Original Investigation

Subtotal Cholecystectomy for "Difficult Gallbladders" Systematic Review and Meta-analysis

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IMPORTANCE Subtotal cholecystectomy (SC) is a procedure that removes portions of the gallbladder when structures of the Calot triangle cannot be safely identified in "difficult gallbladders."

OBJECTIVE To conduct a systematic review and meta-analysis to evaluate current studies and present an evidence-based assessment of the outcomes for the techniques available for SC.

DATA SOURCES A literature search of the PubMed/MEDLINE (1954 to November 2013) and EMBASE (1974 to November 2013) databases was conducted. Search criteria included the words *subtotal*, *partial*, *insufficient* or *incomplete*, and *cholecystectomy*.

STUDY SELECTION Inclusion criteria were all randomized, nonrandomized, and retrospective studies with data on SC techniques and outcomes. Exclusion criteria were studies that reported data on SC along with other interventions (eg, cholecystostomy) without the possibility to discriminate results specific to SC.

DATA EXTRACTION AND SYNTHESIS This systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.

MAIN OUTCOMES AND MEASURES The primary outcome of the study was the occurrence of common bild duct injury. Secondary outcomes included the occurrence of other SC-related morbidities, such as hemorrhage, subhepatic collection, bile leak, retained stones, postoperative endoscopic retrograde cholangiopancreatography, wound infection, reoperation, and mortality.

RESULTS Thirty articles were included. Subtotal cholecystectomy was typically performed using the laparoscopic technique (72.9%), followed by the open (19.0%) and laparoscopic converted to open (8.0%) techniques. The most common indications were severe cholecystitis (72.1%), followed by cholelithiasis in liver cirrhosis and portal hypertension (18.2%) and empyema or perforated gallbladder (6.1%). Morbidity rates were relatively low (postoperative hemorrhage, 0.3%; subhepatic collections, 2.9%; bile duct injury, 0.08%; and retained stones, 3.1%); the rate for bile leaks was higher (18.0%). Reoperations were necessary in 1.8% of the cases; the 30-day mortality rate was 0.4%. The laparoscopic approach produced less risk of subhepatic collection (odds ratio [OR], 0.4; 95% CI, 0.2-0.9), retained stones (OR, 0.5; 95% CI, 0.3-0.9), wound infection (OR, 0.07; 95% CI, 0.04-0.2), reoperation (OR, 0.5; 95% CI, 0.3-0.9), and mortality (OR, 0.2; 95% CI, 0.05-0.9) but more bile leaks (OR, 5.3; 95% CI, 3.9-7.2) compared with the open approach.

CONCLUSIONS AND RELEVANCE Subtotal cholecystectomy is an important tool for use in difficult gallbladders and achieves morbidity rates comparable to those reported for total cholecystectomy in simple cases. The various technical differences appear to influence outcomes only for the laparoscopic approach.

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Gallstone disease is a major health problem that affects 1% to 4% of the Western world population every year and almost 10% to 15% during their lifetime.[1] This percentage corresponds to 6.3 million men and 14.2 million women aged 20 to 74 years in the United States.[2] "Difficult gallbladder" (GB) is a procedure with an increased surgical risk compared with standard cholecystectomies.[3,4] With an incidence of 16% (1 in 6) in a large series,[3] difficult GB is usually associated with severe inflammation that distorts the local anatomy and renders dissections more difficult (ie, acute cholecystitis, empyema, gangrene, perforation, and Mirizzi syndrome) or with cirrhotic livers that increase the risk of bleeding. A scale was introduced by Nassar et al[5,6] to score GB difficulty based on the GB status, cystic pedicle, and degree of adhesions. This scale graded cholecystectomies into 4 grades, with grades 3 and 4 being the most difficult.

Several "damage control" techniques, such as cholecystostomy, fundus-first approach, and subtotal cholecystectomies, aim to decrease the risks related to difficult GB.[7,8] National trends have shown an increase in the use of these techniques that reflects their growing general acceptance to reduce the morbid complications of difficult GB, especially common bile duct (CBD) injuries.[7] Cholecystostomy decompresses severely inflamed GBs or GB empyemas and acts as a bridge toward definitive treatment. The fundus-first approach is a dissection that starts from the fundus of the GB to the infundibulum and is aimed at better identification of the Calot triangle structures.[9-11] Subtotal cholecystectomy (SC) removes portions of the GB when the structures of the Calot triangle cannot be identified and the critical view of safety cannot be achieved.[12]

Our study focused on SC. Although positive outcomes have been described since its introduction, SC has also been associated with postoperative bile leaks and retained gallstones in the GB remnant.[13-36] The aim of the present study was to provide a systematic review and meta-analysis of SC, examine its safety and feasibility, and analyze published results according to the various techniques available.

Methods

Search Strategy

On November 20, 2013, all published studies were screened with no restriction on language, date, or country. A broad search approach was conducted owing to the expected scarcity of randomized clinical trials. No search filter was applied for study type.

