



Safety and efficacy of laparoscopic hepatectomy versus open hepatectomy for giant hepatic cysts: a systematic review and meta-analysis

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Background: With advances in technology and medical treatment, laparoscopy is increasingly used in hepatic cyst surgery. We hope that the analysis the safety and efficacy of laparoscopic hepatectomy versus open hepatectomy in giant hepatic cyst surgery will provide a theoretical basis for the choice of treatment means for clinicians.

Methods: By searching CNKI (China National Knowledge Infrastructure), Wanfang, VIP (China Science and Technology Journal Database), CBM (China Biology Medicine disc), PubMed, Embase and Cochrane Library databases, all Chinese- and English-language articles on the safety and efficacy of laparoscopic hepatectomy and open hepatectomy for hepatic cysts were collected from database establishment to December 2021. Endnote X9 software was used for data checking and screening. Stata 15.1 software was used to analyze the relevant data. Sensitivity analysis was used to assess heterogeneity and funnel plots were used to detect bias in the results.

Results: A total of 43 relevant studies covering 3,375 patients with hepatic cysts were included: 1,733 patients in the laparoscopic hepatectomy group and 1,642 in the open hepatectomy group. Meta-analysis showed that the laparoscopic hepatectomy group had shorter operation time [standard mean difference (SMD) = -2.27, 95% confidence interval (CI): -2.63 to -1.92, P<0.001], less intraoperative blood loss (SMD = -3.62, 95% CI: -4.22 to -3.02, P<0.001), shorter hospital stay (SMD = -2.09, 95% CI: -2.41 to -1.78, P<0.001), faster postoperative gastrointestinal function recovery (SMD = -3.94, 95% CI: -4.68 to -3.20, P<0.001), and less postoperative complications [odds ratio (OR) = 0.45, 95% CI: 0.35 to 0.58, P<0.001] than the open hepatectomy group, with significant statistical differences. Sensitivity analyses were largely centered, and it indicates that the results have a high stability. The funnel plot was left-right symmetrical. It indicates that the intervention group was better than the control group and the results were reliable.

Discussion: There are significant differences in the safety and efficacy of laparoscopic hepatectomy compared with open hepatectomy. Laparoscopic hepatectomy can be selected to reduce postoperative pain. There were few foreign studies included, so whether our results apply to European and American populations still needs further study.

Keywords: Hepatic cysts; laparoscopy; meta-analysis; open fenestration (OF)

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Introduction

Liver cyst belongs to the more common and benign liver tumor, usually because of the liver vagal bile duct or intrahepatic bile duct, lymphatic duct development disorder, leading to the retention of contents formed in the lumen (1). Hepatic cysts are common in people over 50 years of age, and the incidence is high in women. The detection rate of hepatic cysts in the normal population is 2.5–5.0% as an incidental finding on imaging, and only 15% of them are symptomatic (2,3). Asymptomatic cysts <5 cm in diameter do not require special treatment, but surgery is the usual therapeutic measure for larger cysts. When the diameter of the cyst is >10 cm, it can be called a giant hepatic cyst (4). Giant hepatic cysts can impinge on the surrounding organs, resulting in abdominal discomfort or fullness, and even affect digestive and respiratory function, causing jaundice etc. In recent years, with the development of minimally invasive surgery and the promotion and popularization of laparoscopic techniques, laparoscopic fenestration (LF) as the hepatic cyst surgical technique has become more widely accepted (5). Although traditional open fenestration (OF) can complete the operation under direct vision and has a definite effect, it has disadvantages such as longer recovery time and greater trauma compared with laparoscopic surgery (6). Obviously, one of the advantages of laparoscopic liver resection is the small surgical incision, that is, less trauma. Traditional laparotomy, if half the liver is cut, requires a 20–30 cm incision. (I) Laparoscope only needs five holes, basically no scars, patients' postoperative pain is small, compared with the traditional open surgery, the use of laparoscopy can greatly reduce the pain. (II) Patients can get out of bed as soon as possible, the function of each organ system recovers quickly, less complications after surgery, which is conducive to the rapid recovery of patients. (III) More importantly, for professional doctors, laparoscopic has a high resolution, can make the blood vessels around the liver, structure is more clear, more conducive to surgery for professional doctors, laparoscopic has high resolution, can make the liver and liver vessels, bile duct structure show more clear, make the operation more accurate. (IV) The hospital stay was even shorter. Despite so many advantages of laparoscopic hepatectomy nowadays, there is no denying that there is no way to make this technique fully universal, which still has its limitations. (I) One of the very important point is the problem of vision

exposure, like to remove the back of the liver or the top of the diaphragm, the laparoscopic surgical field is more difficult, surgical risk increased significantly, in addition to experienced, skilled doctors in the basis of adequate preoperative preparation can consider implementation, general inconvenience to choose laparoscopic surgery. (II) Laparoscopic hepatectomy also faces the absence of 3D stereo vision and the lack of touch, which may cause some difficulties in positioning. (III) The other is the problem of bleeding, with laparoscopic surgery, once the bleeding is difficult to control, the surgical vision is blurred, at this time it has to be reconverted to open surgery. (IV) In addition to the above factors, there are many details, such as: operation difficulty, high risk, lack of a set of surgical standards, long learning cycle and so on. As a result, this technology can only be carried out in some third-class A large hospitals, and there are many difficulties in promoting it, which need hospitals to introduce talents and technology. The aim of this study was to systematically evaluate the efficacy and safety of laparoscopic hepatectomy versus open hepatectomy in the treatment of giant hepatic cysts by meta-analysis, in order to provide more theoretical basis for clinical treatment. We present the following article in accordance with the PRISMA reporting checklist (available at <https://tcr.amegroups.com/article/view/10.21037/tcr-22-910/rc>).

Methods

Inclusion and exclusion criteria for literature search

Inclusion criteria

(I) Patients with giant liver cysts were selected for the study subjects; (II) laparoscopic hepatic resection was used in the intervention group and open hepatic resection in the control group; (III) at least one indicator was included in the operative time, intraoperative blood loss, hospital stay, postoperative gastrointestinal function recovery time, postoperative incision fat liquefaction, and complications; (IV) randomized controlled trials (RCTs) and case-control studies.

