

Laparoscopic management of Hepatic cystic echinococcosis in Nepal: A single center experience

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Abstract

Introduction: Advances in laparoscopy has replaced many conventional open surgeries; hepatic cystic echinococcosis (CE) surgery is no exception. This study aims to evaluate the feasibility, postoperative outcomes including complications and recurrence rates after employing laparoscopic treatment for hepatic CE.

Methods: This is a prospective study involving patients who underwent laparoscopic intervention for Hepatic CE at Nepal Medical College and Teaching Hospital from 1st July 2014 to 30th June 2019. Laparoscopic partial pericystectomy was done through the Palanivelu hydatid system and technique after pretreatment with albendazole (10 mg/kg) for at least one week. Clavien-Dindo classification was used to classify postoperative complications.

Results: Twenty-two patients were enrolled in the study with a mean age of 33.95 ± 15.24 (18.0-75.0) years, 15 (68.18%) of them being female. Abdominal pain (77.3%) was the commonest complaint and a single cyst in the right lobe of the liver was the commonest pathology. The mean size of the cyst was 10.2 ± 3.0 (5.0-15.0) cms. 40.9% of the cysts belonged to WHO-IWGE Grade CE3, while grade CE2 and CE1 consisted of 27.3% each. The mean operation time was 80.7 ± 19.7 (60-120) minutes. Out of the 22 patients, six (27.3%) had minor grades while four (18.2%) had major grades of Clavien-Dindo complications. Among the major complications, one (4.5%) patient each developed biliary fistula managed with ERCP and stenting, recurrence after three months, intraoperative bleeding requiring conversion to open surgery, and acute kidney injury managed with dialysis. There was no anaphylaxis or operative mortality.

Conclusion: In selected patients, laparoscopic treatment for hepatic CE is feasible even in a resource-limited country like Nepal. With a low rate of conversion, recurrence and mortality, laparoscopic management can be safe, effective and encouraging treatment modality for the patients of hepatic CE.

Keywords: Cystic echinococcosis; Hydatid cyst; Laparoscopic surgery; Partial pericystectomy



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Introduction

Cystic Echinococcosis (CE) or Hydatid Disease is a zoonosis caused by the larval (metacestode) stage of taenid cestode of the genus *Echinococcus*.¹ CE is endemic and a major public health problem in several temperate countries of South America, the Mediterranean region, Middle East, Eastern Europe and Australia.² Despite being a non-endemic country, the disease is frequently observed in

Nepal, probably due to close cultural and socioeconomic association between human and livestock.^{3,4} Humans are the accidental intermediate hosts who acquire infection by direct hand-to-mouth fecal transmission of infective larva or through contaminated water or uncooked food.^{5,6} Larval stage develops into a single or multiple (20-40%) cysts in different organs of the host. The liver is the most common

organ involved (70%), followed by the lungs (20%) and less commonly the spleen, kidneys, heart, bone and brain.^{7,8}

Hepatic CE most commonly presents with vague abdominal pain, abdominal lump and obstructive jaundice.⁹ Among the existing treatment modalities for Hepatic CE, surgery has been the mainstay of therapy for large cysts, symptomatic cysts, superficial cysts prone to rupture, infected cysts and those in vital anatomical locations or exerting a significant mass effect.¹⁰ The surgical treatment includes open or laparoscopic partial/total pericystectomy. Alternative options include percutaneous drainage consisting of Puncture, Aspiration, Injection and Respiration (PAIR) combined with chemotherapy with benzimidazole compounds (albendazole and mebendazole).¹¹ Some advocate radical surgery in the form of complete pericystectomy and liver resection where the entire unopened cyst including the host tissue-derived capsule is removed.¹²

In our setting widespread acceptance of laparoscopic approach for hepatic CE is still limited due to the long learning curve, training exposure, risk for spillage of cyst contents with anaphylaxis, and under-treatment of cyst contents. Only a few centers in Nepal have published results of their experience with laparoscopic approach for hepatic CE.¹³⁻¹⁵ The concerns of incomplete and improper evacuation of cysts, possible intraperitoneal dissemination and subsequent fear of anaphylaxis and recurrence further confine the utilization of laparoscopic technique.¹⁶ This study aims to evaluate the feasibility, post-operative outcomes and recurrences after employing laparoscopic modality of treatment for the hepatic CE.

