

Comparison of laparoscopic cholecystectomy with and without abdominal drainage in patients with non-complicated benign gallbladder disease

A protocol for systematic review and meta analysis

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Abstract

Objective: To evaluate whether conventional postoperative drainage is more effective than not providing drainage in patients with non-complicated benign gallbladder disease following laparoscopic cholecystectomy (LC).

Methods: A search of the electronic databases MEDLINE, EMBASE, Web of science, Cochrane Library, and Chinese Biomedical Database (CBM) was conducted for randomized controlled trials (RCTs) reporting outcomes of LC surgery with and without an abdominal drain.

Results: Twenty-one RCTs involving 3246 patients (1666 with drains vs 1580 without) were included in the meta-analysis. There were no statistically significant differences in the rates of incidence of intra-abdominal fluid (RR: 1.10; 95% CI: 0.81–1.49; $P = .54$) or post-surgical mortality (RR: 0.44; 95% CI: 0.04–4.72; $P = .50$) between the two groups. Abdominal drains did not reduce the overall incidence of nausea and vomiting (RR: 1.16; 95% CI: 0.95–1.42; $P = .15$) or shoulder tip pain (RR: 1.03; 95% CI: 0.76–1.38; $P = .86$). The abdominal drain group displayed significantly higher pain scores (MD: 1.07; 95% CI: 0.69–1.46; $P < .001$) than the non-drainage patients. Abdominal drains prolonged the duration of the surgical procedure (MD: 5.69 min; 95% CI: 2.51–8.87; $P = .005$) and postoperative hospital stay (MD: 0.47 day; 95% CI: 0.14–0.80; $P = .005$). Wound infection was found to be associated with the use of abdominal drains (RR: 1.97; 95% CI: 1.11–3.47; $P = .02$).

Conclusions: Currently, there is no evidence to support the use of routine drainage after LC in non-complicated benign gallbladder disease. Further well-designed randomized clinical trials are required to confirm this finding.

Abbreviations: AMSTAR = A Measurement Tool to Assess systematic Reviews, CBM = Chinese Biomedical Database, CI = confidence interval, IAD = intra-abdominal drainage, LC = laparoscopic cholecystectomy, MD = mean difference, PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-analyses, RCTs = randomized controlled trials, RR = relative risk, VAS = visual analog scale.

Keywords: drain, laparoscopic cholecystectomy, meta-analysis

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JY, YL, and PY contributed equally to this work.

Data Availability: The data supporting this meta-analysis are from previously reported studies and datasets, which have been cited within the text. The processed data are available from the corresponding author upon reasonable request.

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1. Introduction

Due to its reduced invasiveness, rapid postoperative recovery and shorter average postoperative hospital stay, LC has become the surgical treatment of choice for benign gallbladder disease.^[1] Approximately four-fifths of all cholecystectomies are performed laparoscopically.^[2]

Routine drainage of the abdominal cavity after various surgical operations has been the dogma for many decades.^[3] LC is among the most common procedure in abdominal surgery, and the issue of drainage has generally been considered of little consequence. However, routine drainage after LC has become a controversial topic. The majority of surgeons wish to prevent the formation of an intra-abdominal abscess by removing debris and clots through preventive insertion of drainage and timely detection of a number of postoperative complications.^[4] However, some studies have shown that drainage does not prevent infection or leakage, even in contaminated surgery such as perforated appendicitis or ulcer perforation. Thus, this issue has concerned all surgeons.^[5,6]

High quality meta-analyses have been increasingly regarded as a key tool for obtaining the required level of evidence.^[7] The Cochrane Collaboration policy is that Cochrane Intervention reviews should be updated within 2 years.^[8] In comparison with a previous meta-analysis published by Lv Yong and others, the present meta-analysis has included new literature, extended search times, and added new evidence. In order to clarify the advantages and disadvantages of conventional abdominal drainage in LC for non-complicated benign gallbladder disease, we utilized the Cochrane systematic evaluation method to identify randomized controlled trials (RCTs) reporting outcomes of intra-abdominal drainage (IAD), then conducted a meta-analysis.

2. Materials and methods

2.1. Information sources and search

This systematic review and meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines for interventional studies.^[9] A Measurement Tool to Assess systematic Reviews (AMSTAR) was used to assess methodological quality.^[10] The MEDLINE, Cochrane library, Web of Science, EMBASE, Web of Science and Chinese Biomedical Literature (CBM) databases were systematically searched from their inception dates to January 2019. Based on the inclusion criteria, only RCTs that compared patients in whom abdominal drainage was fitted with those without drainage after laparoscopic cholecystectomy were considered. The precise search strategies are presented in Appendix 1, <http://links.lww.com/MD/E204>. In addition, no language or publishing status restrictions were imposed. This study is a meta-analysis and did not involve ethical review, because ethical approval was not necessary as stated by the ethical review committee in our hospital.

2.2. Study selection

2.2.1. Inclusion criteria. Studies were selected based on the following inclusion criteria:

1. Adult patients with non-complicated benign gallbladder disease (such as cholelithiasis, acute calculous cholecystitis, chronic calculous cholecystitis, or gallbladder polyps smaller than one centimeter in diameter);
2. Patients who had undergone LC surgery;

3. The study was a RCT;
4. Results reported outcomes of abdominal drainage versus no abdominal drainage; and
5. Patients with non-complicated benign gallbladder disease were selected for LC.

2.2.2. Exclusion criteria. Studies were not included based on the following exclusion criteria:

1. Non-RCTs (case series, case-control study, and cohort study);
2. Reviews;
3. Any studies conducted in pediatric age groups;
4. Studies that duplicated data where more recent sampling had been incorporated;
5. Trials of patients who required complicated benign gallbladder disease LC (such as atrophic cholecystitis, acute suppurative or gangrenous cholecystitis, gallbladder empyema or gallbladder perforation, confusing anatomy of the hepatobiliary triangle due to adhesions); and
6. Trials of patients undergoing open cholecystectomy, because LC is now firmly established as the gold standard of treatment for symptomatic gallstone disease.

2.3. Data extraction

All data were extracted independently by 2 reviewers (JY, YL) using a standardized extraction form. Any discussion regarding extracted data was agreed by consensus with a third reviewer (PJY). The following data were extracted from each study: lead author, publication year, population characteristics such as sample size, age and sex ratio, type of disease, drainage method, and principal outcomes.

