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A new technique for the laparoscopic treatment of simple hepatic cysts

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ABSTRACT

Background: Simple hepatic cysts are commonly detected in the general population, both solitary and associated with Adult Dominant Polycystic Kidney Disease (ADPKD). Laparoscopic fenestration is a surgical option adopted as first-line treatment and to treat complications. The techniques reported in the literature are associated with cyst recurrence in up to 41% of cases.

Methods: From 2012 to May 2021, 19 symptomatic patients diagnosed with simple HCs underwent an innovative technique for laparoscopic fenestration, which includes simultaneous ethanol injection into the residual cavity. The median follow up was 57 (range 4-116) months. We retrospectively analysed symptomatic relief obtained in the short and long term as primary outcome. We also evaluated the postoperative outcome, recurrence and re-intervention rates.

Results: 11 patients (of 19) were female (58 %), with a median age of 58 (range 31-78) years. Most patients (17 of 19) experienced relief of symptoms after intervention (89,5 %). Radiological recurrence occurred in 21% of patients; nevertheless, only one patient, affected by ADPKD, experienced clinical relapse with abdominal discomfort. No patient needed reintervention. There was no major morbidity (Clavien-Dindo III-IV) nor 90-day mortality. The technique allowed early removal of abdominal drainage (median 2.5 days).

Conclusions: Laparoscopic fenestration of a simple hepatic cyst, with simultaneous ethanol injection, combines the advantages of the laparoscopic approach with those of injecting sclerosing agent. The described technique is associated with symptomatic relief and a favourable outcome in the postoperative period, as well as with good long term results.

Introduction

Simple hepatic cysts (HCs) are solitary or multiple cavities of unknown origin, full of serous fluid, with a diameter ranging from few millimetres to several centimetres. They are often asymptomatic, so diagnosis is incidental due to abdominal imaging performed for other purposes (i.e. US). Sometimes, they become clinically evident, due to abdominal pain or compression on surrounding organs (stomach, colon) [1,2]. In cases with symptoms and/or increasing size, the treatment to solve the disease is a surgical procedure.

In cases of multiple liver cysts detection, Adult Dominant Polycystic Kidney Disease (ADPKD) may be diagnosed [2,3]. ADPKD is a monogenetic disorder characterized by bilateral simple hepatic and renal cysts, in some cases associated with cyst localization in the pancreas,

arachnoid membrane or seminal vesicles [4,5]. The main goal of treatment for patients diagnosed with ADPKD is to reduce the symptoms, in order to improve their quality of life [4]. There is no specific medical therapy for the management of HCs in ADPKD, while surgery is indicated when drugs fail to control symptoms or if a complication develops [6].

The techniques reported in the literature for the treatment of simple hepatic cysts are often associated with unsatisfactory short-term results caused by morbidity and/or a poor long term outcome, due to cyst recurrence (24-41%) [7-9]. The surgical technique that we report was firstly adopted for the treatment of large HCs and was later applied for the experimental treatment of a patient diagnosed with an enormous renal cyst.

The purpose of this retrospective study of a single centre experience

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is to analyse the short and long term symptomatic relief as well as the surgical outcome, after the laparoscopic treatment of simple hepatic cysts.

Methods

From 2012 to May 2021 at the General Surgery “Ospedaliera” section at the Polyclinic Hospital of Bari, 19 patients with a diagnosis of simple HCs underwent laparoscopic fenestration with simultaneous ethanol injection in the residual cavity. The study was designed and conducted respecting the STROBE guidelines for observational studies.

The indication for surgery was symptomatic solitary or multiple HCs, either “isolated” or in association with autosomal ADPKD. In the latter case, patients were considered eligible for surgery in cases of failure of medical and percutaneous options. The first-line imaging modality was US scan, but usually computed tomography (CT) and/or magnetic resonance (MRI) was performed for differential diagnosis with other causes of abdominal pain, and to exclude a primary or secondary tumour. Exclusion criteria were age < 18 years, patients unfit for surgery and/or for laparoscopy. The median follow-up period was 57 (range 4-116) months; at each follow-up, patients underwent medical history assessment, physical examination and US scan.