Exclusion criteria

(I) Reviews, experience summaries and meta-analyses; (II) individual case or case study; (III) basic study conducted on rats, rabbits and other animals; (IV) duplicate publication or

full text cannot be obtained; (V) unknown data description.

Description of intervention

Patients were divided into LF and OF groups for laparoscopic hepatectomy or open hepatectomy respectively.

Outcome indicators

Operation time, intraoperative blood loss, hospital stay, postoperative gastrointestinal function recovery time, and postoperative complications such as incision fat liquefaction or incisional infection were assigned as indicators of patient outcomes.

Search strategy

The studies related to the efficacy and safety of laparoscopic hepatectomy and open hepatectomy for giant hepatic cysts published in CNKI, Wanfang, VIP, CBM, PubMed, Embase, Cochrane Library and other databases were searched from database establishment to December 2021. The search terms included “hepatic cyst”, “cyst of liver”, “liver cysts”, “laparoscopic fenestration”, “LF”, “open fenestration” and “OF”. To expand the sample size to reduce the risk of offset, we included both RCTs and observational studies in this study. We also reviewed the grey literature to complete the search of all the literature whenever possible.

Literature screening and data extraction

After literature retrieval, two reviewers independently screened out duplicate publications using the function in Endnote X9 software. Next, the title and abstract were read as a preliminary screening, unqualified studies were excluded and the full text was downloaded for further review. Any disagreements in opinions were resolved through discussion with a third reviewer.

Extracted information included: author, publication year, sample size, sample size per group, sex, age, type and number of cysts, outcome indicators and intervention measure.

Risk of bias

Randomized controlled trials were assessed according to the

Cochrane Collaboration’s risk of bias tool (7). Assessments considered the generation of random sequences, allocation concealment, blinding to participants and implementers, blinding to outcome evaluators, selective reporting, completeness of outcome data, and other biases. The literature quality evaluation was completed independently by two reviewers, and when disagreements occurred, it was resolved by discussion with a third reviewer.

The Newcastle-Ottawa quality assessment scale (NOS) was used for qualitative evaluation of the included case-control trials. The NOS scale uses a semiquantitative star system for the evaluation of literature quality, with a full score of 9 points. The evaluation included population selection, comparability and exposure evaluation. Again, two researchers independently evaluated the literature, with negotiation of any inconsistencies or adjudication by the third researcher adjudicated (8).

Statistical analysis

We performed a unified analysis of all study findings using Stata 15.1 software and forest plots. The odds ratio (OR) was used for dichotomous variables (postoperative complications). Continuous variables (operation time, intraoperative blood loss, hospital stay and postoperative gastrointestinal function recovery time) were analyzed by standardized mean difference (SMD), and literature heterogeneity was analyzed by the I^2 test. $I^2 > 50\%$ indicates a statistical difference in heterogeneity. If the test results showed statistical homogeneity ($I^2 < 50\%$), a fixed-effects model was used to combine and analyze the data. Each effect size was expressed by the 95% confidence interval (CI), and $P < 0.05$ indicated statistical significance. Sensitivity analysis was performed to test the stabilization of the results, using the Influence Analysis tool provided by Stata 15.1, and funnel plots were used to test whether the results had publication bias.

Results

Literature search results

A total of 1,461 studies were retrieved, and 978 remained after duplicate removal. After preliminary screening and reading the full text, 43 studies were finally included. *Figure 1* shows the literature screening process and results.

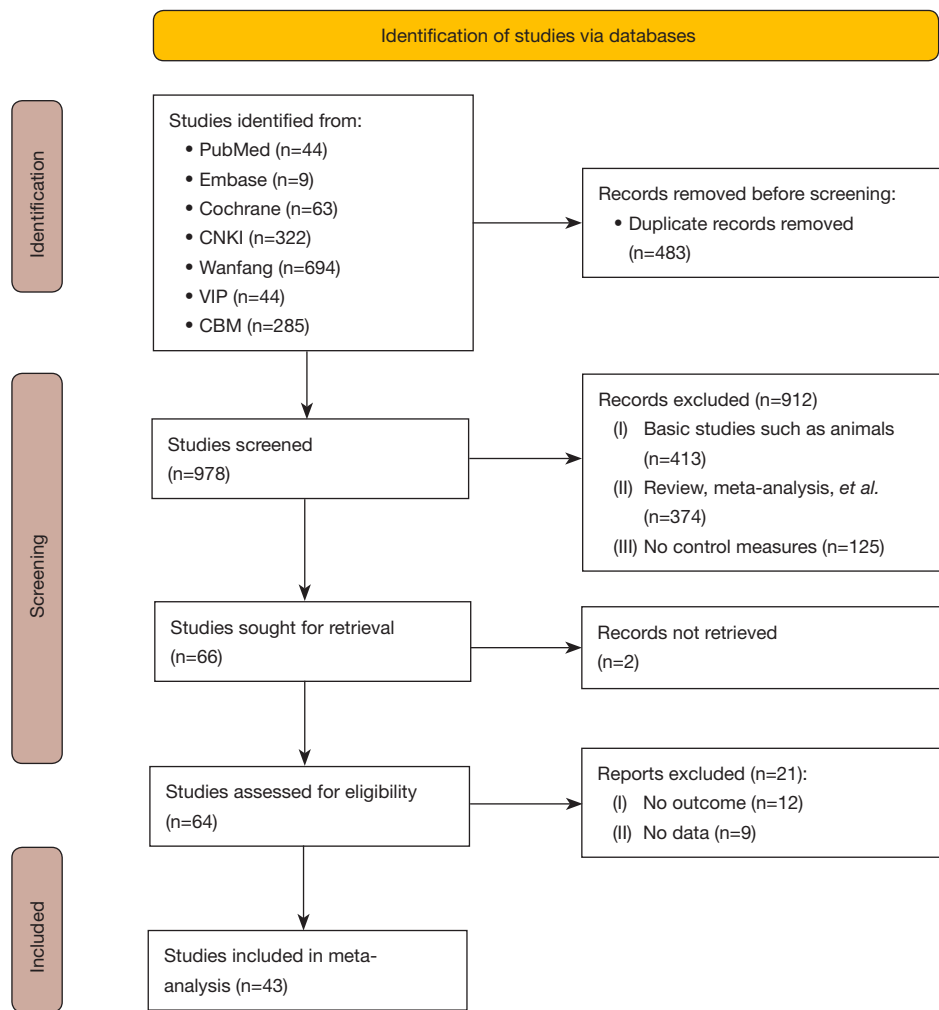


Figure 1 Literature screening flow chart.

