Management of complex liver cystic hydatidosis: challenging benign diseases for the hepatic surgeon
A case series report from an endemic area

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Abstract
Hydatid cysts of the liver are benign lesions which require a wide range of surgical strategies for their treatment. We hypothesized that cysts larger than 15 cm, or compressing main vascular structures, or located in both hemilivers should be considered, as well as complicated cysts, in the category of complex hydatid cysts.

In the Complex Group, 19% of patients had cysto-biliary communication with recurrent cholangitis, 9.5% had cysts eroding the diaphragm or chest wall, or communicating with the bronchial tree, 31% had cysts with contact with main vascular structures, 11.9% had multiple bilobar cysts, 14.3% had giant cysts with organ displacement, and 14.3% had a combination of the above-mentioned types. Type of surgical treatment was different between the two groups (P<.001). Additional procedures were statistically more frequent in the Complex Group (P=.02). Postoperative morbidity was higher in the Complex Group, although not in a significant manner (P=.07). Median hospital stay was longer in the Complex Group (12 vs 7 days, P<.001). No 30-day mortality occurred. Four patients (7.3%), all belonging to the Complex Group, required reoperation for postoperative complications.

Surgery for complex hydatid cysts of the liver is potentially burdened by serious complications. This kind of benign liver disease requires skill-demanding procedures and should be treated in centers with expertise in both hepatobiliary surgery and hydatid disease management.

Abbreviations: CT = computed tomography, ERCP = endoscopic retrograde cholangiopancreatography, US = ultrasound.

Keywords: complex cyst, echinococcosis, hydatidosis, liver, surgical treatment

1. Introduction
Hydatid disease, also named as echinococcosis, is a worldwide diffuse parasitic disease, that is endemic in the Middle East, Far East, South America, Australia, New Zealand, East Africa, and Mediterranean basin countries.[1–3] *Echinococcus granulosus* is the most common among the *Echinococcus* spp. which affects humans, and is the causative agent of cystic echinococcosis. The parasite has the dog as definitive host. Humans are occasional intermediate hosts who contract the disease by accidentally swallowing the tapeworm eggs, usually contained in contaminated food or water. Development of cysts mostly occurs in the liver, where the protoscolices migrate through the portal flow.[1,2,4]

Liver cystic hydatidosis usually remains asymptomatic for a long time, until the cyst size enlarges or complications occur. The most common complications are infection and subsequent abscess formation, rupture of the cyst into the biliary or bronchial system, and rupture into the peritoneal cavity.[5–7] In general, patients with complicated hepatic cysts face serious and sometimes life-threatening clinical situations.[8] In certain occasions, hydatid cysts remain clinically silent or cause few and non-specific symptoms in spite of the fact that they require prompt surgical treatment because of the risk of sudden and severe complications. The latter type of cysts can also be considered as complex hydatid cysts, due to the need for skill-demanding surgery for their cure, although they have little clinically relevant effects.

The surgical department of our academic institution has been considered the reference center for hepatobiliary surgery and for surgical treatment of hydatid cysts in Northern Sardinia, where
hydatidosis is endemic.[9] In the latest decades, we have observed a progressive trend in reduction of surgical interventions for hepatic hydatidosis, mainly due to both reduction of echinococcosis infections and success of non-operative management in most patients. As a result, we observed that surgical treatment of cystic liver hydatidosis of the liver is nowadays almost exclusively reserved to patients with complex cases.

The main purposes of this study were to describe the management of complex hepatic hydatid cysts in an institution located in an endemic area, and also to propose a definition of complex hydatid cyst of the liver.

2. Materials and methods

Data of every patient consecutively submitted to liver surgery has been prospectively collected in an institutional-approved database. The institutional review board of the Department of Medical, Surgical and Experimental Sciences of the University of Sassari approved this retrospective study. For the present study, we queried our database for any patient operated on for hepatic hydatid disease between January 2010 and March 2020. Those with alveolar hydatid cysts were excluded. Before operation, all patients underwent routine blood tests, Boydens test, chest X-ray, liver ultrasound (US), and triphasic liver computed tomography (CT) scan. In selected cases, also cholangio-MRI and/or endoscopic retrograde cholangiopancreatography (ERCP) were carried out. Patients’ demographics and cyst characteristics were collected (age, sex, liver location, number, and size of the cysts, US an CT scan characteristics), as well as type of surgical operation, complications, and hospital stay.

