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ORIGINAL ARTICLE

Laparoscopic cholecystectomy: do risk factors for a prolonged length of stay exist?

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Abstract

Gallstones are one of the most common morbidities in the world. Laparoscopic cholecystectomy is the gold standard for gallbladder stones' removal. Few studies focus on the existence of predictive factors aimed at facilitating cholecystectomy in a day surgery setting. The aim of this retrospective study was to identify clinical factors that could guide day-surgery laparoscopic cholecystectomy safety. The study included 985 consecutive patients who underwent elective laparoscopic cholecystectomy for gallstone disease between May 2006 and February 2015. Patients were divided into two groups: group A with a length of stay ≤ 2 days (922 patients); group B with a length of stay > 2 days (63 patients). Univariate analysis showed that age, sex and the presence of obesity, cardiological, and nephrological comorbidities had a higher likelihood of a longer hospital stay. The logistic regression model showed that only age was a significant predictor of a longer stay. No complication has reached the statistical significance of extending the length of stay in group B. Conversely, the presence of such comorbidities has influenced the hospitalization. Our results allow the identification of a category of patients at high risk of hospitalization within 1 or 2 days from treatment. Moreover, we reported that there is no complication specifically affecting the length of stay. Our findings support the idea that a prolonged length of stay is not linked to the surgical procedure but to the patient's comorbidities.

Keywords Gallbladder · Laparoscopy · Cholecystectomy · Risk factors · Day surgery · Length of stay

Introduction

Gallstones are one of the most common morbidities in the world, affecting about 10–15% of the adult population in USA [1–4], with an incidence of symptomatic cholecystolithiasis up to 2.17 per thousand inhabitants in USA [5, 6]. Gallstones' incidence has increased over 20% during the last 3 decades [1, 7, 8]. Nowadays, approximately 600,000 cholecystectomies are performed annually in the United States, most of them laparoscopically [9–11].

The first "patient" reported to be affected by gallstones was an Egyptian mummy dating back nearly 2000 years before Christ [12]. The first surgical intervention for gallstones was reported in 1687: Stalpert Von der Wiel during a surgery in a patient with a long history of abdominal pain, within a purulent upper abdominal abscess found gallstones [13]. The first surgeon to design and perform a surgical procedure on a gallbladder has been Marion Sims in 1878. He removed multiple stones opening the gallbladder of a patient, without removing it [14, 15].

By the end of the 1880s, open cholecystectomy become the gold standard for treatment of stones in the gallbladder. In 1882, Lungenbuch, a 27 year old surgeon, performed the first cholecystectomy on a 43 year old man affected by a 16 years biliary colic [16]. However, the mortality was high (20%) in the early years of the twentieth century.

Philip Mouret, a French surgeon in Lyon, performed the first video-laparoscopic cholecystectomy (LC) [17]. Following this report, laparoscopic cholecystectomy rapidly became the method of choice for surgical removal of the gallbladder [18]. Hugh et al. showed that laparoscopic cholecystectomy had no significant difference in morbidity and mortality rate compared to traditional surgery. However, they observed that laparoscopic cholecystectomy had a remarkable reduction in postoperative pain, hospitalization, disability and costs compared to open cholecystectomy [19–21].

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Subsequently, thanks to advancements in laparoscopy, minivasive cholecystectomy has become the gold standard for gallbladder stones' removal [22–25].

Since then a significant advancement in technical innovation has led to remarkable progress in the treatment of this disease. Examples of technical innovations are the reduction in the number of trocars, the use of natural orifice for specimen extraction and the high definition (HD) monitor up to the 3D technology.

In the United States and in the United Kingdom, laparoscopic cholecystectomy is performed as a day-surgery procedure [26]. Nevertheless, in Italy this surgical procedure is still performed with a traditional hospital recovery because of health organization issue. Only few hospitals in Italy perform laparoscopic cholecystectomy in a day-surgery setting.

Current and past reports focus on the feasibility of day-surgery procedures; however, few studies focus on the existence of predictive factors aimed at facilitating cholecystectomy in a day-surgery setting [27–29].

The aim of this retrospective study was to identify clinical factors that could guide day-surgery laparoscopic cholecystectomy safety.

Materials and methods

The study included 985 consecutive patients (373 males and 612 females) who underwent elective laparoscopic cholecystectomy due to symptomatic or complicated gallstone disease. Procedures were performed at the Campus Bio-Medico University of Rome between May 2006 and February 2015.

