

Treatment of congenital liver cysts.

A surgical technique tailored through a 35-year experience



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Treatment of congenital liver cyst. A surgical technique tailored through a 35-year experience

BACKGROUND: *The most important aims of the treatment of CLC are long-term relief of symptoms and elimination of cysts. Treatment of choice is yet debated.*

METHODS: *Data of patients treated for CLC during a 35-years experience were retrospectively analyzed. Variables analyzed were: age, sex, hepatic cyst location, cyst diameter, symptoms, surgical procedure, short and long-term outcomes.*

RESULTS: *We examined 49 consecutive patients treated for CLC (mean follow-up, 76 months). The study was divided into two periods: 1975-1999 and 2000-2010. Procedures performed in the first period were needle aspiration and sclerotherapy (n= 6), hepatic resections (9), cystojejunostomy (4), open unroofing (10), and laparoscopic unroofing (8). Omentopexy within the residual cystic cavity was associated with seven open and two laparoscopic unroofing cases. Rates of morbidity and recurrence were 23.5% and 44.1%, respectively. One patient died in the peri-operative period. Procedures performed in the second period were open unroofing (9), laparoscopic unroofing (5), and hepatic resection (1). Omentopexy was associated with all open procedures and two laparoscopic procedures. Overall morbidity in this group was 16.6%, and recurrence occurred in one patient (6.7%).*

CONCLUSIONS: *Cyst unroofing and omentopexy is a safe and highly effective procedure for the treatment of CLC. Laparoscopy is confirmed as the procedure of choice except for cases in which the cysts are in the posterior right liver, where a wide mobilization of the liver is necessary.*

KEY WORDS: Congenital liver cyst, Laparoscopic unroofing, Omentopexy, Surgical treatment.

Introduction

Congenital liver cyst (CLC) is a congenital benign malformation. Determining the precise incidence of this condition is difficult; reports range from 0.10% to 4.7% according to autopsy, surgical, and ultrasonographic series^{1,2}. These cysts are considered to arise from the aberrant

development of intrahepatic biliary radicals that due to the loss of continuity with the biliary tree undergo progressive dilation³. So, these cysts are not in continuity with the biliary tract and do not contain bile⁴. They are lined by a single layer of cuboidal or columnar epithelium resembling that of bile ducts^{5,6}. Intracystic secretion from the epithelium lining is active and this explains the possibility of gradual increase in cyst size.⁷ The natural history of CLC, even of large cysts, is usually silent⁸⁻¹⁰ and cysts are detected incidentally on radiologic imaging^{3,11}, and most of these patients do not require any treatment¹². However in about 16% large cysts become symptomatic because of complications such as intracystic hemorrhage and bile spilling, rupture, torsion, infection, or compression on adjacent structures^{13,14}. Treatment in these cases is requested^{10,15}.

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Various forms of treatment have been proposed, including conservative procedures such as percutaneous aspiration, with or without alcohol injection ^{16,17} and surgery. This commonly involves fenestration or unroofing of the cyst ^{3,18}. The rate of recurrence following this approach has been reported to vary from 29% to 47% when using the open and the laparoscopic approach respectively ⁸. The location of the cyst, incomplete deroofing techniques, and the persistence of secreting epithelium in the residual cystic cavity have been considered predictors for recurrence ¹⁴. The purpose of this study was to evaluate the results of our series following different treatments.

Patients and Methods

Patients who required surgical treatment for various hepatic lesions were identified by means of a computer-based indexing system containing data for all patients undergoing surgery for hepatic growths at the First Department of Surgery, Sapienza Medical School of Rome, Italy.

