



Laparoscopic Versus Robot Techniques for the Choledochal Cyst in Children: An Initial Meta-Analysis

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Abstract

Objective: To compare the postoperative outcomes between robotic techniques and laparoscopic approach for the management of choledochal cyst through a meta-analysis.

Methods: PubMed, the Cochrane Central Search Library, and Embase were applied to retrieved related studies that compared the outcomes of laparoscopic surgery for choledochal cyst to robotic technique. The main outcomes include blood loss, postoperative complications, operative time and length of stay.

Results: There was no significant difference in blood loss, operative time, and rate of complication between robot group and laparoscopy group. The length of stay in robot group was significant shorter than that in laparoscopy group (MD= -0.62, 95% CI -1.17 to -0.07, p<0.03, I²=81%).

Conclusion: Robot techniques were as safe and feasibility as conventional laparoscopy for the management of Choledochal cysts, with similar blood loss, operative time, and rate of complication. But patients treated with robot techniques had shorter length of stay.

Keywords: Laparoscopy; Robot techniques; Choledochal cyst; Meta-analysis

Introduction

Choledochal cysts are rare congenital disease which is featured with congenital biliary tract dilatation. In clinical, Choledochal cysts present with jaundice, abdominal pain, and tumors. Its incidence varies from regional disparity and gender. In the west countries, the incidence of choledochal cysts is 5 to 15 cases per million people [1-3]. However, people in east countries are more vulnerable to choledochal cysts, with an incidence up to 1% [4-6]. The incidence in females is as fourth time as in males [7]. Approximately 80% of choledochal cysts are diagnosed in the first decade of life [8,9]. Choledochal cysts are benign diseases, but patients with choledochal cysts are more susceptible to severe hepatobiliary complications, including cholelithiasis, perforation of the cyst, cholangitis, pancreatitis, and even cancerization, such as carcinoma of bile duct and gallbladder carcinoma. Thus, once the diagnose of choledochal cysts is identified, active surgical treatment is essential. Today, Roux-en-Y hepaticojejunostomy, as we all know, is the main treatment of choledochal cysts, including open surgery, conventional laparoscopy, and robotic-assisted laparoscopy [10]. Since in 1995 Farello et al. performed the first try which treated choledochal cysts with laparoscopy in a six years old girl [11], some studies have indicated the advantages and efficacy of laparoscopic for choledochal cysts [12-16]. Although laparoscopy provides excellent surgical view and increased anatomical and anastomotic accuracy, thereby reducing tissue damage, it also has disadvantages, such as rigid instruments with limited degree of freedom which can hinder tension-free suturing. To overcome the issues mentioned above, the Da Vinci surgical system is applied to combine the advantages of laparoscopy with robotic surgery, which allow for delicate and safe sutures. In 2006, Woo and his colleagues completed the first robotic laparoscopic-assisted choledochocystectomy [17]. Some studies related it have been reported since then [18-20]. Recently, several studies have compared the postoperative outcomes in patients with choledochal cyst who performed robotic laparoscopic-assisted choledochocystectomy to patients with choledochal cyst who performed laparoscopic choledochocystectomy [21-25]. But the results remained controversies. Therefore, we conducted this meta-analysis to compare the postoperative outcomes between robotic techniques and laparoscopic approach for the management of choledochal cyst.

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Received Date: 23 Feb 2022

Accepted Date: 07 Apr 2022

Published Date: 19 Apr 2022

Citation:

Wu Q, Zhao D, He W, Yang Y, Deng L, Zheng L, et al. Laparoscopic Versus Robot Techniques for the Choledochal Cyst in Children: An Initial Meta-Analysis. *Clin Surg*. 2022; 7: 3486.

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Methods

Search strategy

The International Platform of Registered Systematic Review and Meta-analysis Protocols was used for registration of this meta-analysis (registration number: 202190082). In line with the PRISMA guidelines, PubMed, the Cochrane Central Search Library, and Embase were applied to search for related studies that compared the outcomes of laparoscopic surgery for choledochal cyst to robotic technique. The application of PICO search tool is as follows: P: Patients with choledochal cyst; I: robotic laparoscopic-assisted choledochocystectomy; C: Conventional laparoscopic choledochocystectomy; O: Operative time, blood loss, rate of complication, and length of stay. The search terms were as follows: Choledochal cyst, robotic, and laparoscopy. Moreover, in order to retrieve as many relevant studies as possible, references of related literature were manually searched. Two reviewers (Qiao Wu and Dan Zhao) independently performed literature retrieval. The full text and abstracts related to this topic were reviewed. If any discrepancy was existing between the two reviewers, it was sent to the third reviewer (Wenfei He) and figured it out until no discrepancy exists.