Electronic Databases

Studies were identified by searching the following databases: MEDLINE (via PubMed), including the subsets *as supplied by publisher* and *in process* (1954 to November 2013), and EMBASE (via OvidSP) (1974 to November 2013). Searches were adapted to each database and carried out using the specific controlled vocabulary of each database, if available (Medical Subject Heading terms for MEDLINE and Emtree terms for EMBASE), as well as free-text words. The search included the words *acute cholecystitis*, *cholelithiasis*, *Mirizzi syndrome*, *gallstones*, *open*, *laparoscopic* or *laparos**, *subtotal*, *partial*, *insufficient*, *completion* or *incomplete*, and *cholecystectomy*, *gallbladder resection*, and *gallbladder excision*.

Type of Studies

Randomized, nonrandomized, and retrospective studies were eligible. In the absence of randomized studies, nonrandomized and retrospective studies were evaluated if they met the inclusion criteria. Excluded were studies that reported data on SC as well as other interventions (eg, cholecystostomy) without the possibility to discriminate results specific to SC. Case reports and reviews were gathered to screen their reference lists for additional relevant articles but were excluded from the analysis.

Participants

All individuals receiving an open, laparoscopic, or laparoscopic converted to open SC in either the elective or emergency setting were included. Individuals who received SC for trauma or as a secondary procedure were excluded.

Study Selection

One author (M.E.) screened all titles and abstracts of articles identified by the search strategy for relevance. Only clearly irrelevant citations were excluded at this stage. Full copies of all potentially relevant articles were obtained. Two authors (M.E. and G.G.) independently screened the full texts, identified relevant studies, and assessed the eligibility of studies for inclusion. Any disagreement on the eligibility of studies was resolved by discussion and consensus. The reasons for exclusion were recorded for all irrelevant records. Reference lists of included studies and relevant reviews identified during the search were screened for additional articles.

Data Collection and Analysis

The primary outcome of the study was the occurrence of CBD injury. Secondary outcomes included the occurrence of other SC-related morbidity, such as hemorrhage, subhepatic collection, bile leak, retained stones, postoperative endoscopic retrograde cholangiopancreatography (ERCP), wound infection, reoperations, and mortality.

Two authors (M.E. and G.G.) extracted the data independently. In addition to the outcomes, available data on surgical indications, operative technique, length of the operation, and length of stay were collected.

Statistical Analysis

All data were inserted into an Excel database (Microsoft Corp), and data analysis was performed using MIX, version 1.54 (BiostatXL) for the various outcomes. The variables evaluated were categorized as either present or absent (categorical variables), and the descriptive statistics were described with occurrences and relative frequencies. The weighted odds ratio (OR) for the occurrence of postoperative complications among the SC techniques (subgroup analysis) was also calculated. The model used for the meta-analysis was the fixed effect, and the Mantel-Haenszel weighting method was used. Results were

considered significant if the probability of chance of occurrence was less than 5% ($P < .05$).

Subgroup Analysis

We conducted subgroup analysis of removal vs nonremoval of the posterior GB wall from the liver, closure vs nonclosure of the cystic duct (CD) and GB stumps, and laparoscopic vs open SC. Studies selected for the subgroup analysis used only one technique in all of their patients (ie, laparoscopic SC with closure of CD/GB stumps and removal of the posterior wall) or specified outcomes according to the techniques used.

Assessment of Heterogeneity

The heterogeneity of the various outcomes for each subgroup was assessed with the heterogeneity Q value and with funnel plots. If heterogeneity was present, summary effect measures were interpreted with caution.

Missing Data

Articles with missing data relevant to the outcomes were excluded from the analysis. If missing data involved the definition of the 3 subgroups necessary for the subgroup analysis (ie, closure of the CD/GB stumps not reported), those articles were not included in the subgroup analysis.

Results

A total of 750 articles were found using the search strategy, but only 30 were included in the review (**Figure 1**). The total number of patients who underwent SC was 1231: 898 laparoscopic SC (72.9%), 234 open SC (19.0%), and 99 laparoscopic converted to open SC (8.0%).[13-42]

Indications for SC

The indications for SC are presented in eTable 1 in the Supplement. Severe cholecystitis, inflammation, and fibrosis at the Calot triangle were present in 888 patients (72.1%), which made the dissection of the CD and artery difficult and potentially dangerous.* Cholelithiasis in liver cirrhosis and portal hypertension was the cause for SC in 224 patients (18.2%)[14,18,24,39]; gangrene, empyema, or perforated GB in 75 individuals (6.1%)[17,19,32]; Mirizzi syndrome in 37 patients (3.0%)[17-19,26,31,40]; and intrahepatic GB or accidental damage to the GB in 7 patients (0.6%).[17,24,25]