2.3.1. Primary outcome. Intra-abdominal fluid (biloma or bile leak, bleeding, or abscess).

2.3.2. Secondary outcomes. Postoperative pain after 24h, duration of surgical procedure, postoperative hospital stay, nausea and/or vomiting, shoulder tip pain, wound infection, and post-operative mortality.

2.4. Subgroup analyses

We intended to perform the following subgroup analyses: compare geographical areas (comparison of patients from Asia, Europe, and America) and perform a comparison of drainage methods (open drain: drainage through adsorption or catheter cavity; suction drain: drainage by closed suction).

2.5. Assessment of risk of bias in studies included in the review

Assessment of risk of bias was conducted through compliance with the instructions provided in the Cochrane Handbook, which contains seven factors: randomization sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, plus other biases. Each study was divided into low, high, or unclear risk of bias.^[11]

2.6. Statistical analysis

The meta-analysis was conducted using RevMan5.3 (Nordic Cochrane Centre; Oxford, UK) software. Mean difference (MD)

was used to analyze the effect size between measurement data, whereas relative risk (RR) was used for count data. Point estimates and 95% confidence intervals (CIs) were calculated. A χ^2 test was used to assess statistical heterogeneity between the results of each study (using $\alpha=0.05$), with degree of heterogeneity quantitatively ascertained using the I^2 statistic. $P \leq .05$ was considered statistically significant. Where there was no statistical heterogeneity between studies, a fixed-effects model was used for the meta-analysis. Where statistical heterogeneity was detected, the source was further investigated, and if the effects of significant clinical heterogeneity could be excluded, the meta-analysis was conducted using a random effects model. The threshold selected for the meta-analysis was set at $\alpha=0.05$.

2.7. Assessment of publication bias

We employed funnel plot methodology to judge crudely whether any publication bias was present, and then quantified any such bias using an Egger test with Stata 14.0 software (StataCorp; College Station, TX).

3. Results

From an initial literature search, 4877 abstracts were retrieved (Fig. 1). After careful reading, 52 studies that were potentially relevant were identified, although 31 did not meet the inclusion criteria after examining the full text. Finally, 21 RCTs were included,^[3,4,12–30] comprising a total of 3246 patients (1666 with drains vs 1580 without). Table 1 lists the characteristics of the studies included in this review.

3.1. Risk of bias

A total of 21 studies were assessed. Figures 2 and 3 provide a table and graphical summary, respectively, for risk of bias. Seven studies^[3,4,16–18,24,25] were of relatively high quality, whereas the remaining articles were of low quality. Seventeen studies^[3,4,12,15–25,27,28,30] reported specific randomization methods, but only 7^[4,16–18,22,24,28] described specific allocation concealment schemes. Thirteen studies^[12,13,15,17,19–22,26–30] did not clarify whether blinding methods were used or not.

3.2. Publication bias

Funnel plots (incidence of intra-abdominal fluid) are shown in Figure 4. Inverted analysis of the main results was roughly symmetrical. However, due to the small number of research reports that were included in the review, random factors may have had a greater impact on the funnel plot. An additional Egger test for publication bias was conducted. The Egger method uses linear regression, with symmetry of the funnel plot measured according to the natural logarithm of the odds ratio. Parameters of the linear regression for bias were: $t=-0.89$, $P=.424$, with 95% CIs: -2.736 to -1.408 . These results indicate that there was no significant publication bias in the articles included in this review.

3.3. Main outcomes

3.3.1. Intra-abdominal fluid. Nine studies that included a total of 1661 participants provided information about the presence of intra-abdominal fluid. These suggested that there was no difference between the drain (68/834) and no drain groups

(58/827) (RR: 1.10; 95% CI: 0.81–1.49; $P=.54$) (Fig. 5). Heterogeneity was not statistically significant ($I^2=0\%$).

3.3.2. Wound infection. Twelve studies that included a total of 1486 participants provided information about wound infection, which was significantly less common in the no drain group (16/721) than the drain group (37/765) (RR: 1.97; 95% CI: 1.11–3.47; $P=.02$) (Fig. 6). Heterogeneity was statistically significant ($I^2=0\%$).

3.3.3. Vomit and/or nausea. Ten studies that included a total of 1229 participants provided information about symptoms of vomit or nausea, indicating that there was no difference between the drain group (125/624) and the no drain group (100/605) (RR: 1.16; 95% CI: 0.95–1.42; $P=.15$) (Fig. 7). Heterogeneity was not statistically significant ($I^2=0\%$).

3.3.4. Postoperative pain at 24h. Nine studies provided information about postoperative pain after 24h. Each study measured the level of pain using a 10-point visual analog scale (VAS). Pain was significantly lower in the no drain group than in the drain group (MD: 1.07; 95% CI: 0.69–1.46; $P<.001$) (Fig. 8). However, heterogeneity was statistically significant ($I^2=96\%$).

3.3.5. Post-operative mortality. Fourteen studies comprising a total of 2228 participants provided information about post-operative mortality. No difference was detected between the drain (1/1127) and no drain groups (2/1101) (RR: 0.44; 95% CI: 0.04–4.72; $P=.50$) (Fig. 9).

3.3.6. Shoulder tip pain. Nine studies representing a total of 1049 participants provided information about shoulder tip pain, which indicated that there was no difference between the drain group (69/534) and no drain group (64/515) (RR: 1.03; 95% CI: 0.76–1.38; $P=.86$) (Fig. 10). Heterogeneity was not statistically significant ($I^2=12\%$).

3.3.7. Duration of surgical procedure. Twelve studies provided data about the duration of the surgical procedure, which indicated that the drain group was significantly longer than the no drain group (2235 participants; MD: 5.69 min; 95% CI: 2.51–8.87; $P=.005$) (Fig. 11). Heterogeneity was statistically significant ($I^2=81\%$).

3.3.8. Postoperative hospital stay. Eleven studies investigated the length of hospital stay, demonstrating that it was significantly longer for the drain group than the no drain group (2099 participants; MD: 0.47 days; 95% CI: 0.14–0.80; $P=.005$) (Fig. 12). Heterogeneity was statistically significant ($I^2=59\%$).

3.4. Subgroup analysis

Depending on geographical region, subgroup analysis results indicated that for Asian patients, the two drainage groups presented a similar incidence rate for intra-abdominal fluid and shoulder tip pain. However, the no drainage group exhibited a lower incidence rate of postoperative pain after 24h. For Europe and America, similar results to Asian patients were found for incidence rate of intra-abdominal fluid, shoulder tip pain and postoperative pain after 24h in the drainage and no drainage groups.

