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Functional outcome after transperitoneal laparoscopic pyeloplasty at a tertiary care center, Nepal

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Abstract

Introduction: Pyeloplasty is the gold standard surgical treatment for Pelvic-Ureteric Junction Obstruction (PUJO). Laparoscopic pyeloplasty has gained popularity in recent years because it is less invasive, has better cosmesis, and reduces hospital stays with an equivalent success rate compared to open pyeloplasty. This study was designed to find out the success rate of laparoscopic transperitoneal pyeloplasty in cases with unilateral PUJO.

Method: This was a retrospective study, which included four years of data on patients who underwent laparoscopic pyeloplasty from 1 Jan 2019 to 31 Dec 2022 in the Department of Urology, Bir Hospital, National Academy of Medical Sciences, Nepal. Ethical approval was obtained. Microsoft Excel was used for descriptive analysis, frequency, and percentage of clinical and demographic data for age, gender, and site. Pre- and post-operative data of differential renal function (DRF) based on the radio-isotope renography and their association were compared using the χ^2 test. A p-value of <0.05 was considered statistically significant.

Result: Out of 25 cases, renal function improvement was observed in 18(72%), stable in 6(24%), and deteriorated in 1(4%) cases based on DRF analysis. Male to female ratio was 13:12, the mean age was 26 y (8-60 y), and the left side was 14(60%). A mean improvement of DRF of 3.1% was observed in the age group of >30 y, and a mean improvement of DRF of 4.3% was also observed in the cases with DRF ≤30%.

Conclusion: The laparoscopic pyeloplasty showed excellent functional outcomes in the majority of the cases with PUJO.

Keywords: laparoscopic pyeloplasty, pelvi-ureteric junction obstruction radio-isotope renogram

Introduction

Pelvi-ureteric junction obstruction (PUJO) is the most common site of obstruction in the upper urinary tract system.[1] It is defined as the restriction of urine flow from the renal pelvis to the ureter which may lead to progressive renal deterioration if left untreated. [2]

Laparoscopic pyeloplasty (LP) was first introduced by Schuesslerin in 1993.[3] It can be performed via transperitoneal or retroperitoneal route. The LP is preferred to open surgery because of less trauma, better cosmesis, reduced hospital stay, less pain, and blood loss. The reported long-term success rate of LP is >90%.[4, 5]

Ultrasonography and isotope renogram are two methods used to assess renal status before and after surgery. The ultrasonography helps to determine the size, parenchymal thickness, and hydronephrosis of the affected kidney but it is operator-dependent and has difficulty differentiating between a dilated or an obstructed pelvicalyceal system.[6] Radio-isotope diuretic renogram is the reference standard to detect the functional obstruction of the upper urinary tract.[7]

Nepalese studies have reported an 80-95% success rate for open and LP based on diuretic renography studies.[8-9-] The LP service is mostly limited to the central hospitals of Nepal due to its high technical demands and resources.[9-10]

This study was designed to find out the renal functional outcome after analyzing the pre and post-operative differential renal function (DRF) and drainage curve based on diethylenetriaminepenta-acetate (DTPA) renogram in cases with unilateral PUJO, who underwent transperitoneal LP in Bir Hospital, National Academy of Medical Sciences (NAMS), Nepal.

Method

All patients' data, who underwent transperitoneal LP for unilateral PUJO during the period of four years from 1 Jan 2019, to 31 Dec 2022, available in the record section and audit form in the Department of Urology at Bir Hospital, were reviewed. Patients with open pyeloplasty, bilateral PUJO, single kidney, previous pyeloplasty or endopyelotomy, associated with renal stones, split renal function of <10%, and incomplete data were excluded in this study.

This retrospective cross-sectional study was conducted after ethical approval from the Institutional Review Board (IRB), NAMS, Bir Hospital, Ref. No. 722/2079/80.

