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Original Article

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Laparoscopic vs open pyeloplasty in adult; A study of 50 cases

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Abstract:

Background: *Untreated ureteropelvic junction blockage (UPJO) may lead to hydronephrosis and renal dysfunction. UPJO is usually treated by open pyeloplasty (OP), which has a 90% success rate. This surgery requires a large flank incision and has pain, postoperative morbidity, and a long recovery. However, laparoscopic (LP) UPJO treatment is minimally invasive.*

Objective: *The aim of this study is compare operative outcome between laparoscopýc and open pyeloplasty in adults in management of UPJO.*

Method: *This prospective observational study was conducted at the Urology Department of National Institute of Kidney Disease and Urology from February 2022 to January 2023 over a period of one year. During preoperative counseling, patients were presented with two options for surgery: open or laparoscopic pyeloplasty. The patient was given the freedom to choose the technique they preferred. Twenty-five patients agreed to undergo open pyeloplasty while others opted for laparoscopic pyeloplasty. To maintain an equal number of participants, twenty-five patients were selected to undergo laparoscopic pyeloplasty. The study was approved by the ethical committee of NIKDU, and written consent was obtained from each patient.*

Result: *There was no significant differences in age, gender and BMI between the two groups. Surgical site 32.0% in right and 68.0% in left in both the groups. Duration of symptoms little higher in OP but not significantly. There were no significant differences in grade of hydronephrosis, anteroposterior diameter of pelvis renalis, parenchymal thickness, diuretic renography and eGFR between the two groups. Regarding etiology, aperistaltic segment was 56.0% in LP and 64.0% in OP, crossing vesssels was 28.0% in LP and 32.0% in OP, stricture was 16.0% in LP and 4.0% in OP ($p>0.05$). Operative time and blood loss was significantly higher in LP than OP. Hospital stay and analgesic requirement was significantly lower in LP than OP. VAS was significantly lower in LP than OP on 2nd POD as well as on 3rd POD. Improvement of anteroposterior diameter of pelvis renalis was significantly lower in LP than OP. There was no significant difference in post-operative improvement of DRF between the two groups. eGFR improvement was significantly less in LP than OP.*

Conclusion: *Pyeloplasty success in adults is measured by pain relief. Our study found better APD improvement and shorter operative time in the OP group, while the LP group had less blood loss, shorter hospital stays, and required fewer analgesics.*

Keywords: UPJO, Laparoscopic pyeloplasty, open pyeloplasty, adult hydronephrosis

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Introduction

Obstruction or the stenosis between the renal pelvis and the proximal ureter can lead to congenital or acquired uretero-pelvic junction obstruction (UPJO). This halts the flow of urine from the renal pelvis to the ureter, resulting in dilation of the renal pelvis, loss of renal parenchyma, and deterioration of kidney function.[1] UPJO can result from various factors such as an aperistaltic ureteral segment, a crossing vessel to the kidney's lower pole, ischemic or inflammatory strictures, obstructing nephrolithiasis, adhesions, malignancies, fibroepithelial polyps, and others (Krajewski et al., 2017).[1] It can lead to recurrent infections, kidney calculi, renal colic, and deterioration of renal function.

The best treatment for UPJO (ureteropelvic junction obstruction) has been a subject of debate for over a century. To determine the most effective approach, various procedures have been examined. Open pyeloplasty (OP) was originally described by Anderson and Hynes[2] in 1949 as the gold standard for surgical management of UPJO. This procedure has a 90% success rate, but it requires a large flank incision that can cause pain, postoperative complications, and a prolonged recovery period, as noted by Klingler et al.[3] in 2003.

