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Laparoscopic Cholecystectomy in an Academic Hospital: Evaluation of Changes in Perioperative Outcomes

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ABSTRACT

Objective: Evaluate changes in perioperative outcomes over an 82-month period in patients undergoing laparoscopic cholecystectomy by a single attending surgeon in an academic hospital.

Methods: A retrospective review of 1025 consecutive patients undergoing laparoscopic cholecystectomy from September 1992 to February 1997 was compared to the initial 600 patients from May 1990 to August 1992. Statistical analysis included Chi square with Yates correction and Fischer's exact test.

Results: Over the 82-month period there were no significant differences in the overall conversion rate to open cholecystectomy (p=0.26), intraoperative complications (p = 0.81), postoperative complications (p = 0.054) or mortality rates (p=0.66). There were 3 (0.5%) bile duct injuries in the initial 600 patients and only 1 (0.1%) in the group of 1025 patients (p=0.065). There was an increase (p<0.001) in laparoscopic cholecystectomies performed for acute cholecystitis and biliary dyskinesia and an increase (p<0.001) in the percentage of cases performed overall and for acute cholecystitis by the surgery residents over the last 54 months. Despite this, the conversion rates to open cholecystectomy in patients with acute cholecystitis decreased (p < 0.001) over the last 54 months. Additionally, more patients (p < 0.001) were discharged on the day of surgery in the most recent group.

Conclusion: Laparoscopic cholecystectomy can be performed safely by surgery residents under the direct supervision of an experienced laparoscopist without significant changes in perioperative outcomes. Despite an increased percentage of cases being performed for acute cholecystitis over the last 54 months, conversion rates to open cholecystectomy and biliary tract injury rates have decreased, and the perioperative morbidity has remained the same.

Key Words: Laparoscopy, Laparoscopic cholecystectomy, Perioperative outcomes.

INTRODUCTION

Laparoscopic cholecystectomy was initially performed in Germany by Muhe and in France by Mouret.[1-2] Soon after this initial report, McKernan and Saye and Reddick and Olsen performed the first laparoscopic cholecystectomies in the United States in 1988.[1,3] During the next ten years, laparoscopic cholecystectomy evolved into the accepted approach to manage symptomatic gallbladder disease. Multiple prospective randomized trials and retrospective reviews have shown that laparoscopic cholecystectomy allows for shorter hospitalizations, decreased analgesic requirements, earlier return to full activity and decreased total costs.[4-8] The same studies have also demonstrated that laparoscopic cholecystectomy can be performed with minimal morbidity and an infrequent but slightly higher incidence of bile duct injuries than for open cholecystectomy. Perioperative mortality has been reported to be uncommon.

Although cholecystectomy is the most commonly performed laparoscopic procedure by general surgeons, there have been few published reports of large series performed by a single surgeon.[9] We retrospectively reviewed the last 1025 consecutive laparoscopic cholecystectomies performed by a single attending surgeon over a 54-month period. This series was compared to the previously published initial series of 600 consecutive laparoscopic cholecystectomies performed by the same attending surgeon over a 28-month period.[10] Factors evaluated included conversion rates to open cholecystectomy, time to discharge, intraoperative and postoperative complications, mortality, success and outcomes of intraoperative cholangiography and the role of the surgical residents in perioperative outcomes.

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MATERIALS AND METHODS

One thousand and twenty-five laparoscopic cholecystectomies were attempted by a single attending surgeon from September 1992 to February 1997. The initial 600 laparoscopic cholecystectomies attempted by the same attending surgeon from May 1990 to August 1992 were previously published and used for comparison with this most recent series. All surgeries were performed at a teaching hospital by a single attending surgeon or under his direct supervision by a surgical resident. Preoperative evaluation in all patients from both series consisted of an abdominal ultrasound and liver function tests (direct and indirect bilirubin, alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase and albumin). Biliary scintigraphy, oral cholecystography, abdominal CT scans, endoscopic retrograde cholangiopancreatography (ERCP) and serum amylase and lipase were obtained on a selective basis. Those patients with symptoms suggestive of peptic ulcer disease or gastrointestinal reflux disease were evaluated preoperatively by either endoscopy or upper gastrointestinal contrast series. Laparoscopic cholecystectomy was performed using the standard four puncture technique. Pneumoperitoneum was established by the placement of a Veress needle umbilically or by the "open" Hasson technique in selected patients. Patients having prior upper abdominal surgery had the Veress needle inserted into the right or left upper abdomen with the placement of a 5 mm trocar and laparoscope for initial inspection. During the initial 600 laparoscopic cholecystectomies, 5 mm trocars were placed in the right anterior axillary line and the right midclavicular line, and 10 mm trocars were placed in the epigastrium and the umbilicus. In the most recent series, the 10 mm epigastric trocar was replaced by a 5 mm trocar. Blunt dissection and limited electrocautery was used to identify the cystic duct and artery. Anterior and lateral traction were applied to the infundibulum of the gallbladder during this dissection. Intraoperative cholangiograms were performed by digital fluoroscopy in this series of patients and by "static" x-rays in the initial series. The cystic duct and artery were ligated with hemoclips and transected.

