Original Article

Experience with the use of Mohan's Valvotome for Posterior Urethral Valve Ablation at a Centre in North-Eastern Nigeria

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Abstract

Introduction: Posterior urethral valve (PUV) is the most common congenital cause of lower urinary tract obstruction in boys. Management has remained challenging in our region, with features of renal impairment evident in some patients at the time of presentation. Endoscopic valve ablation is the gold standard of treatment, but this is not readily available in our setting. Mohan's valvotome has been described as an alternative device for valve ablation. This study aimed to highlight the clinical presentation, management and early outcomes following valve ablation using Mohan's valvotome. **Methods:** A retrospective study of boys with PUVs managed between September 2014 and June 2018 was done. The demographic characteristics, clinical features, investigations, treatment and initial outcomes were reviewed. The main outcome measures were improved post-ablation urinary stream, serial serum creatinine values at presentation, 4–5 days of initial catheter drainage and at follow-up. **Results:** There were ten boys with the median age at presentation of 4 months (mean: 23.9 months; range 10 days to 7 years). Four patients presented after 1 year. All the patients had features of bladder outlet obstruction with associated fever in seven patients and urinary tract infections in six patients. Nine patients (90%) had suprapubic masses, while 2 had ballotable kidneys with co-existing urinary ascites in one patient. Valve ablation was achieved with Mohan's valvotome. There was a significant improvement in the urine stream in all patients. The median duration of follow-up was 7.5 months. Median serum creatinine was 0.95 mg/dl (mean 0.94 mg/d ± 0.38 mg/dl) at follow-up, compared to a median of 4.03 mg/dl at presentation (P = 0.01). **Conclusion:** Initial drainage and definitive valve ablation with Mohan's valvotome is associated with improved serum creatinine and urinary stream.

Keywords: Mohan's valvotome, posterior urethral valve, serum creatinine, valve ablation

Introduction

Posterior urethral valve (PUV) is a common congenital cause of lower urinary tract obstruction in boys. The mechanical obstruction is due to the presence of a congenital obstructive membrane in the posterior urethra.[1,2] PUV continues to be a major cause of morbidity, mortality and progressive renal insufficiency in children,[3] with an incidence of 1 in 5000-1 in 8000 live births.[4] In sub-Saharan Africa, the incidence of this congenital anomaly is not known. Uba *et al*.[5] reported an estimated incidence of 3–8 cases per year in Jos, North Central Nigeria, while Jaja *et al*.[6] observed that it was responsible for 1 in 2447 of children's admission in Port Harcourt, Nigeria.

The management of PUV remains a challenge worldwide particularly in resource-limited settings, with evidence of progressive renal dysfunction and deterioration already present in some of the patients at the time of presentation.[7,8]

Endoscopic valve ablation is currently the gold standard treatment for PUVs.[9] Other methods that have been employed include Whitaker-Sherwood hook, balloon catheter avulsion and laser ablation.[10-12] Mohan[13] devised a valvotome for valve ablation over two decades ago and there have been few reports of its usefulness in resource-limited settings where facilities for endoscopic visualisation and Bugbee electrode fulguration are not readily available due to prohibitive costs.[13-17]

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This study aimed to highlight the clinical presentation, management and early outcomes following valve ablation using Mohan's valvotome in boys with PUVs in our centre.

Methods

This was a retrospective study of boys with a diagnosis of PUVs managed between September 2014 and June 2018 at a North-Eastern Nigerian tertiary health center. Ethical approval was obtained from the hospital's health research ethics committee. The patients' demographics, clinical features, investigations, treatment, and initial outcome at follow-up were reviewed. Based on the prognostic significance reported in previous studies, the main outcome measures were improved postoperative urinary stream, serum creatinine values at presentation, after 4–5 days of catheter drainage and at the last follow-up. Furthermore, serum creatinine value of 1.0 mg/dl and above was deemed as renal impairment.[18-20] Initial care of patients generally involved adequate resuscitation and bladder drainage with a size 6 Fr feeding tube. Following stabilisation, the technique of valve ablation using Mohan's valvotome was carried out as previously described.[3,13] The device is a cylindrical metallic instrument which comes in two sizes (2 mm and 3 mm diameter) [Figure 1]. It has a closed, proximal rounded tip with a tapered cutting edge (hook) on one side. The opposite end is opened and has a handle attached close to it. The handle is placed at right angles to the cutting edge, and this helps to ascertain the direction of the cutting edge once the valvotome is inserted into the urethra.