Operative Technique and Variants

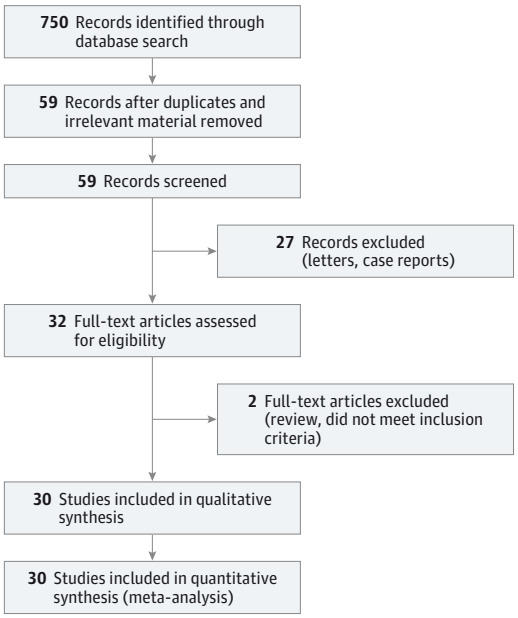
After induction of the pneumoperitoneum and insertion of the laparoscopic ports, the GB is drained and opened with hook diathermy at the fundus or at the Hartmann pouch (eTable 2 in the Supplement). The contents are evacuated into an endobag, and the anterior wall is excised with diathermy, leaving a small strip of the posterior wall attached to the liver.† The remnant mucosa is removed[17,20,33,36,42] or coagulated with diathermy or argon.[23] Intraoperative cholangiography was used in 4 studies.[19,22,23,27] Three studies left the CD or the GB stump opened,[13,29,35] and the other studies used surgical clips, suture ligation, Endoloop (Ethicon), Endo GIA 30 (Covidien), purse string suture, or intracorporeal sutures for closure.‡ A drain was used in all but one study.[40]

Upper midline or right subcostal incisions are used to access the abdomen (eTable 2 in the Supplement). The GB is aspirated and opened at the fundus or at the Hartmann pouch, in which case the incision is extended to the neck without dissecting the CD or artery. The contents are evacuated, and the anterior wall is excised with diathermy. In most of the studies evaluated, the posterior wall was left attached to the liver and the remnant mucosa was coagulated.[16,18,21,24,26,32,37,39] Only one study described the removal of the posterior wall.[20] All but one study[18] did not recommend routine intraoperative cholangiography. The CD was closed from within the GB with a purse string suture, oversewn, or ligated. A drain was used in most studies.[16,18,21,24,26,32,39]

Postoperative Outcomes

The postoperative outcomes analyzed are reported in eTable 3 in the Supplement and the **Table**.[13-18,20-30,32-42] All articles presented data on the outcomes analyzed; however, some studies did not report data necessary for the subgroup allocation and therefore were not entered into the subgroup analysis (Table). Most articles were homogeneous for the outcomes evaluated; however, in 3 studies, heterogeneous outcomes included hemorrhages and retained stones for the subgroup analysis of removal vs nonremoval of the posterior GB wall, as well as hemorrhage for closure vs nonclosure of CD and GB stumps (Table).

Figure 1. Search Strategy According to the Preferred Reporting Items for Systematic Reviews and Meta-analyses



The process of study selection.

*References 13, 15-18, 20, 23, 25-27, 29, 30, 33, 35, 36, 39-42
†References 13, 14, 22, 23, 25, 27, 29-31, 34, 35, 38, 40-43
‡References 14, 17, 22, 23, 25-27, 30, 31, 33, 34, 40-42

Table. Complications Classified According to the Surgical Technique Used

Surgical Technique (No. of Studies)	Patients, No. Affected/ Total No. (%)	No. (%)								
		Hemorrhage	Subhepatic Collection	Bile Leak	CBD Injury	Retained Stones	Post-operative ERCP	Wound Infections	Reoperation	30-d Mortality
Nonremoval of posterior wall (23)[a]	1011/1151 (88.0)	4 (0.4)	30 (3.0)	205 (20.3)	1 (0.09)	33 (3.3)	42 (4.1)	19 (1.9)	20 (2.0)	5 (0.5)
Removal of posterior wall (4)[b]	140/1151 (12.2)	0	4 (2.8)	10 (7.1)	0	4 (2.8)	5 (3.6)	6 (4.3)	1 (0.7)	0
OR (95% CI)		0.9 (0.3-2.5)	1.0 (0.7-1.4)	1.1 (0.9-1.2)	1.0 (0.1-7.3)	1.0 (0.7-1.4)	1.0 (0.7-1.3)	1.0 (0.6-1.5)	1.0 (0.6-1.5)	0.9 (0.4-2.3)
Heterogeneity Q value		40.6[g]	39.6	37.7	39.4	49.0[g]	31.2	25.8	34.0	33.3
Nonclosure of CD and GB stump (3)[c]	100/1161 (8.6)	1 (1.0)	19 (19.0)	42 (42.0)	0	12 (12.0)	15 (15.0)	1 (1.0)	5 (5.0)	2 (2.0)
Closure of CD and GB stump (24)[d]	1061/1161 (91.4)	3 (0.3)	16 (1.5)	175 (16.5)	1 (0.09)	25 (2.3)	32 (3.0)	28 (2.6)	16 (1.5)	3 (0.3)
OR (95% CI)		1.1 (0.4-3.0)	1.0 (0.7-1.5)	0.9 (0.8-1.1)	1.0 (0.1-7.7)	1.0 (0.7-1.5)	1.0 (0.8-1.4)	1.0 (0.7-1.5)	1.0 (0.6-1.6)	1.0 (0.4-2.7)
Heterogeneity Q value		49.0[g]	41.8	36.2	40.1	37.2	32.2	38.8	32.5	37.8
Laparoscopic (10)[e]	471/627 (75.0)	1/471 (0.2)	4/471 (0.8)	149/471 (31.6)	0/471 (0)	8/471 (1.7)	13/471 (2.8)	4/471 (0.8)	7/471 (1.5)	1/471 (0.2)
Open (8)[f]	156/627 (25.0)	1/156 (0.6)	4/156 (2.6)	10/156 (6.4)	0/156 (0)	6/156 (3.8)	7/156 (4.5)	13/156 (8.3)	5/156 (3.2)	2/156 (1.3)
OR (95% CI)		0.4 (0.1-2.0)	0.4 (0.2-0.9)[g]	5.3 (3.9-7.2)[g]		0.5 (0.3-0.9)[g]	0.7 (0.4-1.2)	0.07 (0.04-0.2)[g]	0.5 (0.3-0.9)[g]	0.2 (0.05-0.9)[g]
Heterogeneity Q value		26.3	16.2	43.1		12.0	29.1	16.2	18.5	24.2

