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ORIGINAL RESEARCH

Stentless pyeloplasty for paediatric ureteropelvic junction obstruction: a 15-year experience at Red Cross War Memorial Children's Hospital

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Purpose: This study aimed to evaluate the outcome of stentless dismembered pyeloplasty for congenital ureteropelvic junction obstruction (UPJO).

Materials and methods: We retrospectively reviewed the data of paediatric patients who underwent dismembered pyeloplasty due to congenital UPJO between January 2008 and July 2022. Patients' demographics, indications for surgery, follow-up data, and complications were recorded in a data extraction sheet. The success rate was defined by not needing intervention or reoperation postoperatively. Data analysis was done using Stata/SE 15.0 and $p = 0.05$ was used as a cut-off point for statistical significance.

Results: A total of 91 patients underwent pyeloplasty during the study period. The final analysis included 50 patients, excluding those who underwent stented pyeloplasty (17), aged above 13 years (1), and patients with missing data (23). The median age of study participants was four months (interquartile range [IQR]: 1–110). Most patients (90%) underwent open dismembered pyeloplasty, and 10% underwent laparoscopic-assisted dismembered pyeloplasty. The success rate (not needing surgical intervention postoperatively) was 90%. There was a statistically significant improvement between the pre- and postoperative anteroposterior (AP) pelvic diameter mean ($p = 0.0000$), renal output efficiency at 40 minutes ($p = 0.0000$), and normalised residual activity (NORA) on a mercaptoacetyltriglycine (MAG3) renogram ($p = 0.0001$). However, the difference in differential renal function pre- and postoperatively was not statistically significant ($p = 0.0558$). The most common complications were fever (30%), followed by abdominal pain (26%), and urinary tract infections (22%).

Conclusion: Stentless pyeloplasty is a safe and reliable technique for children. In resource-limited countries, such as sub-Saharan Africa, stentless pyeloplasty could be adopted as a standard technique because it is not inferior to stented pyeloplasty and is associated with low morbidity while being cost-effective.

Keywords: stentless pyeloplasty, paediatric, ureteropelvic junction obstruction

Introduction

Congenital UPJO is a common cause of obstructive uropathy in children, with an incidence of 1 in 500 to 1 250 live births.[1,2] It is the most common cause of antenatal hydronephrosis, and it can result in end-stage kidney disease.[3] At least 14 cases are referred to the Red Cross War Memorial Children's Hospital annually with an antenatal diagnosis of congenital UPJO.[3] Congenital UPJO can be treated either conservatively or surgically, depending on factors such as symptom progression, severity of hydronephrosis (AP renal pelvis diameter), differential renal function (< 40%), and deteriorating differential renal function (decrease of at least 10%) on a MAG3 renogram. The classic option for surgical treatment of UPJO is dismembered pyeloplasty, which can be done through open, laparoscopic-assisted, or robotic-assisted approaches.[1,2,4]

It is still debatable whether it is necessary to put an intraureteric stent following pyeloplasty and also what type of stent is the best.[4] Drainage following pyeloplasty in children with a transanastomotic stent is believed to facilitate adequate drainage and is thought to aid tissue healing by providing support and alignment, preventing subsequent urine leakage and stenosis.[5] However, the use of stents is associated with complications such as infection, stent migration, encrustations, stricture, bladder spasms, and injury to the anastomosis or renal tissue by accidental dislodgement of the stent.[6]

In a systematic network meta-analysis by Liu et al.[4] in 2019, there were no significant differences in operative time, operative success, hospital stay, improvement of renal functions, or overall complications for the external stented, double J (DJ)-stented, and stentless procedures in paediatric pyeloplasty. However, the DJ-stented procedure seemed to have more advantages than external stented and stentless procedures when considering ranking results.[1,5,7,8] Nonetheless, other studies have shown that stentless pyeloplasty has a similar success rate with low morbidity compared to stented pyeloplasty and could be considered a management option in the treatment of congenital UPJO.[2,6,9]

There is much evidence from different studies with no clear conclusion as to whether stented or stentless pyeloplasty is better. In resource-limited countries, especially in sub-Saharan Africa, stentless pyeloplasty might be the best option. This is evidenced by several studies showing that it is cheaper because there is no need for a second procedure, as in stented pyeloplasty, in addition to its associated low morbidity. For over a decade, Red Cross War Memorial Children's Hospital adopted stentless pyeloplasty as the first-line treatment in the surgical management of UPJO. However,

the short and long-term outcomes of stentless pyeloplasty at Red Cross War Memorial Children's Hospital are unknown. Furthermore, there is limited data regarding the outcomes of stentless pyeloplasty in paediatric patients in Africa.

