

PRESENTATION AND MANAGEMENT OF RECURRENT HEPATIC HYDATID CYSTS: A TEN YEAR EXPERIENCE AT A TERTIARY CARE HOSPITAL OF KASHMIR

Khalid Basheer¹, Arshid Iqbal Qadri², Gowhar Aziz Bhat³, Sharankumar Shivaji Narute⁴

Received : 07/11/2022
Received in revised form : 12/12/2022
Accepted : 26/12/2022

Keywords:

Recurrent; Hepatic hydatid cyst; E. granulosus; Albendazole; Spillage; Cystectomy

Corresponding Author:

Dr. Arshid Iqbal Qadri,
Email: arshidqadri@gmail.com
ORCID: 0000-0002-6333-9322

DOI: 10.47009/jamp.2023.5.1.38

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (1); 179-184



¹Assistant Professor, Department of General Surgery, Government Medical College Anantnag, Jammu and Kashmir, India

²Consultant, Department of General Surgery, SMHS Hospital Karan Nagar Srinagar, Jammu and Kashmir, India

³Senior Resident, Department of General surgery, Sher-e-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir, India

⁴Senior Consultant Liver Transplant and HPB, Dr. D Y Patil Hospital and Research Institute, Pune, Maharashtra, India

Abstract

Background: To appraise within an endemic region the presentation of recurrent hepatic hydatid cyst caused by E. granulosus and to study the factors responsible for recurrent hepatic hydatid cyst. **Materials and Methods:** Of all the patients who were studied in the time frame from February 2005 to February 2016, 54 number of patients developed recurrence within five years (Recurrent group) while 164 patients underwent cystectomy for their disease which showed no signs of recurrence at the end of 5-years, (non-recurrent group). **Result:** Most of the patients developed recurrence after 2 years (81.48%) with mean time duration of 38±2.04 months. Segment 8 followed by segment 7 was the commonest segments involved in recurrent cases as opposed to segment 5 and segment 6 in control group. Type 3 was the commonest cyst seen in recurrent cases while type 4 and 5 cyst were more common in non-recurrent group. The average of preoperative and postoperative albendazole therapy in recurrent group was 1.28±1.02 and 2.89± 2.45 weeks whereas in non-recurrent group it was 3.06±2.33 and 7.31±2.69 weeks respectively. Intraoperative spillage (77.77%) and biliary communication (18.51%) was more common in recurrent group. Out of 54 patients, 48 underwent cystectomy, 2 underwent pericystectomy and 4 resections. **Conclusion:** Recurrent hepatic hydatid cyst is major health problem in endemic area adding to the morbidity of patient. Factors responsible for recurrence are inadequate peri-operative chemotherapy, inaccessible location of the cyst, infective stage of cyst and intra-operative spillage. ELISA alone is not effective in diagnosing recurrence early in the course of disease. USG is good screening investigation, but confirmation needs CT scan.

INTRODUCTION

Hydatid cyst may develop in any organ in the body. Liver is the organ most commonly involved. Lungs are second most common organ involved in 10–30% of cases.^[1] Simultaneous involvement of both liver and lung is seen in about 10% of cases.^[2,3] Hepatic hydatid is diagnosed serologically and radiologically. Treatment options for hydatid cyst of liver include non-operative and operative methods. Non-operative methods include chemotherapy and percutaneous treatment of liver hydatidosis. Operative methods include conservative and radical procedures. As

medical therapy alone is not effective, surgery is still the first-choice treatment.^[4]

Despite the number of therapies now available, recurrence remains one of the major problems in the management of hydatid disease, ranging from 4.6% to 22.0% in different series.^[5,6] Recurrent hepatic hydatid cyst was defined as the appearance of active cysts after therapy within 5 years of surgical management, which includes reappearance and continuous growth of live cysts at the site of a previously treated cyst or the appearance of new distant peritoneal disease resulting from spillage.^[7,8] Management of recurrent hepatic hydatid cyst is same as with hepatic hydatid cyst. As there is no

effective medical therapy for recurrent hydatid cyst (RHC), surgery is still the first-choice treatment. The principles of liver hydatid surgery include inactivation of protoscolices within the cyst fluid, evacuation of the cyst contents and prevention of spillage of the cyst contents, secure closure of any cystobiliary communications, and management of the residual cyst cavity. Administering pre- and post-operative courses of anti-helminthic drugs is part of the standard protocol in management of RHC.^[9]

