Redo laparoscopic pyeloplasty among children: A systematic review and meta-analysis

Hamdan Hammad Alhazmi
Department of Surgery, Division of Urology, College of Medicine and King Saud University Medical City, King Saud University, Riyadh, Kingdom of Saudi Arabia

Abstract
Laparoscopic pyeloplasty (LP) is more beneficial than open procedures. However, studies on laparoscopic management of cases with secondary ureteropelvic junction obstruction (SUPJO) after previous failed pyeloplasty in the pediatric population are lacking. This meta-analysis aimed to assess the difference between redo LP (RLP) and redo open pyeloplasty (ROP) for children with SUPJO, focusing on certain criteria. All recent studies on RLP and ROP in children with SUPJO were searched. Search engines such as Medline, PubMed, and The Cochrane Library of Systematic Reviews were used. Sixty citations were specified. Two reviewers extracted data independently, screened the titles, and assessed the quality of each citation. Continuous data reported as a weighted mean difference (WMD) (95% confidence interval) and dichotomous data reported as relative risk were used. We measured the length of hospital stay (LOS) and operative time using weighted mean and success and complication rates using risk difference and odds ratio (OR). A random effects model was used to pool OR that was tested for heterogeneity. We specified six publications that minutely met our eligibility standards. Meta-analysis of given data resulted in the following: ROP showed reduction in operative time by 12 min (WMD: 12.7 min; \( P = 0.14 \)). RLP had shorter LOS than ROP (WMD: 0.6 days; \( P < 0.01 \)). No difference was observed in complication and success rates (OR: 0.8; \( P = 0.50 \) and OR: 1.2; \( P = 0.51 \), respectively). In conclusion, RLP seems to be better than ROP in terms of LOS reduction; however, both are comparable with respect to success and complication rates, especially postoperative urine leakage.

Keywords: Complication, failed pyeloplasty, laparoscopy, outcome, ureteropelvic junction obstruction

INTRODUCTION
Secondary ureteropelvic junction obstruction (SUPJO) can be treated safely and successfully by laparoscopic pyeloplasty (LP) in all age groups.[1] Open Pyeloplasty (OP) in many institutes was the gold standard till the emergence of laparoscopic approach.[2] Advantages of laparoscopy include short length of hospital stay (LOS), less pain, fast recovery, and better cosmetic appearance. However, it is only performed in experienced centers with high patient flow.[3] LP has improved some complications and overcome limitations of OP.[4,5] Several studies proved the superiority of laparoscopy versus the open approach.[6] However, studies comparing laparoscopy and OP in the field of pyeloplasty,
especially in children with SUPJO, are very limited. Some studies showed that LP has the superiority, while other studies showed no extra benefits.\textsuperscript{[7,8]} There are limited data that substantially uphold one type over the other. This meta-analysis study aimed to assess the feasibility and effectiveness of redo LP (RLP) versus that of redo open pyeloplasty (ROP) in children with SUPJO, in terms of operative time, LOS, success rate, and postoperative complications (urine leakage) and to evaluate the quality of proof in the literature and provide accurate clinical information.

**METHODS**

We used three ways to identify relevant studies: (1) search in electronic database, (2) experts’ opinion, and (3) article reviews from those that accomplished our eligibility standards. The following search engines were used in this study: Medline, PubMed, and The Cochrane Library of Systematic Reviews. All chosen articles were then filtered according to the Medical Subject Heading terms to retrieve information that may use different terminologies for the same concepts and to find articles indexed more narrowly. All possible combinations were considered. The study design has been approved by our institutional review board.

A search regimen for every database was designed and executed by a librarian; all search terms and eligible citations were tested. Latin American and Caribbean Health Sciences Literature, Scientific Electronic Library Online, and Excerpta Medica Database were all included in our search. Sixty citations were identified. Two researchers checked the abstracts and titles independently and chose the most relevant articles for in-depth review using our selection standards that presuppose selection of any article comparing RLP with ROP in children with SUPJO.

After the process of selection and review, six studies were used\textsuperscript{[9-14]} [Figure 1], with 97% approval among reviewers. Any disagreement was resolved by unanimity between reviewers. According to the absence of randomized controlled trials, all observational studies that met our selection and eligibility criteria were included.

Our selection criteria were confined to the pediatric population and comparisons between OP and LP for cases with failed primary open pyeloplasty. Two references were excluded from the analysis\textsuperscript{[1,2]} due to (1) mean patient age of 35.0 (range 9–77) years and 29.8 (range 5–65) years and (2) the number of shared children not being mentioned.

The main issue assessed was success rates. In addition, the focus was on study designs and methodologies, concentrating on demographics, sample size and sampling methods, and techniques of pyeloplasty. We tried to overcome any potential confounders in the analysis such as matching of surgeon experience as far as possible [Table 1].