This study aimed to evaluate the outcomes of stentless pyeloplasty, given the safety and efficacy in children, and to compare the incidence of surgery complications and outcomes with other published studies.

Materials and methods

Study design

A retrospective cross-sectional study was conducted at the Red Cross War Memorial Children's Hospital from January 2008 to July 2022.

Study population and data source

The urology theatre computer database was searched for pyeloplasty to identify all children between 0 and 13 years who underwent dismembered pyeloplasty during the study period. Folders of identified patients were retrieved from the medical records. A pretested, structured data collection form was used to extract information from the patient files, picture archiving and communication system (PACS), and the National Health Laboratory track system (NHLS trakCare) Information about age, sex, clinical presentations, antenatal and postnatal ultrasound findings (AP diameter), preoperative differential renal function, operative time, operative findings, postoperative complications (pain, drain output, fever), hospital stay, follow-up ultrasounds postoperatively (AP diameter), postoperative differential renal function, and any improvement in the renal function outcomes were extracted and recorded in the data collection form.

Study population

Inclusion criteria

The study included all children between 0 and 13 years who underwent either unilateral or bilateral pyeloplasty from January 2008 to July 2022.

Exclusion criteria

Children who underwent pyeloplasty but had other obstructive uropathy diseases in addition to UPJO, patients who underwent other surgery on the urinary tract in addition to dismembered pyeloplasty, and any patients' files with insufficient data to measure the outcome of surgery were excluded from the study.

Surgical technique

Open dismembered Anderson-Hynes pyeloplasty was performed as described in Hinman's *Atlas of Pediatric Urologic Surgery* through a flank incision.[10] A subset of patients underwent laparoscopy-assisted pyeloplasty. Pyeloplasty was performed using a 6-0 polydioxanone suture over a 5 Fr feeding tube, which was removed near the completion of the anastomosis. A reduction pyeloplasty was performed in all cases. A perinephric drain was placed and removed when there was an insignificant drain output.

A follow-up ultrasound was performed at six weeks and three months. A control technetium-99m (Tc-99m) MAG3 differential renal function was done postoperatively within the first six months. A cystoscopy, retrograde pyelogram, balloon dilatation, and DJ-stent were an initial intervention for an increase in AP renal pelvis diameter after surgery.

Data management and analysis

Data were entered, cleaned, and analysed by Stata/SE 15.0. The cut-off point of $p = 0.05$ was considered statistically significant.

Ethical clearance

The ethical clearance for this study was obtained from the Human Research Ethics Committee of the University of Cape Town, reference number 427/2023. Permission to conduct the study was obtained from the Red Cross War Memorial Children's Hospital Research Committee, reference number RCC 388 / WC_202308_019.

Results

Enrolment and characteristics of participants

A total of 91 patients underwent pyeloplasty (6.5 pyeloplasty procedures per year) at the Red Cross War Memorial Children's Hospital during the study period. Only 68 (74.7%) files could be retrieved from medical records. Other files could not be retrieved because they were discarded when patients were discharged from the hospital for more than five years. Out of the 68 patients who underwent pyeloplasty, one was older than 13 years, and only 50 underwent stentless pyeloplasty, while the remaining 17 had stented pyeloplasty. Therefore, the final analysis included 50 (73.5%) patients who underwent stentless pyeloplasty during the study period (Figure 1).