Methods

This is a prospective hospital-based study involving 22 consecutive patients who underwent laparoscopic treatment of Hepatic CE by partial pericystectomy during a period of five years (1st July 2014 to 30th June 2019) at the Department of Surgery, Nepal Medical College and Teaching Hospital. The inclusion criteria were the patients with documented Hepatic CE by Ultrasonography (USG) or Computed tomography (CT) and Enzyme-Linked Immunosorbent Assay (ELISA)-IgG test. Patients who were younger than 16 years of age, extrahepatic CE, World Health Organization (WHO) Informal Working Group on Echinococcosis (IWGE) type V Cysts, posteriorly located cysts, patients with cystobiliary communication detected preoperatively, disseminated hydatidosis and not fit for general anesthesia were excluded from the study.

Hepatic CE was diagnosed clinically, serologically by ELISA and radiologically by USG and CT. Cyst size, type and location were identified and classified according to

WHO- IWGE classification.¹⁷ All patients were treated with albendazole (10 mg/kg) for at least one week before surgery and continued postoperatively for three cycles of four weeks at the interval of two weeks. The procedure was done under general anesthesia. Ten millimeter umbilical and 10mm epigastric ports were created, and 5mm ports and Palanivelu cannula were added at locations where deemed appropriate. Betadine® (10% Povidone-iodine) soaked gauze pieces were kept around the cyst along with a 5mm suction cannula in the vicinity of the cyst to prevent peritoneal contamination of cystic fluid if spillage occurred. The Palanivelu Hydatid System was introduced into the cyst and fluid was carefully aspirated. The cavity was then replaced with 10% Betadine® solution and re-aspirated after 10 minutes. Partial pericystectomy was carried with the help of a laparoscopic hook by using monopolar diathermy, which involved resection of the corticalized pericyst (externalized extrahepatic) up to the border with the liver parenchyma while the part of the intrahepatic pericyst (residual cavity) communicating with the remainder of the peritoneal cavity remained in situ.^{18,19} After marsupialization of the cavity, omentoplasty was preferred for the obliteration of the residual cavity in the liver. The laminated membrane, resected pericyst along with the cystic contents and gauze pieces were evacuated through plastic endobag. The drain was kept in proximity to the cyst cavity and removed once the content was non-bilious and less than 2ml/kg body weight for three consecutive days. If the drain was bilious and persistent output for more than two weeks, Endoscopic Retrograde Cholangiopancreatography (ERCP) with sphincterotomy and Common Bile Duct (CBD) stenting was done.

Demographic data, clinical, radiological, and intraoperative findings were collected and recorded in a standard proforma. The primary outcomes evaluated in all patients were successful completion of the procedure by laparoscopy, post-operative complications and recurrences. They were followed up at intervals of three months, six months, and then annually, for detecting recurrence using abdominal ultrasonography. Recurrence was defined as the appearance of a new active cyst or reappearance of live cyst at the site of previously treated cyst.²⁰ The Clavien-Dindo classification was used to classify the postoperative complications.²¹ Grade III or higher Clavien-Dindo complications were classified as major while those lower than grade III were classified as minor complications. Statistical analysis was performed with the help of Statistical Package for the Social Sciences (version 25, SPSS Inc., IBM, Chicago, IL, USA). Variables were expressed as mean \pm standard deviation or percentage of patients, as appropriate. A p-value of 0.05 or less was regarded as statistically significant.

