



CLINICAL AND ECONOMIC OUTCOMES OF LAPAROSCOPIC VERSUS OPEN SURGERY IN THE TREATMENT OF HEPATIC HYDATID CYST

RESULTADOS CLÍNICOS Y ECONÓMICOS DE LA CIRUGÍA LAPAROSCÓPICA VERSUS ABIERTA EN EL TRATAMIENTO DEL QUISTE HIDATÍDICO HEPÁTICO

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ABSTRACT

Introduction: Peru has a high rate of hydatid cyst, however, there are no studies on surgical techniques.

Objective: To compare the clinical and economic results of laparoscopic surgery and open surgery in the treatment of liver hydatid cyst. **Methods:** Analytical and cross-sectional study. The medical records of all adult patients with hepatic hydatid cyst operated by open and laparoscopic partial cystectomy from January 2013 to December 2015 were reviewed. Morbidity, mortality, recurrence, operating time, hospital stay, pain, postoperative Medical rest, and costs were evaluated and compared. **Results:** 22 patients underwent open partial cystectomy (Group 1) and 13 laparoscopies (Group 2). There were no differences in operating times or surgical complications, with postoperative morbidity 27.3% (Group 1) and 30.7% (Group 2). The conversion rate was 18.7%. There were no cases of in-hospital mortality and one case of recurrence (4.5%) after open surgery. No significant differences were found between intraoperative, postoperative, and total cost. Although the average total cost was lower for laparoscopic surgery (1700.99 ± 1195.82 USD for open surgery and 1561.83 ± 702.53 USD for laparoscopic surgery) there were no significant differences (p = 0.64). There was less postoperative pain, shorter hospital stay, and shorter duration of medical rest for laparoscopy (p<0.05). **Conclusion:** Clinical and economic outcomes were similar; however, there was less postoperative pain, hospital stay, and faster reintegration into work with laparoscopic surgery.

Key words: Echinococcosis hepatic; Laparoscopy; Health care costs; Postoperative period (source: MeSH NLM).

RESUMEN

Introducción: Nuestro país tiene una alta tasa de prevalencia de quiste hidatídico. El presente estudio fue realizado en un centro de referencia nacional y es el primer estudio peruano en comparar los resultados clínicos y económicos de las técnicas quirúrgicas para el tratamiento de esta enfermedad.

Objetivo: Comparar los resultados clínicos y económicos de la cirugía laparoscópica y la cirugía abierta en el tratamiento del quiste hidatídico hepático. **Métodos:** Estudio analítico y transversal. Se revisaron las historias clínicas de todos los pacientes adultos con quiste hidatídico hepático operados de quistectomía parcial abierta y laparoscópica desde enero del 2013 a diciembre del 2015. Se evaluaron y compararon morbilidad, mortalidad, recurrencia, tiempo operatorio, estancia hospitalaria, dolor, descanso médico postoperatorio y costos. **Resultados:** 22 pacientes fueron operados de quistectomía parcial abierta (grupo 1) y 13 por laparoscopia (grupo 2). No hubo diferencias en los tiempos operatorios, ni en las complicaciones quirúrgicas, siendo la morbilidad postoperatoria 27,3% (grupo 1) y 30,7% (grupo 2). La tasa de conversión fue de 18,7%. No hubo casos de mortalidad intrahospitalaria y un caso de recurrencia (4,5%) postcirugía abierta. No se encontraron diferencias significativas entre el costo intraoperatorio, postoperatorio y total. Si bien el costo total promedio fue menor para la cirugía laparoscópica (1 700,99 ± 1 195,82 USD para la abierta y 1 561,83 ± 702,53 USD para la laparoscópica) no tuvo diferencias significativas (p=0,64). Hubo menor dolor postoperatorio, menor estancia hospitalaria y menor duración del descanso médico para la laparoscópica (p<0,05). **Conclusión:** Los resultados clínicos y económicos fueron similares; sin embargo, hubo menor dolor post-operatorio, estancia hospitalaria y más rápida reinserción laboral con cirugía laparoscópica.