Included and excluded criteria

Included criteria were shown below: (1) Studies which compared robotic techniques to laparoscopic surgery for the treatment of choledochal cyst; (2) relevant data could be accessible in robot group and laparoscopy group; (3) English studies; (4) studies with full text. Exclusion criteria were shown below: (1) Duplicated studies or studies without enough data; (2) associated studies involved adult patients with choledochal cyst. The process of screening and confirming articles is shown in Figure 1. A total of five qualified researches were enrolled in this meta-analysis.

Data extraction and quality assessment

Qiao Wu and Dan Zhao were appointed as independent reviewers to extract relevant data for each article. If any difference was existed between the two reviewers, an invitation was sent to the third reviewer (Wenfei He) for dealing with the issue until no disagreement exists among three reviewers. For articles without enough data, no one corresponding author was contacted to obtain the original data. The extracted data were shown below: The name of first author, type of study, published year, sample size in robot group and laparoscopy group, blood loss, operative time, rate of complication, length of stay. The Newcastle-Ottawa Scale was applied for evaluating the quality of each included study.

Statistical analysis

Data analysis was performed by R version 4.1.1 (Kick Things) [26]. Odds Ratio (OR) and its 95% Confidential Interval (CI) were used to assess dichotomous data, while weights Mean Differences (MDs) were used to assess continuous data. Tests for heterogeneity

among the five eligible studies were carried out. The definition of heterogeneity was $P < 0.10$ or $I^2 > 50\%$. If heterogeneity was acceptable ($P \geq 0.10$ or $I^2 \leq 50\%$), the fixed-effects model was selected for data analysis. Otherwise, the random-effects model was selected for data analysis. $P < 0.05$ was considered as statistically significant.

Results

Eligible studies

Five studies met the inclusion criteria [21-25]. Table 1 has presented the basic characteristics of each included study. The published year of included studies ranged from 2018 to 2021. The Newcastle-Ottawa Scale score of every included study was summarized in Table 1.

Quantitative synthesis

As presented in Figure 2, there was no significant difference in blood loss between robot group and laparoscopy group (MD= -0.94, 95% CI -3.08 to 1.20, $p=0.39$, $I^2=98\%$). As shown in Figure 3, there was no significant difference in operative time between robot group and laparoscopy group (MD= -1.01, 95% CI -1.39 to 3.41, $p=0.41$, $I^2=99\%$). As shown in Figure 4, there was no significant difference in rate of complication between robot group and laparoscopy group (OR=0.41, 95% CI 0.10 to 1.69, $p=0.22$, $I^2=75\%$). As shown in Figure 5, the length of stay in robot group was significant shorter than that in laparoscopy group (MD= -0.62, 95% CI -1.17 to -0.07, $p=0.03$, $I^2=81\%$). Due to the small number of articles included in this study, subgroup analysis and sensitivity analysis were not performed.

Discussion

Choledochal cyst is a rare congenital disease which is featured with congenital biliary tract dilatation. Clinical manifestations of them include abdominal pain, jaundice, and tumors. Its incidence varies by race and gender [1-3,7]. Due to the high probability of deterioration, once the Choledochal cyst was diagnosed, active surgery is necessary for patients. Open surgery is the traditional approach. With the development of techniques, laparoscopy and even robotic techniques were applied for the management of choledochal cyst. But the feasibility of robotic techniques for the management of choledochal cyst is doubtful. Thus, performing a meta-analysis which compares robotic techniques to laparoscopic surgery for the treatment of choledochal cyst is essential. As shown in Figures 2-4, for the treatment of choledochal cyst, there was no significant difference in blood loss, operative time, and rate of complication between robotic techniques and laparoscopic surgery, (MD= -0.94, 95% CI -3.08 to 1.20, $p=0.39$, $I^2=98\%$), (MD= -1.01, 95% CI -1.39 to 3.41, $p=0.41$, $I^2=99\%$), (OR=0.41, 95% CI 0.10 to 1.69, $p=0.22$, $I^2=75\%$), respectively. As shown in Figure 5, the length of stay in robot group was significant shorter than that in laparoscopy group (MD= -0.62, 95% CI -1.17 to -0.07, $p=0.03$, $I^2=81\%$). These results indicate that the robotic technique is not superior to traditional

Table 1: Characteristics of included studies.