Patients with histologically proven CLC were recruited for this study and their medical records were analyzed retrospectively. The details of procedures adopted were abstracted from clinical charts of the original hospital referral. Variables considered for analysis were age, sex, hepatic cyst location, diameter of cyst, symptoms, surgical procedure, postoperative morbidity and mortality, length of postoperative hospital stay, and long-term outcomes. Current series has been divided into two groups: Group A (January 1975-January 1999) and Group B (January 2000- January 2010). Procedures adopted in the first period are needle aspiration, marsupialization, cystojejunectomy, cystectomy, open (OU) and laparoscopic (LU) unroofing with or without omentopexy, and liver resection (LR). In the second period, OU and LU with or without omentopexy, and LR were the approaches preferred. LU was always performed with harmonic scalpel. A rubber or silicon tube drainage was positioned in all surgically treated cases next the residual cavity. The diagnosis of congenital cyst was routinely confirmed by frozen and final pathological examinations. Patients underwent a follow-up including clinical examination, biochemical tests for liver function and cholestasis, and radiological examinations, including ultrasound computed tomography or magnetic resonance when available. The reappearance of fluid collection at the site of the excised cyst was defined as recurrence. Asymptomatic recurrences were followed whereas symptomatic patients underwent secondary surgery.

Results

From January 1975 to January 2010, 49 cases of symptomatic congenital liver cysts that required surgical intervention were observed at our Institution. During the

study period, 21 other patients treated for multicystic liver disease were excluded from present study. All surgical procedures were performed by the same surgeon (A.T.) Patients data, site of lesion, procedures performed, and recurrences rates in the two periods are listed in Tables I-II-III. There was a female predominance (37 *vs* 12) and the mean age was 43 years (range, 16 - 67). Upper quadrant abdominal pain was the most frequent symptom at hospital entry. In two cases the specificity of cyst-related abdominal pain, because doubtful, was assessed with percutaneous cyst aspiration followed by

TABLE I - Demographic and clinical data of Group A patients (1975-1999).

Age (yr)	42.2±10.6 (16-61)
Gender	
Male	8
Female	26
Cyst location	
Right lobe	26
Left lobe	8
Cyst diameter (cm)	15±4.2 (7-28)
Symptoms	
Abdominal pain	23
Fullness	12
Nausea	5
Vomiting	4
Early satiety	13
Fatigue	7
Dyspnea	3
Surgical procedures	
Hepatic resections	9
Cystectomy	10
Cystojejunostomy	4
Open deroofing (omentopexy)	10(7)
Laparoscopic deroofing (omentopexy)	8(2)
Needle aspiration	6
Operative time (min)	
Hepatic resection	172±17 (160-180)
Cystectomy	142±27 (115-180)
Cystojejunostomy	162±45 (10-220)
Open deroofing	89±21 (55-120)
Laparoscopic deroofing	78±20 (55-110)
Needle aspiration	71±20 (45-95)
Blood unit transfused	0.8±0.7 (0-2)
Morbidity	8 pts (23.5%)
Mortality	1 pt (2.9%)
Postoperative length of stay (days)	
Open surgery	9.6±4 (8-21)
Laparoscopic surgery	6±5 (3-14)
Follow up (months)	50±16 (14-92)

TABLE II - Demographic and clinical data of Group B patients (2000-2010).

Age (yr)	44.6±9.7 (21-67)
Gender	
Male	4
Female	11
Cyst location	
Right lobe	10
Left lobe	5
Cyst diameter (cm)	17±5.1 (8-31)
Symptoms	
Abdominal pain	10
Fullness	5
Nausea	2
Vomiting	1
Early satiety	3
Fatigue	2
Dyspnea	1
Surgical procedures	
Hepatic resections	1
Open deroofting (+ omentopexy)	9(9)
VLA deroofting (+ omentopexy)	5(3)
Operative time (min)	
Hepatic resection	168±13 (152-186)
Open deroofting	92±19 (51-131)
Laparoscopic deroofting	84±16 (53-106)
Blood unit transfused	0.3±0.5 (0-2)
Morbidity	2 pts (16.%)
Mortality	0 pt (0.00%)
Postoperative length of stay (days)	
Open surgery	8.6±3 (8-20)
Laparoscopic surgery	5±4 (3-12)
Follow up (months)	48±14 (12-90)

resolution of pain. Ten patients had undergone previous treatment for their cysts. All patients had a single cyst located in the right (n=36) or in the left lobe (n=13). The mean size of the cyst was 16 cm (range 7-31). Preoperative liver work-up included ultrasonography and computed tomography when available. Magnetic resonance was performed in 21 patients. Omentopexy was associated with cyst unroofing in 9 patients of Group A, and in 12 patients of Group B. The mean postoperative stay was 9.1 days for patients undergoing open procedures and 5.7 days in patients treated with a laparoscopic approach. Five patients underwent associated cholecistectomy; three during open procedures and two during a laparoscopic approach. One death occurred during the hospital stay in group A. Sixteen patients experienced morbidity: 14 (41.1%) in group A and 2

TABLE III - Recurrences.