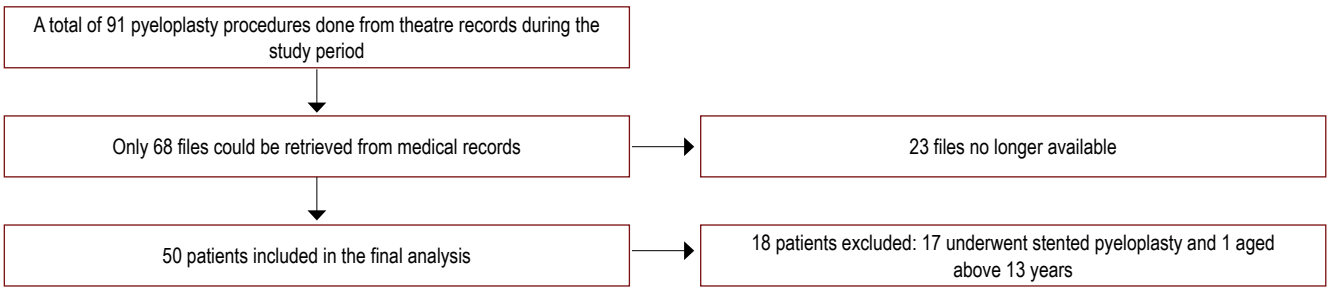

Figure 1: Enrolment of study participants

Participant demographics and operation data

The median age of study participants from the 50 stentless pyeloplasty procedures at the time of surgery was four months (IQR: 1–110 months). All patients were preoperatively assessed with history taking, physical examination, and a renal ultrasound/renal scan. The antenatal diagnosis of UPJO was made in the majority of study participants (43 patients, 86%). Most patients (90%) underwent open dismembered pyeloplasty (Anderson-Hynes technique), and 10% (five patients) underwent laparoscopic-assisted pyeloplasty. The majority (35 patients, 70%) were males (male-to-female ratio of 2.3 : 1), and 64% (32 patients) underwent left-sided pyeloplasty, while 32% (18 patients) underwent right-sided pyeloplasty.

Associated anomalies with pyeloplasty included duplex kidneys (three patients, 6%), multicystic dysplastic kidney disease (three patients, 6%), vertebral, anorectal, cardiac, tracheooesophageal fistula, renal and limb anomalies i.e. VACTERL (two patients, 4%), bilateral congenital inguinal hernia (one patient, 2%), pseudohypoaldosteronism (one patient, 2%), neurogenic bladder secondary to meningomyelocele (one patient, 2%), prematurity (one patient, 2%), non-specific congenital myelopathy (one patient, 2%), micrognathia and laryngomalacia (one patient, 2%), and dysmorphic features/partial trisomy (one patient, 2%). The median intraoperative time was 121 minutes (IQR: 90–250), while the median duration of hospital stay was six days (4–9), and the median duration of the abdominal drain was four days (IQR: 2–8). The median duration of urethral catheterisation was three days (IQR: 1–6) (Table I).

Table I: Patient demographics and operation data

Preoperative variables, *n* = 50	**Participants (frequency)**	**%**
Age in months, median (IQR)	4 (1–110)	
Range of operative time in minutes, median (IQR)	121 (90–250)	
Duration of hospitalisation in days, median (IQR)	6 (4–9)	
Duration of catheterisation in days, median (IQR)	3 (1–6)	
Duration of drain in days, median (IQR)	4 (2–8)	
Sex		
Male	35	70.0
Female	15	30.0
Site		
Right	18	32.0
Left	32	68.0
Antenatal diagnosis of UPJO		
Yes	43	86.0
No	7	14.0
Indications for surgery/presenting symptoms		
Decreased MAG3 function	33	66
Poor renal output drainage efficiency	7	14
Severe HN/increased AP diameter (US)	21	42
Recurrent UTIs	15	30
Approach of surgery		
Open	45	90.0
Laparoscopic	5	10.0

AP – anteroposterior, HN – hydronephrosis, IQR – interquartile range, UPJO – ureteropelvic junction obstruction, US – ultrasound, UTIs – urinary tract infections

Success rate of stentless pyeloplasty

The overall success rate of stentless pyeloplasty among the study participants was 90%. Improvement in AP diameter was observed in 91.5% of the study participants. Success on the MAG3 renogram parameters was 91.7% in improving renal output efficiency at 40 minutes, 63.4% in improving differential renal function, and 85.2% in improving NORA. The mean AP diameter on renal ultrasound was 31.0 ± 11.7 preoperatively, which decreased to 16.0 ± 8.9 postoperatively (p = 0000). The renal output efficiency at 40 minutes on the MAG3 renogram improved from the mean of 47.2 ± 22.9 to 81.8 ± 17.8 (p = 0.000). The NORA mean improved from 2.6 ± 1.9 to 0.8 ± 0.6. (p = 0.001) on the MAG3 renogram. The differences in pre- and postoperative AP diameter, renal output efficiency at 40 minutes, and NORA were statistically significant (p < 0.05). The mean differential function in the diseased kidney was 34.0 ± 12.9 preoperatively, and 36.9 ± 12.1 postoperatively (p = 0.0558). However, the difference was not statistically significant (Table II, Figure 2).