Study	Year	Design	Country	Sample size (R/L)	Blood loss (R/L), ml	Operative time (R/L), Min	Postoperative complication (R/L)	Length of stay (R/L), day	NOS score
Xiaolong Xie	2020	cohort	China	41/104	21.34/21.73	180.61/212.79	2/9	7.55/7.56	7
Hiroyuki Koga	2019	cohort	Japan	10/27	13.09/16.84	-	-	7.4/11.0	6
Hongseun Lee	2018	cohort	Korea	18/49	172.78/108.71	247.94/181.31	2/18	6.22/7.33	6
Jong Hwi Yoon	2021	cohort	Korea	16/23	-	-	8/7	-	7
Shuiqing Chi	2020	cohort	China	70/70	6.81/23.24	229.50/172.00	3/21	6.94/7.91	6

R: Robotic techniques; L: Laparoscopy; Min: Minute; NOS: Newcastle-Ottawa Scale

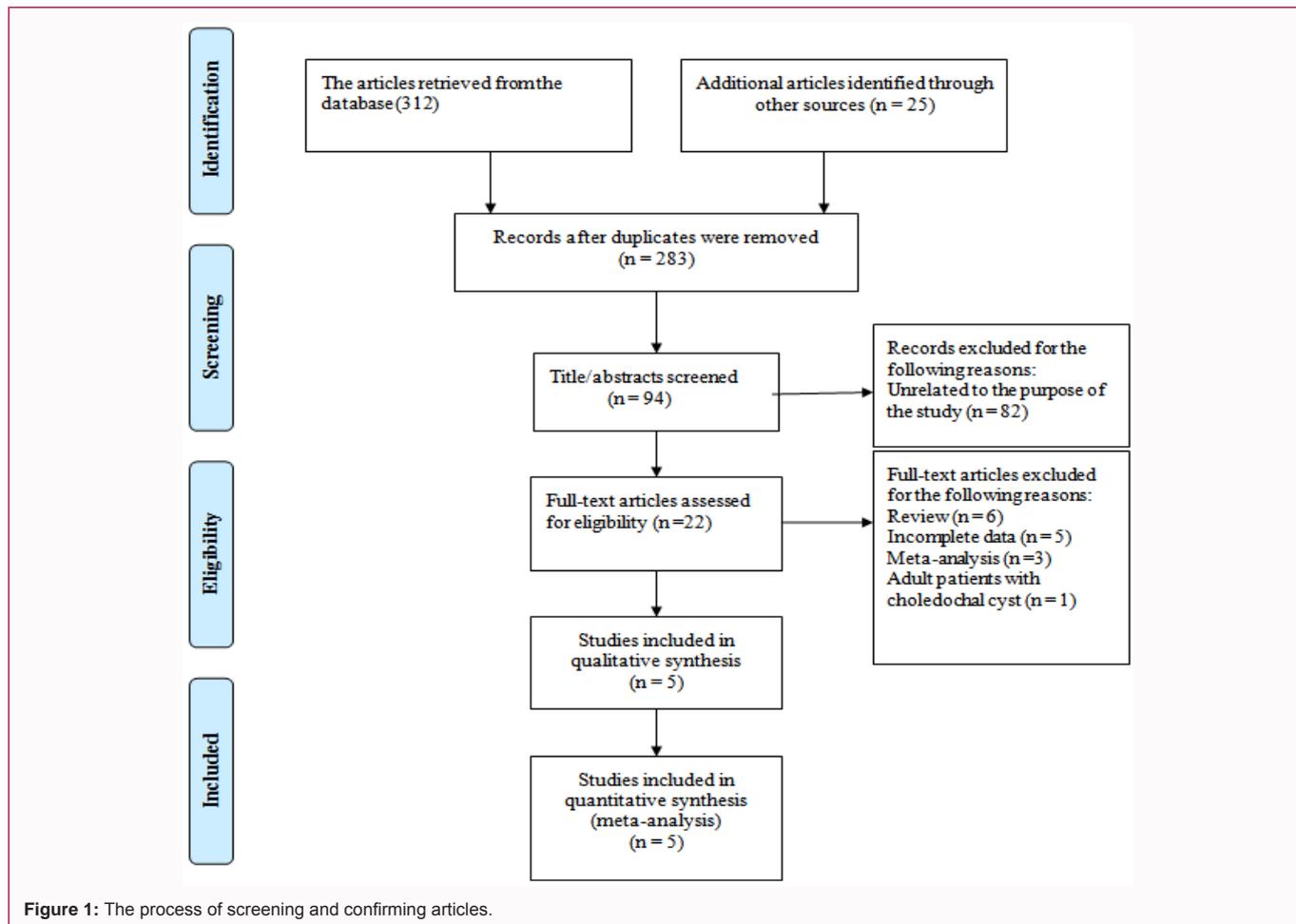


Figure 1: The process of screening and confirming articles.