Furthermore, depending on the method of drainage, subgroup analysis in the present analysis indicated that in open drainage, the incidence of intra-abdominal fluid and shoulder tip pain was similar in both the drainage group and non-drained group.

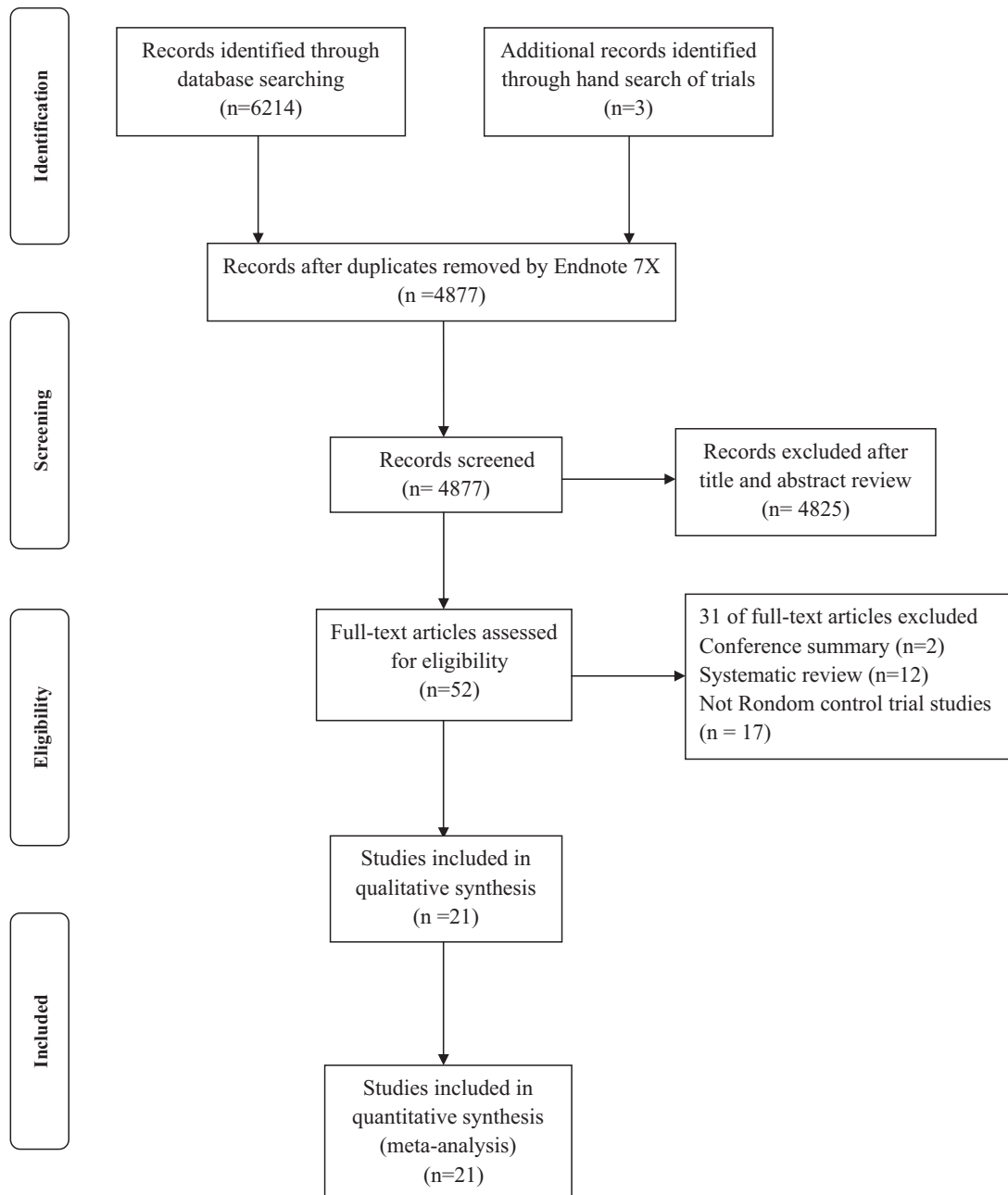


Figure 1. Study flow diagram.

However, the incidence of postoperative pain after 24 h was significantly reduced in the non-drained group. For suction drainage, the incidence of intra-abdominal fluid, shoulder tip pain and postoperative pain after 24 h was similar. However, the incidence of postoperative pain following 24 h after suction drainage was lower than that of open drainage (Table 2).

4. Discussion

The present review has demonstrated that there is no significant advantage of using a drain following LC. Placement of abdominal drainage in these circumstances can prevent intra-abdominal fluid, such as postoperative bleeding and bile leak.^[31] If drains are not placed, most clinicians have concerns about

complications that would require a second operation, which would undoubtedly harm the patient.^[27] However, only a small degree of bleeding, bile leak, or exudation is normally experienced after LC surgery with no clearly adverse reactions and these are completely absorbed by the peritoneum. The meta-analysis suggested that drainage does not prevent the occurrence of intra-abdominal fluid. We found that its total volume was greater in the drain group than in patients without drains. Therefore, due to the lack of credible evidence, the role of abdominal drainage to prevent intra-abdominal fluid cannot be supported.

Conversely, conventional drains increase the incidence of wound infection. However, this observation should be interpreted with caution because the information provided in the studies included in this review is difficult to quantify. We are not

Table 1 Summary of studies included in the meta-analysis.