Technique of Mohan's valvotomy

The patient is placed under general anaesthesia in the supine position, and a well-lubricated size 6 or 8 Fr feeding tube inserted into the urethra. The urinary bladder is filled with 0.9% saline through the feeding tube. The tube is then withdrawn and suprapubic pressure applied to demonstrate the preoperative urine stream and calibre. Initial urethrocystoscopy is done to visualise the PUV leaflets and the urinary bladder. The Mohan's valvotome is then well lubricated and gently inserted through the urethra until urine/saline begins to flow out from its distal end. Valve avulsion is done at the 5, 7 and 12 o'clock positions. With the valvotome in place, sustained suprapubic pressure is then applied over the distended bladder and the valvotome is gently withdrawn. The steady suprapubic pressure displaces/'balloons out' the PUV into the urethral lumen and distends the urethral walls laterally. As soon as the valvotome cutting edge engages the floating valve leaflet at the 5 o'clock position, it is withdrawn from the urethra, thereby ablating the valve. The valvotome is re-introduced, and the process is then repeated in the other two positions, using the handle as a guide to placing the cutting edge appropriately. A check urethrocystoscopyis then repeated to confirm adequacy of valve ablation.

After ablation, the post-operative urinary stream and calibre is also demonstrated by filling up the urinary bladder again and applying suprapubic pressure. A urethral catheter is usually left in place for 72 h, after which it is removed and child allowed to void.

Statistical analysis was performed using the Statistical Package for the Social Sciences version 20 (SPSS Inc., Chicago, Illinois, USA). Values were expressed as proportions, means ± standard deviation and median. Continuous variables (serum creatinine at presentation, at 4th–5th day of bladder drainage and at last follow-up) were compared with Student's *t*-test. A $P = 0.05$ or less was considered statistically significant.

Results

Ten patients were managed during the period, with a median age of 4 months [Table 1]. Six patients presented below the age of 1 year with three patients (30%) before the age of 1 month and 3 (30%) between 1 month and 1 year. Four patients were above 1 year at the time of presentation. None of the patients had a prenatal diagnosis.

All patients presented with obstructive symptoms (straining, poor stream). Nine patients had suprapubic masses (palpable bladder), while two patients had ballotable kidneys with concomitant urinary ascites in one of them. Other symptoms include fever in 7 (70%), urinary tract infections (UTI) in 6 (60%) and anaemia (haematocrit <30%) and urosepsis (high grade fever, severe obstructive symptoms, pus in urine, positive blood and urine bacterial cultures) in one patient each. Pus cells were identified in the urine of seven patients, out of which six presented with fever. Positive urine

Table 1: Patient's age at presentation and serum creatinine values

Age	Creatinine at presentation (mg/dl)	Creatinine after 4-5 days of catheter drainage (mg/dl)	Creatinine at follow up (mg/dl)
10 days	6.35	1.19	0.64
2 weeks	7.22	3.03	1.28
3 weeks	2.70	1.30	NA
32 days	6.65	5.15	5.50
3 months	1.40	1.20	1.20
5 months	4.03	NA	0.69
4 years	3.00	3.00	1.00
4 years	0.59	0.45	0.33
4 years	NA	NA	NA
7 years	6.41	1.85	0.90

NA: Not available

Table 2: Serum creatinine values at presentation, after 4-5 days of catheter drainage and at follow-up

Serum creatinine (mg/dl)	Mean±SD	Range	Median
Creatinine at presentation (*n*=9)	4.26±2.48	0.50-7.22	4.03
Creatinine after 4-5 days of drainage (*n*=8)	2.15±1.51	0.45-5.15	1.58
Creatinine at follow up post-ablation (*n*=8)	0.94±0.38	0.55-1.5	0.95

SD: Standard deviation

Figure 1: The Mohan's urethral valvotome. The cutting edge (hook) is positioned perpendicular to the handle on the other end

Table 3: Mean serum creatinine values in patients presenting above and below the age of 1 year

