



# LAPAROSCOPIC SURGICAL MANAGEMENT OF HYDATID HEPATIC CYST - UP TO DATE REVIEW

ALIN MIHEȚIU<sup>1</sup>, ALEXANDRU SABĂU<sup>2</sup>, DAN BRATU<sup>3</sup>, DAN SABĂU<sup>4</sup>

<sup>1,2,3,4</sup>“Lucian Blaga” University of Sibiu”, Sibiu County Clinical Emergency Hospital

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**Abstract:** Introduction: Hepatic hydatid cyst is a zoonosis that can affect humans in its cycle of development. Being worldwide known, it is more common in endemic areas, Romania being one of the countries where this condition is relatively common. The surgical management of this pathology can be a challenge due to the number of cysts, the location and the structures involved. Materials and methods: We conducted a review of the recent literature in which the cases with this type of pathology, the surgical therapeutic modalities and their results were analysed. Results: There was a tendency towards a laparoscopic surgical approach, which has undeniable advantages over open surgery. Conclusion: The laparoscopic surgical approach remains the standard surgical therapy for this condition.

## INTRODUCTION

Hydatid cyst is a zoonosis that endemically affects regions of the Mediterranean basin, the Middle East, India, Africa, China and South America.(1,2) In Romania, the incidence is 3.3 cases per 100,000 inhabitants. Hydatid cyst is a disease caused by Echinococcus tapeworm, humans being an intermediate host in the life cycle of this parasite. Two subtypes of this parasite, Echinococcus Granulosus and Echinococcus Multilocularis, are the most common.(2) The most commonly affected organ is the liver (70%) followed by the lung (20%) and other organs (eyes, brain, bone marrow, skin, kidneys, spleen, breast etc.) totalling 10%.(1) Complications of hydatid disease include allergic reactions that can lead to anaphylaxis through cyst rupture, cyst infection, cholangitis, or compression of nearby organs. Most patients are asymptomatic, the symptoms appearing as the cyst increases in size. It is most often manifested by embarrassment or pain in the right hypochondrium, but may also include cholangitis and allergic manifestations.(2)

It is usually diagnosed by ultrasound or CT, confirmation can also be made by serology. Although a number of therapeutic modalities have been identified, a standardized treatment protocol has not yet been established.

## AIM

The present paper aims to make an analysis of the recent literature regarding the laparoscopic treatment of hydatid cyst. Among the minimally invasive surgical methods, laparoscopy is the first-line approach when local conditions allow. We thus set out to analyse the two usual surgical options for laparoscopy and the open approach, the frequency, the ways of performing them, the advantages and disadvantages of each procedure.

## MATERIALS AND METHODS

We reviewed the recent literature (2016-2021), using the PubMed and Scholar databases and entering as search terms:

“hepatic hydatid cyst”, “laparoscopy”, “laparoscopic treatment”, “laparoscopic management”.

**Inclusion criteria:** Our research included all clinical trials and case reports over the past 5 years, regardless of the language of report.

**Exclusion criteria:** Articles such as meta-analysis, literature review, editorials and surgical technique reports, studies that presented insufficient data (demographics or analysis of surgical interventions and their results), articles presented only in the form of abstracts, and those whose content could not be accessed were excluded.

Reports of pediatric cases, PAIR procedures or robotic surgery were excluded. An “ahead of print” article was also excluded.

## RESULTS

28 articles were obtained (9 PubMed 19 Scholar), 25 being clinical trials and 3 case reports.(3-23)

The largest study took into account 348 patients. A total of 1393 patients were identified, 793 females (56.92%) and 600 males (43.07%). The mean age of the patients was 40.97 years (table no. 1).

8 articles presented cases with single hepatic hydatidosis, a study with multiple hepatic hydatid cysts, the rest analysing cases with both single and multiple cysts. A number of 888 patients (63.74%) received laparoscopic treatment, 505 (36,25%) being treated by open surgery.

The conversion from laparoscopy to open surgery was performed in 27 cases (3.04%) with a conversion rate of 1:33 cases. 9 studies analysed both the laparoscopic and open approach, highlighting a number of 991 subjects of which 486 (49.04%) with laparoscopic treatment and 505 (50.95%) open surgery treatment. The conversion rate in these studies was 0.5%. It is observed, by comparison, that the conversion rate in the group with strictly laparoscopic approach is higher than in the studies in which the approach was both laparoscopic and classical (5.47% vs 0.50%).

