

Role of uroflowmetry before and after hypospadias repair

Rajat Piplani, Satish K. Aggarwal, Simmi K. Ratan

Department of Paediatric Surgery, Maulana Azad Medical College and Associated Lok Nayak Hospital, New Delhi, India

Abstract

Aims: To study the role of uroflowmetry in the preoperative and early postoperative period in children undergoing hypospadias repair.

Materials and Methods: Twenty-six cases undergoing hypospadias repair over 1 year (tubularized incised plate [TIP] Snodgrass [17 patients], TIP with Snodgraft [5 patients], Duckett's onlay flap [2 patients], and Duckett's tube [2 patients] urethroplasty) were prospectively evaluated with preoperative ultrasound and uroflowmetry and postoperative uroflowmetry at 3 months after the surgery and at 6 and 9 months interval if these dates fell within the study period on follow-up. The parameters studied were maximum flow rate (Q_{max}), average flow rate (Q_{av}), total voided volume, voiding time, and type of curve. Preoperative and postoperative uroflow data were compared.

Results: Twenty-six cases comprised of anterior hypospadias ($n = 8$), mid penile ($n = 11$), and posterior hypospadias ($n = 7$). Fourteen patients had obstructed flow rates preoperatively. While 69% patients (18/26) had obstructed flow rates at 3 months postoperatively, it dropped to 43% at 9 months. Following TIP (Snodgrass) repair, 88% (15/17) had obstructed flow rates postoperatively. Best results were seen in patients undergoing circumferentially epithelialized urethral reconstruction (TIP with Snodgraft, Duckett's onlay flap, and Duckett's tube).

Conclusions: Abnormal uroflow is an inherent aspect of hypospadias in 50% of the cases. Both preoperative and postoperative uroflow evaluation is necessary for meaningful conclusion. Patients with preoperative normal flow rates but obstructed postoperative flow rates need clinical evaluation. Obstructive flow rates are more common after TIP (Snodgrass) repair. The urinary flow rates improve with time.

Keywords: Hypospadias, nomograms, postoperative period, preoperative period, urethra

Address for correspondence: Dr. Satish K. Aggarwal, Sir Ganga Ram Hospital, New Delhi, India.

E-mail: satish.childurology@gmail.com

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INTRODUCTION

Functional success of hypospadias repair depends on the creation of a uniform and adequate caliber urethra up to the meatus. Accordingly, meatal stenosis and urethral stricture are the important complications of surgery. Although functional assessment of the repair is possible by observation of the urinary stream and

voiding cystourethrography, uroflowmetry is considered to be a more objective tool, especially for the detection of a subclinical urethral stricture.^[1-4] It is easy to perform, reliable, and relatively inexpensive. It has also been used for preoperative and long-term postoperative assessment.^[5-13] Several studies have shown that with passage of time, the flow pattern improves in long-term follow-up.^[14-22]

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Preoperative assessment by uroflowmetry has been performed in very few studies.^[11-13] Further, there are only anecdotal reports from Asian continent on this topic.^[22,23] Therefore, we did this study to determine the preoperative and postoperative patterns of uroflowmetry in hypospadias. We aimed to study the correlation of abnormal flow patterns and obstructive symptoms and also to study whether the type of operation had any correlation with uroflow patterns.

MATERIALS AND METHODS

A 1-year prospective observational study from March 2012 to February 2013 was conducted on 26 cases of hypospadias (age between 4 and 12 years) requiring single-stage repair. Children with any associated neurological or urological abnormality related to the bladder, which could potentially affect flow pattern, were excluded. All patients were assessed by renal ultrasound and preoperative uroflowmetry. Hypospadias repair was performed by senior consultants. Postoperative uroflowmetry was done at 3, 6, and 9 months after surgery. Every case had at least one postoperative uroflowmetry at 3 months follow-up, while 6 and 9 months follow-up study was carried out if these fell within the study period. All data including clinical details, symptoms, surgery details, and uroflowmetry were recorded for each visit on a predesigned pro forma. Standard uroflowmetry nomograms as suggested by Toguri *et al.*^[3] were used for defining flow rates and flow patterns.