Study	Geographical areas	Sample size	(D/W)	Average age	Female percent	Type of disease	Comorbidities disease	Drainage methods	Main outcomes
Oiu et al ^[12] 2018	Asia	212	106/106	44	50	Acute calculous cholecystitis	Not started	Open drain	① ② ④ ⑥ ⑦ ⑧
Sharma et al ^[14] 2016	Asia	60	30/30	37	78	Symptomatic gallstone	Not started	Open drain	① ② ③ ④ ⑤
Sharma et al ^[3] 2016	Asia	100	50/50	43	/	Symptomatic gallstone	Not started	Open drain	③ ⑧
Prevot et al ^[15] 2016	Europe	414	236/178	56	51	Symptomatic gallstone	Diabetes; cancer or renal, vascular or pulmonary	Suction drain	⑦ ⑧
Kim et al ^[4] 2015	Asia	193	94/99	57	52	Acutely inflamed gallbladder	Not started	Suction drain	① ② ③ ④ ⑤ ⑥ ⑦ ⑧
Park et al ^[9] 2014	Asia	160	79/80	57	39	Acute cholecystitis	Not started	Open drain	② ⑥ ⑧
Shanm et al ^[17] 2013	Asia	155	79/76	41	85	Chronic calculous cholecystitis	Not started	Open drain	② ③ ⑤
Picchio et al ^[6] 2012	Europe	106	53/53	48	77	Nonacutely inflamed gallbladder	Not started	Suction drain	① ② ④ ⑥ ⑦ ⑧
Lucarelli et al ^[16] 2012	Europe	30	15/15	63	67	Acute calculous cholecystitis	Not started	Suction drain	② ④ ⑥ ⑦ ⑧
El-habban et al ^[19] 2012	Africa	160	80/80	/	73	Symptomatic gallstone	Not started	Open drain	① ② ③ ⑥ ⑦
Nagpal et al ^[20] 2012	Asia	40	20/20	37	75	Symptomatic gallstone	Not started	Open drain	④
Georgiou et al ^[21] 2011	Europe	116	63/53	51	61	Symptomatic gallstone	Not started	Open drain	① ② ④ ⑤ ⑥ ⑦
Tzovaras et al ^[21] 2009	Europe	565	284/281	56	70	Symptomatic gallstone	Not started	Open drain	① ② ③ ④ ⑤ ⑦
Uchiyama et al ^[22] 2007	Asia	120	60/60	58	47	Choleystolithiasis or gallbladder polyp	Not started	Open drain	① ② ③ ④ ⑤ ⑦ ⑧
Mrozowicz et al ^[23] 2006	Europe	150	80/70	55	75	Symptomatic cholelithiasis	Not started	Closed drain	① ② ③ ④ ⑥ ⑦ ⑧
Capitanich et al ^[24] 2005	America	93	40/53	52	59	Symptomatic gallstone	Not started	Open drain	① ③ ⑤ ⑦ ⑧
Nursal et al ^[25] 2003	Europe	60	35/34	50	60	Acute calculous cholecystitis	Not started	Suction drain	① ③ ④ ⑤ ⑦
Nomdedeu et al ^[26] 1997	Europe	50	25/25	52	70	Symptomatic gallstone	Not started	Suction drain	⑧
Hawasli et al ^[27] 1994	America	100	50/50	52	79	Symptomatic cholelithiasis	Not started	Suction drain	② ③ ⑤ ⑦
Thiebe et al ^[28] 1994	Europe	300	131/148	/	/	Symptomatic cholelithiasis	Not started	Closed drain	① ② ③ ⑤ ⑦
Trowbridge et al ^[28] 1982	America	300	56/19	47	70	Symptomatic cholelithiasis	Not started	Suction drain	①

D = drain group, ① = post-operative mortality, ② = wound infection, ③ = vomit or/and nausea, ④ = pain 24 h after surgery, ⑤ = intra-abdominal fluid, ⑥ = duration of surgical procedure, ⑦ = shoulder tip pain, ⑧ = postoperative hospital stay, W = without drain group.

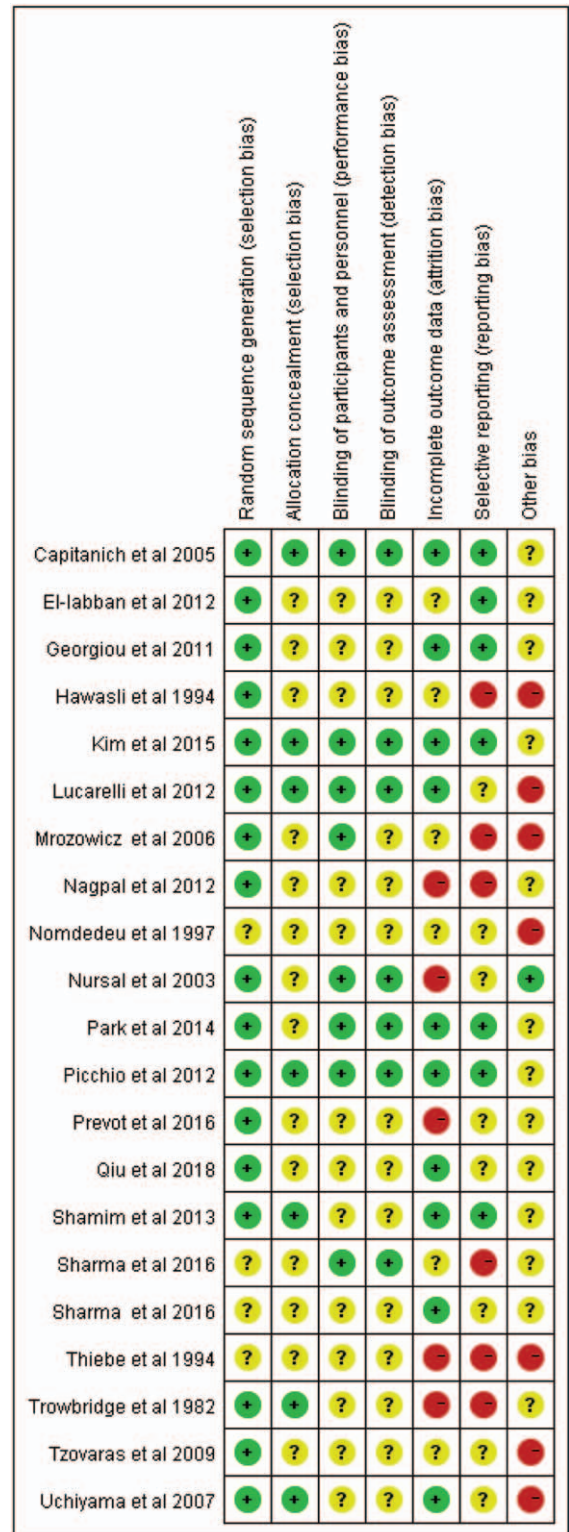


Figure 2. Details of risk of bias results.

sure if the source of infection is the wound, the drain, or both. No original article clearly recorded these details. In addition, a number of authors have stated that antibiotics were used but did not specify the variety, the dose or duration of use, and some authors did not even mention the issue.

