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ORIGINAL ARTICLE

Safety and efficacy of a laparoscopic cholecystectomy in the morbid and super obese patients

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Abstract

Background: Although a laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic cholelithiasis, its safety and efficacy in the morbidly/super obese patients is unknown. The aim of this study was to investigate the safety and efficacy of an elective LC in the morbid/super obese patients.

Methods: A retrospective review of the hospital electronic database and medical records was conducted searching for all elective LC from 2010 to 2013. The data collected included patient demographics and body mass index (BMI), length of hospital stay (LOS), duration of surgery (DOS), intra- and post-operative complications, bile duct injuries, performance of an intra-operative cholangiogram, the incidence of open conversion and the seniority of the operator.

Results: A total of 799 patients (76% female) with a mean age of 46 years and BMI of 31 were included in this study. There were significant differences in the median DOS between the three BMI groups; BMI < 26 [64 min; interquartile range (IQR) 54–83]; BMI 26–40 (72 min, IQR 58–91) and BMI > 40 (82 min, IQR 63–104), $P < 0.001$. There were no statistically significant differences in the LOS, peri-operative complication rates, open conversions or bile duct injuries among the BMI groups.

Conclusions: This study showed that LC can be performed safely in the morbid/super obese patients.

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Introduction

A laparoscopic cholecystectomy (LC) has been established as the gold standard treatment for symptomatic cholelithiasis. Numerous large series has proven the safety and efficacy of this procedure. The overall morbidity and mortality rate is 5–10% and 0.1% respectively, and an open conversion rate of 5–10% is commonly reported.[1–3]

One of the risk factors for cholelithiasis is obesity, the incidence of which is increasing worldwide. [4] Therefore, surgeons are increasingly likely to encounter a growing number of obese patients who require a cholecystectomy for symptomatic cholelithiasis. Traditionally obesity has been considered a relative contraindication to LC, as the technical difficulties associated with this procedure in these patients were thought to be associated with higher morbidity and mortality as well as increased open conversion rates.[5]

However, with increasing experience in laparoscopic surgery and the development of better instruments, the practice of LC in the obese patients is growing. Several recent studies have reported that LC is feasible and can be safely performed in the obese patients.[6–8] These studies have shown that obesity was not associated with higher complication or open conversion rates, and the length of hospital stay (LOS) was equivalent when compared to the non-obese patients. The only consistently reported difference in the literature between the two groups of patients was a longer operating time in the obese patients.

Although there is growing evidence on the safety and efficacy of LC in the obese patients, there is a lack of data on its use in the morbid/super obese [body mass index (BMI) > 40] patients. A review of the literature found only one study which compared laparoscopic to open cholecystectomy in patients with BMI > 50.[9] Laparoscopic surgery was found to be associated with a shorter operating time and LOS, as well as reduced peri-operative complication rates.

The purpose of this study was to investigate the safety [peri-operative morbidity and mortality and the incidence of bile

duct injuries (BDI)] and efficacy (duration of surgery, LOS and open conversion rates) of an elective LC in the morbid/super obese patients (BMI > 40) compared to patients with a BMI < 26 and a BMI 26–40.

Methods

A review of a prospectively maintained electronic database and the medical records for all elective LC performed from July 2010 to September 2013 at a teaching hospital in Adelaide, South Australia was undertaken. The data collected include patient demographics and BMI, LOS, duration of surgery (DOS), intra- and post-operative complications, bile duct injuries, performance of an intra-operative cholangiogram, the incidence of open conversion and the seniority of the operator.

The patients were divided into three groups: BMI < 26, BMI 26–40 and BMI > 40. The LOS was calculated from the day of admission until discharge while the duration of surgery was from the initiation of skin incision to the end of skin closure. Any occurrence of intra-operative complications and/or conversion to open surgery was documented. After discharged from the hospital the patients were regularly followed-up in the outpatient clinic between 4 and 8 weeks, therefore allowing assessment of morbidity and mortality up to 30-days. Post-operative complications were graded according to the Dindo–Clavien[10] classification, and bile ducts injuries according to the Strasberg[11] classification, respectively. The operators were divided into three groups: consultant surgeons, fellows with a fellowship from theRoyal Australasian College of Surgeons or equivalent qualification or surgical trainees in a 5-year General Surgery training programme.

