Risk factors for conversion of laparoscopic cholecystectomy

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Raffaele Costantini, Francesco Caldaralo, Carmela Palmieri, Luca Napolitano, Liberato Aceto, Carlo Cellini, Paolo Innocenti

Institute of Surgical Pathology, "G. D'Annunzio" University of Chieti, Italy

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BACKGROUND: *Conversion during laparoscopic cholecystectomy has adverse effects on operating time, postoperative morbidity and hospital costs. Identifying risk factors for conversion is thus important to help surgeons to plan and counsel the patient and arranging operating schedules accordingly. This study evaluated retrospectively preoperative and intraoperative risk factors for conversion in 906 laparoscopic cholecystectomies for gallbladder calculosis.*
METHODS*: Examined preoperative variables were: age, sex, obesity, arterial hypertension, diabetes, previous acute myocardial infarction, chronic obstructive pulmonary disease, non-ischemic heart disease, chronic hepatitis, hepatic cirrhosis, previous pancreatitis, biliary colics, endoscopic retrograde cholangiopancreatography (ERCP) and abdominal or cardiac surgery, as well as pain, fever, a high white blood cell count, ultrasound signs of cholecystitis at hospitalization. Intraoperative variables were: adhesiolysis, associated hepatic biopsy.*
RESULTS: *Twenty-five operations were converted (conversion rate: 2.76%). Factors significantly associated with conversion were: age over 60 years, diabetes, previous supramesocolic abdominal surgery, ultrasound signs of cholecystitis, white cell count over* $9x10^3/dl$*, previous acute myocardial infarction and preoperative ERCP, intraoperative adhesiolysis* $(0.001<p<0.05)$.
CONCLUSION: *Systematic evaluation of these factors in patients scheduled for laparoscopic cholecystectomy may help predict difficulties of the procedure, allow patients to be better informed about possible conversion, and optimize the planning of interventions for cases at risk.*

KEY WORDS: Conversion, Laparoscopic cholecystectomy, Preoperative and intraoperative risk factors.

Introduction

Laparoscopic cholecystectomy is an increasingly applied technique in every Surgery Unit throughout the world for gallbladder pathologies; in particular, it represents the "gold standard" for treatment of symptomatic gallbladder calculosis and has replaced the traditional open cholecystectomy [1-7]. Although not totally free of disadvantages, such as an increased incidence of iatrogenic lesions of the biliary tract, the technique undoubtedly presents numerous advantages with respect to the traditional "open" approach: reduced postoperative pain, early canalization, reduction of postoperative complications, shorter hospitalization with earlier return to normal work activity by the patient, better cosmetic results [7]. Since the first operation in 1987, the duration of laparoscopic cholecystectomy has continuously decreased in parallel with the increasing experience of surgeons. This circumstance has further reduced the incidence of complications, thanks to a shortened duration of pneumoperitoneum (which strongly affects the cardiocirculatory

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Correspondence to: Raffaele Costantini, MD, via Raffaele Paolucci 209, 66036 Orsogna (Chieti), Italy (e-mail: r.costantini@unich.it)

function) [8]. In spite of these positive aspects, a percentage varying from 2 to 15% of all laparoscopic cholecystectomies still has to be converted in the course of the operation [3,9-18].

Conversion should not be regarded as a complication but as a prudent choice to avoid additional risks/damage in particular cases. However, it has adverse effects on operating time, postoperative morbidity and hospital costs [9,17,19-22]. Identifying risk factors for conversion is thus important, as it will help the surgeon to plan and counsel the patient and introduce new policies to the Unit, arranging operating schedules accordingly [4,7,18,21,23-26].