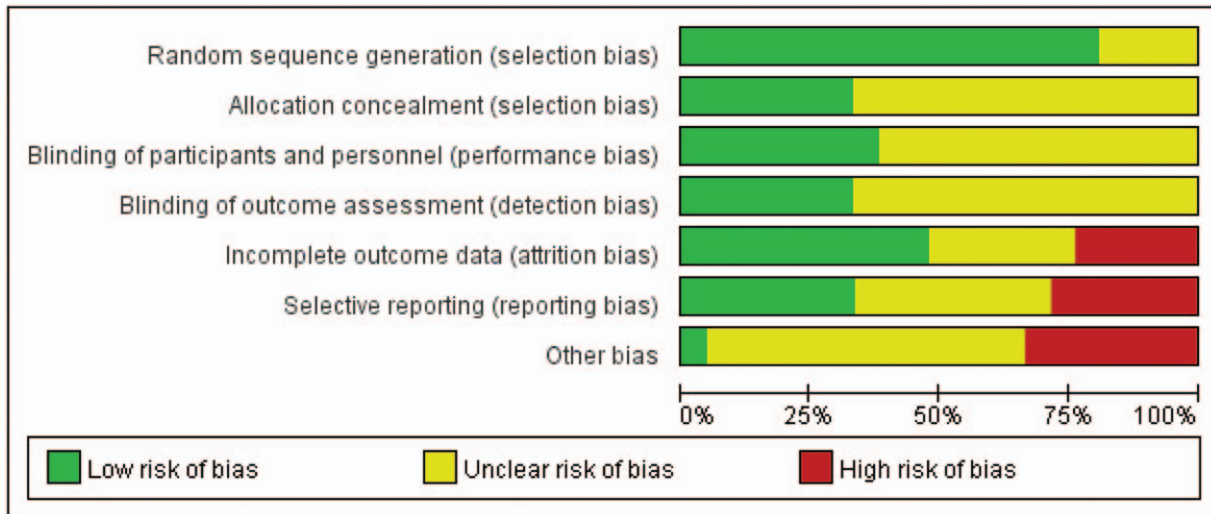


Figure 3. Summary of risk of bias results.

Routine drainage did not reduce the risk of symptoms such as nausea, vomiting or shoulder pain. It is worth discussing this in more detail. Pneumoperitoneum is the leading cause of postoperative nausea/vomiting and postoperative pain, especially postoperative shoulder pain.^[25] It has been confirmed that LC reduces the symptoms of shoulder pain when performed in the presence of low-pressure pneumoperitoneum.^[32] The loss of surface tension between internal organs is due to the presence of CO₂, especially between the liver and diaphragm. An unsupported liver bears on its diaphragmatic peritoneal attachments giving rise to shoulder tip pain. The surface tension between normal viscera and the parietal peritoneum can be restored using a suction drain, thus acting therapeutically.^[33] Similar results have been presented in other studies. However, since the drain is a

foreign body, not only does the diaphragm become irritated, but an inflammatory reaction also occurs shoulder pain increases significantly 24 h after placement.^[13]

We only analyzed studies that used a 10-point VAS to measure postoperative pain after 24h, even when there was significant heterogeneity between the two groups. However, we found that when drainage was not placed after LC surgery, the severity of pain was significantly reduced. Stimulation of the peritoneum and skin may produce pain at the site of the drain.^[34] It is worth noting that subgroup analysis results demonstrated that if conventional drainage after LC surgery was required, suction drainage resulted in less postoperative pain after 24h than open drainage.

The meta-analysis found no significant differences in postoperative mortality between the two groups. Since, there were no deaths

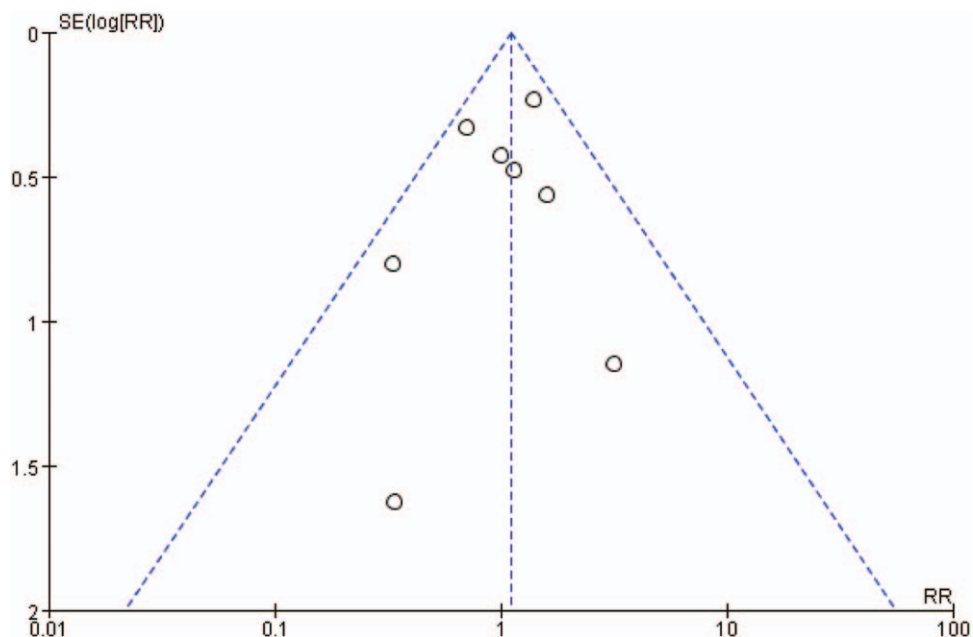


Figure 4. Funnel plots.

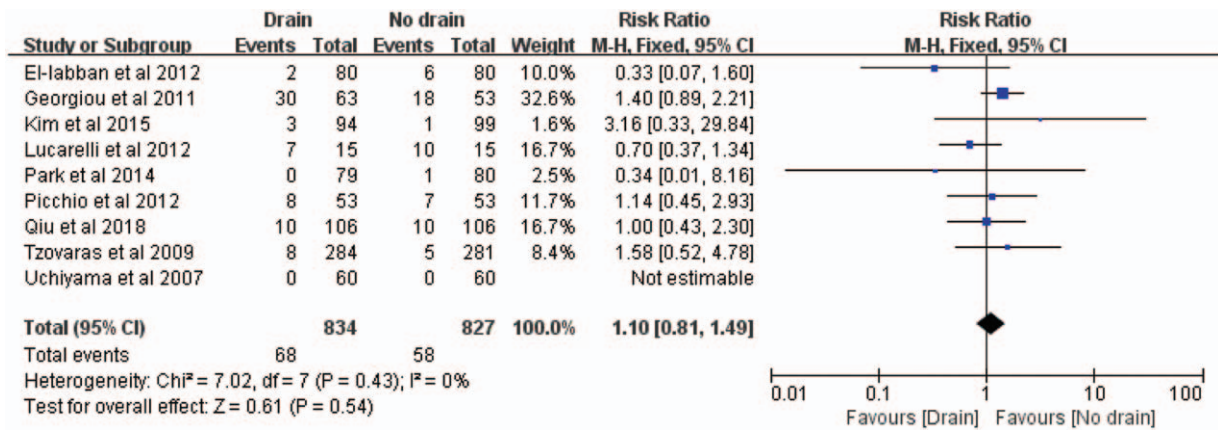


Figure 5. Forest plot of intra-abdominal fluid.

