Int J Clin Exp Med 2015;8(4):4922-4931
www.ijcem.com /ISSN:1940-5901/IJCEM0004322

Original Article

An updated meta-analysis of laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in children

Yidong Huang, Yang Wu, Wei Shan, Li Zeng, Lugang Huang

Department of Pediatric Surgery, West China Hospital of Sichuan University, Chengdu 610041, Sichuan, P. R. China

Received December 1, 2014; Accepted January 29, 2015; Epub April 15, 2015; Published April 30, 2015

Abstract: Purpose: To further explore the feasibility and safety of laparoscopic pyeloplasty (LP) in children with ureteropelvic junction obstruction compared with open pyeloplasty (OP). Methods: PUBMED, Web of science and Cochrane library were searched until Oct. 2014 to find eligible studies. WMD, OR, RD and their 95% CIs were used to estimate the difference. Baseline such as age, gender and crossing vessel, perioperative outcomes such as length of stay, operative time, overall complications, and success rate were compared. All the meta-analyses were performed in Revman 5.2. Results: 15 comparative studies and one RCT were eligible and included in the meta-analysis. Compared with OP, LP groups might be associated with shorted length of hospital stay (WMD: -1.92, 95% CI: -2.45–1.39), reduced complications (OR: 0.71, 95% CI: 0.49-1.01) and equal success rate (RD: 0.01, 95% CI: -0.02-0.04), but prolonged operative time (WMD: 48.64, 95% CI: 31.16-66.12). Conclusion: Our findings supported that laparoscopic pyeloplasty is feasibility and safety in the treatment of UPJ obstruction in children, especially in high-volume centers with experienced experts. Considering the select bias and recall bias, more RCTs are required to further explore the efficiencies of LP.

Keywords: Laparoscopic pyeloplasty, ureteropelvic junction obstruction, children, meta-analysis

Introduction

Ureteropelvic junction (UPJ) obstruction is one of the commonest causes of hydronephrosis in adults, especially in children. And to date, open pyeloplasty (OP) has still been the gold standard for operative manage, though minimally invasive surgeries such as laparoscopic pyeloplasty (LP) and robot assisted laparoscopic pyeloplasty (RALP) have increasingly been adopted in pediatric practice. Liu DB et. al [1] reported an increasing trend of minimally invasive pyeloplasties from 0.34% in 2000 to 11.7% in 2009 by using Kid's inpatient databases (KID). The availability of LP is gradually unrestricted to experienced centers, though this approach is equipment based and technology based.

Since the 21st century, increasing number of studies reported to compare the feasibility and safety of LP with OP. Among these studies, a randomized controlled trial (RCT) [2], which was carried out in 39 children, revealed that there is a trend toward longer operative times in the laparoscopic group but a shorter overall hospitalization. Meanwhile, a meta-analysis [3] was performed to explore this issue, which included nine low-volume studies. But after that, seven another studies [1, 4-9] were also reported, including three large-scaled comparative studies [1, 4, 7], which may added more evidence to the comparison of LP and OP, especially in perioperative complications. Therefore, we updated this meta-analysis. Considering the priority of RCT, we did not pool the data of one RCT with the other comparative studies.

Material and methods

Data source and search strategy

We conducted this meta-analysis in accordance with the Preferred Reporting Items for

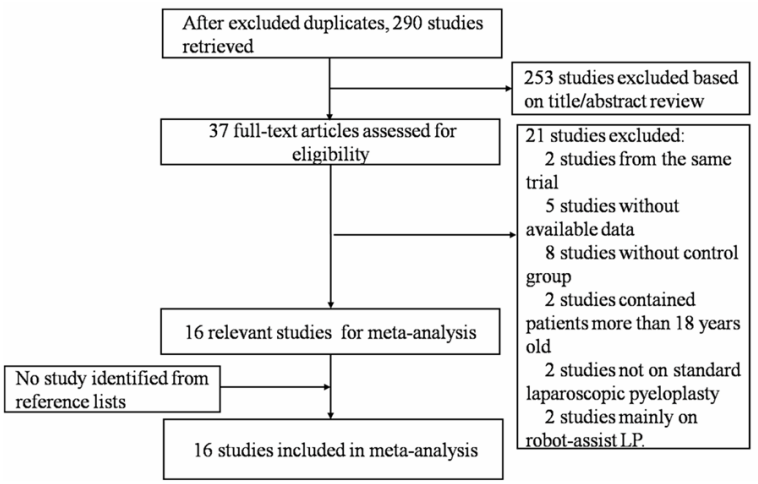

Figure 1. Flowchart of this meta-analysis.

Systematic Reviews and Meta-Analyses [10]. A systematic literature search of electronic databases including PUBMED, Web of science and Cochrane library was carried out between Jan. 1966 and Oct. 2014 to identify eligible studies, using the following words: "hydronephrosis OR ureteropelvic junction obstruction OR pelvi-ureteric junction obstruction OR ureteral obstruction", "pyeloplasty", "young OR children OR child OR kids OR pediatrics" and "laparoscopic". If data from title or abstract were appeared to meet the inclusion criteria, full article would be retrieved. Besides, the reference lists of these article and reviews articles were searched to identify additional eligible studies. When duplicated studies using the same dataset were published, the most recent study or study with larger samples was used.

