

An Observational Study of Demography, Clinical Characteristics, and Outcomes, of Dismembered Pyeloplasty for the Management of Pelviureteric Junction Obstruction

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ABSTRACT

BACKGROUND

Ureteropelvic junction (UPJ) obstruction (UPJO) leads to a functionally significant impairment of urinary transport from the renal pelvis to the ureter. Recently, the increasing use of maternal antenatal ultrasonography (USG) has led to increased diagnosed cases of UPJO. In a setup like ours, where patients are mainly from a lower middle class, minimally invasive techniques are still costly and long-term data for their outcomes are still awaited. The aim of this study is to find the outcome of the gold standard operation, i.e. open pyeloplasty, for the patients of UPJO, with objective criteria of severity, renal function, clinical features, and complications.

METHODS

This prospective observational study was done from September 2016 to October 2018 after taking ethical clearance from the institutional review board. This study included 25 patients of UPJO who were managed surgically with open dismembered Anderson Hynes pyeloplasty with DJ stenting were followed up for three months. UPJO patients were included in the study who underwent USG and renal scan, pre-operatively and at the follow-up time of 3 months. Categorical variables will be presented in numbers and percentages (%), and continuous variables will be presented as mean \pm SD and median. Quantitative variables will be compared using independent t-test / Mann-Whitney Test. Qualitative variables will be correlated using the Chi-Square test. A p-value of < 0.05 will be considered as statistically significant.

RESULTS

The mean age of the patients in our study was 15.93 ± 15.73 years. Overall, significant improvement in clinical features, grade of hydronephrosis, and renal function, was seen three months after the operation ($p < 0.05$) with minimal complications.

CONCLUSIONS

With a success rate of more than 92% as seen in our study, open Anderson Hynes pyeloplasty procedure holds its importance for the treatment of UPJO in the present era of minimally invasive surgery.

KEY WORDS

Hydronephrosis, Open Pyeloplasty, Ureteropelvic Junction

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BACKGROUND

Ureteropelvic junction obstruction (UPJO) leads to a functionally significant impairment of urinary transport from the renal pelvis to the ureter. Although many of them are detected at birth, the problem might not be clinically evident until a much later age in life.¹ The incidence of this UPJO is one case in 1000–2000 births.²

UPJO can occur due to an intrinsic cause aperistaltic ureteric segment or acquired cause stones, inflammatory or a post-operative stricture and urothelial neoplasm.³

A palpable flank mass was the most common presenting feature in the past. But nowadays, due to the widespread use of maternal and antenatal ultrasonography (USG), asymptomatic cases are detected very early.³

The post-natal assessment of a new-born with a history of antenatal hydronephrosis starts with a USG of the renal system. UPJO is the most frequently occurring uropathological diagnosis for ante-natal hydronephrosis. Detection of urologic anomalies prenatally permits interventions that avoid complications (e.g. pyelonephritis, flank or abdominal pain, renal calculi, hypertension, and renal failure); however, upwards of 64% to 94% of affected patients will ultimately not have a significant urologic pathologic abnormality.⁴ Approximately 25% of fetuses with pre-natal hydronephrosis demonstrate resolution on the first post-natal ultrasound. A USG should be performed ideally between 48 hours to one week of life.⁵

The choice of surgical procedure which is to be performed has always been a matter of debate among the surgeons, as a wide range of open and minimally invasive surgical techniques are there for the treatment of UPJO.

Open pyeloplasty has always been the standard of care, but minimally invasive procedures have become increasingly popular. Endopyelotomy with an advantage of less pain and convalescence and with a success rate of 42 - 90% can also be performed. Robotic pyeloplasty and laparoscopic pyeloplasty also have a similar success rate to open pyeloplasty and reduced morbidity and shorter convalescence, but a long-term outcome data for minimally invasive techniques are still awaited and thus open surgery remains the gold standard.⁶