The LC technique used at the authors' institution consists of a standard four trocars approach. An open cut down technique is used to create a pneumoperitoneum, usually starting in the peri-umbilical area where a 12-mm port is used for the laparoscopic camera. In the obese patients, the camera port is usually placed supra-umbilically in closer proximity to the gallbladder, and additional trocars may need to be inserted to assist with retraction of the liver, omentum and/or bowel loops as required. Patients were positioned in steep reverse Trendelenburg to help displace the omentum and bowel loops caudally and improve operative vision; a broad holding strap was routinely placed across the patient's thighs to prevent slippage off the bed during the operation. A 30° camera was used as required. A 10-mm epigastric port and two 5-mm right abdominal ports are placed under vision for instrumentation. The gallbladder fundus is retracted cephaladly and dissection using diathermy is started in the Calot's triangle to expose the cystic artery and the cystic duct. An intra-operative cholangiogram was performed at the surgeons' discretion. The cystic duct and artery is then divided between clips, and the gallbladder dissected off the liver in a retrograde fashion. The gallbladder is then removed through either the umbilical or the epigastric port in an endoscopic retrieval bag. The umbilical fascia and skin is closed with suture; the surgical incisions infiltrated with local anaesthesia. The patients are charted for regular analgesia (paracetamol, NSAIDs, opioids) and anti-emetics (metoclopramide, ondansetron). Patients undergoing LC at the authors' institution were generally admitted for an overnight stay, until the implementation of an ambulatory surgery protocol in mid-2011.

The exclusion criteria for this study included: acute cholecystitis, gallbladder neoplasm, open cholecystectomy and a combined procedure, e.g. repair of an inguinal hernia in conjunction with a LC.

Statistical analysis

Continuous outcomes (LOS and DOS) were tested using ANOVA, whereas categorical outcomes (open conversion, intra- and post-operative complications, and bile duct injuries) were tested using Fisher's exact test. To test for differences in LOS (days) between BMI groups, LOS (days) was transformed by raising to the power of −0.4 owing to non-normality of the residuals in the model using raw data: los_transformed = los−0.4. An ANOVA was then fitted to the data with transformed LOS as the outcome and BMI group as the independent variable. Logistic regression models were used to calculate the odds ratio to compare BMI groups for open conversion, intra- and post-operative complication and bile duct injuries. A $P < 0.05$ was considered a statistically significant result.

Results

A total of 799 consecutive patients who underwent elective LC between July 2010 and Sept 2013 were included in this study. The patient demographics and BMI data are shown in Table 1. An intra-operative cholangiogram was performed in 661 patients (83%) with no significant differences between the various BMI groups.

The overall median duration of surgery was 70 min [interquartile range (IQR) 56–91], with the procedure taking progressively longer to perform as the BMI increases (Table 2). Peri-operative outcomes by BMI group are shown in Table 2.

There were four (0.5%) patients who required conversion to open surgery. Three of the open conversions were as a result of dense adhesions precluding safe laparoscopic surgery, and

Table 1 Patient demographics

	BMI <26, *n* = 170	BMI 26–40, *n* = 553	BMI >40, *n* = 76	Total, *N* = 799
Female, *n* (%)	131 (77)	412 (74.5)	65 (85.5)	608 (76.1)
Mean age, year (SD)	46.8 (19.8)	46.7 (15.6)	40.6 (13.1)	46 (16.4)
Mean BMI (SD)	22 (2.4)	32 (4.0)	46 (5.0)	31 (7.2)

BMI, body mass index.

Table 2 Peri-operative outcomes according to different body mass index (BMI) groups

	BMI <26 *n* = 170	BMI 26–40 *n* = 553	BMI >40 *n* = 76	Total *N* = 799	*P*-value
Median DOS, min (IQR)	64 (54–83)	72 (58–92)	82 (63–104)	70 (56–91)	<0.001
Median LOS, days (IQR)	1.1 (1.0–1.3)	1.1 (1.0–1.3)	1.1 (1.0–1.3)	1.1 (1.1–1.3)	0.269
Conversion, *n* (%)	1 (0.6)	2 (0.4)	1 (1.3)	4 (0.5)	0.244
Post-op complications, *n* (%)	8 (4.7)	25 (4.5)	6 (7.9)	39 (4.9)	0.411
Biliary complications, *n* (%)	0 (0)	4 (0.7)	0 (0)	4 (0.5)	0.718
Cholangiogram, *n* (%)	143 (84)	457 (83)	61 (80)	661 (83)	–
Operator, *n* (%)					
Consultant	114 (67)	361 (65)	52 (68)	527 (66)	0.820
Fellow	21 (12)	86 (16)	11 (15)	118 (15)	
Registrar	35 (21)	106 (19)	13 (17)	154 (19)	

DOS, duration of surgery; LOS, length of hospital stay.

one was because of the inability to dissect safely in the Calot's triangle.