<sup>1</sup>Corresponding author: Alexandru Sabău, B-dul. C. Coposu, Nr. 2-4, Sibiu, România, E-mail: alx\_sabau@yahoo.com, Phone: + 40269 213163  
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## CLINICAL ASPECTS

**Table no. 1. Laparoscopic treatment of liver hydatidosis**

Year	Authors	Number of patients	Sex F/M	Age	Number of patients with Solitary/multiple cysts	Laparoscopic approach	Type of laparoscopic approach	Open surgery approach	Conversion
2019	Kaya S et al(3)	18	14/4	42.9	11/7	18	Conservative	-	1
2021	Wan L et al(4)	13	7/6	32,69	13/0	13	Laparoscopic hepatectomy	-	-
2017	Shrestha SK et al(5)	26	9/17	35,5	26/0	26	Conservative	-	2
2021	Xu Y et al(6)	1	1/0	40	0/1	1	-	-	1
2020	Muñoz C et al(7)	1	1/0	28	1/0	1	Conservative	-	-
2019	Bayrak M et al(8)	60	40/20	43.6	37/23	37	Conservative and radical 16	21	23
2016	Vennarecci et al(9)	34	21/13	45	29/5	4	Conservative	30	-
2018	Grubnik V et al (10)	348	214/134	42,3	-	283	249 conservative/34 radical	65	3
2020	Li YP et al(11)	9	3/6	36.4	9/0	9	Laparoscopic ICG 2 conservative/7 radical-	-	-
2017	Al-Doghan IE et al(12)	54	33/21	45	39/15	47	Conservative	-	7
2016	Pradhan S et al(13)	26	18/8	37,5	-	26	Conservative	-	2
2020	Ahmad U et al(14)	82	35/47	40,2	-	42	Radical	42	-
2017	Ece I et al (15)	130	84/46	46,4	-	38	Laparoscopic partial cystectomy	92	-
2021	Shaikh O et al(16)	7	5/2	41,7	6/1	7	Radical	-	1
2020	Khattoon S et al (17)	21	6/15	33,33	-	21	Conservative	-	-
2017	Malik AA et al(18)	80	41/39	40,27	75/5	40	Conservative	40	-
2021	Shaikh AS et al(19)	35	21/14	40	-	35	27 conservative/4 radical/4 marsupialization	-	-
2016	Bostanci O et al(20)	83	36/47	41,6	-	14	Conservative	69	-
2020	Ahmed HV et al(21)	37	20/17	42	37/0	37	Conservative	-	7
2019	Bektasoglu HK et al(22)	71	35/36	40,2	-	23	Conservative	48	-
2017	Kumar R et al(23)	30	12/18	44	30/0	30	Conservative	-	-
2021	Meazher NM (24)	48	27/21	37,8	-	48	Conservative	-	-
2016	Pothare AN et al(25)	20	8/12	35	18/2	20	Conservative	-	-
2016	Raj RAP et al(26)	1	1/0	65	1/0	1	Conservative	-	-
2017	Hazim SA et al(27)	32	14/18	35	10/22	32	Conservative	-	-
2018	Mansy W et al(28)	103	71/32	35	74/29	6	Conservative	97	-
2020	Grubor N et al (29)	1	1/0	67	1/0	1	Conservative	-	-
2020	Koirala R et al(30)	22	15/7	33,9	18/4	22	Radical	-	-

**Table no. 2. Intraoperative and postoperative data**

Year	Authors	Laparoscopic operative time (minutes)	Open Surgery operative time	Main complication (laparoscopy)	Main complication (open surgery)	Hospital stay (laparoscopy)	Hospital stay (open surgery)
2019	Bektasoglu HK et al(22)	150	113	Biliary drainage(3)	Biliary drainage(7)	3.4	4.7
2017	Malik AA et al(18)	89.9	60.43	Biliary drainage	Biliary drainage	3.40	8.73
2020	Koirala R et al(30)	80.7	-	Port site Infection	-	7.3	-
2016	Pothare AN et al(25)	99.95	-	Biliary drainage	-	5	-
2020	Khattoon S et al(17)	98.28	-	Cystic cavity infection	-	6.57	-
2021	Shaikh O et al (19)	191.86	-	Bile leakage	-	4	-
2017	Ece I et al(15)	95.4	63	Site infection	Wound infection	4.3	6
2020	Ahmad U et al(14)	54.24	60.29	Bile leakage(2.4%)	Wound infection (14.6%)	4.8	3.4
2020	Li YP et al (11)	228	-	Bile leakage	-	5.7	-
2019	Bayrak N et al(8)	50	74	Bleeding	Wound infection	4	7

It is also noted that in 118 cases, there was a single hydatid cyst and in 52 cases the location was multiple. The conversion in patients with solitary hydatid cyst was 8.47% and in those with multiple hydatid cyst, it was 19,23%.