Uroflowmetry was performed on Dorado™ KT (Lorior Medical Technologies, USA) uroflowmetry system using commode chair and uroflow stand with funnel. Minimum voided volume for the test to be valid was taken as 55 ml as per the manufacturer's instruction. The studied parameters were maximum flow rate (Q_{max}), average flow rate (Q_{av}), total voided volume, voiding time, and type of curve. Q_{max} was expressed as percentiles and compared to the Toguri nomograms. Flow rates as described by Kaya *et al.*^[6] were used including normal flow rate ($Q_{max} > 25^{th}$ percentile, normal bell-shaped curve), equivocally obstructed ($Q_{max} 5^{th}-25^{th}$ percentile), and obstructed flow rate ($Q_{max} < 5^{th}$ percentile, obstructive flow curve). The following flow patterns as classified by Kaya *et al.*^[6] were taken into account while interpreting the results.

- Nonobstructive flow curve: A normal flow pattern with smooth bell-shaped curve
- Obstructive flow curve: An obstructed flow pattern with intermittent or plateau curve.

Urological ultrasound was performed to get specific information on pre- and post-void residual volume, bladder

characteristics, and upper tracts status and associated malformations. Institutional ethical clearance was obtained before conducting the study.

Statistical analysis

Preoperative and postoperative uroflow data were compared. The postoperative flow rates were correlated with symptoms and need for intervention for obstructive symptoms. Changes in postoperative flow rates with time at 3, 6, and 9 months were assessed. The quantitative variables were expressed as mean \pm standard deviation and compared across the follow-up using Wilcoxon's test. The qualitative variables are expressed as frequencies/percentages and assessed using McNemar's test. A $P < 0.05$ was considered statistically significant. Statistical Package for the Social Sciences version 16.0 (SPSS Inc., Chicago, IL, USA) software was used for statistical analysis.

RESULTS

Twenty-six patients with a mean age of 6.30 ± 2.61 years were included. They comprised of 16 anterior, three mid penile, and seven posterior hypospadias. However, the final distribution was based on the location at which the corpus spongiosum started deviating and bifurcating as shown in Table 1.

Preoperative ultrasound did not reveal urological abnormality in any patient. Seventeen patients underwent tubularized incised plate (TIP [Snodgrass]) urethroplasty, five had TIP with free graft from inner preputial skin on the dorsal raw area after midline incision on the urethral plate ("Snodgraft"), while transverse preputial island onlay flap (Duckett's) and transverse preputial island tubularized flap (Duckett's) urethroplasty was performed in two patients each. Additional glans substitution with epithelialized dartos fascia and frenuloplasty was performed in five patients [Table 1].

Postoperative complications

One or more major or minor complications occurred in 11 out of 26 patients. Complications requiring repeat

Table 1: Anatomical characteristics of study subjects based on peroperative findings

Peroperative findings	Number of patients	Patients serial numbers
Anterior hypospadias	8	6, 11-14, 17-19
Mid penile hypospadias	11	1, 3-5, 7, 9, 10, 20-22, 24
Posterior hypospadias	7	2, 8, 15, 16, 23, 25, 26
Meatal stenosis	5	7, 12, 13, 22, 24
Chordee	10	1, 2, 5, 11, 15, 16, 23-26
Good projection of urethral plate	13	3, 4, 6-8, 10-17
Associated undescended testis	1	2

Patient's serial number as shown in Table 2

surgery in any form occurred in four cases [Table 2]. Two patients (no. 4 and 15) had partial glans dehiscence and coronal fistula. The fistulas were repaired subsequently without any complications and further included in the study. Six patients (no. 1, 2, 5, 8, 14, and 16) had meatal stenosis, both clinically and on uroflowmetry, which required meatal dilatation, was done at home by parents successfully. Five patients improved consequently, while one patient (no. 8) had decreasing Q_{max} and thin stream. He required urethral dilatation under general anesthesia. One patient (no. 3) developed 180° twists of the penis, requiring skin rearrangement. Three patients (no. 2, 12, and 13) had partial epithelial necrosis on the ventral aspect, which healed spontaneously over 2 weeks.

