Laparoscopic management of liver hydatid cyst: an early center experience of consecutive 25 cases

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Background
Although laparoscopy has become popular in the management of liver hydatid cysts, some surgeons still debate about the increased risk of complications with it. Herein, we report our experience with the laparoscopic management of this disease.

Patients and methods
This retrospective study included 25 consecutive cases diagnosed with liver hydatid disease by examination and laboratory and radiological investigations. The collected data included cyst size, site, number, operative time, blood loss, postoperative complications, hospital stay, and recurrence rates.

Results
The included patients aged between 25 and 50 years (mean=37.28). We included 15 men and 10 women. The performed procedures included deroofing and endocystectomy (48%), pericystectomy (24%), left lateral sectionectomy (16%), wedge resection (8%), and deroofing with endocystectomy and pericystectomy (4%). The mean operative time was 78.2 min, whereas intraoperative blood loss had a mean value of 53.6 ml. The duration of hospitalization had a median value of 3 days, and bile leakage was encountered only in three (12%) cases. All cases were resolved spontaneously.

Conclusion
Laparoscopy appears to be safe and efficacious approach for the surgical management of liver hydatid cyst disease. In experienced surgical hands, it is associated with low conversion rates, low incidence of postoperative complications, and low short-term recurrence rates.

Keywords:
hydatid cyst, laparoscopy, liver

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Introduction

Hydatid disease is a chronic parasitic infection caused by *Echinococcus granulosus*, which is a *Cyclophyllidea cestode* that lives in the intestinal lumen of carnivores, like dogs, in the adult form. When its eggs are released with animal waste, it is ingested by sheep or cattle, which are considered the normal intermediate hosts for that parasite. The life cycle continues when dogs eat infected meat [1,2].

Unfortunately, humans get infected by this parasite either by contacting dogs or consuming contaminated water or food. In this case, humans are considered a blind intermediate host, as the life cycle will stop at this stage, as humans are on the top of the food chain [3]. In the human intestinal lumen, the eggs give larvae that migrate through the portal vein to the liver, which is the most affected organ, as it could be affected in 60–70% of cases. However, other organs could also be affected, including the spleen, lungs, kidneys, brain, and muscles [4].

In intermediate hosts, the larvae forms echinococcal cysts, known as hydatid cysts, and they are composed of three layers: adventitia, laminated membrane, and germinal layer. The latter is the only living part that contains brood corpuscles with scolices, and it secretes the hydatid fluid [5,6].

Complications of hydatid cysts include rupture, compression of a nearby organ, jaundice, or infection. As cyst growth is associated with an increased risk of future complications, treatment is crucial for symptomatic and large cysts. [7,8]. Multiple modalities exist to manage this disease, including medications, percutaneous intervention, and surgical intervention. Surgery is the gold

standard option, and it can be performed via open or laparoscopic approaches [7,9].

The first report on laparoscopic management of hydatid liver disease was published in 1994 [10]. Nevertheless, a subsequent study reported anaphylactic shock as a complication of this approach in managing these lesions [11]. Despite the complications reported, laparoscopic management of hydatid disease has gained popularity among surgeons, especially with increasing laparoscopic hand skills [12].

Laparoscopy has many advantages over the open approach including less invasiveness, shorter operative time, less postoperative pain, and better cosmoses. Additionally, it allows better visualization of the cyst cavity and easy detection of biliary connection [7]. Therefore, we conducted the current study aiming to evaluate the safety, efficacy, and outcomes of laparoscopic management of hepatic hydatid cyst disease.

Patients and methods

This cross-sectional study was conducted at Al Rajhi Liver Hospital, Assiut University, located in Upper Egypt. We retrospectively reviewed the data of consecutive 25 Egyptian patients diagnosed with liver hydatid disease who were managed by laparoscopy between January 2017 and December 2020.