This identification is not always possible; in fact, complications such as bleeding, accidental lesions of the biliary ducts or adjacents organs, intolerance to pneumoperitoneum may arise in the course of any laparoscopic intervention, even the apparently simplest, in which cases conversion is the only possible solution [27]. However, there are several potential risk factors for conversion which can be evaluated in the preoperative period; these can be searched for in various clinical, laboratory and instrumental parameters recorded in the patients. A number of studies have addressed this important issue, although often with conflicting results as regards the relative importance of one or the other as a predictive factor for conversion [4,7,9,10,14,15,18,24,28-33]. The aim of the present study was to retrospectively analyze a high number of perioperative parameters in patients subjected to laparoscopic cholecystectomy in our 6-year experience, in order to identify those significantly correlated with the risk for conversion.

Part of the casuistry of the present paper was included in a previous publication, to assess different parameters and with an aim different from that of analysing risk factors for conversion [34].

Materials and Methods

Records of laparoscopic cholecystectomies performed for gallbladder calculosis from February 2003 to March 2009 in our Surgery Unit were reviewed. A retrospective evaluation was performed of anagraphic data, clinical history, preoperative clinical, laboratory and instrumental data and intraoperative variables to assess which factors were statistically associated with conversion. The variables studied are reported in Table I.

Chi-square test and Fisher's exact test were used where appropriate to analyze the statistical association between data. The level of significance was assessed at $p<0.05$.

Results

Laparoscopic cholecystectomy was performed in 906 patients, 393 males and 513 females, respectively. Mean age was 55 years (57 for males and 53 for females).

Twenty-five interventions were converted (conversion rate: 2.76%). The reasons for conversion were, in order of frequency: adhesions (n. 9; 36%), lack of visualization of Calot's triangle because of acute inflammation (n. 4; 16%); uncontrollable bleeding (n. 4; 16%), bilioenteric fistula (n.3; 12%); intolerance to pneumoperitoneum (n.1; 4%), lesion of the biliary tract due to the stone (n.1; 4%), scarce mobilization of the liver and marked distension of the colon (n.1; 4%), lack of visualization of Calot's triangle because of a hypertrophic liver (n.1: 4%), marked distension of the small bowel (n.1; 4%).

Among conversions due to adhesions, 7 patients were over 60 years old, 2 had had an acute myocardial infarc-

TABLE I - *Variables examined*

Anagraphic variables	Sex
	Age
Clinical History variables	Obesity
	Arterial hypertension
	Diabetes
	Previous acute myocardial infarction
	Chronic obstructive pulmonary disease
	Non-ischemic heart disease
	Chronic hepatitis
	Hepatic cirrhosis
	Previous pancreatitis
	Biliary colics
	Previous ERCP
	Previous abdominal surgery
	supramesocolic
	submesocolic
	Previous cardiac surgery
Variables at hospitalization	Pain
	Time to onset of acute pain
	Fever
	White blood cell count (WBC)
	Ultrasound signs of cholecystitis
Intraoperative variables	Adhesiolysis
	Associated hepatic biopsy

TABLE II - *Anagraphic Variables*

	Variables	TOT	Conv	p value
Sex				
	Male	393	11	ns
	Female	513	14	
Age				
	< 60 yrs	547	7	<0.01
	>60 yrs	359	18	

TABLE III - *Medical variables at clinical history*

Variables	TOT	Conv	p value	Variables	TOT	Conv	p value
Obesity				Arterial Hypertension			
Absent	897	24	ns	Absent	600	14	ns
Present	9	1		Present	306	11	
Chronic Hepatitis				Diabetes Mellitus			
Absent	883	24	ns	Absent	842	19	<0.01
Present	23	1		Present	64	6	
Hepatic Cirrhosis				Acute Myocardial Infarction			
Absent	881	23	ns	Absent	878	20	<0.001
Present	25	2		Present	28	5	
Previous Pancreatits				COPD			
Absent	870	22	ns	Absent	886	23	ns
Present	36	3		Present	20	2	
Biliary Colics				Non-ischemic Heart Disease			
Absent	134	3	ns	Absent	839	21	ns
Present	772	22		Present	67	4	