There were 18 (2.3%) patients who had intra-operative complications; however, there were no statistically significant differences between the groups. Twelve of the 18 intra-operative complications were as a result of bleeding from a minor hepatic laceration and capsular tears; bleeding in eight patients was controlled successfully with just using diathermy, whereas an additional interventions were required in four patients [Surgicel (Ethicon) and/or Floseal (Baxter)]. One patient had an iatrogenic injury to the common hepatic duct discovered intra-operatively which was managed with a T-tube. The other intra-operative complications included a faulty instrument causing prolonged surgery, spillage of gallstones intra-operatively which were subsequently lost, intra-operative tachycardia requiring pharmacological cardioversion and a severe allergic reaction to anaesthetic agents during induction causing hypotension.

There were 4 (0.5%) patients who suffered biliary injuries with no statistically significant differences between each of the BMI groups. Three patients were found to have bile leaks from the cystic duct stumps and the gallbladder bed. These patients were returned to theatre for washout and re-clipping of the cystic duct stump and placement of drains in the Morrison's pouch. One patient was discovered to have an iatrogenic injury to the common hepatic duct intra-operatively and hence a T-tube was placed. All patients recovered satisfactorily without further significant complications.

Overall post-operative complications occurred in 38 (4.8%) patients, with no significant differences between each of the BMI groups (Table 3).

Twenty patients (2.5%) were re-admitted after discharge for various reasons, mostly as a result of inadequately controlled pain ($n = 8$) and superficial wound infections ($n = 5$).

Sub-group analysis adjusting for the operator showed no statistically significant differences in any of the parameters between each of the BMI groups, except for the duration of surgery where consultant surgeons and fellows took a median of 11 and 10 min, respectively, less than the registrars to complete the operation ($P < 0.001$).

Discussion

This study shows that a LC can be performed in the morbid/super obese patients safely and efficiently with equally good outcomes when compared to patients with a normal BMI. The incidence of intra-operative complications was low, ranging from 1% to 2% across the different BMI groups. The overall post-operative complication ($n = 6/76$; 7.9%) rates in the BMI > 40 groups were higher than the other two BMI groups but the differences were not statistically significant. There was no biliary injury or death in the BMI > 40 group. LC in the BMI > 40 group took on a median of 18 and 10 min longer to perform compared to the BMI < 26 and BMI 26–40 groups, respectively. This reflects the more challenging and difficult surgery associated with LC in these groups of patients. However, despite this, there were no significant differences in the open conversion rates or the median duration of hospital stay which was essentially identical (1.1 days) among the groups.

The results of this study compare favourably with other figures published in the literature. The mean LOS in this study was 1.5 (SD 2.6) days, compared to 2–4 days published in similar studies.[6,8,12] The mean operating time was 75 (SD 28) min, compared to 46–98 min from other authors.[6,8,12,13] The overall conversion rate in this study was 0.5%, as compared to 7.7%,[8] 4.2%,[6] and 4.1%.[12] The often quoted conversion rate in the recent literature is approximately 5–8%.[1,2] The intra- and post-operative complication rates reported in this study were lower compared to others published in the literature. Ammori *et al.*[7] reported their intra- and post-operative complication rates of 17.6% and 11.8%, respectively, in the morbidly obese patients, compared to 2.3% and 4.9% in this study. Likewise the re-admission rate in this study (2.5%) compares well to the 2–10% normally quoted in the literature.[1,3,14] The authors believed that one of the main reason for