Results

A total of 22 patients were enrolled in the study. 15 were female (68.18%) and seven were male (sex ratio of 1:2.14) (**Figure 1**). The mean age of the patients was 33.9 ± 15.2 years (range 18-75 years). The majority of the patients, i.e. 20 (91%) were from the mountainous region (Himalayas and Hills), and most of them i.e. 16 (72.7%) belonged to the Tibeto-Burmese population while six (27.3%) belonged to the Indo-Aryan population of Nepal (**Figure 2**).

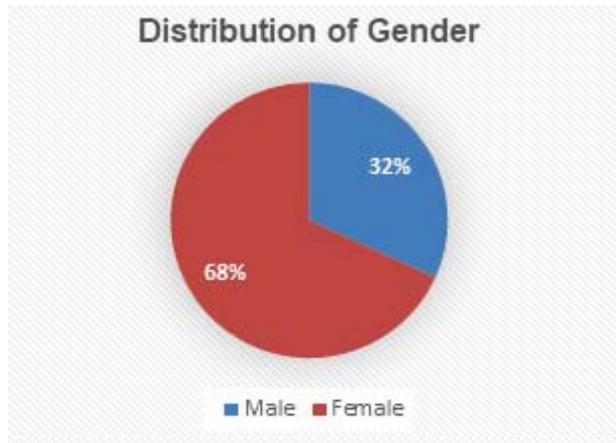


Figure 1. Distribution of Gender

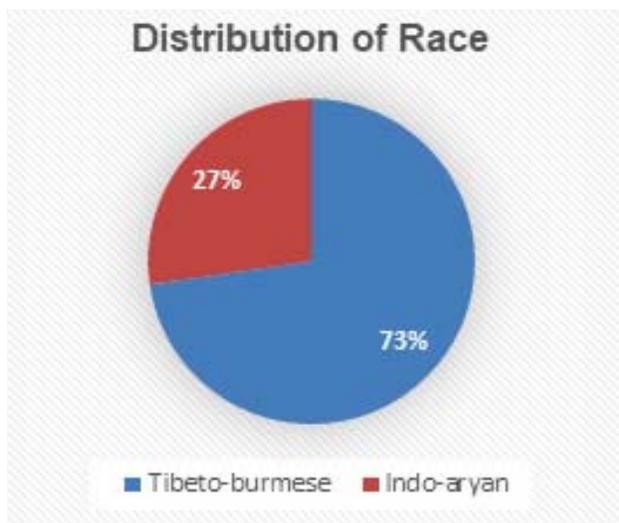


Figure 2. Distribution of Race

Clinical Presentation

Abdominal pain was the most common presenting complaint (n=17, 77.3%) followed by abdominal lump (40.9%) (**Table 1**). Fever was present in one patient. One patient had an incidental diagnosis while undergoing ultrasonography for some other ailments. ELISA was positive in only 10 patients (45.5%).

Table 1. Clinical presentation of the patients with hepatic CE

| Clinical presentation | N (%) |
|-----------------------|-------------|
| Abdominal pain | 17 (77.3 %) |
| Abdominal Lump | 9 (40.9 %) |
| Fever | 1 (4.5%) |
| Incidental Finding | 1 (4.5%) |

Cysts

Twenty (90.9%) patients had their cysts located in the right hemi-liver (segment VI, VII, and VIII) while one (4.5%) had a cyst in the left lobe of the liver (**Table 2**). Both hemi-liver involvement was noted in one patient (4.5%). Single cyst was observed in 18 patients (81.8%) while multiple cysts were noted in four (18.18%) patients all of which were in the right hemi-liver. The mean size of cyst was 10.2 ± 3.0 cm (range; 5.0-15.0 cm). The majority of the cysts i.e. 40.9% belonged to CE3 grade while grade CE2, CE1, and CL consisted of 27.3%, 27.3%, and 4.5% respectively (**Table 3**).