All patients had pre-operative routine laboratory tests and radiological investigation as per hospital protocol: urine routine/microscopic with culture and sensitivity, white blood cell count (WBC), hemoglobin (Hb), platelets, coagulation profile (bleeding time, clotting time, and prothrombin time), renal function test (urea, creatinine, sodium and potassium) and the radiological investigations: the chest x-ray, ultrasonography (USG) of abdomen and pelvis, computer tomography (CT) kidney ureter and bladder (KUB) with or without contrast and diuretic diethylenetriaminepentaacetic acid (DTPA) renogram.

The Anderson-Hynes dismembered pyeloplasty technique was used for surgical correction of PUJO for all cases. A trans-anastomotic JJ ureteric stent was placed in a retrograde manner for all cases. A drain was removed three to four days after surgery. The ureteric stent was removed after four weeks. Patients were assessed after three months with a diuretic renogram and were followed thereafter according to hospital protocol.

A DTPA diuretic renogram was performed as our hospital protocol, in a gamma camera (Nucline Spirit (DHV), Mediso-Medical Imaging Systems, Hungary).

Renal function improvement was considered if DRF on DTPA renogram is increased after surgery.

Renal function stable was considered if DRF on DTPA renogram was the same or up to 5% decreased after surgery.

Renal function deterioration was considered if DRF on DTPA renogram is decreased by more than 5% after surgery.

Data analysis was done by Statistical Package for Social Sciences (SPSS) Version 20. Patients' demographic data for different ages, gender, and site of PUJO were analyzed descriptively in frequency and percentage. Pre-and post-operative data of glomerular filtration rate (GFR) and DRF and its association was compared using $\chi 2$ test; a p-value <0.05 is considered statistically significant.

Result

During the period of four years from 1 Jan 2019 to 31 Dec 2022, there were a total of 61 pyeloplasty surgeries in Bir Hospital. A total of 25 cases of transperitoneal LP were analyzed after the exclusion of 36 cases (21 cases of open pyeloplasty, two cases of LP having a single kidney, two cases of LP associated with stone removal, and 11 cases lost to follow-up).

Out of 25 cases, there were 18 cases of ≤30 years, male to female ratio of 13:12 and left to right side ratio of 14:11, Table 1.

Table 1. Clinico-demographic characteristics of cases with unilateral PUJO who underwent transperitoneal LP

Variables	N(%)	p-value
Age in years		
≤30	18(72%)	0.002
>30	7(28%)	
Sex		
Male	13(52%)	0.779
Female	12(48%)	
Side		
Left	14(56%)	0.401
Right	11(44%)	

PUJO: Pelvi-ureteric junction obstruction
LP: Laparoscopic pyeloplasty

There were seven cases with DRF≤30% and 18 cases with DRF>30% of pre-operative renogram. After LP the renal function was improved, stable, and deteriorated in 18, six and one cases respectively, Table 2.

Table 2. Pre-and post-operative outcome of cases with unilateral PUJO who underwent LP

Variables	N(%)	p value
Pre-op DTPA renogram		
DRF*≤30	7(28%)	0.002
DRF>30	18(72%)	
Post-op DTPA renogram		
DRF≤30	6(24%)	0.169
DRF>30	19(76%)	
Renal function		
Improved	18(72)	
Stable	6(24)	
Deterioration	1(4)	

DRF: Differential Renal Function; DTPA: Diethylenetriaminepenta-acetate; PUJO: Pelvi-ureteric junction obstruction; LP: Laparoscopic pyeloplasty

We found the mean improvement of DRF after LP was 1.6% and 3.1% in cases with age group ≤30 y and >30 y respectively, Table 3.

The mean improvement of post-operative DRF was 4.5% and 1.7% in cases with pre-operative DRF of ≤30% and >30% respectively, Table 4.

