and a left partial hepatectomy. Final pathological examination revealed an atypical congenital liver cyst with multiple internal septations in one case (Fig. 2) and a complicated benign liver cyst with signs of ancient hemorrhage. The postoperative course of these two patients was uneventful. They were free of symptoms and without cyst recurrence 16 and 84 months postoperatively, respectively.

Details of the early and late postoperative outcome of patients in group 1 and 2 are shown in Table 3. There were no postoperative deaths in this series. In group 1, there were no early or late postoperative complications. In group 2, four patients (21%) developed complications, including a transit cardiac arrest during insufflation due to ventricular cardiac arythmia in an elderly ASA III patient, pulmonary complications in two patients (pleural infusion in one case and iatrogenic pneumothorax from the CVP line in the other), and a postoperative biliary leak through the subhepatic drain due to biliary fistula from cut edges of the residual cystic cavity in a patient who was operated on for a superinfected liver cyst. This complication was treated successfully by endoscopic sphincterotomy and stenting.

The mean postoperative hospital stay was 9 days (range, 6–13) in group 1 and 6.1 days (range, 3–17) in group 2. The mean postoperative hospital stay was 9.2 days (range, 6–17 days) in patients managed by a primary or converted open approach (group 1 and converted patients in group 2), whereas it was 5.3 days (range, 3–12) in patients who were treated successfully via the laparoscopic approach ($p < 0.05$). In group 2, there was no difference between SCLC, MLD, and PLD in terms of postoperative hospital stay.

After a mean follow-up of 130 months, the five patients (three with SCLC and two with MLD) operated by open surgery (group 1) are alive and free of symptoms, without

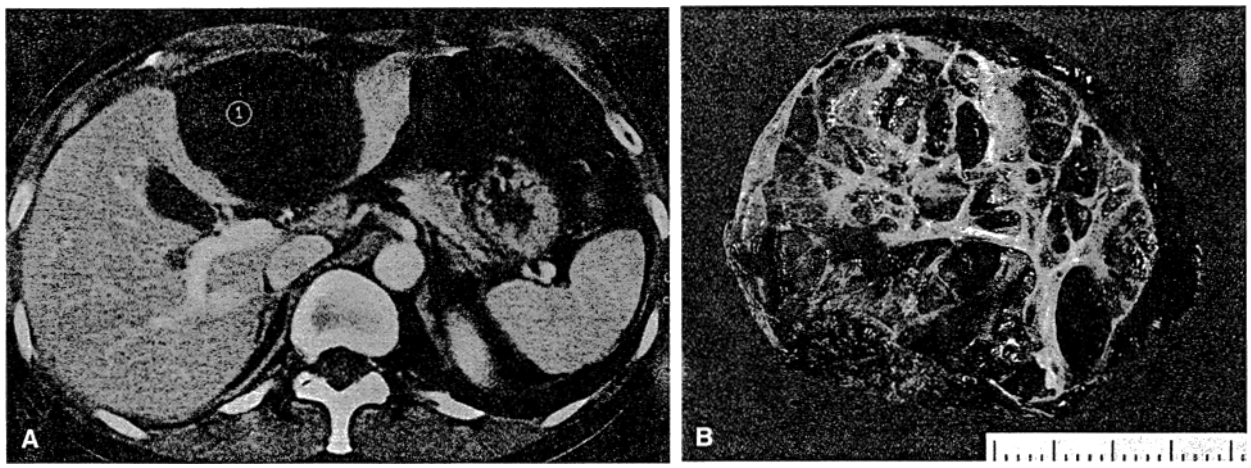


**Fig. 2.** Patient with an atypical congenital liver cyst. **A** Preoperative computed tomography revealed an 8-cm liver cyst located in segment IV. **B** Laparoscopic ultrasonography and macroscopic peroperative examination of the cyst showed an atypical aspect, leading to conversion to laparotomy. Macroscopic examination of the surgical specimen revealed an atypical multilocular cyst with internal septations.