The primary outcome was symptomatic relief in the short and long term. Recurrence of hepatic cysts and the re-intervention rate during the follow up were also investigated. Secondary outcomes were the complication rate (according to Clavien-Dindo classification[10]), time before drainage removal and patient discharge. The operative time and conversion rate were also analysed.

Statistical analysis

Continuous variables are reported as medians (interquartile ranges) and categorical variables as numbers (percentages). The median, instead of the mean, was adopted because of the skewed distribution of the managed variables.

Surgical technique

For the treatment of hepatic cysts, the patient was placed in the

French position, the surgeon standing between the legs. Pneumoperitoneum was achieved through an “open” umbilical approach, introducing a 10 mm trocar or a Single Incision Laparoscopic (SIL) port (after a 23 mm incision). Additional trocars (2 or 3, as needed) were introduced in cases of a standard laparoscopic approach, according to the “triangle” rule.

First of all, aspiration of the cystic fluid was performed, followed by unroofing of the cystic external wall using an energy device. Resection of the cystic wall was performed along its hepatic limits, in order to remove the whole cystic roof. Then, the residual cystic cavity was carefully checked for a biliary leak. The procedure was concluded with the injection of sclerosing alcoholic agent (ethanol 95 %) into the residual cavity (Fig. 1). The amount of alcoholic solution ranged from 10 to 30 ml, according to the cyst diameter. The resected cystic wall was extracted through the umbilical incision and sent for histopathological examination. All patients underwent placement of drainage in the residual cavity.

For the patient diagnosed with a renal cyst, the laparoscopic approach allowed exploration of the abdominal cavity and treatment of the cyst itself. The renal cyst was treated with fenestration associated with alcoholization of the residual cavity.

Results

Most patients were female (58 %), with a median age of 58 (range 31-78) years; 79 % (15 of 19 patients) presented “isolated” cysts, while 4 patients had a diagnosis of ADPKD (21 %). The median cyst diameter was 13 (range 4-25) cm, with a prevalence for the right lobe (60 %).

All patients were symptomatic and diagnosis was due in every case to abdominal pain. Other non-specific symptoms were nausea, early satiety, general discomfort (see Table 1); 7 patients (of the 19) had had previous abdominal interventions, but were not excluded from the mini-invasive approach.

The surgical technique was standardized for HCs, but was later applied for the experimental treatment of one patient diagnosed with an enormous left renal cyst. The patient was a 52-year-old female, with previous interventions for melanoma and mammary carcinoma and a diagnosis of hepatic angioma of the VI-VII segment, 6 cm in diameter. She presented with dull pain in the left flank and dyspnea, so abdominal