The goal of radiographic studies is to determine both the anatomic site as well as the functional significance of an apparent obstruction. Due to the current increase in the use of maternal antenatal USG, there is an increase in the number of asymptomatic new-borns who are being diagnosed with hydronephrosis, many of whom are subsequently diagnosed to have UPJO. A wide range of investigations is there to confirm the diagnosis of UPJO. Anatomic assessment can be made by USG, CT scan, and retrograde pyelography whereas functional assessment can be made by a renal scan.⁷

In a setup like ours, where patients are mainly from a lower middle class, minimally invasive techniques are still costly and long-term data for their outcomes are still awaited. Thus, we aim to study the outcome of open pyeloplasty for the patients of UPJO, with objective criteria of improvement in the severity of hydronephrosis, renal function, and clinical features, and complication of the surgery. This shall help us to reconfirm if the open surgery is still worth for the treatment of UPJO patients.

METHODS

It was a prospective observational study conducted from September 2016 to October 2018. Ethical clearance was obtained for the study. Written and informed consent was obtained from the patients. The study population included 25 patients of UPJO who were managed surgically with open dismembered Anderson Hynes pyeloplasty with DJ stenting. The sample size was based on the study by Khan F., et al⁶ who observed that primary success rate was 87%. Taking this value as reference, the minimum required sample size with 10% margin of error and 5% level of significance is 44 patients. For finite sample size taking population as 40, total sample size calculated is 22. To reduce margin of error, total sample size taken is 25.

Formulae

$$SS \geq \frac{(p(1 - p))}{(ME/z\alpha)^2}$$

$$N = \frac{SS}{(1 + [(SS - 1)/Pop])}$$

Where Z_α is value of Z at two-sided alpha error of 5%,

ME is margin of error

p is prevalence rate.

Pop is population

Calculations-

$$SS = \frac{((0.87 * (1 - 0.87))}{(0.10/1.96)^2} = 43.45 = 44 \text{ (approx.)}$$

$$n = \frac{44}{(1 + (44 - 1)/40)} = 21.20 = 22 \text{ (approx.)}$$

Any patients with extrinsic causes, such as an aberrant vessel or a mass obstructing the UPJ, were excluded from this study. Even patients with previously same side operated kidney, previous renal trauma, patients with renal failure, unfit for the surgery, and not giving consent were excluded.

A detailed history and clinical examination of the patients was recorded. Patients were examined for the symptoms of pain (abdominal or loin pain), fever, dysuria, lump, and hematuria. Patient's urine culture, blood urea, and creatinine were evaluated, and patients were further assessed radiologically to know the anatomical and functional status of the affected side. Positive urine cultures were treated with a course of sensitive antibiotic.

All patients with symptoms and signs were subjected to USG for assessment. Patients were graded according to the grade of hydronephrosis on basis of USG.⁸ Grading system of Society of Foetal Urology was used in both Paediatric and Adults. All the patients were further investigated by IVP or

renal scan to confirm pelviureteric junction obstruction and differential renal function was assessed.

Patients were prepared by overnight fasting; two tablets Gassix and two tablets of Dulcolax were given. Exposure was in the range of 60–75 kV, 600–1000 mA with exposure of <0.1 seconds. Water soluble contrast (non-ionic) dye was used, for which an IV access was obtained. Adult dose was 50–100 mL; paediatric dose – 1 mL/Kg. Images were taken at 5–15 minutes followed by a 30-minute, 45-minute film and post-void film, serially for visualization of the pelvicalyceal system and ureter.

For renal scan (Nuclear Scintigraphy), no specific patient preparation was required. Adequate hydration of the patients was done. Dyes used were: Tc-99m DMSA (dimercaptosuccinic acid) with adult dose: 555 MBq (15–20 mCi) IV (intravenous) and paediatric dose: 1.85 MBq/Kg (0.05 mCi/Kg) IV (intravenous).

Patients with renal function < or = 40% with UPJO and hydronephrosis on an ultrasound scan with clinical symptoms were considered for open Anderson Hynes pyeloplasty with DJ stenting. At three months follow-up of the surgery, USG was done for anatomic assessment and renal scan for functional assessment of the patients.