Criteria for inclusion and exclusion

Studies regardless of the sample size will be eligible for inclusion if they meet the following criteria: 1). comparative study; 2). compared standard LP with OP; 3). proved sufficient data on outcomes of interest; 4). procedures should perform in children (less than 18 years old). Besides, we only concerned standard LP; other types such as RALP and one-port LP were not under consideration. Meanwhile, conference abstracts, review articles, case series, case reports and letters to the editor were excluded.

Data extraction and outcomes of interest

Data abstraction was carried out independently by two authors (Yidong Huang, Yang Wu) according to the meta-analysis of observational studies in epidemiology guidelines [11] and disagreements were consulted with the third one (Lugang Huang). The following outcome parameters were abstracted: author, year, study design, study periods, cases of LP and OP, age periods, gender distribution, sides of obstruction and number of patients with crossing-vessel. Besides, perioperative outcomes such as operative time, length of stay and overall complication rate were also abstracted. In this meta-analysis, complications included urinary leakage, urinary retention, worsening of hydronephrosis, stenosis infection, urinary tract infection, bleed, wound infection, urinoma and symptomatic restenosis and others. Detailed cases of individual complication were also abstracted. Meanwhile, if data were not available, mean plus range of the parameters were also retrieved.

Statistical analysis

Considering the enormous difference of evidence level, we did not pool data from a RCT with other comparative studies. Odds ratio (OR) and its 95% confidential interval (CI) were used to assess dichotomous data, while weight mean differences (WMDs) were used to assess continuous data. Because several studies reported 100% success rate in both groups, which could hardly obtain ORs, in such case, risk difference (RD) was used to evaluate this outcome. The statistical heterogeneity among studies was evaluated by using the Cochrane's Q and I^2 statistics. Heterogeneity was considered significant for P value < 0.05 or I^2 > 50%. Considering the heterogeneity of included studies, we conducted meta-analyses of all comparatives using random effects models. But finally, to present a funnel plot with 95% CI, we used fixed effects models to assess the publication bias. If there is any asymmetry, Begg's and Egger's test were applied. All the meta-analyses were carried out in the Review Manager 5.2 software (The Cochrane Collaboration, Oxford, UK). Differences were considered of significant, if P less than 0.05. All P are two tailed.

Table 1. Baselines of sixteen comparative studies of laparoscopic and open pyeloplasty in children

Author	Year	Study design	Study periods	procedures	N	Age, month (SD/Range)	Boy	Girl	Side (L/R)	Crossing-vessel (n)
Varda BK	2014	P Database	Jan. 2003-Dec. 2010	LP	1517	< 216	1047	470	NA	NA
				OP	10545	< 216	7677	2868	NA	NA
Liu DB	2014	KID	2009 dataset	LP	71	111.6 (8.16)	58	13	NA	NA
				OP	2907	44.4 (1.8)	2068	839	NA	NA
García-Aparicio L	2014	R	Jan. 2007-Feb. 2013	LP	26	5.15 (2.98)	22	4	16/10	1
				OP	32	4.25 (3.06)	24	8	19/13	1
van der Toorn F	2013	P	Apr. 2006-Dec. 2010	LP	57	97.2 (43.2)	40	17	39/18	31
			1995-2005	OP	57	93.6 (36.0)	40	17	38/19	31
Knoedler J	2013	NIS	2004-2008	LP	164	< 216	53	111	NA	NA
				OP	4426	< 216	1403	3023	NA	NA
Herndon CD	2013	R	2004-2010	LP	26	72 (2-204)	15	11	NA	11
				OP	49	12 (< 1-132)	29	20	NA	11
Polok M	2011	R	Jan. 2005-Dec. 2009	LP	10 (12)	170 (58-213)	4	6	7/4	NA
				OP	21 (22)	55 (0.1-164)	9	12	15/6	NA
Penn HA	2010	RCT	2005-2008	LP	20	93.6 (12-80)	17	3	13/7	1
				OP	19	86.4 (12-204)	12	7	12/7	1
Braga LH	2010	R	Jan. 2005-May. 2008	LP	41	94.8 (49.2)	34	7	34/7	13
			2003-2008	OP	67	92.4	49	18	43/24	15
Tong Q	2009	R	Jan. 2005-Dec. 2007	LP	23	7.3 (2-11)	13	10	15/8	3
			Jan. 2002-Dec. 2006	OP	21	8.2 (3-12)	12	9	14/7	2
Valla JS	2009	R	1999-2005	LP	45	70 (4-172)	26	19	27/18	15
				OP	45	22 (1-168)	31	14	32/13	5
Wang L	2009	P	Jun. 2002-Mar. 2006	LP	14	110.4 (40.8)	8	6	NA	NA
				OP	17	109.2 (36.0)	10	7	NA	NA
Vemulakonda VM	2008	PHIS	2001-2006	LP	176	98.2 (68.4)	122	54	NA	NA
				OP	2177	40.2 (52.8)	1548	629	NA	NA
Ravish IR	2007	P	Apr. 2003-Mar. 2005	LP	15	51.6 (12-108)	NA	NA	NA	3
			Jan. 2002-Jun. 2006	OP	14	54.0 (12-96)	NA	NA	NA24/13	2
Piaggio LA	2007	R		LP	37	61 (0.5-216)	26	11		NA
				OP	41	44 (0.5-205)	32	9	29/12	NA
Bonnard A	2005	R	1999-2003	LP	20	88 (25-192)	NA	NA	NA	NA
			1998-2001	OP	17	103 (37-206)	NA	NA	NA	NA

Abbreviations: RCT, randomized controlled trial; P, prospective; R, retrospective; PHIS, Pediatric Health Information System database; NIS, Nationwide Inpatient Sample; KID, Kid's Inpatient Databases; LP, laparoscopic pyeloplasty; OP, open pyeloplasty; SD, standard deviation; NA, not available.

