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Single surgeon experience: intraoperative complications and conversion to open surgery in laparoscopic cholecystectomy, the fore and aft of 20 years' experience.

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Abstract

Background: With the increasing experience of surgeons, there has been a decrease in the conversion rates from Laparoscopic Cholecystectomy (LC) to Open Cholecystectomy (OC). We aimed to investigate the experience of single surgeon in the decrease of conversion and complication rates related with gall bladder disease by examining data from the first and last 5 y of 20 y experiences.
Material and methods: The data of 848 patients with cholelithiasis who underwent LC by the same surgeon in the first and last 5 y of a 20 y period from 1996-2016 were evaluated and compared. The first 5 y (1996-2001) was named as period 1 (n=418) and the last 5 y (2011-2016) were named as period 2 (n=430). Demographic data and conversion reasons were recorded.
Results: Period 1 consisted of 418 patients (380 females, 38 males) and period 2 comprised 430 patients (350 females, 80 males). The mean age was 45.2 y (20-84 y). Unclear obscure anatomy more prominently affected the conversion to OC in males in both periods (p=0.002 and p=0.043). Statistical significance was found in period 1 for male sex (p=0.019). The rate of males was detected higher in period 2 (p=0.001). Conversion to OC was 38 patients (9.1%) in period 1 and 20 patients (4.7%) in period 2.
Conclusion: Surgical experience is associated with lower conversion rates from LC to OC. Also many male patients are being operated on experienced phase.

Keywords: Single surgeon experience, Cholelithiasis, Conversion to open surgery.

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Introduction

Laparoscopic Cholecystectomy (LC) is the most commonly performed surgery for Gallbladder Diseases (GBD). Nevertheless, it can be argued that Open Cholecystectomy (OC) has been replaced by LC in the treatment of GBD, even though the risks for intraoperative injury are higher for LC [1-3]. With the increasing experience of the surgeon and understanding of the aforementioned technique, there has been a decrease in the conversion rate from 0%-22% to approximately 1%-5% of attempted LCs [4]. Due to postoperative complications and long hospital stay, conversion from LC to OC yields serious deteriations in outcomes for patients. The complications and the conversion rate of LC, which are related to experience and the difficulties that occur during surgery, are also effected by the history of previous abdominal surgery, recurrent attacks of cholecystitis, advanced age of the patient, or male sex. However, despite technical developments, and better training of surgeons and laparoscopic tools, conversion remains an important problem for surgeons [5].

There are studies and metaanalyses evaluating the influence of different factors such as technological development, surgical experience, and age and sex of the patient, from different hospitals and various surgeons. However, it came to our attention that no studies have compared data from a single surgeon in relation to their experience in years.

This study aimed to investigate the decrease in conversion from LC to OC and complication rates in GBD through a single surgeon's experience by examining data from the first and last 5 y of a 20 y period.

Patients and Methods

A total of 1550 patients with cholelithiasis underwent LC by the same surgeon at the Department of General Surgery at Goztepe Education and Research Hospital and the Private Bolge Hospital between 1996 to 2016; data of 418 and 430 patients from 1996-2001 and 2011-2016, respectively, were retrospectively reviewed. Written informed consent was obtained from each patient or their family.

Excel documents were used to record patient's data regarding age, sex, indications for LC, status of conversion to OC, reasons for conversion, comorbidities, and types of intraoperative complications. The indications for cholecystectomy were symptomatic and asymptomatic cholecystolithiasis, acute cholecystitis within the first 24 h, gall bladder polyps, and recent obstructive jaundice due to common bile duct stones that were treated previously with Endoscopic Retrograde Cholangio Pancreaticography (ERCP). Surgeon experience in the 'inexperienced period' was defined as the number of LCs performed by the same surgeon during the first 5 y (1996-2001). A total of 418 patients underwent LC during this period named as period 1. LC was not approved for patients who had undergone Previous Upper Abdominal Surgery (PUAS) and those aged>65 y in period 1. The number of LCs performed during the last 5 y period (2011-2016) (period 2) was 430. There were no restrictions with regards to previous abdominal surgery and age for LC in this period. Retrograde cholecystectomy was applied with same dissection technique in both groups.

The pathologic changes due to cholecystitis were unclear, obscure anatomy (UOA), acute inflammation with empyema, and friable edematous tissue around Calot's triangle. The intraoperative complications recorded were uncontrollable haemorrhage due to blood vessel injuries, common bile duct injuries, bowel injury, spillage of gall stones, and duodenal injuries. Each of these complications was also among the reasons for the requirement of conversion to OC.

First-generation cephalosporin was applied preoperatively in each patient intravenously within 1 h of the first incision. The same open and laparoscopic surgical techniques were used in all patients; subcostal incision is preferred in OC, and a four-trocar (2 × 5 mm, 2 × 10 mm) technique with insufflation of the abdominal cavity at 12-15 mm Hg in LS. Following discharge, patient follow-up was conducted in the outpatient clinic.

