A systematic review and meta-analysis of the impact of obesity on postoperative outcomes for patients undergoing laparoscopic cholecystectomy

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ABSTRACT

**Introduction:** Laparoscopic cholecystectomy may reduce post-operative complications in the majority of patients, but it remains a challenge for obesity patients. We aimed to examine the postoperative outcome in obese patients undergoing laparoscopic cholecystectomy.

**Method:** Each author conducted a search form PubMed, EuropePMC, and Sciencedirect databases from on 30 November 2022. According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses we conducted this study. All types of studies, laparoscopy cholecystectomy in obese patients, English papers, older than 18 years old were included in these studies. Abstract only articles, no fully published English papers were excluded from this study.

**Results:** Nine publications including 7138 patients from 1999 to 2022 were identified. Compared with normal weight patients, adult obese patient had higher conversion rates (P=0.002), blood loss (P=0.009), intraoperative complication (P=0.08), postoperative complication (P=0.04), mortality (P=0.45), longer need of surgical time (P<0.00001). No significance difference in length of stay were found (P=0.98).

**Conclusion:** This study found that laparoscopic cholecystectomy for obese patients has a higher conversion rates, the need of longer surgical time, and blood loss compared to normal weight individual. Intraoperative, postoperative complication, and mortality were found but not statically significance. Further prospective studies are required to maximize outcome.

**Keywords:** Laparoscopic Cholecystectomy, Obesity, Postoperative outcome.

INTRODUCTION

Nowadays, obesity is not something that is rarely seen. Obesity will always be seen in any country, both developing and developed countries. It is a multifactorial complex that results from an interaction between physical activity, energy expenditure, biological, genetic, social, and many more. The prevalence of obesity has increased by three times in the last four decades; hence it is one of the highest risk factors in developing non-communicable diseases such as type 2 diabetes, cardiovascular, kidney diseases, and other chronic diseases.¹ Yet, it is not surprising that high BMI rates are one of the leading causes of risk-attributable mortality, with a reduced life expectancy ranging from 5-to 20 years.² Obesity and high central adiposity have been correlated with gallbladder disease risk; therefore, surgery is still the primary treatment for symptomatic gallbladder diseases.³

Laparoscopic cholecystectomy (LC) has become an alternative to open cholecystectomy in the treatment of cholecystitis. It is shown the benefits from reducing postoperative morbidity, mortality, hospital stay, pneumonia, wound infection due to smaller incisions.⁴ LC in obese patients has its challenges as it has been associated with technical difficulties in identification of Calot’s triangle, higher risk of developing pneumoperitoneum, thicker abdominal wall, and intra-abdominal fat. Placing the trocar perpendicular to the fascia may have its challenges as placing the trocar operative field.⁵ The urgency in conducting this systematic review is that because conflicting results from previous studies making obesity as a relative contraindication. Thus, we aimed to examine the postoperative outcome in obese patients undergoing laparoscopic cholecystectomy.

METHODS

We conducted a systematic review based on the proposed guideline of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).⁶ We used the following PICO for our systematic review: P (Obese patients), I (Laparoscopic cholecystectomy), C (non-obese patients), and O (post-operative outcome). We completed the literature search from three unique databases: PubMed, EuropePMC, and ScienceDirect. We used the prespecified search terms as presented in table 1. We include all studies that discuss the outcome of laparoscopic cholecystectomy in the obese population. We defined obese individuals as those having a BMI...
of greater than 30 kg/m² as defined by the World Health Organization (WHO). We included all types of study design, except gray literature. Gray literature was excluded due to the lack of evidence robustness and increasing publication bias. We only had adult population, older than 18 years of age.

Further, we restricted our literature search to the English based literatures. We conducted the literature search on 30 November 2022. The detailed protocol of the current study has been registered at PROSPERO (CRD42021264533) and had received no funding.

The primary outcome of the current systematic review and meta-analysis is the conversion rate to open. In contrast, secondary effects include intra- and postoperative complications, total blood loss, surgical duration, length of hospitalization time, and mortality. Regarding complications, we included all types of complications reported by each study. We reported blood loss in milliliters. Length of stay was reported in days. Lastly, surgical duration was reported in minutes.