Procedures	Group A (1975 - 99) 34 patients		Group B (1999-2010) 15 patients	
	Nr	Recurrences	Nr	Recurrences
Deroofing open	47	15 (44.1%)	15	1 (0.6%)
Deroofing open + omentopexy	3	3 (100%)	-	-
Deroofing VLA	7	0 (0.0%)	9	0 (0.0%)
Deroofing VLA + omentopexy	6	2 (33%)	2	1 (50%)
Needle aspiration	2	0 (0.0%)	3	0 (0.0%)
Cystojejunostomy	6	6 (100%)	-	-
Cystectomy	4	0 (0.0%)	-	-
Hepatic resection	10	4 (40%)	-	-
	9	0 (0.0%)	1	0 (0.0%)

(13.3%) in group B. Complete follow-up was achieved in all patients. The mean clinical follow up period was 76 months (range 12-216). Recurrences occurred in 44.1% in Group A and in 0.6% in Group B.

Discussion

CLC are commonly encountered in clinical practice but the large majority of them being asymptomatic do not require any treatment^{9,13}. Possibly because of this low number requiring treatment, uniform management of CLC has not been clearly defined and a number of interventional and surgical options have been proposed also depending on individual expertise in liver surgery and on the evolution of technology. Current series refers to a 35-year experience on the treatment of CLC of a single surgeon (AT) developed at a single Institution. The variability of surgical techniques adopted in the first part of current experience reflects paucity of personal and general experience in the treatment of CLC at that time. Marsupialization, external drainage, total cystectomy and cystojejunostomy were all attempts to borrow surgical techniques which we used at that time in our Institution for the treatment of parasitic cysts. All patients treated with marsupialization and external drainage experienced a troublesome postoperative course and short term recurrences. Three cystoenteric anastomoses were performed in three patients with bile stained fluid complicated cysts, previously treated with repeated percutaneous instillation of sclerosing agents. Main complications, namely severe recurrent cholangitis, described in literature occurred in all cases^{14,19}. In one of these patient an hepatic resection was necessary one year after the cystoenteric anastomosis, because of the development of a liver abscess. Total cystectomy has been evidenced as the first choice approach in the treatment of parasitic cyst²⁰. However, the pericyst and the cleavage plane between the pericyst and the hepatic parenchyma have been unquestionably defined as the bases of feasibility of this procedure²¹. Which is not the case for uncomplicated congenital cysts where there is no pericyst and no appreciable cleavage plane distinguishes the ultrathin remnant cystic wall from

the cyst-bearing liver tissue. Excision of a simple cyst wall can be tedious and increase risk of biliary or vascular injury and likely should be avoided. Among the 10 patients in our series who underwent total cystectomy, 6 procedures were performed on cysts where a consistent cystic membrane had been induced by previous repeated treatments with sclerosing agents. The presence of this newly formed membrane eased the removal of the residual cyst wall even if a tedious bleeding hindered the procedure all the time. However, no recurrence was observed in these patients. In the remnant 4 patients, cystectomy was attempted as primary treatment and recurrence occurred, even if delayed, in all cases. All these surgical procedures tested in the first period of current experience were abandoned because all of them proved unsuitable for the effective treatment of CLC.

Development of imaging and its application to the therapeutic field has led to the proposal of percutaneous aspiration with or without instillation of sclerosing agents as a procedure to treat CLC²²⁻²⁴. Though effective in immediate palliation of symptoms, percutaneous aspiration has resulted in our experience, in agreement with that of other Authors²⁴⁻²⁶, associated with high rates of recurrences even in cases where the procedure had been associated with instillation of sclerosing agents.