Minimally invasive procedures like endopyelotomy, acucise catheter incision, balloon dilatation, and laparoscopic pyeloplasty have been developed over the last two decades to treat UPJ obstruction.[4]

Laparoscopic techniques have become increasingly popular in urology practice with the advancement of technology. These procedures can be carried out through either transperitoneal or retroperitoneal approaches.[5] However, anterograde and retrograde endopyelotomies have been shown to have poorer outcomes and carry a greater risk of bleeding compared to laparoscopic procedures.[6]

In 1993, Schuessler et al.[7] introduced laparoscopic pyeloplasty (LP) as a safe and effective technique, which has since been established as a successful alternative to open pyeloplasty. Success rates of LP range from 93% to 100%, which is comparable to the outcomes of open pyeloplasty.[8] According to existing literature, LP has been shown to reduce the morbidity rate when compared to open pyeloplasty. Patients who undergo LP typically experience a shorter hospital stay and require less narcotic use than those who undergo open pyeloplasty.[9]

The purpose of this study was to assess the effectiveness of laparoscopic management of UPJO, including operative time, bleeding, intraoperative complications, hospital stays, short-term complications, and success rate.

Method:

This prospective observational study was conducted at the Urology Department of National Institute of Kidney Disease and Urology from February 2022 to January 2023 over a period of one year. The study included 59 ureteropelvic junction obstruction (UPJO) individuals who met the criteria. Adults with UPJ obstruction after renal surgery (open, endoscopic, or laparoscopic) were included. Exclusion criteria included poor ipsilateral renal function (<15%), neoplastic blockage requiring non-pyeloplasty operations, severe uncompensated cardiac disease, paediatric patients, and pregnant women. In preoperative counselling, patients were given two surgery options: open or laparoscopic pyeloplasty. The patient could pick their technique. Twenty-five patients choose open. Others choose laparoscopic. To maintain an equal number of participants, 25 laparoscopic pyeloplasty patients were chosen.

The study was approved by the ethical committee of NIKDU, and written consent was obtained from each patient.

Preoperative workup

Patients were evaluated with a medical history review, clinical examination, and blood and urine tests before surgery. UPJO was diagnosed by ultrasound KUB, IVU, and DTPA renogramme . A micturating cystourethrogram (MCUG) was sometimes used to rule out vesicoureteric reflux (VUR). Intravenous pyelography (IVP) and DTPA renogramme results supported symptomatic severe upper tract dilatation (Grade 3/4) as UPJO. DTPA renogramme diagnostic criteria were t1/2 > 20 minutes (time to excrete half of the radionucleotide concentration post-furosemide infusion) and an obstructive type II O'Riley curve.

Surgical intervention:

Both methods used dismembered Anderson-Hynes pyeloplasty. The ureter was repositioned ventrally to correct a crossing lower pole vessel.

Laparoscopic pyeloplasty :

Pneumoperitoneum was created openly during "three port laparoscopic pyeloplasty" in the modified lateral decubitus posture. Identifying the ureter and dissecting the thin PUJ portion required colon mobilisation. Percutaneous stay sutures with prolene 3-0 stabilised the renal pelvis for anastomosis. The ureter was laterally spatulated by 2 cm after a section was removed. After that, superfluous pelvic tissue was removed and the PUJ segment was reanastomosed using vicryl 4-0 sutures. Antegrade laparoscopic suction tube stenting followed posterior wall completion. The surgery ended with an anterior wall anastomosis and a 10 Fr drain through the lateral port after hemostatic control**.**

Open pyeloplasty:

The surgery began with a flank incision in the lateral position. The retroperitoneum was used to locate the ureter and trace it to the UPJ. Narrowed renal pelvis segments were excised with traction sutures. A 2 cm ureter widening and reduction pyeloplasty were then done. The anastomosis used vicryl 4-0 sutures. First, the posterior wall was continuously sutured. After antegrade stenting, the anterior wall was anastomosed. Hemostatic control was followed by a 10 Fr drain in the operative bed.

Renal ultrasounds were performed 6 weeks after stent removal and 6 and 12 months thereafter. The operation was successful if it eased symptoms, reduced hydronephrosis severity (Grade<2), and improved DTPA renogramme characteristics.