Laparoscopic conservative (cystectomy, partial cystectomy, drainage and epiploonoplasty) 689 cases were resolved, representing 77.59% of the laparoscopic surgical approach.

Radicality (total cystectomy, pericystectomy, maximal pericystectomy) was used in 132 cases (14.86%), the other procedures used being laparoscopic hepatectomy or laparoscopic marsupialization.

10 studies were presented with complete data regarding the duration of surgery, postoperative complications and length of hospital stay (table no. 2).

The average duration of laparoscopic surgery was 113.83 minutes. It should be noted that in two studies (11,19), the duration of surgery was longer due to the surgical technique, which was particular - closed cystectomy and cystectomy under ICG control.

In these two situations, the average duration of surgery was 209.93 minutes. Excluding these studies, the average duration of laparoscopic surgery was 89.75 minutes. In the open approach, the result was 74,144 minutes.

The main complication in laparoscopic surgery was biliary drainage, and in open surgery, wound infection, the total number of complications being higher in open surgery. The average length of hospital stay in laparoscopy was 4.8 days and in open surgery, 5.9 days.

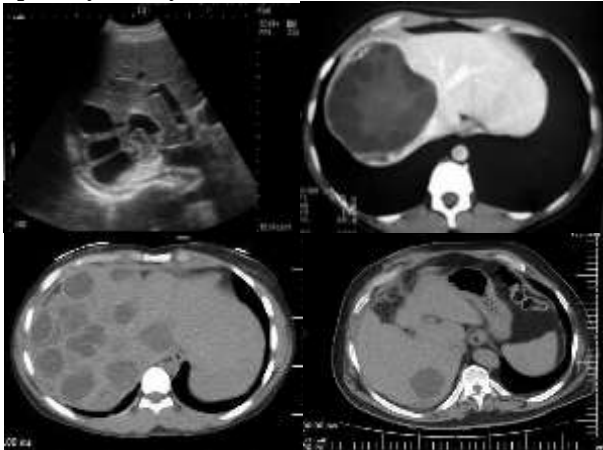
## CLINICAL ASPECTS

We observe a slight longer duration of intervention in the laparoscopic approach, a lower rate of postoperative complications and a shorter hospital stay than open surgery.

### DISCUSSIONS

Most patients with hydatid cyst are asymptomatic so most of the time the discovery is incidental. Abdominal ultrasonography is the most commonly used method of diagnosis, but it cannot reveal small cysts, as CT is needed.

**Figures no. 1,2,3,4. Ultrasound and CT scan images of hepatic hydatid cyst**



The first ultrasonographic classification of hydatid cyst was made by Gharbi. This classification was modified by the World Health Organization (WHO) in 2001.

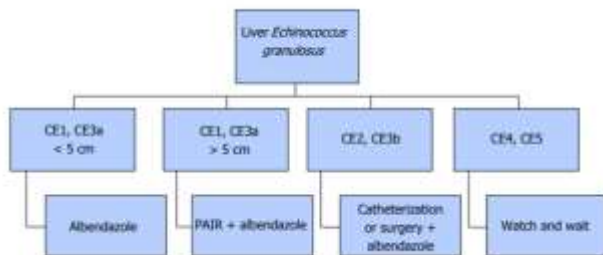
**Table no. 3. WHO classification of hydatid cyst**

WHO stage	Characteristics	Activity
CE1	Unilocular, anechoic cyst with double line sign	Active
CE2	Multiseptated "rosette-like" "honeycomb pattern" cyst	Active
CE3a	Cyst with detached membrane (water-lily sign)	Transitional
CE3b	Daughter cysts in solid matrix	Transitional
CE4	Heterogeneous cyst, no daughter vesicles	Inactive
CE5	Solid matrix with calcified wall	Inactive

Therapeutic options for hepatic hydatid cyst include surgery, percutaneous treatment, pharmacotherapy and monitoring. Since there is no randomized study in the literature to analyse all these options, it is difficult to establish a therapeutic protocol.

