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Treatment of acute cholecystitis

A comparison of open vs laparoscopic cholecystectomy

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Abstract
Background: In this study, the clinical results and cost-effectiveness of open vs laparoscopic cholecystectomy in the treatment of acute cholecystitis were compared.
Methods: Over a 5-year period (1994–98), 894 cholecystectomies were performed, 545 (60.96%) of them laparoscopically and 349 (39.04%) by the open method. The study included 209 patients with a clinical diagnosis of acute cholecystitis; 115 (55.02%) of them were operated on by the open method and 94 (44.98%) by the laparoscopic method.
Results: A comparison analysis revealed that the mean postoperative treatment period was 8.40 days after open and 4.38 days after laparoscopic cholecystectomy. In the group operated on by the open method, 106 patients received an antibiotic, a mean of 5.09 ampules and 3.2 tablets or suppositories of an analgesic, and 2.91 dressings per patient; whereas in the group submitted to the laparoscopic method, the comparable figures were 43, 3.13, 2.1, and 1.47, respectively. In 31 (26.96%) employed patients operated on by the open method, the mean absenteeism from work was 42 days; whereas in 31 (32.98%) of those operated on by the laparoscopic method, it was 17 days. The mean operating times for the procedures were 89 and 115 min for the open and laparoscopic methods, respectively. Two patients submitted to open cholecystectomy died within 30 days postoperatively. Wound infection was recorded in 10 (8.7%), prolonged biliary secretion in two, and cicatricial hernia in five (4.35%) patients. In the group submitted to laparoscopic cholecystectomy, there were no deaths; nine (9.57%) conversions were required; four patients had to be reoperated on, two of them for bile lobe hemorrhage and two for massive biliary secretion from the open cystic duct; herniation at the site of supraumbilical incision developed in three patients, and infection developed at the same site in two (2.13%) patients. The hospital cost was significantly higher in laparoscopic patients ($1181 vs $873) USD), as was the total cost of treatment for acute cholecystitis ($1430 vs $1316). However, the cost for sick leave and rehabilitation was significantly lower in laparoscopically treated patients ($486 vs $1199).
Conclusions: Our comparison analysis of the results and cost-effectiveness of the surgical treatment of acute cholecystitis clearly pointed to the advantages of laparoscopic over open cholecystectomy—i.e., better clinical outcome and a more rapid resumption of daily activities. Hospital and total costs of treatment were on average higher in laparoscopic patients, except for the employed ones, where the lower sick leave cost translated into a significant reduction in total costs.

Key words: Cholecystitis — Cholecystectomy — Laparoscopy — Outcome — Cost-effectiveness

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The first laparoscopic cholecystectomy in Croatia was performed in 1992 [2]. At the County General Hospital in Požega, with a catchment population of some 75,000, the first such procedure was done in October 1994. The approach to the surgical treatment of acute cholecystitis has not been changed radically by the introduction of the new method, although results point to a number of advantages of laparoscopic over open cholecystectomy.

Materials and methods

The study covered a 5-year period (1994–98), during which 894 cholecystectomies were performed at the Department of Surgery of the County General Hospital in Požega, Croatia. The open method was used in 349 (39.04%) and the laparoscopic approach was used in 545 (60.96%) patients. The clinical symptoms of acute cholecystitis (history, laboratory parameters, ultrasonography findings, elevated body temperature, pain in the upper right abdominal quadrant) were verified in 221 (24.72%) patients. The results of 209 cholecystectomies were analyzed, since in 12 patients the procedure had to be extended to revision of the common bile duct (in addition to acute cholecystitis, a coexistent icterus was found in six, biliodigestive fistula in two, and distended choledochous duct in four