Data were obtained from several sources, including historical records, basic clinical examinations, laboratory investigations, and outcome measures. These data were then recorded, processed, and analysed using the Statistical Package for the Social Sciences (SPSS version 12.0) software. The qualitative data were depicted in terms of frequency and percentage, while the quantitative data were presented using the mean and standard deviation. The Chi-Square test was conducted to analyse qualitative data, while the unpaired t-test was chosen for quantitative data analysis. A significance level of less than 0.05 was chosen for determining statistical significance.

Results

Table 1: Demographic profile of the study subjects (N=50)

	Laparoscopic Pyeloplasty (LP)	Open pyeloplasty (OP)	p-value
Age (years)			
10 - 20	8 (32.0)	8 (32.0)	
21 - 30	8 (32.0)	12 (48.0)	
31 - 40	7 (28.0)	4 (16.0)	
>40	2 (8.0)	1 (4.0)	
Mean ± SD	27.96 ± 11.42	24.68 ± 8.62	[a]0.257
Gender			
Male	15 (60.0)	18 (72.0)	[b]0.370
Female	10 (40.0)	7 (28.0)	
BMI			
Under weight	1 (4.0)	1 (4.0)	
Normal weight	15 (60.0)	21 (84.0)	
Over weight	9 (36.0)	3 (12.0)	
Mean ± SD	23.54 ± 2.30	23.07 ± 2.09	[a]0.455

[a]Unpaired t test and [b]Chi-Square test was done

Mean age of the patients in Laparoscopic group was 27.96 ± 11.42 years and in open group was 24.68 ± 8.62 years but there was no significant difference in age between the groups. There was no significant difference in gender between the two groups. Mean BMI was almost same in both the groups.

Table II: *Clinical and pre-operative findings of the study subjects (N=50)*

	Laparoscopic Pyeloplasty (LP)	Open pyeloplasty (OP)	p-value
Surgical side			
Right	8 (32.0)	8 (32.0)	1.000
Left	17 (68.0)	17 (68.0)	
Duration of symptoms (months)	6.04 ± 1.65	6.60 ± 2.00	0.285
Grade of Hydronephrosis			
III	17 (68.0)	12 (48.0)	0.152
IV	8 (32.0)	13 (52.0)	
Anteroposterior diameter of pelvis renalis (mm)	18.00 ± 3.12	19.95 ± 4.09	0.064
Prenchymal thickness (mm)	11.48 ± 1.81	12.23 ± 4.87	0.475
Diuretic renography, DRF (DTPA)	30.96 ± 9.32	30.44 ± 5.08	0.808
eGFR (ml/min/1.73m2)	30.71 ± 9.30	30.49 ± 4.66	0.916

[a]Unpaired t test and [b]Chi-Square test was done

Surgical site 32.0% in right and 68.0% in left in both the groups. Duration of symptoms little higher in open group but not significantly. There were no significant differences in grade of hydronephrosis, anteroposterior diameter of pelvis renalis, parenchymal thickness, diuretic renography and eGFR between the two groups.

Table III : *Etiology of UPJO (N=50)*

Etiology	Laparoscopic Pyeloplasty (LP)	Open pyeloplasty (OP)	p-value
Aperistaltic segment	14 (56.0)	16 (64.0)	0.368
Cross in vessels	7 (28.0)	8 (32.0)	
Stricture	4 (16.0)	1 (4.0)	

Regarding etiology, aperistaltic segment was 56.0% in LP and 64.0% in OP, cross in vesssels was 28.0% in LP and 32.0% in OP, stricture was 16.0% in LP and 4.0% in OP. There was no significant difference between the two groups.