Table 3. Pre-operative and post-operative changes of DRF according to the age group of cases with unilateral PUJO who underwent LP

Age in years	Pre-op DRF (mean) %	Post-op DRF (mean) %	p-value
≤30	37.0	38.6	0.922
>30	34.4	37.5	0.907

DRF: Differential Renal Function; PUJO: Pelvi-ureteric junction obstruction; LP: Laparoscopic pyeloplasty

Table 4. Pre-operative and post-operative changes of DRF with unilateral PUJO who underwent LP

Differential Renal Function	Pre-op DRF (mean) %	Post-op DRF (mean) %	p-value
DRF ≤30%	17.7	22.2	0.739
DRF >30%	42.3	44	0.954

DRF: Differential Renal Function; PUJO: Pelvi-ureteric junction obstruction; LP: Laparoscopic pyeloplasty

Discussion

We found a high renal functional outcome success rate of transperitoneal LP based on DRF and the O'Reilly curve in 24(96%) cases. Various studies showed a success rate of >90% in LP,[10-11] which is consistent with our findings.

The age of the patient in the present study varied from 8 to 58 years and the mean age was 26 years. The PUJO was more common in males with male:female ratio of 13:12 and involvement of left to right site was noted in the ratio of 14:11. These findings are similar to other studies.[12,13]

Anderson-Hynes dismembered pyeloplasty, first described as an open surgical method in 1949, is the criterion standard for the management of PUJO.[13] LP addresses all potential causes of PUJO, which may be intrinsic as stenosis from scarring of the ureter or incomplete recanalization during development, the neurogenic or muscular deficit with abnormal peristalsis or extrinsic as high insertion of the ureter, crossing lower pole renal vessels, malrotated kidney and due to prior surgery or stone disease.[14]

A radio-isotope diuretic renogram data shows the superiority of detecting functional urinary obstruction before operation and after operation during follow-up.[15] It is a time-activity curve with a graphic representation of the radio-isotope uptake and excretion by the kidneys. There may be sub-optimum isotope renogram report due to poor hydration, instability and position of the patient during the procedure (supine vs sitting), renal failure status, urinary bladder fullness, and immature kidneys e.g., infants or neonates because the maturation of the kidney completes after 18 months.[15] We used Technetium-99m (99mTc) DTPA diuretic scan to evaluate the functional status of kidneys in all patients pre-operatively and after three months during the period of follow-up. The 99mTc-DTPA is the dynamic renal agent to assess the glomerular function, which is neither secreted nor resorbed by the kidney tubules and is freely filterable with the glomerulus with an extraction fraction of 20%. A widely known technique first described by Gates is used to quantify the DRF and GFR with a simplified imaging protocol.[16] Diuretic renography has a propensity to a very low radiation exposure 3.3 mSv/370 MBq for 99Tc-DTPA and 3.7 mSv/370 MBq for 99mTc-MAG3 (mercaptoacetyltriglycine)[17] and effect of radiation can be minimized after voiding. The 99mTc-DMSA (dimercaptosuccinic acid) is a static renal scintigraphy, a primary choice to assess cortical morphology, pyelonephritis, and renal scar. We used to advise the DMSA in the pediatric age group <2 years. Another agent Tc-99m MAG3 is the radiopharmaceutical agent of choice to assess renal function having an extraction fraction of 40% and it provides a better gamma image with low background activity with faster clearance than DTPA.[16] Unfortunately, MAG3 is scarce in Nepal due to its high cost. The debate on the normal variation of differential renal function is ongoing. Studies have shown that the unilateral variation of up to 5% in differential renal function is insignificant but a unilateral variation of 7–9% may be associated with major renal dysfunction.[18, 19] Patients with >10% unilateral variation showed an increased risk of renal function deterioration.[20] The supernormal function phenomena observed in hydronephrotic kidneys may be a true compensatory hyperfunction or a technical artifact, or a reservoir effect [21] which is not infrequently observed in cases of PUJO.

The renal function may not be improved after pyeloplasty, if associated with longer duration