Therapeutic behaviour is dictated by the location of the cyst, the symptoms it causes, local and systemic complications, but because they cannot be standardized it is desired to be translated into an objective element, applicable to all cases of hepatic cyst, namely the WHO classification.

**Figure no. 5. WHO recommendation for hydatid hepatic treatment (31)**



Exclusive drug treatment (Albendazole, Praziquantel) is recommended for ineligible patients or as an adjunct to PAIR

or surgical treatment. The cure rate under drug treatment is around 30%. In combination with surgery, preoperative treatment is recommended 4-30 days before surgery and 30 days postoperatively.(31,32)

Puncture-Aspiration-Injection-Respiration (PAIR) technique performs the injection of scolicid agent followed by the extraction of inactivated cystic contents. It is the most used minimally invasive method. Not suitable for daughter cysts, solid content or multiple cysts.

Until recently, the surgical approach to hydatid cyst was the most common way to resolve this pathology, and it remains in the therapeutic routine today due to the advantages over PAIR. Complicated cysts, particular localizations, daughter bladder cysts (CE2, CE3b), large or small cysts regardless of WHO staging may have surgical resolution.(1,33,34)

The risk of intra-abdominal contamination is reduced, open or laparoscopic surgical approach being able to achieve effective isolation measures.

Surgical treatment has two objectives:

- destruction of the parasite
- treatment of the remaining cavity

Destruction of the parasite is achieved by aspirative puncture of the cystic content, introduction of scolicide substances and subsequently re-aspiration of the content.

Regarding the attitude towards the cyst, there are 3 options:

- conservative (maintain cavity, drainage +/- omentoplasty)
- reductive (partially reduce cavity)
- radical (total perichistectomies, closed cystectomies, hepatectomies).(1)

**Figures no. 6,7. Intraoperative aspect of liver hydatidosis. Hydatid cyst specimen**



All these variants can be performed in both open surgery and laparoscopy.

The first laparoscopic solution of hepatic hydatidosis dates back to 1992.(2,35) Originally intended for selected cases and with limited indications, laparoscopy has become the surgical technique of choice over time. The advantages over the classical approach overlaps with the benefits of minimally invasive surgery compared to classical surgery.

Most laparoscopic surgery centers do not limit the indications of laparoscopic approach depending on the size of the cyst, their number or the evolutionary stage. However, it recommends caution when the location is deep, or close to important vascular elements.(36,37)

Disadvantages or limitations consist in access difficulties for certain locations (e.g. posterior location), increased risk of contamination, higher learning curve. Strong contraindications to the laparoscopic approach are recurrence after laparoscopic surgery or contact with significant vascular elements.(37,38,39) Compared to open laparoscopy surgery, the number of postoperative complications is lower, the average length of hospital stay is shorter, with an operating time slightly above the average of open surgery.(8,10,15,20,40)

Conservative surgery consists of cystotomy or partial perichistectomy. This attitude is preferred by most of the

## CLINICAL ASPECTS

authors in our study. The increased frequency of conservative treatment, with the maintenance of the cystic walls is explained by the fact that it is an easy, fast intervention, without significant risks of intraoperative complications and rarely with biliary drainage in the postoperative period. However, it is affected by a higher number of recurrences.(2,3,20,37)

**Figures no. 8,9. Laparoscopic pericystectomy**



Tuxun T et al in a comprehensive review of the literature that included 914 patients found that conservative surgery was accounted for 75.16% for cystectomy and 14.77% for partial pericystectomy.(37) The data obtained are similar to those found in our study.

Radical surgery requires perichystectomy or liver resection. It is not as common as the conservative approach, it has a lower recurrence rate, but the postoperative complications and the duration of the surgery are longer.(2,14,15,20,22,37,40) Closed pericystectomy has the advantage of performing an excision outside the risk of contamination, but the duration of surgery is longer.(14)

Liver resections for hydatid cyst benefit from a very low recurrence rate, but with a higher rate of intraoperative, postoperative complications and duration of surgery compared to conventional radical laparoscopy. In addition, the technique addresses carefully selected cases.(4,37)

The conversion from laparoscopic surgery to open surgery should not be classified as a failure, as it is preferable when the isolation conditions are not optimal, when the location is difficult or is juxtavasular.

