Original Article

Urinary Flow Rates in Anterior Hypospadias: Before and After Repair and its Clinical Implication

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Abstract

Context: Hypospadias is a common urological anomaly which could be surgically corrected with good cosmetic results. **Aims:** We aimed to detect changes in urinary flow parameters both before and after tubularised incised plate urethroplasty (TIPU) using uroflowmetry. **Settings and Design:** Data collected were clinically implemented hypothesising the probability of urethrocutaneous fistula following stricture with Qmax variation. **Materials and Methods:** This study is a prospective analysis done from December 2017 to October 2019. A total of 104 cases of anterior hypospadias were included in the study. A single surgical unit did TIPU. Pre-operative and post-operative uroflowmetry was done, and Qmax was recorded at 3 months, 6 months and 1 year after surgery. Mean Qmax was calculated for all intervals. A significant decrease in Qmax of a child (<2 standard deviation) was ascertained. Urethral calibration was done in those cases with a significant decrease of Qmax and analysed statistically. **Results:** The mean age was 6.97 ± 2.41 years. Out of 104 children, 73 (70.2%) and 31 (29.8%) had distal and mid-shaft hypospadias, respectively. The pre-operative mean Qmax of the population was 6.20 ± 0.42 ml/s. Arithmetic mean Qmax at 3 months, 6 months and 1 year was 8.53 ± 0.42, 11.18 ± 0.47 and 13.71 ± 0.44 ml/s, respectively. On comparing the pre-operative with post-operative mean Qmax, a significant increase was found postoperatively ($P < 0.0001$). Twenty-four patients had significantly decreased Qmax value after 6 months. In these patients, follow-up urethral dilation was done with significant improvement. **Conclusion:** The changes in maximum flow rate (Qmax) are suitable for use in routine follow-up. A significant decrease in Qmax over time indicates the onset of urethral stricture. These cases are to be intervened before venturing to redo urethroplasty.

Keywords: Anterior hypospadias, maximal flow rate (Qmax), tubularised incised plate urethroplasty, uroflowmetry

Introduction

Hypospadias is one of the common congenital urological anomalies in children. There are more than 250 surgical procedures for it. Tubularised incised plate urethroplasty (TIPU) with various technical modifications is preferred over various procedures with reported better results.[1] Few Articles focused on the role of uroflowmetry in the post-operative evaluation of children with hypospadias to detect asymptomatic strictures. Strictures are culpable for the formation of urethrocutaneous fistulae (UCF). Despite its simplicity and non-invasive nature, surgeons are reluctant to adopt uroflowmetry as an acceptable method for assessment.

Uroflowmetry is an established non-invasive investigation used to evaluate lower urinary tract dysfunction in an outpatient setting. Maximum flow rate (Qmax) has currently gained a central role in the long-term follow-up of hypospadias surgery in the paediatric population.[2] Even asymptomatic urethral stenosis can be identified.[3] This is of utmost importance as urethral stenosis and UCF represent the most common complications of hypospadias surgery (10%–30%).[4] However, for that, repeated follow-up of asymptomatic post-operative cases is needed causing parents psychological distress.

On the other hand, relaxing follow-up protocol may sometimes ignore a small set of children with chances of developing UCF postoperatively. Unfortunately, the literature is sparse on

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Received: 09-08-2021 **Revised:** 31-05-2022 **Accepted:** 09-06-2022 **Available Online:** 04-01-2023

Access this article online

Quick Response Code:

Website: www.afrjpaedsurg.org

DOI: 10.4103/ajps.ajps_125_21

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How to cite this article: Sharma SP, Chowdhary S, Kumar R, Yadav MK, Sharma SP, Panigrahi P. Urinary flow rates in anterior hypospadias: Before and after repair and its clinical implication. Afr J Paediatr Surg 2023;20:102-5.

monitoring urinary function during follow-up for hypospadias TIPU surgery.[5] Some studies have examined TIP functional outcomes using uroflowmetry with short-term and midterm follow-ups stating conflicting results.

This study aims to detect changes in urinary maximum flow rate in anterior hypospadias (distal penile and mid-shaft) after TIPU using uroflowmetry. Additionally, further follow-up visits were ascertained by determining the mean Qmax. Those cases not achieving desired Qmax were intervened and further analysed.

Materials and Methods

This study was done in the department of paediatric surgery from December 2017 to October 2019. A total of 104 consecutive cases of toilet-trained children with anterior hypospadias (distal penile and mid-penile) were included in the study.

Inclusion criteria

Toilet-trained children with anterior hypospadias (distal penile and mid-penile) with follow-up for 1 year.

Exclusion criteria

1. Patients with posterior hypospadias (proximal penile, penoscrotal and perineal)
2. Patients with severe chordee
3. Unable to perform uroflowmetry test.