Kashmir is part of the endemic zone of hydatid disease. Recurrence of the disease is a major health problem in the region as in any other endemic region. Liver is the most common organ to get involved and recommended management which is surgical removal of the cyst carries morbidity due to grave nature of surgery especially in the recurrent cyst. Thus, the present study was conducted in our institute with the aim of assessing risk factors for recurrence and prevention of same in future.

MATERIALS AND METHODS

After obtaining written informed consent from all the patients, this prospective and retrospective study was conducted in the Departments of Surgical Gastroenterology, Sher-I-Kashmir Institute of Medical Sciences, Srinagar, Kashmir on all the patients admitted and operated with diagnosis of liver hydatid cyst from February 2005 to February 2016. We defined a 'recurrent cyst' to be any growing cyst at the original operative site with respect to segmental anatomy of liver or in the neighboring liver tissue or in general peritoneal cavity (due to spillage) within 5 years of treatment. New cyst arising in other part of liver or in different organ and or after 5 years of primary treatment were not considered recurrent cyst for the study purpose. Hydatid cysts of the liver grow to 1 cm during the first 6 months and 2–3 cm annually, thereafter, depending on host tissue resistance.^[5] Five-year cut-off was applied to exclude chance of having a second primary cyst, and it would be unlikely to miss true recurrence in a patient who was on regular follow up.

A total of 54 patients with recurrent hepatic hydatid cyst as per above definition who were operated at the index (primary surgery) presentation as well as for the recurrence in this tertiary care center and only patients who underwent cystectomy were included in the study. Control comprises of patient with hepatic hydatid cyst operated in department of surgical gastroenterology in whom follow up of at least 5 years was able to be completed and in whom no recurrence was detected, thus including cases from February 2005 till February 2011. In patients recurrent hydatid cyst arising not in the segment or adjacent segments of the liver as at the primary presentation, cases of recurrent hydatid cyst referred to the department who were not operated in the department at their primary presentation were excluded. This was done to prevent possible bias due

to different institutional protocol and experience in operating hydatid cyst. Patients who had undergone any other surgery other than cystectomy for hepatic hydatid cyst were excluded from the study.

We extracted demographic data and information on clinical features, diagnostic methods, surgical interventions and long-term results with special emphasis on intraoperative technique and chemotherapy compliance of the patients from the patient's medical records and by reminding them about routine follow up by telephonic communication. The standardized protocol used the enzyme-linked immunosorbent assay (ELISA) indirect hemagglutination test (IHA) for cystic echinococcosis and abdominal ultrasonography six monthly for a period of 5 years. Any suspicion of recurrence based on the ultrasound was confirmed with computed tomography (CT). US and contrast enhanced CT findings was described according to Gharbi classification.^[10]

Patients suspected to have biliary communication underwent MRCP for confirmation and documentation of the same. Magnetic resonance was not routinely used for diagnosis of recurrent hydatid cyst. Anatomical localization of the recurrent cyst with respect to segmental anatomy of the liver was with the help of imaging studies. Ultrasound and CT findings were correlate to assess the diagnostic ability of ultrasound in distinguishing residual cavity and recurrent hepatic hydatid cyst and thus knowing the role of ultrasound in follow up.