TABLE IV - *Surgical variables at clinical history*

Variables	TOT	Conv	p value
Previous ERCP			
Absent	865	20	<0.01
Present	41	5	
Previous abdominal interventions			
Absent	521	8	<0.05
Present	385	17	
In the supramesocolic space			
Absent	870	18	<0.001
Present	36	7	
In the submesocolic space			
Absent	557	15	ns
Present	349	10	
Previous cardiac interventions			
Absent	874	23	ns
Present	32	2	

tion, 7 had undergone abdominal surgery (5 in the supramesocolic space), 1 had ultrasound evidence of acute cholecystitis, 5 showed a white cell count over $9x10^3$/dl and 1 presented fever at hospitalization.

Among conversions because of a bilio-enteric fistula, 2 patients were over 60 years old, 2 had diabetes, 2 had undergone endoscopic retrograde cholangiopancreatography (ERCP) before the intervention, 2 had had previous abdominal surgery, 1 had pain, fever and a white cell count over $9x10^3$/dl at hospitalization; only 1 had ultrasound evidence of cholecystitis.

Among conversions for an inflammatory process, 3 patients were over 60 years old, 1 had diabetes, 3 had undergone abdominal surgery, 1 had pain, fever, high white cell count and ultrasound evidence of acute cholecystitis at hospitalization.

All patients presenting bleeding were over 60 years old, only 1 patient suffered from hypertension and 2 had undergone adhesiolysis during cholecystectomy.

Based on a statistical univariate analysis, the factors which proved significantly associated with conversion were: age over 60 years ($p<0.01$), diabetes ($p<0.01$), previous myocardial infarction ($p<0.001$), preoperative ERCP ($p<0.01$), previous abdominal surgery ($p<0.05$) - in particular in the supramesocolic space ($p<0.001$)-, a white cell count > $9x10^3$/dl ($p<0.05$), ultrasound evidence of acute cholecystitis ($p<0.05$), intraoperative adhesiolysis ($p<0.001$) (Tables II-VI).

A non-statistically significant association was found between conversion and: sex, obesity, arterial hypertension, chronic obstructive pulmonary disease, non-ischemic heart disease, previous acute pancreatitis, chronic hepatitis, hepatic cirrhosis, biliary colics, previous abdominal surgery in the submesocolic space, previous cardiac surgery, pain and fever at hospitalization, pain for 72 hours or more before hospitalization, associated hepatic biopsy (Tables II-VI).

Discussion

In patients undergoing laparoscopic cholecystectomy for gallbladder calculosis in our casuistry, the percentage of conversion is in line with the lowest values reported in the literature (less than 3%), confirming once more the wide applicability of the procedure [1,11,12,35,36].

TABLE V - *Variables at hospitalization*

Variables	TOT	Conv	p value
Pain			
Absent	737	18	ns
Present	169	7	
Acute pain			
For less than 72 hrs	115	3	ns
For more than 72 hrs	54	4	ns
Fever			
Absent	782	18	ns
Present	124	7	
WBC			
< 9 x 10^3/dl	717	15	<0.05
> 9 x 10^3/dl	189	10	
Ultrasound signs of cholecystitis			
Absent	865	21	<0.05
Present	41	4	

TABLE VI - *Intraoperative variables*

Variables	TOT	Conv	p value
Adhesiolysis			
Absent	760	10	<0.001
Present	146	15	
Associated hepatic biopsy			
Absent	884	23	ns
Present	22	2	

The retrospective analysis of several variables in the clinical history as well as of symptoms, laboratory and instrumental data at examination, and the analysis of some intraoperative variables has identified several parameters significantly associated with conversion. Only some of these associations confirm previous results in the literature, as discussed below.