Basic characteristics of included literature

The 43 studies included 3,375 patients with hepatic cysts. Basic information of the studies is shown in *Table 1*.

Quality assessment

There were 12 randomized controlled studies. According to the risk of bias tool of the Cochrane Collaboration, all were low risk of bias studies. One study used a random number table. None stated whether allocation concealment was performed, did not state the subject blindness method, did not state if there was a blind method for the outcome evaluator, did not state if there was a selective report or if

the outcome indicators were complete, and did not contain other risk of bias. *Figures 2,3* show the risk of bias evaluation of the included studies. There were 31 case-control studies: 5 low-quality studies and 26 medium-high-quality studies.

Meta-analysis of operative time

Of the 43 studies, 42 reported problems related to operation time: $I^2=94.0\%$, using the random-effects model to compare the two groups (SMD =-2.27, 95% CI: -2.63 to -1.92, $P<0.001$). The operation time in the LF group was significantly shorter than that in OF group, and the difference had statistical significance, as shown in *Figure 4*.

Table 1 Basic characteristics of the 43 included studies

Study	Year	Sample		M/F		Age (years)		NOS grade
		LF	OF	LF	OF	LF, mean \pm SD or median	OF, mean \pm SD or median	
Bian (9)	2018	112	112	47/65	44/68	43.5 \pm 2.6	42.4 \pm 2.3	6
Cao <i>et al.</i> (10)	2016	40	40	23/17	22/18	51.0 \pm 4.20	50.90 \pm 5.10	–
Chen (11)	2013	27	28	14/13	14/14	46.80 \pm 4.70	46.80 \pm 4.70	6
Chen (12)	2015	25	25	11/14	10/15	42.48 \pm 1.41	42.71 \pm 1.32	–
Chen <i>et al.</i> (13)	2011	50	50	23/27	–	41.30 \pm 2.50	–	5
Chen <i>et al.</i> (14)	2006	17	19	10/7	13/6	41.10	44.20	8
Ding <i>et al.</i> (15)	2013	28	23	12/16	9/14	45.70 \pm 3.60	49.50 \pm 4.70	5
Ferrizado (16)	2009	37	34	17/20	13/21	51.10 \pm 20.30	52.60 \pm 21.80	6
Gall <i>et al.</i> (17)	2009	48	11	18/30	5/6	60.00	60.00	8
Gigot <i>et al.</i> (18)	2001	15	9	2/13	4/5	57.00	45.00	7
Guo <i>et al.</i> (19)	2010	31	27	12/19	9/18	45.00 \pm 9.80	42.00 \pm 11.20	7
Huang (20)	2016	33	33	12/21	14/19	46.10 \pm 4.20	45.30 \pm 3.70	–
Jian (21)	2015	20	18	9/11	8/10	54.90 \pm 8.30	53.20 \pm 7.60	–
Jiang <i>et al.</i> (22)	2009	30	15	15/15	10/5	45.00	45.00	6
Kirbiririti (23)	2013	50	50	34/16	33/17	–	–	–
Lao (24)	2017	59	40	21/38	10/30	56.1 \pm 12.6	55.6 \pm 12.8	6
Li <i>et al.</i> (25)	2018	50	50	22/28	24/26	48.17 \pm 2.31	48.20 \pm 2.36	6
Li (26)	2021	90	90	32/58	30/60	47 \pm 9	47 \pm 10	–
Lian <i>et al.</i> (27)	2016	38	30	25/13	19/11	41.88 \pm 12.37	42.13 \pm 11.69	6
Liu <i>et al.</i> (28)	2020	50	50	34/16	35/15	45.83 \pm 2.25	45.94 \pm 2.39	–
Liu <i>et al.</i> (1)	2016	39	24	8/31	5/19	47.1 \pm 7.7	47.0 \pm 7.8	6
Liu <i>et al.</i> (29)	2012	19	13	10/9	4/9	55.30	56.80	7
Liu (30)	2019	46	43	26/20	22/21	47.69 \pm 4.76	48.08 \pm 4.58	6
Qin <i>et al.</i> (31)	2016	63	54	30/33	25/29	56.70 \pm 4.30	57.10 \pm 4.50	6
Song <i>et al.</i> (32)	2017	42	32	19/23	15/17	48.2 \pm 5.3	48.3 \pm 5.2	6
Sun <i>et al.</i> (33)	2014	28	21	8/20	9/12	69.70	71.30	6
Wang (34)	2016	42	41	22/20	21/20	56.35 \pm 4.45	56.35 \pm 4.45	6
Wang <i>et al.</i> (35)	2016	24	48	2/22	7/41	61.40 \pm 8.10	59.30 \pm 7.90	6
Wu (36)	2012	40	32	12/19	14/18	45.00 \pm 9.80	42.00 \pm 11.20	5
Xiao <i>et al.</i> (37)	2013	30	30	16/14	17/13	43.50 \pm 2.30	44.1 \pm 2.40	–
Xiao <i>et al.</i> (38)	2016	30	30	15/15	14/16	55.70 \pm 3.10	58.80 \pm 6.30	5
Xu and Liu (39)	2011	31	32	12/19	14/18	45.00 \pm 9.80	42.00 \pm 11.20	5
Xu (40)	2016	41	41	21/20	22/19	48.14 \pm 2.21	48.38 \pm 2.25	–
Yan and Wu (41)	2013	26	20	10/16	10/10	54.70	54.70	6