and higher degree of obstruction, especially in adult kidneys. A study showed that parenchymal recovery was inadequate in older patients and children after 38 months.[22] Therefore, the outcome after pyeloplasty in adults and children is not the same.[4] Majority of our patients 18(72%) were at the age of >30 years. The mean improvement of renal function after pyeloplasty based on DRF was observed by 3.1% (from 34.4% to 37.5%) and 1.6% (from 37% to 38.6%) in >30 years age and ≤30 years age groups respectively, the result didn't show the statistical significance (p=0.8619). Various studies showed conflicting reports on functional outcomes after pyeloplasty comparing pre-operative and post-operative DRF, some had a linear relationship with favorable outcomes with higher DRF of >30%[20,23] while others showed no correlation of pre-operative DRF only and renal recoverability[24] and another study showed better recoverability with poor functioning kidney.[25] Our result in seven cases with DRF ≤30%, all seven cases showed improvement with a mean increment of DRF by 4.3% (from 17.7% to22%). Though the improvement was more in poorly functioning kidneys (DRF ≤30%), the result wasn't statistically significant (p=0.7391). We had 18 cases with DRF >30% and among them, 17 cases showed improvement. The cases with DRF of >30% showed a mean improvement of 1.2% (from 42.36% to 44%). These results showed no statistical significance (p=0.9536). Several variables influence the outcome after surgery such as the duration and degree of obstruction, the function of the contralateral kidney, patient age, pyelo-lymphatic backflow, compliance of the ureter and renal pelvis, and the use of nephrotoxic medications, which had made it difficult to study in real clinical practice.[20] Therefore, counseling before surgery should be focused on the improvement of symptoms or stabilization of renal function.

The management of PUJO with poorly functioning kidneys is inconsistent in the literature. The poorly functioning kidney is defined as DRF from 10-30% among the various studies.[23] Some consider a cutoff of DRF <10% as an indication for nephrectomy while others recommend initial decompression through percutaneous nephrostomy or straightforward pyeloplasty.[25, 26] The benefit of nephrostomy is confirmed in cases with pyonephrosis, systemic toxicity, and bilateral PUJO or solitary kidney. We did not have any cases who underwent surgery with a nephrostomy tube, the possibility that none had undergone surgery with nephrostomy during the period of study. Our routine hospital practice for cases with DRF <10% is an indication for nephrectomy if normal contralateral kidney function. A recent study had shown that pyeloplasty was reported to be beneficial in poorly functioning kidneys with DRF ≤10% in 55(74%) cases if the nephrostomy drainage was >400 ml/day.[26]

The renal function of the affected kidney is mentioned as relative, regardless of the absolute individual function of both kidneys. It has been observed that if function in one kidney is impaired, there may be a compensatory increase in the function of the contralateral kidney. In such cases, the relative function might not reflect the actual functional state of the affected kidney, which may increase, decrease, or remain stable compared with a previous report.[20,21] Therefore the drainage curve pattern is a good indicator to verify the degree of obstruction and success of treatment rather than relying only on DRF.[27] Our study showed a decrease of GFR as well as DRF in one case after sub-analysis of renal function of the operated kidney. The renal biopsy an invasive diagnostic test is not routinely performed at the time of pyeloplasty. Renal biopsy reports showed a better prediction of outcome after surgery than preoperative DRF. Studies showed the presence of glomerulosclerosis, widened bowman capsule, interstitial fibrosis, and tubular atrophy in the histopathological specimen were poor predictors for renal recoverability, while normal histology is a strong predictor for good renal function recoverability after pyeloplasty.[28, 29]

The best drainage method for LP surgery is controversial. However, most surgeons nowadays prefer to place an internal stent to reduce the urine leak.[30] Various studies showed the conflicting results of internal or external or no diversion during pyeloplasty. The non-stenting had advantages such as no anesthesia required to remove the stent, no stent-related complications, early mobilization, and increased patient satisfaction[31,32] with equivalent anastomotic results and long-term surgical outcome success.[33] The rate of infection, stricture, encrustation or calculus formation, tissue injury, bleeding, dislodgement, stent migration, longer hospital stay, and costs were found to be higher with stenting.[34] Our all cases had intra-operative JJ stent which was removed after four weeks.