Statistical Analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Quantitative variables were compared using the independent t-test/Mann-Whitney Test, and Qualitative variables were correlated using the Chi-Square test. A p-value of <0.05 was considered statistically significant. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

Age Group (Yrs.)	No. of Patients	Percentage (%)
0-10 yrs.	12	48 (%)
11-20 yrs.	3	12 (%)
21-30 yrs.	6	24 (%)
31-40 yrs.	1	4 (%)
41-50 yrs.	3	12 (%)
Total	25	100 (%)
Mean ± SD	15.93 ± 15.73 (2 mths. - 49 yrs.)	

Table 1. Age Distribution

Urine Routine and Microscopy	No. of Patients	Urine Culture			
		E. coli	Pseudomonas	Staphylococcus Aureus	No Growth
1-2 Pus Cells	14 (56%)	0 (0%)	0 (0%)	1 (4%)	13 (52%)
2-3 Pus Cells	5 (20%)	1 (4%)	1 (4%)	0 (0%)	3 (12%)
5-6 Pus Cells	3 (12%)	2 (8%)	0 (0%)	0 (0%)	1 (4%)
Occasional Pus Cells	2 (8%)	1 (4%)	0 (0%)	0 (0%)	1 (4%)
Within normal limit	1 (4%)	0 (0%)	0 (0%)	0 (0%)	1 (4%)
Total	25 (100%)	4 (16%)	1 (4%)	1 (4%)	19 (76%)

Table 2. Correlation between Urine Culture and Urine Routine Microscopy

Grade	Pre-Operatively	Postoperative Grading				χ ² -value
		Grade 1	Grade 2	Grade 3	Grade 4	
Grade 1	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	23.18 P=0.004
Grade 2	12 (48%)	9 (75%)	2 (16%)	1 (8.33%)	0 (0%)	
Grade 3	11 (44%)	1 (9.09%)	9 (81.8%)	1 (9.09%)	0 (0%)	
Grade 4	2 (8%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	
Total	25 (100%)	10 (40%)	11 (44%)	4 (16%)	0 (0%)	

Table 3. Comparison of Pre- and Post-Operative Grade of Hydronephrosis on USG

Renal Scan	Pre-Op	3 Month Postoperatively			χ ² -value
		Improvement	Stable	Deterioration	
21-40%	16 (64%)	15 (93.75%)	0 (0%)	1 (6.25%)	12.50 p=0.014
11-20%	7 (28%)	7 (100%)	0 (0%)	0 (0%)	
5-10%	2 (8%)	1 (50%)	1 (50%)	0 (0%)	
Total	25 (100%)	23 (92%)	1 (4%)	1 (4%)	
Mean ± SD 24.28 ± 9.06					

Table 4. Comparison of Pre-Operative and 3-Months Post-Operative Renal Function

Chief Complaints	Pre-Operative	3 months Postoperative	χ ² -value
Pain	20 (80%)	13 (52%)	17.47, p= 0.0001
Dysuria	14 (56%)	2 (8%)	52.94, p= 0.0001
Fever	8 (32%)	0 (0%)	38.10, p= 0.0001
Hematuria	7 (28%)	4 (16%)	4.19, p= 0.040
Lump	3 (12%)	0 (0%)	12.77, p= 0.007

Table 5. Comparison of Chief Complaints: Pre-Operative and 3 Months Post-Operative

The mean age of the patients in our study was 15.93 ± 15.73 years. The age distribution has been shown in Table 1. The gender distribution was skewed towards males, with 23 males (92%) and two females (8%). Among the 25 cases of UPJO, 15 patients had left-sided involvement and ten patients had right-sided involvement.

In this study, one to two pus cells were seen in 14 patients of which only one patient had a positive urine culture, two to three pus cells were seen in five patients of which two patients had a positive urine culture, five to six pus cells were seen in three patients of which two patient had a positive urine culture, Occasional pus cells were present in two patients of which one had a positive urine culture (table 2).

After the operation, minor wound complications were seen in eight patients. Four of them had a discharge through the suture line and four of them had wound gape, managed by daily dressing and secondary suturing, respectively.