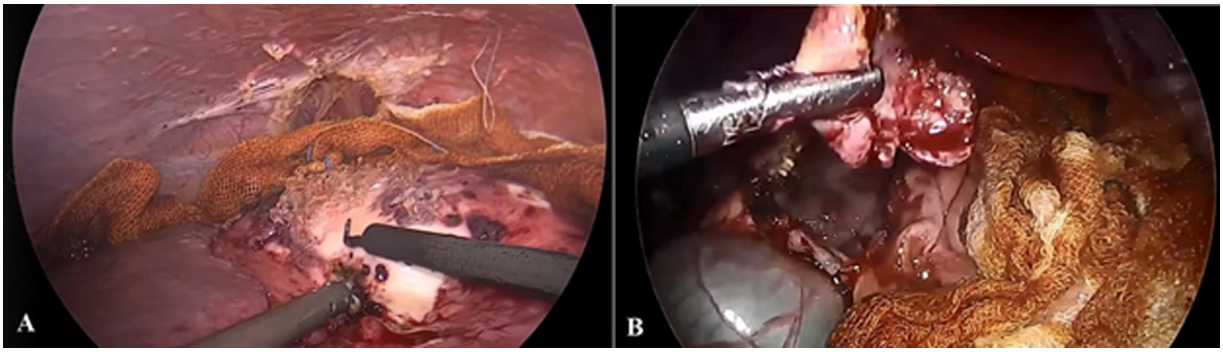
We included patients aged between 18 and 60 years, who were classified according to the American Society of Anesthesiologists [13] as class I or II. In contrast, we excluded cases having American Society of Anesthesiologists class more than II, previous upper abdominal operations, or having hydatid cysts in any organ other than the liver. Patients presenting with complicated cysts or those who had any contraindications for laparoscopy were also excluded.

All patients underwent the same preoperative preparation by the same surgical team. Patients underwent complete history taking with emphasis on risk factors for catching such diseases like working with sheep or previous history of traveling to another country endemic with hydatid disease. Moreover, routine abdominal examination and anesthetic assessment were performed. All routine preoperative laboratory studies were ordered for all cases including detection of circulating hydatid antibodies by ELISA [14]. Radiological assessment included abdominal ultrasonography (including classification of the cyst according to the Gharbi classification [15]) and triphasic pelviabdominal computed tomography. Chest radiograph was ordered to exclude the presence of lung affection. In selected cases in whom biliary connection was suspected (segment IV lesions), magnetic resonance cholangiopancreatography was performed. After confirming the diagnosis, all patients were commenced on daily albendazole (Alzental; Eipico, Ramadan City, Egypt) 10 mg/kg for 2 weeks before the operation.

Regarding ethical considerations, our study gained approval from the local ethical committee of Faculty of Medicine, Assiut University. Before surgery, we obtained an informed written consent from all the participants following complete explanation of the details, benefits, and complications of the laparoscopic intervention.

The laparoscopic procedure was performed under general anesthesia and then, pneumoperitoneum was established via either a veress needle or the open method. The camera port was inserted above or below the umbilicus for the introduction of a 30° camera. After exploration of the abdominal cavity and confirmation of the cyst site, two working ports were inserted. We used either hypertonic saline or povidone-iodine (Fig. 1) as

Figure 1



(a) Deroofing of the cyst cavity by hook. (b) Extraction of the cyst content. The gauze soaked with betadine is noted in the surgical field in both images.

scolicidal agents, and before cyst aspiration, it was surrounded by two gauzes soaked with either of the previously mentioned agents.

Aspiration of the cyst fluids then injection the same amount which aspirated by scolicidal agent. Another method for cyst irrigation aspiration was to use a wide-bore suction device (10 mm). The choice of the suction irrigation method and the scolicidal agent was dependent on operator preference. We kept the scolicidal agent for at least 10 min inside the cyst for complete eradication of the living parasites, to prevent further spread into other abdominal organs. After that the cyst was opened (Fig. 1a), and the germinal layer was dissected, removed (Fig. 1b), and extracted outside the abdominal cavity in an endobag (Fig. 2). Care was taken to notice any yellowish discoloration of the cyst wall adherent to the liver, which may indicate biliary connection. If detected, it was closed by vicryl sutures.