Postoperative surgical interventions

Surgical interventions done among patients with failed pyeloplasty, and those who were suspected of failed pyeloplasty, included redo-pyeloplasty (two patients, 4%), balloon dilatation (two patients, 4%), DJ-stent insertion (one patient, 2%), cystoscopy and retrograde pyelogram (one patient, 2%), percutaneous nephrostomies (two patients, 4%), and (one patient, 2%) non-functioning kidney post-pyeloplasty due for nephrectomy if they become symptomatic. Patients who underwent redo-pyeloplasty and stenting improved clinically and functionally following the procedures (Table IV).

The most common complications were fever (30%), followed by abdominal pain (26%), and urinary tract infections (22%). Gross haematuria and pyelonephritis were complications least associated with stentless pyeloplasty among the study participants (Table IV).

Table II: Success of pyeloplasty

Variable	***n* (%)**
Overall successful pyeloplasty (not needing surgical intervention postoperatively)	50 (90.0)
Improvement in AP renal pelvis diameter	47 (91.5)
Improvement in MAG3 differential function	41 (63.4)
Improvement in renal output efficiency at 40 minutes	24 (91.7)
Improvement in NORA	27 (85.2)

AP – anteroposterior, MAG3 – mercaptoacetyltriglycine, NORA – normalised residual activity

Table III: Types of surgical interventions post-pyeloplasty

Interventions	**Frequency (%)**
Redo-pyeloplasty	2 (4.0)
Balloon dilatation	2 (4.0)
Stent	1 (2.0)
Cystoscopy plus retrograde pyelogram	1 (2.0)
Nephrostomies	2 (4.0)
Pending nephrectomy (non-functioning)	1 (2.0)

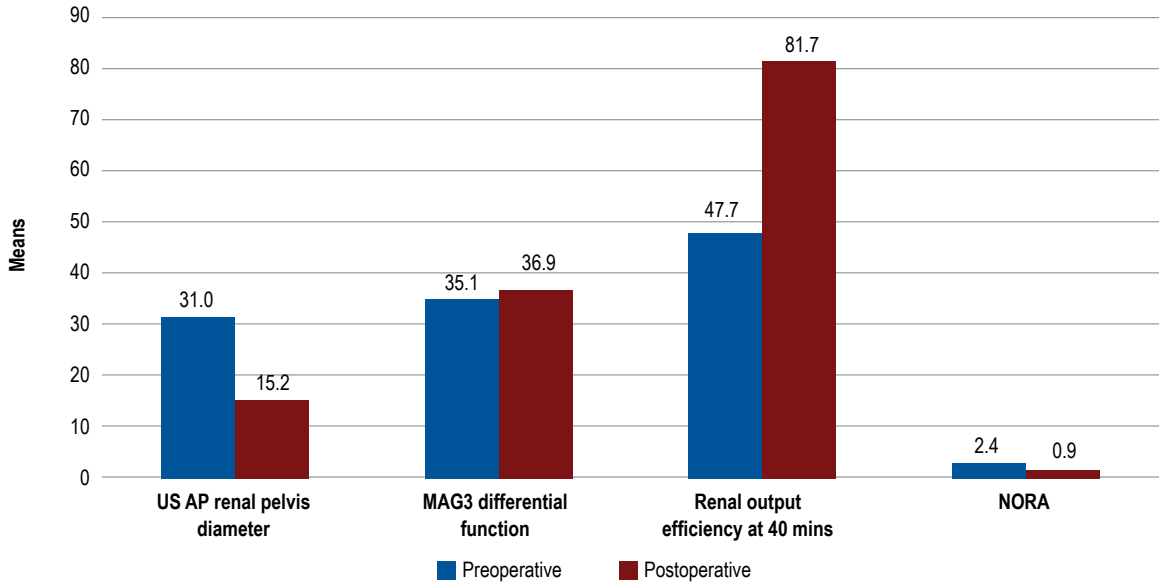

Figure 2: Comparison of pre- and postoperative outcome variables
US AP ($p = 0.0000$), MAG3 ($p = 0.0558$), renal output efficiency ($p = 0.0000$), NORA ($p = 0.0001$)
AP – anteroposterior, MAG – mercaptoacetyltriglycine, NORA – normalised residual activity, US – ultrasound

Table IV: Prevalence of postoperative complications, $n = 50$

Variable	Frequency (%)
Fever	15 (30.0)
Abdominal pain	13 (26.0)
Urinary tract infections	9 (22.0)
Urinary leakage	2 (4.0)
Gross haematuria	1 (2.0)
Pyelonephritis	1 (2.0)