In the literature, the conversion has values between 4.92% -19%, values similar to those in our analysis, where there is a higher percentage in the analyzes that show strictly the laparoscopic approach.(37,39)

The explanation is given by the fact that the indication for laparoscopic surgery was more extensive in these patients, compared to the centers where both types of approach were chosen. This extension of the indication comes through the greater experience of the operative team in laparoscopy, which allowed such an approach in cases with multiple hydatidosis, large size or problematic locations, cases that would otherwise have been included from the beginning for the open surgery approach.

**Figures no. 10,11,12,13 Special devices for laparoscopic hydatid cyst treatment**



The laparoscopic combined approach with indocyanine green fluorescence is a technique with obvious benefits in terms of resection time, resected tissue, avoidance of injury to noble elements in the area or rapid detection of an injury. However, it is a technique at the beginning, which requires special equipment, training of the operating team, as well as a more consistent number of studies.(11,41)

In search of technical solutions to achieve the best possible isolation, evacuation and a laparoscopic approach as easy as possible, special instruments dedicated to this pathology were imagined. The patented system used in our clinic (OSIM Patent 120809 / 30.04.2008) has the advantage that it achieves a fixed anchoring of the cyst parts, can fragment the contents of the cyst and can achieve concomitant aspiration instillation.(42)

## CONCLUSIONS

Laparoscopic treatment of hydatid cyst remains a safe and effective method with broad indication both to the patient and the health system. It is the first option when PAIR has no indication and remain the first option even in cases previously considered as an indication for open surgery.

## REFERENCES

1. Sabau D. Chistul hidatic hepatic. In: Chirurgia ficatului, Irinel Popescu (sub redacția) Ed. Universitară „Carol Davila” București, ISBN 973-7918-58-4; 2004. p. 321-353.
2. Gomez I, Gavara C, López-Andújar R, Belda Ibáñez T, Ramia Ángel JM, Moya Herraiz Á, Orbis Castellanos F, Pareja Ibars E, San Juan Rodríguez F. Review of the treatment of liver hydatid cysts. *World J Gastroenterol.* 2015 Jan 7;21(1):124-31. doi: 10.3748/wjg.v21.i1.124. PMID: 25574085; PMCID: PMC4284328.
3. Kaya S, Altuntas YE, Kaptanoglu L, Altin Ö, Kement M, Küçük HF, Bildik N. Laparoscopic treatment of hepatic hydatid cysts. Our approach. *Ann Ital Chir.* 2019;90:560-564. PMID: 31617852.
4. Wan L, Ran B, Aji T, et al. Laparoscopic hepatectomy for the treatment of hepatic alveolar echinococcosis. *Hépatectomie laparoscopique pour le traitement de l'échinococcose alvéolaire hépatique.* *Parasite.* 2021;28:5. doi:10.1051/parasite/2021001.
5. Shrestha SK, Thapa PB, Maharjan DK, Tamang TY. Laparoscopic Approach for Management of Hydatid Cyst of Liver. *J Nepal Health Res Counc.* 2017 Jan;15(1):67-70. doi: 10.3126/jnhrc.v15i1.18017.
6. Xu Y, Hu X, Li J, Dong R. Hepatic Hydatid Cyst Misdiagnosed as Simple Cyst: A Case Report. *Am J Case Rep.* 2020;21:e923281. Published 2020 Aug 2. doi:10.12659/AJCR.923281.
7. Muñoz C, Alborno C. Laparoscopic pericystectomy for segment VIII hydatid cyst of the liver with diaphragmatic compromise. *Cir Esp (Engl Ed).* 2020 Jan;98(1):47. English, Spanish. doi: 10.1016/j.ciresp.2019.08.005.
8. Bayrak M, Altuntas Y. Current approaches in the surgical treatment of liver hydatid disease: single center experience. *BMC Surg.* 2019;19(1):95. Published 2019 Jul 17. doi:10.1186/s12893-019-0553-1.
9. Vennarecci G, Manfredelli S, Guglielmo N, Laurenzi A, Goletti D, Ettore GM. Major liver resection for recurrent hydatid cyst of the liver after suboptimal treatment. *Updates Surg.* 2016 Jun;68(2):179-84. doi: 10.1007/s13304-016-0368-x.
10. Grubnik V, Iliashenko V, Bugridze Z, Grubnik V, Giuashvili S. Liver Cystic Echinococcosis Laparoscopic Treatment Effectiveness. *Georgian Med News.* 2018 May;(278):20-25. Russian.
11. Li YP, Ma ZG, Tuxun T, Li ZD, Meng Y, Chen X. The