After ensuring good wash and hemostasis, a drain was inserted into the cyst cavity, Morrison pouch, or under the left lobe based on cyst location and surgeon preference. Intraoperative blood loss was calculated by subtracting the fluid used for wash from the amount collected in the suction device. Of note, the cyst fluid and scolicidal agent used were collected in a separate suction device for easy calculation of the amount of blood loss.

After surgery, all cases were transferred to the recovery room and then to the internal ward. Oral intake was usually allowed on the first postoperative day when the patient passed flatus, and abdominal examination was unremarkable. Most patients were discharged after 3 days after operation unless complications were encountered. Postoperative complications were noticed and recorded. Postoperative bile leakage was defined according to the International Study Group for Liver Surgery (ISGLS) [16].

Postoperative albendazole was commenced for 1 month after surgery at the same dose mentioned before. Regular follow-up visits were scheduled 2 weeks, 1, 3, 6, and 12 months after operation.

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 26 for Mac (IBM SPSS Inc., Chicago, Illinois, USA) was used for tabulating, coding, and analyzing our data. Qualitative data were represented as frequencies and relative percentages, whereas quantitative data were expressed as mean±SD and/or median (range).

Results

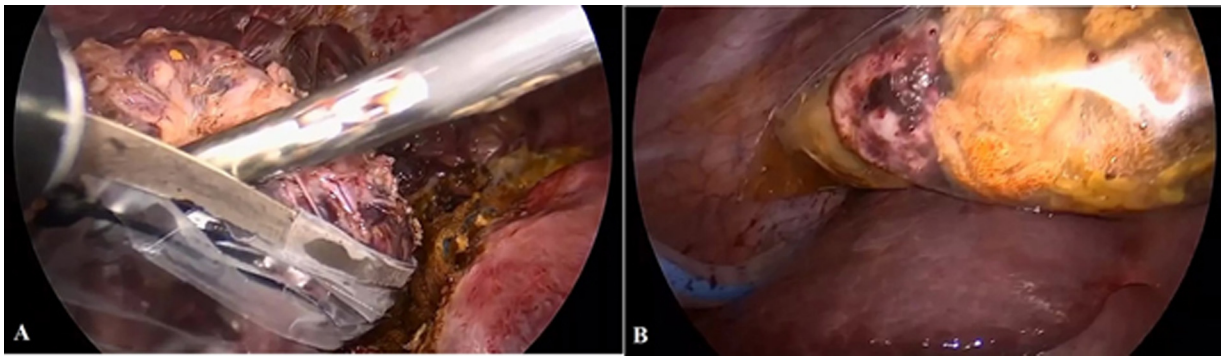
Starting with the demographic characteristics of the included cases, they had a mean age of 37.28 years (range, 25–50 years). The study included 15 (60%) males and 10 (40%) females. Table 1 illustrates these data.

Pain was the commonest complaint reported by the included patients, as it was reported by 80% of cases, whereas the remaining five (20%) cases reported swelling. Table 2 illustrates these data.

Table 1 Demographic criteria among the study cases

Items	Study participants (*N*=25)
Age (years)	
Mean±SD	37.28±7.51
Median (minimum–maximum)	37 (25–50)
Sex [*n* (%)]	
Male	15 (60)
Female	10 (40)

Figure 2



Extraction of the cyst through the laparoscopic port in an endobag.