Clinical and subjective assessment of the stream

Subjective assessment of the preoperative and postoperative urinary stream was made both by the investigator as well as by the parents. The difference was more appreciated in cases which had meatal stenosis preoperatively. Five patients (no. 7, 12, 13, 22, and 24) had meatal stenosis preoperatively clinically, but their stream improved

postoperatively both on observation and on uroflowmetry. Two patients of posterior hypospadias (no. 2 and 8) had worsening of stream postoperatively along with obstructive flow pattern following TIP (Snodgrass) repair [Table 2].

Preoperative obstructive flow

Fourteen patients had obstructive flow (Q_{max} <5th percentile) preoperatively. Ten out of them (71%) continued to have obstructive flows in postoperative assessment also although clinically they had improved stream. In one patient (no. 17), the flow rates improved to equivocal flow (5th–25th percentile), and in three patients (no. 5, 22, and 24), the flow rates improved to normal (Q_{max} >25th percentile) in the last study [Table 2].

Preoperative normal flow

Twelve patients had normal flow rates preoperatively. Postoperatively, nine out of them had normal flow rates. Three patients (no. 1, 2, and 15) had poor flow rates postoperatively at 6 months follow-up [Table 2].

Nine patients (no. 18–26) who had undergone TIP with inlay graft (Snodgraft), Duckett’s onlay and

Table 2: Uroflowmetry findings

Patient details				Flow rate				Clinical observations		Changes in flow pattern	
Serial number	Age (years)	Type of hypospadias (peroperative)	Urethroplasty	Preoperative Q_{max} , ml/s (Toguri percentile)	3 months postoperative Q_{max} , ml/s (Toguri percentile)	6 months postoperative Q_{max} , ml/s (Toguri percentile)	9 months postoperative Q_{max} , ml/s (Toguri percentile)	Preoperative stream	Postoperative stream-last study	Preoperative curve	Postoperative curve
1 ^{ps}	4	Mid	TIP (Snodgrass)	6.2 (>25)	4.8 (<5)	5.2 (<5)		Average	Average	Plateau	Plateau
2 ^{c + ps}	4	Posterior	TIP (Snodgrass)	11.2 (>25)	3.3 (<5)	7.3 (<5)		Average	Thin	Plateau	Plateau
3 ^t	4	Mid	TIP (Snodgrass)	11.6 (>25)	3.1 (<5)	11.5 (>25)	9.1 (>25)	Good	Good	Bell	Bell
4 ^f	6	Mid	TIP (Snodgrass)	24.8 (>25)	9.8 (20)	10 (>25)		Good	Good	Bell	Plateau
5 ^{ps}	10	Mid	TIP (Snodgrass)	10.2 (<5)	9.1 (15)	10.6 (<5)	17.2 (>25)	Average	Average	Plateau	Plateau
6	8	Anterior	TIP (Snodgrass)	10.5 (<5)	6.8 (<5)	7.9 (<5)	8.4 (<5)	Average	Average	Plateau	Plateau
7 ^s	4	Mid	TIP (Snodgrass)	3.5 (<5)	2.4 (<5)	5.2 (<5)	6.7 (<5)	Thin	Average	Plateau	Plateau
8 ^{d + ps}	4	Posterior	TIP (Snodgrass)	5.3 (<5)	2.2 (<5)	3.8 (<5)		Average	Thin	Plateau	Plateau
9 ^s	8	Mid	TIP (Snodgrass)	7.2 (<5)	7.0 (<5)	5.8 (<5)	8.1 (<5)	Average	Average	Plateau	Plateau
10	6	Mid	TIP (Snodgrass)	20.7 (>25)	17.4 (>25)			Good	Good	Plateau	Plateau
11	7	Anterior	TIP (Snodgrass)	14.6 (>25)	14.5 (>25)			Good	Good	Bell	Bell
12 ^s	5	Anterior	TIP (Snodgrass)	2.4 (<5)	8.9 (<5)			Thin	Average	Plateau	Plateau
13 ^s	4	Anterior	TIP (Snodgrass)	8.7 (<5)	6.0 (<5)			Thin	Average	Intermittent	Plateau
14 ^{ps}	4	Anterior	TIP (Snodgrass)	6.2 (<5)	5.2 (<5)	5.5 (<5)		Thin	Average	Plateau	Plateau
15 ^f	4	Posterior	TIP (Snodgrass)	6.4 (>25)	5.7 (<5)			Average	Average	Intermittent	Plateau
16 ^{ps}	6	Posterior	TIP (Snodgrass)	5.6 (<5)	7.1 (<5)			Thin	Average	Plateau	Plateau
17	8	Anterior	TIP (Snodgrass)	9.8 (<5)	7.8 (10)			Average	Average	Plateau	Plateau
18 ^s	6	Anterior	TIP (Snodgraft)	19.0 (>25)	22.8 (>25)			Good	Good	Bell	Bell
19 ^s	6	Anterior	TIP (Snodgraft)	5.2 (<5)	10.3 (<5)			Thin	Good	Plateau	Plateau
20 ^s	8	Mid	TIP (Snodgraft)	17.9 (>25)	14.8 (>25)			Good	Good	Bell	Bell
21	4	Mid	TIP (Snodgraft)	6.8 (>25)	7.3 (<5)	9.4 (<5)	13.7 (>25)	Good	Good	Plateau	Plateau
22 ^s	12	Mid	TIP (Snodgraft)	5.4 (<5)	28.5 (>25)			Thin	Good	Plateau	Bell
23	4	Posterior	Duckett’s onlay	6.8 (<5)	9.7 (<5)	13.1 (10)	13.9 (>25)	Thin	Good	Plateau	Plateau
24 ^{s + g}	5	Mid	Duckett’s onlay	5.6 (<5)	14.6 (>25)			Thin	Good	Plateau	Bell
25 ^c	11	Posterior	Duckett’s tube	20.8 (>25)	16.2 (>25)			Good	Good	Bell	Bell
26	12	Posterior	Duckett’s tube	15.4 (>25)	35.8 (>25)	20.4 (>25)		Good	Good	Bell	Bell