Abbreviations: CBD, common bile duct; CD, cystic duct; ERCP, endoscopic retrograde cholangiopancreatography; GB, gallbladder; OR, odds ratio.

[a] References 13-15, 18, 21-30, 32, 34, 35, 37-42.

[b] References 17, 20, 33, 36.

[c] References 13, 29, 35.

[d] References 14-18, 20-28, 30, 32-34, 36, 38-42.

[e] References 14, 22, 27, 29-31, 35, 36, 38, 42.

[f] References 16, 18, 21, 24, 26, 32, 37, 39.

[g] $P < .001$.

Hemorrhage

Hemorrhage was identified in 4 patients (0.3%). Ransom[30] reported 1 case of bleeding from a preoperative endoscopic sphincterotomy site that did not require reoperation. Two studies[13,21] reported 2 cases of postoperative bleeding from the GB wall or the liver bed requiring reoperation. Hubert et al[23] described a patient with port site bleeding who underwent hemostasis under local anesthetic.

Subhepatic Collection

Subhepatic collection was reported in 36 patients (2.9%). The CD was left open in 19 of 100 patients (19.0%) who had nonclosure.[13,29,35] Radiologic drainage was conducted in 2 of these patients, and an additional patient underwent a reoperation.[29] The CD was closed in 16 of 1061 patients (1.5%).§ Of these, 4 patients (25.0%) had a subhepatic hematoma,[25,28,36] 6 (37.5%) developed a subphrenic abscess,[16,24,33] and 6 (37.5%) experienced a subhepatic biloma.[25,26,28] One subhepatic collection was reported in a study in which closure of the CD was variable.[31]

Bile Leak

Bile leak occurred in 221 patients (18.0%). Bile leak developed in 42 of 100 patients (42.0%) in whom the CD or Hartmann pouch was left open and in 175 of 1061 patients (16.5%) following closure of the CD or GB stump; there was no comment regarding CD closure in 4 of 70 patients (5.7%).[19,31,37] Because the incidence of bile leak was high in most series, drains were routinely applied for postoperative monitoring. The leaks resolved spontaneously in 69 patients (5.6%) after 4 to 12 days without intervention.||

Common Bile Duct Injury

One patient (0.08%) had CBD injury. No mention was made about the classification of the injury or the intervention required.[41]

Retained Stones

Thirty-eight patients (3.1%) presented with retained stones in the postoperative period. Twenty-five of 1061 patients (2.4%) had their CD or GB stump closed,# and 12 of 100 patients (12.0%) did not have the stump closed.[13,29,35] There was no comment on CD closure in 3 studies.[19,31,37] Endoscopic retrograde cholangiopancreatography was performed in 30 of 38 patients (78.9%) to remove CBD stones.** Five of 38 patients (13.2%) underwent CBD exploration,[15,18,24] and 3 patients (7.9%) had completion cholecystectomy.[14]

Postoperative ERCP

Endoscopic retrograde cholangiopancreatography was performed in 51 patients (4.1%). Indications were retained stones

§References 14-18, 20-28, 30, 32-34, 36, 38-41

|| References 15-18, 20-22, 25, 26, 28, 30, 32, 36

#References 14-18, 20-28, 30, 32-34, 36, 38-42

**References 13, 15, 17-19, 23, 24, 26, 27, 29, 30, 32-35

in 30 patients (58.8%),†† persistent bile leaks in 16 patients (31.4%),[13-15,17,18,26,27,29-35] and CBD strictures or Mirizzi syndrome in 5 individuals (9.8%).[13-15,18,19,29,31,33-35]