Based on the inclusion criteria, three reviewers (HS, JH, and YE) independently assessed eligibility unblinded, standardized. The reviewers’ disagreements were settled by consensus. The data extraction sheet was created using the data extraction template created by the Cochrane Consumers and Communication Group. The authors collected data from the papers without contacting the authors for more information.

The median age at the time of treatment, ASA status, body weight, detailed surgical procedure, complication, surgical duration, hospitalization time, mortality rate, and conversion rate were all retrieved from each study.

To assess the risk of bias, we utilized the Newcastle Ottawa Scale (NOS) to assess the risk of bias of the included study, which consists of a total quality rating of nine stars; cohort studies were rated as having a total quality rating of nine stars. We also performed a meta-analysis of total 9 eligible articles. The characteristics as well as the variables and the detailed procedures studied were presented at Table 1. The 9 articles that were included in the study involved 7138 adult patients with cholelithiasis.

Our meta-analysis showed that there is an association between high body mass index with increase rate of blood loss (SMD 0.18 [-0.03 - 0.39]; p=0.009; I²=82%), conversion to open (RR 1.53 [1.17 - 2.01]; p = 0.0021; I²=88%), postoperative complications (RR1.12 [1.01-1.25]; p=0.04; I²=0%), and surgical duration (SMD 0.24 [0.16 – 0.33]; p<0.00001; I²=16%), but not with intraoperative complications (RR1.64 [0.94,2.85]; p=0.08; I²=72%), hospitalization (SMD 0.00 [-0.13 - 0.13]; p=0.98; I²=45%), surgical duration (SMD 0.24 [0.16 - 0.33]; p<0.00001; I²=16%), and mortality (RR 0.53 [0.10,2.73] p=0.45; I²=0%). Funnel plot and forest plot were displayed in Figure 2 – 8. In terms of bias, most of the funnel plot in this study is relatively symmetrical.

DISCUSSIONS

Obesity is a worldwide medical condition and affects a great percentage of the population. There are different criteria in defining obesity. According to the Japan Society for the Study of Obesity (JASSO), the definition of obesity is BMI ≥ 25.0 kg/m² while WHO defines obesity as BMI ≥ 30 kg/m².4 There is old belief that the laparoscopic is preferred over open surgery in obese patients although it possess additional technical challenge due to the thickness of the abdominal wall, hence it can cause more complication and more surgical time need. Our meta-analysis aimed to measure and pool the different quality of data from similar studies regarding the laparoscopic for obese patient especially laparoscopic cholecystectomy.

Pooled analysis showed slightly difference in blood loss between obese patient and normal weight patient, though it is not statically significant (p=0.09), as mentioned by Kaushik R, 2010, blood loss may occurred due to various reasons, such as surgeon related procedures due to identifying anatomical landmark, abundant abdominal fat, trocar insertion, differs dissection technique, slippage of clips/ligatures found in obese patients, yet on the other hand it may cause higher conversion rate to open (p=0.002). The surgical time is considered as a parameter for technical challenge. The surgical time is statistically longer among the obese group (p<0.00001). Furthermore, the heterogeneity result data has been evaluated with the funnel plot and it shows minimal heterogeneity.

Our study found that there was no difference in length of stay between obese patient group and normal weight patient group, though it is not statically significant (P=0.98). Lauro A, et al. 2018, reported a markedly elevated value of hospital stay for obese patient group, far beyond those reported in other studies but it has very
small proportion of population compared to the others.\textsuperscript{15}

Our study showed an insignificant result related to the risk of mortality in obese patients. (\(P<0.05\)). Only one study differentiates between morbidity obese (BMI>40) from obese (BMI 30-40). Ammori BJ, et al. 2001 reported higher overall mortality in the morbidly obese (BMI>40) patient group.\textsuperscript{7} In the obese group, Ammori BJ, et al. 2001, is in consistent with Chang WT, et al. 2009, and Lauro A, et al. 2018, who reported that obese (BMI 30-40) group is not associated with complication and morbidity.\textsuperscript{15,15} The mortality risk might be caused not due to the procedure but might be due to the comorbid.