Table 2 Analysis of the complaints among the study cases

Items	Study cases (*N*=25) *n* (%)
Pain	20 (80)
Swelling	5 (20)

Table 3 Criteria of the lesion among the study cases

Items	Study cases (*N*=25) *n* (%)
Site of the lesion	
Right lobe	15 (60)
Left lobe	6 (24)
Bilobar	4 (16)
Size of the lesion (cm)	
Mean±SD	8.44±3.28
Median (minimum–maximum)	8 (4–15)
Multiplicity	
Single	24 (96)
Multiple	1 (4)
Gharbi classification	
Mean±SD	3.1±0.7
Median (minimum–maximum)	3 (2–4)

As illustrated in Table 3, the right lobe was the commonest affected site (60%), whereas the left lobe was affected in 24% of cases. The remaining four (16%) cases had bilobar affection. The mean size of the detected liver hydatid lesions was 8.44 cm (range, 4–15). The majority of cysts were single in nature (96%), whereas the remaining cases had multiple lesions (4%). Gharbi classification had a mean value of 3.1 (range, 2–4).

When it comes to the operative details, deroofing and endocystectomy was the commonest performed operation (12 cases – 48%), followed by pericystectomy (six cases – 24%). Other procedures included left lateral sectionectomy (four case – 16%), wedge resection (two cases – 8%), and deroofing with endocystectomy and pericystectomy in only one (4%) case. Cystobiliary communication was noticed in two (8%) cases, and it was sutured by vicryl stitches. Concomitant cholecystectomy was performed in four (16%) cases, and all of these cases had their cysts in direct contact with the gall bladder. Conversion to the open approach was performed in only one (4%) case owing to bleeding that obscured the operative field. The mean duration of operation was 78.2 min (range, 40–110 min), whereas intraoperative blood loss had a mean value of 53.6 ml (range, 20–100 ml). The previous data are summarized in Table 4.

The mean duration of hospitalization was 3.28 days (range, 2–8 days). Postoperative bile leakage was encountered in three (12%) cases, and it was managed conservatively, with complete resolution on the fifth postoperative day. Table 5 illustrates these data.

Table 4 Operative data among the study cases

Items	Study cases (*N*=25) *n* (%)
Type of surgery	
Deroofing with endocystectomy	12 (48.0)
Deroofing with endocystectomy, pericystectomy	1 (4.0)
Left lateral sectionectomy	4 (16.0)
Pericystectomy	6 (24.0)
Wedge resection	2 (8.0)
Cystobiliary communication	2 (8.0)
Concomitant cholecystectomy	4 (16)
Conversion	1 (4)
Duration (min)	
Mean±SD	78.2±17.53
Median (minimum–maximum)	74 (40–110)
Volume of blood loss (ml)	
Mean±SD	53.6±24.13
Median (minimum–maximum)	40 (20–100)

Table 5 Postoperative data among the study cases

Items	Study cases (*N*=25) *n* (%)
Hospital stay (days)	
Mean±SD	3.28±1.91
Median (minimum–maximum)	3 (2–8)
Complications	
Bile leak closed spontaneously in the fifth day	3 (12)

Discussion

Laparoscopic management of hydatid liver disease has become popular among hepatobiliary surgeons in spite of the initial exaggerated fear of complications such as anaphylaxis. Nowadays, all procedures performed for that disease with the open approach could be performed via laparoscopy including puncture and aspiration, marsupialization, unroofing and drainage, unroofing and omentoplasty, and partial and complete pericystectomy[17,18].

This study was conducted at Al Rajhi Liver Hospital aiming to evaluate the safety, efficacy, and outcomes of laparoscopic management of hepatic hydatid cyst disease. We included a total of 25 cases whose age ranged between 25 and 50 years (mean=37.28 years).

Shrestha *et al*. [19] conducted a study in 2017 handling the same perspective, and they included 26 cases that had a mean age of 35.5 years (range, 21–55 years). The previous findings are near age range reported by us. However, all age groups are equally affected in other geographical areas, with the average age of presentation being older [20].

In the current study, we included 15 (60%) males and 10 (40%) females. Likewise, Tai *et al*. [6] reported the superiority of males, as they formed 56.5% of the included 46 cases. Another study reported that finding [19]. Contrarily, Ahmed *et al*. [12] reported higher prevalence of female sex, as females constituted 54.05% of the included cases, whereas the remaining cases were males.