Wound Infections

Wound infections were reported in 32 patients (2.6%). Five infections (15.6%) developed after laparoscopic SC,[14,41] 14 (43.8%) occurred after open SC,[18,23,24,26,32,39] and 13 (40.6%) happened after laparoscopic converted to open SC.[13,17,19,25,28,33]

Reoperations

Reoperations were reported in 22 patients (1.8%). Reasons for the reoperations included CBD exploration for stones (5 patients [22.7%]),[15,18,24] laparotomy for subphrenic abscess, infected residual stone, or biliary leak (5 [22.7%])[13,29,32-34]; completion laparoscopic cholecystectomy of the GB remnant (4 [18.2%])[14,29]; Roux-en-Y choledochojejunostomy for Mirizzi syndrome (2 [9.1%])[15]; laparoscopy and peritoneal lavage for biliary leak and biliary peritonitis (2 [9.1%])[31,34]; laparotomy for postoperative bleeding from the GB wall and liver bed (2 [9.1%])[13,21]; emergency repair of incarcerated port site hernia (1 [4.5%])[29]; and laparotomy 2 months following the operation for adhesive small-bowel obstruction (1 [4.5%]).[39]

30-Day Mortality

The mortality rate was 0.4% (n = 5). The causes of death were myocardial infarction (n = 2),[28,29] acute on chronic renal failure (n = 1),[32] severe sepsis (n = 1),[26] and pulmonary sepsis and multiorgan failure (n = 1).[13]

Subgroup Analysis

The pooled outcomes analyzed according to the surgical technique used are reported in the Table. The subgroup analysis of the removal vs nonremoval of the posterior wall and closure vs nonclosure of the CD or GB stumps did not produce significant differences in the risk (OR) of any of the outcomes evaluated (Table). However, the laparoscopic approach produced less risk of subhepatic collections, retained stones, wound infections, reoperations, and mortality and more bile leaks compared with the open approach (Table and **Figures 2**, **3**, and **4**).‡‡

Discussion

Subtotal cholecystectomy was first reported by Madding[44] in 1955 as a replacement for cholecystostomy and a rescue procedure in cases of technically difficult total cholecystectomy (TC). His technique involved incising the GB at the fundus down to 1 cm from the CD, followed by excising the redundant GB wall. Thirty years later, Bornman and Terblanche[39] described their experience in managing difficult GBs in cases of severe cholecystitis and portal hypertension. Subtotal cholecystectomy was performed by piecemeal excision of the GB, starting at the Hartmann pouch and leaving a rim of the posterior wall attached to the liver. The mucosa of this remnant was coagulated or left intact, and the CD was closed from within the GB with a purse-string suture. This technique was adopted by numerous surgeons with minor modifications.[18,21,24,32,37]

With the introduction of laparoscopic cholecystectomy by Muhe (1985) and Mouret (1987),[45] laparoscopic SC was considered a rescue technique in cases of difficult GBs to avoid misidentification injuries of the bile duct and vascular structures from severe inflammations that otherwise would have required conversion to an open cholecystectomy.§§ Bickel and Shtamler[38] (1993) described their successful experience in the treatment of 6 patients with the use of laparoscopic SC. They opened the GB with hook diathermy and resected only the anterior wall, leaving the posterior wall attached to the liver, which was coagulated at a later point in the operation.[38] Crosthwaite et al[40] reported 5 cases of laparoscopic SC. Chowbey and colleagues[17] presented 53 cases of laparoscopic SC with removal of the posterior GB wall and the use of an Endo GIA 30 stapler to transect the GB neck. Beldi and Glättli[13] performed the procedure on 37 patients without closure of the CD or Hartmann pouch. Palanivelu et al[14] reported on the largest series of laparoscopic SC in the literature, which included 206 patients with liver cirrhosis and cholelithiasis.