Table 1.
Demographics of Patients Undergoing Laparoscopic Cholecystectomy—An Evaluation of Changes in Perioperative Outcomes.

	May 1990 – Aug 1992	Sept 1992 – Feb 1997
Number	**600**	**1025**
Male (%)	158 (26.3%)	250 (24.4%)
Female (%)	442 (73.7)	775 (75.6%)
Age		
Mean	52.2 years	49.8 years
Range	20-90 years	14-01 years

Table 2.
Indication for Laparoscopic Cholecystectomy – An Evaluation of Changes in Perioperative Outcomes.

Indication	May 1990 – Aug 1992	Sept 1992 – Feb 1997	p value
Elective	**548 (91.3%)**	**816 (79.6%)**	**p<0.001**
Symptomatic cholelithiasis	531 (88.5%)	749 (73.1%)	
Biliary dyskinesia	17 (2.8%)	62 (6.0%)	p<0.05
Asymptomatic cholelithiasis	0	5 (0.5%)	
Admitted	**52 (8.7%)**	**209 (20.4%)**	**p<0.001**
Acute cholecystitis	41 (6.8%)	166 (16.2%)	p<0.001
Gallstone pancreatitis	11 (1.8%)	35 (3.4%)	
Cholangitis/symptomatic choledocholithiasis	0	8 (0.8%)	
Total	600	1,025	

Table 3.
Management of Common Bile Duct Stones Diagnosed by Intraoperative Cholangiography from Sept 1992 – Feb 1997 – An Evaluation of Changes in Perioperative Outcomes.

	# of patients	Additional therapy
Open common bile duct exploration (CBDE)	10	-
Postoperative ERCP	24	
Sphincterotomy/stone extraction	16	-
(-) ERCP	6	-
unable to cannulate CBD	2	2 (open CBDE)
Monitored (stones < 4 mm)	4	-
Total	38	2

The gallbladder was dissected from the liver bed in a retrograde direction using electrocautery. The gallbladder was removed through the epigastric incision in the first series of patients. In the most recent series of patients, a 5 mm, 0° laparoscope was placed in the epigastric port for visualization, and the gallbladder was removed through the umbilical incision. Closed suction drains were used infrequently and at the discretion of the attending surgeon. Fascial closure of the umbilical trocar site with an absorbable suture was performed in the majority of patients. All skin incisions were reapproximated with an absorbable subcuticular suture.

RESULTS

A laparoscopic cholecystectomy was attempted in 1025 patients, 775 (75.6%) females and 250 (24.4%) males, from September 1992 to February 1997. Mean age for the patients was 49.8 years and ranged from 14 to 91 years. Patient demographic from this series and the initial series of 600 patients is demonstrated in **Table 1**.

A laparoscopic cholecystectomy was performed electively in 816 (79.6%) patients with 209 (20.4%) patients admitted prior to surgery. The indications for laparoscopic cholecystectomy for both series are summarized in **Table 2**. A surgery resident was the operating surgeon under the direct supervision of the attending surgeon in 838 (81.8%) of the cases in this series and in 52.0% of the cases in the initial series of 600 patients. Intraoperative cholangiography was selectively attempted in 235 (22.9%) patients. Only 11 (4.7%) of the intraoperative cholangiograms could not be completed. Choledocholithiasis was diagnosed by intraoperative cholangiograms in 38 (3.7%) patients. Management of the common bile duct stones is summarized in **Table 3**.

Twenty-seven (2.6%) patients overall and 5 (3.0%) patients with acute cholecystitis had to be converted to an open cholecystectomy. The indications for conversion to open cholecystectomy in these patients are shown in **Table 4**. The conversion rate overall and for acute cholecystitis was 4.0% and 29.0%, respectively, in the initial series of 600 patients.