Table 2. Characteristics of cysts in the liver

| Location of Cyst | Single | Multiple | N (%) |
|------------------|--------|----------|------------|
| Right hemi-liver | 16 | 4 | 20 (90.9%) |
| Left hemi-liver | 1 | 0 | 1 (4.5%) |
| Both hemi-liver | 1 | 0 | 1 (4.5%) |
| Total | 18 | 4 | 22 (100%) |

Table 3. WHO-IWGE Grading of Cysts

(*CL- Cystic Lesion **CE- Cystic Echinococcosis)

| WHO-IWGE Grade ¹⁷ | N (%) |
|---|-----------|
| *CL (Unilocular cyst, no wall) | 1 (4.5%) |
| **CE1 (Cyst wall, hydatid sand) | 6 (27.3%) |
| CE2 (Multivesicular, multiseptated cyst, daughter cysts, honeycomb pattern) | 6 (27.3%) |
| CE3 (Detached membrane, water lily sign) | 9 (40.9%) |
| CE4 (Heterogeneous contents, no daughter cysts) | 0 (0%) |
| CE5 (Cyst with partial or complete wall calcification) | 0 (0%) |
| Total | 22 (100%) |

Procedure

The mean operating time was 80.7 ± 19.7 minutes (range 60.0-120.0 minutes). The mean hospital stay was 13.7 ± 9.7 days (range 5-36 days). Mean hospital stay without complication was 7.3 ± 2.7 days (range 5-17 days) while that with complications was 21.4 ± 9.4 days (range 5-36 days) ($p=0.007$, Chi-square test). The mean follow-up period was 37.1 ± 24.9 months (range 9.8-76.0 months).

Complications

Out of the 22 patients, postoperative complications were observed in 10 (45.45%) patients, of which six (27.27%) belonged to minor grade while four (18.18%) belonged to major grade of Clavien-Dindo complications (**Table 4**). Three of the patients (13.63%) had superficial umbilical port site infection (Clavien-Dindo Grade I complication). There were minor bile leaks (Clavien-Dindo Grade II complication) in three patients (13.63%) which were noted in the pericystic drain. One patient (4.5%) developed persistent biliary drainage (Clavien-Dindo grade IIIa complication) for more than two weeks who required ERCP with sphincterotomy and CBD stenting.

Table 4. Complications

| Complications | | Clavien-Dindo Grade | N (%) |
|---------------|--|---------------------|-------------|
| Minor | Superficial Port Site Infection | I | 3 (13.6%) |
| | Bile leak | II | 3 (13.6%) |
| Major | Persistent Biliary Drainage/ Biliary fistula | IIIa | 1 (4.5%) |
| | Recurrence | IIIa | 1 (4.5%) |
| | Intraoperative bleeding | IIIb | 1 (4.5%) |
| | Acute Kidney Injury | IVa | 1 (4.5%) |
| Total | | | 10 (45.5 %) |

A recurrence (Clavien-Dindo grade IIIa complication) was noted in one of the patients (4.5%) at three months during regular follow up. The patient was later managed by PAIR. Major intraoperative bleeding (Clavien-Dindo grade IIIb complication) occurred in one of the patients (4.5%) whose hemostasis was achieved after converting the procedure to

open. One of the patients (4.5%) suffered from acute kidney injury (Clavien-Dindo grade IVa complication) on the first postoperative day but recovered after multiple episodes of hemodialysis and other supportive care. There was no operative mortality or incidence of anaphylaxis during or after surgery.

Discussion

Laparoscopic surgeries are popular worldwide as they offer many advantages over conventional open surgeries.²² Cosmetic benefits and less post-operative pain are already well-established advantages of laparoscopic surgeries. The advances in technology and improvement in surgeons' skills have enabled to replicate the principles of conventional hydatid cyst surgery using a laparoscopic approach.²³ Spillage of cyst content and thus contamination of the whole abdominal cavity and concomitant anaphylaxis are overstressed fears that pull back the surgeons from adopting minimal invasive techniques.¹⁹ Various articles have proven the safety and efficacy of laparoscopic approach for Hepatic CE.^{13,14,19} In fact, the actual risk of spillage and anaphylaxis may be much lower in laparoscopic surgery than open surgery.²⁴