**Table 3.** Results of treatment in patients with congenital liver cysts

| | Open fenestration (group 1) | Laparoscopic fenestration (group 2) |
|---|---|---|
| *Conversion* | — | 4 (21%) |
| *Mortality* | 0 | 0 |
| *Complications* | | |
| perioperative | 0 | 1 (cardiac arrest) |
| postoperative | 0 | 3 (biliary leak, pleural effusion, pneumothorax) |
| *Mean POHS* | 9 days | 6.1 days (successful lap. fenestration, 5.3 days) |
| *Mean duration of follow-up (mo)* | 130 | 38.5 |
| *Cysts recurrence at FU* | | |
| simple liver cysts | 0 | 0 |
| multicystic liver disease | 0 | 0 |
| multilocular liver cyst | — | 1 (reoperated) |
| polycystic liver disease | — | 1 (50%) |

POHS, postoperative hospital stay; lap., laparoscopic; FU, follow-up

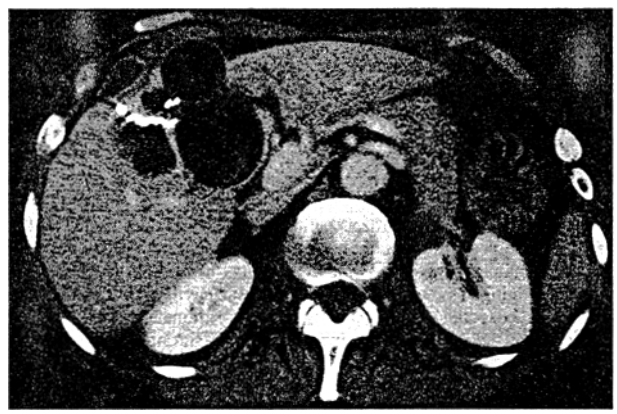

**Fig. 3.** Patient with a multilocular congenital liver cyst located in segment IV after two previous laparoscopic fenestrations. This patient was finally reoperated by open cyst resection to achieve a definitive cure.

cyst recurrence. One patient suffers from spastic colon. In the group treated laparoscopically (group 2), one patient died 1 year postoperatively from progression of initial occult gallbladder carcinoma, with no sign of liver cyst recurrence. The 10 patients with simple hepatic cysts remain free of symptoms, without evidence of cyst recurrence. In the seven patients with multicystic liver disease, one patient with a multilocular congenital hepatic cyst developed cyst progression at the site of two previous laparoscopic fenestrations (Fig. 3). Open cyst removal was necessary to achieve a definitive cure. The two PLD patient remain free of symptoms, but one of them developed an obvious cystic disease 100 months postoperatively. Thus, in group 2, cyst recurrence or disease progression occured in none of the 10 patients with simple cysts (0%), one of the seven patients with multicystic liver disease (14%), and one of the two patients with PLD (50%). The difference was not significant. In the whole series, only one patient with a multilocular hepatic cyst required reoperation (5.3%).

## Discussion

The detection of hepatic cysts has become more common due to the increasing use of ultrasonography. Their reported prevalence is estimated to be between 0.8% [4] and 3.8% [19] during routine abdominal ultrasound examinations. Appropriate preoperative differentiation between congenital, parasitic, and neoplastic liver cysts by imaging techniques is crucial since treatment options may vary from observation in asymptomatic congenital liver cysts to surgical treatment in parasitic and neoplastic hepatic cysts. Confusion between a congenital and a neoplastic liver cyst could lead to inappropriate treatment, exposing the patient to tumor recurrence, as reported recently by Zacherl et al. [39] and Heintz and Junginger [10]. Cystic neoplasms demonstrate typical features on imaging techniques, including the presence of thick irregular cyst walls, heterogenous intracystic fluid, and hypervascular internal septations [2, 13, 17, 38].