There were 13 (1.3%) intraoperative complications and only 1 (0.1%) bile duct injury. The intraoperative complication rate was 1.0%, and the bile duct injury rate was 0.5% in the initial series of 600 patients. **Table 5** summarizes the intraoperative complications that occurred in the series of 1025 patients. There were two major complications: a common bile duct laceration and a duodenal injury. The anterior common bile duct laceration was repaired primarily. A T-tube was placed after the repair. This patient recovered uneventfully. The duodenal injury went unrecognized until the third postoperative day. The injury was most likely secondary to electrocautery. This complication was managed by duodenal exclusion and drainage. He died of multisystem organ failure on the sixty-sixth postoperative day.

Major postoperative complications occurred in 28 (2.7%) patients and are summarized in **Table 6**. The postoperative complication rate was 1.2% in the initial series of 600 patients. Nine patients required secondary procedure related to their postoperative complications. Endoscopic retrograde cholangiopancreatography was performed in three patients, one for a cystic duct stump

Table 4.
Indications for Conversion to Open Cholecystectomy – An Evaluation of Changes in Perioperative Outcomes.

Indication	May 1990 – Aug 1992	Sept 1992 – Feb 1997
Adhesions (prior abdominal surgery)	4 (0.7%)	6 (0.6%)
Acute cholecystitis	12 (2.0%)	5 (0.5%)
CBDE	2 (0.3%)	10 (1.0%)
Failed preoperative ERCP	-	1 (0.1%)
Impacted cystic duct stone	-	2 (0.2%)
Bile duct laceration	3 (0.5%)	1 (0.1%0
Common bile duct	2	1
Right hepatic duct	1	-
Failed laparoscopic CBDE	-	1 (0.1%)
Gallbladder cancer	-	1 (0.1%)
Bleeding	1 (0.2%)	-
Obesity	1 (0.2%)	-
Equipment malfunction	1 (0.2%)	-
	24 (4.0%)	27 (2.6%)

leak and two for symptomatic choledocholithiasis. They were managed successfully with a common bile duct stent in the patient with a cystic duct stump lead and with sphincterotomy and stone extraction in the latter two. The two patients with subhepatic abscess were managed by laparotomy and closed suction drainage and percutaneous CT-guided drainage, respectively. All four patients with umbilical hernias underwent repair, one emergently for an incarcerated hernia. Three patients (0.3%) unexpectedly had adenocarcinoma of the gallbladder. The diagnosis was made by the pathologist and not intraoperatively in two of the patients. Both had mucosal-based lesions and are alive at 18 and 23 months, respectively. The third patient was converted to an open procedure, but had unresectable disease. She is alive at six months. Fourteen (1.4%) patients were readmitted to the hospital within 30 days of their laparoscopic procedure.

There were 5 (5.0%) postoperative deaths **(Table 7)** and only one, a duodenal injury, was directly related to a complication of the procedure itself. The initial series of 600 patients had 1 (0.2%) mortality, resulting from a postoperative myocardial infarction.

Ninety-two (9.0%) patients were discharged on the day of surgery, 896 (87.8%) within 24 hours of surgery, and 948 (92.9%) with 48 hours surgery. In the initial series of 600 patients, no patients were discharged on the day of surgery, 537 (89.5%) were discharged within 24 hours of surgery, and 564 (94.0%) within 48 hours of surgery.

DISCUSSION

Although symptomatic cholelithiasis remained to be the most common diagnosis in both groups, there was an increased incidence of laparoscopic cholecystectomy for biliary dyskinesia and acute cholecystitis in the second group of patients ($p<0.001$). The total number of cholecystectomies performed has increased during the laparoscopic era.[11-13] The increased willingness to recommend elective cholecystectomy for biliary dyskinesia can be attributed to the implementation and widespread use of cholecystikinin-augmented hepatobiliary scanning to document a poorly contracting gallbladder as much as it can be attributed to the laparoscopic technique.[14] Before the cholecytokinin-augmented hepatobiliary scans became available in 1989, surgeons were less willing to subject patients to an open cholecystectomy when gallstones were not documented. Since the laparoscopic era, the threshold to subject a patient to cholecystectomy who doesn't have gallstones has decreased when he/she

Table 5.
Intraoperative Complications - An Evaluation of Changes in Perioperative Outcomes.