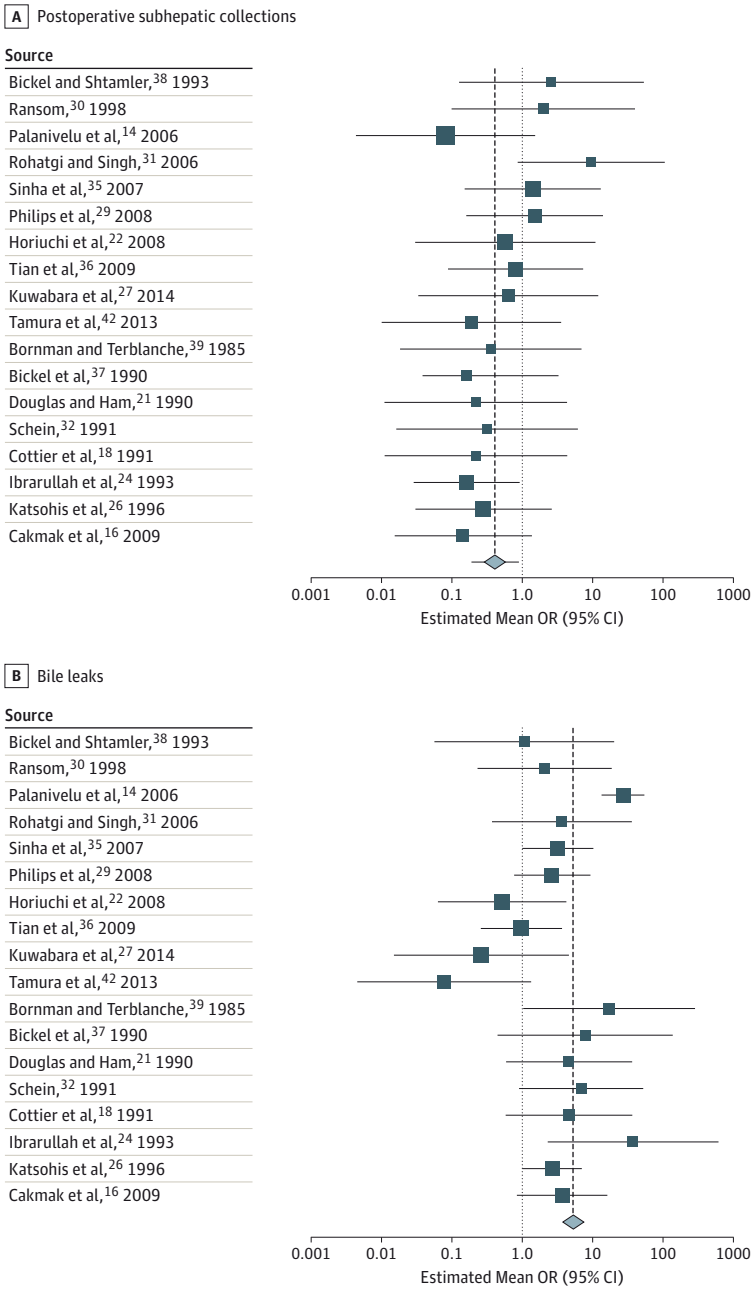
According to the pooled analysis of studies selected in our review, the incidence of postoperative complications found for SC were different from those usually reported for TC. Subtotal cholecystectomy usually is performed for difficult GBs in which the degree of inflammation, fibrosis, and adhesions significantly increases the risk of complications, especially CBD injuries.[22,23,28] Therefore, complication rates similar to those reported for TC mean that difficult GB cases undergoing SC are managed as safely as simple cholecystectomies undergoing TC. This outcome is especially true in the case of CBD injuries that were less frequent in SC (1 of 1231 [0.08%]) than TC (668 of 162 464 [0.4%]),[47-51] definitely achieving the purpose for which SC was created. As theoretically predicted, CBD injury was absent in the subgroup in which the CD or GB stump was left open because of avoidance of the hazardous dissection of the CD in cases with difficult Calot triangles.[52-58]

Rates of postoperative hemorrhages were similar between SC (4 of 1231 [0.3%]) and TC (392 of 152 297 [0.3%]).[47-51] Bleeding from the liver bed is theoretically avoided in SC by not removing the posterior GB wall. This result is even more interesting in the series of Palanivelu et al,[14] with an incidence of 0% in patients with cirrhosis, a subgroup particularly susceptible to postoperative hemorrhage. However, low incidences of postoperative hemorrhages (0%) were also found with the removal of the posterior GB wall,[17,20,33,36] and no significant differences in the risk (OR) were observed when compared with the nonremoval group. It is possible in this case that the low number of patients from studies reporting removal of the posterior wall (n = 140) did not allow for a proper estimate of the incidence of postoperative hemorrhages in this subgroup. It is also possible that the heterogeneity among the studies evaluating this outcome could have influenced the results.

Postoperative subhepatic collections and bile leaks were more frequent following SC than TC (collections: 2.9% [36 of

††References 13, 15, 17, 18, 23, 24, 26, 27, 29, 30, 32-35
‡‡References 14, 16, 18, 21, 22, 24, 26, 27, 29-32, 35-39, 42
§§References 12-14, 17, 22-25, 27-30, 34-36, 38, 40-43, 46

