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# Management of giant hepatic cysts in the laparoscopic era

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**Purpose:** We sought to evaluate the feasibility and outcomes of laparoscopic resection of giant hepatic cysts and surgical success, focusing on cyst recurrence.

**Methods:** From February 2004 to August 2011, 37 consecutive patients with symptomatic hepatic cysts were evaluated and treated at Dong-A University Hospital. Indications were simple cysts (n = 20), multiple cysts (n = 6), polycystic disease (n = 2), and cystadenoma (n = 9).

**Results:** The median patient age was 64 years, with a mean lesion diameter of 11.4 cm. The coincidence between preoperative imaging and final pathologic diagnosis was 54% and half (n = 19) of the cysts were located in segments VII and VIII. Twenty-two patients had American Society of Anesthesiologists (ASA) classification I and II, and nine had ASA classification III. Surgical treatment of hepatic cysts were open liver resection (n = 3), laparoscopic deroofing (n = 24), laparoscopic cyst excision (n = 4), laparoscopic left lateral sectionectomy (n = 2), hand assisted laparoscopic procedure (n = 2), and single port laparoscopic deroofing (n = 2). The mean fellow-up was 21 months, and six patients (16%) experienced radiographic-apparent recurrence. Reoperation due to recurrence was performed in two patients. Among the factors predicting recurrence, multivariate analysis revealed that interventional radiological procedures and pathologic diagnosis were statistically significant.

**Conclusion:** Laparoscopic resection of giant hepatic cysts is a simple and effective method to relieve symptoms with minimal surgical trauma. Moreover, the recurrence is dependent on the type of pathology involved, and the sclerotherapy undertaken.

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## INTRODUCTION

Liver cysts are frequently detected incidentally during screening imaging examinations, showing increased prevalence with age [1]. But most of them are asymptomatic and need no therapy. Surgery of cystic lesions is indicated when they become highly symptomatic, complicated, or demonstrate rapid growth [2-4].

Laparoscopy has become popular for the treatment of liver cysts [5-7]. Because of its advantages such as reduced postoperative pain and discomfort, lower morbidity, early mobilization, recovery, shorter hospital stay and cosmetic benefits [8]. But the management of symptomatic giant hepatic cysts has been debated; so far there is still no consensus on the optimal treatment in those patients [9].

The long-term surgical outcome depends on the ability to differentiate between the types of hepatic cysts because most hepatic cysts can be managed with wide

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deroofing laparoscopically, while others should be resected [10].

We report a single institution's experience with laparoscopic resection of symptomatic giant liver cysts, focusing on cyst recurrence.

## METHODS

Between February 2004 and August 2011, 37 patients (4 men and 33 women) with a mean age of 64 years (range, 31 to 93 years) were evaluated and treated in Dong-A University Hospital.

Surgery was performed when patients' complaints were potentially related mechanically to giant hepatic cysts, ruling out alternative medical conditions. Only dominant and symptomatic lesions were deroofed.

We considered giant hepatic cyst as operative indication to be complex, larger (over 6 cm), had mural papillary projection, septation or debris, or having features that suggest that it is something other than a simple cyst.

All patients underwent preoperative ultrasonography and computed tomography (CT). Additionally, magnetic resonance imaging (MRI) and α-fetoprotein, and careinoembryonal antigen and carbohydrate antigen 19-9 (CA 19-9) serum levels were checked for preoperative diagnosis.

Malignancy was suspected in cases of cystic wall thickening or papillary growth within the cyst. When we had suspected malignancies preoperatively, we considered them to hepatic malignancies, not to giant hepatic cysts that we described, and operated them according to principles of oncologic surgery.

All giant solitary liver cysts were considered for laparoscopy regardless of their size and anatomic location with laparoscopic deroofing. Open liver resection was undertaken at a primary procedure for suspected neoplastic change.

Postoperatively the proportion of resected proportion of the cyst was calculated (square measure of resected specimen: width × length / $r^2$ × 3.14; r=half diameter of cyst). Recurrence was evaluated by follow-up computed tomographic scan. If a cyst is enlarged radiographically to more than 75% of preoperative diameter, we assessed for recurrence.

### Statistical analysis

Data were summarized using descriptive statistics: frequency and percentage for categorical variables and mean and standard deviation for continuous variables. Differences in patients' demographic and clinical characteristics were compared across subgroups with Fisher exact test for categorical variables.