Patient who was diagnosed with recurrent hepatic hydatid cyst and who meets the inclusion criteria were considered for surgical therapy and proceed to routine laboratory blood work considered for assessing surgical fitness and as part of surgical and anaesthesia workup which include - complete blood count, liver function test, renal function test, random blood sugar, prothrombin time, INR, chest X-ray, echocardiogram and infective virology for HBV, HCV and HIV. Biochemistry tests done specifically for recurrent hydatid cyst were - Differential blood counts including absolute eosinophil count – Leukocytosis may suggest infection of the cyst and Eosinophilia which can be present in hydatid cyst patients.

ELISA is helpful in diagnosis of hydatid cyst and post-operative follow up. Though 6 monthly ELISA was done as part of routine follow up elevated levels or rising trend were always correlated with ultrasound before considering CT for confirmation of recurrence.

A right subcostal approach was used in all patients for surgical intervention in hepatic hydatid cyst. The principles of operative management include adequate exposure of the cyst, safe decompression, and prevention of intraoperative contamination by use of active scolicidal agents. We used 10% povidone iodine as the scolicidal agent. Pre-operative 3weeks courses and post-operative 3 cycles of 3 weeks with 1 week of gap in between two cycles of anti-helminthic drugs (Albendazole 10mg/kg/day) were planned for

all patients as per standard protocol of the department for all patients with hepatic hydatid (new case or recurrent cases).

Documentation of successful/ incomplete treatment was done for all patients. Many patients have poor compliance due to varied reasons and in some cases, treatment needs to be disconnected due to associated adverse reactions especially hepatotoxicity. Post-operative care included early ambulation, early enteral feeds, and early discharge. Postoperatively, a follow-up program was carried out routinely. All patients were followed up initially every 2 weeks for 3 months, and thereafter every 6 monthly for 5 years. Ultrasonography of abdomen and pelvis was done every 6 monthly. In case of any doubt, CT abdomen was done. Hydatid serology IgG and IgM by ELISA was done every 6 months.

Statistical Methods

The data was analyzed descriptively. The appropriate statistical tests used to analyze the statistical data were Student's independent t-test and Chi-Square and Fischer's exact tests for categorical data. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Most of the patients (57%) were of middle age group (21-40 years) with median age of patients was 35 years with female predominance (62.9%). Only 12 patients presenting with complaints and pain (47.36%) was the predominant symptom followed by fever (36.84%). Maximum (59.26%) cases diagnose with recurrent hydatid cyst by USG and confirmed by CT (40.74%) as shown in [Table 1].

Most of the patients developed recurrence after 2 years (81.48%) as depicted in [Figure 1]. The mean time duration for development of recurrence was

38 ± 2.04 months. The minimum time duration for development of recurrence was 8 months and maximum time duration was 60 months.

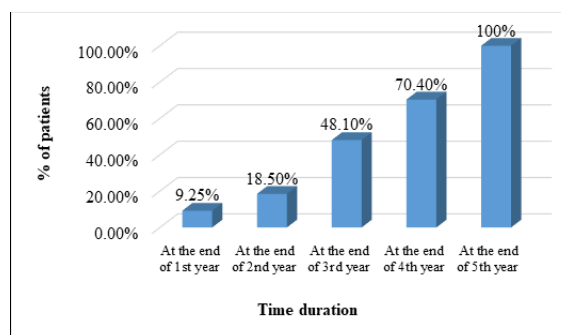


Figure 1: Time gap for recurrence

Segment 8 followed by segment 7 was the most common segments involved in recurrent cases as opposed to segment 5 and segment 6 in control group. Type 3 was the most common cyst seen especially in recurrent cases. Type 4 and type 5 cyst (inactive cysts) were more common in non-recurrent group [Table 2].

Our standard protocol was 3 weeks of preoperative and 3 cycles of 3 weeks each (separated by gap of 1 week) of albendazole therapy in post-operative setting as shown in [Table 3]. The average of preoperative and postoperative albendazole therapy in recurrent group was 1.28 ± 1.02 weeks and 2.89 ± 2.45 weeks whereas in non-recurrent group it was 3.06 ± 2.33 weeks and 7.31 ± 2.69 weeks respectively. Intraoperative spillage (77.77%) and biliary communication (18.51%) was more common in recurrent group. Out of 54 patients, 48 underwent cystectomy, 2 underwent pericystectomy and 4 resections, [Table 4]. Only 9 patients had inadvertent spillage and 12 patients had biliary communication.