Table 1 (continued)

Table 1 (continued)

Study	Year	Sample		M/F		Age (years)		NOS grade
		LF	OF	LF	OF	LF	OF	
Yang and Chen (42)	2015	25	25	13/12	13/12	32.57±9.85	32.08±10.12	7
Yi <i>et al.</i> (43)	2007	52	117	21/32	43/74	43.00±9.20	45.00±12.80	6
Zhang <i>et al.</i> (44)	2010	52	42	20/32	18/24	58.13	63.29	7
Zhao and Wang (45)	2016	38	38	19/19	18/20	44.50±5.80	44.50±5.80	–
Zhao (46)	2016	40	40	21/19	20/20	45.70±3.10	47.40±2.40	7
Zheng (47)	2020	50	50	27/23	28/22	45.92±4.18	46.07±4.18	6
Zheng and Zeng (48)	2012	49	49	20/29	22/27	59.32±9.56	60.15±9.93	–
Zhu and Wan (49)	2019	50	50	10/40	10/40	42.86±3.63	42.52±3.78	6
Zou <i>et al.</i> (50)	2011	22	20	10/12	9/11	24.60±12.30	24.60±12.30	–

LF, laparoscopic fenestration; NOS, Newcastle-Ottawa quality assessment scale; OF, open fenestration.

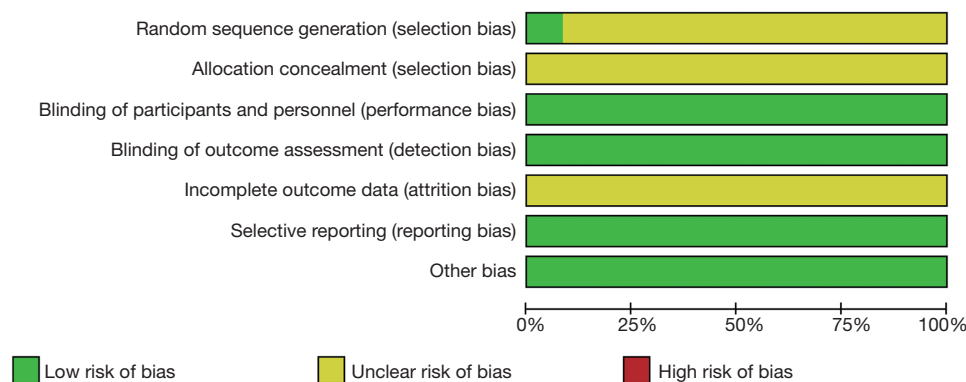


Figure 2 Risk of bias graph.

Meta-analysis of intraoperative blood loss

A total of 39 studies reported problems related to intraoperative blood loss: $I^2=97.0\%$, using the random-effects model for comparison between the two groups (SMD =-3.62, 95% CI: -4.22 to -3.02, $P<0.001$). The intraoperative blood loss in LF group was significantly less than that in the OF group, and the difference had statistical significance, as shown in Figure 5.

Meta-analysis of length of hospital stay

A total of 38 studies reported issues regarding hospitalization: $I^2=91.4\%$, using a random-effects model for comparison

between the two groups (SMD =-2.09, 95% CI: -2.41 to -1.78, $P<0.001$). The length of hospital stay in the LF group was significantly shorter than that in the OF group, and the difference had statistical significance, as shown in Figure 6.

Meta-analysis of postoperative recovery time of gastrointestinal function

A total of 39 studies reported the problems related to the recovery time of postoperative gastrointestinal function: $I^2=97.0\%$, using the random-effects model for comparison between the two groups (SMD =-3.94, 95% CI: -4.68 to -3.20, $P<0.001$). The postoperative gastrointestinal function recovery time in the LF group was significantly shorter

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Cao HW 2016	?	?	+	+	?	+	+
Chen JY 2015	?	?	+	+	?	+	+
Huang CD 2016	?	?	+	+	?	+	+
Jian WH 2015	?	?	+	+	?	+	+
Kirbiririti 2013	?	?	+	+	?	+	+
Liu HY 2020	+	?	+	+	?	+	+
Li ZY 2021	?	?	+	+	?	+	+
Xiao B 2013	?	?	+	+	?	+	+
Xu SY 2016	?	?	+	+	?	+	+
Zhao BF 2016	?	?	+	+	?	+	+
Zheng XH 2012	?	?	+	+	?	+	+
Zou YH 2011	?	?	+	+	?	+	+

Figure 3 Risk of bias summary.

than in the OF group, and the difference had statistical significance, as shown in Figure 7.

Meta-analysis of postoperative complications

A total of 34 studies reported problems related to the recovery time of postoperative gastrointestinal function, $I^2=0.0%$, using the fixed-effects model for comparison between the two groups (OR =0.45, 95% CI: 0.35 to 0.58, $P<0.001$). The incidence rate of postoperative complications in the LF group was significantly less than that in the OF

group, and the difference had statistical significance, as shown in Figure 8.

Sensitivity analysis

The sensitivity analysis results suggested there was no significant heterogeneity (Figure 9).

Funnel plot

A funnel plot was constructed to detect publication bias, and as it was basically left-right symmetrical, the results had no significant publication bias, as shown in Figure 10.

Discussion

Non-infectious hepatic cysts have an incidence of about 5% and the traditional treatment for symptomatic or large cysts are puncture and aspiration, cyst fenestration, cyst internal drainage, and cyst resection (51,52). Cyst aspiration is minimally invasive, but the postoperative recurrence rate is as high as 100% (53). OF of hepatic cysts is effective because the surgeon can complete manipulation under direct vision, but it is invasive and patients’ postoperative recovery is slow. Since hand-held laparoscopic treatment of non-parasitic hepatic cysts was reported in 1991, LF of hepatic cysts has gradually become one of the main methods of treatment (54). With the continuous improvement of laparoscopic techniques and instruments, current laparoscopic treatment of hepatic cysts has the advantages of minimal trauma, small scar, mild pain, exact effect, rapid recovery and low recurrence rate, and has become the first choice (55,56).

