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Curative effect of different drainage methods on laparoscopic inguinal hernia repair
A meta-analysis

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Abstract

Background: Laparoscopic inguinal hernia repair has developed rapidly as an important surgical method for inguinal hernia repair; however, postoperative complications, especially postoperative seroma, are becoming an important factor hindering its development. Many studies have shown that placing a negative-pressure drainage tube in the preperitoneal space can effectively reduce postoperative seromas. Accordingly, this study aimed to compare differences in postoperative seroma between surgical procedures with drainage tubes (DRG) and those without drainage tubes (nonDRG).

Methods: PubMed/Medline, EMBASE, Cochrane Library, China National Knowledge Infrastructure, and Wanfang databases were searched from the establishment of the database to May 1, 2021. Odds ratio (OR), mean difference (MD), standardized mean difference (SMD), and 95% confidence interval (CI) were selected as the effect scale indices for the evaluation of the difference in seroma, operation time, hospital stay time, blood loss, and recovery time. All of these were compared using RevMan 5.3 Software.

Results: Sixteen studies involving 4369 patients, 2856 in the DRG group and 1513 in the nonDRG group, were included. The incidence of seroma in the DRG group was lower than that in the nonDRG group (OR = 0.16, 95% CI: 0.07–0.35, $P < .001$). Additionally, the operation time (min) in the DRG group was longer than that in the nonDRG group (MD = 3.67, 95% CI: 2.18–5.17, $P < .001$). Nevertheless, no significant differences were found in hospital stay (days) (SMD = 0.22, 95% CI: –0.10–0.54, $P = .17$), blood loss (mL) (MD = 0.28, 95% CI: –0.14–0.69, $P = .19$), and recovery time (h) (SMD = 0.54, 95% CI: –0.60–1.69, $P = .35$) between the 2 groups.

Conclusion: Despite the slightly prolonged operation time, negative pressure drainage in the preperitoneal space during laparoscopic inguinal hernia repair can significantly reduce the occurrence of postoperative seroma without increasing blood loss, recovery, and hospital stay.

Abbreviations: CI = confidence interval, DRG = drainage, LIHR = laparoscopic inguinal hernia repair, MD = mean difference, non-DRG = non-drainage, OR = odds ratio, RCT = randomized controlled trial, SMD = standardized mean difference, TAPP = transabdominal preperitoneal, TEP = totally extraperitoneal.

Keywords: drainage, inguinal hernia, laparoscopy, meta-analysis, seroma.

1. Introduction

Inguinal hernia, an external abdominal hernia occurring in the inguinal region, makes up a vast proportion of external abdominal hernias. It is a common and frequent disease worldwide. According to the 2018 World Inguinal Hernia Guidelines, approximately one-third of men are likely to be affected by inguinal hernia in their lifespan, and 20 million patients undergo inguinal hernia surgery every year, demonstrating the high incidence of inguinal hernia.[1] In China, more than 1 million inguinal hernia surgeries (tension-free repair) have been performed on adults every year since 2017.[2] The *Lancet* rated the diagnosis and treatment of inguinal hernia in China and obtained scores of 99 and 100 in 2016 and 2017, respectively.[3,4]

Since 1993, transabdominal preperitoneal hernia repair (TAPP) and totally extraperitoneal hernia repair (TEP) are the gold standard procedures for laparoscopic inguinal hernia repair (LIHR). In the past 10 years, given the rapid development of LIHR surgery in China, the number of LIHRs has

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The datasets generated during and/or analyzed during the current study are publicly available.

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accounted for 10–40% of tension-free inguinal hernia repair surgeries.[2] LIHR is superior in terms of easing postoperative pain, shortening postoperative recovery time, hospital stay time,[5,6] and reducing postoperative complications, in which postoperative seroma is one of the most commonly observed complications.[7]

Seroma, named after its similarity with plasma in terms of main components, refers to the limited exudation that infiltrated between the mesh and the anterior abdominal wall for various reasons. The incidence of seroma varies because different definition criteria were used, in which seroma after laparoscopic inguinal hernia ranges from 5.7 to 66.7%.[8] Surgical intervention may be necessary after an intractable seroma forms a shell.[9]

In recent years, several studies have shown that negative pressure drainage in the preperitoneal space during TAPP and TEP surgery can significantly reduce postoperative seroma. By contrast, other studies have shown that drainage has no significant effect on their occurrence, but may be related to the type of hernia, surgical skills, and heterogeneity of patients' basic conditions.

At present, the efficacy of negative pressure drainage in reducing seroma is still uncertain due to the lack of relevant reports, small number of cases, and discrepancies in conclusions drawn from some studies in this field. Thus, this meta-analysis was conducted to investigate the clinical efficacy of negative pressure drainage after LIHR through data comparisons, seeking relatively objective and accurate conclusions, to provide evidence-based medical evidence for clinical treatment.

2. Materials and Methods

2.1. Search strategy

The PubMed/Medline, EMBASE, Cochrane Library, China National Knowledge Infrastructure, and Wanfang databases were searched for studies published from their inception to May 1, 2021, comparing the drainage tube group (DRG) and non-DRG groups. Medical Subject Headings were retrieved twice to reduce omissions in relevant bibliographies. The terms used for the search referred to combinations of the following: hernia, inguinal hernia, total extraperitoneal herniorrhaphy, TEP, transabdominal preperitoneal, TAPP, laparoscopy, drainage, and seroma, only in English and Chinese.

This study was approved by the Ethics Committee of the Affiliated Hospital of the North Sichuan Medical College.