ANAGRAPHIC VARIABLES

In our study, the univariate analysis showed a significant association between conversion and an **age over 60 years**, a result similar to what observed in several previous studies in the literature [1,4,8,19,23,31,37,38]. The increased risk in the elderly may be due to a high number of biliary colics that these patients very often present at their clinical history, which possibly results in a distortion of the anatomy of the cystic duct and in a greater difficulty to prepare the hilus of the gallbladder [4]. As will be reported below, however, in our study the association between previous biliary colics and conversion proved not significant, thus suggesting a different hypothesis for the link between advanced age and conversion itself. This could lie in the fact that elderly patients often tend to seek hospital assistance long after the start of the disease, when complications have already occurred. Nevertheless, other studies show that age is not a risk factor for conversion [32,39].

Sex proved not to be significantly predictive of conversion in the present study, similarly to the results by Chandio et al [38] but in contrast to many studies in the literature, which indeed show a significant association with the male sex [1,8,12,21-23,31,32,37,40]. The reason for this association is, however, not clear. Some authors hypothesize that this is due to male patients tending to seek medical care only after repeated painful episodes and in any case later than women [29]. Others report that, in the context of symptomatic gallbladder stones, inflammation and fibrosis are more extensive in men than in women [26].

VARIABLES OF THE CLINICAL HISTORY

Obesity is reported as significantly associated with conversion in many papers [8,21,23,41], for instance, Hutchinson et al [29] reported that a BMI >27.2 kg/m^2 represents a significant factor predictive of nearly a three-fold-higher conversion rate, but at the same time is considered one of the main indications for laparoscopy [41]. It is believed, ultimately, that the increase in the experience of the surgeon and the improvement in the surgical apparatus can lead to a reduction of the conversion rate in these patients [13,14]. Our study does not show any association between obesity and conversion, in line with the results of a number of other authors [42,43].

The presence of **hypertension** was not a risk factor in our study. In the literature, the paper by Livingston et al. is the only to show that hypertension is a risk factor for conversion, even though the reason for such an association is not clear [32]. A possibility is that hypertensive patients have less pain and thus seek medical care with delay, a circumstance which would promote complications [44, 45].The other studies do not take into consideration hypertension in an isolated fashion, but they consider **cardiovascular diseases** in general, some authors showing a significant association of these pathologies with conversion [9,46]. **Non-ischemic heart diseases** (atrial fibrillation, valvulopathies, cardiomyopathies) were not, in our study, associated with conversion. In contrast, the univariate analysis of our casuistry showed an interesting item not considered in isolation in any previous study: the significant link between conversion and previous myocardial infarction. In this case, too, the reason is not clear. We also analyzed the association between **cardiosurgical interventions** and conversion, but the data were not significant.

Another factor which proved to be associated with con-

version in our casuistry was **diabetes**. The reason can be searched for in the long-term microvascular complications of this condition, which also affect the wall of the gallbladder [46].
Furthermore, diabetic neuropathy leads to an increase in the pain thresholds and does not allow evaluation of symptoms, signs and complications of gallbladder calculosis at an early stage [47]. Patients often come to medical observation quite late and with complex pictures. In the literature, there are a number of papers reporting, instead, that diabetes is not associated with conversion [4,9], though Ibrahim et al showed that diabetic patients who had conversion presented a significantly higher glycosylated hemoglobin [23].
Similarly to what is found in other studies, **chronic obstructive pulmonary disease** was not significantly associated with conversion in our data [9].
With respect to previous **pancreatitis**, the results from the literature and those from our study are similar, showing a lack of association with conversion [13,33,46]. The execution of **ERCP** before the intervention proved associated with an increased risk for conversion in our study, in line with the recent results by Ercan et al [1], but in contrast to those of all previous papers in the literature, which show a lack of a significant association [see [11]].
Two patients in whom conversion was necessary in our study presented **hepatic cirrhosis;** in one the hypertrophic liver did not allow visualization of the gallbladder hilus, in the other the presence of adhesions did not permit the isolation of the structures to be sectioned. The univariate analysis did not show a significant association between hepatic cirrhosis and conversion, unlike other previous studies [21,48]. Relatively recent data [49] underline the safety of the laparoscopic technique in cirrhotic patients; the reported conversion rate ranges from 4.4 to 9.5%, a result indicating that the surgeon's experience is an important variable for the success of laparoscopy in these cases [50]. The preoperative diagnosis of **chronic hepatitis** was also not associated with conversion in our study.

