

COMPARISON OF LAPAROSCOPIC VERSUS OPEN PYELOPLASTY FOR URETEROPELVIC JUNCTION OBSTRUCTION IN ADULTS: A SYSTEMATIC REVIEW AND META- ANALYSIS

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Abstract: Introduction: There are several surgical treatment options that are available for the treatment of ureteropelvic junction obstruction (UPJO), however results in the adult population are limited. Objectives: To compare clinical outcomes (complication rate, operative time and hospital days) between the laparoscopic versus open pyeloplasty for UPJO in adults. Methodology: MEDLINE and EMBASE were searched through July 22, 2021 to include randomized and nonrandomized controlled trials comparing outcomes of patients treated by laparoscopic pyeloplasty (LP) and by open procedure (OP) for UPJO. The effect size (ES) of the PL and PA treatments was extracted from each study to calculate the combined measurements for continuous operating time (OT) and hospital (HT) variables. Data were pooled using a random effects model. Results: The literature search resulted in 997 studies and 4 met the inclusion criteria with a total of 279 patients. There was a significant difference in the OT between the groups with a moderate ES favoring the PA (SMD, 1.54; 95%CI: 1.21, 1.86; I2=96.8%; p=0.000) and for the HT favoring a LP (SMD, -0.89; 95%CI: -1.29, -0.50; I2=96.1%; p=0.000). Regarding complications, there was a significant difference between LP and OP favoring LP (OR, 0.50; 95%CI: 0.27, 0.95; I2=00.0%; p=0.923). There was no difference between the LP and OP groups for the success rate. Conclusion: LP resulted in significantly lower percentage of complications and hospitalization time than OP, but it had no significant impact on the success rate and also presented significantly longer operative time. **Keywords:** laparoscopic pyeloplasty, open pyeloplasty, ureteropelvic junction obstruction.

INTRODUCTION

Open pyeloplasty (OP) has been the reference for the surgical treatment of

ureteropelvic junction obstruction (UPJO) with a success rate of 90%, as originally described by Anderson and Hynes¹. This procedure involves making a large flank incision, but carries the risk of pain, postoperative morbidity, and a prolonged post-surgery recovery.² Marcin Polok et al.³ conducted a 14-year randomized controlled trial where common complications included secondary UPJO, pyeloplasty reoperation, and one patient who required repeat intervention for urolithiasis. Schuessler et al.⁴ first described laparoscopic pyeloplasty (LP) in 1993, which soon established itself as a safe and effective technique under experienced laparoscopic hands, with a success rate of 93% to 100%, comparable to the clinical results of open pyeloplasty⁵. The existing literature reports that LP reduced the morbidity rate when compared to open pyeloplasty, with reduced length of stay and less use of narcotics⁶. Therefore, versatility and safety mark LP as the superior treatment modality. Few randomized clinical trials have been performed to compare the clinical outcomes of laparoscopic and open pyeloplasty⁷. Still, they lack comprehensive data on various parameters such as postoperative pain assessment, patient satisfaction, and quality of wound healing.⁶⁻⁸. Therefore, the objective of this literature review was to compare the clinical results (complication rate, operative time and days of hospital stay) between laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in adults.

GOALS

To compare the clinical results (complication rate, operative time and length of stay) between laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in adults.

METHODS

SEARCH STRATEGY

This study follows the recommendations of Enhancing the Quality and Transparency of Health Research, including the Preferred Reporting Items for Systematic Reviews guideline. We performed a literature search in the PubMed-MEDLINE and EMBASE databases, until July 22, 2021. In Appendix 1, we describe the search terms for each of the databases accessed.

INCLUSION AND EXCLUSION CRITERIA

Eligible studies followed the following inclusion criteria: (1) adult human studies; (2) presenting a comparison between laparoscopic (LP) versus open (PA) pyeloplasty for ureteropelvic junction obstruction; (3) success rate assessment (in events per group); complication rate (in events per group); operative time (in minutes) and length of hospital stay (in days); (4) success rate assessment method and (5) randomized clinical trials or comparative studies. Exclusion criteria for this study were: (1) animal studies; (2) case studies, letters to the editor, reviews or meta-analyses; (3) articles related to patient preparation, imaging, preoperative care related to specific clinical situations such as: bilateral ureteropelvic junction obstruction (UPJO), horseshoe kidney UPJO, ectopic kidney UPJO, and coexisting urolithiasis; (4) manuscripts describing only technical notes, specific instrumentation, or pure experimental research; (5) procedures defined as "laparoscopically assisted", in which part of the procedure was performed externalizing the UPJ at skin level; (6) salvage procedures such as ureterocalicostomy or ileal ureter; and (7) studies not published in English.