For the purposes of this study, we divided the patients into two groups, the “Complex Group” and the “non-Complex Group”. We considered in the former patients having at least one of the following conditions:

- Cysto-biliary communication with recurrent cholangitis;
- Erosion of the diaphragm or chest wall, or communication of the cyst with the bronchial tree;
- Contact with or compression of main vascular structures, such as vena cava, hepatic veins, portal vein, or main portal branches;
- Multiple bilobar cysts;
- Giant cysts with organ displacement.

Type of surgical operation and surgical outcomes were compared between the Complex Group and the non-Complex Group. The patients’ demographic and cyst characteristics were summarized with descriptive statistics. Continuous variables were analyzed using the t test or Mann–Whitney U test, as appropriate. Differences in proportions between the groups were evaluated using the χ² or the Fisher exact test, where appropriate. All P values lower than .05 were considered to indicate statistical significance.

3. Results

During the considered time frame, 55 patients underwent surgery for treatment of hydatid cyst disease of the liver. Of those, 24 (43.6%) were males, and 31 (56.4%) females. Mean age was 60.6 years (range 19–79). Ten patients (18.2%) presented with recurrent hydatid cysts. Signs and symptoms of the study population are resumed in Table 1. As for the characteristics of the cysts, 18 patients (32.7%) had cysts located in both hemilivers, while 22 (40.0%) had more than one cyst. Mean cyst size was 10.0 cm (range 3.4–24.0 cm), and 30 (54.5%) patients had at least one cyst measuring 10 cm or more in diameter. Nine patients (16.4%) presented with additional hydatid cyst location other than liver (Table 2). Characteristics of the complex cases, according to our inclusion criteria, were resumed in Table 3. In particular, 8 (19.0%) patients had type I (cysto-biliary communication with recurrent cholangitis) (Fig. 1), 4 (9.5%) had type II (erosion of the diaphragm or chest wall, or communication with the bronchial tree) (Figs. 2 and 3 and Supplementary Material: Video 1, http://links.lww.com/MD/F294), 13 (31%) had type III (contact or compression of vascular structures: vena cava, hepatic veins, portal vein and/or main portal branches) (Fig. 4), 5 (11.9%) had type IV (multiple bilobar cysts) (Fig. 5), and 6 (14.3%) had type V (giant cysts with organ displacement) (Fig. 6 and Supplementary Material: Video 2, http://links.lww.com/MD/F295). Six patients (14.3%) had a combination of the above mentioned types.

The surgical procedures carried out were: radical pericystectomy (4.8% vs 69.2%), subtotal pericystectomy (14.3% vs 0%), partial pericystectomy (23.8% vs 7.7%), hepatic segmentectomy (45.2% vs 15.4%), right hepatectomy (7.1% vs 0%), and left hepatectomy (4.8 vs 7.7%) in the Complex Group and non-

### Table 1

| Characteristics of the patients included in the study. | N (%) |
|-------------------------------------------------------|-------|
| Age (mean, range)                                      | 60.6 (19–79) |
| Male sex                                               | 24 43.6 |
| Symptoms/signs                                         |       |
| Abdominal pain                                         | 19 34.5 |
| Palpable abdominal mass                                | 31 56.4 |
| Fever                                                  | 8 14.5 |
| Jaundice                                               | 7 12.7 |
| Nausea/vomiting                                        | 6 10.9 |
| Anorexia                                               | 20 36.4 |
| Upper abdominal tenderness                             | 5 9.1 |
| Abdominal distension                                   | 22 40.0 |
| Recurrent cholangitis                                   | 6 10.9 |
| Elevated ALT/AST                                        | 15 27.3 |
| Patients with recurrent cysts                          | 10 18.2 |

### Table 2

| Characteristics of the cysts. |
|------------------------------|
| N (%)                        |
| Cyst location                 |
| Right lobe                   | 30 54.5 |
| Left lobe                    | 7 12.8 |
| Bilobar                      | 18 32.7 |
| Cyst number                  |
| Patients with single cyst    | 33 60.0 |
| Patients with multiple cyst  | 22 40.0 |
| Cyst size (cm, mean, range)  |
| <10 cm                       | 25 45.5 |
| ≥10 cm                       | 30* 54.5 |
| Additional hydatid cyst location other than liver       |
| Lung                         | 9 16.3 |
| Kidney                       | 6 10.9 |
| Pelvis                       | 1 1.8 |
| Peritoneum                   | 1 1.8 |

* In 6 cases cyst diameter was ≥15 cm.
Complex Group, respectively. In general, the type of surgical procedure was statistically different between the two groups of the study ($P < .001$). Additional procedures during primary surgery for treatment of liver cystic hydatidosis were statistically more frequent in the Complex Group ($97.6\%$ vs $61.5\%$, $P = .02$) (Table 4). All those additional procedures became necessary for the complete treatment of the hydatid disease, except for one case in which a concomitant adrenalectomy was planned for a 5-cm right incidentaloma.