^gGlans substitution and frenuloplasty, ^fFistula, ^tTorsion, ^dUrethral dilatation, ^cChordee correction (Nesbitt’s), ^sPreoperative meatal stenosis, ^{ps}Postoperative meatal stenosis. TIP: Tubularized incised plate

Duckett’s tube urethroplasty had normal flow rates postoperatively ($Q_{max} >25^{th}$ percentile), irrespective of preoperative flow rates and adverse glans anatomy [Table 2].

Flow rates on follow-up

All the 26 patients had 3 months postoperative uroflowmetry assessment, whereas only 13 patients had assessment at 6 months while only seven patients could be assessed at 9 months. Eighteen patients (69%) had obstructive flow rates at 3 months follow-up, while only eight patients (31%) had normal flow rates at 3 months [Table 2].

Four out of 13 patients (30%) had normal flow rates at 6 months. It is noteworthy that out of these four, three patients had obstructed flow rates at 3 months follow-up study. This suggests that the flow rates improved in these three patients with passage of time.

Four out of 7 patients (57%) who could be followed up at 9 months had normal flow rates. However, all these subjects had shown improvement in flow over time since their initial readings at 3 and 6 months.

Further, it can be seen from Table 2 that the majority of patients retained their preoperative curve characteristics postoperatively also. Two patients (no. 22 and 24) with preoperative meatal stenosis and with plateau curve improved postoperatively to normal bell-shaped curve, while one patient (no. 4) with bell-shaped curve preoperatively had plateau curve postoperatively. This patient had fistula in the postoperative period and had fistula closure and further included in this study. Two patients (no. 13 and 15) with intermittent flows changed to plateau curve postoperatively.

Statistical analysis

Q_{max} values at 3, 6, and 9 months preoperatively and postoperatively were compared, and P values were derived [Table 3]. Average Q_{max} values depicted a fall in the 6th month postoperatively and later rose to the preoperative levels. However, this variation was statistically insignificant. The only significant change in Q_{max} on follow-up was seen in between 3 and 9 months postoperatively ($P = 0.002$).

On comparison of flow patterns in patients with hypospadias in the preoperative and postoperative period [Table 4], no significant difference was found ($P > 0.05$).

DISCUSSION

The causes of abnormal flow pattern in a case of hypospadias could be hypoplastic urethra with poor spongiosal cover, meatal stenosis, and associated bladder over activity preoperatively. Postoperatively, noncompliant neourethra lacking the spongy cover, meatal stenosis, noncompliant glanular part of neourethra due to fibrosis of stretched glans wings and urethral stricture as a complication of hypospadias surgery could lead to abnormal uroflow.