QUALITY ASSESSMENT OF STUDIES

Two reviewers (RPS and LPS) assessed the quality of all eligible studies using the methodological index for non-randomized studies. (MINORS)⁹. This instrument consists of 12 items that assess the methodological quality of non-randomized surgical studies. Each of these items is scored from 0 to 2, with 0 indicating that the problem was not reported in the evaluated study, 1 corresponding to inadequately reported items, and 2 corresponding to properly reported items⁹.

DATA EXTRACTION

Three reviewers (RPS, LPS, and AD) independently assessed the articles included in this review and performed primary data collection (eg, author, country of recruitment). From each article was extracted: success rate (in events per group); the definition of the success rate of each study; complication rate (in events per group); operative time (in minutes) and length of hospital stay (in days). Any differences were resolved by consensus.

STATISTICAL ANALYSIS

The effect size (ES) (standardized mean difference, SMD) of laparoscopic versus open pyeloplasty was extracted from each study to calculate pooled measurements for continuous variables. The magnitude of the effect for SMD was considered as “small” if equal to 0.2, “moderate” if 0.5 and large if 0.8¹⁰. The odds ratio (OR) was extracted from each study to combine the pooled results for patients treated via laparoscopic pyeloplasty and the open procedure for ureteropelvic junction obstruction.¹¹ Heterogeneity between studies was tested with the Q test¹². The index I² was used to quantify the extent of heterogeneity. Publication bias was estimated using the funnel plot and the Egger and Begg tests.^{13,14} Sensitivity analyzes that excluded each of the individual articles were conducted to

assess whether any specific study significantly influenced the pooled overall results. All P values less than 0.05 were considered statistically significant. All statistical analyzes were performed in Stata v. 15.0 (StataCorp LP, College Station, Texas, USA).

RESULTS

Nine hundred and ninety seven articles were identified for this study and of these 375 were removed for being duplicates. One hundred and ninety-nine articles had their full text reviewed and four studies selected for qualitative analysis (Figure 1).

We present in Table 1 the general characteristics of the studies: author, country of recruitment, number of patients for laparoscopic pyeloplasty and for the open procedure for obstruction of the ureteropelvic junction. The median MINORS score was 18 (interquartile range (IQR), 16-19).

The success rate (in events per group); complication rate (in events per group); operative time (in minutes) and length of hospital stay (in days) are described in Tables 2 and 3.

SUCCESS RATE

All studies were included in the analysis of the success rate between laparoscopic versus open pyeloplasty¹⁵⁻¹⁸ (Figure 2A). The four studies did not show significant differences between the success rate between LP and PA¹⁵⁻¹⁸. Pooled analyzes failed to demonstrate any difference between the LP and PA groups (OR, 0.95; 95%CI: 0.67, 1.35; I²=00.0%; p=0.993). However, it must be noted that the classification of success established by each study is different. Klingler et al. 2003¹⁵ considered as complete success absence of any clinical symptoms combined with significant reduction of hydronephrosis on renal ultrasound and intravenous pyelogram (IVP) and no signs of obstruction on IVP and/or