However, in cases where the liver cysts are complicated by hemorrhage or superinfection, it can be difficult to dif-

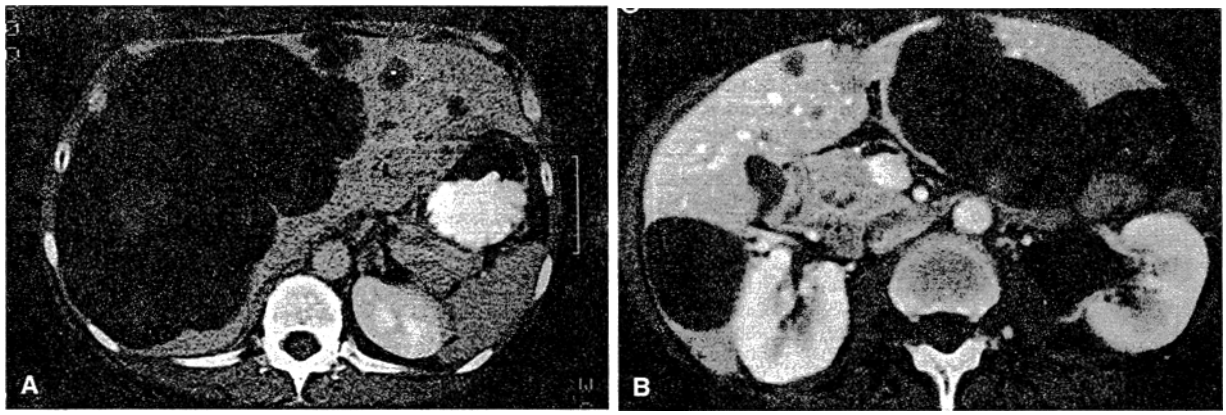


**Fig. 4.** Selection of congenital liver cysts for the laparoscopic approach. **A** This huge hepatic cyst located in the anterior segment of the right liver is easily amenable to laparoscopic fenestration. **B** This posterior liver cyst is more difficult to reach laparoscopically. The deep-sited cyst located in segment IV was inaccessible for fenestration, but it was treated by laparoscopic ultrasound-guided alcohol sclerotherapy at the same time.

ferentiate between benign congenital liver cysts and cystic neoplasms on radiological examination [3, 36, 37]. Despite an extensive preoperative work-up and careful perioperative management, this differential diagnosis was impossible in two of our patients, leading to conversion to an open approach and resection of the cysts. During the surgical exploration, the presence of any unusual cystic fluid, coupled with careful inspection of the inner cyst wall, should alert the surgeon to cases where the internal cystic walls have an irregular and nodular aspect; any such finding should be followed up by multiple biopsies and frozen-section examinations [7, 9, 20, 23, 37]. The malignant nature of two cysts was not recognized at operation in the series reported by Wellwood et al. [37].

It should be emphasized that most congenital liver cysts, even large ones, remain silent in asymptomatic patients and do not require any treatment [32]. Because the natural history of congenital liver cysts is benign, treatment options should be considered only in highly symptomatic patients or complicated liver cysts. These conditions occur only in 10–16% of these patients [20, 32]. Thus, it is important to be strict in the selection of patients according to their symptoms and to focus on specifically cyst-related complaints [9].

Indeed, the causal relationship between abdominal pain and the presence of large liver cysts must be always questioned. It should be accepted only when the cyst is large enough and all other possible causes have been excluded. In patients suffering from chronic abdominal pain in whom its relation to the presence of liver cysts is questioned, we recommend the use of percutaneous aspiration as a pretherapeutic test. If the abdominal complaints resolve after percutaneous aspiration (and return with cyst recurrence), the symptoms can be reasonably attributed to cystic disease. If the symptoms are not relieved after aspiration, the search for another cause of the symptoms should be continued [9, 30]. At the same time, percutaneous radiologically guided aspiration of hepatic cysts can also help to exclude other diagnostic entities, such as neoplastic cysts and liver abscess [30, 31]. The selection was very strict in this series, with 62% of our patients suffering from complicated liver cysts. The strict attention to patient and disease selection and to specific cyst-related symptoms before deciding on the surgical treatment resulted in an absence of residual or recurrent complaints during long-term follow-up. By contrast, in a multicenter Belgian study reported by us in 1996 [9], 18% of the patients suffered from residual or recurrent symptoms during late follow-up—obviously due to the poor selection process before surgery.