Median hospital stay was significantly longer in the Complex Group (12 vs 7 days, $P < .001$). In total, 15 patients (27.3\%) developed one or more postoperative complications. Postoperative morbidity was higher in the Complex Group (33.3\% vs 7.7\%), although not in a significant manner ($P = .07$). Reoperation for occurrence of post-operative complications was needed in 4 patients of the Complex Group. In the non-Complex group, one patient developed a pleural effusion and one an intra-abdominal abscess. The main part of the complications, as expected, was registered in the Complex Group: 1 patient developed pneumonia, 1 an isolated pleural effusion, 1 a wound infection and a pleural effusion, 3 an intra-abdominal abscess and a pleural effusion, 3 a post-operative bleeding requiring re-laparotomy, 1 a colonic ischemia, and 5 an isolated biliary fistula (Table 5).

Five patients developed a postoperative biliary fistula, which resolved spontaneously in 2 cases within an average of 7 days. In 2 patients, the biliary fistula was resolved with ERCP and...
sphincterotomy, while 1 patient who initially had a biliary-enteric anastomosis necessitated a re-laparotomy for anastomotic fistula repair and drainage.

There was no 30-day mortality. One patient, who initially underwent a partial pericystectomy for a cyst located in close vicinity of the hepatic hilum (Fig. 1), was re-operated after 3 months for persistent episodes of cholangitis and deceased 12 months after the first operation for sepsis caused by carbapenem-resistant Klebsiella pneumoniae.

4. Discussion

The patients with liver hydatid cysts should receive some form of treatment. Observation alone with ultrasound follow-up could be

Figure 2. CT scan revealing multiple hydatid cysts of the right hepatic lobe involving the diaphragm, the lower pulmonary right lobe, and eroding the chest wall in a 78-year-old woman (A and B). She underwent a right heptectomy associated to diaphragm repair with mesh, costal resection, and atypical pulmonary resection.

Figure 3. CT scan showing multiloculate hydatid cysts of the right hepatic lobe abutting the diaphragm and involving the lower pulmonary right lobe in a 44-year-old man. He underwent radical pericystectomy associated to diaphragm repair, and lower pulmonary lobectomy (A–C: CT axial view; D: CT lateral view; E and F: coronal view).
only considered in selected patients with small and asymptomatic cysts containing dense calcifications, the latter being features of cyst death and inactivation.\(^\text{[10]}\) Surgery has been considered for years the mainstay of treatment. However, the management of hepatic hydatid disease has considerably changed over the last 20 years; in fact, the spreading of prevention programmes in endemic areas, along with the use of chemotherapy with benzimidazole compounds, has led to an effective control of the disease.\(^\text{[10]}\) In addition, advances in minimally invasive forms of treatment, such as PAIR (puncture–aspiration–injection–reaspiration), have further reduced the need for surgical interventions.\(^\text{[12,13]}\) Nonetheless, surgery still maintains a prominent role when nonoperative management has failed or is not considered feasible, and also in complex and/or complicated hydatid cysts.

In surgical management of liver hydatidosis, different clinical situations may require more complex management than usual, however, there is no a unique definition of “complex” liver hydatidosis that is commonly accepted. According to our experience, we think that complex cases and complicated cases cannot be considered the same. A cyst can be complex, but not complicated (i.e., an uncomplicated giant cyst which requires complex management, or multiple cysts). In contrast, infected hydatid cysts, and those with cysto-biliary or cysto-bronchial communications, can be clearly considered as complicated cysts, requiring a complex surgical procedure. Therefore, we arbitrarily created the aforementioned definition of “complex cases,” which refers to those cases which encompass complicated and non-complicated cysts that need difficult and skill-demanding surgical procedures. Gharbi’s and WHO classifications are commonly used in defining characteristics of hepatic cysts.\(^\text{[14,15]}\) However, none of them has utility in evaluating the complexity of management and the operative risk. Botrugno et al, in a cohort of 38 patients considered as complex hydatid cysts of liver those with a diameter \(\geq 10\) cm, as well as recurrent and multiple cysts,\(^\text{[16]}\) while others reported as complex those cases of difficult management.\(^\text{[8,17,18]}\)