Statistical analysis

The NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for the statistical analysis. Data are reported as frequency and ratio. Fisher's exact test, Pearson's Chi-square test and Yates's continuity correction test were used to compare qualitative data. The results were evaluated with 95% confidence intervals and the level of significance was accepted as $p<0.05$.

Results

Eight hundred forty-eight patients (730 females (86.1%) and 118 males (13.9%)) were included in the study. The mean age was 45.2 y (range, 20-84 y). Period 1 constituted 418 patients (380 females, 38 males) and period 2 comprised 430 (350 females, 80 males) (Table 1).

Table 1. *Demographic characteristics of patients.*

	Period 1 (1996-2001)	Period 2 (2011-2016)
Total number of patients	418 (380 F/38 M)	430 (350 F/80 M)
Conversion to OC	38 (13 F/25 M)	20 (10 F/10 M)
Age (y)	45.2 (range, 20-84)	

F: Female; M: Male; OC: Open Cholecystectomy.

The number of conversions from laparoscopy to OC was 38 (25 females, 13 males) in period 1 and 20 (10 females, 10 males) in period 2 (Table 1). The reasons for conversion from laparoscopy to OC in periods 1 and 2 were as follows: UOA with adhesions between the omentum, gall bladder, peritoneum, and surrounding tissues around Calot's triangle (12 in period 1 and 8 in period 2); acute inflammation with empyema (7 in period 1 and 2 in period 2); technical problems (insufflator problems) (5 in period 1 and 2 in period 2); uncontrolled haemorrhage (4 in period 1 and 2 in period 2); common bile duct injury (CBDI) (4 in period 1 and 1 in period 2); bowel injury (4 in period 1 and 1 in period 2); gallstone spillage (2 in period 1 and 2 in period 2); friable edematous tissue around Calot's triangle (1 in period 2 only); and duodenal injury (1 in period 2 only) (Table 2). There were no statistically significant differences between periods 1 and 2 when the reasons for conversion to OC were compared ($p>0.05$).

Table 2. *Reasons for conversion from laparoscopic to open cholecystectomy.*

	Period 1 (n=38/418)	Period 2 (n=20/430)	Total (n=58/848)	p
	n (%)	n (%)	n (%)	
Unclear obscure anatomy[a]	12 (2.9)	8 (1.9)	20 (2.4)	[a]0.457
Acute inflammation with empyema	7 (1.7)	2 (0.5)	9 (1.1)	[b]0.103
Technical problem[b]	5 (1.2)	2 (0.5)	7 (0.8)	[b]0.281
Uncontrollable hemorrhage	4 (1)	2 (0.5)	6 (0.7)	[b]0.999
Common bile duct injury	4 (1)	1 (0.2)	5 (0.6)	[b]0.211

Bowel injury	4 (1)	1 (0.2)	5 (0.6)	[b]0.211
Spillage of gallstones	2 (0.5)	2 (0.5)	4 (0.5)	[b]0.427
Friable edematous tissue around Calot's triangle	0 (0)	1 (0.2)	1 (0.1)	[b]0.999
Duodenal injury	0 (0)	1 (0.2)	1 (0.1)	[b]0.999

[a]Yates's Continuity Correction Test; [b]Fisher's exact test; [a]Adhesions between omentum, gall bladder, peritoneum, and surrounding tissues around Calot's triangle; [b]Insufflator stopped working.

UOA was statistically more prominent in terms of conversion to OC in males for both periods (p=0.002 and p=0.043) (Table 3). No significant difference was noted for conversion due to acute inflammation with empyema in male patients for period 2. However, a significant difference was found in period 1 for male sex (p=0.019). Other causes for conversion were not statistically significant.

The rate of male patients undergoing conversion was detected as significantly higher in period 2 compared with period 1 (p=0.001) (Table 4). Conversion to OC was determined in 38 patients (9.1%) in period 1 and 20 patients (4.7%) in period 2 (Table 5).