Table 2. Summary of perioperative outcomes of laparoscopic and open pyeloplasty in children

Author	Year	procedures	Approach	n	Operative time, min (SD/range)	Length of stay, d (SD/range)	Conversion
Varda BK	2014	LP	NA	NA	254 (226-283)*	2.3 (1.4-3.2)*	NA
		OP			207 (184-230)*	2.8 (2.5-3.0)*	
Liu DB	2014	LP	NA	NA	NA	2.86 (0.55)	NA
		OP			NA	3.46 (0.19)	
Garcı´a-Aparicio L	2014	LP	Trans	26	151.85 (7.1)	3.51 (1.4)	0
		OP			129.53 (5.9)	6.34 (0. 2)	
van der Toorn F	2013	LP	Trans	57	177 (50.5)	1.2 (0.46)	NA
		OP			108 (25.6)	6.7 (1.3)	
Knoedler J	2013	LP	NA	NA	NA	2.42 (1.77-3.08)*	NA
		OP			NA	2.75 (2.56-2.95)*	
Herndon CD	2013	LP	NA	NA	387 (88)	1.04 (1-2)	NA
		OP			281 (48)	1.13 (1-2)	
Polok M	2011	LP	Trans	10	179 (153-250)	3	NA
		OP			95 (41-154)	2.5	
Penn HA	2010	LP	Trans	20	151 (94-13)	1.22 (0.85-2.00)	0
		OP			130 (83-225)	1.51 (1-3.04)	
Braga LH	2010	LP	Trans	41	178	2.3	0
		OP			146	3.4	
Tong Q	2009	LP	Retro	23	102.6 (8.5)	2.5 (0.4)	0
		OP			95.4 (7.2)	5 (1.2)	
Valla JS	2009	LP	Retro	42	155 (80-260)	4.1	3
		OP			98 (45-210)	5.1	
Wang L	2009	LP	Retro	14	193.6 (74.7)	5.3 (1.1)	NA
		OP			120.1 (27.5)	9.3 (2.1)	
Vemulakonda VM	2008	LP	NA	NA	NA	2.68 (2.59)	NA
		OP			NA	2.58 (2.44)	
Ravish IR	2007	LP	Retro	15	214 (32.26)	6.4 (2.84)	NA
		OP			159 (21.39)	9.06 (2.96)	
Piaggio LA	2007	LP	Trans	37	278 (156-413)	2.4 (1-5)	0
		OP			144 (78-230)	2.5 (1-9)	
Bonnard A	2005	LP	Retro	20	218.6 (140-310)	2.4 (1-5)	2
		OP			95.6 (50-150)	5 (3-7)	

Abbreviations: LP, laparoscopic pyeloplasty; OP, open pyeloplasty; SD, standard deviation; NA, not available; Trans, transperitoneal; Retro, retroperitoneal. *: Refers to mean and 95% confidence interval.

Results

Characteristics of included studies

290 publications from all above database were retrieved after removing duplicates. Among these studies, 37 studies were finally leaved behind for full-text assessment. Detailed steps of literature search were shown in **Figure 1**. After excluded 21 studies due to different reasons, 16 studies including one RCT [2], eight retrospective studies [5, 8, 9, 12-16], three prospective studies [6, 17, 18] and four studies from database [1, 4, 18, 19] were included in the meta-analysis. No additional studies identified from the reference lists. Among these 16 studies, five [1, 4, 7, 8, 19] did not mention the approaches of LP and five another studies [13, 14, 16-18] including 114 children carried out LP by retroperitoneal approaches. The remaining six studies [2, 5, 6, 9, 12, 15] including 191 children chose the transperitoneal approaches. The detailed characteristics of included studies were presented in **Tables 1**-**3**.

Table 3. Summary data of postoperative complications of laparoscopic and open pyeloplasty in children