The Newcastle–Ottawa Scale was employed for assessing the quality of nonrandomized studies in meta-analyses.\textsuperscript{[15]} The quality of methodology was categorized as high (score 5–7) and low methodological quality (score <5). Applicability, comparability, and selection of groups as well as outcome evaluation and follow-up adequacy were all independently assessed and scored by two specialists [Table 2]. The percentage of consensus and agreement among reviewers was almost 97%.

The success after the procedure was measured by the absence of obstruction in the radiological investigations during follow-up. Moreover, success could be defined as disappearance of symptoms, amelioration of hydronephrosis on ultrasound, improvement of the renal functions, and disappearance of proteinuria.
### RESULTS

Six publications met our selection standards. All of them were full-text papers. None of our selected articles was a review article; otherwise, it would have been subsequently excluded because it would not provide extra information.

#### Study characteristics

Table 1 presents the study characteristics and methodology for the six observational studies included in the meta-analysis. Of these, none used a prospective design, but all of them used a retrospective design. Of the six retrospective studies, two used prospectively collected data, two from North America, two from Egypt, one from India, and one from Brazil. One publication reported matching numbers of patient groups for age and surgical procedure, and all of them were based on a single-surgeon experience. All publications reported on similar outcomes with regard to operative time, complications, LOS, and success rates. Information was available for all six studies apart from some minute data obtained by directly contacting the authors.

#### Operative time

Of the six studies that assessed operative time, two showed similar operative time for RLP and ROP, two indicated that OP time was shorter than RLP time (with an insignificant difference in one study), and two revealed that RLP operative time was insignificantly shorter than OP time. The meta-analysis of six studies showed that ROP was associated with a 12-min reduction of operative time (random effects model; WMD: 12.7 min; 95% confidence interval [CI] 24.6–3; P = 0.14). Results for heterogeneity and overall effect were as follows: test for heterogeneity: \( \chi^2 = 29.2, \text{df} = 4 (P <0.0001), F = 88.4\% \); test for overall effect: \( Z = 0.66 (P = 0.69) \), as shown in Figure 2.

#### Length of hospital stay

Of the six studies that analyzed the LOS, four reported that RLP was associated with a shorter hospital stay, while two showed no difference between the two approaches. The meta-analysis of extractable data
from all studies demonstrated a significantly shorter hospital stay after RLP than after ROP (random effects model; WMD: 0.6 days; 95% CI: 0.6–0.4; \( P < 0.01 \)), subtotal (95% CI), and WMD = −0.49 (−0.57, −0.41), test for heterogeneity: \( \chi^2 = 8.00, \text{df} = 3 (P < 0.01), F = 47.8\% \), test for overall effect: \( Z = 18.36 (P = 0.004) \), as shown in Figure 3.

Complication rate

Of the six studies that appraised complication rate, three had similar complication rates for both procedures.\(^{[11,13,14]} \) Three showed slightly higher complication rates after ROP,\(^{[9,10,12]} \) and no study reported more complications following RLP; all differences were statistically significant. The meta-analysis of these six studies showed that both procedures had similar complication rates (random effects model, OR: 0.8; 95% CI: 0.3–1.6; \( P = 0.50 \)), total events: 11 laparoscopic, 13 open pyeloplasty, test for heterogeneity: \( \chi^2 = 4.05, \text{df} = 8 (P < 0.91), F = 0\% \), test for overall effect: \( Z = 0.76 (P = 0.50) \), as shown in Figure 4.

Success rate

Of the six studies that evaluated this outcome, three revealed a 100% success rate for both approaches,\(^{[10,11,14]} \) two showed higher success rates with RLP than with ROP (100% vs. 97% and 99% vs. 97%),\(^{[9,13]} \) and one had a better success rate with ROP than with RLP (100% vs. 97%).\(^{[12]} \) The meta-analysis of these six studies demonstrated equivalent success rates for both procedures (random effects model, OR: 1.2; 95% CI: 0.5–3.5; \( P = 0.51 \)), total events: 88 laparoscopic, 153 open pyeloplasty, test for heterogeneity: \( \chi^2 = 2.25, \text{df} = 7 (P < 0.84), F = 0\% \), test for overall effect: \( Z = 0.56 (P = 0.79) \), as shown in Figure 5.

**DISCUSSION**

We compared RLP with ROP in our systematic review using six observational studies.\(^{[9-14]} \) Patients were selected meticulously according to the quality standards in these studies. Measurement of outcome and follow-up appropriateness were also considered. RLP has no advantage over ROP regarding operative time, especially when a random effects model was used in our pooled tests. When we considered the heterogeneity among researches, the analysis became more conservative.