Table 3. *Relation between conversion reasons from laparoscopic to open cholecystectomy and sex on periods 1 and 2.*

	Period 1 (n=38/418)		p	Period 2 (n=20/430)		p
	Male (n=38) n=13 (%)	Female (n=380) n=25 (%)	Male (n=80) n=10 (%)	Female (n=350) n=10 (%)		
Unclear obscure anatomy[a]	5 (13.2)	7 (1.8)	0.002**	4 (5)	4 (1.1)	0.043*
Acute inflammation with empyema	3 (7.9)	4 (1.1)	0.019*	1 (1.3)	1 (0.3)	0.338
Technical problem[b]	1 (2.6)	4 (1.1)	0.381	1 (1.3)	1 (0.3)	0.338
Uncontrollable hemorrhage	1 (2.6)	3 (0.8)	0.321	1 (1.3)	1 (0.3)	0.338
Common bile duct injury	1 (2.6)	3 (0.8)	0.318	0 (0)	1 (0.3)	0.999
Bowel injury	1 (2.6)	3 (0.8)	0.318	1 (1.3)	0 (0)	0.186
Spillage of gallstones	1 (2.6)	1 (0.3)	0.174	1 (1.3)	1 (0.3)	0.338
Friable edematous tissue around Calot's triangle	0 (0)	0 (0)	-	1 (1.3)	0 (0)	0.186
Duodenal injury	0 (0)	0 (0)	-	0 (0)	1 (0.3)	0.999

Fisher's exact test; **p<0.01; *p<0.05; [a]Adhesions between omentum, gall bladder, peritoneum, and surrounding tissues around Calot's triangle; [b]Insufflator stopped working.

In both periods, direct trocar entry was made after creating pneumoperitonium through a veress needle. Drains were used routinely when necessary in both periods, and intra-abdominal collection was examined using postoperative Ultrasonography (USG) when drains were not used.

Table 4. *The relation between Period 1 and 2 and sex of the patients.*

		Period 1 (n=418)	Period 2 (n=430)	Total (N=848)	p
		n (%)	n (%)	n (%)	
Sex	Female	380 (90.9)	350 (81.4)	730 (86.1)	0.001**
	Male	38 (9.1)	80 (18.6)	118 (13.9)	

Pearson's chi-square test; **p<0.01.

Table 5. *The number of converted patients in Periods 1 and 2.*

		Period 1 (n=418)	Period 2 (n=430)	Total (N=848)	p
		n (%)	n (%)	n (%)	
Cholecystectomy	LC	380 (90.9)	410 (95.3)	790 (93.2)	0.015*

Conversion to OC	38 (9.1)	20 (4.7)	58 (6.8)

Yates's continuity correction test; *p<0.05; OC: Open Cholecystectomy; LC: Laparoscopic Cholecystectomy.

Discussion

LC has become the standard procedure for treating cholelithiasis due to its quick recovery period and economic benefits. However, conversion from LC to OC is still quite possible. This has been reported with a high variability in the literature, ranging from 0%-20%. This variation is argued to occur as a result of the experience of surgeons and other risk factors such as patient age, sex, and the presence of acute cholecystitis and PUAS [4].

It is important to note that conversion to OC from LC is not failure of an LC procedure. It is a process whereby it is necessary to continue a surgical procedure that cannot be completed *via* LC without facing complications. The reasons for conversion in 1/3 of the patients were reported as the lack of proper assessment of gallbladder anatomy due to inadequate dissection, intense adhesions, and inflammation [6,7]. The findings in our study indicate that there was no significant difference between the two periods in terms of the reasons for conversion from laparoscopy to OC and the results are compatible with previous literature findings (Table 2) [8,9]. Although statistically insignificant, UOA was the major cause of conversion in both periods. It means that conversion due to UOA does not diminish, regardless of the increased surgical skill. It is important because we cannot reduce the overall conversion rates despite defining the pathologic changes of UOA in cholecystitis using advanced investigation modalities. On the other hand, UOA due to adhesions and difficulty in dissection were the most prominent causes for conversion to OC in male patients, both in period 1 and period 2 (Table 3). We suggest that surgeons must be extremely diligent in patients with UOA findings on USG or CT, especially in male patients. Laparoscopy should be performed by an experienced surgeon to avoid potential complications. Acute inflammation with empyema was not a significant cause of conversion in male patients in period 2 (p=0.338). However, a significant difference was reported related with male sex in period 1 (p=0.019). We may suggest that as surgical experience increases, acute inflammation with empyema causes less conversion to OC.

CBDI is a feared complication of LC. LC is more difficult than OC and the risk for CBDIs is greater for older patients, male patients, and for patients with a history of biliary colic and cholecystitis attacks. One third of serious CBDIs can be detected during surgery [8-10]. CBDI occurred in four patients in period 1, all which were detected in the early postoperative period. Three patients received a T-tube for the bile duct, and one underwent hepaticojejunostomy with laparotomy. In period 2, totally one patient was found to have CBDI intraoperatively and the procedure was converted to OC; the common bile duct repair was achieved using a T tube. The risk of intraoperative complications, particularly CBDI has increased with the introduction of LC. This high risk is expected to decline as surgeon experience in laparoscopic procedures increases [4]. We also observed few CBDIs in our series.