Age distribution	Mean creatinine at presentation (mg/dl) (n=9)	Mean creatinine after catheter drainage (mg/dl) (n=8)	Creatinine at follow up (mg/dl) (n=8)
Below 1 year	4.73±2.36	2.37±1.74	1.06±0.38
Above 1 year	3.33±2.92	1.77±1.28	0.74±0.36
P	0.47	0.62	0.29

cultures were obtained in four patients, with the isolation of Klebsiella, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* in each. Abdominal ultrasonography showed moderate-to-severe hydronephrosis in seven patients, with co-existing urinary ascites in one of the boys. Bladder wall thickening was demonstrated on ultrasonography in three boys. One patient had left palpable undescended testis as an associated anomaly. Micturating cystourethrogaphy (MCUG) and urethrocystoscopy were diagnostic in all patients. Vesicoureteric reflux (VUR) involving three renal units was seen in two boys (Grade IV unilateral VUR in one patient and bilateral Grade IV VUR in the other). Radio-isotopic renal scanning was not done due to non-availability in our environment.

Type I PUV was found on urethrocystoscopy in nine patients. Valve ablation was achieved with Mohan's valvotome after successful initial urethral catheterisation, continuous bladder drainage and stabilisation before surgery.

The serum creatinine at presentation (available in nine patients) ranged between 0.59 and 7.22 mg/dl, with a median of 4.03 mg/dl (mean 4.26 mg/dl ± 2.48) [Table 2]. Eight of the nine boys had renal impairment at presentation (serum creatinine above 1.0 mg/dl) [Table 1].

The median serum creatinine after 4–5 days of initial catheter drainage (recorded in 8 patients) was 1.58 mg/dl with a range of 0.45–5.15 mg/dl (mean: 2.15 mg/dl ± 1.51) [Table 2]. Although the mean creatinine at presentation was higher in children below the age of 1 year compared to values in children above 1 year (4.73 mg and 3.33 mg, respectively), the difference was not statistically significant (P = 0.47) [Table 3].

There were statistically significant differences between creatinine at presentation and creatinine after 4–5 days of drainage (P = 0.03), creatinine at presentation and at follow-up (P = 0.01), as well as creatinine after drainage and at follow-up (P = 0.04). One patient died 7 weeks post-ablation from urosepsis despite a reduction in serum creatinine value. The median duration of follow-up within the study period was 7.5 months (range: 7 weeks to 45 months). Post-intervention MCUG and ultrasonography at follow-up were available in 2 and 4 patients, respectively. There was significant improvement in the grade of VUR (from Grade IV to Grade II VUR) and the degree of hydronephrosis in these patients. Two patients were lost to follow-up.

Discussion

Patients with bladder outlet obstruction secondary to PUVs patients continue to have major morbidity, mortality and progressive renal impairment depending on the extent of the pathology before presentation.[3] Prenatal diagnosis was not made in any of the patients in this study and many of them presented at a median age of 4 months. This pattern of presentation is similar to the findings by Uba *et al*.[5] and Talabi *et al*.[21] in Nigeria. By contrast, Sudarsanan *et al*.[14] in India reported 30% antenatally diagnosed cases of PUVs and a median age at presentation of 45 days. It would appear that delayed presentation is relatively common in developing countries based on previous reports.[7,8,17] Ohagwu *et al*.[22] reported that negative attitude, long distances to service providers, considerably heavy financial cost, long waiting periods and unsatisfactory previous scan experience are major barriers to prenatal ultrasound in Nigeria, and these barriers have indirectly made the prenatal diagnosis of PUV difficult.[22] In our study, only three patients (30%) were seen in the neonatal period, similar to the report of Macpherson *et al*. that a third are diagnosed in the neonatal period and another third during the remainder of the 1st year of life.[23] Similar to observations from previous reports, we believe that the more severe the obstruction and the occurrence of complications, the sooner the presentation of patients.[20,23]

Voiding dysfunction (poor stream, straining) was the most common clinical feature on presentation. Previous studies also reported similar observations.[7,14,24] Fever was most likely

secondary to septicaemia and UTI resulting from urine stasis and subsequent bacterial colonisation. Renal impairment was seen in eight patients at presentation, with creatinine values above 1.0 mg/dl (median creatinine = 4.03 mg/dl). Similarly, a review of 21 patients with PUV by Odetunde *et al*. reported that 71% of the patients in their study had renal failure at presentation, out of which 62% required renal replacement therapy but only 19.05% got the renal replacement therapy done within the study period.[7]