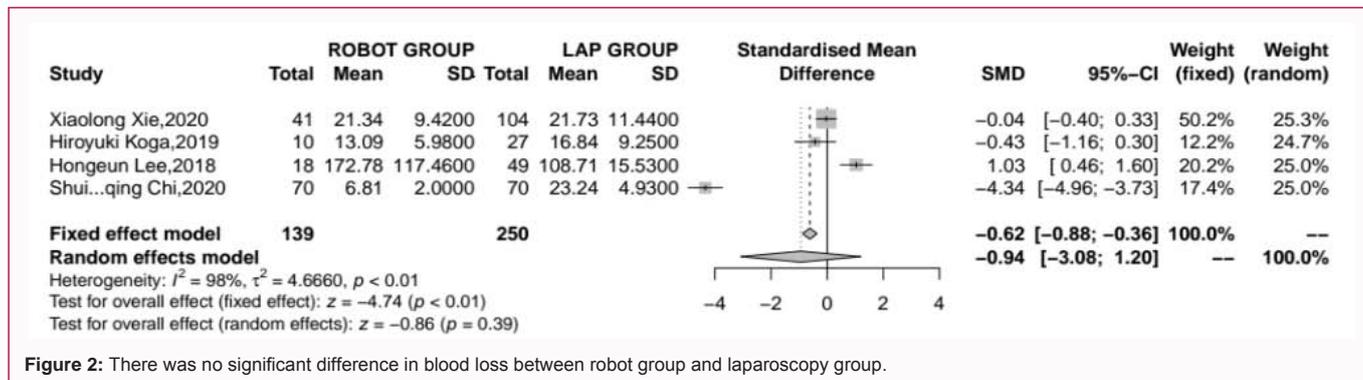


Figure 2: There was no significant difference in blood loss between robot group and laparoscopy group.

laparoscopic surgery in the treatment of choledochal cyst. Even if the robotic techniques have the advantage of shorter length of stay, it does not mask its disadvantage of high cost. The heterogeneity of this meta-analysis is high. Due to the number of included studies is small, sensitive analysis was not carried out. On the one hand, we hypothesize that the source of high heterogeneity is the individual differences among patients in each study. As far as we know, there are five types of choledochal cysts. Different types of choledochal cysts are likely to account for the high heterogeneity. On the other hand, robotic techniques have only recently been applied for choledochal cysts. There is a long learning curve for mastering the technology [27]. Lack of surgical experience for mastering the techniques may also account for the high heterogeneity of this study. There are several limitations in this meta-analysis. Firstly, included studies are

retrospective study. Secondly, the number of original studies included in this meta-analysis is small. Thirdly, the heterogeneity is high. But this study is the first meta-analysis comparing robotic technology and laparoscopic surgery for choledochal cysts, which may provide some suggestions for the management of choledochal cysts. A multi-centre, prospective randomized controlled trials with large sample size need to be performed to further evaluate the feasibility of robotic techniques for the management of choledochal cysts.

Conclusion

It is feasible to treat choledochal cysts with robotic technology. But except shorter hospital stay, the blood loss, operation time and the rate of complication are not superior to laparoscopy. In addition, it is indisputable that robotic surgery is expensive. The choice of operation

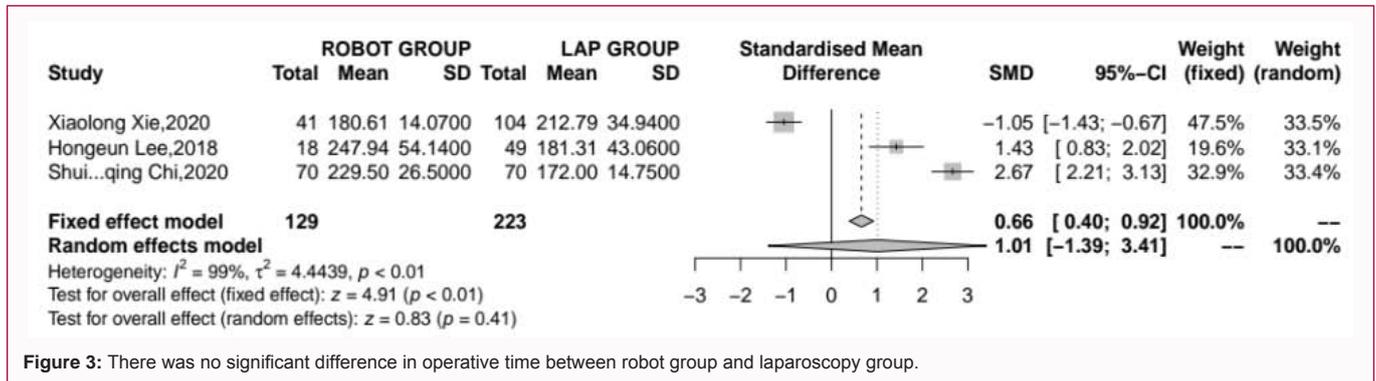


Figure 3: There was no significant difference in operative time between robot group and laparoscopy group.