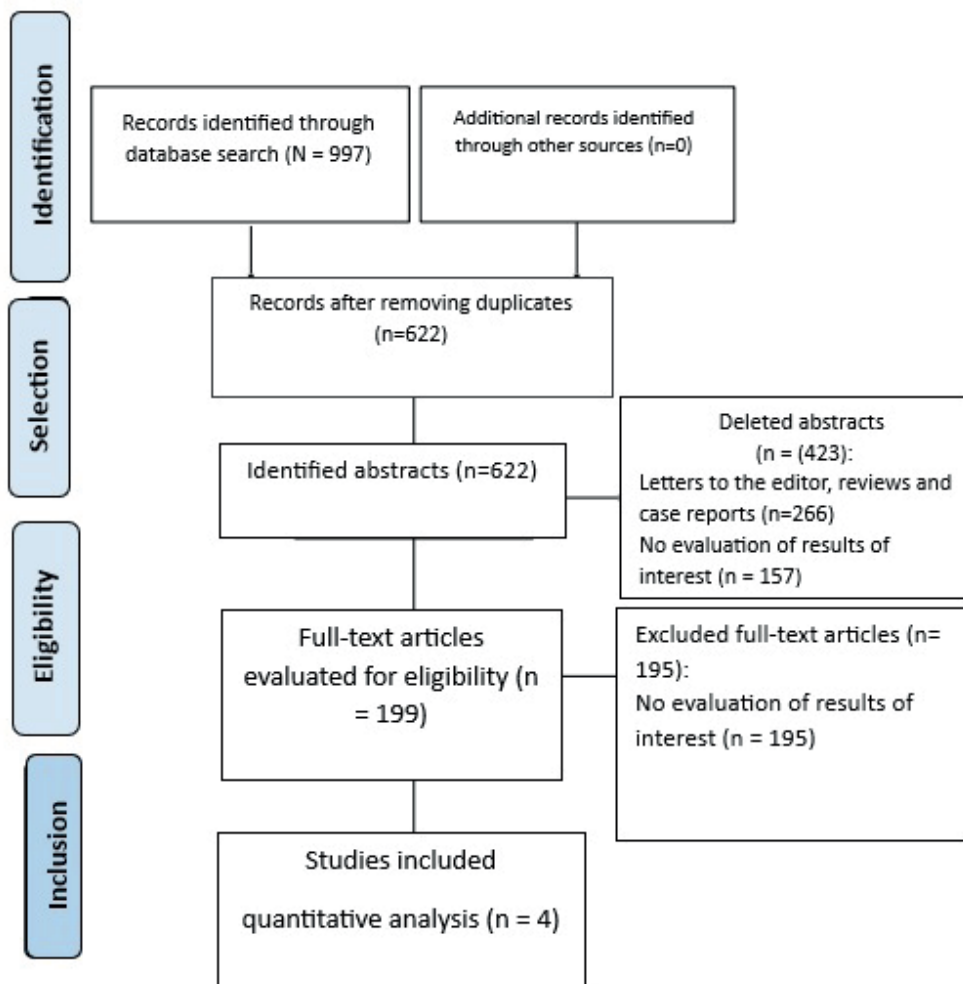


Figure 1. Flow diagram of research studies, identification and selection of literature (PRISMA).

Author, year	Country	DE	PL	PA
Klingler, 2003 ¹⁵	Austria	Prospective	40	15
Calvert, 2008 ¹⁵	Grã-Bretanha	Retrospective	49	51
Bansal, 2011 ¹⁷	Índia	Prospective	28	34
Rehman, 2020 ¹⁸	Estados Unidos	Prospective	30	32

Note: DE, study design; PL, laparoscopic pyeloplasty. PA, open pyeloplasty.

Table 1. Characteristics of the studies included in the systematic review and meta-analysis.

Author, year	Success rate		Complication rates	
	PL	PA	PL	PA
Klingler, 2003 ¹⁵	35/40	14/15	7/40	6/15
Calvert, 2008 ¹⁷	41/42	46/48	7/42	12/48
Bansal, 2011 ¹⁶	26/28	34/34	0/28	1/34
Rehman, 2020 ¹⁸	25/30	30/32	5/30	13/32

Note: LP, laparoscopic pyeloplasty; PA, open pyeloplasty

Table 2. Results of success and complication rates between laparoscopic versus open pyeloplasty.

Author, year	Operative time (minutes)		Hospitalization time (days)	
	PL	PA	PL	PA
Calvert, 2008 ¹⁶	159±33	95±31	5±2	6±2
Bansal, 2011 ¹⁷	244±42	122±11	3±1	8±1
Rehman, 2020 ¹⁸	168±23	159±33	4±1	7±2

Note: Data presented as mean ± SD. LP, laparoscopic pyeloplasty; PA, open pyeloplasty

Table 3. Operative time and length of hospital stay between laparoscopic versus open pyeloplasty.