In the same period, 64 patients underwent LC converted in laparotomy, and 23 patients directly underwent laparotomy cholecystectomies for gallstones. These patients were excluded from our analysis because laparotomy actually implies a longer hospital stay compared to laparoscopy.

Patients with an iatrogenic lesion of biliary tract and patients that performed a preoperative endoscopic retrograde cholangiopancreatography (ERCP) were excluded from the analysis, due to their prolonged hospitalization.

Patients were divided into two groups according to the length of stay: group A with a length of stay ≤ 2 days (922 patients); group B with a length of stay > 2 days (63 patients).

The reason that we used the cutoff of 2 days is that the reimbursement is higher for an ordinary regimen compared to a day-surgery regimen. Furthermore, this is also insufficient to cover the costs of the surgical procedure. To this end, it was necessary for the patients to spend two nights in our hospital.

Patients characteristics such as age, sex, preoperative cholestasis, obesity and comorbidities, were subsequently investigated to find possible factors that could predict a shorter length of stay.

In all cases a standardized four-port technique was performed using the French style technique. Pneumoperitoneum was achieved to a value no higher than 14 mmHg. Dissection of the Calot's triangle was performed. The cystic artery and the cystic duct were cut between titanium clips (artery first). Monopolar electrocautery was used in a hemostatic modality. Surgical drain was placed only in selective cases.

Statistical analysis

Demographic and clinical characteristics of the patients have been reported as percentage, or as mean and standard deviation, depending on the nature of the variables. To assess the possible predictors of a longer length of stay, we performed a univariate analysis, comparing patients in group A vs. those in group B. Specifically we used Fisher's exact tests and odds ratios, or *t* tests, as appropriated. Significant factors in the univariate analysis were then analyzed by means of a backward stepwise logistic regression. To analyze the incidence of complications and comorbidities on the length of stay in group B, we performed a univariate *t* test analysis comparing the mean days of stay in patients with and without the complication/comorbidity. For all the performed analysis, a *p* value less than 0.05 was deemed significant. Data were analyzed using SPSS Version 20.

Results

The primary end-point was to investigate the presence of prognostic factors that affect the length of stay in patients. Statistical analysis showed a significant difference between the two groups. Univariate analysis showed that age, sex, and the presence of obesity, cardiological, and nephrological comorbidities had a higher likelihood of a longer hospital stay, as reported in Table 1.

Mean age in groups A and B was, respectively, 54 ± 15 and 64 ± 16. However, the logistic regression model showed that only age was a significant predictor of a longer stay, as shown in Table 2.

At this point of the analysis, we performed a subgroup analysis of postoperative complications in group B patients. Interestingly, no complication has reached the statistical significance of extending the length of stay in this group. Conversely, the presence of comorbidities has influenced the hospitalization (Table 3). As a result, we were able to identify some risk factors. No differences were detected in ASA score between the two groups (Group A 2 ± 1; Group B 2 ± 1; $p = 0.961$). Table 4 reports the total number of complications and comorbidities in group B patients. The mean hospital stay in group B was 7 ± 4 days.

Table 1 Difference between group A (length of stay < 2 days) and B (length of stay > 2 days)

	Group A (%)	Group B (%)	OR	*p*
Sex				
M	36.9	52.4	1.88	**0.016**[a]
F	63.1	47.6		
Cholestasis				
Yes	14.9	23.8	1.79	0.07[a]
No	85.1	76.2		
Cardiological comorbidities				
Yes	30.7	44.4	1.81	**0.035**[a]
No	69.3	55.6		
Pneumological comorbidities				
Yes	5.7	9.5	1.73	0.263[a]
No	94.3	90.5		
Nephrological comorbidities				
Yes	0.0	6.3	139.54	**< 0.001**[a]
No	100.0	93.7		
Obesity				
Yes	11.0	20.6	2.11	**0.038**[a]
No	89.0	79.4		
Age (mean ± SD)	54 ± 15	64 ± 16	–	**< 0.001**[b]

Bold value indicates statistical significance, with *p* less than 0.05

SD standard deviation, *OR* odds ratio

[a]Fisher's exact test

[b]*t* test

Discussion

Laparoscopic cholecystectomy represents one of the most common surgical procedures performed daily in hospitals globally.

Stephenson et al. first described the feasibility of day-surgery laparoscopic cholecystectomy (LC) in England. 15 selected patients were successfully treated with a mean hospitalization of 8.5 h [30].