In the current study, it was evident that right lobe lesions were more common compared with the left lobe. Rooh-ul-Muqim and colleagues confirmed our findings as the right lobe was affected in 83.2% of cases, whereas the left lobe was affected in 11.62% of cases. The remaining cases had bilobar lesions [20]. Other authors reported that segment VII was the commonest affected one (29.72%), followed by segment VI (24.32%) and segment V (18.91%). Other affected segments included segments VIII, III, and IV, which was affected in 13.51, 8.1, and 5.4% of the included cases, respectively [12].

In our study, the mean size of the detected liver hydatid lesions was 8.44 cm (range, 4–15 cm). Another study reported that the diameter of the cystic hydatid lesions ranged between 4 and 16 cm [17]. Additionally, Tai *et al*. [6] reported that the diameter of detected hydatid cysts ranged between 3 and 12 cm, with a mean value of 7 cm. The diameters reported by the previous studies are near to our findings.

Regarding cyst number in the current study, most cysts were single in nature (96%), whereas the remaining cases had multicentric lesions (4%). Other authors also reported the safety of laparoscopy in managing multiple hepatic hydatid lesions, as eight (18.18%) out of 44 cases had multiple cysts [6].

In our study, pain was the commonest complaint reported by the included patients, as it was reported by 80% of cases, whereas the remaining five (20%) cases reported swelling. As we excluded complicated cases, no cases with jaundice or fever were reported. JabbariNooghabi *et al*. [7] agreed with our findings, as pain was the commonest presentation of such cases. It was reported by 68.52% of the included cases. Other presentations included flank pain (44.44%), vomiting (31.48%), fever (27.78%), gastrointestinal discomfort (24.07%), abdominal lump (14.81%), and jaundice (3.7%). Furthermore, Shrestha *et al*. [19] also confirmed that abdominal pain was reported by 50% of cases, whereas abdominal lump was discovered in 23.06% of patients. Other presentations included nausea, dyspepsia, fever, and jaundice, whereas accidental discovery occurred in three (11.53%) cases.

When it comes to the operative data, in the current study, and owing to source-limited settings and the unavailability of special suction devices recommended for hydatid cyst removal, we used either the veress needle or wide-bore suction apparatus for cyst aspiration and irrigation.

Multiple methods have been used to decrease spillage risk and facilitate cyst evacuation during suction of the cyst content [21,22]. Palanivelu *et al*. [23] described a new special trocar-cannula device that allows complete cyst evacuation. It also enabled good inspection of the inner side of the cyst. No cases developed recurrence 5.8 years after operation. Moreover, Sağlam [24] used a perforator-grinder aspirator apparatus, whereas other authors used a liposuction device during laparoscopic management of the same purpose [25].

In fact, although there is some fear from the increased risk of cystic fluid spillage during laparoscopy, some surgeons believe that the increased intraabdominal pressure elicited by pneumoperitoneum could be protective against that complication [26]. This theory is physically accepted.

In our study, we encountered only two (4%) cases with cystobiliary communication, and they were managed by vicryl sutures. The existing literature reports that cystobiliary communication ranged between 3.5 and 18%, whereas the orifice of this fistula could be seen in 11.7–17.07% of cases during surgical management of liver hydatid cyst [27–29]. It is of crucial importance to assess this communication before operation, and it could be anticipated in patients with history of jaundice, biliary duct dilatation, cholangitis, and patients having a large-diameter cyst [29]. In a previous study conducted in 2015, using a cutoff value of 9.1 cm for cyst diameter had 69.2% sensitivity and 41.1% specificity in the detection of cystobiliary connection [7].