Author	Year	procedures	1	2	3	4	5	6	7	8	9	10	Overall	Follow up times	Success rate%
Varda BK	2014	LP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	47	NA	NA
		OP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	717	NA	NA
Liu DB	2014	LP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		OP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Garcı´a-Aparicio L	2014	LP	0	0	0	0	0	0	0	0	0	0	0	NA	100%
		OP	0	0	0	0	0	0	0	0	0	0	0	NA	100%
van der Toorn F	2013	LP	0	0	0	0	1	0	0	0	2	2	5	More than 12	98%
		OP	0	0	0	0	0	0	0	0	1	2	3	More than 72	95%
Knoedler J	2013	LP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	NA
		OP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	161	NA	NA
Herndon CD	2013	LP	0	0	0	0	0	0	0	0	0	2	2	More than 6	96%
		OP	0	0	0	0	3	0	0	4	0	0	7	More than 6	96%
Polok M	2011	LP	0	0	0	0	1	0	0	0	1 (2)	1	3 (4)	30 (12-70)	83.5%
		OP	0	0	0	0	2	0	0	0	1	1	4	30 (12-70)	95.5%
Penn HA	2010	LP	0	0	0	0	0	0	0	0	0	0	0	8.1 (1-18)	100%
		OP	0	0	0	0	0	0	0	0	0	0	0	11.1 (4.4-32)	95%
Braga LH	2010	LP	2	0	0	0	2	0	0	0	0	0	4	28	95%
		OP	1	0	2	0	1	0	0	0	0	0	4	48	95.5%
Tong Q	2009	LP	1	0	0	0	1	0	0	0	0	1	3	19 (6-36)	95.7%
		OP	1	0	0	0	0	0	1	0	0	1	3	24 (12-48)	95.2%
Valla JS	2009	LP	6	0	0	1	1	0	0	0	0	5	13	25 (9-80)	97%
		OP	3	0	0	1	1	0	1	0	0	6	12	3.8 (9-98)	96%
Wang L	2009	LP	1	0	0	0	0	0	1	0	1	0	3	12	100%
		OP	1	0	0	0	0	0	0	0	1	0	2	12	100%
Vemulakonda VM	2008	LP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		OP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ravish IR	2007	LP	2	0	0	0	1	0	0	0	0	0	3	23 (13-36)	93.4%
		OP	0	0	0	0	1	0	2	0	0	0	3	24 (18-34)	100%
Piaggio LA	2007	LP	1	0	0	0	1	2	0	0	0	1	5	6.3 (1-24)	97%
		OP	4	0	0	0	3	2	1	0	0	2	10	24 (3-48)	83%
Bonnard A	2005	LP	2	0	0	0	1	0	0	0	0	0	3	24 (12-60)	96%
		OP	2	0	0	0	3	0	0	0	0	0	5	21 (12-51)	100%

Abbreviations: LP, laparoscopic pyeloplasty; OP, open pyeloplasty; NA, not available. 1. Urinary leakage, 2. Urinary retention, 3. Worsening of hydronephrosis, 4. Stenosis infection, 5. Urinary tract infection, 6. Bleeding, 7. Wound infection, 8. Urinoma, 9. Symptomatic restenosis, 10. Other.

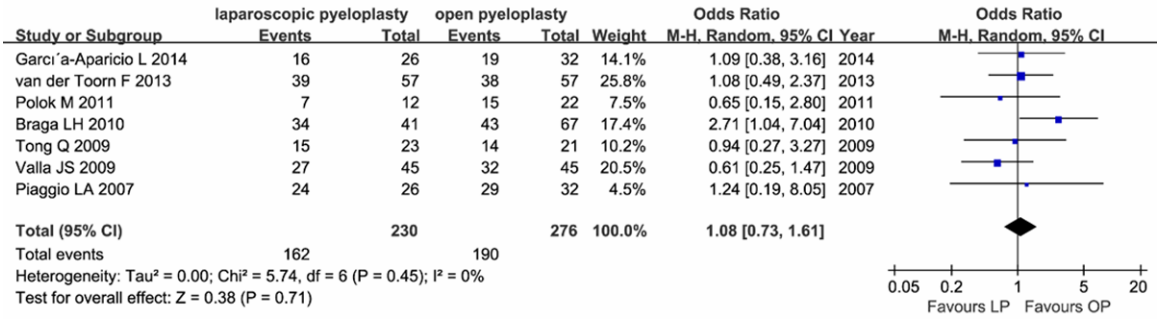

Figure 2. Forest plot and meta-analysis of side of UPJ obstruction in children.

Baseline of included studies

16 studies including 2262 LP cases and 20455 OP cases were eligible and included in this meta-analysis. Meta-analyses of baseline data revealed that children in LP groups were older than in OP (WMD: 26.65, 95% CI: -13.90-67.20), but did not reach statistically significant

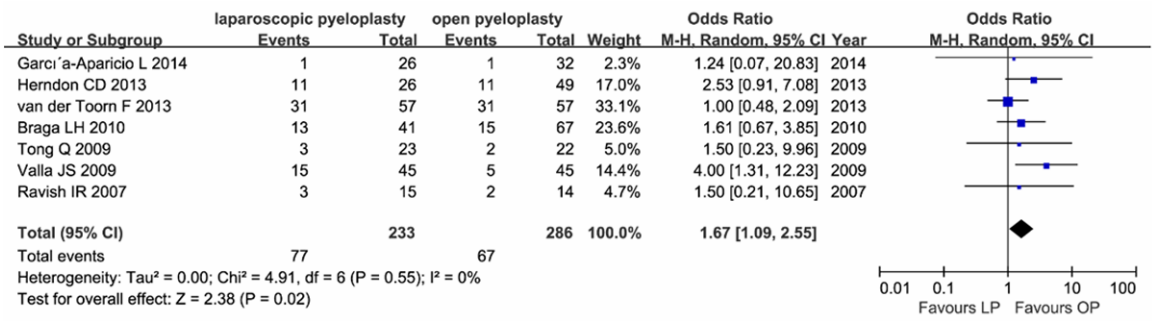

Figure 3. Forest plot and meta-analysis of crossing vessel in children with UPJ obstruction.