The average rate of pyeloplasty failure is 2-5% and the time of failure is around 3-11 months.[34] The failure after pyeloplasty is due to the urine leak from the anastomotic site, ureteral ischemia, inadequate hemostasis and not recognizing the lower pole crossing vessels.[34] The treatment of recurrence after pyeloplasty is redo-pyeloplasty, endopyelotomy, or ureterocalicostomy.[34]

Follow-up in patients after pyeloplasty is required to assess the functional status of the operated kidney and the re-intervention if needed.[35] A satisfactory diuretic isotope renogram, unobstructed curve, and $T_{1/2} \leq 20$ minutes at 3-6 months after pyeloplasty with maintained renal function and stable hydronephrosis suggested no need for further follow-up and showed no functional loss with time.[36,37] Our study analyzed the diuretic renogram after three months of unilateral PUJO cases who underwent transperitoneal LP to subjectively document the surgical outcome.

Our study isn't without limitations. The monocentric, selective to transperitoneal LP, the low number of patients, retrospective type, higher rate of drop-out, and single follow-up with the duration after three months, are the limitations of our study. We were unable to study the other variables e.g., symptoms, duration, grades of hydronephrosis, renal pelvis diameter, etc. due to the retrospective nature of the study, which could be the additional predictors of the renal functional outcome after surgery

Conclusion

The transperitoneal LP showed a high early functional outcome success rate in cases with unilateral PUJO relying on differential renal function and curve analysis of the diuretic radio-isotope renography.

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Conflict of Interest

None

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None

Author Contribution

Concept, design, planning: PR, AB, CM, RBB; Literature review: PR, RBB; Data collection: PR, AB, CM; Data analysis: PR, AB, CM, RBB; Draft manuscript: PR, RBB; Revision of draft: PR, AB, CM, RBB; Final manuscript: PR, AB, CM, RBB; Accountability of the work: PR, AB, CM, RBB.

Reference

1. Tripp BM, Homsy YL. Neonatal hydronephrosis—the controversy and the management. Pediatric Nephrology. 1995 Aug;9:503-9. | DOI | PubMed | Google Scholar | Full Text |
2. Koff SA. Problematic ureteropelvic junction obstruction. The Journal of urology. 1987 Aug;138(2):390. | PubMed | Google Scholar |
3. Schuessler WW, Grune MT, Tecuanhuey LV, Preminger GM. Laparoscopic dismembered pyeloplasty. The Journal of urology. 1993 Dec 1;150(6):1795-9. | DOI | PubMed | Google Scholar |
4. Elbaset MA, Zahran MH, Sharaf MA, Elmeniar AM, Ezzat O, Elgamal M, et al. Longterm functional success after pyeloplasty for pelvi-