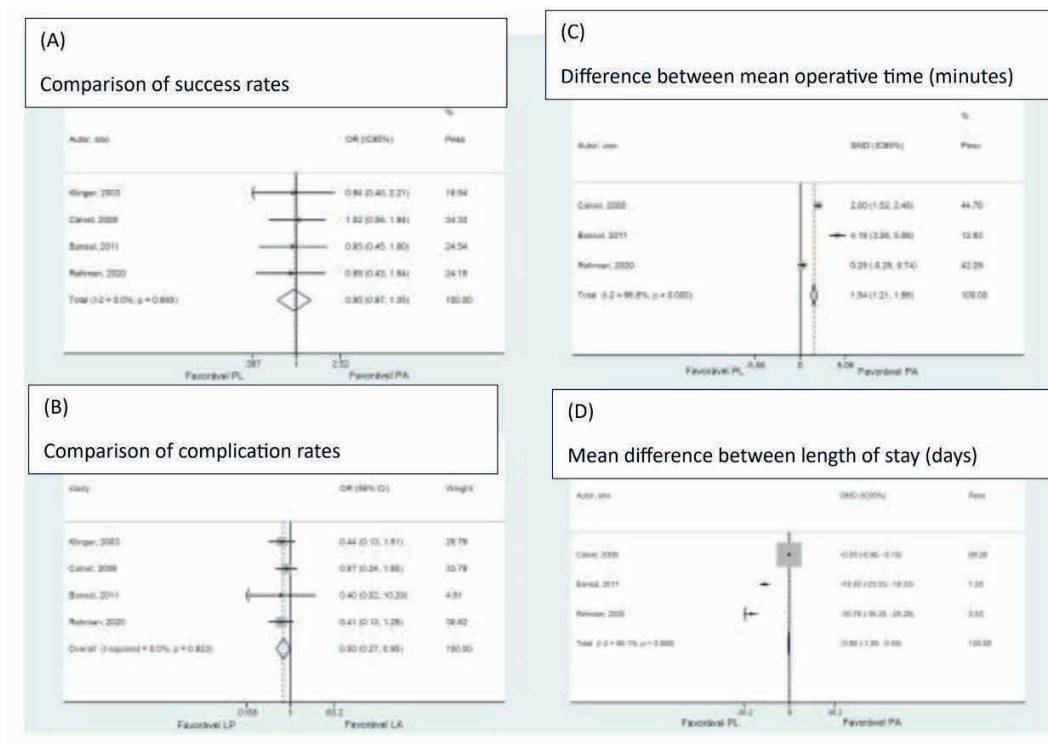


Figure 2. Forestplots of (A) odds ratio (OR) for success rate; (B) OR for complication rate; (C) standard mean difference for surgical time; and (D) standard mean difference for postoperative hospitalization.

diuresis nephrography. The definition by Calvert et al. 2008¹⁶, absence of symptoms or a significant improvement without evidence of obstructed drainage on the MAG-3 diuretic renogram. The definition of success for Bansal et al 2011¹⁷ was radiological improvement of UPJO, maintenance of renal functional status and symptomatic improvement. Rehman et al. 2020¹⁸ defined success as symptomatic improvement with a reduction in the degree of hydronephrosis detected on renal ultrasound (Grade <2) and improvement in MAG3 scan parameters (differential function – t1/2).

COMPLICATION RATE

The four studies were included in the analysis of the total of any kind of complications between the PL versus PA15-18 studies (Figure 2B). All studies were included in the pooled complication rate analysis15-18. There was a significant difference between PL and PA with an OR favoring PL and a high significant heterogeneity between studies (OR, 0.50; 95%CI: 0.27, 0.95; I2=00.0%; p=0.923).