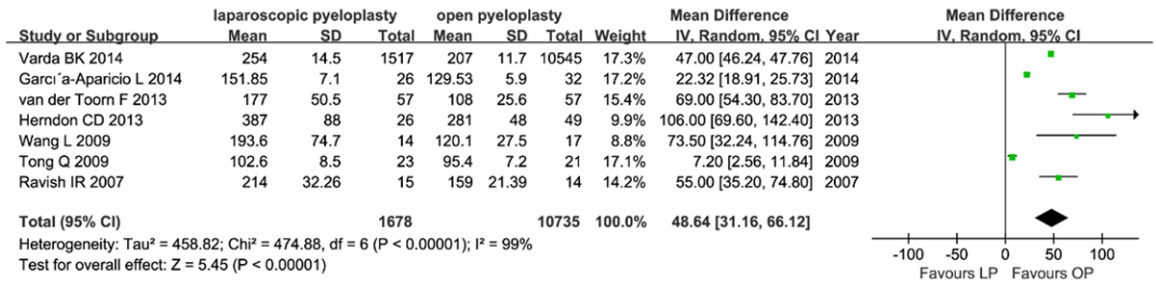

Figure 4. Forest plot and meta-analysis of operative time comparing LP and OP in children with UPJ obstruction.

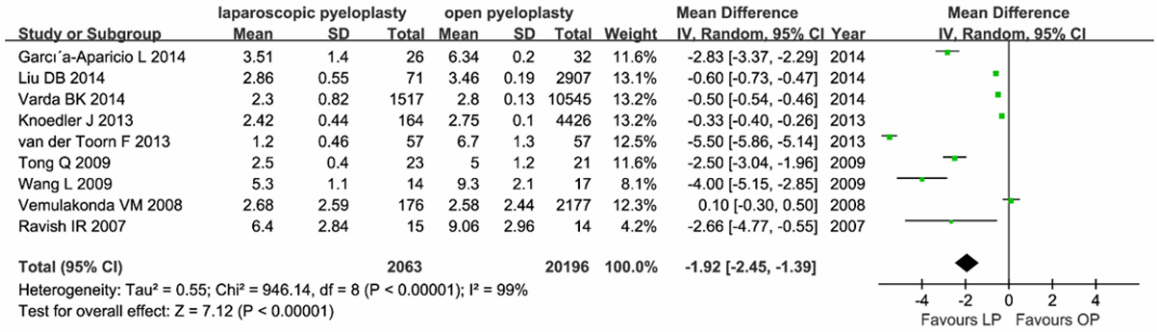

Figure 5. Forest plot and meta-analysis of length of hospital stay comparing LP and OP in children with UPJ obstruction.

differences (P = 0.20). Besides, there were not any significant differences of gender and tumor side between these two groups (OR: 1.03, 95% CI: 0.85-1.24; OR: 1.08, 95% CI: 0.73-1.61, **Figure 2**, respectively), and there was no evidence of heterogeneities (I^2: 0%, P: 0.72; I^2: 0%, P: 0.45, respectively). However, when it comes to crossing vessel, children in LP groups appeared to have more crossing vessel than in OP groups (OR: 1.67, 95% CI: 1.09-2.55, **Figure 3**).

Operative time

Among 16 included studies, three studies [1, 7, 19] did not report this outcome and six studies [2, 9, 12, 14-16] reported mean or mean plus range, which were hard to pool with the remaining seven studies [4-6, 8, 13, 17, 18] with adequate data. Meta-analysis of the seven studies [4-6, 8, 13, 17, 18] revealed that pyeloplasty through laparoscopic approach might take more time than through open approach (WMD:

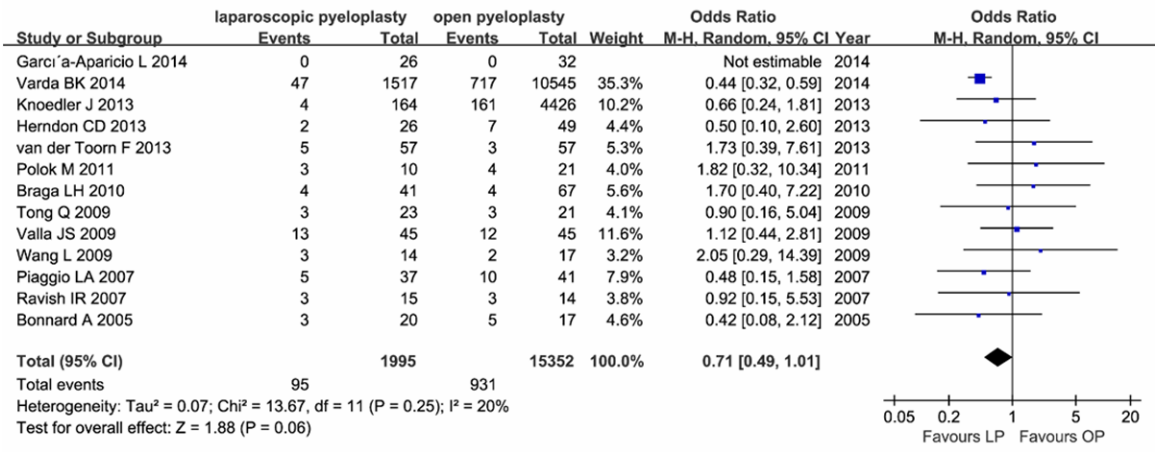

Figure 6. Forest plot and meta-analysis of overall complication comparing LP and OP in children with UPJ obstruction.