In our study, twenty-one patients underwent partial pericystectomy through laparoscopic technique. One of the patients suffered excessive intraoperative bleeding as the cyst was in close proximity to the right hepatic vein. Conversion to an open procedure was required for control of hemorrhage. The conversion rate (i.e. 4.5%) in our study was comparable to that of Shrestha et.al (i.e. 7.69%), although some other studies have reported a conversion rate of 0% to 12.5%.^{14,15,25} However, the conversion of the procedure from laparoscopic to open should not be regarded as a failure. The safety of the patient should be of primary consideration.²⁵

The mean age of the patients in our study was 33.9 ± 15.2 years which was comparable to the average age of presentation shown by various other studies.^{13,19,26} Female predominance with a sex ratio of 1:2.14 was observed in our study (**Figure 1**), similar to the findings of Hazra et.al and Maharjan et.al (Nepal) and Islami Parkoohi et.al (Iran).^{13,26,27} However, some other articles from Nepal and abroad have shown equal or male predominance.^{14,19} Majority of the patients (73.3%) were of Tibeto-Burmese (Mangoloid) origin in our study (**Figure 2**). Since other studies have not looked into it and our study number was small a definite conclusion is not possible. The probable reason may be dietary as the Tibeto-Burmese population is usually non-vegetarian (consumption of pork and goat is common).

Abdominal pain followed by abdominal lump was the major complaint at presentation in our study and these findings are consistent with other articles (Table 1).^{15,19,28} Likewise, our study showed single cyst in the right lobe of the liver as the most common pathology which has been documented in various other studies (Table 2).^{19,28} It is well recognized that the larva burrows through the intestine and travels to the liver via the portal venous system and commonly seeds in its right lobe (60-70%) because of preferential portal flow.²⁹⁻³¹

The mean operating time (80.7 minutes) in our study was higher than those reported by Shrestha et.al (40.51 minutes) and Palanivelu et.al. (52 minutes).^{14,19} The reason for slightly longer operating time in our study may be partly because our operating time was calculated from the induction of anesthesia till extubation and partly due to our learning curve which decreased gradually on subsequent surgeries. Some of the studies of Li et.al had their average operating time of about 174 minutes.³² The average duration of hospital stay (13.6 days) in our study was also higher in comparison to other studies.²⁵ The complications in patients had a significant impact on hospital stay (7.3 days vs 21.4 days, $p=0.007$). Since most of our patients belonged to the relatively inaccessible rural mountainous region and lacked facilities to stay in Kathmandu, they would often opt to stay in the hospital till sutures were removed.

Postoperatively, six of the patients had minor complications; three developed superficial port site infections (Clavien-Dindo grade I complication) and three had biliary drainage from the pericystic drain (Clavien-Dindo grade II complication) (Table 4). All six patients recovered well with conservative treatment alone. Many authors also have acknowledged that conservative management was adequate for the Clavien-Dindo grade I and II complications.^{14,25,28} However, three of the patients with major grades of Clavien-Dindo complications required interventions. One patient (4.5%) had recurrence i.e. Clavien-Dindo grade IIIa complication in the third month and had to undergo PAIR for complete resolution. Another patient (4.5%) had persistent bile in the pericystic drain for more than two weeks which fell under Clavien-Dindo grade IIIa complication. The biliary fistula was treated with ERCP with sphincterotomy and CBD stenting and the drain was removed after five days. A similar complication was encountered by Shrestha et.al in one of their patients (3.8%) and Yagmur et. al in two of their patients (4.5%) who all recovered with ERCP with sphincterotomy and CBD stenting.^{14,33} The recurrence rate of 4.5% in our study was comparable to other studies that have reported recurrence rate 0-9%.^{2,32,34} However, the cumulative recurrence rate of laparoscopic treatment of hepatic CE has been reported to be 1.1%.²⁵