Palabras clave: Equinococosis hepática; Laparoscopia; Costos de la atención en salud; Período posoperatorio (fuente: DeCS BIREME).

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INTRODUCTION

Hydatid cyst is a chronic, zoonotic, and parasitic infectious disease caused by *Echinococcus granulosus*. The highest prevalence of hydatidosis in humans and animals is found in the Mediterranean region of Europe, regions of central and southern Russia, central Asia, China, Australia, South America, and North and East Africa⁽¹⁾. Peru today is probably the country in South American with the highest incidence and prevalence of cystic echinococcosis, with rates of up to 79 per 100,000 are found in Pasco and 39 per 100,000 in Huancavelica⁽²⁾; while in Chíncha (south of Lima) it has a surgical incidence of 32 per 100,000 during 1996-1998⁽³⁾.

70% of hydatid cysts are located in the liver, 25% in the lungs, and 5-10% in other locations⁽⁴⁾. Treatment options depending on the type and size of the cyst are medical treatment, surgery, and percutaneous drainage (PAIR: puncture-aspiration-injection-reaspiration). Surgical treatment is the fundamental pillar in the management of the hepatic hydatid cyst^(5,6) and could be conservative or radical. Partial cystectomy is conservative surgery, while total pericystectomy and liver resection are radical treatments.

After the first laparoscopic cystectomy of hydatid disease of the liver reported by Katkhouda N, et al in 1992⁽⁷⁾, there was little acceptance in the world due to the risk of recurrence, cyst rupture with subsequent dissemination in the abdominal cavity and anaphylactic shock. Recently, these myths were dropped based on research and improvements in the learning curve in laparoscopic and hepatobiliary surgery. However, since then there have been only two meta-analyses^(18,21) without any randomized studies. They include few publications of retrospective case series that compare open versus laparoscopic surgery in the treatment of hepatic hydatid cyst, but none compared the costs between both types of surgeries. South America has one of the highest prevalence rates of this disease that causes great economic losses and no national or international study compares the real costs of both types of treatments. The objective of this study is to compare the clinical and economic outcomes between both surgical techniques for the treatment of liver hydatid cyst.

METHODS

Design and setting

A retrospective, analytical and cross-sectional study

was concluded on all adult patients undergoing open and laparoscopic partial cystectomy for liver hydatid cyst from January 2013 to December 2015 at the Servicio de Cirugía de hígado y vías biliares del Hospital Nacional Edgardo Rebagliati Martins.

Population and sample

During the study period, the statistical office of the hospital had a population of 61 patients diagnosed with liver hydatid cyst. The type of sampling was a census. The medical records of all these patients were reviewed, to select adult patients with pathological confirmation of hydatid cyst, excluding other types of cysts and thus standardize criteria and avoid bias in the study. Inclusion and exclusion criteria were taken into account.

The inclusion criteria were as follows: a patient who underwent hepatic partial cystectomy by open or laparoscopic surgery, older than 14 years old, with confirmation of the disease by intraoperative findings and pathological anatomy, and access to the entire medical history. Cases of recurrence and a history of previous liver surgeries were excluded from the study.

Of the 61 patients diagnosed with hepatic hydatid cyst discharge from the hospital's statistical database, 23 patients were excluded for the following reasons: Cystadenocarcinoma (1 patient), cysts from other locations (4 patients), simple hepatic cyst (10 patients), previous liver recurrences and surgeries (5 patients) and incomplete medical history (3 patients). Of the 38 patients who met the inclusion criteria, 3 patients who started as laparoscopic surgery and were converted to open surgery due to pelvic adhesions and a posterior location of the cyst, to avoid bias in the comparison of the groups. This study included 35 patients who met the inclusion criteria, of which 22 patients were treated with open surgery (group 1) and 13 with laparoscopic surgery (group 2). All patients received albendazole 10 mg/Kg, 1 month before surgery, and 1 month after surgery.