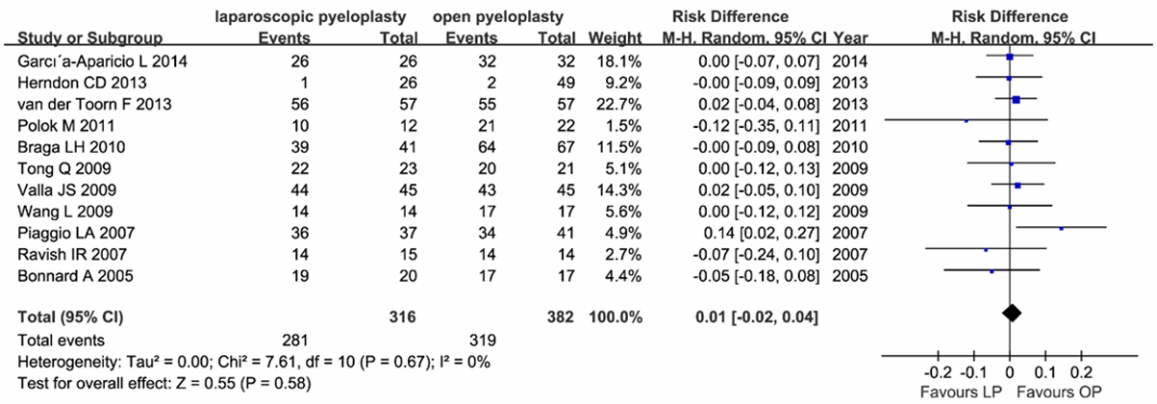

Figure 7. Forest plot and meta-analysis of success rate comparing LP and OP in children with UPJ obstruction.

48.64, 95% CI: 31.16-66.12). However, the estimated data were with unacceptable statistical heterogeneity (I = 99%, **Figure 4**). Hence, sensitivity analyses were carried out to evaluate if it was influence by the individual study. But we did not find any study excluded could dismember the huge heterogeneity.

Length of stay

All the included studies provided length of stay. But only nine [1, 5-7, 13, 17-19] of which reported it as mean and SD. Pooled data of these studies showed that children in LP groups may have less hospital stay time than in OP groups (WMD: -1.92, 95% CI: -2.45--1.39, **Figure 5**). Length of hospital stay time of LP was significantly shorter by 1.92 days. However, the heterogeneity could not be ignored (I^2: 99%, P < 0.00001). And there is no individual study accounting for the enormous heterogeneity.

Overall complications

As to complications, 14 studies [2, 4-9, 12-18] reported overall complications and 12 studies reported detailed complications. Among the nine considered complications, the top two complications in both groups were urinary leakages (27 cases; LP: 15 cases, OP: 12 cases) and urinary tract infection (23 cases; LP: 9 cases, OP: 14 cases). The detailed complications was displayed in **Table 3**. Overall, children in LP groups had 95 complications, account for 4.76%; while children in OP groups had 931 complications, account for 6.06%. Meta-analysis of 14 studies [2, 4-9, 12-18] which reported overall complications revealed that people might have less complication in LP groups than in OP groups (OR: 0.71, 95% CI: 0.49-1.01; I^2: 20%, **Figure 6**). Though it showed a margin significant difference, it turned to be significant when we using RD as estimated

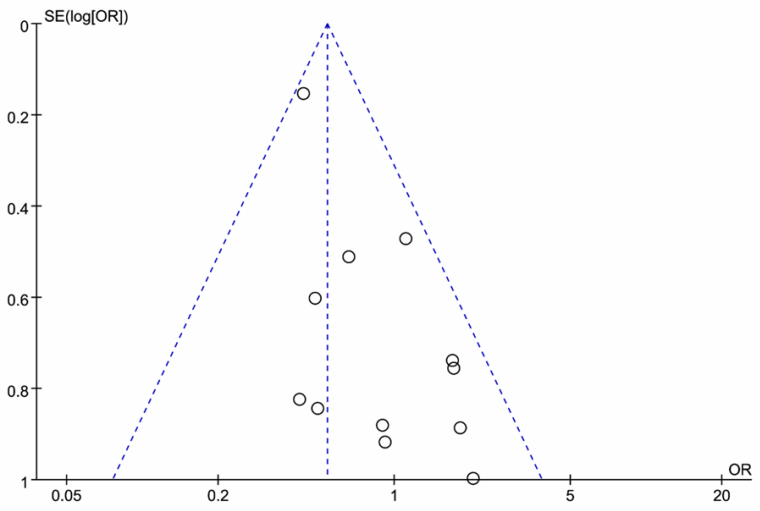

Figure 8. Funnel plot of overall complication comparing LP and OP in children with UPJ obstruction.

parameter (RD: -0.03, 95% CI: -0.04--0.02, P < 0.00001). Besides, the heterogeneity became weaker (I^2: 0%, P: 0.46). That maybe due to add of one study [5], in which both groups had no complication.

Success rate

Except one RCT [2], there are 11 studies [5, 6, 8, 9, 12-17, 20] measured success rate. In LP groups, success rate was range from 83.5% to 100%; while in OP groups, success rate was range from 83% to 100%. Pooled data of these 11 studies showed that there was no statistically significant difference between this two groups (RD: 0.01, 95% CI: -0.02-0.04, **Figure 7**), which was without any evidence of heterogeneity (I^2: 0%). Besides, pooled OR from nine studies of which showed a similar insignificant results (OR: 1.17, 95% CI: 0.51-2.65; I^2: 0%, P: 0.65).