OPERATIVE TIME

Three studies were included in the comparison of the mean difference in operative time between the LP versus PA16-18 studies (Figure 2C). There was a significant difference between PL and PA with large effect sizes favoring PA and non-significant heterogeneity between studies (SMD, 1.54; 95%CI: 1.21, 1.86; I2=96.8%; p =0.000). A study by Calvert et al 2008¹⁶ showed a longer operative time for PL 159±33 minutes compared to BP 95±31 minutes (p<0.001). The same result was seen in the work by Bansal et al. 2011¹⁷ with operative time of 244 ± 42 minutes for LP and 122 ± 11 minutes for PA (p<0.001) (Table 3).

HOSPITALIZATION DAYS

Three studies were included in the comparison of the standard mean difference

for postoperative hospitalization between articles in PL versus PA 16-18 (Figure 2D). There was a significant difference between PL and PA with a large effect size favoring PA and non-significant heterogeneity between studies (SMD, -0.89; 95%CI: -1.29, -0.50; I2=96.1 %; p=0.000). In Table 3 we present the results of Bansal et al. 2011¹⁷ and Rehman et al. 2020¹⁸, both studies showed a shorter hospital stay for patients operated on using LP compared to patients undergoing AP.

DISCUSSION

In this meta-analysis, we found that LP resulted in significantly lower percentage of complications and hospitalization time, but had no significant impact on the success rate, and also significantly increased operative time. These results demonstrate that laparoscopic pyeloplasty can improve some perioperative surgical variables compared to open pyeloplasty. Although this meta-analysis failed to find significant differences in postoperative clinical outcomes (success rate and operating time), improvements in perioperative variables, such as length of stay and percentage of complications, may influence clinical outcomes in the medium and long term. term19. In addition, previous studies failed to identify lower rates of complications after surgery, but following the same trend in relation to success rate, operative and hospitalization time19. Since Bauer et al.20 in 1999, most of the comparative studies between LP and AP are in the pediatric population. Uhlig et al.22 and Mei et al.23 in their systematic reviews and meta-analyses including most of these comparative studies. They confirmed the shortest operative time for the open procedure and the shortest hospital stay for laparoscopy, and also, no difference was observed regarding complications or success rate. It must be noted that each of these studies included adult and pediatric populations

in the statistical analyses. Our study has some limitations. First, our joint analysis showed significantly high heterogeneity for operative time ($I^2 = 96.8\%$; $p = 0.000$) and hospitalization time ($I^2 = 96.1\%$; $p = 0.000$), however something that was already expected considering the results of another previous meta-analysis¹⁹ for the same variables, respectively, for operative time ($I^2 = 91.0\%$; $p = 0.001$) and hospitalization time ($I^2 = 99.0\%$; $p = 0.001$). Such findings can be attributed to several factors, including the comparison of different types of surgery, sample sizes and surgeons' experience. Second, there were limitations inherent to any meta-analysis,

such as selection bias, publication bias, and lack of study information. Finally, most of the included studies were not prospective randomized clinical trials comparing PL vs. SHOVEL.

CONCLUSION

In summary, our data demonstrated that laparoscopic pyeloplasty for ureteropelvic junction obstruction can reduce hospitalization time and the percentage of complications in adults, with no effect on the postoperative success rate and with longer operative time.

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APPENDIX

Search strategy in online databases

pubmed

("laparoscopes"[MeSH Terms] OR "laparoscopes"[All Fields] OR "laparoscope"[All Fields] OR "laparoscopical"[All Fields] OR "laparoscopically"[All Fields] OR "laparoscopies"[All Fields] OR "laparoscopy"[MeSH Terms] OR "laparoscopy"[All Fields] OR "laparoscopic"[All Fields]) AND ("pyeloplasties"[All Fields] OR "pyeloplasty"[All Fields]) AND "open"[All Fields] AND ("pyeloplasties"[All Fields] OR "pyeloplasty"[All Fields]) AND "ureteropelvic"[All Fields] AND ("junction"[All Fields] OR "junction s"[All Fields] OR "junctional"[All Fields] OR "junctionally"[All Fields] OR "junctions"[All Fields]) AND ("obstruct"[All Fields] OR "obstructed"[All Fields] OR "obstructing"[All Fields] OR "obstruction"[All Fields] OR "obstructions"[All Fields] OR "obstructive"[All Fields] OR "obstructs"[All Fields])

Embase

laparoscopic pyeloplasty and open pyeloplasty and ureteropelvic junction obstruction