Uroflowmetry is an objective and noninvasive tool to study the functional results of hypospadias repair.^[1-4] However, our study has shown that it is equally important to do preoperative flow assessment if we wish to use the postoperative flow data for clinical benefit. We observed a nearly 50% incidence of preoperative poor flow rates probably inherent to the anomaly which is a huge number. There are limited studies on this aspect in the literature, but all of these have shown variable rates of poor preoperative flow characteristics.^[11-13] This aspect has been shown to be of great clinical significance in our series, in that it sets a benchmark for postoperative flow rates in cases that have good preoperative flows. In our study, all patients who had poor postoperative flows, but good preoperative flows had clinical obstruction needing intervention. Therefore, we suggest that such a finding should alert the surgeon for a possible correctible cause. On the other hand, obstructive flows in the postoperative follow-up carried little significance if the preoperative flows were also poor, which indicates an inherent abnormality and not a true correctible obstruction. Wolfenbittel *et al.*^[12] reported decrease in flow rates after hypospadias surgery even up to 10 years after surgery with the patient remaining asymptomatic. They coined the term “benign flow rate impairment” where the poor flow rate is because of stiff neourethra albeit of normal caliber. It may be impossible to distinguish this from an anastomotic stricture as this will also show poor flow rates. However, on follow-up, the flow

Table 3: Comparison of preoperative and postoperative (at 3, 6 and 9 months) Q_{max} values* in study subjects along with P -values

Uroflow	Preoperative	Postoperative (3 months)	Postoperative (6 months)	Postoperative (9 months)
Mean±SD	10.30±6.08	10.81±8.12	8.90±4.46	11.01±3.90
P -values				
Preoperative	-	0.372	0.299	0.059
Postoperative (3 months)	-	-	0.322	0.002
Postoperative (6 months)	-	-	-	0.062
Postoperative (9 months)	-	-	-	-

*Mean maximum flow rates (Q_{max}) in ml/s preoperatively and postoperatively at 3, 6 and 9 months are shown in Table 2. SD: Standard deviation

Table 4: Comparison of preoperative and postoperative flow patterns in study subjects along with P values

Curve	Number of patients (%)		P
	Preoperative	Postoperative	
Bell	7 (26.92)	8 (30.77)	0.380
Plateau	17 (65.38)	18 (69.23)	0.384
Intermittent	2 (7.69)	0	0.075
Total	26 (100)	26 (100)	

rates in untreated stricture will decrease further, while in benign, the flow rates will improve. Our study suggests that postoperative obstructive flows acquire clinical significance only if the preoperative flows were normal. In this light, studies that do only the postoperative flow rates seem clinically irrelevant.

Poor flow rates after TIP repair are well known in the literature, the reported incidence being 7%–67%.^[4] In our study, it is 70%. However, there are anecdotal contradictory reports such as Pandey *et al.*,^[22] who have reported improved flow rates after TIP repair. Poor flows after TIP repair seem to be related to creation of a tight and fixed obstruction at the level of glans which in most cases is related to mobilization of glans wings and their closure in midline to achieve good results. This is more so when dartos or tunica vaginalis is used for additional soft tissue cover over urethroplasty. Usually, poor anatomy of the glans and urethral plate is a relative contraindication for TIP (Snodgrass) repair, but ultimately, it depends on the surgeon's preference. Three of our patients who despite having poor glans anatomy underwent TIP repair and developed decreased postoperative flows.

In our study, 89% of the cases (8/9) who received circumferentially epithelialized neourethra (either by Snodgraft or Duckett's onlay or Duckett's tube) showed good flow rates postoperatively [Table 2]. A review by Gonzalez *et al.*^[4] also shows low rates of obstruction in patients undergoing Mathieu's repair as compared to those undergoing TIP repair (17.6% vs. 24.6%). Postoperative obstructive flow patterns have been seen in up to two-thirds of the patients (66.7%) who underwent TIP urethroplasty as compared to onlay preputial flap techniques (33.3%), following posterior hypospadias repair.^[4,15] With these observations, it is evident that the secondary epithelialization of TIP repair does not match the functional qualities of a primarily epithelialized surface of Duckett's onlay, Duckett's tube, or Snodgraft repair. Exploration of preoperative and postoperative data in our study suggests a better relationship between flow rates and the type of operation rather than preoperative anatomical factors. This is because, although the patients selected for TIP (Snodgrass) repair have better and favorable