in 13 of the 14 trials, they were not considered related to the surgery. Duration of surgery in the drain group was significantly longer than that of the no drain group, although surgical techniques in different countries may lead to these differences. However, placement of an

intraoperative drain undoubtedly increases the duration of surgery, but the difference between the two groups was only 6 min, which appears to be of no clinical significance. Conversely, the duration of the clinical drain placement is generally <1 day, suggesting that a

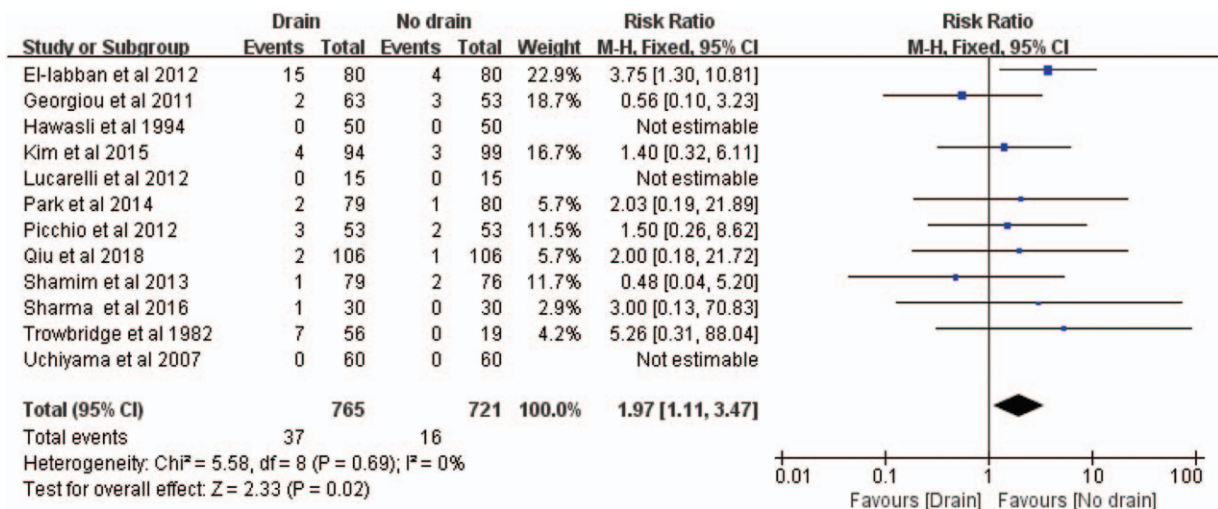


Figure 6. Forest plot of wound infection.

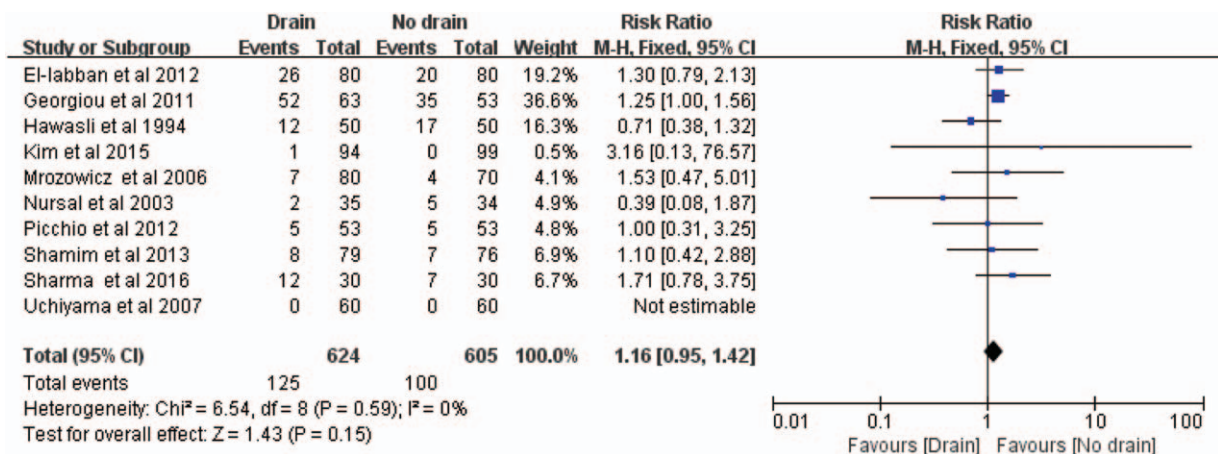


Figure 7. Forest plot of vomit and/or nausea.

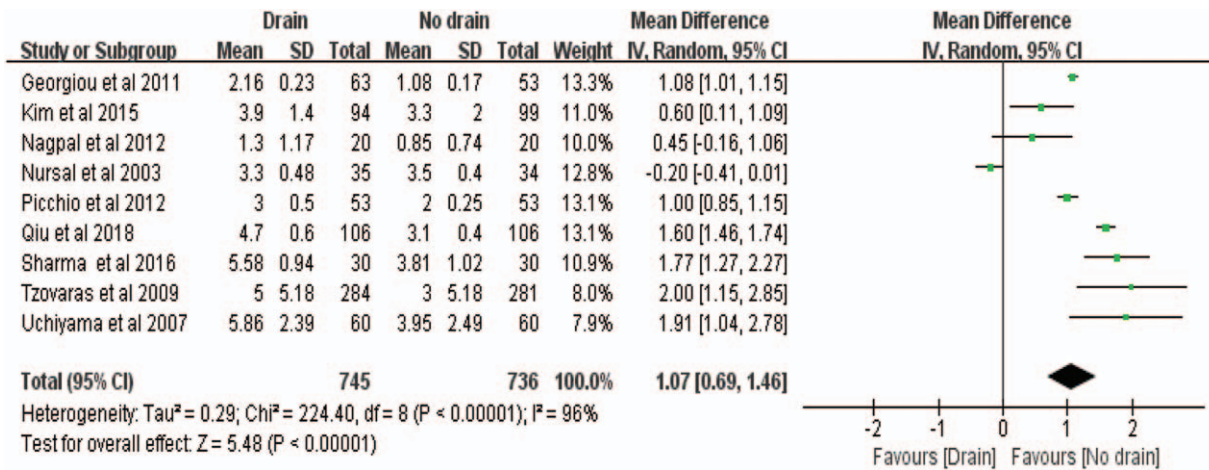


Figure 8. Forest plot of pain 24h after surgery.