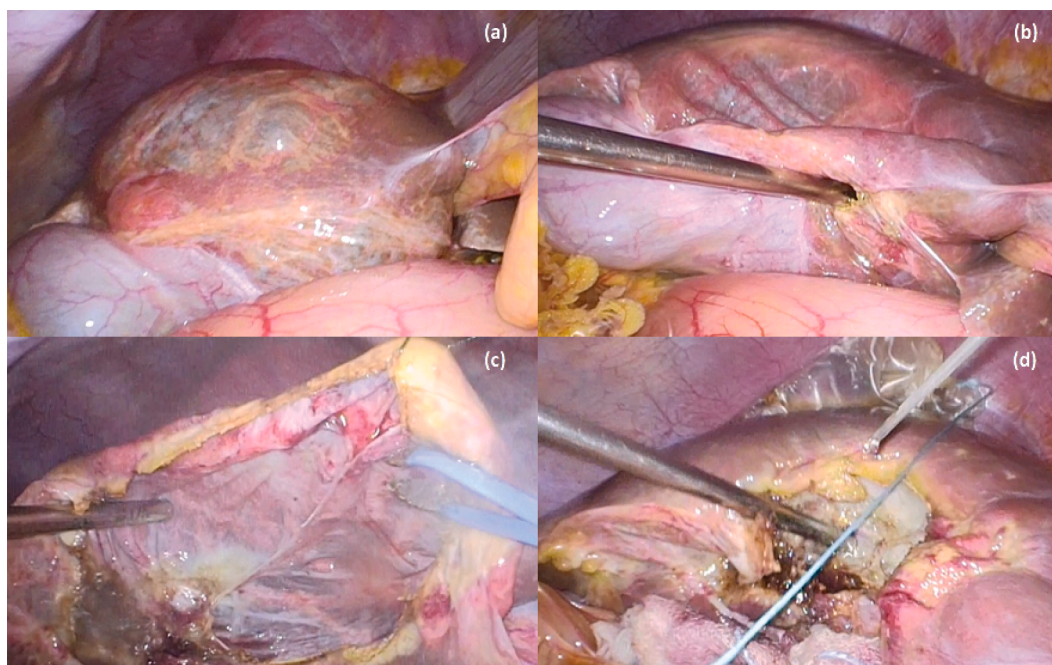


Fig. 1. Laparoscopic treatment of simple hepatic cysts (a): aspiration of cystic fluid (b), resection of cyst wall (c), alcoholic sclerosing agent injection (d).

Table 1
Patients' demographic and cyst characteristics

	N. of patients 19
Age (median, range) (years)	58 (31-78)
Sex	
M	8 (42%)
F	11 (58 %)
Previous surgery	7 (37 %)
Cyst diameter (median, range) (cm)	13 (4-25)
Cyst localization	
Right lobe (S5-6-7-8)	12 (63 %)
Left lobe (S2-3-4)	5 (26,5%)
Bilobar	2 (10,5%)
Type of cyst	
Single cyst	9 (45 %)
Multiple cysts	7(35 %)
APD*	4 (21 %)
Clinical presentation	
Abdominal pain	19 (100 %)
Early satiety	10(52,6 %)
General Discomfort	3 (16 %)
Nausea	1 (5,3 %)

APD Adult Polycystic Disease

ultrasound (US) was performed. The US scan detected a large solitary exophytic renal cyst measuring 17 × 16 × 19 cm and the hepatic angioma, with a stable diameter. The liver was intraoperatively explored but the angioma was located deep down and no signs of potential complications were detected; therefore, only the renal cyst was treated.

The laparoscopic procedure was concluded successfully in all patients, with no need for conversion to open surgery. In cases of SIL (3 patients), there was no conversion to a standard laparoscopic or open approach. The median operative time was 86 (range 30-145) min. In all cases, drainage was positioned at the end of the procedure; it was removed in the first postoperative days (median 2.5 days) or during ambulatory visits (range 1-10 days), according to the amount of serous output.

There was no major morbidity (Clavien-Dindo III-IV) nor 90-day mortality. We observed only two cases (10.5 %) of postoperative fever, treated with antibiotics (Table 2). Median hospital stay was 4 (range 3-7) days. All patients experienced relief of symptoms, except two who had no benefit (89.5 % vs 10.5 %). Four patients (21%) suffered radiological cyst recurrence during the follow-up but three of them remained asymptomatic. Only one of these patients, who was affected by ADPKD, had a relapse of abdominal discomfort (Table 3). Nevertheless, re-intervention due to cyst recurrence was not needed during the follow-up period.

The patient who underwent renal cyst fenestration and simultaneous alcoholization had an uneventful postoperative course and was discharged on the fourth day. At the 4-month follow-up the patient, who had obtained immediate symptomatic relief, did not report any relapse of symptoms.