Publication bias

We didn't find any possible publication bias among comparisons between LP groups and OP groups. Hence, we only showed one funnel plot of overall complications (**Figure 8**).

Discussion

The findings of the present meta-analysis showed that children in LP groups may benefit from shortened length of hospital stay and reduced overall complications, though the LP groups are with prolonged operative time. Besides, the success rate of LP is similar to OP. Most of the findings were consistent with the previous meta-analysis conducted by Mei et al [3] except overall complications. In the previous meta-analysis, pooled estimated data revealed that overall complications in LP groups were not significantly different from those of the OP groups (OR: 0.78, 95% CI: 0.46-1.34). But in this meta-analysis, a significant association was reported between this two groups (OR: 0.71, 95% CI: 0.49-1.01; RD: -0.03, 95% CI: -0.04--0.02).That mainly thanks to the expansion of sample size and the shrink of confidence interval.

As to baseline information, children who underwent LP might older than children who underwent OP (WMD: 26.65), which mainly because the selection of pyeloplasty approach is mostly based on surgeons' discretion and experience. Since children in little age (less than 2 years) recover quickly from open surgery and laparoscopic surgery in this group is difficult to perform. Consequently, some authors chose not to perform LP in children younger than one year [2, 17, 21-23] and some of them even do not perform LP in children less than two years old [24] or three years old [25]. From **Table 1**, we may easily find the different mean ages between these two groups. Only two authors [5, 13] carried out the comparison of LP and OP in infant (less than one year), which showed a comparative outcomes in LP groups to other studies. With the development of laparoscopic technology, we believed that more children less than one year will become the candidate for LP in experienced hands. As to aberrant crossing vessel, LP groups appeared to have more patients with crossing vessel than OP groups (OR: 1.67, 95% CI: 1.09-2.55). The difference of these two parameters may potentially influent the comparison of the two groups.

Meta-analysis of seven included studies showed that LP might take more time in surgery than LP. But the heterogeneity is enormous. LP

in most of the studies took 2.5 hours to 3.5 hours. But in study reported by Tong et al [13], laparoscopic surgery took 80 minutes to 120 minutes. While in study reported by Piaggio et al [15], laparoscopic surgery lasted for 156 minutes to 413 minutes. Maybe the surgical experience or the learning curve of different centers account for the significant heterogeneity. Mei et al [3] performed a linear regression analysis and demonstrated that laparoscopic operative time may have inverse association with surgeon experience. The learning curve was significant in the study reported by Bonnard et al [16]. The mean operative time was decreased from four to three hours and two patients were transferred to open surgery at the beginning of their experience. In some sense, complication rate, length of hospital stay and success rate might be also influenced by surgeon experience. As to success rate, meta-analysis of this outcome did not find any different between these two groups (P = 0.58). Most of the studies defined it as resolution of symptoms and decreased hydronephrosis and/or improved renographic drainage. Garcı´a-Aparicio et al [5] considered a procedure successful if RUS demonstrates a decrease in hydronephrosis. But still there are two studies conducted by Vemulakonda et al [19] and Polok et al [9], which did not clearly describe the definition. The lack of definition of "success" and different follow-up times might potentially influence the comparison of success rate, but the results were consistent with the RCT conducted by Penn et. al [2].

There are several limitations which should be taken into account. Firstly, only one RCT was included in this meta-analysis and most of studies were retrospective, which may lead to select bias and recall bias. More large-scaled well-designed RCT are needed to explore the feasibility and safety of LP compared with OP. Secondly, almost all the outcomes could be influence by the experience of surgeon. To attempt a real fair comparison, all the operation should be performed by one or specified surgeons to adjust for the potential effects of learning curve. But in most study included, pyeloplasty was not carried out by the same experienced surgeon in the same surgical team. This may bias our results in a certain degree.

Conclusion

Our findings of this meta-analysis revealed that LP groups were with less length of hospital stay and lower complication rate than OP groups. Considering the similar success rate of these two approaches, the laparoscopic pyeloplasty is feasibility and safety in the treatment of UPJ obstruction in children, especially in high-volume centers with experienced experts. Considering the select bias and recall bias, more RCTs are required to further explore the efficiencies of LP.

Acknowledgements

Yidong Huang was responsible for the initial planning, data collection, statistical analysis and for conducting the study. Yang Wu, Wei Shan, Li Zeng and Lugang Huang contributed to data collection, data extraction, data interpretation, and manuscript drafting. Yidong Huang was the guarantor for this paper and has full responsibility for this study.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Yidong Huang, Department of Pediatric Surgery, West China Hospital of Sichuan University, Chengdu 610041, Sichuan, P. R. China. Tel: (86) 13981821819; E-mail: adamshyd@126.com

References

[1] Liu DB, Ellimoottil C, Flum AS, Casey JT and Gong EM. Contemporary national comparison of open, laparoscopic, and robotic-assisted laparoscopic pediatric pyeloplasty. J Pediatr Urol 2014; 10: 610-5.

[2] Penn HA, Gatti JM, Hoestje SM, DeMarco RT, Snyder CL and Murphy JP. Laparoscopic versus open pyeloplasty in children: preliminary report of a prospective randomized trial. J Urol 2010; 184: 690-695.

[3] Mei H, Pu J, Yang C, Zhang H, Zheng L and Tong Q. Laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in children: a systematic review and meta-analysis. J Endourol 2011; 25: 727-736.