2.2. Inclusion and exclusion criteria

The following inclusion criteria were applied: first, the original study must have compared TAPP and TEP performed for inguinal hernia. Subjects must include both the DRG and non-DRG groups. Second, the original study types included randomized controlled trials (RCTs), cohort studies, and retrospective analysis studies. Third, at least one of the following indicators should be considered: postoperative seroma, operation time, hospitalization time, intraoperative blood loss, and recovery time. The exclusion criteria were as follows: review articles, case reports, abstracts, editorials, letters to the editor, studies with insufficient data on outcome measures, and incomplete documents or documents with incomplete data.

2.3. Data extraction

Original data, including the first author, year of publication, type of procedure, sample size, age, sex, and outcome, were independently extracted from the articles by 2 authors and keyed them in a standardized form. Conflicts in data abstraction were resolved by referring to the original article.

2.4. Quality assessment

The quality of the literature was independently assessed by the authors, in accordance with the Cochrane Collaboration Handbook. The assessment tools included the following criteria: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of the assessment results, incomplete data of the results, selective reporting, and other sources of bias. A controversial article was selected after discussion with a third researcher.

2.5. Statistical analysis

Review Manager version 5.3 (The Cochrane Collaboration, Copenhagen, Denmark) was used to perform a meta-analysis. Odds ratio (OR), mean difference (MD), standardized mean difference (SMD), and 95% confidence interval (CI) were selected as the effect scale indicators. The heterogeneity of each study was evaluated using the Cochrane Q test and I^2 test; if case $I^2 \geq 50\%$, heterogeneity appeared between studies. A random-effects model was used in cases of significant heterogeneity. Otherwise, a fixed-effects model was used. This study conducted a sensitivity analysis by excluding studies one by one, and the stability of the results of I^2 and the changes in the combined effect size after excluding studies were analyzed.

3. Results

3.1. Basic information of the included studies

A total of 972 original studies were obtained by searching the databases. A total of 949 duplicate, irrelevant, and unqualified studies were excluded after reading the texts and abstracts, and the remaining 23 studies satisfied the research topic. Furthermore, 7 studies were excluded because of improper grouping or different outcomes.

Finally, 16 studies[10–25] were identified, including 6 RCTs,[12,14,17–19,21] 8 retrospective clinical controlled studies,[10,11,15,16,20,22,23,25] and 2 cohort studies.[13,24] A detailed flowchart of the selection process is presented in Figure 1.

Seven of the 16 included studies focused on TAPP procedures, whereas the other 9 studies focused on TEP procedures. A total of 4369 patients were included in the study, in which 754 were TAPP cases and 3615 were TEP cases. Moreover, 2856 cases belonged to the DRG group, whereas 1513 cases to the non-DRG group. Of the 9 studies in the TEP group, 7 clearly indicated that the drainage tube was placed between the mesh and parietal peritoneum, and 2 did not specify the exact location. Of the 7 studies in the TAPP group, 3 indicated that the drain was placed between the mesh and parietal peritoneum, and 4 indicated that the drain was placed between the mesh and preperitoneal space. The baseline data are shown in Table 1.

3.2. Seroma

The studies included in the analysis reported postoperative seromas.[10–25] A total of 4369 patients were enrolled, including 2856 patients in the DRG group and 1513 patients in the non-DRG group. The analysis of heterogeneity showed obvious heterogeneity among the study groups ($P < .001$, $I^2 = 82\%$); therefore, the random-effects model was adopted. Accordingly, a significant difference in seroma was found between the DRG group and the non-DRG group. The occurrence of seroma in the DRG group was significantly less than that in the non-DRG group, and the difference was significant (OR = 0.16, 95% CI: 0.07–0.35, $P<.001$) (Fig. 2).

The surgical methods were divided into 2 subgroups for analysis: 7 TAPP articles[10,11,13–15,17,20] included in the study analyzed a total of 754 cases, in which 326 cases belonged