The operative time was quite short in ROP when compared with RLP among centers with unpretentious experience in LP.\(^{[9,12]} \) This observation proposes that ROP may be beneficial to centers with low LP experience because it may lengthen the learning curve of LP.
However, we should interpret this estimate cautiously because meta-analysis of six studies shows that ROP was associated with only a 12-min reduction of operative time.

Laparoscopy is somewhat challenging among the pediatric population due to the lack of space and difficult hardware installment.\[14\] For this reason, RLP requires more operative time than ROP. We speculate that the ROP operative time was quite short due to relative low mean age of children in our studies. Such ages provide diminished space for articulation of the laparoscope.

In addition, the difference between experiences of surgeons might be a causative factor influencing the operative time. This difference may be due to smaller caseload and case volume among surgeons dealing with children.\[17\]

A significantly short LOS was observed using a random effects model for RLP when compared with that for ROP. Recent articles showed early patient discharge, and a trend was observed for this. This trend may be due to the modern tendency of hospitals to reduce charges and costs and minimize patient stay by any means.\[18,19\] Early discharge was not observed in a series of four studies.\[12,14\]

As a real effect on LOS, RLP may not have a true effect on LOS when compared with ROP due to the underlying reason of the modern direction of hospitals that tends to minimize the length of hospital stay. The difference observed (0.6 days reduction) had a very restricted clinical rapport even if it was due to the type of procedure performed.

LP tries to imitate open pyeloplasty; however, experts refer to potential advantages with the laparoscope. The complication and success rates in both RLP and ROP appear to be equivalent, and this is not surprising. Therefore, it is necessary to mention that the follow-up duration was not too long to detect late failures.\[20\] Moreover, this was demonstrated in studies of ROP with long-term follow-up periods.\[21\] Several different methods are available to measure success for these minimally invasive procedures. Thus, it will be difficult, premature, and problematic to form a judgment to define success and success rates. Success could be assessed by pain relief and improvements in renal scan results and hydronephrosis. In our selected studies, stability or improvement in scintigraphy or ultrasound after pyeloplasty is considered as a way to measure success, due to poor reporting of outcomes.

To the best of our knowledge, this study is the first meta-analysis on RLP in the pediatric population. It is imperative to evaluate new modality outcomes

**Figure 4:** Pooled estimate of complication rate using a random effect model. CI: Confidence interval, WMD: Weighted mean difference

**Figure 5:** Pooled estimate of success rate using a random effect model. CI: Confidence interval, WMD: Weighted mean difference
and compare them with conventional ones before implementation of this new technology on patients. Multiple designs were undertaken for identification of studies, including three ways to identify relevant studies. Therefore, we expect to have included most of the studies related to our topic.

The process of selection itself helped to reduce perplexity although our selected studies had small sample sizes. We matched age and surgical practicability and inclusion of single-surgeon experience.

This study has several limitations. Our level of evidence is low due to inability to identify randomized control trials. It is better to find a randomized control trial comparing two surgical techniques, but it is very rare due to intrinsic limitations related to blinding and randomization. Therefore, we address our question using observational studies as it is the strongest available and feasible option. In addition, all potential biases in selected studies were transferred to our report.

We tried our best to contact authors to access primary data; however, only published data were used in performance of this review. In addition, keeping in mind that all studies have their methodological limitations is important.[22] Nonetheless, we can still deduce useful information upon analysis of these observational studies as long as we eliminate any confounding factors.

By data explorations, we could easily recognize reasonable explanations for differences observed in results among selected studies, through meta-analysis and systemic reviews. In the absence of unexplained homogeneity, while the findings associated with the combined estimates are weaker, these estimates provide the best estimate of the mean effect and thus constitute beneficial information for surgeons facing the challenge of making a decision based on the restricted evidence available.

Cost issues are a very important point to be further discussed in the future because this may reveal decisive differences between both procedures. We did not discuss this issue because it is related to the surgeon and his/her daily practice decisions.

CONCLUSIONS

RLP and ROP seem to be equipollent with regard to success rates and postoperative complication rates. The rating of the effect of treatment on operation time supplied by the random effects model does not support or recommend one method over the other. However, RLP showed significantly shorter LOS than ROP.