Table 3 Peri-operative complications

BMI	<26 *n* = 170	26–40 *n* = 553	>40 *n* = 76	Total *N* = 799
Dindo–Clavien grading, *n* (%)				
I	4 (2.4)	3 (0.5)	3 (3.8)	10 (1.3)
II	2 (1.2)	8 (1.4)	1 (1.3)	11 (1.4)
IIIa	0 (0.0)	5 (0.9)	0 (0.0)	5 (0.6)
IIIb	1 (0.6)	8 (1.4)	2 (2.6)	11 (1.4)
IV a	1 (0.6)	1 (0.2)	0 (0.0)	2 (0.3)
IV b	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)
V	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.1)
Minor- grade I & II, *n* (%)				
Pain	3 (1.8)	3 (0.5)	1 (1.3)	7 (0.9)
Port site infection	1 (0.6)	6 (1.1)	2 (2.6)	8 (1.0)
ARF	0 (0.0)	0 (0.0)	1 (1.3)	1 (0.1)
Collection	0 (0.0)	2 (0.4)	0 (0.0)	2 (0.3)
DVT	0 (0.0)	0 (0.0)	1 (1.3)	1 (0.1)
Port site bleeding	1 (0.6)	0 (0.0)	0 (0.0)	1 (0.1)
Delirium	1 (0.6)	0 (0.0)	0 (0.0)	1 (0.1)
Major – grade III/IV/V, *n* (%)				
Choledocholithiasis/pancreatitis	0 (0.0)	3 (0.5)	1 (1.3)	4 (0.5)
Bile leak	0 (0.0)	3 (0.5)	0 (0.0)	3 (0.4)
Bleeding	1 (0.6)	2 (0.4)	0 (0.0)	3 (0.4)
Collection	0 (0.0)	3 (0.5)	0 (0.0)	3 (0.4)
Papillary Stenosis	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.1)
Respiratory distress/acidosis	1 (0.6)	0 (0.0)	0 (0.0)	1 (0.1)
Deranged LFT/ERCP	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.1)
Mortality	0 (0.0)	1 (0.2)	0 (0.0)	1 (0.1)

ARF, acute renal failure; DVT, deep vein thrombosis; LFT, liver functioning test; ERCP, endoscopic retrograde cholangiopancreatography.

the favourable results reported in this study was the surgeons' increasing experience with operating in the morbid and super obese patients. Other factors such as better laparoscopic equipment and improved anaesthetic and peri-operative care of the obese patients are also major contributions. It must also be noted that 15–20% of the patients reported in these other studies had acute cholecystitis, a possible explanation for higher open conversion and complication rates compared to this study.

The authors acknowledge several limitations inherent to all retrospective studies, as is the case with the current study. First, a prospective study could have allowed a more systematic collection of data such as the ASA grade and patient co-morbidities which would have provided useful information for clinical practice. Although this study has established the safety and efficacy of LC in the morbid/super obese patients, it is not known if the same results could be achieved in someone who is morbid/super obese with high ASA and multiple co-morbidities. For example, performing a LC in an obese patient suffering from obstructive sleep apnoea can be challenging from the respiratory system point of view, especially if prolonged insufflation with CO_2 is required. Second, the follow-up duration was only up to 8 weeks post-operatively; therefore, long-term (e.g. 6- or 12-months) data such as the incidence of incisional hernia or resolution of symptoms is unknown. A longer follow-up could also reveal how well and how soon before the patient could return to their normal daily routine or work.

Lastly the authors acknowledge the small number of patients in the morbid and super obese groups. However, to the authors' knowledge, this study reported the second largest number of morbid/super obese (BMI > 40) patients in the literature after Khan *et al.*[9] Therefore, the authors believe that this study provides important data on the safety and efficacy of LC in the morbid/super obese patients. Overall only four (0.5%) patients suffered a BDI which provides the reassurance that LC is a safe procedure consistent with other figures in the literature. While the total number of morbid/super obese patients was small (n = 76), no patient in this groups suffered a bile duct injury. The authors calculated the sample size required to detect statistically significant differences based on

the data from this study; using an alpha value (*P*-value) of 0.05 and power of 0.8. For biliary complications, the number of patients needed to detect a significant odds ratio of 0.5 is 4267 people per group. This means that just comparing the rate of BDI in two groups of patients would require 8534 patients. These figures are very difficult to achieve even in multi-centre studies, and the authors believed a meta-analysis or a population-based registry might be the only way to achieve this. Therefore, with the results of this study the authors hope to add additional data to the growing evidence in the literature that LC in this group of patients is safe.

Conclusion

This study has shown that LC can be performed safely in the morbid and super obese patients and with the same favourable outcomes as seen in those patients with a normal BMI. Therefore, LC should be considered as the gold standard treatment for the morbid and super obese patients with symptomatic cholelithiasis.

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Conflicts of interests

None declared.

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