Furthermore, instillation of sclerosing agents should be looked at with due caution because it may lead to irreversible sclerosing cholangitis in case of the presence of possible, undetected communication with the biliary system^{7,16}. Ten LR were performed in the present series, most of them in the first period: 2 as primary treatment of very large cysts completely substituting the hepatic parenchyma of the left lobe and 7 as secondary treatment of recurring, complicated cysts. Only one LR was performed in the second period in a patient with a giant cyst substituting the right liver (Fig. 1). No atypical resection was performed.

No recurrence was observed in these patients. However, even if it has proven a safe procedure for benign cystic disease²⁷, we consider LR too aggressive for the routinely treatment of CLC.

First described by Lin²⁸, a technique of fenestration of the cyst wall rapidly grew in surgeons' consideration²⁹⁻³¹. However, downside of this approach such as intraoperative bleeding and biliary fistula and high incidence of recurrence have been reported^{32,33}. We have started the use of cyst fenestration since the first period of our experience. However when analyzing the results of this procedure, a high rate of recurrences were detected; most of them following fenestration of cysts sited in the right posterior lobe. Because of difficult access and poor visualization, only a very limited, insufficient fenestration of the cyst wall had been performed in these patients. We postulate that the high recurrence rate may be due to the early formation of adhesions between the diaphragm, the anterior parietal wall and the limbs of the remnant cystic wall, refilling the cyst. Paralleling the development



Fig. 1: A giant cyst substituting the right hepatic liver.

of liver surgery, simple fenestration was, progressively, set aside in favor of a, however, wide unroofing of the cyst wall extended at the parenchymal border, also in ill sited cysts, after extensive liver mobilization had been achieved. To attempt the further improve of the efficacy of this procedure we begun, since the mid 80's to combine wide unroofing with an omental transposition flap. This on the the assumption that the omentum acts in keeping the cyst cavity open to the abdomen and is competent itself to resorb fluid which is produced by cystic endothelium^{19,34,35}. The greater omentum was prepared from the transverse colon and inserted as an omental flap into the cyst cavity. The flap was secured at the residual cystic border with several 2/0 absorbable suture. Destruction of the endothelium of the cyst cavity by ablation with the use of argon beam coagulation (ABC) has been proposed^{36,37}. We have resort to ABC in few cases, causing in one a severe bleeding from a major branch of the right hepatic vein. Because there is no available evidence that ABC will decrease recurrence rates and because of potential risks connected with the uncertain, variable depth of thermal injury^{19,38}, we have stopped to treat the internal cyst wall with ABC. Laparoscopic approach for the unroofing of hepatic cysts has been first introduced in 1991³⁹⁻⁴¹ and then advocated by many groups with the promise of an equivalent symptom relief to open procedure, reduced postoperative morbidity, shorter hospital stay and quicker recovery⁴²⁻⁴⁷.

Since 1994 we have introduced this mini invasive approach to treat CLC. However, since the adoption of laparoscopy should not change the indications and targets of open surgery, minim invasive approach should be renounced whenever it interferes with any of the steps identified as fundamental for the successful outcome of

the open procedure. Therefore, we have excluded from the laparoscopic approach large or deep-sited cysts, centrally or posteriorly located in the right part of the liver. In agreement with other authors^{13,34,38,44}, we consider small, superficial, peripheral cysts, located in the segments II and III or in anterior part of segments IV, V and VI the best indication for laparoscopy. A reduction in hospital stay and postoperative morbidity is seen in the present selected series in favour of laparoscopic procedure when compared to open procedures. Results following LU with omentopexy do not differ from those observed after OU whether adequate selection of patients, on the basis of their cyst location, is performed. Despite the safety and ease of LU, careful selection of patients is necessary if acceptable long-term results are to be obtained with this procedure. The most important aim of the treatment of CLC is long-term success with respect to relief of symptoms and elimination of cysts. The association of extensive cyst unroofing and omentopexy, has resulted dramatically effective in achieving all of these targets. A clear decrease of postoperative complications and recurrences is observed in the second group where OU and LU with omentopexy were the procedures most exclusively adopted. Furthermore, whether the negligible number of recurrences following the unroofing procedure associated with omentopexy, performed in the first period, were subtracted, the overall recurrence rate of group A would reach 60%.