Table 1. Breakdown of costs for laparoscopic and open cholecystectomy

Item	Cost
Day of hospital treatment	$ 36.00
Anesthesia	
medical work, 1 min	0.36
medical supplies	35.00
Operation	
operating room, 1 min	0.32
supplies for	
open cholecystectomy	210.71
laparoscopic cholecystectomy	695.43
medical work, 1 min	0.61
Analgesic, 1 ampule	0.80
1 supp	0.30
Antibiotic, mean daily therapy	12.77
Dressing in	
open cholecystectomy	0.84
laparoscopic cholecystectomy	0.66
Sick leave, 1 day	28.57
Cost of treatment for scar herniation after superior medial laparotomy	2755.00
Cost of treatment for scar herniation after supraumbilical incision	1017.00

patients). An open cholecystectomy was performed in 115 (55.02%) patients and a laparoscopic cholecystectomy in 94 (44.98%) patients with acute cholecystitis. For open cholecystectomy, a superior medial laparotomy was done, whereas for laparoscopic cholecystectomy, the four-trocar technique was used, with gallbladder puncture through a 5-mm trocar subcostally on the right if necessary and bacteriologic analysis of the gallbladder content.

A comparison between the two patient groups included the following parameters: duration of postoperative hospital stay, administration of antibiotics and analgesics, number and cost of wound dressings, intraoperative complications, early and late postoperative complications, use of drainage, number and size of stones, duration of sick leave, cost of hospital treatment, and total cost of treatment for acute cholecystitis. The total cost of treatment was calculated according to the following formula: hospital cost (HC) + sick leave (rehabilitation) cost (RC) + cost of late postoperative complications (CC) = total cost (TC).

Hospital cost included the following items:

1. PRS — cost of preoperative stay = mean duration (days) from the onset of symptoms to operation × price per day of hospital stay (accommodation + medical work)
2. OP — cost of operation = cost of operating room + supplies + medical work
3. A — cost of anesthesia = supplies + medical work
4. POS — cost of postoperative stay = duration (days) of hospital stay after operation × price per day
5. D — cost of analgesics and antibiotics = number of drugs × price
6. Drs — cost of dressing = number of dressings × price of material per dressing

In cases of laparoscopic cholecystectomy, the cost of conversion (CONV) was added to the cost of operation (OP).

Sick leave (rehabilitation) cost for employed patients was calculated by multiplying the price of a single day of sick leave by the duration of the sick leave.

Cost of late postoperative complications included postoperative scar herniation requiring surgical intervention and treatment of residual choledochal calculi, the cost of which was then added to those listed above.

Total treatment cost was calculated for each patient from the breakdown of costs shown in Table 1 gross domestic product GDP (gross domestic product) in Croatia for 1998 was $4663.

Statistical analysis

The categorical data were compared using the chi-square test. Nonnormally distributed continuous data were compared using the Wilcoxon test, and normally distributed continuous data were compared using Student's *t*-test. The difference was considered statistically significant if the p value was <0.01. The analysis was performed using the MedCalc statistical package (MedCalc Software, Mariakerke, Belgium).

Results

The analysis included the results obtained in 209 patients operated on during the 5-year period (1994–98) for the clinical picture of acute cholecystitis, which was subsequently verified by pathohistologic examination of the gallbladder. The pathohistologic diagnosis was acute cholecystitis, purulent or gangrenous, in 159 patients and subacute cholecystitis in 27 patients, whereas a descriptive diagnosis was recorded in 23 patients. There were 69 (33.01%) men and 140 (66.99%) women with a mean age of 57.18 years (range, 18–89). In the series of 115 patients submitted to open cholecystectomy, the mean time elapsed from the onset of clinical symptoms to the operation was 3.79 days. Seventy (60.87%) patients were operated on within 72 h, 34 (29.57%) patients within 3–7 days, and 11 (9.56%) patients >7 days from the onset of symptoms. Ultrasonography (US) confirmed the diagnosis of acute cholecystitis in 112 patients, whereas in three patients the US finding was quite vague. Leukocytosis of >10,000 was recorded in 66 (57.39%) patients, and a body temperature of >37°C was noted in 48 (41.74%) patients. Laboratory signs of a mild form of acute pancreatitis were present in three patients. In this series, 106 patients received antibiotics for a mean of 4.4 days (range, 1–23), while the mean use of analgesics was 5.09 ampules and 3.2 tablets or suppositories per patient.

The mean duration of the operative procedure was 89 min (range, 49–133), and the mean duration of operating room occupancy was 119 min. There were no intraoperative complications (such as biliary duct injury, massive bleeding, or intraabdominal organ injury). A signaling drain was introduced in all patients. Multiple stones were found in 79 patients; very small stones, with a diameter smaller than the cystic duct lumen, were found in 41 patients. Four patients had no stones, whereas 32 patients had solitary cystic calculi.