In all patients, TIPU was done. Cases operated by a single surgical unit were included in the study. The pre-operative and post-operative uroflowmetry was done at 3 months, 6 months and 1 year after surgery. Uroflowmetry was done using FlowComp Uroflowmeter (manufactured by Status Medical Equipment). The maximum urine flow rate (Qmax) was recorded in millilitre per second & voided volume (VV) was measured in millilitres. The average of Qmax of the study population was calculated at each interval denoted as the mean Qmax. A significant decrease in Qmax was noted if its change of value (ΔQ) was below 2 standard deviation (SD) of prior Qmax. Those post-operative cases with a significant decrease of Qmax were posted for weekly urethral calibration/dilation done for 4 weeks. The institute's ethical committee approved the study.

Distributions of data sets obtained in the study were checked for normality using the Kolmogorov–Smirnov test. Means were separated using Tukey's test when data were normally distributed and variances were homogeneous (Bartlett's test for equal variances). The experimental data were subjected to one-way ANOVA, followed by Tukey's *post-hoc* comparison of means, considering durations of treatment (preoperative as control and post-operative after 3 months, after 6 months and after 1 year as experimental) independent variables. All statistical analyses were performed using MINITAB 16 (Minitab Inc., State College, Pennsylvania, USA).

Results

The mean age of patients was 6.97 ± 2.41 years (range: 4–12 years). Out of 104 patients, 73 (70.2%) had distal penile hypospadias and 31 (29.8%) patients had mid-penile hypospadias. Meatus was pinpointed in 44 (42.3%) patients. Only 20 (19.2%) patients had superficial chordee, which was corrected with penile degloving. The pre-operative mean Qmax was 6.20 ± 0.42 ml/sec. After a pre-operative assessment, all cases proceeded for TIPU by a single surgical unit under anaesthesia in the paediatric surgical OT complex. Each patient was kept with silicon urethral stent for 7–10 days, and the dressing was first changed on the 3rd-day postoperatively and the 7th day again with the removal of a stent with open dressing on the 10th day followed by discharge of patient excluding accidental stent removal in two patients. All patients were advised to follow-up at 3-month intervals, excluding OPD clinic visits, for minor concerns as when required. Fistula (UCF) developed in 23 (22.1%) patients during the first 3-month post-surgery. Children without fistula were posted for uroflowmetry at 3 months, and assessment of stream was noted with advice to follow-up after 6 months. At 6 months of follow-up, the rest of 81 cases, those cases with Qmax (Qmax 6) <25% at Qmax of 3 months (Qmax 3) were intervened by calibrating the urethra. Infant feeding tube of appropriate size over a ureteral double-J stent guide wire to keep the feeding tube tip stiff was used. Dilation was gentle with adequate lubrication under sedation at a single attempt. Further increase of feeding tube size, if needed was done on the next weekly visit. Twenty-four patients needed dilatation after 6 months (mean Qmax = 12.69 ± 0.28). Adequacy of dilation was assessed by urine stream clinically and reconfirmed from parents. All patients were advised similarly and followed with uroflowmetry at 1-year post-surgery. Two of those 24 cases developed UCF after 7 months and 9 months postoperatively, and the rest of the cases had improved Qmax at 1 year of follow-up ($t = 10.25$; $P < 0.0001$). Values of mean Qmax at 3 months, 6 months and 1 year were 8.53 ± 0.42, 11.18 ± 0.47 and 13.71 ± 0.44 ml/s, respectively [Table 1]. On comparing pre-operative mean Qmax values with Qmax at 3 months, 6 months and 1 year of follow-up, there was a significant increase of mean Qmax value after 3 months, 6 months and 1 year of follow-up ($F = 55.40$; $P < 0.0001$; df = 3, 315) [Table 1].

Table 1: Comparison of change of mean Qmax preoperative in anterior hypospadias (distal penile and mid-penile) patients at different time intervals post-operatively

Time interval	Qmax value
Preoperative	6.20±0.42[a]
After 3 months	8.53±0.42[b]
After 6 months	11.18±0.47[c]
After 1 year	13.71±0.44[d]

Superscript alphabets represent the comparison of means Qmax amongst the different time intervals based on Tukey's *post-hoc* test. Values are mean±SE. Qmax: Maximum flow rate, SE: Standard error

Discussion

TIPU is one of the most widely used techniques for the surgical correction of primary hypospadias.[1] Still, an obstructive urinary flow pattern is often observed in asymptomatic boys following such surgery.[2,4] Whether this observation is relevant and whether the obstructive urinary flow pattern requires correction remains debatable as long-term follow up data are lacking.[6]

One of the most important outcomes is a satisfactory urinary function. To objectify urinary function, uroflowmetry nomograms are useful. Uroflowmetry is a simple and non-invasive test to evaluate lower urinary tract function. The International Continence Society has standardised specific objective measurements to be recorded during uroflowmetry, including flow curve pattern, maximal flow rate, average flow rate, voiding time, flow time, VV and time to maximum flow. Maximal flow rate (Qmax) is the most relevant variable for assessing bladder outflow.[5,7]