[4] Varda BK, Johnson EK, Clark C, Chung BI, Nelson CP and Chang SL. National trends of perioperative outcomes and costs for open, laparoscopic and robotic pediatric pyeloplasty. J Urol 2014; 191: 1090-1095.

[5] Garcia-Aparicio L, Blazquez-Gomez E, Martin O, Manzanares A, Garcia-Smith N, Bejarano M, Rodo J and Ribo JM. Anderson-hynes pyeloplasty in patients less than 12 months old. Is the laparoscopic approach safe and feasible? J Endourol 2014; 28: 906-908.

[6] van der Toorn F, van den Hoek J, Wolffenbuttel KP and Scheepe JR. Laparoscopic transperitoneal pyeloplasty in children from age of 3 years: our clinical outcomes compared with open surgery. J Pediatr Urol 2013; 9: 161-168.

[7] Knoedler J, Han L, Granberg C, Kramer S, Chow G, Gettman M, Kimball B, Moriarty J, Kim S and Husmann D. Population-based comparison of laparoscopic and open pyeloplasty in paediatric pelvi-ureteric junction obstruction. BJU Int 2013; 111: 1141-1147.

[8] Herndon CD, Herbst K and Smith C. The transition from open to laparoscopic pediatric pyeloplasty: a single-surgeon experience. J Pediatr Urol 2013; 9: 409-414.

[9] Polok M, Chrzan R, Veenboer P, Beyerlein S, Dik P, Klijn A, Kuijper C and de Jong T. Nondismembered pyeloplasty in a pediatric population: results of 34 open and laparoscopic procedures. Urology 2011; 78: 891-894.

[10] Moher D, Liberati A, Tetzlaff J and Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. Open Med 2009; 3: e123-130.

[11] Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA and Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. JAMA 2000; 283: 2008-2012.

[12] Braga LH, Pace K, DeMaria J and Lorenzo AJ. Systematic review and meta-analysis of robotic-assisted versus conventional laparoscopic pyeloplasty for patients with ureteropelvic junction obstruction: effect on operative time, length of hospital stay, postoperative complications, and success rate. Eur Urol 2009; 56: 848-857.

[13] Tong Q, Zheng L, Tang S, Zeng F, Du Z, Mei H, Wu Z, Pu J and Ruan Q. Comparison of laparoscopic-assisted versus open dismembered pyeloplasty for ureteropelvic junction obstruction in infants: intermediate results. Urology 2009; 74: 889-893.

[14] Valla JS, Breaud J, Griffin SJ, Sautot-Vial N, Beretta F, Guana R, Gelas T, Carpentier X, Leculee R and Steyaert H. Retroperitoneoscopic vs open dismembered pyeloplasty for ureteropelvic junction obstruction in children. J Pediatr Urol 2009; 5: 368-373.

[15] Piaggio LA, Franc-Guimond J, Noh PH, Wehry M, Figueroa TE, Barthold J and Gonzalez R. Transperitoneal laparoscopic pyeloplasty for primary repair of ureteropelvic junction obstruction in infants and children: comparison with open surgery. J Urol 2007; 178: 1579-1583.

[16] Bonnard A, Fouquet V, Carricaburu E, Aigrain Y and El-Ghoneimi A. Retroperitoneal laparoscopic versus open pyeloplasty in children. J Urol 2005; 173: 1710-1713; discussion 1713.

[17] Ravish IR, Nerli RB, Reddy MN and Amarkhed SS. Laparoscopic pyeloplasty compared with open pyeloplasty in children. J Endourol 2007; 21: 897-902.

[18] Wang X, Zhang Z, Peng N and Liu C. Retroperitoneal laparoscopic versus open dismembered pyeloplasty for ureteropelvic junction obstruction. J Xray Sci Technol 2013; 21: 429-439.

[19] Vemulakonda VM, Cowan CA, Lendvay TS, Joyner BD and Grady RW. Surgical management of congenital ureteropelvic junction obstruction: a Pediatric Health Information System database study. J Urol 2008; 180: 1689-1692; discussion 1692.

[20] Wang L, Qin W, Tian F, Zhang G, Yuan J and Wang H. Cytokine responses following laparoscopic or open pyeloplasty in children. Surg Endosc 2009; 23: 544-549.

[21] Olsen LH, Rawashdeh YF and Jorgensen TM. Pediatric robot assisted retroperitoneoscopic pyeloplasty: a 5-year experience. J Urol 2007; 178: 2137-2141; discussion 2141.

[22] Lam PN, Wong C, Mulholland TL, Campbell JB and Kropp BP. Pediatric laparoscopic pyeloplasty: 4-year experience. J Endourol 2007; 21: 1467-1471.

[23] Sedlacek J, Kocvara R, Molcan J, Dite Z and Dvoracek J. Transmesocolic laparoscopic pyeloplasty in children: a standard approach for the left-side repair. J Pediatr Urol 2010; 6: 171-177.

[24] Singh H, Ganpule A, Malhotra V, Manohar T, Muthu V and Desai M. Transperitoneal laparoscopic pyeloplasty in children. J Endourol 2007; 21: 1461-1466.

[25] Yu J, Wu Z, Xu Y, Li Z, Wang J, Qi F and Chen X. Retroperitoneal laparoscopic dismembered pyeloplasty with a novel technique of JJ stenting in children. BJU Int 2011; 108: 756-759.