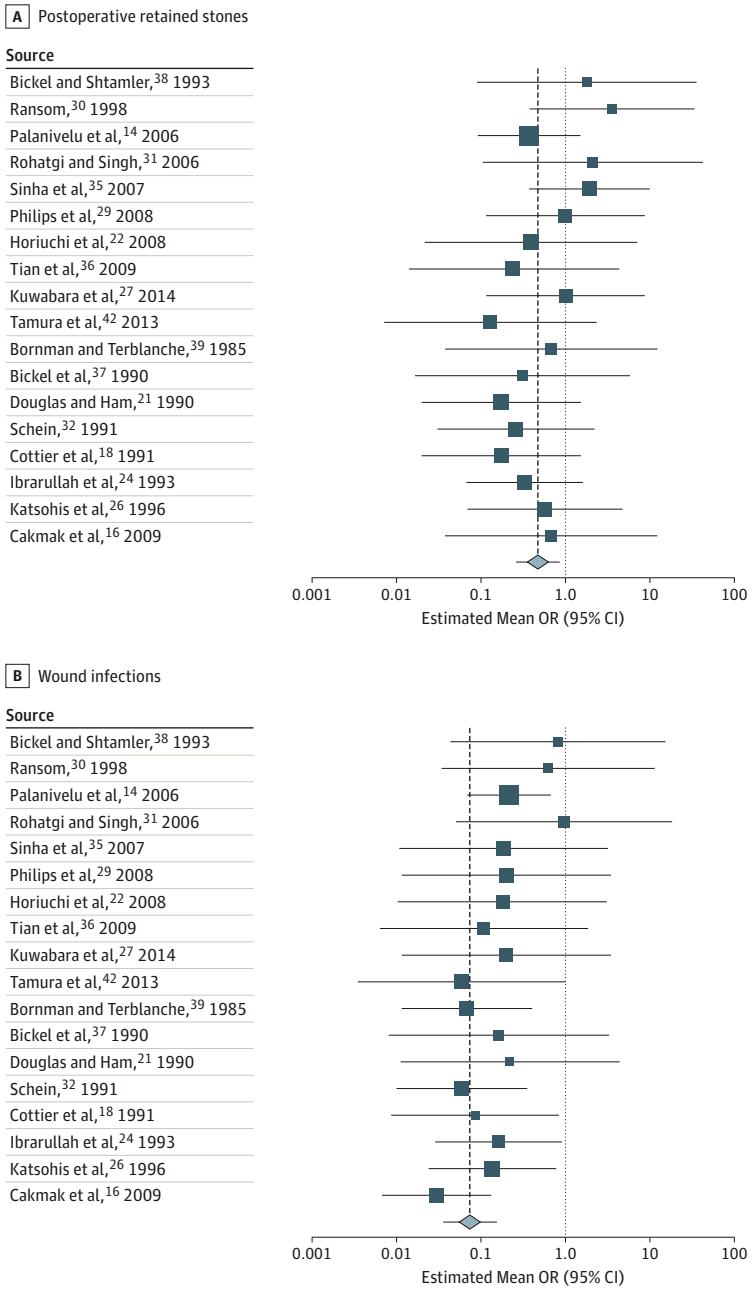
Figure 2. Fixed-Effect Results of Laparoscopic vs Open Subtotal Cholecystectomy for Postoperative Subhepatic Collections and Bile Leaks



Boxes indicate estimated mean odds ratio (OR); diamond, summary statistic; limit lines, 95% CIs; and dashed line, overall estimated OR. Size of the data marker corresponds to the relative weight assigned to the pooled analysis using fixed-effects models. The x-axes use a log scale.

1231] vs 0.1% [83 of 64 208]; leaks: 18.0% [221 of 1231] vs 0.3% [450 or 154 869]).[47-51] Since most collections were bilomas, a possible explanation is derived from the higher amount of local tissue inflammation present in patients undergoing SC compared with TC. It is likely that, in difficult GBs, the edematous tissues of the Hartmann pouch or CD stump increase the bile leak once the edema disappears and the suture loses its watertight properties when the CD or GB stumps are closed,[59] or bile leaks from the unsecured duct accumulate in the subhepatic space when the CD or GB stumps are left open. A contributing factor could be the eventual presence of undiagnosed stones in the CBD, which increases the CBD pressure and causes the CD stump to open partially and leak.[60] Subhepatic collections and bile leaks seemed less frequent in the group in which the stumps were closed, but the weighted analysis did not find any significant difference in the risk (OR) compared with the group in which the stump was left open. Palanivelu et al[14] reported a peculiar series of 206 cases of laparoscopic SC in patients affected by liver cirrhosis (Child-Pugh classes A and B). In this group, the bile leak rate was high (65.0% [134 cases]) compared with the other series in which the CD was secured. The exclusion of these patients with cirrhosis from

Figure 3. Fixed-Effect Results of Laparoscopic vs Open Subtotal Cholecystectomy for Postoperative Retained Stones and Wound Infections