Table IV : *Perioperative findings of the study subjects in two groups (N=50)*

	Laparoscopic Pyeloplasty (LP)	Open pyeloplasty (OP)	p-value
Operative time (minutes)	142.88±5.04	113.00±10.21	<0.001
Blood loos (ml)	52.80±22.32	72.40±11.91	<0.001
Hospital stay (day)	5.12±0.33	5.80±0.41	<0.001
Analgesic requirement (Diclofenac/mg)	380.00±38.19	434.00±59.02	<0.001

Operative time was significantly higher in LP (142.88 ± 5.04) minutes than OP (113.00 ± 10.21) minutes. Blood loss was significantly lower in LP (52.80 ± 22.32) ml than OP (72.40 ± 11.91) ml. Hospital stay was significantly lower in laparoscopic group (5.12 ± 0.33) days than OP (5.80 ± 0.41) days. Analgesic requirement was significantly lower in laparoscopic group (380.00 ± 38.19) mg than OP (434.00 ± 59.02) mg.

Table V: *Post-operative findings of the study subjects in two groups (N=50)*

	Laparoscopic Pyeloplasty (LP)	Open pyeloplasty (OP)	p-value
VAS for pain on 1st POD	87.76 ± 3.02	87.16 ± 3.31	0.506
VAS for pain on 2nd POD	55.44 ± 4.14	59.00 ± 6.10	0.020
VAS for pain on 3rd POD	30.64 ± 4.54	33.04 ± 3.74	0.047
Improvement of anteroposterior diameter (APD) of pelvis renalis (mm)	4.92 ± 1.55	7.04 ± 3.64	0.010
Post-operative improvement of DRF	31.08 ± 4.07	32.64 ± 4.02	0.179
Post-operative improvement of eGFR (ml/min/1.73m2)	31.51 ± 4.04	34.70 ± 4.87	0.015

Pain reduced in both the two groups from 2nd POD onward. VAS was significantly lower in laparoscopic group than open group on 2nd POD as well as on 3rd POD. Improvement of anteroposterior diameter of pelvis renalis was significantly lower in laparoscopic group (4.92 ± 1.55) mm than open group (7.04 ± 3.64) mm. There was no significant difference in post-operative improvement of DTPA between the two groups (31.08 ± 4.07 vs 32.64 ± 4.02). eGFR significantly improved less in laparoscopic group (31.51 ± 4.04) than open group (34.70 ± 4.87).

Discussion

The Laparoscopic group had a mean age of 27.96 ± 11.42 years, while the OP had a mean age of 24.68 ± 8.62 years. However, there was no significant difference in age between the two groups in this study. Merder et al.[10] revealed that the median age of the Laparoscopic group was 26 years, while that of the OP was 35 years. The study found that males were predominant, which was similar to Merder et al.[10]. The surgical side was more commonly left-sided, which was also similar to Merder et al.[10].

In this study, it was found that the pre-operative diuretic renography (DRF) and GFR were relatively similar in both groups. There was no significant difference in the pre-operative DRF and GFR between the two groups. Similarly, Merder et al.[10] also

discovered no notable difference in DRF and GFR between the groups. Furthermore, in their study, there was no significant statistical difference in the improvement of DRF and eGFR postoperatively between the two groups. Although there was no significant difference in postoperative DRF, there was a significant difference in GFR in this study. In another study by Mc Aleer and Kaplan[11], it was shown that renal function did not increase after pyeloplasty, regardless of the initial value. Additionally, Ylinen et al.[12] showed in their study that patients with a preoperative DRF value of less than 30% did not experience improvement even if the result of pyeloplasty was successful.

The study found that the anteroposterior diameter (APD) of the renal pelvis was larger in the open surgery group compared to the LP before the procedure, though the difference did not reach statistical significance. However, the open surgery group showed significant improvement compared to the LP after the operation. In a study conducted by Merder et al.[10] in 2021, it was found that preoperatively, the OP group had a statistically higher APD (p: 0.004). Postoperatively, the OP group showed a greater improvement in APD (p: 0.001), which could be attributed to the more frequent and successful pelvic renalis excision. Palmer et al. rejected dilatation of the pelvis renalis and obstruction in diuretic renography as a true predictor after pyeloplasty. According to Park et al.[13], the improvement of hydronephrosis after a successful pyeloplasty takes long time.