Regarding the type of operation performed in our study, deroofing and endocystectomy was performed in 12 (48%) cases, whereas pericystectomy was done for

six (24%) cases. Other procedures included left lateral sectionectomy (16%), wedge resection (8%), and deroofing with endocystectomy and pericystectomy (4%). Tai *et al.* [6], in their 46-case study, reported that pericystectomy was the commonest procedure performed (41.3%), followed by cystectomy (36.95%) and hepatectomies (21.74%). Tuxun *et al.* [30] reported that cystectomy was the commonest performed procedure (60%), followed by partial cystectomy (15%) and pericystectomy (8%). The remaining cases underwent segmental liver resection. Moreover, Ramia *et al.* [31] reported that about one-third of the included cases had more radical procedures as 12 cases underwent left lateral sectionectomy and another four cases had formal liver resections.

Apparently, there is a great debate about the best procedure performed for this disease. This would depend on many factors including cyst location, relation to biliary and vascular structures, surgeon experience, and the availability of technological facilities required for different operations. Although many surgeons may advocate pericystectomy and liver resection as the best radical options [32,33], it needs more advanced surgical skills and associated with more postoperative morbidity [6].

In the current study, the duration of operation ranged between 40 and 110 min (mean=78.2 min). Another recent study reported that operative time had a mean value of 66 min, with a range between 66 and 160 min [12]. Yağmur *et al.* [17] reported that operative time had a median value of 90 min (range, 60–190). On the contrary, another study reported that operative time was significantly prolonged in the laparoscopic group (115.71 min) compared with the open approach (37.77 min) [7].

Of course, it is expected to find a heterogenicity in the operative time reported in different studies and that could be attributed to difference in surgical experience, cyst characteristics, type of operation performed, and need for simultaneous procedures like cholecystectomy. Our good surgical experience could explain the reduced operative time compared with some previous studies.

Our findings showed that conversion to the open approach was performed in only one (4%) case owing to surgical bleeding. Yağmur *et al.* [17] reported that conversion to the open approach was performed in 6.81% of cases because of restricted access. As it was difficult to deal with the cyst laparaoscopy it was safe to convert to open to avoid spillage of the cyst contents and hydatidiosis. Another study reported that conversion was required in 8% of the included cases [31]. Ahmed *et al.* [12] reported that conversion to the open approach was done in seven (18.91%) of 37 cases. Indications for laparotomy included uncontrolled bleeding, restricted access to the cyst, or inability to suture the cystobiliary communication. The need for conversion will differ between studies according to cyst characters, surgeon experience, intraoperative events, and source settings. In the current study, intraoperative blood loss had a mean value of 53.6 min (range, 20–100). In the same context, another 2019 study reported that blood loss had a mean value of 60.8±22.3 ml for the laparoscopic approach (P=0.005) [23], which was significantly lower than the open group.

In our study, the mean duration of hospitalization was 3.28 days (range, 2–8). Other authors reported a similar hospital stay like the one reported by us, as it ranged between 3 and 12 days (mean=3.8) [12]. Moreover, Yağmur *et al.* [17] reported that hospital stay had a mean value of 3 days (range, 2–10 days).

In the current study, postoperative bile leakage was encountered in only three (12%) cases, and it spontaneously resolved at the fifth postoperative day. A previous review including previous 57 articles and 914 hydatid liver disease reported that bile leakage was encountered in 6% of cases [30]. Rooh-ul-Muqim *et al.* [34] documented the same complication in four (10%) of 40 cases. Yağmur *et al.* [17] reported that seven (15.91%) of 44 cases had postoperative bile leakage, of which five cases were conservatively managed, whereas the remaining two cases required ERCP. Other authors reported higher incidence of postoperative biliary fistula, as it was encountered in 36.7% of cases that were managed by laparoscopy [7]. The difference between different studies could be explained by difference in cyst location and relation to biliary system.

Another study reported other complications including port site infection (7.69%) and port site hernia (3.84%) after the same procedure [19]. However, these complications were not encountered in the current study.

During the follow-up period scheduled in our study, we did not encounter any recurrent lesions. Similarly, JabbariNooghabi *et al.* [7] also negated the occurrence of any recurrence after laparoscopic management of these lesions, with a mean follow-up period of 17.86 months. Another study also reported no recurrence using the same approach [19]. Tai *et al.* [6] reported only one (2.27%) case of recurrence, after they have followed cases for a median of 25 months.