Conclusion

The results of our study, even if referred to a small number of patients and thus in need of further confirmation, indicate unroofing associated with omentopexy as a safe and highly effective treatment of uncomplicated CLC. Laparoscopy has confirmed a safe approach to turn to, presently, only in case of favorable sited cysts where the completeness of the procedures does not need extensive liver mobilization. Technologic advances may overcome present laparoscopic difficulties, such adequate liver exposure and vascular control, and consequent contraindications to its use.

Riassunto

INTRODUZIONE: L'obiettivo principale del trattamento delle cisti congenite del fegato (CLC) è rappresentato dalla eradicazione delle cisti o quantomeno dalla risoluzione dei sintomi da esse derivati. Le modalità di trattamento chirurgico attualmente proposte sono ancora dibattute.

METODO: I dati relativi ai pazienti trattati per CLC durante 35 anni di esperienza sono stati retrospettivamente analizzati, suddividendo il periodo di studio in due parti a partire dal 1975 al 1999 e dal 2000 al 2009,

rispettivamente. Tra i dati clinici analizzati sono stati considerati l'età e il sesso dei pazienti, la localizzazione e dimensione delle cisti, i sintomi correlati alla patologia, le procedure chirurgiche eseguite ed i risultati a breve e lungo termine.

RISULTATI: Sono stati esaminati 49 consecutivi casi di pazienti trattati per CLC (follow-up medio di 76 mesi). Le procedure eseguite durante il primo periodo hanno compreso ago-spirazione con scleroterapia delle cisti (6), resezioni epatiche (9), cistodigünostomie (4), decapitazioni aperte (10) e laparoscopiche (8). In 9 dei pazienti trattati mediante decapitazione delle cisti (7 aperte, 2 laparoscopiche) è stata eseguita l'omentoplastica della cavità cistica residua. I ratei di morbidità e recidiva sono risultati del 23.5% e 44.1%, rispettivamente. È stato osservato un solo caso di mortalità peri-operatoria.

Le procedure eseguite durante il second periodo sono state rappresentate da una resezione epatica e 14 decapitazioni (9 aperte, 5 laparoscopiche). L'omentopexy è stata eseguita in tutti i casi di decapitazione aperta e in due casi di decapitazione laparoscopica. La morbidità è risultata del 16.6% con evidenza di recidiva in un solo paziente (6.7%).

CONCLUSIONI: La decapitazione delle cisti associate ad omentoplastica del cavo residuo rappresenta un sicuro ed efficace trattamento nel caso di CLC. L'approccio laparoscopico rappresenta la metodica di scelta ad eccezione dei casi in cui le cisti abbiano sede posteriore destra e che richiedano ampie mobilizzazioni del fegato.

References

1. Gaines PA, Samson MA: *The prevalence and characterization of simple hepatic cysts by ultrasound examination*. Br J Radiol, 1989; 62:335-37.
2. Caremani M, Vincenti A, Benci A, Sassoli S, Tacconi D: *Ecographic epidemiology of nonparasitic hepatic cysts*. J Clin ultrasound, 1993; 21:115-18.
3. Farges O: *Patologia cistica del fegato*. In: Di Carlo I: *Chirurgia epatica*. Torino: Minerva Medica, 2007; 69-77.
4. Sherlock S: *Diseases of the liver and biliary system*. 8th ed. Oxford: Blackwell Scientific Publ, 1989; 633-54.
5. Cowles RA, Milholland MW: *Solitary hepatic cysts*. J Am Coll Surg, 2000; 191:311-21.
6. Kew MC: *Hepatic tumors and cysts*. In: Feldman M, Scharschmidt BF, Sleisenger MH: *Gastrointestinal and Liver Disease*. Philadelphia, PA: Saunders WB, 1998; 1381-382.
7. Lai ECS, Wong J: *Symptomatic non-parasitic cysts of the liver*. World J Surg, 1990; 14:452-55.
8. Gigot JF, Legrand M, Hubens G, de Canniere L, Winin E, Deweer F, Druart ML, Bertrand C, Devriendt H, Droissart R, Tugilimana M, Hauters P, Vereecken L: *Laparoscopic treatment of nonparasitic liver cysts: Adequate selection of patients and surgical technique*. World J Surg, 1996; 20:556-61.