Improvement in renal function with continuous passive catheter drainage of the bladder (serum creatinine values at 4–5th day of admission) before ablation was observed in 6 (85.7%) of seven children, with a significant reduction in serum creatinine values. This allowed proper stabilisation of the patient in preparation for valve ablation therapy. Our observation mirrors the finding of Sudarsanan *et al*.[14] who identified 12 patients with deranged renal function at presentation, out of which 9 (75%) patients eventually had improvement in renal function after initial catheter drainage.[14] Relief of the obstruction permitted a reduction in the high back pressure that caused the glomerular and tubular injury. This insult is a potentially reversible damage if intervention is instituted early.[25] According to findings in some studies, early presentation or diagnosis below 1 year has been associated with more severe obstruction and a higher risk of development of end-stage renal insufficiency.[23,26] This is suggested by the consistently high the serum creatinine values at presentation, following initial catheter drainage and at follow-up in our patients who presented below 1 year compared to boys above 1 year of age on presentation. Overall, sustained improvement in renal function was highlighted by the significant improvement in the post-operative urinary stream in all patients and marked reduction in serum creatinine levels following intervention and at the last follow-up within the study period. A longer follow-up of a larger cohort is however needed. We are aware of the importance of radio-isotopic renal scanning in the pre- and post-operative follow-up assessment of differential renal function and renal parenchymal scarring. However, this is presently not available in our centre.

The gold standard treatment for PUVs is cytoscopic valve fulguration.[9] Other methods that have been employed include Whitaker-Sherwood hook, balloon catheter avulsion and laser ablation.[10-12] Since the introduction of the Mohan'svalvotome[13] for valve ablation, there have been few reports of its usefulness in resource-limited settings where facilities for endoscopic visualisation and Bugbee electrode fulguration are not readily available due to prohibitive costs.[14-17] The Mohan's valvotome is a cheap and easy to use device which comes in 2 mm and 3 mm sizes.[3,13] This makes it appropriate for use in neonates and small infants. In our series, sustained improvement in renal function was highlighted by the marked reduction in serum creatinine levels following intervention and at the last follow-up within the study period. Improvement in the urinary stream and sustained significant reduction in median serum creatinine (0.95 mg/dl) following Mohan's valvotomy was achieved in the eight patients with available creatinine results. None of our patients required vesicostomy or upper urinary tract diversion before valve ablation. Complications that can occur following valve ablation include residual valves, recurrent UTI and renal failure.[14] Hence, all patients need to be on long-term follow-up. The drawback to the use of Mohan's valvotomy is that it is not performed under direct vision, and therefore urethral polyps or redundant urethral mucosal folds may be caught by the valvotome hook.[17] This has however been disputed in some previous reports, especially in studies where urethrocystocopy was performed alongside the use of Mohan'svalvotome.[14-17] We recommend proper application of suprapubic pressure to distend the urethra and displace the urethral wall from the central lumen, ensuring that the only tissue likely to be caught by the withdrawing valvotome is the floating valve leaflets. Where available, pre and post-ablation urethrocystoscopy should be combined with the procedure to access the valve configuration and confirm the adequacy of ablation to preclude the incidence of residual valves.

Mortality was recorded in an infant who presented at 32 days of life with a serum creatinine of 7.22 mg/dl, the highest value recorded amongst the patients. Although there was a sustained reduction in creatinine value (1.28 mg/dl) during the past follow up by 6th post-operative week, he eventually died from urosepsis. However, autopsy was not done.

In the period under review in this study, the median duration of follow-up was 7.5 months (range: 7 weeks to 45 months). All patients continue to be followed up as we are well aware of the need for a systematic, long-term follow-up protocol of these patients. However, cost is an issue in the management of majority of patients in our setting. This limits our ability to follow up these children with additional studies postintervention. Furthermore, it is often difficult to convince parents about the need for compliance with regular, scheduled clinic visits and further investigations, especially if the child appears to be doing well.

Furthermore, our study is retrospective and is limited by the small number of patients involved. This is partly because the paediatric surgery division of our centre is in its nascent phase. We also think that perhaps underdiagnosis in the community might also be a contributing factor (authors' observation). To our knowledge, this is the first report on the management of PUVs from the North-Eastern region of Nigeria. A prospective, multicentre study would be beneficial to give a more robust representation of the management of PUVs in the region.

Conclusion

PUV is an important cause of renal impairment in boys and management remains challenging. The Mohan's valvotome for valve ablation has been associated with improved urinary stream and reduction in serum creatinine. This could be an invaluable tool, especially in developing regions where electrofulguration is not readily available.

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Conflicts of interest
There are no conflicts of interest.

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