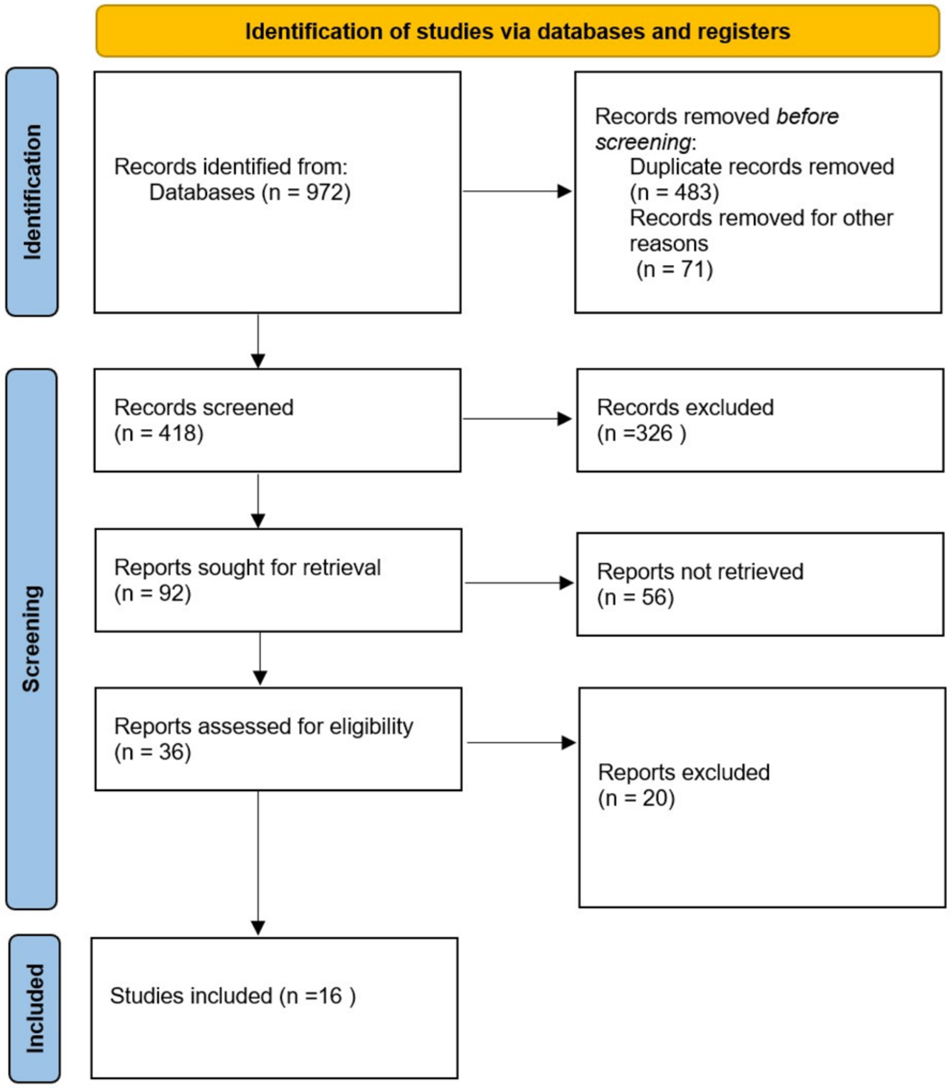

Figure 1. Screening process of the paper.

Table 1

Basic information of included studies.

Author, year	Study design	Sample size (DRG/non-DRG)	Age (year) (DRG/ non-DRG)	Gender (m) (DRG/ non-DRG)	Outcome
Li, et al 2021	Retrospective	57/73	53.54 ± 10.24/56.75 ± 9.57	51/54	①②③
Fang, H et al 2021	Retrospective	65/181	61.5 ± 7.3/60.6 ± 8.1	NA	①②③⑤
Zhou, et al 2020	RCT	36/36	49.3 ± 8.9/44.6 ± 7.6	28/29	①②③④⑤
Wang, et al 2020	Cohort study	26/24	56.04 ± 1.41/55.00 ± 1.39	26/24	①②③
Ju, et al 2020	RCT	45/45	48.71 ± 15.33/46.06 ± 13.97	42/41	①②③
Li, et al 2019	Retrospective	30/30	55.2 ± 8.5/56.1 ± 8.7	22/20	①②③④⑤
Xin, et al 2018	Retrospective	48/67	55.23 ± 9.84/55.03 ± 10.55	48/65	①②③⑤
Fan, J et al 2018	RCT	41/37	53.5 ± 14.7/48.9 ± 18.7	39/35	①②③
Si, et al 2018	RCT	38/30	67.34 ± 12.54/66.53 ± 12.08	68/0	①②③
Wang, et al 2017	RCT	65/62	NA	118/9	①
Zhu, et al 2016	Retrospective	295/537	48.52 ± 24.57/51.61 ± 21.73	250/462	①②③④⑤
Liu, et al 2016	RCT	70/40	54.9 ± 17.8/53.6 ± 15.6	64/36	①②
Chen, et al 2016	Retrospective	65/45	51.0 ± 11.3	104/5	①
Gao, et al 2015	Retrospective	321/157	54.2 ± 23.8/47.6 ± 26.8	275/122	①②③
Qin, et al 2012	Cohort study	47/3	50.2 ± 12.5	45/5	①
Ismail, M, et al 2009	Retrospective	1607/146	46.7 ± 13.8/39.0 ± 15.8	840/79	①②③④

DRG = drainage, non-DRG = non-drainage, RCT = randomized controlled trial. Outcome: ① = seroma, ② = operation time, ③ = hospital stay, ④ = recovery time, ⑤ = blood loss.