Variables and instruments

The independent variables were: laparoscopic partial cystectomy and open partial cystectomy. All surgeries were performed under general anesthesia and after antibiotic prophylaxis with cefazolin 1g in anesthetic induction.

Laparoscopic partial cystectomy:

The patient was placed on the operating table in a fowler position and tilted to the right or left



according to the location of the cyst, with the legs apart; and the main surgeon stood between the patient's legs (French technique). Four ports were inserted: transumbilical (10 mm) with 30-degree optics, epigastric (10 mm), and two additional ports depending on the location of the cyst for each patient. Pneumoperitoneum was performed between 12 and 15 mmHg. Gauze pads soaked with 20% hypertonic saline were placed around the cysts, isolating the cyst from the rest of the abdominal cavity and were also placed in the subdiaphragmatic and subhepatic space. The cyst was perforated and aspirated with a laparoscopic puncture needle connected to the 10 mm aspirator and 20% hypertonic saline solution was injected into the cystic cavity as a scolicalid agent and after 5 minutes the cyst was aspirated (this procedure was repeated 3 times). The cystotomy was performed with monopolar electrocautery. Since the beginning of the surgery, 2 aspirators (5 and 10 mm) were used, one for the interior of the cystic cavity and the other to the side of the cyst, in case there was any spillage of its contents into the cavity. Before the opening of the cyst, a latex bag was inserted into the abdominal cavity to place the membranes or daughter vesicles of the cyst and remove all its contents. A partial monopolar or bipolar cystectomy was performed, depending on the surgeon's preference. The residual cystic cavity was explored and bile leaks were sought with the optic. If any bile leak was detected, a 3: 0 polyglactin suture was placed. This residual cavity was irrigated with hypertonic saline solution, aspirated and a tubular drain was placed inside of it. The tubular drainage was withdrawn in his first postoperative control in an external clinic, after 10 to 14 days after surgery. The median follow-up was 36 months; where he had ultrasound controls.

Open partial cystectomy:

A right subcostal incision was made, which on some occasions it expanded to the left due to the location, size of the cyst, and the liver. The surgical technique was similar to that described for laparoscopic surgery with 2 aspirators and for the extraction of the membranes and cysts a spoon and forceps of Foerster were used. Follow-up was the same as for the laparoscopic group.

The dependent variables were: intrahospital mortality, surgical complications, recurrence, operative time, hospital stay and postoperative pain, initiation of oral analgesics in the postoperative period, medical rest, operative, postoperative and total cost. They were defined as follows:

Intrahospital mortality: Death during the hospitalization period that includes surgery or during hospital readmission after discharge up to 30 days postoperatively.

Surgical complications: Postoperative complications secondary to surgery.

Recurrence: Appearance of hydatid cyst in the same place or another place of the hepatic parenchyma and/or intraabdominal, in the follow-up for 3 years.

Operative time: Time elapsed from induction of anesthesia until the patient leaves the operating room for recovery.

Hospital stay: Duration of hospitalization of the patient from surgery to hospital discharge.

Postoperative pain: Pain from the operative wound and abdomen secondary to surgery and was measured by the Visual Analog Scale (VAS).

Initiation of oral analgesics: The postoperative day where parenteral analgesics is no longer necessary and starts orally.

Medical rest: Days of medical rest after surgery.

Operating cost: Costs of the surgical act.

Postoperative cost: Cost of the immediate postoperative until its first control in an external office.

Total cost: Sum of the operative and postoperative costs.

Procedures

The medical records were reviewed to fill in the patient's data collection form and the VAS scale was used for the assessment of pain on the first day of the postoperative period, described in the clinical history.