ureteral junction obstruction in unilateral poorly functioning kidney in exclusively adults-population. Urology. 2019;131:234–9. | DOI | PubMed| Google Scholar |
5. Echeverria P, Reed F, Gatti JM, Braga LH, Cherian A, Garcia-Aparicio L, et al. Latitudes and attitudes: A multinational study of laparoscopic pyeloplasty in children. Journal of Pediatric Urology. 2023 Feb 1;19(1):86-e1. | DOI | PubMed | Google Scholar |
6. Duong HP, Piepsz A, Khelif K, Collier F, De Man K, Damry N, et al. Transverse comparisons between ultrasound and radionuclide parameters in children with presumed antenatally detected pelvi-ureteric junction obstruction. European journal of nuclear medicine and molecular imaging. 2015 May;42:940-6. | DOI | PubMed | Google Scholar |
7. Elzaki A. The Utility of Radioisotope Renography in Assessment of Renal Function: A Single-Center Experience. Annals of Medicine and Medical Sciences. 2022 Oct 1;1:1-6. | Google Scholar | Full Text |
8. Regmi P, Basnet RB, Shrestha A, Shrestha PM. Evaluation of the functional outcome of surgically corrected uretero-pelvic junction obstruction. Journal of Patan Academy of Health Sciences. 2019 Oct 15;6(1):21-4. | DOI | Google Scholar| Full Text |
9. Katwal BM, Koju S, Kunwar KJ , Shrestha D , Verma R , Shrestha PC . Laparoscopic Surgeries in Urology: Initial Burgeoning Experience at National Transplant Centre, Nepal. Kathmandu Univ Med J (KUMJ). 2021 Apr-Jun;19(74):160-3. | PubMed | Google Scholar | Full Text |
10. Joshi R. Laparoscopic pyeloplasty for pelvi-ureteric junction obstruction: Our single center experience. Journal of Kathmandu Medical College. 2019;8(4):212-7. | DOI | Google Scholar | Full Text |
11. Goel P, Gupta DK. Postoperative results following surgery for PUJO in children. Journal of Paediatric Surgeons of Bangladesh. 2010;1(1):53-64. | Google Scholar | Full Text |
12. Woodward M, Frank D. Postnatal management of antenatal hydronephrosis. BJU international. 2002 Jan;89(2):149-56. | DOI | PubMed | Google Scholar |
13. O'Reilly PH, Brooman PJ, Mak S, Jones M, Pickup C, Atkinson C, et al. The long-term results of Anderson–Hynes pyeloplasty. BJU international. 2001 Mar;87(4):287-9. | DOI | PubMed | Google Scholar |
14. Williams B, Tareen B, Resnick MI. Pathophysiology and treatment of ureteropelvic junction obstruction. Current urology reports. 2007 Mar;8(2):111-7. | DOI | PubMed | Google Scholar |
15. Taylor AT, Brandon DC, de Palma D, Blaufox MD, Durand E, Erbas B, et al. SNMMI procedure standard/EANM practice guideline for diuretic renal scintigraphy in adults with suspected upper urinary tract obstruction 1.0. Seminars in nuclear medicine 2018 Jul;48(4):377-90. | DOI | PubMed | Google Scholar |
16. Holness JL, van der Westhuizen DJ, Davids MR, Warwick JM. Measurement of glomerular filtration rate and its current status in African countries. African Journal of Nephrology. 2022 Jul 1;25(1):74-81. | DOI | Google Scholar | Full Text |
17. Stabin M, Taylor A, Eshima D, Wooter W. Radiation dosimetry for technetium-99m-MAG3, technetium-99m-DTPA, and iodine-131-OIH based on human biodistribution studies. Journal of Nuclear Medicine. 1992 Jan 1;33(1):33-40. | PubMed | Google Scholar | Full Text |
18. Taylor A, Manatunga A, Halkar R, Issa MM, Shenvi NV. A 7% decrease in the differential renal uptake of MAG3 implies a loss in renal function. Urology. 2010 Dec 1;76(6):1512-6. | DOI | PubMed | Google Scholar | Full Text |
19. Passoni NM, Peters CA. Managing ureteropelvic junction obstruction in the young infant. Frontiers in Pediatrics. 2020 May 27;8:242. | DOI | PubMed | Google Scholar | Full Text |
20. Khalaf IM, Shokeir AA, El-Gyoushi FI, Amr HS, Amin MM. Recoverability of renal function after treatment of adult patients with unilateral obstructive uropathy and normal contralateral kidney: a prospective study. Urology. 2004 Oct 1;64(4):664-8. | DOI | PubMed | Google Scholar |
21. Elbaset MA, Edwan M, Elmeniar AM, Sharaf MA, Ezzat O, Elgamal M, et al. The sequence of intervention determines the risk of early postoperative acute kidney injury in infants with bilateral ureteropelvic junction obstruction. Journal of Pediatric Urology. 2022 Dec 1;18(6):801-e1. | DOI| PubMed |Google Scholar | Full Text |
22. Yayla D, Demirtas G, Karabulut B, Tiryaki H. What is the Critical age for the Improvement of Parenchymal Thickness after Pyeloplasty?. Urology Journal. 2023 Jan 2;20:7301. | DOI | PubMed | Google Scholar |
23. Abbas T, Elifranji M, Al-Salihi M, Ahmad J, Vallasciani S, Elkadhi A, et al. Functional recoverability post-pyeloplasty in children with ureteropelvic junction obstruction and poorly