Lein et al. indicated a relation between complications and male patients [11]. It was strongly believed that laparoscopy in male patients was more difficult and thus fewer indications were approved. There was a strong relation between periods 1 and 2 and male sex in our study. The rates of male patients undergoing LC were significantly lower in period 1 compared with period 2 (p=0.001) (Table 4). One of the possible reasons for this low number of indicated LCs in male patients during the inexperienced stage of period 1 may be the high degree of difficulty and greater requirement for conversion to OC. However, more male patients underwent LC in period 2 as the surgeon's experience increased and complication rates did increase. Complications such as CBDI, which are attributed to male sex in particular, did not increase in period 2 (p=0.211). This can only be explained by the increased surgical experience.

In this study, the conversion rate was determined as 38 (9.1%) in period 1 and 20 (4.7%) in period 2, which compares favourably with rates reported in the literature (Table 5) [12-14]. It appears that previous history of abdominal surgery and/or new gall bladder inflammation are two of the most frequent situations that carry increased operative risk and are the main reasons for conversion to OC, as was also observed in the present study. Pathologic changes related with pericholecystitis make laparoscopy challenging, disrupt the local anatomy, and increase the difficulty of identifying Calot's triangle and common bile duct [7,15]. Pericholecystitis can also predispose patients to haemorrhage from the gallbladder bed or cystic artery, which causes an increased risk of gallbladder perforation and thus spillage of gallstones into the peritoneal cavity during dissection of the gallbladder [15]. Conversion to OC due to uncontrollable haemorrhage did not yield any significant differences between periods in our study.

A meta-analysis demonstrated that age>65 y, male sex, acute cholecystitis, thickened gall bladder wall, diabetes mellitus and PUAS were significantly associated with increased risk for conversion. It is important for surgeons to evaluate such risks for a proper operation plan [4]. In period 1, patients with PUAS and those aged over 65 y prior to surgery did not undergo LC. Older patients, some male patients with obesity, and patients with previous upper abdominal surgery underwent OC. In period 2, all patients with these characteristics underwent LC. As the surgeon experience increased in period 2, a decrease in conversions to OC (p=0.015) was observed (Table 5). Although the number of LCs increased and many more male patients underwent LC in period 2, including those who would have been considered high risk in period 1, the conversion rates decreased from 9.1%-4.7%.

Although no statistically significant, surgical experience was also associated with fewer complications. A recent meta-analysis of 17 randomized controlled trials studying a total of 3040 individuals comparing a variety of open and closed access techniques found no difference in complication rates;

potentially life threatening injuries to blood vessels occurred in 0.9 per 1000 procedures and to the bowel in 1.8 per 1000 procedures. Currently, there are no demonstrable differences in the safety of open *versus* closed techniques for establishing access and creating the initial pneumoperitoneum; therefore, decisions regarding choice of technique are left to the surgeon and should be based on individual training, skill, and case assessment. A high index of suspicion and prompt conversion to laparotomy are required to recognize and treat complications related to access [16,17]. In our study, all accesses were made with the closed technique after creating pnomoperitonium *via* a veress needle, without any complications in both periods.

The use of drains in LCs in the early days was not a highly accepted approach for minimally invasive interventions. When it was understood that the use of drains did not increase complications or costs, surgeons started to use them routinely [18].

Drains were used in both periods, and when they were not used, intra-abdominal collection was assessed using USG postoperatively. In period 2, in one only patient, 100 mL of bile came through drain, which was interpreted as either Luschcka duct leakage or bile from the liver bed. This procedure was not converted to laparotomy, it was then managed with ERCP and the bile leakage resolved. One reason to leave a drain would be the risk for bile leak, even though it does not necessarily prevent or treat postoperative bile collection, bleeding or bile peritonitis [18]. The CBDIs in all four patients in period 1 were identified owing to the use of drains. Note, the use of drains in LCs has no any additional benefits, it can be argued that they may cause increased pain.

Patient and surgeon-related factors are significantly associated with conversion to OC; specifically, male sex, older age, and surgeons with low-volume surgery [19,20]. The risk of intraoperative complications has declined with increasing surgical experience and use of intraoperative cholangiography [3]. We were not able to perform intraoperative cholangiography. We observed that the rates of conversion were not significantly reduced even though the surgeon was more experienced. In this respect, one has to remember that conversion is not failure and great attention should be paid to avoid further complications. Beyond that, UOA is an important cause of conversion even if a surgeon is experienced. Therefore, conversion should not be avoided if necessary, otherwise some known complications will be inevitable.

Conclusion

This single surgeon study for GBD demonstrates that increased surgeon experience is associated with lower conversion rates from LC to OC. Although it was not statistically significant, complication rates were shown to be reduced in the more experienced second period. However, as experience increases, surgeons have moved on from the belief that LC surgery is more difficult and many more male patients are being to undergo this procedure. UOA should also be kept in mind because it remains among the major causes of conversion.

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