Likewise, with the help of the information from the hospital accounting office, the costs per patient were found to find the total cost of both surgical treatments (intra and postoperative cost) in an Excel spreadsheet, using the costing system. ABC; to know the direct and indirect costs; fixed and variable for each patient operated. The exchange rate considered was USD 1 (US dollar) equivalent to 3.43 soles.

Statistical Analysis

For statistical analysis, the Stata 12 program was used. The Student's t-test was performed on independent samples to compare the means of the quantitative variables for both treatments, after evaluating normality with the Shapiro Wilk test. The chi-square test was performed for the categorical variables.



A value of $p < 0.05$ was used to define statistical significance.

Ethical aspects

The data was confidential, protecting the identity of the patients, and respecting ethical principles. The research project was approved by the research and ethics committee of the Hospital Nacional Edgardo Rebagliati Martins. (Letter No. 2442-GHNERM-GRPR-ESSALUD-2018).

RESULTS

Demographic data and cyst characteristics

Both groups were similar in age, gender, number, size, and type of cyst according to the WHO-IWGE classification of hydatid cyst; as can be seen in Table 1, and all were ASA (American Society of Anesthesiologists Classification) II.

Of the 35 operated patients: 22 patients underwent open partial cystectomy (group 1), and 13 patients laparoscopic (group 2).

Intra-operative and postoperative

The operating time was longer for group 2, but no significant differences were found, 324 ± 142.9 minutes (group 2), and 244 ± 76.3 minutes (group 1). Postoperative pain on the first day was significantly lower for the laparoscopic group, with a VAS scale of 1 (mild pain) compared to 4 (moderate pain) for the group operated by open surgery. As postoperative analgesia, Metamizole 1g every 8 hours was used for both groups; and in group 1, Tramadol 50 -100 mg (depending on the patient's weight) had to be used every 6-8 hours to reduce pain. The initiation of oral analgesics was faster for group 2 (3 ± 1.7 days) than in group 1 (4.5 ± 1.6 days). Likewise, for group 2, the postoperative hospital stay and the days of medical rest were significantly shorter (Table 2).

The conversion rate to open surgery was 18.75%. There were no cases of in-hospital mortality and there was only 1 case of recurrence (4.5%), after one year of open surgery. There were no significant differences in surgical complications, 27.3% for group 1, and 30.7% for group 2. (Table 3). In group 1, a re-operation of the biliodigestive bypass was required for biliary stenosis and then cholangioplasty by interventional radiology, in 2 patients for intrahepatic collection, percutaneous drainage and intravenous antibiotics were performed. 1 patient with infection of the superficial surgical site was treated with drainage of the surgical wound, healings, and intravenous antibiotics. 1 patient with an intrahepatic collection was treated with intravenous antibiotics and 1 patient with a biliary fistula stopped draining spontaneously at 2 weeks. For group 2, there were 2 patients with biliary fistula (1 patient needed a sphincterotomy for ERCP and the other patient only needed observation and stopped draining within a week), 1 patient needed percutaneous drainage and intravenous antibiotics for intrahepatic collection, and 1 patient with mild subcutaneous emphysema was only observed.

Economic results

No significant differences were found in the intraoperative, postoperative, complications, and total cost between both surgical techniques. While the average total cost was lower for laparoscopic surgery, but without significant differences (1700.99 ± 195.82 US dollars for open and 1561.83 ± 702.53 US dollars laparoscopic surgery (Table 4).

The minimum total cost per patient found for open surgery was US \$ 874.63 and for laparoscopic surgery was US \$ 774.81, while the maximum total cost per patient was higher for open surgery (US \$ 5321.62) than for laparoscopic surgery (US \$ 3,312.33).

Table 1. Demographic data and cyst characteristics of the population studied.