Since the first report of the laparoscopic treatment of congenital liver cysts by Paterson-Brown and Garden [28] in 1991, many other series have been reported [6, 9, 10, 15, 18, 21, 24, 27, 29, 35, 39]. In most of these series, only short-term follow-up was available. Our experience shows that the laparoscopic treatment of patients with congenital liver cysts is safe and yields excellent long-term results. Again, a strict and specific selection process, coupled with a meticulous surgical technique, is required to achieve the best results. Indeed, not all hepatic cysts are treatable laparoscopically (Fig. 4). Deep-sited and posterior liver cysts are difficult to reach during laparoscopic exploration [9, 27]. Access to the posterior segment of the right lobe requires extensive mobilization of the liver, which could be quite difficult to achieve laparoscopically. Strict attention to preoperative computed tomography is needed to determine the appearance of the cyst at the liver surface and thus to evaluate its intraoperative accessibility. Finally, after laparoscopic deroofing, hepatic cysts located in segment VIII will exhibit a residual cyst cavity that may be covered immediately by the diaphragm after exsufflation, leading to early cyst recurrence. To address this problem, laparoscopic ultrasonography can be used to detect cysts that are not apparent on the liver surface and to depict the anatomic relationship of the cyst wall with hepatic vascular and biliary structures [25]. Thus, the best candidates for the laparoscopic approach are patients who present with relatively few, large, accessible cysts that are located either in the anterior segments of the right liver (segments IV through VI in Couinaud's classification) [5] or in the left lateral segments [9, 27]. The only conversions in our series were related to a dubious differential diagnosis of hepatic cysts and to difficulty in obtaining laparoscopic access in an inadequately selected patient with a posterior liver cyst.

The importance of employing the appropriate technique and following it meticulously throughout the laparoscopic procedure cannot be overstressed. For the fenestration tech-

**Table 4.** Recurrence rates during follow-up time in patients treated by laparoscopic fenestration for congenital liver cysts

| First author | Year of publication | No. of patients | Mean duration of follow-up (mo) (range) | Recurrence rate (%) |
|---|---|---|---|---|
| Lange [21] | 1992 | 6 | 5.5 (1–11) | 17% |
| Vogl [35] | 1995 | 7 | — | 14% |
| Morino [27] | 1996 | 10 | (4–60) | 0 |
| Gigot (BGES[a]) [9] | 1996 | 17 | 10 (1–48) | 44% |
| Krahenbuhl [18] | 1996 | 8 | 12.6 (1–38) | 12.5% |
| Diez [6] | 1998 | 9 | (6–36) | 11% |
| Heintz [10] | 1998 | 7 | 33 (2–43) | 28% |
| Martin [24] | 1998 | 13 | 25 (2–80) | 8% |
| Katkhouda [15] | 1999 | 16 | 30 (3–78) | 0 |
| Payatakes [29] | 1999 | 12 | 36 (4–84) | 22% |
| Zacherl [39] | 2000 | 7 | 37 (7–77) | 14% |
| Present series[b] | 2000 | 17 | 36 (3–122) | 6% (0 in SCLC) |

SCLC, simple congenital liver cyst

[a] Multicenter series of patients from the Belgian Group for Endoscopic Surgery

[b] Two patients operated on for polycystic liver disease were excluded.