In this study, operation time, intraoperative blood loss, hospital stay, gastrointestinal function recovery time and postoperative complications of LF versus OF were analyzed. Compared with the laparotomy group, laparoscopic group had shorter operation time, less intraoperative blood loss, shorter hospital stay, faster postoperative recovery of gastrointestinal function and less postoperative complications. Sensitivity analysis demonstrated that the heterogeneity of the results was small, and the funnel plot revealed no significant publication bias. The number of included patients was large, making the results more reliable in showing that laparoscopic treatment can reduce pain and promote faster recovery of patients compared with

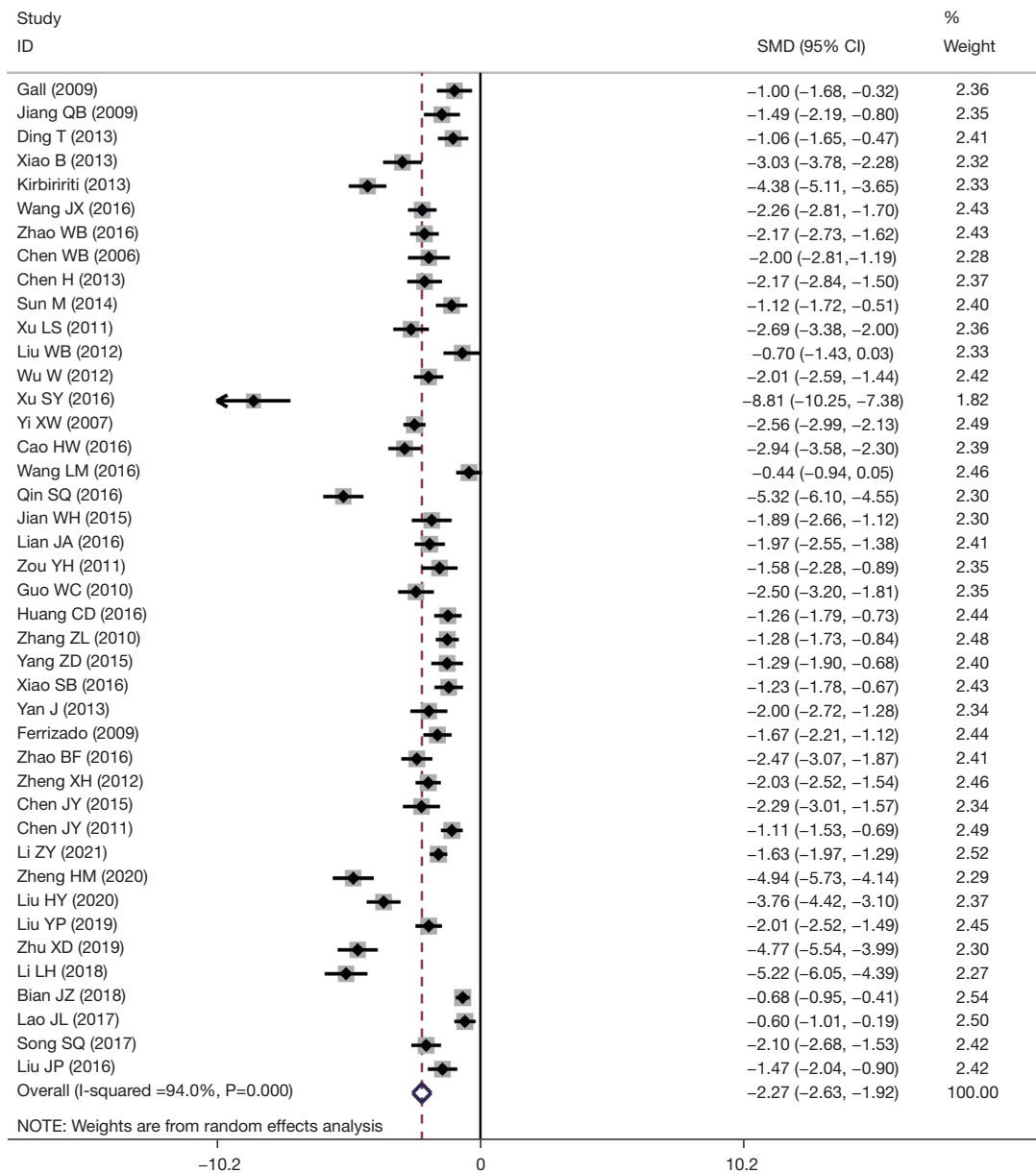


Figure 4 Combined forest plot of operative time. SMD, standard mean difference; CI, confidence interval.

the OF group, with higher efficacy and safety. The results of this study confirm the dominant position of laparoscopic surgery in modern surgery.

Study limitations: (I) all but two of the included studies were Chinese, so whether the same conclusion can be drawn for European and American populations still needs further study; (II) the randomized controlled trial methods were mostly unclear. The overall quality of the literature was uneven, with no high-quality original studies; (III) the

conditions, age, sex and geographic location of the included study subjects differed, which may have led to a selection bias.

Conclusions

The clinical efficacy and safety of laparoscopic hepatectomy as treatment for giant hepatic cysts were superior to open hepatectomy. However, the conclusions still need to be