Parameter	Group 1	Group 2	p-value
	Open	Laparoscopic	
Number of patients	22	13	
Age (years \pm SD)	50.1 \pm 17.13	41.4 \pm 12.56	0.35
Gender (% M / F)	14/86	23/78	0.47
Classification WHO-IWGE			
CE1	4 (18.2%)	1 (7.7%)	0.28
CE2	9 (40.9%)	6 (46.2%)	0.94
CE3	9 (40.9%)	6 (46.2%)	0.94
Number of cysts	1.4	1	0.25
Cyst size (mm \pm SD)	104.6 \pm 51.7	134 \pm 37.8	0.3

Data are presented as: mean \pm DE, DE: Standard deviation, %, n (%).

M: male, F: female, WHO-IWGE CE1: unilocular cystic lesion and Hydatid grit, CE2: multivesicular, multiseptated cystic lesion, CE3: unilocular cystic lesion with the detachment of the laminar membrane within the cyst, mm: millimeters.

Table 2. Intra and postoperative parameters of the studied population.

Parameter	Group 1	Group 2	p-value
	Open	Laparoscopic	
Operative time (min \pm SD)	244 \pm 76.3	324 \pm 142.9	0.23
Pain PO (EVA scale)	3.7 \pm 1.6	1.4 \pm 0.89	0.008
Initiation of analgesic PO (day PO \pm SD)	4.5 \pm 1.6	3 \pm 1.7	0.04
Hospital stay PO (day \pm SD)	5 \pm 1.6	3 \pm 1	0.01
Days of DM PO (day \pm SD)	56.3 \pm 19.1	19.4 \pm 8.7	0.0043
Re-entry due to emergency	2	1	0.63
Re-operation	1	0	0.6

Data are presented in: mean \pm SD, SD: Standard deviation, min: minutes, PO: orally, PO: postoperative, DM PO: Postoperative medical rest.

Table 3. Postoperative surgical complications of the studied population.

Surgical complication	Group 1	Group 2
	Open	Laparoscopic
Collection intrahepatic and biliary fistula		1
Subcutaneous emphysema		1
intrahepatic collection	3	1
biliary fistula	1	1
Biliary strictures	1	
ISQ surface	1	
Total	6 (27.3%)	4 (30.7%)

ISQ: Infection of the surgical site.

**Table 4.** Costs of open surgery and laparoscopic surgery of the liver hydatid cyst of the studied population.

Costs	Group 1	Group 2	p-value
	Open	Laparoscopic	
Intra-operative cost	627.16 ± 122	885.77 ± 265.28	0.99
Postoperative cost	1073.83 ± 1171.69	676.06 ± 580.34	0.09
Cost of complications	413.15 ± 1060.84	244.96 ± 504.70	0.26
Total cost	1700.99 ± 1195.82	1561.83 ± 702.53	0.35

Data presented in average ± DE, US dollars.

DISCUSSION

Surgery is the main treatment for liver hydatid cyst. The surgeon's experience in laparoscopic surgery and a better understanding of this disease has made it possible for laparoscopy as an option to open surgery with an adequate selection of cases.

Clinical results

The conversion rate of laparoscopic surgery found was 18.75%, being within the range reported by other investigations for this type of pathology (0 to 27%)⁽⁸⁻¹¹⁾. This was mainly caused by multiple adhesions and a cyst located in segment 7, not achieving adequate visualization and the need for conversion to open surgery⁽⁸⁻¹¹⁾.

The mean size of the cyst in our study was greater in both treatment groups (104.6 mm ± 51.7 mm for open surgery and 134 mm ± 37.8 mm for laparoscopic surgery) in comparison to previously published studies^(8,10,12-14) that compared both types of treatment. The mean was 70 to 90 mm for open cystectomy and 60 to 80 mm for laparoscopic.

The operative time was not different in both surgeries, however, it was greater than that found by other studies^(8,12,14,15), because we considered the mean operative time from the start of anesthesiological induction up to the passage to recovery. While in the other studies they are very heterogeneous in the definition of operative time or do not include their definition. Furthermore, the cyst size was larger in our research, which led to a longer duration of surgery. The other factor that would be important to consider is the learning curve in hepatobiliary laparoscopic surgery of the cases at the beginning of the study.