Two (1.74%) patients died within 30 days postoperatively, both of them from cardiorespiratory decompensation associated with bronchopneumonia. Wound infection developed in 10 (8.7%) patients; the mean number of dressings was 2.91 per patient. Prolonged biliary secretion was recorded in two (1.74%) patients. One patient had to be reoperated on for adhesive ileus.

The mean duration of postoperative hospital stay was 8.4 days (range, 6–27). Postoperative scar herniation was recorded in five (4.35%) patients, at the site of laparotomy. In this group of patients, there ware no residual choledochal calculi. Thirty-one (26.96%) patients were employed, with a mean sick leave duration of 42 days (range, 26–79).

In the series of 94 patients submitted to laparoscopic cholecystectomy, the mean time elapsed from the onset of clinical symptoms to the operation was 3.25 days. Fifty-seven (60.64%) patients were operated on within 72 h, 27 (28.72%) patients within 3–7 days, and 10 (10.64%) patients >7 days from the onset of symptoms. US confirmed the diagnosis of acute cholecystitis in all 94 patients.

Leukocytosis of >10,000 was recorded in 39 (41.49%) patients and body temperature of >37°C in 57 (60.64%) patients. Laboratory findings confirmed the presence of a mild form of acute pancreatitis in two patients. None of the patients from this group had icterus or suspected choledocholithiasis. Forty-three patients received antibiotics for a mean of 2.3 days (range, 1–12); the mean use of analgesics was 3.13 ampules and 2.1 tablets or suppositories per patient.

The mean duration of the operative procedure was 115 min (range, 44–169), and the mean operating room occupancy was 145 min. No deaths were recorded within 30 days postoperatively. In nine (9.57%) patients, conversion was carried out for unclear anatomic relationships, or to allow correct completion of the procedure. Reoperation was required in four patients. In two cases, it was for massive intrahepatic bleeding from the gallbladder lobe, requiring no intervention other than toilet. In the other two, it was for excessive biliary secretion via drainage; in these cases, the bile leaked through the cystic duct from which the clamps had fallen off. All surgical reinterventions were performed within 72 h.

Multiple calculi were found in 74 cases and small stones in 29. Two patients were free of stones, whereas 18 patients had solitary cystic calculi. Wound infection at the site of supraumbilical incision developed in two (2.13%) patients; the mean number of dressings was 1.74 per patient. Herniation at the site of the supraumbilical incision developed in three (3.19%) patients. The mean duration of postoperative hospital stay was 4.38 days (range, 2–19). Thirty-one (32.98%) patients were employed; they took a mean sick leave of 17 days (range, 10–27).

Statistical analysis of the groups yielded highly significant ($p < 0.001$) differences in favor of the laparoscopically operated patients for the following parameters: (a) duration of postoperative hospital stay, (b) number of patients administered antibiotics and duration of antibiotic administration in those requiring antibiotic therapy, (c) use of analgesics, (d) number of dressings and use of dressing material, and (e) duration of sick leave (the proportion of employed patients in the total number of cases did not differ significantly between the two groups). There were no significant differences in the rate and cost of late postoperative complications between the two groups either.

A comparison of costs between the two groups revealed to the following statistically significant differences: (a) hospital cost was significantly greater ($p < 0.001$) in the laparoscopic group than in the open group ($1181 vs $873), (b) sick leave cost was significantly lower ($p < 0.001$) in the laparoscopic patients than in those operated on by the open method ($486 vs $1199), (c) total treatment cost was significantly higher ($p < 0.001$) in the laparoscopic group patients than in the open group ($1430 vs $1316), and (d) in the category of employed patients, total treatment cost was significantly lower ($p = 0.0065$) for the laparoscopic group ($1750 vs $2167).