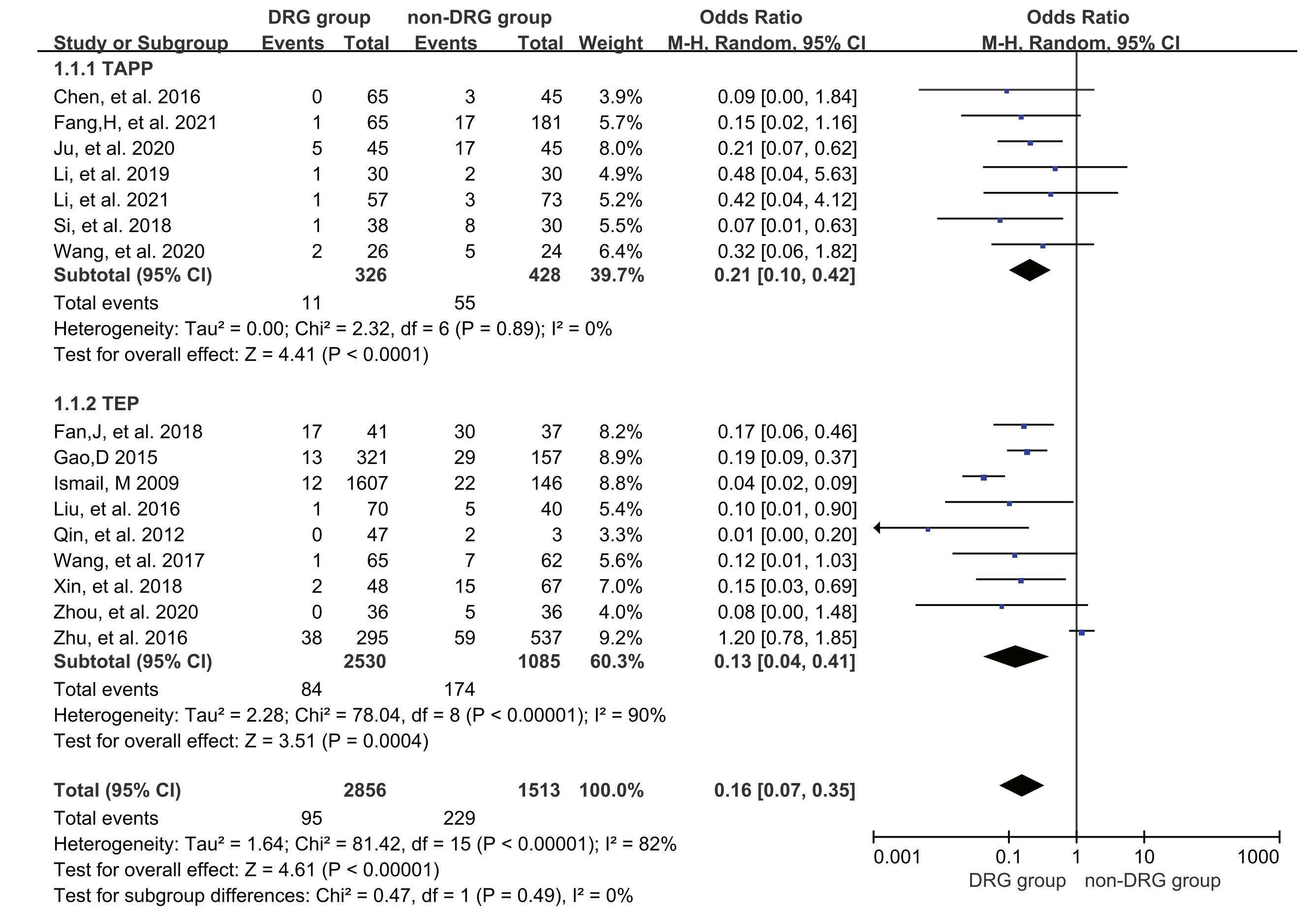

Figure 2. Forest plot of comparison on seroma formation: DRG vs non-DRG. DRG = drainage, non-DRG = non-drainage.

the DRG group and 428 cases to the non-DRG group. In the heterogeneity analysis, no significant heterogeneity was found among the study groups (P = .89, I^2 = 0%); therefore, the random-effects model was adopted. The results showed a significant difference in seroma between the DRG and non-DRG groups. The occurrence of seroma in the DRG group was significantly less than that in the non-DRG group, and the difference was significant (OR = 0.21, 95% CI: 0.1–0.42, P<.001).

Nine TEP articles[12,16,18,19,21–25] analyzed in the study enrolled a total of 3615 cases, in which 2530 cases belonged to the DRG group and 1085 to the non-DRG group. The heterogeneity analysis showed significant heterogeneity among the study groups (P < .001, I^2 = 90%). The results showed a significant difference in seroma between the DRG and non-DRG groups. The occurrence of seroma in the DRG group was significantly lower than that in the non-DRG group, and the difference was significant (OR = 0.13, 95% CI: 0.04–0.41, P = .0004). Sensitivity analysis was performed after excluding the articles individually. After excluding 1 article,[22] the heterogeneity decreased significantly (I^2 = 45%). After reading the full text, the cases included in the article had a history of the following lower abdominal surgery: appendix resection, partial colon surgery, rectal surgery, ovarian surgery, fallopian tube surgery, uterine surgery, ureter surgery, bladder surgery, and prostate surgery. Accordingly, there may be large differences in abdominal or intestinal adhesions between the groups, leading to differences in the corresponding data of the corresponding operations, which leads to an increase in heterogeneity between studies. However, regardless of excluding any of the abovementioned studies, the structure of the forest plot was not significantly changed and the combined effect size was still significant, suggesting that the results of the meta-analysis were stable and reliable.

3.3. Operation time

Thirteen studies[10–18,21–23,25] provided data regarding the operation time (min) with a total of 4082 cases, covering 2679 cases in the DRG group and 1403 in the non-DRG group. Heterogeneity analysis showed heterogeneity among the results of each study (P = .001, I^2 = 63%), and the random-effects model was adopted. The average operation time of the DRG group was significantly longer than that of the non-DRG group (MD = 3.67, 95% CI: 2.18–5.17, P < .001) (Fig. 3). Sensitivity analysis was performed after removing the articles individually. After excluding 1 article,[12] a significant reduction (I^2 = 50%) in heterogeneity was found. After reading the full text, only 72 cases were included in that article, which was poor in representation, and the structure of the forest plot did not change significantly after excluding this article. After excluding another article,[22] the heterogeneity was reduced but still high (I^2 = 55%); this article included many patients with a history of lower abdominal surgery. There may be large differences in abdominal or intestinal adhesions between the groups, leading to differences in the corresponding operation times, which in turn led to increased heterogeneity between the studies. Regardless of whether any of the abovementioned documents were excluded, no change was found in the overall results, suggesting stable and reliable results in the meta-analysis.