In this particular study, there was no significant difference observed in the pre-operative grade of hydronephrosis between the two groups. However, the grade of hydronephrosis improved in all cases in both groups postoperatively. Merder et al.[10] conducted a study and reported that there was no statistically significant difference in the grade of hydronephrosis between the two groups before the operation. In their study, the postoperative improvement in hydronephrosis was 58% in the OP group and 52.9% in the LP group, while the worsening of hydronephrosis was 6.5% in the OP group and 11.8% in the LP group (p=1.000). Sarhan et al.[14]'s study showed that the postoperative improvement in hydronephrosis was 69%, and the worsening was 9%.

Operative time was significantly higher in LP (142.88 ± 5.04) minutes than OP (113.00 ± 10.21) minutes. Median operative time was 150 min in OP and 210 min in LP (p=0.001) in the study of Merder et al.[10]. Calvert et al.[15] found increased operative time in LP in their study also.

Blood loss was significantly lower in LP (52.80 ± 22.32) ml than OP (72.40 ± 11.91) ml in this study. Median intraoperative blood loss was 220 cc in OP and 150 cc in LP (p=0.001) in the study of Merder et al.[10].

Hospital stay was significantly lower in LP (5.12 ± 0.33) days than (5.80 ± 0.41) days in this study. Median Hospital stay in OP was 6 and in LP was 4 days (p=0.001) (Merder et al., 2021).[10] Bansan et al.[16] reported the mean hospital stay in OP was 8.29 days and LP was 3.14 days. Ba°ataç et al.[17] found hospital stay time in OP and LP as 4.14 days and 2.8 days, respectively.

In this study, analgesic requirement was significantly lower in LP (380.00 ± 38.19) mg than OP (434.00 ± 59.02) mg. Analgesic requirement (diclofenac) was significantly higher in OP group than LP group in the study of Merder et al.[10], (p=0.001). Ba°ataç et al.[17] and Memon et al.[9] found analgesic requirement was higher in OP compared to LP group in their study also. In this study there was no complication except pain. There no significant difference in pain according to VAS between the two groups and VAS was significantly lower in LP than OP on 2nd POD as well as on 3rd POD. Merder et al.[10] revealed that the complication rate in OP was 15.8% and in LP was 10% in their study (p=0.661). No intraoperative complication was recorded in any group in their study.

In this study success rate was 100% in both the two groups. Success rate in OP was 87.1% and in LP was 91.18% in the study of Merder et al.[10] (p: 0.407). Comparing both approach, LP has technical difficulty and needs longer learning curve, needs advanced laparoscopic skills.

Etiology was aperistaltic segment (56.0%) in LP and 64.0% in open group, cross in vesssels was 28.0% in LP and 32.0% in open group, stricture was 16.0% in labaroscopic group and 4.0% in open group. There was no significant difference between the two groups in this study. The etiology in OP group was 74.2%, aperistaltic segment and in LP group it was 55.9% crossing vessels.

Success rates of both OP and LP are exceeding 90% in the literature.[18] Our success rates were found to be compatible with these rates. LP needs experience in laparoscopy, technically more difficult and expensive

approach than OP.[19,20] Small sample size and single center experience is the main limitation of this current study. The main purpose of pyeloplasty is elimination of pain, correction of kidney drainage and prevent deterioration of kidney function.

Conclusion

Although pyeloplasty reduces pain in adults, DRF, eGFR, and hydronephrosis do not improve. We think pain alleviation is the most significant and practical success criterion for adult pyeloplasty. Our study found improved APD, decreased mean operative time, intraoperative blood loss, hospital stay, and analgesic requirement in LP.

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