In our series, 19% of the patients had a cysto-biliary communication, a common complication of hepatic echinococcosis reported in 26% to 80% of cases.\(^\text{[4,11,19]}\) Cysto-biliary communication generally causes severe symptoms due to biliary infection, but can present with a wide spectrum of clinical manifestations. Depending on the size and location of cysts, patients can be asymptomatic or have jaundice, cholangitis, liver abscess, and sepsis.\(^\text{[6,19]}\) Cysto-biliary communications can be diagnosed preoperatively or at the time of operation; in both cases they must be meticulously repaired.\(^\text{[6]}\) The cysts located in the central liver segments, multivesicular cysts, and those over 10 cm in diameter are more likely to fistulize with the biliary tree.\(^\text{[2,6,19]}\) Fistulization can occur in small-calibre ducts or major
biliary ducts. In presence of minor leakages we used simple suture repair during total or partial perycystectomy, whereas a T-tube was placed in the common bile duct in presence of major biliary communications. It should be noted that cysto-biliary communications have been considered an important predictive factor for postoperative complications. In fact, the intrabiliary rupture of the cyst increases postoperative morbidity, ranging from 16% to 55%, and mortality, ranging from 1.25% and 7%. Four patients of the present series underwent surgery for erosion of the diaphragm by the cyst wall, and in two of them there was also a communication with the bronchial tree. Thoracic complications of hepatic hydatid cysts are seen in ~2% to 16% of cases. Liver cyst can be infected and produce a secondary hepatic abscess that may rupture into a bronchus, or can be in direct communication with the bronchial tree. The clinical picture is predominately pulmonary, with respiratory symptoms such as cough, dyspnea, and hemoptysis.

Figure 5. CT scan showing multiple hydatid cysts located in the right lobe of the liver in a 72-year-old man (A–D). There was a cysto-biliary communication with presence of hydatid material in the common bile duct. ERCP plus sphincterectomy was carried out before the surgical operation.

Figure 6. CT scan of a 75-year-old woman with a giant hydatid cyst measuring 25 cm in its major diameter containing daughter cysts, and causing mediastinal shift with displacement of the heart, inferior vena cava, stomach, and right kidney (A–C). To note, there was a compensatory hypertrophy of the left hepatic lobe (B). Operation performed: Right hepatectomy with diaphragm repair.
cough, dyspnea, thoracic pain, biliptrysis, or even respiratory failure.\[21,23\] Patients with biliary-bronchial communications always require a complex procedure for their treatment, due to the contemporaneous involvement of liver, diaphragm, and lung. Although treatment of the hydatid liver cyst and diaphragm repair might be sufficient in some cases, as the pulmonary infection may resolve after the abolition of the biliary-bronchial communication,\[23,24\] it is our opinion that also resection of the involved lung parenchyma should be warranted. In this series, a right lower lobectomy and an atypical pulmonary resection were carried out along with the surgical treatment of the liver cyst in two cases, through a thoracoabdominal incision. In one of them (described in Supplementary Material: videoclip 1, http://links.lww.com/MD/F294), also a costal resection was necessary due to inflammatory involvement of the chest wall. All these thoracoabdominal procedures were carried out by the same surgical team.

We have considered as complex cases those in which the cysts are in contact with or cause compression of major vascular structures. We observed these features in 30.9% of patients, most of whom were asymptomatic. Complete or incomplete obstruction of the portal vein or its main branches may result into decreased portal vein inflow as well as hepatic morphological and functional changes, including atrophy of the involved lobe and subsequent compensatory hypertrophy of the contralateral lobe.\[25,26\] The position of the cyst represents an important factor influencing the choice of the surgical treatment. When the wall of the cyst is located either in direct contact with or in the close vicinity of major vessels such as vena cava, hepatic veins, portal vein, and/or main portal branches, the surgical treatment of the cyst is associated with an increased risk of intraoperative and postoperative bleeding.\[27\] There is little evidence about those cases in the literature, with mostly case reports. In line with other authors,\[5\] we usually prefer to perform a subtotal or a partial lobectomy.