In this study, there was an overall significant improvement in the grade of hydronephrosis after three months. (p<0.05) It has been shown in Table 3. In this study, there was an overall improvement in renal function after three months. (p =0.014) (table 4).

In our study, significant improvement in all the chief complaints—pain, dysuria, fever, hematuria, and palpable lump—was seen after three months of operation (p<0.05) (table 5).

DISCUSSION

In our study, most of the patients were in the zero to ten years of age group, i.e. 12, nine of which presented at or before three years of age, two of them were antenatally diagnosed cases. No such similarity of age-wise occurrence of the disease has been observed with any other study; hence, because of the importance of antenatal detection and diagnosis due to the increasing use of antenatal USG, there has been an increase in the number of cases of hydronephrosis due to UPJO, being

detected in post-natal scans. UPJO is the most frequent cause of hydronephrosis and accounts for 64% of cases.⁹ Similar importance of antenatal diagnosis has been shown by Karnak et al.¹⁰ in which they have emphasized that SFU (society of fetal urology) hydronephrosis grade on ultrasound correlates with the severity of cortical damage and this demands the need for further investigation and operative intervention. Lee MD et al.¹¹ in their meta-analysis have inferred that children with any degree of antenatal hydronephrosis were at a greater risk of post-natal pathology as compared with the normal population.

In our study, in the age groups of 11–20 years and above, there was delayed manifestation of UPJO, the reason for this late presentation can be attributed to the generalized symptoms of patients, i.e. presenting with flank pain, urinary complaints, infection at a later age; not pointing to specific diagnosis leading to incidental detection of UPJO.¹²

Krajewsk W et al.³ in their study have also quoted that older children and adults may present with intermittent pain in abdomen or flank pain, nausea, vomiting, hematuria or features of urinary tract infection. Kumar et al.¹³ studied 53 adults in which abdominal pain was the presenting feature in 35 patients, lump in three patients, UTI in three patients and Incidental presentation in 11 patients.

Of the 25 patients, 23 (92%) males were involved and two (8%) females were involved. The predominant male population was also seen in other studies.^{14,15} Thus, male gender was more commonly affected than females. But a very high percentage of the affected males in our study can be attributed to the small sample size in our study.

In our study of 25 cases, the left side was more commonly involved than the right side (15 versus 10) as seen in other studies.^{10,16}

In our study, the common presenting feature was loin pain or abdominal pain which was present in 20 patients with other associated complaints. Clark WL et al.¹⁷ had similar results with the majority of the patients (77%) presenting with flank pain. In another study by Mikkelsen SS et al.,¹⁸ 20 patients presented with pain, nine had a urinary tract infection, two had hematuria. Whereas Gupta et al.¹⁵ in their study showed that majority of the patients, i.e. 126 had localized abdominal distension due to lump, 84 had pain, 42 had urinary tract infection, 21 had a fever, trauma in five patients, seven had hematuria, and six had an incidental detection. A more frequent occurrence of an abdominal lump in this study was attributed to the predominant paediatric sample size of 313 in the study, in comparison to a diverse sample size of 25 in our study.

In our study amongst the 25 patients of UPJO, all the patients were having serum urea and creatinine within the normal range and six patients had a positive urine culture. Organisms isolated from the urine cultures were *Escherichia coli* in four patients, *Pseudomonas* spp. and *Staphylococcus aureus* in one patient each whereas 19 patients out of 25 had a negative urine culture. Wang et al.¹⁹ state that the presence of pus and bacteria in urine examination are the important lab parameters for UTI.

In our study, *E. coli* was the most frequent cause of UTI, as well as elsewhere in the world in adults and childhood. One patient with *Pseudomonas* species and *Staphylococcus* species in their urine cultures respectively were also reported in our study. Ramanan PV et al.²⁰ and Gupta P et al.²¹ in their studies also concluded that *E. coli* is the most common cause of UTI.

In our study on USG, a maximum number of patients were having Grade 2 and Grade 3 hydronephrosis pre-operatively, i.e. 12 (48%) and 11 (44%), respectively. Instead, Ross et al.²² in their study of 125 patients have shown that Grade 3 hydronephrosis was present in 71 patients and Grade 4 hydronephrosis in five patients.