Table 1: Demographic data, clinical presentation, and diagnosis of patients

Parameters	No. of patients	Percentage
Age group (years)	11-20	03
	21-30	13
	31-40	18
	41-50	11
	51-60	08
	61-70	01
Sex	Male	20
	Female	34
Clinical presentation	Asymptomatic	35
	Symptomatic	19
Symptomatic	Pain	09
	Fever	07
	Jaundice	02
	Vomiting	01
Diagnosis	USG	32
	CT	22

Table 2: Segments of liver involved by hydatid cyst and types of cysts.

Parameters	Recurrent group (n=54)	Non-recurrent group (n=164)
Segments	1	00 (0.0%)
	2	04 (7.40%)
	3	05 (9.25%)
	4	08 (14.81%)
	5	17 (31.48%)
		00 (0.0%)
		08 (4.87%)
		24 (14.63%)
		36 (21.95%)
		72 (43.90%)

	6	13 (24.07%)	66 (40.24%)
	7	18 (33.33%)	48 (29.26%)
	8	27 (50.0%)	22 (13.41%)
Types of cysts	Type 1	04 (7.40%)	46 (28.04%)
	Type 2	11 (20.37%)	26 (15.85%)
	Type 3	35 (64.81%)	48 (29.26%)
	Type 4	02 (3.70%)	24 (14.63%)
	Type 5	02 (3.70%)	20 (12.19%)

Table 3: Albendazole Therapy

Number of weeks		Recurrent group (n=54)	Non-recurrent group (n=164)
Preoperative regimen completed	1	41 (75.92%)	63 (38.41%)
	2	08 (14.81%)	60 (36.58%)
	3	05 (9.25%)	41 (25.0%)
Post-operative regimen completed	3	20 (37.03%)	20 (12.19%)
	6	20 (37.03%)	24 (14.63%)
	9	14 (25.92%)	120 (73.17%)

Table 4: Management of recurrent hydatid cyst

Surgery performed	Frequency (%)	Preoperative albendazole	Postoperative albendazole
Cystectomy	48 (88.88%)	3weeks	3 cycles of 3 weeks
Pericystectomy	02 (3.70%)	3weeks	3 cycles of 3 weeks
Resection	04 (7.40%)	3weeks	3 cycles of 3 weeks

DISCUSSION

Most patients with RHC of liver were asymptomatic and were suspected on ultrasonography done as investigation on follow up. Ultrasonography was able to diagnose recurrence in only 32 out of 54 patients with sensitivity of 59.3%. Rest of the patients it was not able to differentiate between residual cavity and actual recurrence. This observation was confirmed by computed tomography of abdomen. What we observed that classical features of round homogenous cyst with floating membrane and calcified wall is not that common in recurrent cyst compared to hydatid cyst who are not operated yet. Ultrasound though considered to be very good investigation for hydatid cyst of liver with high positive predictive value in most studies we could not say same in the case of recurrent hydatid cyst as per our observation.

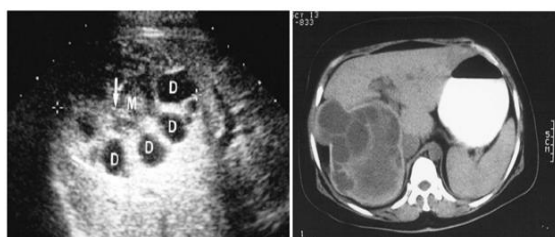


Figure 2: Liver hydatid with matrix and daughter cyst seen ultrasonography and CT

CT had 100% sensitivity in current study when correlated with intra-operative findings. MRC was done in two patients who had jaundice with an objective of delineating the biliary tree before surgical planning and ruling out any associated pathology. Serology test was done every 6 monthly as part of routine follow-up. The study observed positive ELISA with increasing titer was seen in 20.3% of cases, that is low to suggest ELISA alone as a diagnostic modality in identifying recurrence.