The overall complication was measured as well in our study, though risk of the intraoperative complication is not significantly higher among adult obese patients (\(P=0.08\)), the group has significant more risk of postoperative complication compared to adult normal weight patients (\(P=0.04\)), as mentioned by previous studies, intraoperative and postoperative complications were higher among the morbidly obese patients than normal weight patients, gallbladder bed bleeding, cystic artery bleeding, trocar wound bleeding, omental bleeding, wound infection, bile leak, wound hematoma and others were still reported, it may be happen due to its own susceptibility in morbidly obese patients group.

Furthermore, the assessment of risk of bias from eligible studies that was displayed as funnel plot showed a relatively symmetrical and can be concluded that there was a minimal bias occurred within eligible studies.

Our limitations are due to the low number of prospective, randomized studies included. The number of prospective studies was only three compared to the retrospective studies which is six. As we only included 9 studies, we could not perform meta regression to exclude or confounding variables. In addition, the population was not defined according to the clinical parameters such as associated co-morbidities, cholecystitis, and its severity as well as the complications such as infection rate, sepsis, et cetera. Bile duct injury were not reported in most of the study.

**CONCLUSIONS**

In conclusion, current study found that laparoscopic cholecystectomy for obese patients has a higher conversion rates, the need of longer surgical time, and blood loss compared to normal weight individual. Intraoperative, postoperative complication, and mortality were found but not statically significance. Further prospective studies are required to maximize outcome.

**DATA AVAILABILITY**

All data are available upon reasonable request by contacting the corresponding author (J.H).

**CONTRIBUTIONS**

Study conception and design: NMC and JH.

Acquisition of data: NMC and JH.

Analysis and interpretation of data: NMC and JH.

Draft of manuscript: JH.

Critical revision of manuscript: NMC and JH.

**CORRESPONDING AUTHOR**

Correspondence to Jeremiah Hilkiah Wijaya.

**ETHICS DECLARATIONS**

**Ethics Approval**

Not applicable.

**Consent for Publication**

Not applicable.

**Conflict of Interest**

The authors declare no competing interests.

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**REFERENCES**


Figure 1. PRISMA flow diagram.
Figure 2. depicts the a) forest plot and b) funnel plot of blood loss (mL).

Figure 3. depicts the a) forest plot and b) funnel plot of conversion to open.

Figure 4. depicts the a) forest plot and b) funnel plot of intraoperative complication.

Figure 5. depicts the a) forest plot and b) funnel plot of postoperative complication.

Figure 6. depicts the a) forest plot and b) funnel plot of hospitalization.

Figure 7. depicts the a) forest plot and b) funnel plot of surgical duration.