### Table 4

| Surgical procedure                      | All patients (n = 55) | Complex Group (n = 42) | Non-Complex Group (n = 13) | P   |
|-----------------------------------------|----------------------|------------------------|---------------------------|-----|
| Subtotal pericystectomy                 | 5 (9.1%)             | 6 (14.3%)              | 0 (0%)                    | <.001|
| Partial pericystectomy                  | 12 (21.7)            | 10 (23.8%)             | 1 (7.7%)                  |     |
| Radical Pericystectomy                  | 11 (20.0%)           | 2 (4.8%)               | 9 (69.2%)                 |     |
| Hepatic segmentectomy                   | 21 (38.2%)           | 19 (45.2%)             | 2 (15.4%)                 |     |
| Right hepatectomy                       | 3 (5.5%)             | 3 (7.1%)               | 0 (0%)                    |     |
| Left hepatectomy                        | 3 (5.5%)             | 2 (4.8%)               | 1 (7.7%)                  |     |
| Additional procedure                    | 35 (63.6%)           | 41 (97.6%)             | 8 (61.5%)                 | .02 |
| Diaphragm repair                        | 4 (11.4%)            | 4 (10.0%)              | 0 (0%)                    |     |
| T-tube placement in the CBD             | 11 (31.4%)           | 10 (23.8%)             | 1 (7.7%)                  |     |
| Cholecystectomy                         | 15* (42.8%)          | 9 (21.4%)              | 6 (46.2%)                 |     |
| Bilio-enteric anastomosis (Roux-en-y)   | 1 (2.8%)             | 1 (2.3%)               | 0 (0%)                    |     |
| Right Adrenalectomy†                    | 1 (2.8%)             | 1 (2.3%)               | 0 (0%)                    |     |

CBD = Common Bile Duct.

* Excluding those cases in which an upfront right hepatectomy was carried out.
† Concomitant intervention for right adrenal incidentaloma.

### Table 5

| Postoperative complications          | All patients (n = 55) | Complex Group (n = 42) | Non-Complex Group (n = 13) | P   |
|--------------------------------------|----------------------|------------------------|---------------------------|-----|
| Total no. of patients with morbidity | 15 (27.3%)           | 14 (33.3%)             | 1 (7.7%)                  | .07 |
| Respiratory infection                | 1 (5.9%)             | 1 (6.7%)               | 0 (0%)                    |     |
| Pleural effusion                     | 3 (17.6%)            | 2 (13.3%)              | 1 (50%)                   |     |
| Wound infection                      | 1 (5.9%)             | 1 (6.7%)               | 0 (0%)                    |     |
| Biliary fistula                      | 5 (29.5%)            | 5 (33.3%)              | 0 (0%)                    |     |
| Intra-abdominal abscess              | 3 (17.6%)            | 2 (13.3%)              | 1 (50%)                   |     |
| Postoperative bleeding               | 3 (17.6%)            | 3 (20.0%)              | 0 (0%)                    |     |
| Colonic ischemia                     | 1 (5.9%)             | 1 (6.7%)               | 0 (0%)                    |     |
| Total no. of complications*          | 17 (100%)            | 15 (100%)              | 2 (100%)                  | .14 |
| Reoperation                          | 4 (7.3%)             | 4 (9.5%)               | 0 (0%)                    | .24 |
| 30-day mortality                     | 0 (0%)               | 0 (0%)                 | 0 (0%)                    |     |
| 1-year mortality                     | 1 (1.8%)             | 1 (2.3%)               | 0 (0%)                    | .76 |
| Median hospital stay (days, range)   | 10 (4–57)            | 12.0 (6–57)            | 7.0 (4–11)                | <.001|

* Four patients presented more than one complication.
Surgical treatment of hydatid cysts of the liver traditionally encompasses conservative and radical interventions. Conservative operations, such as cystectomy, removal of cystic material, deroofing, and marsupialization procedures, mostly consist in drainage and evacuation of the cystic content. Radical approaches such as total, subtotal, or partial pericystectomy have as a goal the removal of the cyst with a rim of surrounding liver parenchyma. The ideal surgical treatment of liver hydatid cysts remains a matter of debate. In a recent meta-analysis, Pang et al demonstrated that radical procedures reduce the rates of postoperative complications and cyst recurrence when compared to conservative surgery. Although prospective studies comparing conservative vs radical approaches have not been done, we believe that radical surgical treatment should be always pursued, when feasible. In fact, many studies confirm that total removal of the cysts along with the entire pericystium is preferred in the complex group and skill-demanding cases, in the same ways as complicated cysts.

In accordance with others, it is our thought that surgical treatment of hydatid cysts will be more frequently reserved for the most complex and skill-demanding cases, thus patients should be preferably referred to centers experienced not only in hepatobiliary surgery, but also in management of hydatid disease. A definition of complex cases may also be useful in stratifying patients for surgical treatment. We recognize that the present study has some limitations, the main being its retrospective design and the small sample size. However, there are few studies in the literature that have described special challenging cases, in which the management of complicated cysts has been reported together with that of complex albeit paucisymptomatic cases.

5. Conclusions

Management of liver cystic hydatidosis may represent a challenging situation for hepatic surgeons, burdened by serious complications. Cysts of large diameter (>15 cm), or compressing main vascular structures, or located in both hemilivers, albeit often of little clinical relevance, can be considered as complex and skill-demanding cases, in the same ways as complicated hydatid cysts.
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