Odds ratios (ORs) for measuring the strength of a predictor variable (in two groups or levels in this study) on an outcome were calculated with 95% confidence intervals (CIs) using logistic regression. The multivariate model was created using a backward elimination method, and the probability was set at 0.20 for removal. ORs were also adjusted for factors affecting the response variable.

Null hypotheses of no difference were rejected if P-values were less than 0.05, or, equivalently, if the 95% CIs of risk point estimates excluded 1. By its nature, this study is exploratory and therefore no adjustment for multiple testing was applied. All statistical analyses were carried out using SAS 9.1.3 (SAS Institute Inc., Cary, NC, USA) statistical software.

### Surgical technique

The patient is positioned in the inverted-Y position with the surgeon between the legs and the scopist sitting at the side.

A 10- to 12-mm port was inserted 2-3 cm above the umbilicus and two 10-cm ports surrounded the umbilicus in a 90° V-shaped fashion and a subxiphoid trocar is used for retraction or as an irrigation/suction device. Hand ports were placed to aid in the mobilization of liver, especially if the lesion was located in the segment VII and VIII. After complete mobilization of the cyst, the blue dome of the cyst is fenestrated and the cyst contents are aspirated.

Next, wide deroofing was performed using ultrasonic coagulation shears (Harmonic scalpel, Ethicon Inc., Somerville, NJ, USA) or bovie cautery; removing the entire cystic wall is not necessary. The wall at the cyst is excised to within 3 mm of the liver parenchyma and the resected cystic wall specimens were routinely sent for pathologic evaluation to exclude malignancies. The back wall of the cysts was carefully examined for evidence of bile leak, and if identified, a hemostatic clip or a tie is applied when needed. Careful hemostasis of the cyst edge is performed with electrocautery or argon beam coagulator. A Jackon-Pratt drain was inserted within the cyst cavity.

## RESULTS

Giant hepatic cysts, with a mean diameter of 11.4 cm (range, 6 to 32 cm), were encountered in 37 patients. Presenting symptoms were abdominal pain (n = 10), vegetative symptoms (n = 19), (impaired gastrointestinal transport, early satiety, nausea, vomiting, or acid reflux), dyspnea (n = 2).

Cysts incidentally found during the screening examinations accompanied with increased size were seen in seven patients (18.9%).

Twelve cases involved the right lobe and 14 the left lobe; eleven were bilateral. Internal septation was seen by imaging study in 15 patients (40%) and preoperative diagnoses were simple cyst (n = 20), multiple cysts (n = 6), polycystic liver disease (n = 2), cystadenoma (n = 9). The mean serum CA

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**Table 1.** Study patients' baseline characteristics

| Variable | Value |
|---|---|
| All patients | 37 (100) |
| Sex | |
| Male | 4 (10.8) |
| Female | 33 (89.2) |
| Age (yr) | 63.62 ± 12.93 |
| ≤59 | 12 (32.4) |
| 60–69 | 11 (29.7) |
| ≥70 | 14 (37.8) |
| Preoperative diagnosis | |
| Single cyst | 20 (54.1) |
| Multiple cysts | 6 (16.2) |
| Polycystic | 2 (5.4) |
| Cystadenoma | 9 (24.3) |
| Correctness of imaging study | |
| Yes | 20 (54.1) |
| No | 17 (45.9) |
| Size (cm) | 11.41 ± 6.22 |
| <10 | 17 (45.9) |
| ≥10 | 20 (54.1) |
| Location | |
| Both | 11 (29.7) |
| Left | 14 (37.8) |
| Right | 12 (32.4) |
| Septation | |
| Yes | 15 (40.5) |
| No | 22 (59.5) |
| Aspiration and sclerotherapy | |
| Yes | 11 (29.7) |
| No | 26 (70.3) |
| Serum CA 19-9 | 10.23 ± 11.75 |
| Detection | |
| Screening | 7 (18.9) |
| Others | 30 (81.1) |
| ASA classification | |
| I | 3 (9.7) |
| II | 19 (61.3) |
| III | 9 (29.0) |
| Operative procedure | |
| Open | 3 (8.1) |
| Laparoscopic deroofing | 24 (64.9) |
| Laparoscopic cyst excision | 4 (10.8) |
| Laparoscopic left lateral sectionectomy | 2 (5.4) |
| HALS | 2 (5.4) |
| SPL | 2 (5.4) |
| Accompanied operation | |
| Yes | 11 (29.7) |
| No | 26 (70.3) |
| Operative periods (min) | 132.22 ± 101.44 |
| Resection proportion (%) | 46.19 ± 32.52 |
| <40 | 14 (43.8) |
| ≥40 | 18 (56.3) |
| Bile tinged cyst content | |
| Yes | 3 (8.1) |
| No | 34 (91.9) |
| Follow-up period (mo) | 21.14 ± 19.95 |
| Recurrence | |
| Yes | 6 (16.2) |
| No | 31 (83.8) |
| Reoperation | |
| Yes | 2 (5.4) |
| No | 35 (94.6) |
| Radiographic recurrence | |
| <50 | 26 (70.3) |
| 50–75 | 5 (13.5) |
| >75 | 6 (16.2) |
| Final pathologic diagnosis | |
| Simple cyst | 27 (73.0) |
| Polycystic | 2 (5.4) |
| Cystadenoma | 5 (13.5) |
| Cystadenocarcinoma | 1 (2.7) |