Complication	May 1990 - Aug 1992	Sept 1992 - Feb 1997
Abdominal wall hematoma	2	5 (0.5%)
Bowel injury	1 (0.1%)	4 (0.4%)
duodenum		1 (0.1%)
ileum		3 (0.3%)
Liver laceration/bleeding	-	2 (0.2%)
Bile duct laceration	3 (0.5%)	1 (0.1%)
Omental vein laceration	-	1 (0.1%)
Total	6 (1.0%)	13 (1.3%)

has a positive hepatobiliary scan. Whether patients are benefiting from this is to be determined.[15] Unfortunately, the outcomes in this subset of patients has not been clearly defined. Initially, laparoscopic cholecystectomy for acute cholecystitis was considered a relative contraindication because surgeons reported increased perioperative morbidity and conversion rates to open cholecystectomy in as many as 33% of the cases.[16] Not surprisingly, our conversion rate in the initial 600 patients for acute cholecystitis was 29.0%, and this accounted for the highest percentage of conversion to open cholecystectomy. Recently, conversion rates have been reported to be 10%, and perioperative complication rates have been reported to be comparable to those of an open cholecystectomy for acute cholecystitis.[17,18] We were able to perform a laparoscopic cholecystectomy in 97% (161/166) of the patients with acute cholecystitis in the last 54 months, and common bile duct exploration became the most common indication for conversion to open cholecystectomy. Our review supports what others have demonstrated—that although laparoscopic cholecystectomy for acute cholecystitis is more technically challenging, it can be performed safely by an experienced laparoscopist.[19] It should also be noted that our low conversion rate persisted despite the fact that a surgery resident was the operating surgeon in 68.7% of the acute cholecystitis cases. The conversion rate of laparoscopic cholecystectomy for acute cholecystitis performed by surgery residents had been reported to be 30.5%.[20]

The most common complications of laparoscopic surgery are related to Veress needle and trocar insertion.[21] Although intraoperative complications occurred at a similar rate (1.0% to 1.3%) between the two groups, the latter series had more complications related to Veress needle placement. Most of these injuries occurred in patients having prior abdominal surgery. A more liberal use of an alternative entry site Veress needle puncture or an open technique (Hasson) in patients having prior abdominal surgery would have been a safer means in preventing these injuries.[22,23] As expected, the peak incidence of bile duct injuries happened during the initial series in the first 75 patients. Since that time, there has been only one bile duct injury in 1550 patients. This was significant in the fact that a surgery resident has performed nearly 82% of all laparoscopic cholecystectomies in the last 1025 patients. A similar low incidence of bile duct injuries in laparoscopic cholecystectomies performed by surgery residents was reported by Wu et al.[24]

Postoperative complications occurred in only 1.5% of the cases in the initial series, but in 2.7% in this series. The increase was attributed to a higher incidence of cardiopulmonary complications. The alterations in cardiopulmonary physiology are well tolerated in most patients undergoing laparoscopic cholecystectomy but may not be tolerated in those patients with poor cardiopulmonary reserve. The increased intra-abdominal pressure may cause acid-base disturbances, decreased regional and systemic oxygen delivery, and a reduced cardiac preload with an increased cardiac afterload.[25-27]

Table 6.
Postoperative Complications - An Evaluation of Changes in Perioperative Outcomes.

Complication	May 1990 - Aug 1992	Sept 1992 - Feb 1997
Myocardial ischemia/CHF	1 (0.2%)	7 (0.7%)
Umbilical Hernia	-	4 (0.4%)
Pancreatitis	-	3 (0.3%)
Postcholecystectomy diarrhea	-	2 (0.2%)
DVT/pulmonary embolus	2 (0.3%)	2 (0.2%)
Pneumonia	2 (0.3%)	2 (0.2%)
Subhepatic abscess	1 (0.2%)	2 (0.2%)
Retained common bile duct stones	-	2 (0.2%)
Small bowel obstruction	1 (0.2%)	2 (0.2%)
Cystic duct stump leak	2 (0.3%)	1 (0.1%)
Total	9 (1.5%)	28 (2.7%)

However, Tangle et al. reported that the perioperative morbidity rate for laparoscopic cholecystectomy in the elderly population was not different from that reported for patients less than 65 years of age, and Maxwell et al. reported similar results in octogenarians.[28,29] Two patients in this series and in the initial series developed deep venous thrombosis in their lower extremities, and one of them (in each series) had a fatal pulmonary embolus. The incidence of deep venous thrombosis and pulmonary embolus after laparoscopic cholecystectomy has been reported to be higher than for open cholecystectomy, but the true incidence after laparoscopic cholecystectomy is not known.[30] Our routine is to use sequential compression devices on all patients during laparoscopic cholecystectomy. Sequential compression of the lower extremities has been shown to effectively neutralize venous stasis during laparoscopic cholecystectomy.[31] But whether this decreases the risk of postoperative thromboembolic complications after laparoscopic cholecystectomy has not been determined. Another postoperative complication that occurred in two patients was a subhepatic abscess. This complication may be the result of spilled gallstones, and it is reported with increasing frequency.[32] Perforation of an acutely inflamed or emphysematous gallbladder during laparoscopic cholecystectomy was not associated with an increased incidence of subhepatic abscess compared to those patients with unperforated gallbladders when patients were given appropriate antibiotics and their abdominal cavities were properly irrigated.[33]