Acute Kidney Injury (AKI) i.e. Clavien-Dindo grade IVb complication was encountered in one of the patients (4.5%) on the first post-operative day. Despite extensive workup, the cause was not identified. A similar case of AKI with unidentifiable cause was reported by Avgerinos et.al. in one of their patients (3%) on the 11th postoperative day following surgical treatment of hepatic CE.³⁵ Some articles have mentioned immune-mediated parasitic nephropathies without physical invasion of the kidney by parasites in unexplained kidney injuries.^{36,37} Kaur et.al had reported a case of AKI due to iodine toxicity during the instillation of povidone-iodine in a hydatid cyst cavity.³⁸ Due to the unavailability of testing for serum iodine levels and immune-mediated parasitic nephropathies in Nepal, our study could not establish the cause. The patient's renal function parameters improved and normalized on the 35th postoperative day after 16 cycles of hemodialysis and supportive care.

Despite the excessive concern, there are very few incidences of frank anaphylaxis, even in case of a ruptured hydatid cyst.³⁹ Shah et.al had reported anaphylaxis in two (6.5%) of their patients during the immediate post-operative period.¹⁵ However, there was no incidence of anaphylactic reaction in our study. The use of an extra suction cannula, securing the periphery of the cyst with Betadine® soaked gauge pieces and retrieval of specimens in plastic endobag were used to prevent uncontrolled spillage of cyst content. The operative mortality in our study was none while Tuxun et.al have reported mortality up to 0.22% during the laparoscopic treatment which is lesser compared to the open surgeries for hepatic CE.²⁵

Our study has helped in exhibiting the safety and efficacy of laparoscopy for the treatment of hepatic CE with low rates of recurrences and complications. We do not routinely offer more radical surgeries in view of increased operative risk.⁴⁰ However, this was a small study and did not have a control open arm to compare to. We also had a longer hospital stay. Therefore, a large scale prospective multicenter randomized trial comparing laparoscopic with the open approach of treatment for hepatic CE may help establish the superiority over conventional open techniques.

Conclusion

In selected patients, laparoscopic treatment for hepatic CE is feasible even in a resource-limited setting. With a low rate of conversion, recurrence and mortality, laparoscopic management along with pre and post-operative anthelmintic chemotherapy can indeed be safer, effective and encouraging treatment modality for the patients of hepatic CE.