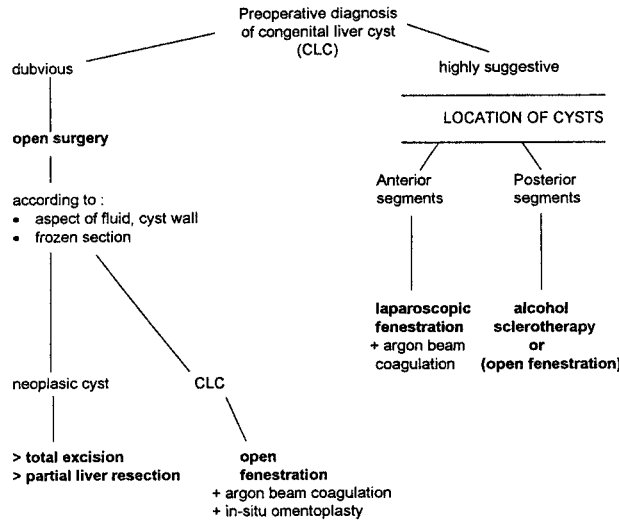


**Fig. 5.** Management algorithm for patients with nonparasitic liver cysts.

nique, as reported by Lin et al. in 1968 [22], wide deroofing of the cyst wall is a key factor in avoiding cyst recurrence. However, it also increases the risk of bleeding and biliary leak from the small vascular and biliary structures within the fenestrated hepatic edges, which are injured during laparoscopic deroofing. Thus, a close inspection of the fenestrated cyst wall for possible bile leakage is required during the procedure. Nevertheless, this complication was missed in one of our patients, leading to postoperative biliary fistula. In addition to wide deroofing of the cyst wall, eliminating the epithelium lining the residual cystic cavity with the application of an argon beam coagulator is regarded by our team as the most important factor to avoid cyst recurrence, because it destroys the cyst epithelium and thus suppresses further fluid secretion.

Finally, laparoscopic fenestration for congenital liver cysts is a simple procedure that allows excellent recovery and a complete resolution of symptoms, as shown by our experience, if the selection of patients and cystic liver diseases is appropriate. As in other series [9, 27, 35], the use of the laparoscopic approach reduced the postoperative stay of these patients. The most interesting feature in this series is the excellent long-term result achieved, undoubtedly due to appropriate selection of the patients and surgical technique. The best results, with no late residual or relapsing symptoms and cyst recurrence, were obtained in patients suffering from simple congenital liver cysts. This outcome compares favorably with the recurrence rates reported in the literature during a limited period of follow-up (Table 4). In our series, the only patients with recurrences were those with multilocular liver cyst or polycystic liver disease. The selection of patients with polycystic liver disease for the laparoscopic approach should include only those with type I PLD according to the Morino [27] and Gigot [8] classifications—a situation that is very comparable to patients with dominant hepatic cysts. Other patients with type II or type III PLD [4] should be excluded from treatment with the laparoscopic approach due to its inability to efficiently fenestrate multiple deep-sited cysts and to reduce the volume of polycystic hepatomegaly [8, 14, 27].

In conclusion, with adequate selection of patients and cystic diseases and the application of the proper technique performed by surgeons experienced in hepatobiliary diseases and laparoscopic surgery, the laparoscopic fenestration of congenital liver cysts is a safe procedure that is associated with minimal morbidity, a rapid recovery, and excellent long-term results. Laparoscopic fenestration proved to be technically feasible in 90% of our patients with congenital liver cysts and conferred symptomatic relief in 95% of them during a mean follow-up of 38.5 months. Accordingly, we are proposing a stratified algorithm for the treatment of congenital liver cysts, depending on the suspected pre- and perioperative diagnosis of the cyst's nature and its location within the liver parenchyma (Fig. 5). Further prospective controlled studies are now needed to evaluate the respective role of percutaneous alcohol sclerotherapy and laparoscopic surgery in the treatment of patients with congenital liver cystic disease.

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