The mortality rate did increase from 0.2% to 0.5% ($p = 0.66$). The mortality rate for the 82-month period was 0.25%, and this is similar to other reported series.[6-8] No classification system to assess preoperative comorbidities was calculated as part of the study for either group. Only one mortality was directly related to an intraoperative complication. This patient had a duodenal injury, probably the result of thermal damage from electrocautery that went unrecognized until the third postoperative day. A pyloric exclusion was performed, but the patient succumbed to multisystem organ failure.

Patients were discharged from the hospital at relatively the same time postoperatively between the two series **(Table 7)**. A small percentage of patients in this series were discharged on the same day as their surgery. Other institutions have had more success performing laparoscopic cholecystectomies on an outpatient basis.[34,35] It is difficult to pinpoint the reason for our institution's inability to match these results. Perhaps we are not properly educating our patients on the safety of outpatient laparoscopic cholecystectomy and the expected postoperative events. We are currently implementing a clinical pathway for outpatient laparoscopic cholecystectomy. This is intended to uniformly educate all health care employees involved in the perioperative care of patients undergoing laparoscopic cholecystectomy in order to improve our same day discharge rate. The results of this study will be

Table 7.
Postoperative Deaths from Sept 1992 - Feb 1997 - An Evaluation of Changes in Perioperative Outcomes.

age/sex	Postop day	Complication
#1 68yrs/Female	0	Myocardial infarction
#2 74yrs/Male	5	Myocardial infarction
#3 56yrs/Female	6	Pulmonary embolus
#4 81yrs/Female	13	Aspiration pneumonia
#5 64yrs/Female	66	Duodenal perforation/multisystem organ failure
Total 5 (0.49%)		

reported in a couple of years. Nevertheless, the average length of stay for all patients, including those that were converted to an open procedure, was only 1.25 days for the 82-month period.

Intraoperative cholangiograms (IOC) were performed selectively. Patients in this series with an elevated alkaline phosphatase, total bilirubin or serum transaminases, a history of jaundice or gallstone pancreatitis or a radiographically documented dilated common bile duct underwent IOC. Any difficulty recognizing the biliary tract anatomy was an absolute indication for IOC. An increased percentage of IOC were attempted in this series (22.9% compared to 18.5%). This increase likely represents a greater percentage of laparoscopic cholecystectomies performed in patients with acute cholecystitis. In this series, only 11.5% of the patients having an elective laparoscopic cholecystectomy underwent IOC. Yet, 48.8% of the patients with acute cholecystitis had IOC. When inflammatory changes were encountered in the triangle of Calot, IOC was used liberally. The success rates were similar at 95.3% for this series and at 95.5% for the initial series. Digital fluoroscopy was used during the last 54 months. This technique has been reported to be less time consuming and more accurate than static IOC.[36,37] Laparoscopic ultrasound was not used to evaluate the common bile duct in any of the patients in either series. Choledocholithiasis was identified during IOC in 17.0% (38/224) of the patients in this series and in 6.6% (7/106) in the initial series. Initially, IOC was used more frequently in patients that did not have clinical suspicion for choledocholithiasis. This was during the learning phase of the procedure. As our proficiency with the procedure increased and as prospective randomized studies suggested its more selective use in patients with clinical criteria suggesting choledocholithiasis, our percentage of positive IOC increased.[38,39] In our entire series of 1625 patients, 1253 did not have their biliary tract imaged by IOC or ERCP. Only 2 (0.16%) have returned with symptomatic choledocholithiasis. This is much less than other series have reported.[40]

CONCLUSION

Laparoscopic cholecystectomy can be performed by surgery residents under the direct supervision of an experienced laparoscopist with minimal intraoperative and postoperative morbidity. The indications for laparoscopic cholecystectomy over the last 82 months has evolved to include a greater percentage of patients with biliary dyskinesia and acute cholecystitis. Despite an increased number of cases being performed for acute cholecystitis, conversion rates to open cholecystectomy and biliary tract injury rates have decreased, and the perioperative morbidity has remained the same.

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