Discussion

UPJO is a common cause of congenital hydronephrosis.[2] The aetiology of UPJO is divided into intrinsic and extrinsic causes.[11] Approximately one-third of UPJO will require interventions due to indications such as a decreased differential renal function (DDRF) of less than 40% or a 10% decline in follow-up, pain, recurrent infections, increased hydronephrosis with decreased corticomedullary differentiation with time, haematuria, and to treat pathologies like a stone.[7] Pyeloplasty can be done open, laparoscopic, or robotic-assisted with similar success rates.[7] In the neonatal period, open dismembered pyeloplasty remains the gold standard with laparoscopy performed in older children. Both open and laparoscopic pyeloplasty are performed at the Red Cross War Memorial Children's Hospital. In this study, 86% of UPJO were diagnosed during the antenatal period, which is in keeping with the current literature that shows most cases are diagnosed antenatally because of an increase in the routine use of prenatal ultrasound.[1,3]

Stenting after pyeloplasty is a long-term traditional practice to ensure patent anastomosis following pyeloplasty. However, stents are associated with several disadvantages, such as increased urinary infection, encrustation, migration, breakage, and the need for a second surgery, flank pain, bladder spasms, exposure of the upper tract to high pressure during micturition, and retained or forgotten stents.[2,7] Even though stenting after pyeloplasty has traditionally been the standard practice for a long time, it is against the original principles of dismembered pyeloplasty. Anderson-Hynes, with their originally designed pyeloplasty, did not use stents, and stated:[7,12]

> "We are convinced that the so-called splinting of any anastomosis is not only unnecessary, but it is against all the principles of plastic procedure, as it leads to infection and fibrosis at the line of suture and subsequent stricture. The line of anastomosis should be wide enough."

This study evaluated the outcome of stentless pyeloplasty in paediatric patients. Concerns about non-stented pyeloplasty include anastomosis dehiscence, leakage, and a higher incidence of stricture formation.[13] Our success and complication rates are comparable to global results. Worldwide, the success rate of pyeloplasty ranges from 90% to 100%, similar to our study. This study also showed a statistically significant difference in AP diameter, renal output efficiency, and NORA, in line with other studies.[15,] Only two patients (4%) required redo-pyeloplasty, and one patient (2%) had end-stage hydronephrosis. Therefore, this study provides evidence that stentless pyeloplasty is safe and effective, according to a recent trend in several studies involving non-stented repairs.[2,7,16-17]

The most common complications in this study were fever (30%), followed by abdominal pain (26%). In a study by Joshi et al,[17] stent-related pain was encountered in 80% of patients who underwent pyeloplasty, significantly higher compared to our study. Urinary leakage is one of the fears of stentless pyeloplasty. Some studies have reported increased urinary leakage in non-stented pyeloplasty in paediatrics.[16] However, in our study, only two patients (4%) had postoperative urine leakage, less than the findings in stented pyeloplasty, where at least 26% had urinary leakage.[1] The median duration of hospital stay was six days (IQR: 4–9), comparable to stented pyeloplasty.[1] Overall, postoperative complications in our study are low compared to stented pyeloplasty, which ranges from 32% to 94%.[17,18] This proves the advantages of stentless pyeloplasty and its few associated complications.

In paediatrics, removal of the stent will often require a second operation with general anaesthesia. In resource-constrained countries, such as sub-Saharan Africa, with an added low doctor-to-patient ratio, stentless pyeloplasty is a feasible alternative that provides theatre space for other patients who need operations. Removal of the stent under local anaesthesia using a magnetic tip DJ catheter has fallen out of favour due to technical difficulties.[19-20]

Limitation

The limitations of this study are that the data were retrospectively analysed, some of the files could not be retrieved, and it is a single-centre study with no comparison to stented pyeloplasty.

Conclusion

Stentless pyeloplasty is a safe and reliable technique for pyeloplasty in children. In resource-limited countries, like sub-Saharan Africa, stentless pyeloplasty should be adopted as a standard technique. Stentless pyeloplasty does not have an inferior success rate compared to stented pyeloplasty, and is associated with low morbidity while being cost-effective.

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Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

Research ethics and institutional approval was obtained from the Faculty of Health Sciences Human Research Ethics Committee (reference number: 427/2023) and the Red Cross War Memorial Children's Hospital (reference number: RXH: RCC 338/WC_202308_019).

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