Values are presented as number (%) or mean ± standard deviation.
CA 19-9, carbohydrate antigen 19-9; ASA, American Society of Anesthesiologists; HALS, hand assisted laparoscopic surgery; SPL, single port laparoscopy.

19–9 was 10.

According to American Society of Anesthesiologists (ASA) classification, ASA I, II, was observed in 22 patients (73%), and ASA III in nine patients (26%). History of previous aspiration and alcohol sclerosis of the cyst was identified in 11 patients (30%).

Demographic and clinical characteristics are as follows (Table 1).

Concomitant surgical procedures were performed in 12 patients (32.4%), mainly laparoscopic cholecystectomy (n = 10).

Surgical approaches were open liver resection (n = 3), laparoscopic deroofing (n = 24), laparoscopic cyst excision (n = 4), laparoscopic left lateral sectionectomy (n = 2), hand assisted laparoscopic procedure (n = 2), and single port laparoscopic deroofing (n = 2). Open liver resections were open conversion cases and were usually performed when cyst was located at posterior area where could not approachable by laparoscopic methods or cyst was too large.

**Table 2.** Prognostic factors affecting giant hepatic cyst recurrence

| Variable | Recurrence | | P-value |
|---|---|---|---|
| | Yes (n = 6) | No (n = 31) | |
| Size (cm) | | | 0.189 |
| <10 | 1 (16.7) | 16 (51.6) | |
| ≥10 | 5 (83.3) | 15 (48.4) | |
| Posterior 7, 8 segment | | | 1.000 |
| Yes | 3 (50.0) | 16 (51.6) | |
| No | 3 (50.0) | 15 (48.4) | |
| Multiple | | | 0.394 |
| Yes | 1 (16.7) | 12 (38.7) | |
| No | 5 (83.3) | 19 (61.3) | |
| Septation | | | 0.198 |
| Yes | 4 (66.7) | 11 (33.5) | |
| No | 2 (33.3) | 20 (64.5) | |
| Aspiration and sclerotherapy | | | 0.005 |
| Yes | 5 (83.3) | 6 (19.4) | |
| No | 1 (16.7) | 25 (80.6) | |
| Serum CA 19-9 | | | 0.593 |
| <6.2 | 4 (66.7) | 15 (48.4) | |
| ≥6.2 | 2 (33.3) | 16 (51.6) | |
| Operative procedure | | | 0.421 |
| Open | 1 (16.7) | 2 (6.5) | |
| Laparoscopic | 5 (83.3) | 29 (93.5) | |
| Bile tinged cyst content | | | 0.470 |
| Yes | 2 (33.3) | 2 (11.1) | |
| No | 4 (66.7) | 29 (88.9) | |
| Resection proportion (%) | | | 0.365 |
| <40 | 4 (66.7) | 12 (38.7) | |
| ≥40 | 2 (33.3) | 19 (61.3) | |
| Final pathologic diagnosis | | | 0.092 |
| Cyst | 3 (50.0) | 26 (83.9) | |
| Polycystic | 1 (16.7) | 1 (3.2) | |
| Cystadenoma | 1 (16.7) | 4 (12.9) | |
| Cystadenocarcinoma | 1 (16.7) | 0 (0) | |

Values are presented as number (%).
CA 19-9, carbohydrate antigen 19-9.