Most publications have reported fewer days hospitalized after surgery and better management of postoperative pain in favor of laparoscopic treatment^(5,16,17). There are clear advantages of laparoscopic surgery which are shorter hospital stay, fewer days of postoperative

medical rest, faster return to work due to less pain after surgery, and better management of the operative wound.

At the beginning of the experience with laparoscopic surgery for hydatidosis in the world was not very well accepted because of the risk of intraperitoneal spread and recurrence. However, due to the pre and postoperative prophylaxis of albendazole, the use of 2 aspirators, the isolation of the cyst from the rest of the abdominal cavity with various gauzes with a scolical substance and the improvement of surgical dexterity currently there are no differences in recurrence after open or laparoscopic surgery. As found by Sokouti M, et al.⁽¹⁸⁾ in the last meta-analysis where they compared both surgical techniques, reporting 2.83% for laparoscopic and 4.74% for open surgery. This is related to what was described in our research, where we have no recurrence cases for laparoscopy and 4.5% for open cystectomy.

There was no case of mortality in our entire series, as well as that reported by other studies, which found a very low mortality rate for laparoscopic partial cystectomy of 0% and 0 to 3% for open^(8,10-15, 18-20). The postoperative morbidity published in the last decade^(8,10-15,18-20) is from 13 to 30% for laparoscopic surgery and from 17 to 33% for open surgery, finding no significant differences between both types of surgery. Similar to what was found in this study, 30.7% for laparoscopic and 27.3% for open. The main complications were intrahepatic collection (11.4%) and biliary fistula (8.6%). Intrahepatic collections were treated in 75% of cases with percutaneous drainage and biliary fistulas were treated with ERCP sphincterotomy in 33% of cases. The most dangerous complication was bile duct stricture (2.9%), which required reoperation and subsequent percutaneous cholangioplasty; therefore, a magnetic resonance imaging (MRI) is always important as part of the pre-operative study and an intraoperative cholangiography.

Economic results

Regarding the comparison of the economic results of both types of treatment, we only found the study by Pinto P, et al.⁽¹⁰⁾ in Chile that makes the aforementioned comparison. This study does not establish what type of costing system they used; however, it seems to be an estimate and they determined a total cost (intra and postoperative without complications) of US \$2107 for laparoscopy and US \$2045 for open surgery. In our research, we use the ABC costing system, which gives us a more real and detailed cost per patient. There were no significant differences between the intraoperative, operative, and total costs between both treatments. The postoperative cost was higher for open surgery, but without statistical differences. Despite a longer hospital stay, greater demand for supplies for wound management, postoperative pain, higher cost of complications, and more days of medical rest. In economic terms, the latter is subsidized by the social security to which the hospital belongs, assuming this an indirect cost of the disease. However, a study with more cases should be carried out to assess whether this economic trend towards the higher postoperative cost of open surgery could be real.

Despite finding a higher total cost for open surgery than for laparoscopic surgery (\$ 149 higher), there were no significant differences between the costs of both surgical techniques.

One of the main strengths of this research is to present the clinical and economic results for both surgical techniques, since previously only clinical variables have been compared, without taking into account the cost of the surgeries, which is an important factor to consider in hospital administration. The highest quality of treatment for patients at the lowest possible cost, avoiding excess hospital expenses, and generating significant savings with greater efficiency and quality of service.

The limitations of this study are the retrospective design, with few cases, but it is the beginning of research that combines clinical and economic variables for this type of pathology, to analyze them and achieve greater efficiency and quality in our surgeries.

CONCLUSION

The clinical results (mortality, surgical complications, and recurrence) and the economic results (operative, postoperative and total costs) were similar for both types of surgery; however, there was less postoperative pain, hospital stay, and quicker reintegration into working life for patients operated on by laparoscopic surgery.

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