Our study has some limitations: first of all, it is a single-center retrospective study that included a relatively small number of cases. Moreover, it lacks long-term follow-up of the included cases. These drawbacks should be well covered in the upcoming studies. Moreover, it is recommended to perform prospective studies to compare between different laparoscopic procedures in the management of such pathology.

Conclusion

Based on the previous findings, laparoscopy appears as a safe and efficacious approach that is recommended for the surgical management of liver hydatid cyst disease. In experienced surgical hands, it is associated with low conversion rates, low incidence of postoperative complications, and low short-term recurrence rates.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 AbiFadel S, Asmar K, Faraj W, Khalife M, Haddad M, El-Merhi F. Clinical review of liver hydatid disease and its unusual presentations in developing countries. Abdom Radiol 2019; 44:1331–1339.

2 Bhutani N, Kajal P. Hepatic echinococcosis: a review. Ann Med Surg 2018; 36:99–105.

3 Rinaldi F, Brunetti E, Neumayr A, Maestri M, Goblirsch S, Tamarozzi F. Cystic echinococcosis of the liver: a primer for hepatologists. World J Hepatol 2014; 6:293–305.

4 Bekçi TT. Diagnosis and treatment of human hydatid disease. Eur J Gen Med 2012; 9:15–20.

5 Alghofaily KA, Saeedan MB, Aljohani IM, Alrasheed M, McWilliams S, Aldosary A, *et al.* Hepatic hydatid disease complications: review of imaging findings and clinical implications. Abdom Radiol 2017; 42:199–210.

6 Tai QW, Tuxun T, Zhang JH, Zhao JM, Cao J, Muhetajiang M, *et al.* The role of laparoscopy in the management of liver hydatid cyst: a single-center experience and world review of the literature. Surg Laparosc Endosc Percutan Tech 2013; 23:171–175.

7 JabbariNooghabi A, MehrabiBahar M, Asadi M, JabbariNooghabi M, Jangjoo A. Evaluation and comparison of the early outcomes of open and laparoscopic surgery of liver hydatid cyst. Surg Laparosc Endosc Percutan Tech 2015; 25:403–407.

8 Motie MR, Rezapanah A, Pezeshki Rad M, Razavian H, Azadmand A, Khajeh M. Primary localization of a hydatid cyst in the latissimus dorsi muscle: an unusual location. Surg Infect (Larchmt) 2011; 12:401–403.

9 Botezatu C, Mastalier B, Patrascu T. Hepatic hydatid cyst – diagnose and treatment algorithm. J Med Life 2018; 11:203–209.

10 Bickel A, Loberant N, Shtamler B. Laparoscopic treatment of hydatid cyst of the liver: initial experience with a small series of patients. J Laparoendosc Surg 1994; 4:127–133.

11 Khoury G, Jabbour-Khoury S, Soueidi A, Nabbout G, Baraka A. Anaphylactic shock complicating laparoscopic treatment of hydatid cysts of the liver. Surg Endosc 1998; 12:452–454.

12 Ahmed HV, Sherwani AY, Aziz R, Shera AH. Hydatid cyst liver, laproscopic management-our experience with 37 patients. J Surg Res 2020; 3:066–074.

13 Knuf KM, Maani CV, Cummings AK. Clinical agreement in the American Society of Anesthesiologists physical status classification. Perioper Med 2018; 7:1–6.

14 Kamel MA, Maher KM, Rabia I, Helmy AH, El Adawi AI, Mousa MA, Mahgoub AM. A con: a purified hydatid glycoprotein fraction effectively diagnoses human hydatidosis. J Egypt Soc Parasitol 2006; 36:945–958.

15 Gharbi HA, Hassine W, Brauner M, Dupuch K. Ultrasound examination of the hydatic liver. Radiology 1981; 139:459–463.

16 Brooke-Smith M, Figueras J, Ullah S, Rees M, Vauthey JN, Hugh TJ, *et al.* Prospective evaluation of the International Study Group for Liver Surgery definition of bile leak after a liver resection and the role of routine operative drainage: an international multicentre study. HPB 2015; 17:46–51.