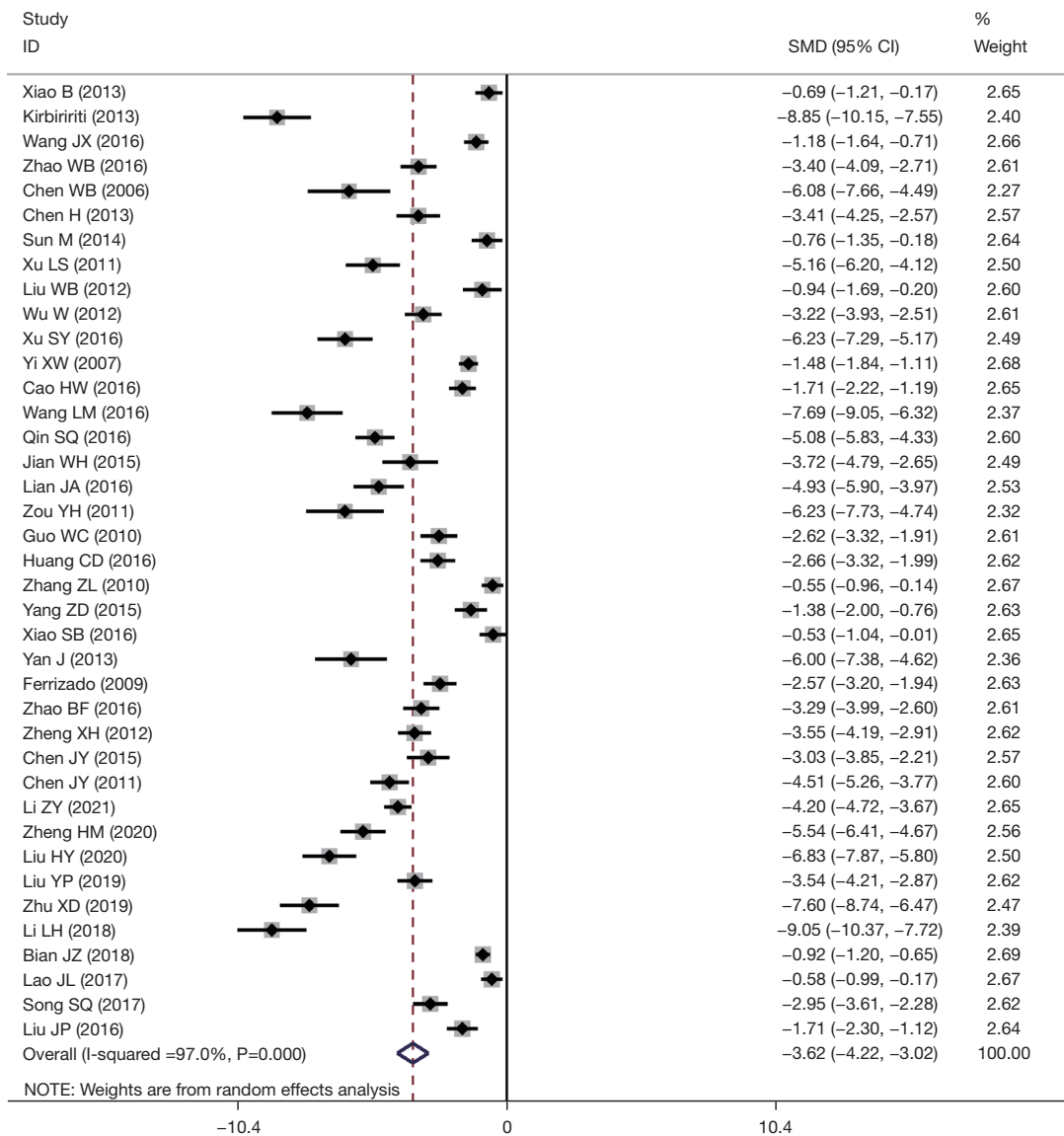


Figure 5 Combined forest plot of intraoperative blood loss. SMD, standard mean difference; CI, confidence interval.