Also, in studies in endemic regions compared to non-endemic regions have shown lower values of serology titers. Eosinophilia was seen 5 (9.3%) of the patients of recurrent hydatid cyst which is in line with other studies done in endemic region.^[11,12]

The recurrence developed after a time gap ranging from 8 months to 60 months with mean at 38 months (median=39.5). Thus, half of the recurrence occurred by the end of 3 years. Most of the recurrence (44/54 patients) occurred after 2 years and this can be explained by indolent course of the disease. It required more than 1 year follow up time (in present study 6 months) to definitely diagnose recurrence in most cases due to drawbacks of ultrasonography and ELISA. Though follow up time was cut short in patients who were suspected of recurrence which is difficult in Kashmir valley especially in patients from far flung areas.

It was observed that right lobe was involved in 88.9% of the patients whereas 26.7% of the patients had their left lobe involved by disease at their index presentation before undergoing any surgery for hepatic hydatid cyst. Most patients had large cyst involving more than one lobe, only 29.6% in recurrent group and 31.7% in non-recurrent group had single segment involvement, while rest had more than one segment involved by the disease. When anatomical location was analyzed, it was noted that recurrent group showed segment 8 and segment 7 involvement in 50% and 33.3% of the case respectively while non-recurrent group predominantly showed involvement of segment 5 (43.9%) and segment 6 (40.2%). It should be kept in mind that almost 70% of the patients had more than one segment involved. Segment 7 and 8 especially segment 8 were located deep in the rib cage close to the diaphragm making them difficult to access and thus making it difficult for perform curative surgery. On contrary segment 6 and segment 5 were easily accessible and performing surgery without spillage

and contamination is comparatively easy. This may be the reasons for observation made in the study. Most of the cysts were large in size with average size approximating 6 cm in largest diameter, there was no statistically significant difference noted in the two groups with respect to size of the cyst, unlike location of the cyst.



Figure 3: Post inactivation and evacuation, daughter vesicles are identified and removed

In most studies it is noted that spillage during removal of the cysts, incomplete excision of the endocyst, and type of surgical intervention are main factors reported in the literature for causing recurrence.^[14] Moreover, we observed that factors such as choice of incision and exogenous daughter cyst formation occurring in older cysts are also important in the development of recurrence. Maximum surgical care to avoid intra-abdominal contamination of the cystic contents during operative conservative interventions should be undertaken. The choice of incision should be good enough to achieve the best exposition in patients with long-standing, huge, multiple cysts, especially those located in the seventh or eighth segments of the liver.^[8] Moreover, we suggest the use of intraoperative US in long-standing patients so that any exophytic development or daughter cyst is not missed. Prospective studies should be done evaluating the use of intraoperative US and recurrence rates after laparoscopic conservative interventions.

Type 3 was the most common cyst presenting to our institute comprising 38.07% of all patients at their index presentation. This type was seen more common in recurrent group comprising 64.8% of the cases at index presentation, suggesting live and active cyst carries more risk of recurrence than dead and inactive cyst which would be obvious. Though it was also most common cyst in the non-recurrent group comprising 29.3% of the cases but was significantly less than 64.8% association in the recurrent group. Type 4 and type 5 cysts were inactive cyst and together they formed only 7.4% of the recurrent group as compared to 26.8% in the non-recurrent group suggesting that these cysts carry less potential for recurrence which is obvious as they seldom show activity, though radiological judgment can be wrong at times. Especially intra-operative finding of putty material with minimal daughter cyst are suggestive of inactive cyst especially in a calcified wall.