Study or Subgroup	DRG group Mean	SD	Total	non-DRG group Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Fan,J, et al. 2018	91.1	35.9	41	96.9	32	37	0.9%	-5.80 [-20.87, 9.27]
Fang,H, et al. 2021	95.8	10.4	65	92.1	13.9	181	9.3%	3.70 [0.46, 6.94]
Gao,D 2015	39	9.4	321	35	8.1	157	13.8%	4.00 [2.37, 5.63]
Ismail, M 2009	30.4	6	1607	28.1	6.8	146	15.0%	2.30 [1.16, 3.44]
Ju, et al. 2020	56.78	9.77	45	54.65	8.86	45	7.9%	2.13 [-1.72, 5.98]
Li, et al. 2019	54.3	12.7	30	57.5	14.2	30	3.7%	-3.20 [-10.02, 3.62]
Li, et al. 2021	56.84	13.8	57	56.35	8.8	73	7.3%	0.49 [-3.62, 4.60]
Liu, et al. 2016	74.9	17.8	70	73.65	15.6	40	4.1%	1.25 [-5.13, 7.63]
Si, et al. 2018	52.5	12.06	38	48.83	15.23	30	3.9%	3.67 [-2.99, 10.33]
Wang, et al. 2020	69.04	3.49	26	64.38	3.41	24	13.0%	4.66 [2.75, 6.57]
Xin, et al. 2018	138.44	24.86	48	136.01	27.34	67	2.1%	2.43 [-7.18, 12.04]
Zhou, et al. 2020	47.8	7.6	36	37.3	10.5	36	7.1%	10.50 [6.27, 14.73]
Zhu, et al. 2016	45.3	15.71	295	38.52	16.43	537	11.9%	6.78 [4.51, 9.05]
Total (95% CI)			**2679**			**1403**	**100.0%**	**3.67 [2.18, 5.17]**

Heterogeneity: Tau² = 3.53; Chi² = 32.79, df = 12 (P = 0.001); I² = 63%
Test for overall effect: Z = 4.82 (P < 0.00001)

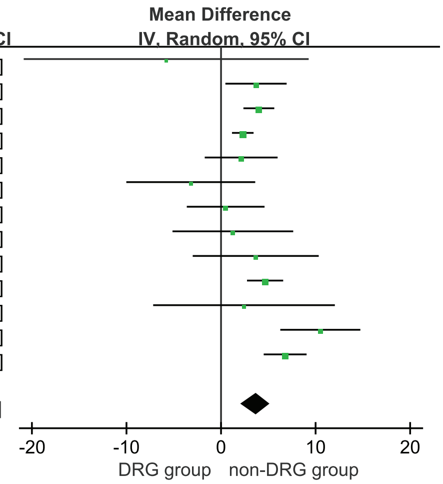

Figure 3. Forest plot of comparison on operation time: DRG vs non-DRG. DRG = drainage, non-DRG = non-drainage.

Study or Subgroup	DRG group Mean	SD	Total	non-DRG group Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Fan,J, et al. 2018	2.138	0.738	41	2.204	0.625	37	8.0%	-0.10 [-0.54, 0.35]
Fang,H, et al. 2021	1.1	0.3	65	1	0.2	181	8.8%	0.43 [0.15, 0.72]
Gao,D 2015	2.96	0.35	321	3.05	0.31	157	9.2%	-0.27 [-0.46, -0.07]
Ismail, M 2009	1.079	0.28	1607	1.017	0.14	146	9.2%	0.23 [0.06, 0.40]
Ju, et al. 2020	4.39	1.78	45	4.11	1.84	45	8.2%	0.15 [-0.26, 0.57]
Li, et al. 2019	3.5	1.4	30	3.8	1.2	30	7.7%	-0.23 [-0.73, 0.28]
Li, et al. 2021	2.36	0.55	57	2.38	0.54	73	8.5%	-0.04 [-0.38, 0.31]
Si, et al. 2018	3.29	0.98	38	1.93	0.69	30	7.4%	1.55 [1.01, 2.10]
Wang, et al. 2020	1.69	0.09	26	1.71	0.09	24	7.4%	-0.22 [-0.78, 0.34]
Xin, et al. 2018	4.38	0.94	48	4.69	1.14	67	8.4%	-0.29 [-0.66, 0.08]
Zhou, et al. 2020	3.6	1.2	36	2.9	1.6	36	7.9%	0.49 [0.02, 0.96]
Zhu, et al. 2016	3.36	0.67	295	2.84	0.45	537	9.3%	0.97 [0.82, 1.11]
Total (95% CI)			**2609**			**1363**	**100.0%**	**0.22 [-0.10, 0.54]**

Heterogeneity: Tau² = 0.28; Chi² = 155.50, df = 11 (P < 0.00001); I² = 93%
Test for overall effect: Z = 1.36 (P = 0.17)

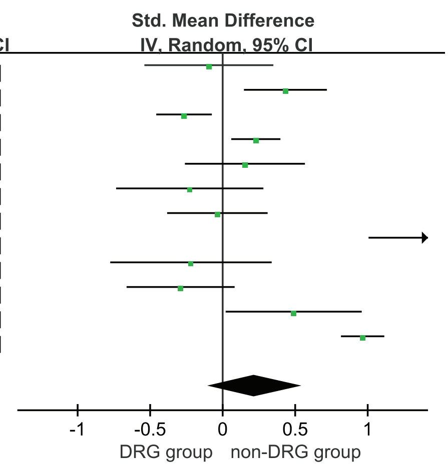

Figure 4. Forest plot of comparison on hospital stay: DRG vs non-DRG. DRG = drainage, non-DRG = non-drainage.