Prasad and Foley performed 103 LC; of these, 51 patients experienced a day-surgery hospitalization. Patients enrolled in this study were selected specifically based on the following requirements: less than 60 years of age, a motivation to have a day-surgery, no history of jaundice or other anesthetic contraindication and having an adult at home to look after them immediately after LC. Median hospital stay was 12 h. The study showed that day-surgery LC was a safe and cost-effective procedure (median cost of operation was about £419) [31].

In Italy, Campanelli et al. were the first to report day-surgery LC. They reported 1334 series of LC, 72 (5.4%) of which was performed in an outpatient management. 90.2% of patients were able to intake oral fluids on the same day of the operation and had normal bowel peristalsis within the first postoperative day. A subset of patients was treated as outpatients LC. Specifically, those patients that had the following characteristics: < 70 years of age; ASA 1, 2; body mass index < 35; biliary colic; no history of jaundice; no suspected bile duct calculi; motivated. 24–48 h after discharge, patients were followed up by telephone. The study shows that day-surgery LC is a feasible procedure [32].

Recently, Al-Omani et al. showed 1140 cases series with a success rate of 96%. Patient selection criteria was as follows: 13–70 years of age; body mass index < 40; living in Riyadh (1 h from Prince Sultan Military Medical City); American Society of Anesthesiology (ASA) physical status (PS) I or II; living with responsible persons; accompanied to the unit by someone responsible to take him/her home postoperatively. Forty-six patients (4%) failed to be discharged on the same day due to persistent abdominal pain and postoperative emesis. Five patients (0.4%) who underwent day-surgery LC successfully had to be readmitted. Patients who developed abdominal pain, abdominal wall hematoma, and vomiting, were treated conservatively. None of the patients had major complications, and all were discharged within 48 h. Authors concluded that day-surgery LC is both safe and feasible in a local setting. Furthermore, the study states that a careful patient selection is essential in ensuring a high success rate [33].

These studies underline the feasibility of a day-surgery LC; however, they did not report on the follow-up of these patients, including but not limited to information regarding readmission and complication rates.

Table 2 Logistic regression analysis

	B	SE	*p*	Odds ratio	95% CI for odds ratio
Sex (ref: female)	0.42	0.27	0.1233	1.53	0.89–2.61
Cardiological comorbidities	0.27	0.31	0.3773	1.31	0.72–2.39
Nephrological comorbidities	20.02	2408.00	0.9934	495E+006	–
Obesity	0.70	0.37	0.0621	2.01	0.97–4.18
Age	0.04	0.01	**0.0001**	1.04	1.02–1.06
Constant	– 5.43			1.52	0.89–2.61

Bold value indicates statistical significance, with *p* less than 0.05

Table 3 Incidence of complications and comorbidities on length of stay in group B patients

		No. of days in patients without complication/comorbidities, mean (SD)	No. of days in patients with complication/comorbidities, mean (SD)	*p*
Complications	Liver function index elevation	6.9 (3.7)	8.7 (3.1)	0.095
	Leukocytosis	7.2 (3.7)	5.5 (1.3)	0.693
	Hemobilia	7 (3.7)	8 (3.5)	0.393
	Dysuria	6.9 (3.6)	9.3 (4)	0.266
	Bladder globe	7.1 (3.7)	7 (2.6)	0.680
	Emesis	7 (3.6)	7.7 (4.7)	0.843
	Biliary vomiting	7.3 (3.7)	4.6 (0.9)	0.081
	Abdominal pain	7.3 (3.8)	5.4 (1.8)	0.198
	Chest pain	7.2 (3.7)	4.3 (0.6)	0.107
	Fever	7.4 (3.8)	6.1 (2.9)	0.171
Comorbidities	Cardiological	6.1 (3.1)	8.2 (3.9)	0.036
	Pneumological	6.9 (3.6)	8.8 (3.4)	0.134
	Nephrological	6.6 (3.2)	14 (2.9)	0.001
	Dyspnea	6.9 (3.5)	10 (5)	0.226
	Hypertension	6.6 (3.5)	7.8 (3.8)	0.249
	Previous myocardial infarction	7.1 (3.6)	6.7 (4.6)	0.528
	COPD	6.8 (3.6)	9.6 (3.2)	0.068
	BPH	6.7 (3.3)	13.7 (3.5)	0.007
	Obesity	6.5 (3.3)	9.3 (4)	0.02
	Thyroid disease	6.9 (3.6)	9.3 (3.5)	0.169
	Diabetes	6.7 (3.4)	10.8 (4.2)	0.016
	Dyslipidemia	7.1 (3.7)	6.7 (3.1)	0.988
	Preoperative cholestasis	6.6 (3.6)	8.3 (3.7)	0.117

To our knowledge there are no studies in the literature that investigate factors affecting the length of stay after a LC. Our study is the first to describe these data.