Preoperative therapy with albendazole sterilizes the cysts and reduces their tension, making surgery easier.^[15] As per observation in present study, preoperative use of albendazole was associated with a significantly decreased rate of cyst viability at the time of surgery, as was assessed by the motility of the scolices and their ability to exclude 5% eosin under immediate microscopy. These findings are correlated with the previous studies.^[16,17] Though in their study 8 weeks of pre-operative albendazole was recommended, our departmental protocol was to advise patient to take minimum of 3 weeks of preoperative albendazole 10mg/kg/day followed by surgery and latter with post-operative albendazole therapy which consist of 3 cycles of 3 weeks of therapy with a gap of 1 week between two cycles. Even though this regimen is shorter, compliance of patient was not always good. Only 9.3% of patients completed the pre-operative regimen in recurrent group while 29.3% did so in non-recurrent group. Compliance for post-operative albendazole therapy was better with one quarter (14 patients) of the patients completing the therapy in recurrent group and three quarter (120 patients) of the patient completing their therapy in non-recurrent group. Though compliance was not good in both the groups when analysis done comparing reurrent and non-recurrent it was evident that albendazole therapy was statistically better in non- recurrent group. These findings are comparable with the study conducted by Horton RJ.^[18]

Most common surgery performed at our department was cystectomy and the scolicial agent used is 10% polyvinylpyrrolidone iodine (Betadine) with contact time of 15 minutes. Intraoperative spillage was found to be significant risk factor for recurrence of hydatid cyst. Intra-operative needle puncture for confirmation of site and diagnosis before cyst aspiration was the most common time when spillage occurred. Biliary communication was seen in 18.3% of the patients may be due larger size cysts seen in current study, though we could not find any study to support our this observation (biliary communication with respect to size of cyst). Recurrent cases underwent surgery after 3 weeks of pre-operative albendazole therapy, which was followed by 3 cycles of 3 weeks of albendazole therapy. 48 of these patients underwent cystectomy while 2 underwent pericystectomy, rest 4 patients who had their cyst in left lateral sector underwent left lateral sectorectomy for recurrent hydatid cyst. All these patients were able to complete peri-operative albendazole therapy. Chemotherapy compliance was best due to proper counseling and upfront purchase of medications. Spillage was still seen in 9 patients, all had micro spillage at the time of aspiration of cyst. This spillage was prevented from contaminating general peritoneal cavity by drapes soaked in 10% betadine solution. Biliary communication was seen in 12 patients which was successfully treated with suture closer during surgery. None of the patients had post-operative complication requiring invasive management.

In present study we found that hepatic hydatid cyst is an important social problem in an endemic area like ours. Most of these patients were from far flung areas with poor socio-economic status and poor sanitation facilities. Most were in the occupation of animal husbandry or farming. As most of the cyst were asymptomatic or with minimal symptoms many present late with enormous size. When these patients were operated recurrence was a problem. We found that peri-operative chemotherapy with albendazole was effective in reducing recurrence but compliance was poor in our population. Highly infective stage of cyst – type 3 and type 2 should always be treated with adequate albendazole therapy pre-operatively. Inaccessible anatomical location especially segment 8 and segment 7 cyst needs better exposure and every efforts should be done to remove entire cyst and its contents. Intra-operative spillage was a significant risk factor and should be avoided. Use of scolicalid agents were advocated and they should be used with the knowledge of their contact time for the given concentration. To identify recurrence early regular follow up is required as most of them are asymptomatic. We didn't find routine serology test very effective in diagnosis recurrence. Ultrasonography is good investigation for follow up as it is cost effective, no radiation hazard, and an bedside investigation easy to repeat. For definitive diagnosis CT scan is good investigation to differentiate between residual cavity and recurrent hepatic hydatid cyst. Surgical management for recurrent hepatic hydatid cyst is same as that in the primary case. All precautions should be taken to prevent further recurrence.^[19,20]

CONCLUSION

Recurrent hepatic hydatid cyst is major health problem in endemic area adding to the morbidity of the patient. Factors responsible for recurrence are inadequate peri-operative chemotherapy, inaccessible location of the cyst, infective stage of the cyst and intra-operative spillage. ELISA alone is not effective in diagnosing recurrence early in the course of the disease. USG is good screening investigation but confirmation needs CT scan.