The resection proportion of the cysts was less than 40% (n = 15), more than 40% (n = 18). The median operating time was 132 minutes (range, 45 to 505 minutes). Three patients' cysts (8.1%) had bilious contents, but in one biliary communication was identified and clipped intraoperatively. The final pathologic diagnoses were simple cyst (n = 27), polycystic liver disease (n = 2), cystadenoma (n = 5), and cystadenocarcinoma (n = 1). In two cases each seemed like simple cyst clearly, biopsy for pathologic study was not performed. Preoperative diagnosis by ultrasonography or CT scan to postoperative finding was correct in 20 patients (54%) (Table 1).

The mean follow-up period was 21 months (range, 2 to 60 months). All but one patient experienced complete relief of symptoms after surgery. Radiographic recurrence was identified in six patients (16.2%) and two patients received reoperation for a recurrence of the same cyst. Among factors predicting recurrence of the cysts, size, location (seg VII or VIII), open or laparoscopically, serum CA 19-9 level, proportion of resected cyst, final pathologic type and previous history of aspiration and sclerotherapy of the cysts were statistically significant (Tables 2, 3).

## DISCUSSION

Giant cystic lesions of the liver represent a wide spectrum of disease ranging from simple benign cysts, to potentially malignant biliary cysts [11]. Preoperative differential diagnosis between congenital, parasitic and neoplastic giant hepatic cysts by imaging techniques such as ultrasonography, CT and MRI is crucial since management options may vary from observation to surgical treatment. In particular, cases complicated by hemorrhage or superinfection can be difficult to differentiate by radiological examination [12,13].

Accurate diagnosis is essential for adequate treatment. Our experience demonstrated that preoperative differentiation of biliary cystadenoma from other complicated cystic lesions by means of radiologic image is inaccurate, with only 55% accuracy [14]. The role of the frozen section still is controversial [15]. In our patients, frozen sections are routinely performed to decide the appropriate surgical management, but it proved difficult to confirm the diagnosis for certain. Furthermore, biliary cystadenoma never can be excluded until a definite examination of the specimen [16].

Recent studies have reported elevated serum or cystic fluid levels of CA 19-9, but their clinical significance remains controversial. All of our patients had preoperative assessment of tumor marker levels, but the clinical value for differential diagnosis between simple cyst, cystadenoma, and cystadenocarcinoma was minimal.

**Table 3.** Univariate and multivariate logistic regression analysis

| Variable | Univariate | | | Multivariate | | |
|---|---|---|---|---|---|---|
| | OR | 95% CI | P-value | OR | 95% CI | P-value |
| Size (cm) | | | | | | |
| <10 | 1.00 | | Reference | | | |
| ≥10 | 5.33 | 0.56–51.09 | 0.147 | | | |
| Posterior 7, 8 segment | | | | | | |
| Yes | 0.94 | 0.16–5.39 | 0.942 | | | |
| No | 1.00 | | Reference | | | |
| Multiple | | | | | | |
| Yes | 0.32 | 0.03–3.05 | 0.320 | | | |
| No | 1.00 | | Reference | | | |
| Septation | | | | | | |
| Yes | 3.64 | 0.57–23.13 | 0.171 | | | |
| No | 1.00 | | Reference | | | |
| Aspiration and sclerotherapy | | | | | | |
| Yes | 20.83 | 2.04–212.97 | 0.010 | 15.38 | 1.39–170.16 | 0.026 |
| No | 1.00 | | Reference | 1.00 | | Reference |
| Serum CA 19-9 | | | | | | |
| <6.2 | 3.30 | 0.29–37.10 | 0.334 | | | |
| ≥6.2 | 1.00 | | Reference | | | |
| Operative procedure | | | | | | |
| Open | 2.90 | 0.22–38.32 | 0.419 | | | |
| Laparoscopic | 1.00 | | Reference | | | |
| Bile tinged cyst content | | | | | | |
| Yes | 2.67 | 0.18–39.63 | 0.476 | | | |
| No | 1.00 | | Reference | | | |
| Resection proportion (%) | | | | | | |
| <40 | 3.20 | 0.49–20.81 | 0.223 | | | |
| ≥40 | 1.00 | | Reference | | | |
| Final pathology diagnosis | | | | | | |
| Simple cyst | 1.00 | | Reference | 1.00 | | Reference |
| Others | 4.80 | 0.74–31.08 | 0.100 | 2.12 | 0.24–18.46 | 0.198 |

A multivariate logistic regression model was created using a backward elimination method, and the probability was set at 0.20 for removal. In a multivariate model, asp, sclero Tx and final pathology were found to be significant factors affecting recurrence. However, these results should be interpreted with caution due to small sample size.
OR, odds ratio; CI, confidence interval; CA 19-9, carbohydrate antigen 19-9.