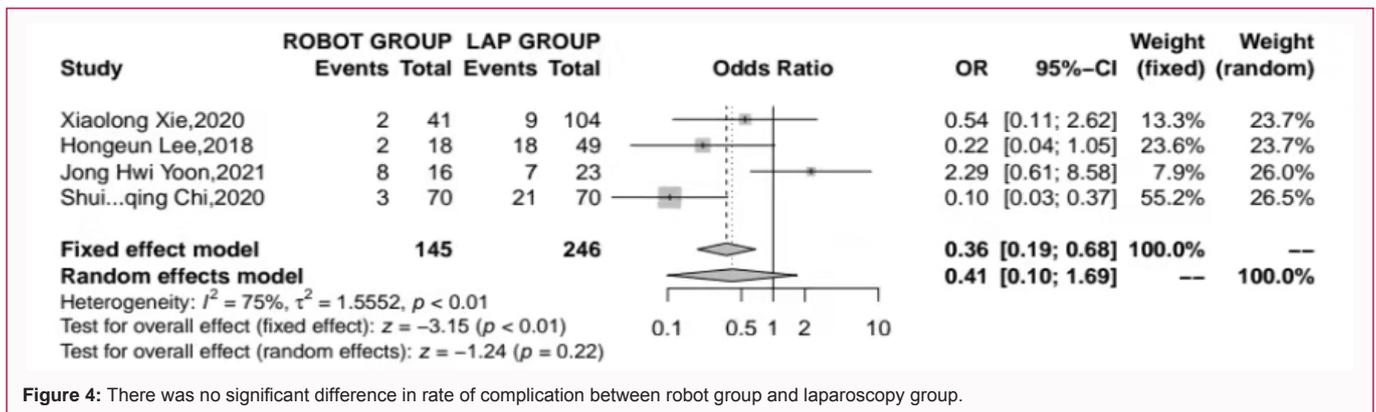


Figure 4: There was no significant difference in rate of complication between robot group and laparoscopy group.

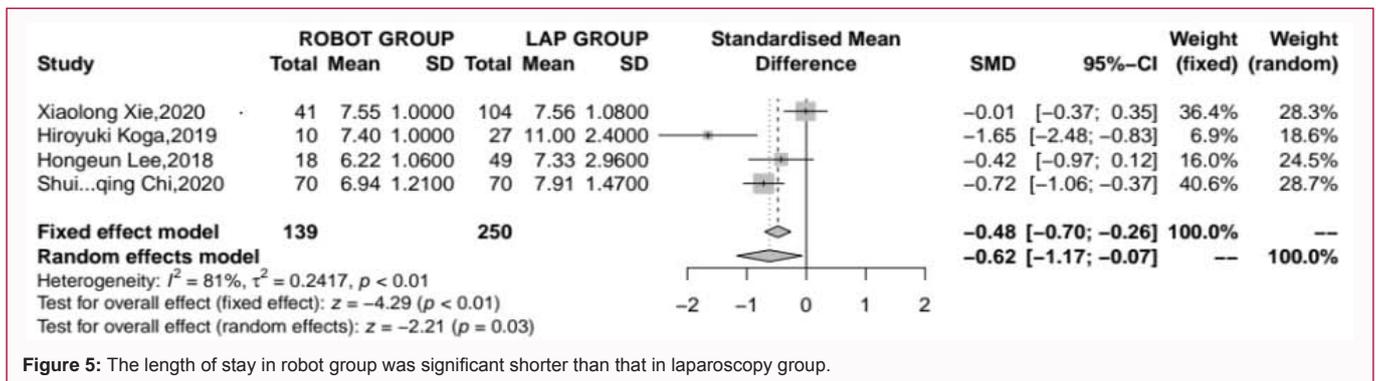


Figure 5: The length of stay in robot group was significant shorter than that in laparoscopy group.

mode of choledochal cyst needs comprehensive consideration.

Acknowledgment

Thanks for the support of science and technology project of Nanchong City, Sichuan Province, China (19SXHZ0113).

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