Table 2
Postoperative findings in a series of 19 patients with hepatic cyst underwent simultaneous laparoscopic fenestration and ethanol injection

Postoperative drainage output (mean ± SD) (mL)	88 ± 109
Drainage removal (median, range) (days)	2,5 (1-10)
Hospital stay (median, range) (days)	4 (3-7)
Postoperative complications	
– Clavien-Dindo score	
Grade I-II	2 (10,5 %)
Grade III-IV	0 (0 %)
– 90-day mortality	0 (0%)
– early (90-day) recurrence	0 (0%)
– overall recurrence (57-months follow up)	4 (21%)

SD standard deviation

Table 3
Long-term outcome of 19 patients underwent mini-invasive surgical fenestration and ethanol injection for simple hepatic cyst

Duration of follow up (median, range) (months)	57 (4-116)
Symptomatic remission (n. pt.)	18 (95 %)
Symptomatic recurrence (n. pt.)	1 (5,3 %)
90-day reoperation	0 (0%)
Histological finding	
Connective-fibrous wall cyst	60 %
Biliary cystadenoma	25%
Echinococcus cyst	5%
Other	10%

n. pt. number of patients

Discussion

Simple HCs, either solitary or associated with ADPKD, are due to a polycystin-1 (PC-1) deficiency, genetically inherited or acquired as a somatic mutation. The clinical presentation of HCs is conditioned by cyst diameter, location and complications [7,11,12]. Surgery is generally indicated for “large” HCs, with a cavity diameter exceeding 4-5 cm, and/or increasing in size^{1,3,11}. The clinical presentation and severity of cystic disease also depend on the location and amount of parenchymal volume occupied. According to their location, hepatic cysts can cause many non-specific disturbances, such as pain, dyspepsia, loss of appetite, sensation of gastric satiety, dyspnea [7,8,13]. HCs can be associated with pressure-related complications, such as jaundice, portal vein occlusion, portal hypertension with splenic varices, compression of the inferior vena cava and Budd-Chiari Syndrome [7,14,15]. Rarely, patients with simple cysts are diagnosed in an emergency situation, because of intracystic haemorrhage, infection or intraperitoneal rupture [7,8,12,14].

Open unroofing of single or multiple HCs was the standard surgical treatment until the 1990s, when laparoscopy gained widespread acceptance, particularly for the treatment of hepatic benign conditions [16–18]. The mini-invasive approach is recommended, especially in patients without previous abdominal surgery, if HCs are accessible and located in the anterior segments of the liver[13]. The laparoscopic treatment of HCs has several advantages in terms of short-term outcome, as compared with the open approach [2,12,19,20]. Furthermore, it is recognized to be as safe and effective as the open approach for avoiding recurrence of symptoms and re-intervention [1,3,21,22].

In our series, patients with HCs of the posterior segments (S7-8) and who had received previous abdominal interventions were not excluded from the mini-invasive approach (see Table 1). Also, 3 cases of SIL fenestration are described, performed in young patients with easily accessible HCs. The results of these procedures are comparable to those performed with the standard laparoscopic approach, and there was no need for conversion to standard laparoscopy or open surgery. Our data are supported by other experiences in the literature, which demonstrate that the SIL approach is as safe and effective as the standard laparoscopic approach, with the advantage of having a “no scar” effect [16,23]. Separate analysis and comparison with the standard laparoscopic technique has not been performed, due to the limited number of patients treated in SIL in our series.

In a review of the literature, the pooled symptomatic relief after surgery is 90.2% but symptomatic recurrence during follow-up is 9.6% with a 7.1% rate of reintervention for the same cyst[3]. In patients affected by ADPKD, the results are worse. In this subset of patients, 24 % of patients experience radiological cyst recurrence after intervention and most of them (22 %) have a relapse of symptoms[7]. In a recent review of the literature, Rawla et al. described higher recurrence rates, up to 41% [8]. Furthermore, a reintervention rate for HC recurrence of 9 % is described [14].

Factors associated with failure of the surgical procedure are deep-seated cysts, an incomplete deroofting technique, localization of the

cyst in segment VII-VIII and the presence of diffuse ADPKD [3,14]. Several technical improvements have been described to avoid both failure of the procedure and the recurrence of the symptoms. Nonetheless, no clinical advantages have been demonstrated after procedures like omentopexy (or omentoplasty), that is omental transposition in the residual cavity [3] or concomitant cholecystectomy [3]. Other experimental options have been proposed by Faulds et al. [24], with replacement of the residual cystic cavity with a pedicle graft from the falciform ligament; and Fischer and Voeller [25], who reported a case of fibrin glue fixation of the omentum to the residual cavity after cyst wall excision.