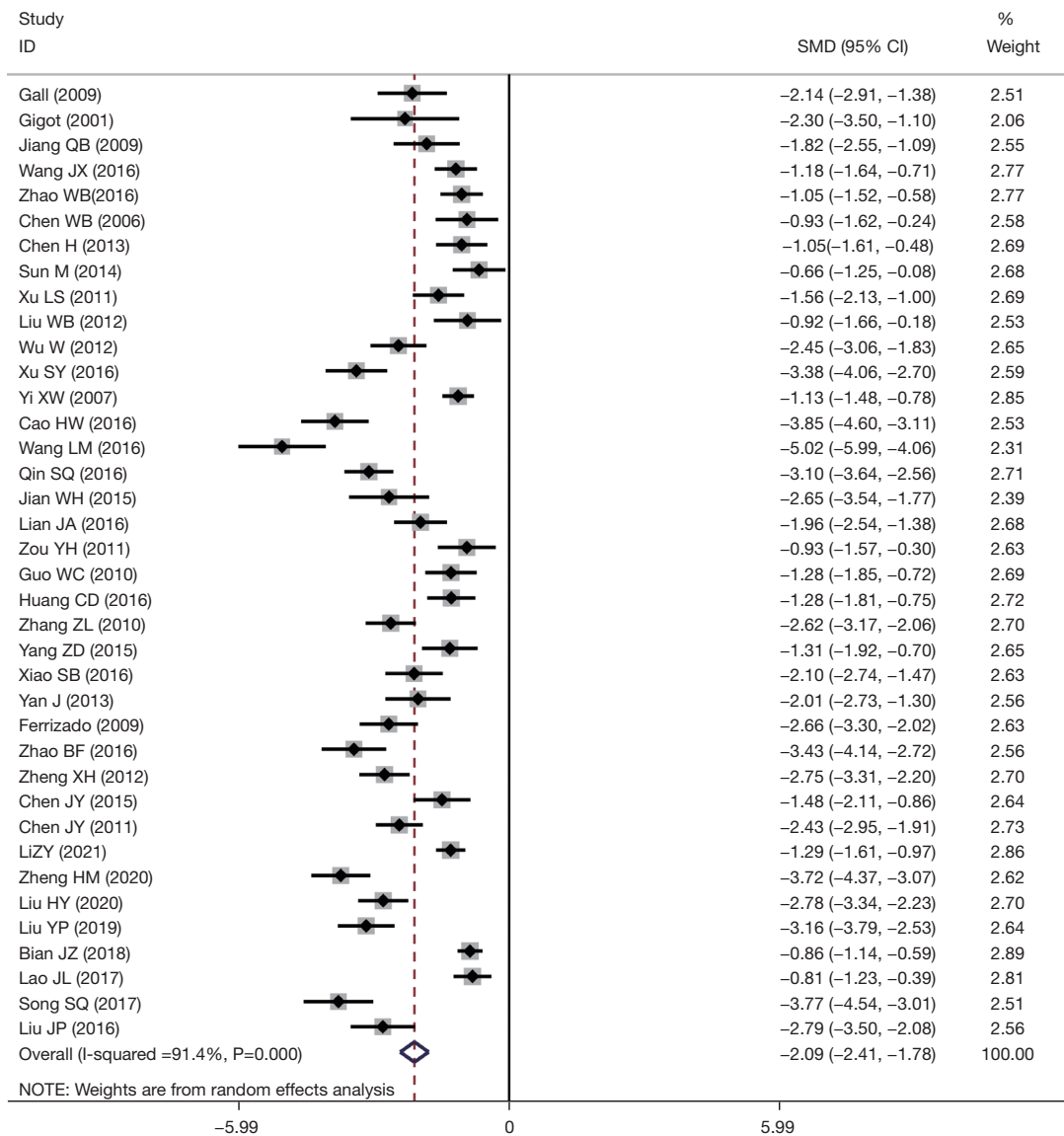


Figure 6 Combined forest plot of length of hospital stay. SMD, standard mean difference; CI, confidence interval.

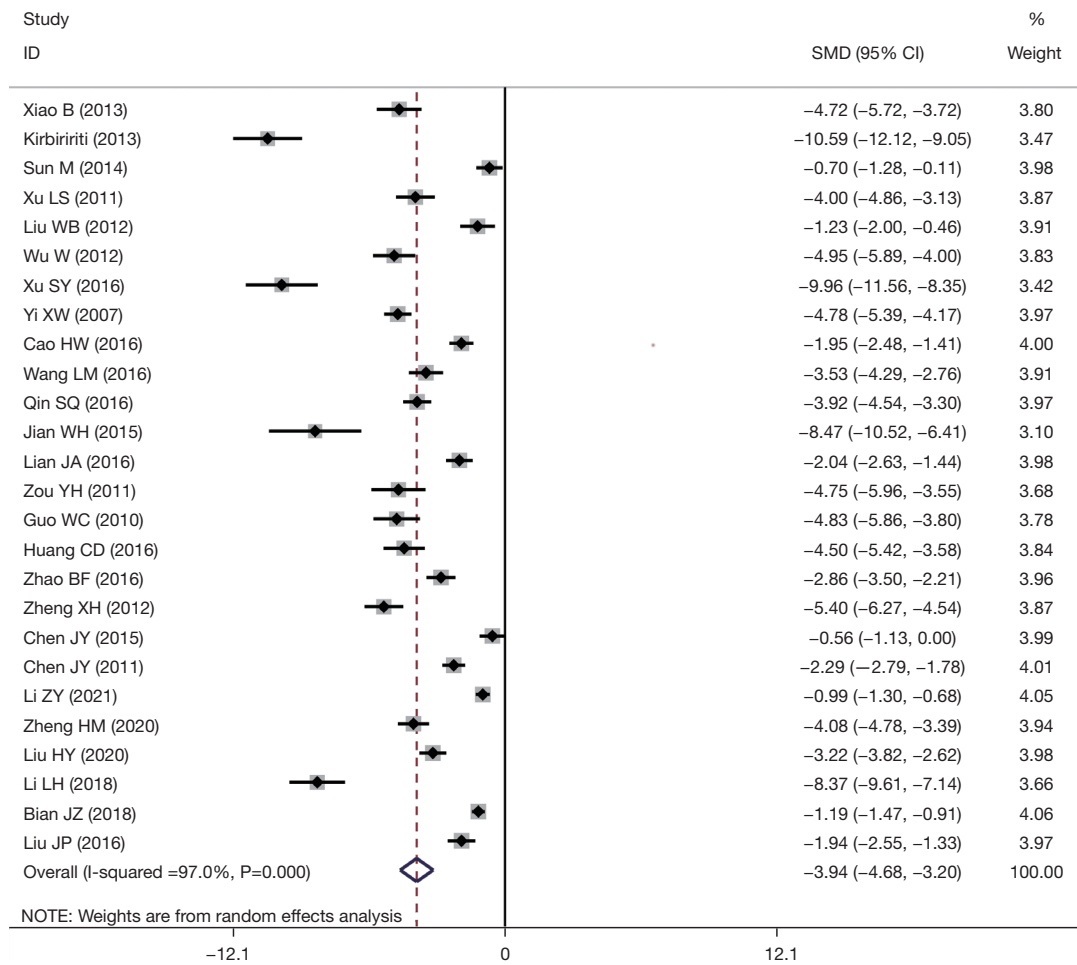


Figure 7 Combined forest plot of postoperative gastrointestinal function recovery time. SMD, standard mean difference; CI, confidence interval.