## CLINICAL ASPECTS

- application of laparoscopy combined with indocyanine green fluorescence imaging technique for hepatic cystic echinococcosis. *BMC Surg.* 2020;20(1):249. Published 2020 Oct 22. doi:10.1186/s12893-020-00911-8.
12. Al-Doghan IE, Hussein HK, Jasim HA. Laparoscopic Treatment of Hepatic Hydatid Cyst. *Mustansiriya Med J.* 2017;16:8-2.
  13. Pradhan S, Ghimire B, Kansakar P, Singh Bhandari R, Joshi Lakhey P, et al. Laparoscopic management of hydatid cyst of liver. *J Ultrasound Med.* 2017;40:37-40.
  14. Ahmad U, Anwar A, Khan S. A, Ain Q. U, Kamal M, Aman Z. Outcome of laparoscopic versus open surgery in patients with hydatid cyst of liver. *Rawal Medical Journal.* 2020;45(4):806-809.
  15. Ece I, Yilmaz H, Yormaz S, et al. Comparison of mid-term clinical outcomes of laparoscopic partial cystectomy versus conventional partial cystectomy for the treatment of hepatic hydatid cyst. *J Minim Access Surg.* 2017;13(4):296-302. doi:10.4103/jmas.JMAS\_238\_16.
  16. Shaikh O, Kumbhar U, Bhattarai S, Chilaka S, Reddy N, Tajudeen M. Feasibility of Laparoscopic Closed Cystectomy for Hepatic Hydatid Cyst in Segments VI, VII, and VIII. *Cureus.* 2021;13(3):e13957. Published 2021 Mar 17. doi:10.7759/cureus.13957
  17. Khatoon S, Talpur A, Shaikh AA. Laparoscopic Treatment of Hydatid Cyst of Liver: Outcome at Tertiary Care Hospital. *Journal of Pharmaceutical Research International;* 2020. p. 164-168.
  18. Malik AA, Ayoub I, Wani MA, Bari SU. Laparoscopic versus conventional surgery for hepatic hydatid disease: a comparative study. *J Minim Invasive Surg Sci.* 2017;6(4):e57109.
  19. Shaikh A S., Tandur A E, Pathrabe Y S, Patil D S, Bhandarwar AH, Shaikh NA. Laparoscopic management in hydatid disease of liver: a series of 35 cases. *International Surgery Journal.* 2021;8(4):1134-1142.
  20. Bostanci O, Kartal K, Yazici P, Karabay O, Battal M, Mihmanli M. Laparoscopic versus open surgery for hydatid disease of the liver. A single center experience. *Ann Ital Chir.* 2016;87:237-41. PMID: 27340157.
  21. Ahmed HV, Sherwani AY, Aziz R, Shera AH. Hydatid Cyst Liver, Laproscopic Management-Our Experience with 37 Patients. *Journal of Surgery and Research.* 2020;3:066-074.
  22. 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;2019:121240
  23. Kumar R, Kaur K, Hastir A. Laparoscopic treatment of hydatid cyst of liver. *J. Evolution Med Dent Sci.* 2017;6(41):00-00, DOI: 10.14260/Jemds/2017/0000.
  24. Meazher NM, Al-Janabi FA, Hamzah BM, Obaid HN. Outcomes of Laparoscopic Surgery of Liver Hydatid Cyst. *Indian Journal of Forensic Medicine & Toxicology.* Oct-Dec 2021;15(4):3314-3320.
  25. Pothare AN, Ilamkar KN. A case series of laproscopic management of hydatid cyst of liver. *International Surgery Journal.* 2016;4:319-322.
  26. Raj RAP, Manivannan R, Anand P. A novel approach in laparoscopic management of hydatid cyst of liver. *Journal of Evolution of General Surgery and Laparoscopy.* 2016;2(1):13-14.
  27. Hazim SA, Isam AA, Abdulkarem OMS. The Role of Laparoscopy in the Treatment of Patients with Liver Hydatid Cyst in Kirkuk General Hospitals. *Journal of Kirkuk Medical College.* 2017;5(1).