functioning kidneys: Systematic review. Journal of Pediatric Urology. 2022 Jul 21. | DOI | PubMed | Google Scholar |
24. Bowen DK, Mittal S, Aghababian A, Eftekharzadeh S, Dinardo L, Weaver J,et al. Pyeloplasty is a safe and effective surgical approach for low functioning kidneys with ureteropelvic junction obstruction. Journal of Pediatric Urology. 2021 Apr 1;17(2):233-e1. | DOI | PubMed | Google Scholar |
25. Al Misbah T, Chowdhury AM. Evaluation of renal function after pyeloplasty determined by 99mTc DTPA renogram. BIRDEM Medical Journal. 2022 May 10;12(2):142-6. | DOI | PubMed | Google Scholar |
26. Singh UP, Kakoti S, Sureka SK, Danish N, Kumar A, Tamboli Z, et al. Percutaneous nephrostomy in Ureteropelvic junction obstruction with poorly functioning kidney: Is it still pertinent in adults? Turkish Journal of Urology. 2022 May;48(3):229. | DOI | PubMed | Google Scholar | Full Text |
27. Wickramasekara N, Ignatius J, Lamahewage A. Sonographic follow-up after pyeloplasty: a large, retrospective cohort analysis. Pediatric Surgery International. 2023 Feb 18;39(1):132. | DOI | PubMed |Google Scholar | Full Text |
28. Bhat GS, Maregowda S, Jayaram S, Siddappa S. Is renal biopsy a better predictor of the outcome of pyeloplasty in adult ureteropelvic junction obstruction? Urology. 2012 Feb 1;79(2):321-5. | DOI | PubMed | Google Scholar |
29. Chowdhury MZ, Salim KH, Kabir MH, Tabriz SE, Khan MK. Correlation between Renal Histopathology and Differential Renal Function in Unilateral Congenital Ureteropelvic Junction Obstruction in Children. The Planet. 2019;3(01):9. | Google Scholar | Full Text |
30. Li J, Li Z, He Y, Fan S, Liu P, Yang Z, et al. Development of the prediction model for negative outcomes after primary laparoscopic pyeloplasty in children: a retrospective study of 535 patients. Translational Andrology and Urology. 2022 Dec;11(12):1680. | DOI | PubMed | Google Scholar | Full Text |
31. Srivastava P, Jaiman R, Kumar D. Stent versus stentless pyeloplasty in congenital pelvic ureteric junction obstruction kidney in children. International Journal of Surgery. 2022;6(2):83-102. | DOI | Google Scholar | Full Text |
32. Ceyhan E, Ileri F, Ceylan T, Aydin AM, Dogan HS, Tekgul S. Predictors of recurrence and complications in pediatric pyeloplasty. Urology. 2019 Apr 1;126:187-91. | DOI | PubMed | Google Scholar |
33. Murali V, Donati-Bourne J, Thomas M, Luscombe C, Golash A, Fernando H. Day-case catheterless and drainless minimal-access pyeloplasty in adults: A single-center experience of 13 years. International Journal of Urology. 2021 May;28(5):514-8. | DOI | PubMed | Google Scholar |
34. Seneviratne L, Hingalagoda C, Manikkage Y, Wickramasekera C, Udurawana SU, Samaraweera C, et al. Management of ureteropelvic junction obstruction in an era of minimally invasive surgery. Sri Lanka Journal of Surgery. 2021 Nov 30;39(3). | DOI | Google Scholar | Full Text |
35. Kumar M, Singh SK, Arora S, Mittal V, Patidar N, Sureka SK, et al. Follow-up imaging after pediatric pyeloplasty. Indian Journal of Urology: IJU: Journal of the Urological Society of India. 2016 Jul;32(3):221. | DOI | PubMed | Google Scholar | Full Text |
36. Reis LO, Ikari O, Zani EL, Moretti TB, Gugliotta A. Long-Term Results of Anderson–Hynes Pyeloplasty in Children: How Long Follow-Up Is Necessary?. European Journal of Pediatric Surgery. 2015 Dec;25(06):509-12. | DOI | PubMed | Google Scholar |
37. Pohl HG, Rushton HG, Park JS, Belman AB, Majd M. Early diuresis renogram findings predict success following pyeloplasty. The Journal of urology. 2001 Jun;165(6 Pt 2):2311-5. | DOI | PubMed | Google Scholar |