Conflict of Interests: none

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References

1. Mandal S, Mandal MD. Human cystic echinococcosis: epidemiologic, zoonotic, clinical, diagnostic and therapeutic aspects. *Asian Pac J Trop Med.* 2012 Apr;5(4):253-60.
2. Ibrahim I, Tuerdi M, Zou X, Wu Y, Yasen A, Abihan Y et.al. Laparoscopic versus open surgery for hepatic cystic echinococcosis: a systematic review and meta-analysis. *Int J ClinExp Med.* 2017;10(12):16788-97.
3. Joshi DD, Yamasaki H. Histopathological and molecular confirmation of Porcine Cystic Echinococcosis (CE)/Hydatidosis in Nepal. *Journal of Institute of Medicine.* 2010 Dec; 32(3):54-8.
4. Joshi A, Shrestha K, Shah LL. Infected Hydatid Cyst: Various Presentations. *Postgraduate Medical Journal of NAMS.* 2011 (11);59-61.
5. Pakala T, Molina M, Wu GY. Hepatic Echinococcal Cysts: A Review. *J Clin Transl Hepatol.* 2016 Mar 28;4(1):39-46.
6. Kaman A, Tanır G, Çakmakçı E, Demir P, Öz FN, Aydın Teke T, et.al. Characteristics, diagnosis, and treatment modality of pediatric patients with cystic echinococcosis: a single centre experience. *Turk J Pediatr.* 2019;61(5):704-13.
7. Moro PL, Schantz PM. Echinococcosis: historical landmarks and progress in research and control. *Ann Trop Med Parasitol.* 2006 Dec;100(8):703-14.
8. Wen H, Vuitton L, Tuxun T, Li J, Vuitton DA, Zhang W, et.al. Echinococcosis: Advances in the 21st Century. *Clin Microbiol Rev.* 2019 Feb 13;32(2):e00075-18.
9. Nunnari G, Pinzone MR, Gruttadauria S, Celesia BM, Madeddu G, Malaguarnera G et.al. Hepatic echinococcosis: clinical and therapeutic aspects. *World J Gastroenterol.* 2012 Apr 7;18(13):1448-58.
10. McManus DP. Echinococcosis with particular reference to Southeast Asia. *Adv Parasitol.* 2010;72:267-303.
11. Tamarozzi F, Vuitton L, Brunetti E, Vuitton DA, Koch S. Non-surgical and non-chemical attempts to treat echinococcosis: do they work? *Parasite.* 2014;21:75.
12. Al-Saeedi M, Khajeh E, Hoffmann K, Ghamarnejad O, Stojkovic M, Weber TF, et al. Standardized endocystectomy technique for surgical treatment of uncomplicated hepatic cystic echinococcosis. *PLOS Neglected Tropical Diseases.* 2019;13(6):e0007516.
13. Maharjan SB, Paudyal S, Shah S, Dahal R, Shah JN. Clinical profile and surgical outcome of abdominal hydatid cyst at a university hospital, Nepal. *Journal of Patan Academy of Health Sciences.* 2018 Dec;5(2):52-7.
14. Shrestha SK, Thapa PB, Maharjan DK, Tamang TY. Laparoscopic Approach for Management of Hydatid Cyst of Liver. *J Nepal Health Res Council.* 2017 Jan;15(1):67-70.
15. Sah S, Adhikary S, Agrawal C, Gupta R, Ghimire A. Laparoscopic management of liver echinococcal cyst at B. P. Koirala Institute of Health Sciences Dharan, Nepal an institutional review. *Health Renaissance.* 2017;13(1):86-94.
16. Yaghan R, Heis H, Bani-Hani K, Matalka I, Shatanawi N, Gharaibeh K, et.al. Is fear of anaphylactic shock discouraging surgeons from more widely adopting percutaneous and laparoscopic techniques in the treatment of liver hydatid cyst? *Am J Surg.* 2004 Apr;187(4):533-7.
17. World Health Organization. (2017). Meeting of the WHO Informal Working Group on Echinococcosis (WHO-IWGE): WHO Headquarters, Geneva, Switzerland, 15-16 December 2016. World Health Organization. Available from: <https://apps.who.int/iris/handle/10665/254869>.
18. Stancu B, Andercou O, Pintea D, Mironiuc A, Pop DA. Laparoscopic simultaneous partial pericystectomy and total cystectomy for hydatid liver cysts - case report. *Clujul Med.* 2015;88(3):415-9.
19. Palanivelu C, Jani K, Malladi V, Senthilkumar R, Rajan PS, Sendhilkumar K, et.al. Laparoscopic management of hepatic hydatid disease. *JLS.* 2006 Jan-Mar;10(1):56-62.
20. Prousalidis J, Kosmidis C, Anthimidis G, Kapoutzis K, Karamanlis E, Fachantidis E. Postoperative recurrence of cystic hydatidosis. *Can J Surg.* 2012 Feb;55(1):15-20.

21. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004 Aug;240(2):205-13.
22. Al-Shareef Z, Hamour OA, Al-Shlash S, Ahmed I, Mohamed AA. Laparoscopic treatment of hepatic hydatid cysts with a liposuction device. *JLS.* 2002 Oct-Dec;6(4):327-30.
23. Rodríguez-Sanjuán JC, Gómez-Ruiz M, Trugeda-Carrera S, Manuel-Palazuelos C, López-Useros A, Gómez-Fleitas M. Laparoscopic and robot-assisted laparoscopic digestive surgery: Present and future directions. *World J Gastroenterol.* 2016 Feb 14;22(6):1975-2004.
24. Mookherjee A, Kantamani B, V S M, Chandran P. Experience of Management of Liver Hydatid Disease in a Tertiary Care Hospital– Comparison of Surgical Techniques. *J Evol Med Dent Sci.* 2016;5(02):148-53.
25. 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 Jul;24:43-50.
26. Hazra NK, Batajoo H, Ghimire S, Sathian B. Open Conservative Surgical Management of Cystic Echinococcosis in a Tertiary Care Hospital, Nepal. *J Clin Diagn Res.* 2015 Jul;9(7):PC01-3.
27. Islami Parkoohi P, Jahani M, Hosseinzadeh F, Taghian S, Rostami F, Mousavi A, et.al. Epidemiology and Clinical Features of Hydatid Cyst in Northern Iran from 2005 to 2015. *Iran J Parasitol.* 2018 Apr-Jun;13(2):310-316.
28. Venukumar R. Clinical presentation of hydatid cyst of liver: descriptive study. *Int Surg J.* 2017;4:214-6.
29. Kumar MJ, Toe K, Banerjee RD. Hydatid cyst of liver (Case report). *Postgraduate Medical Journal.* 2003;79(928):113-4.
30. Jarnagin, William R, Belghiti J, Blumgart LH. *Blumgart's Surgery of the Liver, Biliary Tract, and Pancreas.* Philadelphia: Elsevier Saunders, 2012.
31. Bektasoglu HK, Hasbahceci M, Tasci Y, Aydogdu I, Malya FU, Kunduz E, et.al. Comparison of Laparoscopic and Conventional Cystotomy/Partial Cystectomy in Treatment of Liver Hydatidosis. *Biomed Res Int.* 2019 Feb 5;2019:1212404.
32. Li H, Shao Y, Aji T, Zhang J, Kashif K, Ma Q et.al. Laparoscopic approach for total cystectomy in treating hepatic cystic echinococcosis. *Parasite.* 2014;21:65.
33. Yağmur Y, Akbulut S, Gümüş S, Babür M, Can MA. Laparoscopic management of hydatid cyst of the liver. *S Afr J Surg.* 2016 Sep;54(3):14-17.
34. Sokouti M, Sadeghi R, Pashazadeh S, Abadi SEH, Sokouti M, Ghojazadeh M. et.al. A systematic review and meta-analysis on the treatment of liver hydatid cyst using meta-MUMS tool: comparing PAIR and laparoscopic procedures. *Arch Med Sci.* 2019 Mar;15(2):284-308.
35. Avgerinos ED, Pavlakis E, Stathoulopoulos A, Manoukas E, Skarpas G, Tsatsoulis P. Clinical presentations and surgical management of liver hydatidosis: our 20 year experience. *HPB (Oxford).* 2006;8(3):189-93.
36. Barsoum RS. Tropical parasitic nephropathies. *Nephrol Dial Transplant.* 1999;14(3):79–91.
37. Altay M, Unverdi S, Altay FA, Ceri M, Akay H, Ozer H, et.al. Renal injury due to hepatic hydatid disease. *Nephrol Dial Transplant.* 2010 Aug;25(8):2611-5.
38. Kaur G, Swami AC, Sharma A, Kaur A. Povidone-iodine toxicity in a child posted for laparoscopic removal of hepatic and renal hydatid cysts. *Indian J Anaesth.* 2015 Feb;59(2):135-6.
39. Bensghir M, Fjouji S, Bouhabba N, Ahtil R, Traore A, Azendour H, Kamili ND. Anaphylactic shock during hydatid cyst surgery. *Saudi J Anaesth.* 2012 Apr; 6(2):161-4
40. He YB, Yao G, Tuxun T, Bai L, Li T, Zhao JM, et.al. Efficacy of radical and conservative surgery for hepatic cystic echinococcosis: a meta-analysis. *Int J Clin Exp Med.* 2015 May 15;8(5):7039-48.