Acknowledgment

I would like to thank the following people who helped me in this meta-analysis: Mr. Ayman Emad; a librarian who establish the test search terms; Mr. Ahmed Mamdouh and Mr. Mohamed Esam for assessing the results and scoring; and Mrs. Nahla Naser and Dr. Ahmad Almalky who checked researches independently and held in-depth review filtering eligibility criteria.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Basir A, Behjati S, Zand S, Moghaddam SM. Laparoscopic pyeloplasty in secondary ureteropelvic junction obstruction after failed open surgery. J Endourol 2007;21:1045-51.
2. Eden C, Gianduzzo T, Chang C, Thiruchelvam N, Jones A. Extraperitoneal laparoscopic pyeloplasty for primary and secondary ureteropelvic junction obstruction. J Urol 2004;172:2308-11.
3. Nerli RB, Reddy MN, Hiremath MB, Shishir D, Patil SM, Guntaka A, et al. Surgical outcomes of laparoscopic dismembered pyeloplasty in children with giant hydrouretonephrosis secondary to ureteropelvic junction obstruction. J Pediatr Urol 2012;8:401-4.
4. Knoessler J, Han L, Granberg C, Kramer S, Chow G, Getman M, et al. Population-based comparison of laparoscopic and open pyeloplasty in paediatric pelvi-ureteric junction obstruction. BJU Int 2013;111:1141-7.
5. Bansal P, Gupta A, Mongha R, Narayan S, Das RK, Bera M, et al. Laparoscopic versus open pyeloplasty: Comparison of two surgical approaches- a single centre experience of three years. Indian J Surg 2011;73:264-7.
6. Powell C, Gatti JM, Jiang D, Murphy JP. Laparoscopic pyeloplasty for ureteropelvic junction obstruction following open pyeloplasty in children. J Laparoendosc Adv Surg Tech A 2015;25:858-63.
7. Song SH, Lee C, Jung J, Kim SJ, Park S, Park H, et al. A comparative study of pediatric open pyeloplasty, laparoscopy-assisted extracorporeal pyeloplasty, and robot-assisted laparoscopic pyeloplasty. PLoS One 2017;12:e0175026.
8. Piaggio LA, Corbetta JP, Weller S, Dingevan RA, Duran V, Ruiz J, et al. Comparative, prospective, case-control study of open versus laparoscopic pyeloplasty in children with ureteropelvic junction obstruction: Long-term results. Front Pediatr 2017;5:1:10.
9. Hammady A, Elbadawy MS, Rashed EN, Moussa A, Gamal W, Dawood W, et al. Laparoscopic repyeloplasty after failed open repair of ureteropelvic junction obstruction: A case-matched multi-institutional study. Scand J Urol 2017;51:402-6.
10. Abdel-Karim AM, Fahmy A, Moussa A, Rashad H, Elbadawy M, Badawy H, et al. Laparoscopic pyeloplasty versus open pyeloplasty for recurrent ureteropelvic junction obstruction in children. J Pediatr Urol 2016;12:401.e1-401.e6.
11. Piaggio LA, Noh PH, Gonzalez R. Reoperative laparoscopic pyeloplasty in children: Comparison with open surgery. J Urol 2007;177:1878-82.
12. Moscardi PR, Barbosa JA, Andrade HS, Mello MF, Cezarino BN, Oliveira LM, et al. Reoperative laparoscopic ureteropelvic junction obstruction.
obstruction repair in children: Safety and efficacy of the technique. J Urol 2017;197:798-804.
13. Abraham GP, Siddaiah AT, Ramaswami K, George D, Das K. Laparoscopic management of recurrent ureteropelvic junction obstruction following pyeloplasty. Urol Ann 2015;7:183-7.
14. Romao RL, Koyle MA, Pippi Salle JL, Alotay A, Figueroa VH, Lorenzo AJ, et al. Failed pyeloplasty in children: Revisiting the unknown. Urology 2013;82:1145-7.
15. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol 2010;25:603-5.
16. Lam PN, Wong C, Mulholland TL, Campbell JB, Kropp BP. Pediatric laparoscopic pyeloplasty: 4-year experience. J Endourol 2007;21:1467-71.
17. Cook A, Khoury A, Bagli D, McLorie GA, El-Ghoneimi A, Farhat WA, et al. The development of laparoscopic surgical skills in pediatric urologists: Longterm outcome of a mentorship-training model. Can J Urol 2005;12:2824-8.
18. Bonnema J, van Wensch AM, van Geel AN, Pruyn JF, Schmitz PI, Uyl-de Groot CA, et al. Cost of care in a randomised trial of early hospital discharge after surgery for breast cancer. Eur J Cancer 1998;34:2015-20.
19. Caplan G, Board N, Paten A, Tazelaar-Molini J, Crowe P, Yap SJ, et al. Decreasing lengths of stay: The cost to the community. Aust N Z J Surg 1999;69:433-7.
20. Madi R, Roberts WW, Wolf JS Jr. Late failures after laparoscopic pyeloplasty. Urology 2008;71:677-80.
21. Psooy K, Pike JG, Leonard MP. Long-term followup of pediatric dismembered pyeloplasty: How long is long enough? J Urol 2003;169:1809-12.
22. Schünemann HJ, Jaeschke R, Cook DJ, Bria WF, El-Solh AA, Ernst A, et al. An official ATS statement: Grading the quality of evidence and strength of recommendations in ATS guidelines and recommendations. Am J Respir Crit Care Med 2006;174:605-14.