patient must be hospitalized or taken home and readmitted to an appropriate medical institution. Therefore, unnecessary drainage will unreasonably lead to increased use of resources. In addition, there was a significant difference in postoperative hospital stay between the two groups, with a shorter stay in the no drain group. This confirms that pain caused by drain stimulation can affect a patient’s respiratory activity, hinder early patient activity and prolong hospital stays which increases economic burden. Therefore, unnecessary drain placement is not only unhelpful, but also harmful.^[35]

Drains can lead to a number of complications. First, migration of the drain and secondly, its breakage. Thirdly, the drain can be responsible for fever and fourthly it can perforate the intestine.^[36] In many cases, drainage is not helpful, and the drain should not be routinely used because it does not have any advantage and may even bring unfavorable morbidity to the patient.^[37-39] It can be seen from previously published literature that the occurrence of bile leaks is due to poor surgical technique, rather than the

inevitable result of not using a drain after surgery.^[37-41] In addition, a clinically serious bile leak is rare and cannot be prevented through use of a drain.^[21,40,42] However, the majority of surgeons continue to use drainage, not because of reliable data and research reports, but due to traditional teaching and anecdotal complications.^[43]

4.1. Strengths and limitations for research

The strength of this meta-analysis is that it is a review solely of RCT studies with a sufficiently large sample size. In addition, this study solves a critical problem that clinicians face in surgical procedures. Moreover, this study will force clinicians to reconsider traditional standards of care about the correct use of drains. However, in order to confirm our conclusions, additional high quality randomized trials should be conducted.

A limitation of the meta-analysis is that it may have an impact on patients with cirrhosis and comorbidities associated with

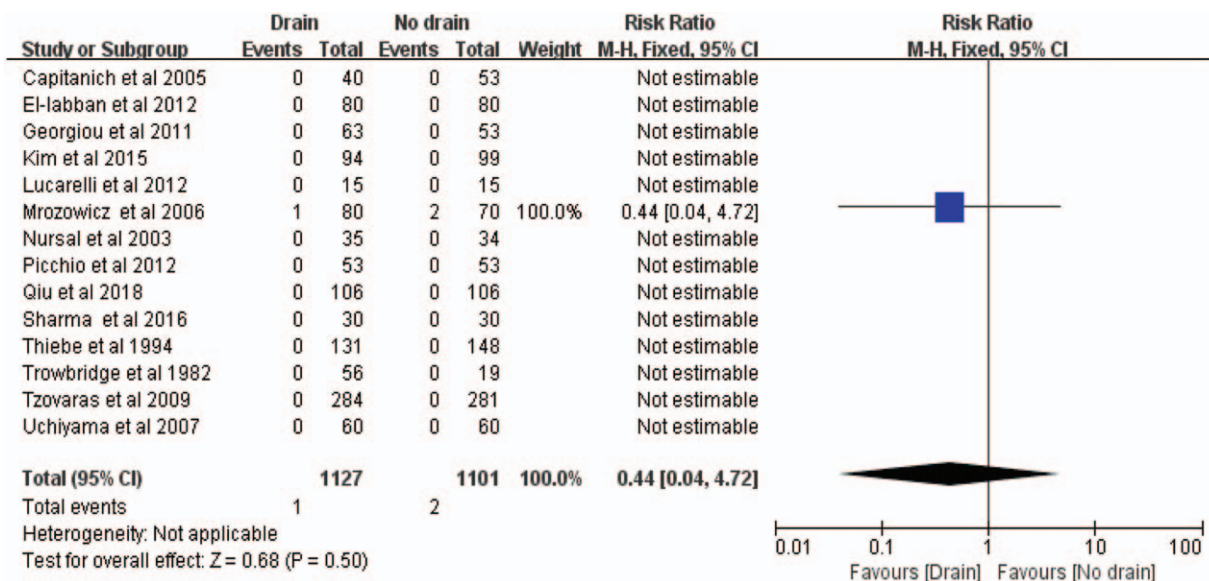


Figure 9. Forest plot of post-operative mortality.

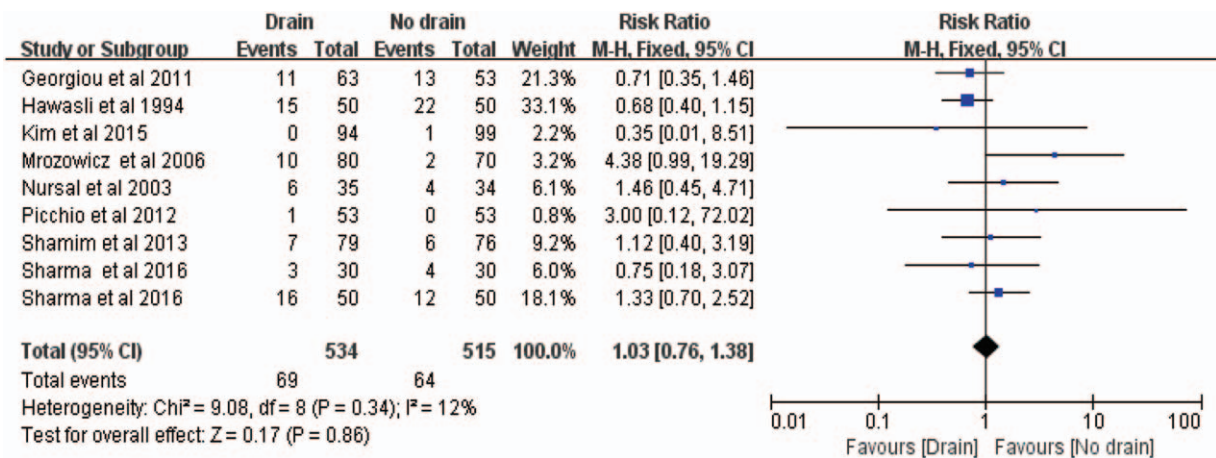


Figure 10. Forest plot of shoulder tip pain.