9. Tan YM, Chung A, Mack P, Chow P, Khin LW, Ooi LL: *Role of fenestration and resection for symptomatic solitary liver cysts*. *Anz J Surg*, 2005; 75:577-80.
10. Sanfelippo PM, Beahrs OH, Weiland LH: *Cystic disease of the liver*. *Ann Surg*, 1974; 179:922-25.
11. Marvik R, Myrvold HE, Johnsen G, Roysland P: *Laparoscopic ultrasonography and treatment of hepatic cysts*. *Surg Laparosc Endosc*, 1993; 3:172-74.
12. Gigot JF, Metairie S, Etienne J, Horsmans Y, van Beers BE, Sempoux C, Deprez P, Materne R, Geubel A, Glineur D, Gianello P: *The surgical management of congenital liver cysts*. *Surg Endosc*, 2001; 15:357-63.
13. Gogot JF, Hubert C, Banice R, Kendrick ML. *Laparoscopic management of benign liver diseases: Where are we?* *HPB*, 2004; 6(4):197-212.
14. Kwon AH, Matsui Y, Inui H, Imamura A, Kamiyama Y: *Laparoscopic treatment using an argon beam coagulator for nonparasitic liver cysts*. *Am J Surg*, 2003; 185(3):273-77.
15. Lai ECS, Wong J: *Symptomatic nonparasitic cysts of the liver*. *World J Surg*, 1990; 14:452-56.
16. Montorsi M, Torzilli G, Fumagalli U, Bona S, Rosati R, De Simone M, Rovati V, Mosca F, Filice C: *Percutaneous alcohol sclerotherapy of simple hepatic cysts: Results from a multicentre survey in Italy*. *Hepatobil Surg*, 1994; 8:89-94.
17. Tikkakoski T, Makela JR, Leinonen S, Paivansalo M, Merikano J, Karttunen A, Siniluoto T, Kairaluoma MI: *Treatment of symptomatic congenital hepatic cysts with single-session percutaneous drainage and ethanol sclerosis: technique and outcome*. *JVIR*, 1996; 7:235-39.
18. Belcher HV, Hull HC: *Nonparasitic cysts of the liver: report of three cases*. *Surgery*, 1969; 65:427-31.
19. Longmire WP, Trout HH, Greenfield J, Tompkins RK: *Elective hepatic surgery*. *Ann Surg*, 1974; 179:712-21.
20. Tocchi A, Mazzone G, Costa G, Cassini D, Bettelli E, Agostini N, Miccini M: *Symptomatic nonparasitic hepatic cysts*. *Arch Surg*, 2002; 137(2):154-58.
21. Tagliacozzo S: *Chirurgia dell'epatidiosi epatica*. Roma: EMSI, 1997; 7-9 and 111-27.
22. Kairaluoma MI, Leinonen A, Stahlberg M: *Percutaneous aspiration and alcohol sclerotherapy for symptomatic hepatic cysts. An alternative to surgical intervention*. *Ann Surg*, 1989; 210:208-15.
23. Roemer CE, Ferrucci JT, Mueller PR, Simeone JF, VanSonnenberg E, Wittenberg J: *Hepatic cysts: Diagnosis and therapy by sonographic needle aspiration*. *AJR*, 1981; 136:1065.
24. Saini S, Mueller PR, Ferrucci JT, Simeone JF, Wittenberg J, Butch RL: *Percutaneous aspiration of hepatic cysts does not provide definitive therapy*. *AJR*, 1983; 141:559-60.
25. Hansman MF, Ryan JA, Holmes JH: *Management and long-term follow up of hepatic cysts*. *Am J Surg*, 2001; 181:404-10.
26. Chouillard E, Gumbs A, Fangio P, Torcivia A, tayar C, Laurent A, Dache A, Lacherade JC, Tran Van Nhieu J, Cherqui D: *Liver resection for cystic lesions: A 15-years experience*. *Minerva Chir*, 2010; 65(5):495-506.
27. Iwatsuki S, Todo S, Starzi TE: *Excisional therapy for benign hepatic lesions*. *Surg Gynecol Obstet*, 1990; 171:240-46.