17 Yağmur Y, Akbulut S, Gümüş S, Babür M, Can MA. Laparoscopic management of hydatid cyst of the liver. S Afr J Surg 2016; 54:14–17.

18 Helmy AH, Rizk H, Essawy M, Reda M, El Ghanam M, Abdelrahman Y, *et al.* Surgical management of hydatid liver cysts; intra-operative PAIR, cysto-pericystectomy and omentoplasty. Kasr El-Aini J Surg 2005; 6:31–38.

19 Shrestha SK, Thapa PB, Maharjan DK, Tamang TY. Laparoscopic approach for management of hydatid cyst of liver. J Nepal Health Res Council 2017; 15:67–70.

20 Nisćigorska J, Sluzar T, Marczewska M, Karpińska E, Boroń-Kaczmarska A, Morańska I, *et al.* Parasitic cysts of the liver—practical approach to diagnosis and differentiation. Med Sci Monit 2001; 7:737–741.

21 Palanivelu C, Senthilkumar R, Jani K, Rajan P, Sendhilkumar K, Parthasarthi R, *et al.* Palaniveluhydatid system for safe and efficacious laparoscopic management of hepatic hydatid disease. Surg Endosc Other Intervent Tech 2006; 20:1909–1913.

22 Jani K. Spillage-free laparoscopic management of hepatic hydatid disease using the hydatid trocar canula. J Minim Access Surg 2014; 10:113.

23 Palanivelu C, Jani K, Malladi V, Senthilkumar R, Rajan P, Sendhilkumar K, *et al.* Laparoscopic management of hepatic hydatid disease. JSLS 2006; 10:56.

24 Sağlam A. Laparoscopic treatment of liver hydatid cysts. Surg Laparosc Endosc 1996; 6:16–21.

25 Al-Shareef Z, Hamour OA, Al-Shlash S, Ahmed I, Mohamed AA. Laparoscopic treatment of hepatic hydatid cysts with a liposuction device. JSLS 2002; 6:327–330.

26 Bickel A, Loberant N. The feasibility of safe laparoscopic treatment of hydatid cysts of the liver. Surg Endosc 1995; 9:934–935.

27 Ertem M, Karahasanoglu T, Yavuz N, Erguney S. Laparoscopically treated liver hydatid cysts. Arch Surg 2002; 137:1170–1173.

28 Acarli K. Controversies in the laparoscopic treatment of hepatic hydatid disease. Istanbul, Turkey: Elsevier; 2004.

29 Pedrosa I, Saíz A, Arrazola J, Ferreirós J, Pedrosa CS. Hydatid disease: radiologic and pathologic features and complications 1: (CME available in print version and on RSNA Link). Radiographics 2000; 20:795–817.

30 Tuxun T, Zhang JH, Zhao JM, Tai QW, Abudurexti M, Ma HZ, *et al.* World review of laparoscopic treatment of liver cystic echinococcosis—914 patients. Int J Infect Dis 2014; 24:43–50.

31 Ramia JM, Poves I, Castellón C, Diez-Valladares L, Loinaz C, Serrablo A, *et al.* Radical laparoscopic treatment for liver hydatidosis. World J Surg 2013; 37:2387–2392.

32 Elhamel A. Pericystectomy for the treatment of hepatic hydatid cysts. Surgery 1990; 107:316–320.

33 Sharma D, Babu R, Borgharia S, Baruah D, Thomas S, Kumar A. Laparoscopy for liver hydatid disease: where do we stand today? Surg Laparosc Endosc Percutan Tech 2009; 19:419–423.

34 Rooh-ul-Muqim KK, Khalil J, Gul T, Farid S. Laparoscopic treatment of hepatic hydatid cyst. J Coll Physicians Surg Pak 2011; 21:468–471.