It is generally accepted that small asymptomatic cysts do not require therapeutic intervention. Clear guidelines for optimal management of the different varieties of giant hepatic cysts have not been defined. Symptomatic giant hepatic cysts certainly require definitive therapy but there is no consensus regarding the best surgical approaches [17–19]. The goal of surgical treatment of giant hepatic cysts is to remove as much of the exposed wall as possible and to avoid recurrence [16,20,21]. There is still some controversy about the preferable procedure, but most studies seem to agree on laparoscopic deroofing as the initial approach for the majority of giant liver cysts [22].

Enucleation could be performed atraumatically if a plane of cleavage exists between the hepatic cyst and the liver, but is particularly difficult if the cyst is extremely large, and may lead to transection of large biliary radicals and blood vessels

run along the cyst wall [23].

Total cyst excision or major hepatic resection yields recurrence rates of zero. However, these kinds of treatments are often associated with significant morbidity. This is frequently not acceptable to patients with benign disease, old age, severe underlying medical condition, or when the postoperative reserve function of liver is suspicious [24]. To ensure maximal deroofing, the cyst wall was excised together with a small rim of surrounding hepatic parenchyma, until the bottom of the cyst expanded and subsequently protruded almost to the level of the liver surface [25].

Accurate diagnosis of cystadenoma is of importance, as the management is totally different from other non-neoplastic cysts. Cystadenoma has multilocular cystic lesions lined by mucus secreting cuboidal or columns epithelium with an accompanying densely cellular "ovarian-like" stroma [14]. Complete excision of the tumor is the choice of treatment of biliary cystadenoma. Any therapy short of complete excision leads to local recurrence and risk of malignant transformation. After deroofing of the cyst what confirmed to adenoma by postoperative histologic findings, although early reintervention has been proposed, surgery may be postponed until symptomatic or radiologic recurrence because of its lower rate of malignancy and relatively long term clinical course to be a cystadenocarcinoma [15,22].

The recurrence of giant hepatic cysts has been the main obstacle to more widespread use of the laparoscopic deroofing procedure [25,26]. If the cyst has rigid walls, spontaneous collapse of the cavity is problematic [9]. Factors predicting recurrence included an incomplete deroofing technique, previous surgical treatment, deep seated cysts, located in segments VII and VIII, and a diffuse form of polycystic kidney, biliary cystadenoma [27].

Large cysts in the right posterior lobe have a high recurrence rate due to the intimate contact between liver and diaphragm, which blocks the continuous drainage of the deroofed cysts into the peritoneal cavity, causing reaccumulation of its contents into the bare area [12,28].

When the blue dome of the cyst with adhesions to the diaphragm became visible laparoscopically, the adhesion was carefully dissected as far posterior as possible before the cyst wall was opened. In our study, cyst size or location could not predict symptomatic recurrence [29]. Also, recurrence was very frequent after the interventional radiologic procedure [9]. In our analysis, use of an interventional radiologic procedure and pathologic diagnosis significant predicted recurrence.

Recently the use of various sclerosing agents, pantopaque, ethanol, tetracycline derivative minocycline hydrochloride, nonsurgical, less invasive, repeated needle aspiration and sclerotherapy have been reported [24], but failed in persistently treating symptomatic cysts. The therapeutic effect is based on the destruction of the secreting epithelial layer of the cyst wall with marked inflammatory reaction. It should be emphasized that sclerothrapy is applicable only when bleeding, hydatid disease, neoplastic processes, and communication with the biliary trees have been ruled out [30]. Thus, these options should be limited to patients in a palliative setting, with a high postoperative risk or limited life expectancy.

In conclusion, laparoscopic resection of giant hepatic cysts is a simple and effective method to relieve symptoms with minimal surgical trauma. Recurrence is dependent on the type of pathology involved, and the sclerotherapy undertaken. General application of the laparoscopic technique should await a careful evaluation of safety and effectiveness in a larger series of patients, in comparison with the open surgical procedure. Adequate selection of patients and type of cystic liver together with meticulous surgical techniques are recommended.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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