On the pre-operative nuclear scan, the evaluation of these patients showed that 16 patients had a differential renal function between 21% and 40%, seven patients had a function between 11% and 20% and only two patients had DRF between 5% and 10%. Patients with a DRF \leq 40% with UPJO and hydronephrosis on an ultrasound scan with clinical symptoms were considered for open Anderson Hynes pyeloplasty with DJ stenting. In another study by Han SW et al.,²³ also the need for correction by surgery in cases with renal function $<$ 40% or the association of infection despite antibiotic was given.

Chiou et al.²⁴ in 2004 in their study, have concluded that a DTPA scan of $<$ 40% is a good indicator for pyeloplasty whereas $<$ 35% is useful to predict poorly preserved renal function. Gupta et al.¹⁵ concluded that in infants with UPJO, an early correction is usually not necessary when the DRF is above 40% but any decrease or an associated recurrent UTI despite the antibiotic being given requires surgical correction.

In the present study, patients' intraoperative urine culture from the dilated renal pelvis was taken, no organisms were isolated from the samples, hence there is not much importance of intraoperative urine culture in these cases.

In our study, DJ stent was kept for a period of six weeks after surgery in all the patients, which is consistent with the study of Mufarrij et al.²⁵ who stated that removal of DJ stent should be done between four to six weeks.

In the case of children, success after Pyeloplasty for the repair of UPJO is identified by a combination of clinical and radiographic criteria. In post-operative follow-up, USG and renal scan are the most widely used investigations.⁷ In our study, the USG graded improvement was seen in 84% of patients and deterioration was seen in one patient.

Cost et al.²⁶ in 2010 demonstrated that follow-up of paediatric patients at a three-month post-operative period can determine the need for further investigations and subsequent intervention if required. Hsi RS et al.²⁷ in 2015 also stated the use of USG as the most commonly used modality for follow-up after pyeloplasty.

In our study, post-operatively nuclear renal scan was performed at the end of the third month and the post-operative status was an improvement in 92% patients and deterioration in one patient.

Pohl et al.²⁸ in 2001 also concluded that an improvement in renal function at a three-month renal scan required no further evaluation. Even in Faure et al.²⁹ study on 66 children who underwent pyeloplasty, an early renal scan was performed at a duration of seven weeks after surgery and one week after DJ stent removal which showed that maximum of the renal units (87%) had improved drainage on the renal scan.

In our study, there was a significant decrease in signs and symptoms post-operatively and significant improvement in renal function. Additionally, on the basis of ultrasound imaging, there was a significant improvement in the grade of hydronephrosis. Post-operative stable renal function compared to pre-operative function or subsequently an

improvement in renal function highlights the effectiveness of the treatment outcome.

The success rate of surgery in our study was 92% based on the renal scan imaging at a three monthly post-operative period which is comparable to the other studies. Mikkelsen et al.¹⁸ reported 95.2% success rate and O'Reilly et al.³⁰ reported 91.1% success rate. Khan et al.⁶ in 2014 in their review series have also concluded that the success rate of minimally invasive pyeloplasty is similar to open pyeloplasty, i.e. more than 90%.

Conventionally open pyeloplasty has been the benchmark of care and precision, but minimally invasive surgical techniques have become increasingly popular due to its comparable results and other advantages related to minimally invasive surgery technique of short stay, less pain, and morbidity; whereas, endopyelotomy has a lower success rate than other procedures (42–90% depending on the approach).

The limitations of our study are poor compliance of patients due to the predominantly rural population and sample size. In our study, an open surgical technique was not compared with minimally invasive surgical techniques.

CONCLUSIONS

Open Anderson Hynes pyeloplasty is an effective surgical procedure in reducing clinical symptoms and improving the functional outcome of the patient. USG and renal scan can be appropriately used for the assessment of anatomical and functional status in UPJO. With a success rate of more than 92% as seen in our study, this procedure holds its importance for the treatment of UPJO in the present era of minimally invasive surgery.

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