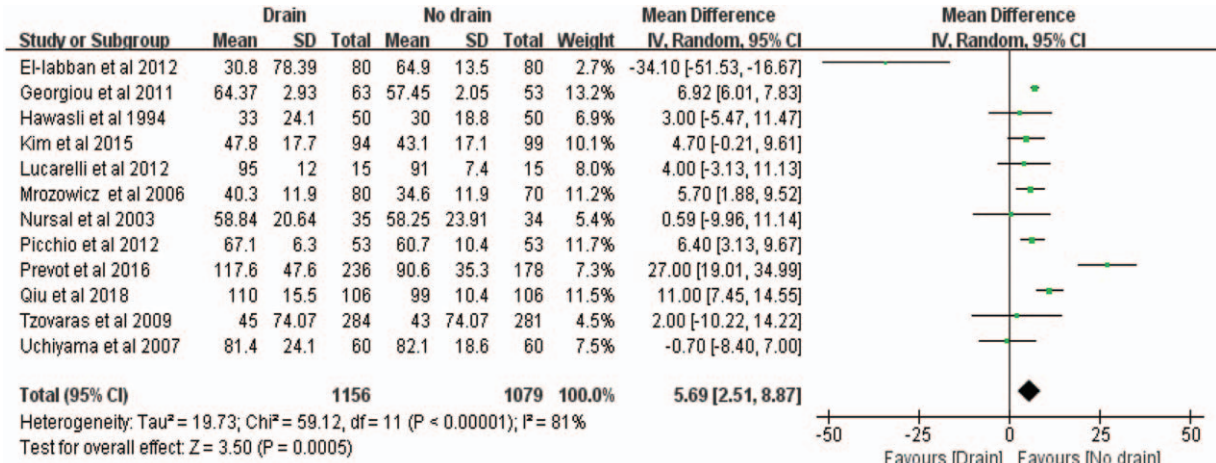


Figure 11. Forest plot of duration of the surgical procedure.

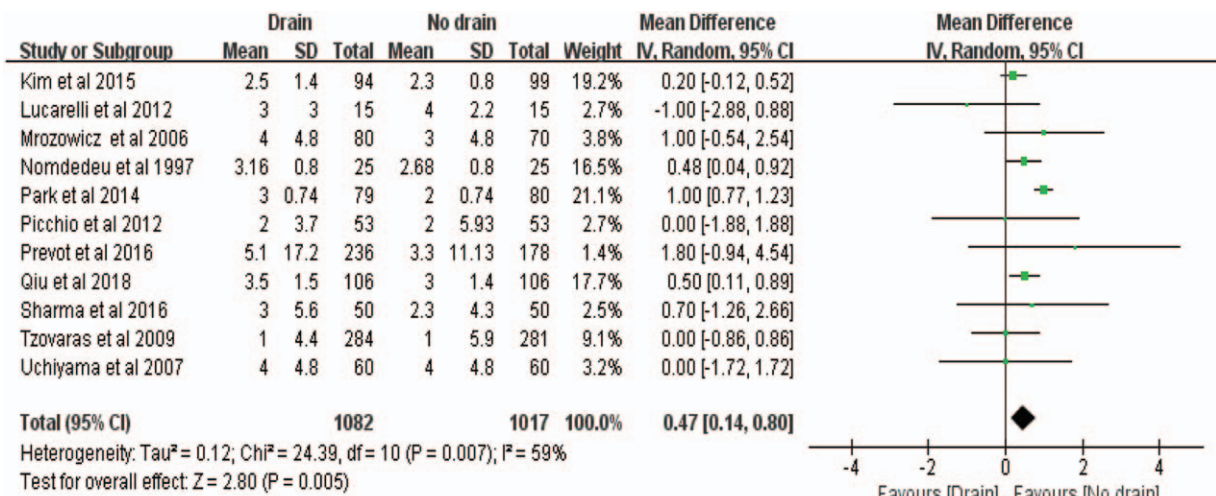


Figure 12. Forest plot of postoperative hospital stay.

Table 2
Subgroup analyses based on geographical areas and drainage methods.

Variables	Intra-abdominal fluid				Shoulder tip pain			Postoperative pain after 24h				
	S/P	Statistical method	Effect estimate	P	S/P	Statistical method	Effect estimate	P	S/P	Statistical method	Effect estimate	P
Geographical areas												
Asia	4/684	RR (M-H, Fixed, 95% CI)	1.09 (0.52, 2.28)	.82	4/508	RR (M-H, Fixed, 95% CI)	1.12 (0.68, 1.84)	.66	5/625	MN (IV, Random, 95% CI)	1.26 (0.72, 1.79)	<.001
Europe and America	4/817	RR (M-H, Fixed, 95% CI)	1.21 (0.86, 1.70)	.27	5/541	RR (M-H, Fixed, 95% CI)	0.98 (0.67, 1.42)	.90	4/856	MN (IV, Random, 95% CI)	0.87 (0.29, 1.46)	.003
Drainage methods												
Open drain	6/1332	RR (M-H, Fixed, 95% CI)	1.14 (0.79, 1.64)	.49	4/431	RR (M-H, Fixed, 95% CI)	0.99 (0.66, 1.50)	.97	6/1113	MN (IV, Random, 95% CI)	1.41 (1.04, 1.78)	<.001
Suction drain	3/329	RR (M-H, Fixed, 95% CI)	1.01 (0.59, 1.72)	.98	4/468	RR (M-H, Fixed, 95% CI)	0.82 (0.51, 1.30)	.40	3/368	MN (IV, Random, 95% CI)	0.46 (-0.42, 1.35)	.30

CI=confidence interval, Fixed=Fixed-effect model, IV=inverse variance, M-H=Mantel-Haenszel, MN=mean difference, P=patients, Random=random-effect model, RR=risk ratio, S=study.

benign cholecystitis. However, due to the lack of relevant information in the published literature, we did not conduct subgroup analysis and sensitivity analysis. The results presented here represent the unequal quality of the 21 studies included in this review which may have affected the standard of evidence, as the heterogeneity of outcomes is too great.

5. Conclusions

5.1. Implications for practice

The meta-analysis indicated that there were statistically significant differences in wound infection, pain 24h after surgery, duration of surgical procedure, and postoperative hospital stay. However, there were no significant differences in intra-abdominal fluid, vomit and/or nausea, post-operative mortality, or shoulder tip pain. Therefore, we found no advantage in using drainage following LC for non-complicated benign gallbladder disease. Currently, there is no evidence to support their use in such circumstances.

5.2. Implications for research

The purpose of the study was to investigate non-complicated benign gallbladder disease, excluding complicated benign gallbladder disease. Further randomized clinical trials are required to compare drainage use in LC performed for complicated benign gallbladder disease and are worthy of study in the future.

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