REFERENCES

1. Kulpati DD, Hagroo AA, Talukdar CK, Ray D. Hydatid Disease of Lung. *Indian J Chest Dis.* 1974; 16: 406–10.
2. Recep T, Sema O, Nuri S, Refik A, Ibrahim A, Hasan O, et al. Pulmonary Hydatid Cyst in Children. *Ann Med Sci.* 2000; 9: 59–62.
3. Altinok MT, Kilie S, Irsi AS, Alkan A, Baysal RT, Du IA. Hydatid Disease with Rare Localizations: A Case Report. *Medicin Inonu Univ.* 2002; 9: 210–3.
4. Safioleas M, Misiakos E, Manti C, et al. Diagnostic evaluation and surgical management of hydatid disease of the liver. *World J Surg* 1994; 18: 859-65.
5. Sielaff TD, Taylor B, Langer B. Recurrence of hydatid disease. *World J Surg.* 2001;25:83–6.
6. Kapan M, Kapan S, Goksoy E, et al. Postoperative recurrence in hepatic hydatid disease. *J Gastrointest Surg.* 2006;10:734–9.
7. Magistrelli P, Masetti R, Coppola R, Messia A, Nuzzo G, Picciocchi A. Surgical Treatment of Hydatid Disease of the Liver A 20 Year Experience. *Arch Surg.* 1991; 126(4): 518–22.
8. Pedrosa I, Saiz A, Arrazola F, et al. Hydatid disease: radiologic and pathologic features and complications. *Radiographics* 2000; 20:795–817.
9. Sozuer E, Akyuz M, Akbulut S. Open surgery for hepatic hydatid disease. *Int Surg.* 2014;99(6):764-9.
10. Gharbi HA, Hassine W, Brauner MW, et al. Ultrasound examination of the hydatid liver. *Radiology* 1981; 139: 459-63.
11. Sachar S, Goyal S, Goyal S, Sangwan S. Uncommon locations and presentations of hydatid cyst. *Ann Med Health Sci Res.* 2014;4(3):447-52.
12. Joshi U, Subedi R, Jayswal A, Agrawal V. Clinical Characteristics and Management of the Hydatid Cyst of the Liver: A Study from a Tertiary Care Center in Nepal", *Journal of Parasitology Research*, vol. 2020, Article ID 8867744, 7 pages, 2020. <https://doi.org/10.1155/2020/8867744>.
13. Kapan M, Kapan S, Goksoy E, et al. Postoperative recurrence in hepatic hydatid disease. *J Gastrointest Surg.* 2006; 10:734–9.
14. Velasco-Tirado V, Romero-Alegría Á, Belhassen-García M, Alonso-Sardón M, Esteban-Velasco C, López-Bernús A, Carpio-Perez A, Jimenez López MF, Muñoz Bellido JL, Muro A, Cordero-Sanchez M, Pardo-Lledias J, Muñoz-Bellvis L. Recurrence of cystic echinococcosis in an endemic area: a retrospective study. *BMC Infect Dis.* 2017;17(1):455.
15. Morris DL, Chinnery JB, Dykes PW, et al. Penetration of albendazole sulphoxide into hydatid cyst. *Gut* 1987; 28:75–80.
17. Arif SH, Shams-Ul-Bari, Wani NA, Zargar SA, Wani MA, Tabassum R, Hussain Z, Baba AA, Lone RA. Albendazole as an adjuvant to the standard surgical management of hydatid cyst liver. *Int J Surg.* 2008;6(6):448-51.
18. Shams-Ul-Bari NA, Arif SH, Malik AA, Khaja AR, Dass TA, Naikoo ZA. Role of albendazole in the management of hydatid cyst liver. *Saudi J Gastroenterol.* 2011;17:343–347.
19. Horton RJ. Chemotherapy of Echinococcus infection in man with albendazole.
20. *Trans R Soc Trop Med Hyg* 1989;83:97–102.