In our series, 17 patients (of 19) experienced relief of the symptoms after intervention (89,5 %). A long-term follow up of almost 5 years (57 months) revealed radiological cyst recurrence in 21% of patients. Nevertheless, only one patient affected by ADPKD experienced a relapse of symptoms (5% clinical recurrence), probably because of his underlying disease. Finally, none of the patients in the series needed reintervention for HC recurrence.

Our good long term results are likely due to the sclerosing agent injection that was always performed after fenestration, in order to complete the surgical procedure. Alcohol injection into the residual cystic cavity is a procedure that was borrowed from the percutaneous technique, but performed surgically, in order to enhance the results of fenestration. After ethanol injection, the residual cyst epithelium is destroyed and fluid re-accumulation is avoided. Besides the effect of relieving the symptoms and preventing cyst recurrence in the long-term period, this procedure determines scarce cyst secretion in the post-operative days. After the standard intervention, drainage is usually left in the abdominal cavity in order to drain the secretions produced by the cystic epithelium lining the bottom of the HC, which is not removed during fenestration. The technique that we describe causes chemical elimination of the residual cavity epithelium, thus the drainage can usually be removed in the first postoperative days (median 2.5 days). This is not a matter of secondary importance, because persistence of the drainage tube could lead to abdominal infections, besides patient discomfort. Unfortunately, in literature there is little information about the timing for drainage removal after fenestration [3,8,24].

In literature, the pooled estimate of having a major complication after surgery (Clavien-Dindo grade III-IV) is 3.3 %, with a mortality rate of 0-2 %. These results are worse for patients affected by ADPKD, the complication rate being 11-23%, while the most common postoperative complications are ascites, pleural effusion, bleeding, bile leakage and infections [13,15]. The main causes of death are irreversible shock and hepatic abscesses [3]. In our series, no major complications nor mortality were observed.

Median hospital stay was 4 (range 3-7) days, comparable with other authors' results [3,7,13]. Finally, Bernts et al. [3] describe a conversion rate of 4.5 %, mainly due to intraoperative bleeding, difficult positioning of the HC or extensive adhesions [7,13]. In our series, no conversion to open surgery was needed.

The limitations of our study are its retrospective nature and the lack of any means of comparison. Additionally, the experience was conducted in a single center on a small number of patients. Finally, in the reported series, only 4 patients were affected by ADPKD, therefore a judgment of the treatment of this subset of patients cannot be made. Reporting of symptoms by patients was subjective and not based on a standardized questionnaire grading symptoms according to their severity.

Conclusions

Laparoscopic fenestration combined with simultaneous ethanol injection in the residual cavity is a feasible option for the treatment of simple hepatic cysts. Compared with results in the existing literature, our technique has some advantages in the postoperative period, as well as favourable long term results. This is a relevant point, considering that

the long term relief of symptoms is a major goal of treatment for patients affected by HCs. Further analyses on larger series of patients should be conducted to validate the safety and effectiveness of this technique.

Ethical disclosure

No funding was received. The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

The authors state no conflict of interest.

Data are available on a repository.

The study protocol met the principles in the Declaration of Helsinki. All patients gave their consent to take part in this study.

CRediT authorship contribution statement

Cinzia Bizzoca: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Project administration. **Felicia Fiore:** Methodology. **Fabrizio Aquilino:** Methodology, Software, Data curation, Visualization. **Salvatore Fedele:** Software, Data curation, Visualization. **Maria Di Salvo:** Formal analysis, Data curation, Visualization. **Giuseppe Lucarelli:** Methodology, Validation, Supervision. **Leonardo Vincenti:** Conceptualization, Validation, Resources, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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