Figure 8. depicts the a) forest plot and b) funnel plot of mortality.
<table>
<thead>
<tr>
<th>Author &amp; Year</th>
<th>Study Type</th>
<th>Procedural details</th>
<th>Number of Patients (n)</th>
<th>Number of Obese Patients (n)</th>
<th>Number of Obese Females (n)</th>
<th>Mean Age of Obese Patients (years)</th>
<th>Mean BMI (kg/m²)</th>
<th>ASA Grade (I/II/III/IV)</th>
<th>NOS Score</th>
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</thead>
<tbody>
<tr>
<td>Ammori 2001</td>
<td>CS-Retro</td>
<td>10-mm laparoscope umbilical incision. Cystic artery was divided between 6-mm stainless steel clips (LC200; Ethicon, Edinburgh, UK). Intraoperative cholangiography were performed. Cystic duct was occluded with 9-mm stainless steel clips (LC300). The gallbladder was removed from its bed using a neodymium yttrium-aluminium-garnet laser or a diathermy probe. Absorbable sutures (polyamide or polydioxanone) were used to close the fascia at the umbilicus.</td>
<td>864</td>
<td>205</td>
<td>149</td>
<td>49.5 (40-62)</td>
<td>37.1 (31-44)</td>
<td>116/57/32/-</td>
<td>7</td>
</tr>
<tr>
<td>Afaneh 2014</td>
<td>CS-Retro</td>
<td>Conventional 4-port technique; 2-cm laparoscope infraumbilical incision (the Gel Point system [Applied Medical, Rancho Santa Margarita, CA]). The Hasson cut-down technique in the umbilicus to access the abdomen. Intraoperative cholangiography were performed.</td>
<td>1382</td>
<td>479</td>
<td>961</td>
<td>49.3 (31-67)</td>
<td>38 (30.8-49.5)</td>
<td>43/317/110/9</td>
<td>7</td>
</tr>
<tr>
<td>Raakow 2019</td>
<td>CS-Pros</td>
<td>Antibiotic single-shot treatment (cefotaxim or cefuroxim and metronidazole) applied intravenously preoperatively in all patients. A 15–20 mm middle umbilical incision. Patient was positioned in 10°–20° reverse Trendelenburg position and slightly tilted to the left. The cystic duct and cystic artery were clipped with an endoscopic clip applier (Ligamax; Ethicon) and cut in between. Fascia was closed in all patients with a nonabsorbable suture and an absorbable suture for the skin closure.</td>
<td>318</td>
<td>106</td>
<td>79</td>
<td>41.8 (27.9-55.7)</td>
<td>34.4 (30.3-38.4)</td>
<td>31/61/14/-</td>
<td>7</td>
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<tr>
<td>Gregori 2018</td>
<td>CS-Retro</td>
<td>A single shot co-amoxiclav 1.2 gram IV was administered intraoperatively. A conventional 4-port technique. Patients were placed in a supine reverse Trendelenburg position with closed legs and mild left lateral rotation. Optical trocar (12 mm) was inserted at the umbilical port to establish pneumoperitoneum. They used the Hasson technique. Following abdominal exploration, a cholecystectomy was carried out, with previous identification and separated section of cystic duct and cystic artery, according to the “critical view of safety” proposed by Strasberg.</td>
<td>730</td>
<td>294</td>
<td>190</td>
<td>53.9 (22.8-7)</td>
<td>n.s.</td>
<td>16/26/52/-</td>
<td>6</td>
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<td>Farkas 2011</td>
<td>CS-Retro</td>
<td>Conventional 4-port technique with 2-cm laparoscope infraumbilical incision.</td>
<td>1027</td>
<td>491</td>
<td>n.s.</td>
<td>42.7 (27-58.4)</td>
<td>n.s.</td>
<td>n.s.</td>
<td>6</td>
</tr>
<tr>
<td>Author &amp; Year</td>
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<td>Number of Patients (n)</td>
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<td>Chang 2009</td>
<td>CS-Retro</td>
<td>Conventional 4-port technique with 2-cm laparoscope infraumbilical incision.</td>
<td>627</td>
<td>65</td>
<td>46</td>
<td>49.7(35.8-63.6)</td>
<td>32.9 (29.9-35.9)</td>
<td>8/55/2/-</td>
<td>6</td>
</tr>
<tr>
<td>Paajanen 2012</td>
<td>CS-Retro</td>
<td>Conventional 4-port technique with 2-cm laparoscope infraumbilical incision.</td>
<td>1581</td>
<td>437</td>
<td>352</td>
<td>53.4 (n.s.)</td>
<td>35.5 (30.6-43.8)</td>
<td>I-II: 338</td>
<td>7</td>
</tr>
<tr>
<td>Gatsoulis 1999</td>
<td>CS-Retro</td>
<td>10-mm laparoscope umbilical incision, two 5-mm, and one 8-mm stab incisions in the right upper quadrant. Surgical clips (United States Surgical Corporation) were used to control the cystic artery and cystic duct. Either a KTP-532 (Laserscope), Argon (HGM) or Nd:YAG (LaserSonics) laser was used for hemostasis and dissection of the gallbladder. Umbilical incision was closed with a single fascial stitch.</td>
<td>145</td>
<td>23</td>
<td>18</td>
<td>51 (34-67)</td>
<td>23.34 (n.s.)</td>
<td>III-IV: 102</td>
<td>n.s.</td>
</tr>
<tr>
<td>Lauro 2018</td>
<td>CS-Retro</td>
<td>Conventional 4-port technique with 2-cm laparoscope infraumbilical incision.</td>
<td>464</td>
<td>67</td>
<td>43</td>
<td>57 (40.3-73.7)</td>
<td>n.s.</td>
<td>I-II: 41 III-IV: 28</td>
<td>6</td>
</tr>
</tbody>
</table>

CS-Retro: Cross-sectional-retrospective; CS-Pros: Cross-sectional-prospective; n.s: not specified