Clinical, instrumental and laboratory variables at hospitalization

Our data showed an association between conversion and echographic signs of **acute cholecystitis** and a leucocyte count over $9x10^3$ / dl. Among the patients with echographic signs of acute cholecystitis (such as pericholecystic edema and thickened walls of the organ), 9.76% were converted, versus 2.43% of those without acute cholecystitis, this was statistically significant. This association confirms the data in the literature [1,7,9,12,13,23,29,31,38-40]. Already in 1997, Matranga et al showed a significantly increased risk of technical difficulties in laparoscopic cholocystectomy when preoperative ultrasonography demonstrated a gallbladder wall thickening [51]. The subsequent year, another study specifically devoted to the evaluation of the echographic signs predictive for conversion showed that a distended gallbladder, a wall thickness over 3 mm and the wedging of stones in the biliary tract are significant [52]. A few studies show a significant association between a thickened wall only and conversion [10,14]. Other studies show that the ultrasound diagnosis of acute cholecystitis is not predictive for conversion [33]. Data from the literature indicate as significant a raised white cell count [1]. Different values of leucocytes, however, are considered, i.e., over: $10x10^3$/dl [13,33], $11x10^3$ /dl [9], $12x10^3$ /dl [4] or $13x10^3$/dl [19]. In our study statistical significance was reached for a level of white cell count over 9 x 10^3/dl, in line with the results by Rosen et al [7].
The analysis of clinical factors, such as **pain** and **fever** at hospitalization, acute pain for approximately 72 hours or less, was not significant. Our hypothesis is that the considered variables are influenced by the way the patient reports the symptoms, by his/her pain threshold, and associated pathologies which can mimic the symptoms of gallbladder calculosis. A number of papers have dealt specifically with the problem of the best "timing" for the intervention in acute cholecystitis [47-49,53,57]. The paper by Knight et al [54] shows that laparoscopic cholecystectomy for acute cholecystitis before or after 72 hours since hospital admission does not influence the conversion rate significantly. This result is confirmed by the data of Soffer et al [55], showing that the timing of laparoscopic cholecystectomy in patients with acute cholecystitis has no clinically relevant effect on conversion rates, operative times, or length of stay. The results of the study by Peng et al [56] evidence, instead, that if cholecystectomy is performed 48 hours after the start of the symptomatology, the conversion rate is higher, a result also confirmed by Pezzolla et al who recommend the intervention within 72-96 hours to reduce the risk of conversion [57]. F**ever** is also reported as significantly associated with conversion in the literature, but not in our study [7, 9].

intraoperative variables

The presence of **adhesions** did not allow visualization of some structures to be prepared and sectioned in 9 cases out of 25 (36.0%), and this proved to be the most frequent cause of conversion in our casuistry. Of these, 7 patients had previously undergone **abdominal interventions**, 5 of which were in the **supramesocolic** district. As already described, also in the literature the association between previous interventions in the supramesocolic space and conversion is significant while that between operation in the **submesocolic** space and conversion is not [1,12-14,18,21,23,27,46]. This is probably because the area involved in cholecystectomy surgery and that of the previous abdominal intervention have to coincide to

increase the risk of conversion. Among the patients subjected to adhesiolysis during the intervention in our study, a significant percentage was associated with conversion and among all patients undergoing conversion because of adhesions, 5 had previously been subjected to surgery in the supramesocolic district. Numerous studies in the literature have shown that the presence of adhesions is associated with conversion [33].