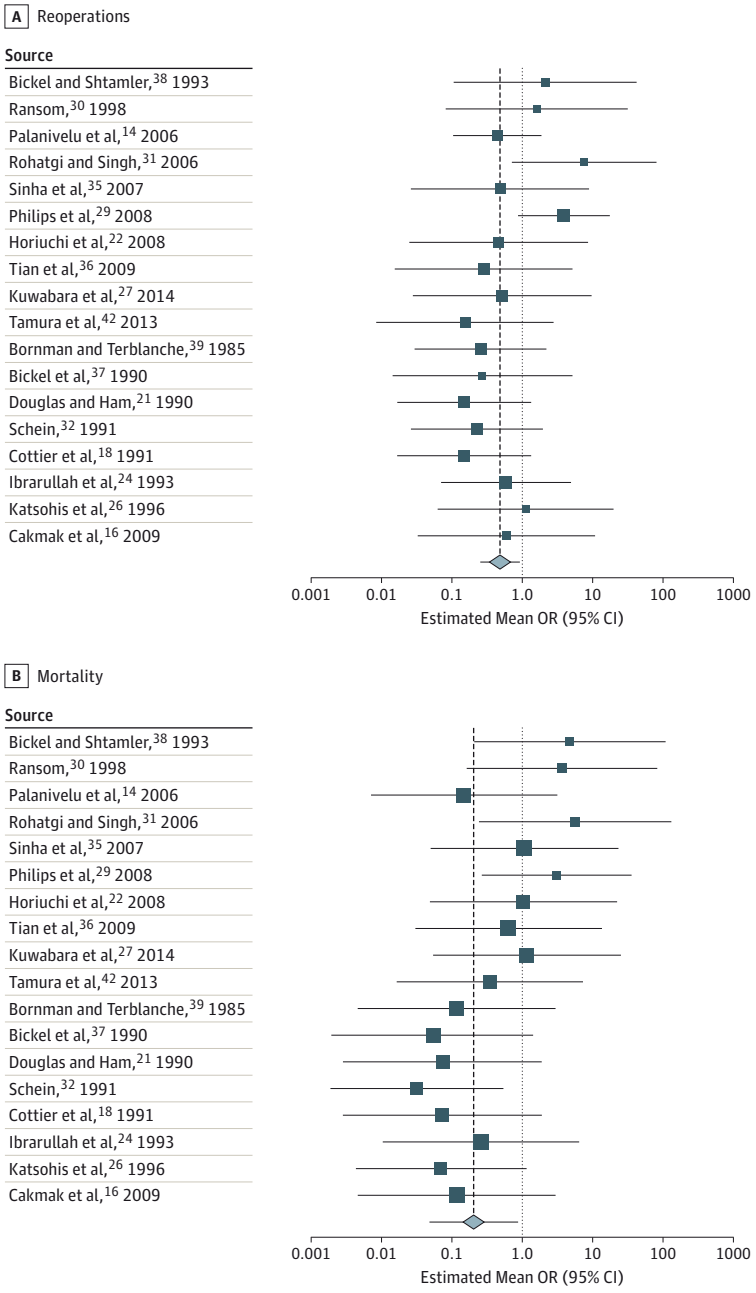
Boxes indicate estimated mean odds ratio (OR); diamond, summary statistic; limit lines, 95% CIs; and dashed line, overall estimated OR. Size of the data marker corresponds to the relative weight assigned to the pooled analysis using fixed-effects models. The x-axes use a log scale.

the analysis decreases the bile leak rate for the group with closure of the CD or GB stump to 4.8% (41 of 855).

Retained stones were more frequent following SC (3.0% [38 of 1231 patients]) than TC (0.3% [77 of 26 809]).[48,49,51] It is possible that stones were missed in the GB remnant or slipped from the GB into the CBD during difficult dissections, especially if the CD was left open.[23,61] Similarly, postoperative ERCPs were more frequent following SC (4.1% [51 of 1231 patients]) than TC (0.2% [22 of 9542]).[48] Although an apparent higher incidence of retained stones (15.0%) was present in the subgroup in which the CD or GB stump was left open (3.0%), no significant differences in risk (OR) were observed with the weighted analysis. Reoperation rates and mortality rates were higher following SC than TC (reoperations, 1.8% [22 of 1231 cases] vs 0.2% [113 of 49 911]; mortality, 0.4% [5 of 1231] vs 0.08% [129 of 166 753]).[47-51,62] This finding could reflect the greater technical difficulty of patients undergoing SC than TC. However, no significant differences were observed in the subgroup analysis in closure vs nonclosure of the CD/GB stumps and removal vs nonremoval of the posterior GB wall.

No case of incidental GB cancer was reported in the specimens removed or in the GB remnant, and no long-term fol-

Figure 4. Fixed-Effect Results of Laparoscopic vs Open Subtotal Cholecystectomy for Reoperations and Mortality



Boxes indicate estimated mean odds ratio (OR); diamond, summary statistic; limit lines, 95% CIs; and dashed line, overall estimated OR. Size of the data marker corresponds to the relative weight assigned to the pooled analysis using fixed-effects models. The x-axes use a log scale.

low-up data were available for patients undergoing SC in the studies examined. The rare incidence of incidental GB cancer,[63] combined with the fact that SC is limited to select patients, reduces the possibility of GB carcinoma developing in the GB remnant. Therefore, the necessity of a completion cholecystectomy to prevent the development of GB cancer is unlikely. However, some authors[43] recommended collecting biopsies from the GB remnant to exclude incidental GB cancer or predisposing factors, such as mucosal dysplasia.

Conclusions

Subtotal cholecystectomy is an important tool for general and hepatobiliary surgeons facing complex intraoperative situations at high risk of postoperative complications. Subtotal cholecystectomy is not a replacement for TC; however, when necessary, it achieves morbidity rates in difficult GBs comparable to those reported for TC, especially regarding

CBD injuries. In this way, treatment in patients with complex conditions undergoing SC is managed as safely as in patients with simple conditions undergoing TC. Laparoscopic SC generally produces better outcomes compared with open SC, but no significant differences were found between the techniques of closure vs nonclosure of the CD or GB stumps and removal vs nonremoval of the GB posterior wall.

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