In our study, most patients were of age range 5–10 years, followed by <5 years and 10–15 years with a mean age of 6.97 ± 2.41 years (range: 4–12 years). Patients were of older age range compared to the ideal age for hypospadias repair. Reasons could be attributed to lack of awareness of parents about this disease, reluctance to consult a surgeon for an otherwise healthy infant or toddler, and importantly financial overburden. A similar finding was also reported by previous authors.[7,8] The current European guidelines recommend surgery between 6 and 18 months of age.[9,10]

Distal penile hypospadias was a more common variety present in 73 (70.2%) patients and 31 (29.8%) patients had mid-penile hypospadias. Many researchers quoted similar figures, for example, Baltrak *et al*. found 85.6% of patients with distal penile hypospadias and 14.4% with mid-penile hypospadias.[8]

Clinically, meatus was pinpointed with thin urinary stream in 42.3% of patients and superficial chordee was present in only 19.2% of patients preoperatively. In a study done by Pandey *et al*., a thin urinary stream was present in about 22% of patients, and chordee was present in 20% of patients.[11]

Significantly, few studies have compared pre-operative to post-operative uroflow rates with quite a dilemma in results,[5] this aberration was perhaps due to the lack of supporting spongiosa preoperatively and post-surgery due to non-elastic hypoplastic urethra.[12] A published report on follow-up case of TIPU revealed the absence of smooth muscles and elastin fibres in incised plate tissue. This could explain the poor compliance of this segment.[13] This finding, however, was not noticed in our study, initially, but a progressive decrease in flow rates after 6 months lead to intervention in some of our cases. Further, doubling of incised plate width or more after incision on the urethral plate could help deciding the use of Snodgraft for improved compliance.[14]

Our study compared preoperative mean Qmax values with Qmax at 3 months, 6 months and 1 year of follow-up. There was a significant increase in mean Qmax value after 3 months, 6 months and 1 year of follow-up. Holmdahl *et al*. performed uroflow studies 2 and 12 months after surgery and concluded that urinary flows tend to improve spontaneously during follow-up due to softening of tissues.[15] This suggests that the urethral lumen further improves with time after urethroplasty, probably because of oedema resolution and collagen remodelling.

Gupta *et al*. studied uroflowmetry nomograms for healthy children 5–15 years age range.[5] They found the flow rate of this age group of children was 15.26 ± 4.54 ml/s. The present study finding of pre-operative mean Qmax (in children with anterior hypospadias) was 7.00 ± 4.263 ml/s, approximately half of the above-average value. Following postoperatively for 1 year of surgery, the mean Qmax (12.84 ± 3.605 ml/s) was comparable with the usual range described by Gupta *et al*.[5] However, some recent studies suggested that although uroflow rates tend to improve, they might remain abnormal in the long term. Andersson *et al*. evaluated the results of TIP urethroplasty postoperatively and concluded that spontaneous improvement was seen over 7 years of follow-up.[16]

Post-operative urethral calibration/dilation was done in 24 out of 81 children (29.6%) because of a significantly decreased Qmax value (<Qmax3-2 SD) after 6 months. Garibay *et al*. operated upon various types of hypospadias with different techniques.[3] They were able to identify meatal stenosis and stricture based on uroflowmetry that responded to either dilation or surgery. Anwar *et al*. successfully detected asymptomatic urethral strictures using uroflowmetry and treated them by urethral dilation. We used calibration for the exact cause.[17] Non-responder to calibration was quantified as decreased Qmax at 1 year to <25% of Qmax of 6 months. Amongst these probable non-responders, only two cases developed fistula, signifying calibration as the last venture to prevent delayed fistula. The rest of the cases showed an improved flow rate. Nonetheless, authors consider calibration/dilatation as a double-edged sword hampering healing of the urethroplasty suture line. Authors also consider redo urethroplasty as gold standard for recurrent strictures with or without fistula as suggested by other researchers.[18,19]

Uroflowmetry itself has some limitations in its use. It can only be used in toilet-trained children with no apparent complications such as fistula. The strength of this study is that this is one of the few series reporting the results of uroflowmetry performed pre and postoperatively in patients undergoing TIPS hypospadias repairs. Authors also attempted urethral dilation by set objective criteria before advising the need of redo urethroplasty. However, this hypothesis warrants more long-term follow-up as dilation might not suffice. This study included older children which limit its use in infants commonly operated in many urology centres.

Conclusion

Uroflowmetry is the most straightforward non-invasive quantifiable assessment of neourethra following urethroplasty. In recent times, preferring TIPU procedure is like walking on a knife-edge owing to studies ascribing more chances of urethral stricture and functional obstruction with this surgery. Thus, changes in maximum flow rate can signify results of the urethroplasty procedure with an advantage of choice to intervene in some. Authors observed delayed fistula postoperatively following stricture in some cases. This signifies uroflowmetry is quite essential in all cases. We recommend uroflowmetry as a baseline study to be done even after 1 year of follow-up of operated infants to detect stricture and change in flow subsequently.

Acknowledgement

Dr. Bhupendra Kumar, Department of Zoology, BHU, Varanasi (U.P.) - 221005 (INDIA) for statistical analysis. Email- bhupendrakumar@bhu.ac.in.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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