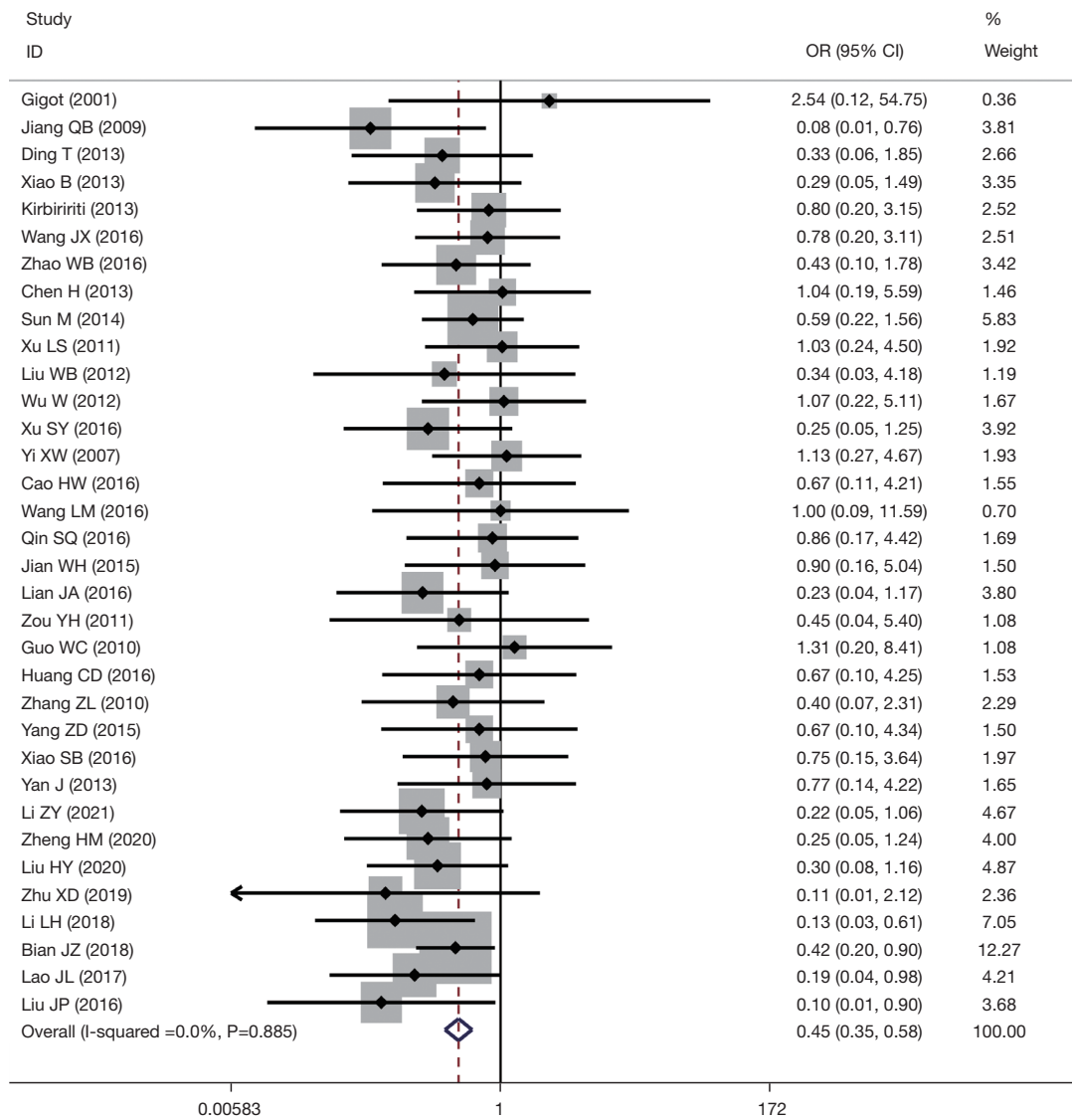


Figure 8 Combined forest plot of postoperative complications. OR, odds ratio; CI, confidence interval.

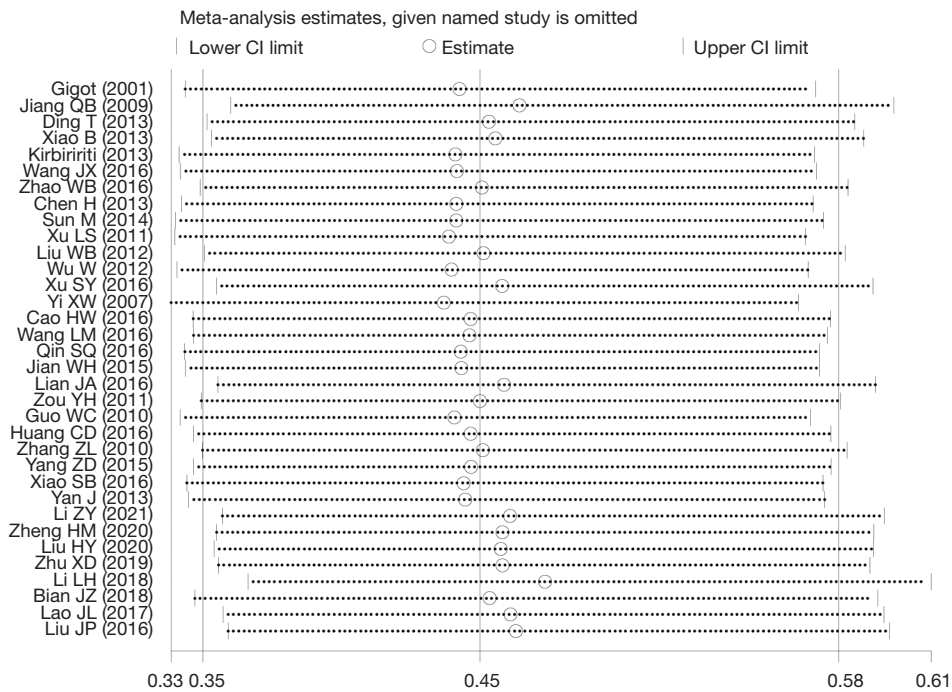


Figure 9 Sensitivity analysis. X-axis: confidence interval.

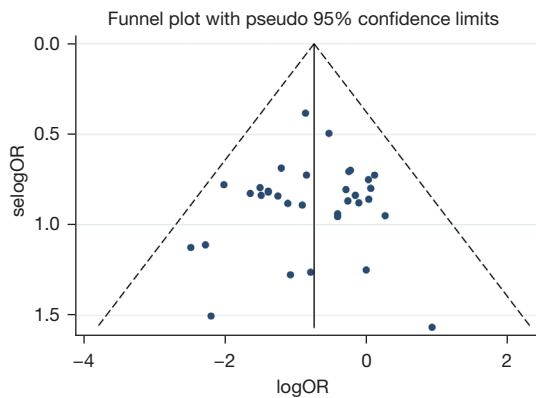


Figure 10 Funnel plot for publication bias. OR, odds ratio.

further confirmed by more reliable studies.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at <https://tcr.amegroups.com/article/view/10.21037/tcr-22-910/coif>.

[amegroups.com/article/view/10.21037/tcr-22-910/rc](https://tcr.amegroups.com/article/view/10.21037/tcr-22-910/rc)

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://tcr.amegroups.com/article/view/10.21037/tcr-22-910/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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