  28. Mansy W, Mohamed M, Saber S. Outcomes of radical surgical management in liver hydatid cysts: 7 years center experience. *Mini-invasive Surg.* 2018;2:36 <http://dx.doi.org/10.20517/2574-1225.2018.48>.
  29. Grubor N, Tadić B, Milosavljević V, Knežević Đ, Matic S. Laparoscopic approach in the treatment of echinococcal liver disease - case report and literature review. *Srpski arhiv za celokupno lekarstvo.* 2020;148(7-8):480-483.
  30. Koirala R, Rajbhandari AP, Maharjan S, Adhikari SS. Laparoscopic management of Hepatic cystic echinococcosis in Nepal: A single center experience. *Journal of Society of Surgeons of Nepal (JSSN).* 2020;23(1)
  31. Manterola C, Mansilla JA, Fonseca F. Preoperative albendazole and scolices viability in patients with hepatic echinococcosis. *World J Surg.* 2005;29:750-753 [PMID: 15880282 DOI: 10.1007/s00268-005-7691-6.
  32. Bildik N, Cevik A, Altintaş M, Ekinçi H, Canberk M, Gülmen M. Efficacy of preoperative albendazole use according to months in hydatid cyst of the liver. *J Clin Gastroenterol.* 2007;41:312-316 [PMID: 17426473 DOI: 10.1097/01.mcg.0000225572.50514.e6].
  33. Dziri C, Haouet K, Fingerhut A. Treatment of hydatid cyst of the liver: where is the evidence? *World J Surg.* 2004;28:731-736 [PMID: 15457348 DOI: 10.1007/s00268-004-7516-z].
  34. El Malki HO, El Mejdoubi Y, Souadka A, Mohsine R, Ifrine L, Abouqal R, Belkouchi A. Predictive factors of deep abdominal complications after operation for hydatid cyst of the liver: 15 years of experience with 672 patients. *J Am Coll Surg.* 2008;206:629-637 [PMID:18387467 DOI:10.1016/j.jamcollsurg.2007.11.012].
  35. Katkhouda N, Fabiani P, Benizri E, Mouiel J. Laser resection of a liver hydatid cyst under videolaparoscopy. *Br J Surg.* 1992;79:560-561 [PMID: 1535261 DOI: 10.1002/bjs.1800790628].
  36. Zaharie F, Bartos D, Mocan L, Zaharie R, Iancu C, Tomus C. Open or laparoscopic treatment for hydatid disease of the liver? A 10-year single-institution experience. *Surg Endosc.* 2013 Jun;27(6):2110-6. doi: 10.1007/s00464-012-2719-0. Epub 2013 Jan 31. PMID: 23370963; PMCID: PMC3661041.
  37. Tuxun T, Zhang JH, Zhao JM, Tai QW, Abudurexti M, Ma HZ, Wen H. World review of laparoscopic treatment of liver cystic echinococcosis--914 patients. *Int J Infect Dis.* 2014 Jul;24:43-50. doi: 10.1016/j.ijid.2014.01.012.
  38. Mirelis CG, Bekiaridou KA, Bougioukas IG, Xanthoulis AI, Tsalkidou EG, Nannou G, et al. Long-term results of surgical treatment of hydatid disease. *Acta Chir Belg.* 2006;106:684-687.
  39. Acarli K. Controversies in the laparoscopic treatment of hepatic hydatid disease. *HPB (Oxford).* 2004;6(4):213-221. doi:10.1080/13651820410024003.
  40. Ibrahim I, Tuerdi M, Zou X, Wu Y, Yasen A, Abihan Y, Xu O, Balati M, Zhao J, Li T, Tuxun T. Laparoscopic versus open surgery for hepatic cystic echinococcosis: a systematic review and meta-analysis. *Int J Clin Exp Med.* 2017;10(12):16788-16797.
  41. Nishino H, Hatano E, Seo S, et al. Real-time navigation for liver surgery using projection mapping with indocyanine green fluorescence: development of the novel medical imaging projection system. *Ann Surg.* 2018;267(6):1134-40.
  42. Sabău D, Coman A, Bratu D, Smarandache G, Dumitra A, Sabău A. Chirurgia laparoscopică a chistului hidatic hepatic – performanțe și limite. *Chirurgia, Septembrie-Octombrie,* 2007;102(5)