3.4. Length of hospital stay

Twelve studies[10–18,22,23,25] described the length of hospital stay (days); 3972 patients were included in this meta-analysis, with 2609 cases in the DRG group and 1363 in the non-DRG group. In the heterogeneity analysis, each study showed significant heterogeneity ($P < .001$, $I^2 = 93\%$); therefore, the random-effects model was adopted. The length of stay in the DRG group was close to that of the non-DRG group, and the difference was not significant (SMD = 0.22, 95% CI: −0.10–0.54, $P = .17$) (Fig. 4). Sensitivity analysis was performed after removing articles individually. After removing 1 article,[22] the heterogeneity was significantly reduced ($I^2 = 83\%$). After reading the full text, the article included many cases of a history of lower abdominal surgery. There may be large differences in basic conditions between the groups, and the length of hospital stay is greatly affected, resulting in increased heterogeneity. Sensitivity analysis indicated stable and reliable results in the meta-analysis.

3.5. Blood loss

Five studies[10,12,15,16,22] provided data on blood loss (mL). There were 1325 cases in total, including 590 and 735 in the DRG and non-DRG groups, respectively. The analysis of heterogeneity showed no obvious heterogeneity between the results of each study ($P = .95$, $I^2 = 0\%$); therefore, a fixed-effects model was adopted. The amount of blood loss in the DRG group was similar to that in the non-DRG group, but the difference was not significant (MD = 0.28, 95% CI: −0.14–0.69, $P = .19$) (Fig. 5).

3.6. Recovery time

Four studies[12,15,22,25] described the recovery time (h), and 2717 patients were included in this meta-analysis, with 1968 and 749 cases in the DRG and non-DRG groups, respectively. The analysis of heterogeneity showed obvious heterogeneity between the results of each study ($P < .001$, $I^2 = 99\%$); therefore, the random-effects model was adopted. The recovery times of the DRG and non-DRG groups were comparable, and the difference was not significant (SMD = 0.54, 95% CI: −0.60–1.69, $P = .35$) (Fig. 6). Sensitivity analysis was performed after removing articles individually. After removing 1 article,[22] the heterogeneity decreased significantly ($I^2 = 51\%$). After reading the full text, the article included many cases of a history of lower abdominal surgery. There may be great differences in basic conditions between the groups, affecting the recovery time and leading to an increase in heterogeneity.

3.7. Risk of bias in included studies

A relatively obvious publication bias can be observed from the bias analysis chart. According to the analysis of all included studies, the main reason lies in the retrospective studies, resulting

Study or Subgroup	DRG group Mean	SD	Total	non-DRG group Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Fang,H, et al. 2021	5.9	1.9	181	5.6	1.7	65	68.9%	0.30 [-0.20, 0.80]
Li, et al. 2019	16.7	3.9	30	17.2	4.5	30	3.8%	-0.50 [-2.63, 1.63]
Xin, et al. 2018	25.06	10.1	48	24.84	12.48	67	1.0%	0.22 [-3.91, 4.35]
Zhou, et al. 2020	24.7	5.2	36	23.9	5.9	36	2.6%	0.80 [-1.77, 3.37]
Zhu, et al. 2016	13.48	6.39	295	13.2	5.11	537	23.7%	0.28 [-0.57, 1.13]
Total (95% CI)			**590**			**735**	**100.0%**	**0.28 [-0.14, 0.69]**

Heterogeneity: Chi² = 0.68, df = 4 (P = 0.95); I² = 0%
Test for overall effect: Z = 1.32 (P = 0.19)

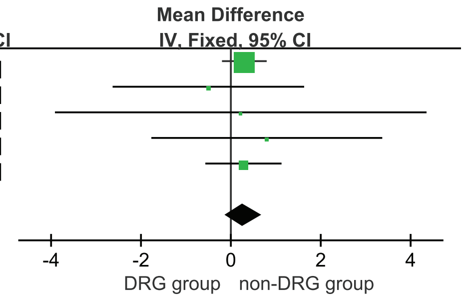

Figure 5. Forest plot of comparison on blood loss: DRG vs non-DRG. DRG = drainage, non-DRG = non-drainage.

Study or Subgroup	DRG group Mean	SD	Total	non-DRG group Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Ismail, M 2009	7.7	1.5	1607	7.5	1.28	146	25.5%	0.13 [-0.03, 0.30]
Li, et al. 2019	9.4	1.5	30	9.9	1.7	30	24.4%	-0.31 [-0.82, 0.20]
Zhou, et al. 2020	2.9	1.3	36	2.4	1.2	36	24.6%	0.40 [-0.07, 0.86]
Zhu, et al. 2016	5.84	0.95	295	4.57	0.43	537	25.5%	1.91 [1.75, 2.08]
Total (95% CI)			**1968**			**749**	**100.0%**	**0.54 [-0.60, 1.69]**

Heterogeneity: Tau² = 1.34; Chi² = 242.21, df = 3 (P < 0.00001); I² = 99%
Test for overall effect: Z = 0.93 (P = 0.35)

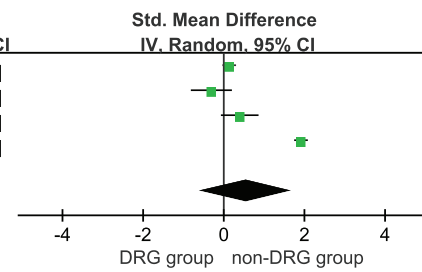

Figure 6. Forest plot of comparison on recovery time: DRG vs non-DRG. DRG = drainage, non-DRG = non-drainage.