Discussion

When performed by an experienced, well-trained surgeon, laparoscopic cholecystectomy is the method of choice for the treatment of acute cholecystitis. Our operative technique did not differ substantially from that used in the treatment of chronic cholecystitis, except for the use of four trocars instead of the three trocars employed in nearly one-third of the procedures for chronic cholecystitis [1]. Gallbladder puncture was almost always performed to relieve tension of the cholecyst, which was usually filled with infected matter, to facilitate the subsequent gallbladder manipulation. The safe placement of clips on the cystic duct and cystic artery posed considerable difficulties because of tissue edema or even necrosis. A suction irrigation pump was established and a drain was inserted. The two groups of patients included in the study were closely matched in terms of age, sex, and clinical and laboratory signs.

The selection of patients for laparoscopic treatment was not based on the clinical severity of disease, but was dictated by technical and organizational considerations. Namely, the technical equipment required for the method, and completed surgical team educated for laparoscopic procedure is only available during regular working hours.

The time elapsed from the onset of symptoms to the operation was similar in the two groups of patients [16]—i.e., >50% of the patients in both groups were operated on within 72 h. Of the nine conversions from the laparoscopic to the open method, only two occurred in patients operated on within the first 3 days. The four patients from the laparoscopic group who required reoperation (two for biliary secretion and two for massive hemorrhage) underwent cholecystectomy >3 days after the onset of symptoms, a finding that underscores the need to institute of surgical treatment within 72 h of the onset of symptoms of the acute stage of the disease. The relatively high percentage of conversions (9.57%) can in part be considered a reflection of the learning curve, since the study period covers the first 5 years of our application of the laparoscopic technique [5, 8, 14, 20].

There were no major intraoperative complications, such as injury to the bile duct, blood vessels, or intraabdominal organs, in either group of patients, and early postoperative complications did not differ significantly between the laparoscopic and open patients [22]. The rate of wound infection was significantly higher for open cholecystectomy; but in the group of patients who had the laparoscopic procedure, the rate of infection did not differ significantly from the reference data for the same procedure in chronic cholecystitis [6, 14]. There were no deaths among the laparoscopic cholecystectomy patients, which is consistent with other reports [9, 19, 22, 24]. The mortality rate (1.74%) recorded for the open group could be ascribed in part to the undeniable fact that open cholecystectomy actually consists of two simultaneous operations—i.e., one on the intraabdominal organ and the other, no less difficult, on the abdominal wall [12, 13, 17, 18].

The number of dressings and use of dressing material were significantly greater after open cholecystectomy, thereby increasing the cost of treatment. The use of antibiotics and analgesics was also greater after the open procedure; however, it was usually associated with the laparotomy wound rather than the cholecystectomy, especially in the case of analgesics. As in earlier series, the operating time was longer for laparoscopic cholecystectomy; however, it decreased with growing experience [14, 22]. Postoperative hospitalization was significantly shorter after lap-

aroscopic cholecystectomy, as has also been reported elsewhere [3, 10, 11, 22]. This difference is also due to the laparotomy wound rather than the cholecystectomy; a similar effect is seen for the significantly reduced sick leave after laparoscopic cholecystectomy. The relatively high rate of the postoperative scar herniation after open cholecystectomy (4.35%) may have been due to the poor quality of the suture material supplied at the time (due to financial restrictions).

The results of the cost analysis showed that hospital cost was higher by 35.28% for laparoscopic cholecystectomy, although the cost of the operation itself (including anesthesia) is more than twice that for the open procedure [4, 21, 22, 23]. Nevertheless, the high cost of the laparoscopic procedure is offset by the reduction in postoperative hospital stay as well as in the use of antibiotics, analgesics, and dressing material. The unfavorable cost-effectiveness ratio is improved by the shorter period of rehabilitation and faster return to work after laparoscopic cholecystectomy [3, 7, 9, 11, 24]. In the final analysis, the total costs of treatment for acute cholecystitis by the laparoscopic method exceeded the costs for open cholecystectomy by 8.66%.

The results of this study clearly show that the costs of sick leave and rehabilitation are significantly higher in patients who have the traditional open procedure (146.71%); thus, the treatment of acute cholecystitis by laparoscopic cholecystectomy in employed patients is significantly less expensive. This aspect needs to be taken into consideration when choosing the mode of operation. Both employers and health insurance companies should be made cognizant of this factor as well, so that they can establish a more enlightened policy for workers with this condition.

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