Our results allow the identification of a category of patients at high risk of hospitalization within 1 or 2 days from treatment. Group B can be defined as "older" than group A. There is the possibility that this may increase the chances for patients to have comorbidities and consequently prolonging the length of stay. We believe that presence of obesity, cardiological and nephrological diseases results in more fragile patients, therefore increasing the length of stay. Moreover, we reported that there is no complication specifically affecting the length of stay.

Our findings support the idea that a prolonged length of stay is not linked to the surgical procedure but to the patient's comorbidities. Furthermore, at the multivariate analysis, only age is linked to a high risk too hospitalization.

The limit of our study was linked to a disparity between groups A and B. However, at the same time these data support the fact that a prolonged hospitalization is a rare event after this type of surgical procedure.

In conclusion, the laparoscopic cholecystectomy is a surgical operation that can be safety performed in a day-surgery regimen. However, outcomes on health and economic savings depend on an accurate preoperative selection of patients.

Table 4 Type and incidence of complications and comorbidities in group B patients

	Type of complication/comorbidity	*n* (%)
Complications	Liver function index elevation	6 (7.2)
	Leukocytosis	4 (4.8)
	Necrotic gallbladder	1 (1.2)
	Intestinal ischemia and paralytic ileus	1 (1.2)
	Biliary fistula	2 (2.4)
	Heart attack	1 (1.2)
	Diarrhea	1 (1.2)
	Respiratory arrest	1 (1.2)
	Wound hematoma	1 (1.2)
	Earache	1 (1.2)
	Odynophagia	1 (1.2)
	Mastitis	1 (1.2)
	Wound bleeding	1 (1.2)
	Hemobilia	3 (3.6)
	Sore throat	1 (1.2)
	Cough	1 (1.2)
	Cholangitis	2 (2.4)
	Melena	2 (2.4)
	Abdominal wall abscess	1 (1.2)
	Urinary burning	3 (3.6)
	Bladder globe	3 (3.6)
	Emesis	3 (3.6)
	Abdominal pain with Blumberg +	1 (1.2)
	Cardiac arrhythmia	1 (1.2)
	Acute hepatitis	1 (1.2)
	Hypotension	1 (1.2)
	Palpitation	2 (2.4)
	Biliary vomiting	5 (6.0)
	Epigastric pain	1 (1.2)
	Abdominal pain	8 (9.6)
	Thoracic pain	3 (3.6)
	Fever	17 (20.4)
Comorbidities	Sclerotic myocardiopathy with ectopic ventricular beats	1 (1.2)
	Dyspnea from minimal efforts	3 (3.6)
	Hypertension	23 (27.6)
	Thoracic pain at rest	1 (1.2)
	Left ventricular hypertrophy	1 (1.2)
	Mitral insufficiency	2 (2.4)
	Tricuspidal insufficiency	1 (1.2)
	Previous myocardial infarction	3 (3.6)
	Extrasystoles	2 (2.4)
	Atrial fibrillation	2 (2.4)
	COPD	5 (6.0)
	Asthma	1 (1.2)
	Bronchiectasis	1 (1.2)
	Renal insufficiency	1 (1.2)
	BPH	3 (3.6)
	Obesity	13 (15.6)
	Degenerative maculopathy	1 (1.2)
	Hyperuricemia	1 (1.2)
	GERD	2 (2.4)
	Thyroid disease	3 (3.6)
	Microcythemia	1 (1.2)
	Chronic hepatitis HCV related	1 (1.2)
	Glaucoma	1 (1.2)
	Ulcerative rectocolitis	1 (1.2)
	Bipolar syndrome	1 (1.2)
	Sjogren's syndrome	1 (1.2)
	Anxious-depressive syndrome	1 (1.2)
	Diabetes	5 (6.0)
	Rheumatoid arthritis	1 (1.2)
	Dyslipidemia	3 (3.6)

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval No ethical approval was necessary according to Italian law.

Research involving human participants and/or animals This article does not contain any studies with human participants performed by any of the authors.

Informed consent No informed consent was necessary according to Italian law.

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