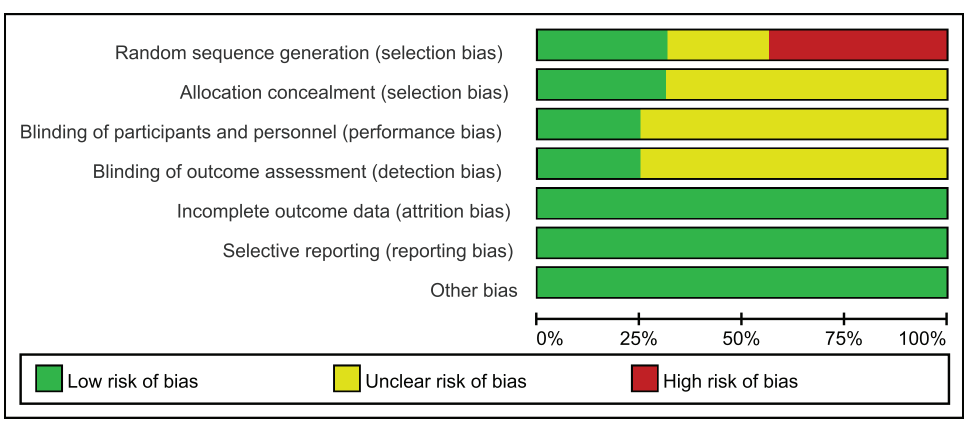

Figure 7. Consensus risk-of-bias assessment of the included studies. Green = low risk, yellow = unclear, red = high risk.

in a publication bias. The risk of bias in the included studies is shown in Figure 7.

3.8. Subgroup analysis based on RCT/retrospective study

Based on the bias analysis chart suggesting obvious publication bias, we re-analyzed prospective randomized and retrospective studies separately. The baseline data are shown in Table 2.

There were 6 RCT studies,[12,14,17–19,21] 2 of which were on TAPP and 4 on TEP. A total of 545 patients were included, including 158 TAPP cases and 387 TEP cases, of which 295 cases belonged to the DRG group and 250 to the non-DRG group. A random-effects model was used. In that RCT study, significant difference was found in the incidence of seroma between the DRG group and the non-DRG group (OR = 0.15, 95% CI: 0.08–0.28, P <. 001), and no significant difference was found in the length of hospital stay between the DRG and non-DRG groups (SMD = 0.51, 95% CI: −0.14–1.16, P = .12), and no significant difference was found in the operation time between the DRG and non-DRG groups (MD = 3.84, 95% CI: −0.77–8.46, P = .10).

In the retrospective study,[10,11,13,15,16,20,22–25] 5 focused on TAPP and 5 on TEP. A total of 3824 patients were analyzed, including 596 TAPP cases and 3228 TEP cases, of which 2561 cases belonged to the DRG group and 1263 to the non-DRG group. A random-effects model was adopted. In the retrospective study, a significant difference was found in the incidence of seroma between the DRG and non-DRG groups (OR = 0.18, 95% CI: 0.06–0.54, P = .002), and no significant difference was found in the length of hospital stay between the DRG and non-DRG groups (SMD = 0.09, 95% CI: −0.30–0.48, P = .65). A significant difference was noted in the operation time between the DRG group and the non-DRG group (MD = 3.51, 95% CI: 1.98–5.04, P < .001).

4. Discussion

This study compared the effects of LIHR (TAPP and TEP) on seroma formation with and without drainage, and reduced the interference of different surgical procedures on the research conclusions. A total of 4369 cases were included, of which 754 were TAPP and 3615 were TEP. In addition, there were 2856 and 1513 patients in the DRG and non-DRG groups,

Table 2

Basic information of included RCT/retrospective studies.

	Study design	Included study	Sample size(DRG/non-DRG)	OR	MD/SMD	Confidence interval (95%CI)	Effect model	*P*-value
Seroma	RCT	6[12,14,17–19,21]	295/250	0.15		0.08–0.28	Random	*P*<0.00001
	Retrospective	10[10,11,13,15,16,20,22–25]	2561/1263	0.18		0.06–0.54	Random	*P*=0.002
Operation time	RCT	5[12,14,17,18,21]	230/188		3.84	−0.77–8.46	Random	*P*=0.10
	Retrospective	8[10,11,13,15,16,22,23,25]	2449/1215		3.51	1.98–5.04	Random	*P*<0.00001
Hospital stay	RCT	4[12,14,17,18]	160/148		0.51	−0.14–1.16	Random	*P* = .12
	Retrospective	8[10,11,13,15,16,22,23,25]	2449/1215		0.09	−0.30–0.48	Random	*P* = .65

DRG = drainage, non-DRG = non-drainage, MD = mean difference, OR = odds ratio, RCT = randomized controlled trial, SMD = standardized mean difference.

respectively. The results showed that the difference in the incidence of seroma in the DRG group and non-DRG group under LIHR was significant, so does the difference in operation time between them. However, no significant difference was found in blood loss, hospital stay, and recovery time. Meanwhile, in the subgroup analysis based on study types, the incidence of seroma and the length of hospital stay in the DRG and non-DRG groups in the RCT and retrospective studies were the same as the above conclusions. A significant difference was noted in the incidence of seroma between the 2 groups, but there was no significant difference in the length of hospital stay. In contrast to the above conclusion, no significant difference was found in the operation time between the 2 groups in the RCT study, but a significant difference was noted in the operation time between the 2 groups in the retrospective study.