28. Lin TY, Chen CC, Wang SM: *Treatment of non-parasitic cystic disease of the liver: A new approach to therapy with polycystic liver*. *Ann Surg*, 1968; 168:921.
29. Wellwood JM, Madara JL, Cady B, Haggitt RC: *Large intra-hepatic cysts and pseudocysts: Pitfalls in diagnosis and treatment*. *Am J Surg*, 1978; 135:57.
30. Farges O, Bismuth H: *Fenestration in the management of polycystic liver disease*. *World J Surg*, 1995; 19:25-30.
31. Henne-Bruns D, Kiomp HJ, Kremer B: *Non-parasitic liver cysts and polycystic liver disease: Results of surgical treatment*. *Hepatogastroenterology*, 1993; 40:1-5.
32. Litwin DEM, Taylor BR, Greig P, Langer B: *Nonparasitic cysts of the liver: the case for conservative surgical management*. *Ann Surg*, 1987; 205:45.
33. Martin IJ, Mckinley AJ, Currie EJ, Holmes P, Garden OJ: *Tailoring the management of nonparasitic liver cysts*. *Ann Surg*, 1998; 228:167-72.
34. Gloor B, Ly Q, Candinas D: *Role of laparoscopy in hepatic cyst surgery*. *Dig Surg*, 2002; 19:494-99.
35. Collins D, Hogan AM, O'Shea D, Winter DC. *The omentum: anatomical, metabolic, and surgical aspects*. *J Gastrointest Surg*, 2009; 13:1138-146.
36. Daniell J, Fisher B, Alexander W: *Laparoscopic evaluation of the argon beam coagulator. Initial report*. *J Reprod Med*, 1993; 38:121-25.
37. Go PM, Goodman GR, BruhnEW, Hunter JG: *The argon beam coagulator provides rapid hemostasis of experimental hepatic and splenic hemorrhage in anticoagulated dogs*. *J Trauma*, 1991; 31:1294-300.
38. Gambling TC, Holloway SE, Heckman JT, Geller DA: *Laparoscopic resection of benign hepatic cysts: A new standard*. *J Am Coll Surg*, 2008; 207(5):731-76.
39. Z'graggen K, Metzger A, Klaiber C: *Symptomatic simple cyst of the liver: treatment by laparoscopic surgery*. *Surg Endosc*, 1991; 5:224-25.
40. Fabiani P, Katkouda N, Jovin L: *Laparoscopic fenestration of biliary cysts*. *Surg Laparosc Endosc*, 1991; 1:162-65.
41. Paterson-Brown S, Garden OJ: *Laser-assisted laparoscopic of liver cyst*. *Br J Surg*, 1991; 78:1047.
42. Kathkouda N, Mavor E.: *Laparoscopic management of benign liver disease*. *Surg Clin North Am*, 2000; 80:1203-211.
43. Tagaya N, Nemoto T, Kubota K: *Long-term results of laparoscopic unroofing of symptomatic solitary nonparasitic hepatic cysts*. *Surg Laparosc Endosc Percutan Tech*, 2003; 13(2):76-79.
44. Krahenbuhl L, Baer HU, Renzulli P, Z'graggen K, Frei E, Buchler MW: *Laparoscopic management of nonparasitic symptom-producing solitary hepatic cysts*. *J Am Coll Surg*, 1996; 183:493-98.
45. Morino M, De Giulio M, Festa V, Garrone C: *Laparoscopic management of symptomatic nonparasitic cysts of the liver*. *Ann Surg*, 1994; 219(2):157-64.
46. Cappellani A, Zanghi A, Di Vita M, Menzo EL, Conti P: *Nonparasitic cysts of the liver: Laparoscopic treatment and long-term results*. *Ann Ital Chir*, 2002; 73(1):85-88.
47. Mazza OM, Fernandez DL, Pekoly J, Pfaffen G, Claria RS, Molmenti E, de Santibanes E: *Management of nonparasitic hepatic cysts*. *J Am Coll Surg*, 2009; 209(6):733-39.