Considering **hepatic biopsy** performed to assess the stage of a chronic hepatitis or a hepathic cirrhosis, we evaluated if and to what extent this procedure could cause intraoperative complications, mostly haemorrhagic, due to the hepatic disease. Our data show that performing a biopsy is not a risk factor for conversion.

In conclusion, our study shows that factors significantly associated with conversion are: age over 60 years, diabetes mellitus, previous abdominal interventions in the supramesocolic space, ultrasound signs of cholecystitis, a white cell count over $9x10^3$ / dl, intraoperative adhesiolysis, previous acute myocardial infarction and preoperative ERCP.

Though none of the reported factors can be regarded as a real contraindication to the laparoscopic approach, their systematic evaluation (at least of the preoperative variables) in patients scheduled for the intervention appears important. It may help predict the difficulty of the procedure, allow patients to be better informed about possible conversion, and optimize the planning of interventions, particularly by selecting the most experienced surgeons for cases at risk [8,21,22,36,37,46,58].

Riassunto

PREMESSA E SCOPO DELLO STUDIO. La conversione durante l'intervento di colecistectomia laparoscopica presenta ripercussioni negative sulla durata dell'intervento, la morbilità postoperatoria ed i costi per la degenza ospedaliera. L'identificazione dei fattori di rischio per la conversione è pertanto importante per aiutare il chirurgo ad informare correttamente il paziente e per pianificare le modalità di intervento in maniera ottimale. Lo scopo di questo studio è stato quello di valutare retrospettivamente i fattori di rischio per conversione, preoperatori ed intraoperatori, negli interventi di colecistectomia laparoscopica eseguiti per calcolosi della colecisti nel nostro Istituto di Patologia Chirurgica nel periodo Febbraio 2003-Marzo 2009.

MATERIALI E METODI. Sono state valutate n. 906 colecistectomie laparoscopiche effettuate nel periodo indicato. Le variabili preoperatorie considerate sono state: età, sesso, obesità, ipertensione arteriosa, diabete, pregresso infarto miocardico acuto, broncopneumopatia cronica ostruttiva, patologia cardiaca non ischemica, cirrosi epatica, pregressa pancreatite, coliche biliari, pregressi interventi chirurgici addominali o cardiaci, effettuazione di colangiopancreatografia retrograda endoscopica (ERCP), come pure la presenza all'atto della ospedalizzazione di: dolore, febbre, conta leucocitaria elevata, segni ultrasonografici di colecistite. Le variabili intraoperatorie considerate sono state: presenza di adesiolosi, effettuazione di biopsia epatica associata.

RISULTATI: Sono state convertite 25 colecistectomie (frequenza di conversione: 2.76%). Fattori preoperatori significativamente associati a conversione sono risultati: età superiore a 60 anni, diabete, pregresso intervento di chirurgia addominale sopramesocolica, pregresso infarto miocardico acuto, ERCP preoperatoria, nonchè segni ecografici di colecistite e una conta leucocitaria superiore a $9x10^3$/dl all'ospedalizzazione. Fra i fattori intraoperatori, la presenza di adesiolisi è risultata significativamente associata a conversione ($0.001<p<0.05$).

DISCUSSIONE E CONCLUSIONI: Nella nostra casistica di pazienti sottoposti a colecistectomia laparoscopica per calcolosi, la percentuale di conversione è risultata analoga a quella dei valori più bassi riportati in letteratura (<3%), confermando ancora una volta l'ampia applicabilità della procedura. L'analisi retrospettiva di numerose variabili relative alla storia e presentazione clinica del paziente ha rivelato la significativa associazione di svariate di queste con la conversione. La valutazione sistematica di queste variabili nei pazienti candidati alla colecistectomia laparoscopica può aiutare a prevedere le difficoltà della procedura, consentire ai pazienti di essere meglio informati circa la possibilità della conversione, ed ottimizzare la pianificazione degli interventi per i casi a rischio.

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