Seroma refers to limited exudation between the mesh and anterior abdominal wall for various reasons. It is named based on its main components, which are similar to those of plasma. The main causes of seroma formation are as follows: a) presence of a huge hernia sac, long medical history, combined with other diseases, history of hernia belt use, history of sclerosing agent injection, recurrent hernia, etc; b) surgeries such as dissociation of the surgical area, trauma caused by anatomy, and implantation of the mesh[26]; gentle maneuvers during the operation can reduce seroma formation[27]; c) foreign body stimulation, such as by foreign matter, mesh, and hernia nails, which can mediate inflammatory reactions and cause fluid exudation in the surrounding tissues and thus increase the risk of postoperative seroma[28]; and d) dead space between the mesh and the tissue.[29] The gaps in the wound tissue spare a space for fluid accumulation to cause seroma formation; eliminating dead space can reduce the formation of seroma.[27]

Various clinical measures are available to prevent seromas, among which catheter drainage is a key research direction.[8] Theoretically, by excluding the influence of the abovementioned patients and the 2 fixed factors of surgery, negative pressure drainage of the catheter can significantly reduce the influence of the latter 2 variable factors, which can effectively reduce the stimulation of mesh displacement and the volume of the dead space and thus reduce the occurrence of postoperative seroma, severity of seroma, and a series of complications such as postoperative pain, cellulitis, infection of the operating area, and hernia recurrence. To verify the correctness and feasibility of the above-mentioned theory, we conducted a meta-analysis of related studies that met the inclusion criteria.

A previous study found that catheterization and drainage can effectively reduce the size and occurrence of seroma,[30] whereas another study suggested that drainage is not effective in reducing the occurrence of seroma.[22] In response to the studies with the opposite conclusions, we have included RCTs, cohort studies, and retrospective studies in recent years, which have advantages in terms of increasing sample size and credibility and decreasing errors. The results showed that catheterization and drainage after TAPP and TEP significantly reduced the seroma formation.

A meta-analysis revealed that postoperative drainage of inguinal hernia can reduce the formation of severe postoperative seromas,[31] but the analysis included a total of 6 articles, only 4 of which focused on laparoscopic surgery. However, all the articles included in our study focused on laparoscopic surgery, with a greater number of cases, recent publication, higher quality, and more scientific subgroup allocation. We divided the included articles into 2 subgroups: TAPP and TEP. Accordingly, the difference in seroma production between the 2 groups was significant. Subgroup analyses based on the study types were also conducted. Accordingly, the incidence of seroma in the DRG group was lower than that in the non-DRG group in the RCT study and retrospective study, and the difference was significant.

A previous study showed no significant difference in postoperative complications such as hematoma and seroma[22] regardless of whether drainage is placed during TEP operation. In this study, 61 of the included patients had a history of surgical operations, ranging from colorectal, uterine appendages, and urinary system to other lower abdominal surgeries, 139 of which had risk factors for hernia recurrence, such as chronic obstructive pulmonary disease and ascites, and 109 had combined cardiovascular, blood, endocrine, and other basic diseases according to the analysis of the literature. Owing to the large differences between the research subjects and the high risk in the study's bias score, the accuracy of the research results should be further verified; thus, the research results cannot be expanded to an overall conclusion. Except for this study, the results of the remaining studies suggest that the placement of a negative pressure drainage tube after laparoscopic inguinal hernia can effectively reduce postoperative seroma without increasing blood loss, extending the recovery time and hospital stay, which means that the placement of a negative pressure drainage tube is of positive significance in reducing the formation of postoperative seromas.

As regards the operative time, overall, the operative time in the DRG group was longer than that in the non-DRG group. In the RCT study, no significant difference was found in the operative time between the 2 groups. In the retrospective study, the operative time in the DRG group was longer than that in the non-DRG group. The prolonged operation time in the DRG group may be caused by the extra time required to place and fix the drainage tube during the operation. Although the conclusions of the meta-analysis based on grouping methods were different to some extent, the MDs were 3.67 minutes, 3.84 minutes, and 3.51 minutes, which had negligible effects on the overall operation time, showed no significant difference in clinical practice, and did not affect patient recovery.

Regarding hospital stay, the meta-analysis based on the overall study and subgroup studies showed no significant difference in the hospital stay between the DRG and non-DRG groups. The above conclusions suggest that the placement of negative-pressure drainage during LIHR does not affect the length of hospital stay.

A total of 16 studies were selected in accordance with the inclusion and exclusion criteria in the present study, and relevant data from the 16 studies were explored in a meta-analysis. However, our study has some limitations. First, only a few articles, including some retrospective studies, were included. Second, articles in foreign languages are not enough, showing the shortage of retrieval skills. Third, given the inconsistency between the type and severity of inguinal hernia, differences in the surgical skills and abilities of surgeons between studies, a bias in implementation, and a certain degree of heterogeneity may come into being consequently.

5. Conclusions

The results of the meta-analysis revealed that placing a negative pressure drainage tube in the preperitoneal space after LIHR can effectively reduce the formation of postoperative seroma, without any influence on intraoperative blood loss, recovery time and hospital stay, but only prolonged the operation time slightly. In conclusion, the operation is not only safe and feasible, but also worthy of clinical promotion. Nevertheless, well-designed, large-scale, and multicenter studies are needed to confirm the results of this study.

Author contributions

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