anatomical factors, their functional results were found to be poorer than those undergoing Snodgraft and glans substitution techniques despite having worse anatomical factors. This is possibly because epithelialized neourethra is achieved right at the time of surgery by latter techniques, while in the Snodgrass operation, a raw area is left in the dorsal urethra which is expected to leave some scarring and therefore relatively noncompliant and poor quality urethra.

Further, we have carried out glans substitution in five cases with very unfavorable glans anatomy and found better postoperative flows in all of them. This observation lends credence to the common view including that of ours that one of the main reasons for decreased flow after TIP was tight glansplasty, resulting in increased resistance at glanular urethra. In our technique of glans substitution, once the neo-meatus is formed, a triangular defect is left in the glans which is filled in by a dartos flap brought along with inner preputial skin. The dartos fills the gap and the epithelium serves as the frenulum.

Meatal stenosis is the only consistent anatomic factor, which results in obstructive flow both preoperative as well as postoperative period. Since not all the patients who have poor flows preoperatively had meatal stenosis, there is bound to be other factors inherent to hypospadias resulting in poor flows; probably abnormal glans anatomy and projection of urethral plate onto the glans. In our study, there were 13 cases (50%) with poor glans urethral plate anatomy, and of these, four underwent TIP repair. Three of these developed complications of meatal stenosis and penile torsion. The fourth patient underwent glans substitution along with TIP repair. This observation also lends credence to our belief that the main reason for poor flow outcomes after TIP (Snodgrass) repair is the unfavorable anatomy of glans-meatus complex. Only two out of five patients with meatal stenosis preoperatively had improvement in stream and Q_{max} postoperatively [Table 2]. We also observed in our study that the patients who had subjective weakness of stream postoperatively when kept on home-based meatal dilatation had improvement in flow rates.

As per statistical calculations in our study, there is a significant improvement in the Q_{max} from 3 months postoperative to 9 months postoperative ($P = 0.002$). This suggests that with passage of time after hypospadias surgery, the urethra further improves probably because of resolution of edema and collagen remodeling. The similar view has also been expressed in several other studies.^[5-9,14-22]

Holmdahl *et al.*^[7] 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. Some recent studies however suggested that although uroflow rates tend to improve, they might remain abnormal in the long term.^[5,14]

Andersson *et al.*^[5] evaluated the results of TIP urethroplasty postoperatively and concluded that spontaneous improvement was seen over 7 years of follow-up. However, 32% of the boys still had obstructed flow patterns in them without symptoms. Further, they added that use of TIP repair in proximal hypospadias had worse flows. In our study also, two patients with proximal hypospadias repaired with TIP (Snodgrass) had low Q_{\max} values postoperatively.

Olsen *et al.*^[11] studied 21 infants with hypospadias and compared them with an age-matched control group using an ultrasound probe to measure flow. They concluded that 31% infants with hypospadias void with low Q_{\max} with plateau-shaped curves, as against none in control group. Using same method in 42 patients, Wolffebuttel *et al.*^[12] found plateau pattern in 6% of children before and 41% after surgery. They found that most patients with abnormal postoperative flow also had an abnormal flow preoperatively, suggesting that this finding might reflect a factor inherent to the condition rather than the effect of surgery. In our study also, 75% patients (9/12) with preoperative nonobstructive flow rates had postoperative $Q_{\max} > 5^{\text{th}}$ percentile while 71% (10/14) with preoperative obstructive flow rates remained obstructed ($Q_{\max} < 5^{\text{th}}$ percentile) even after repair. In contrast, in another study performed in older children with preoperative and postoperative uroflowmetry by Tuygun *et al.*,^[13] 25% cases had low preoperative flow rates which normalized after TIP repair.

Malyon *et al.*^[21] also observed low flow rates in hypospadiac population as compared to controls. This finding further supports our results, where more than 50% patients (14/26) had preoperative $Q_{\max} < 5^{\text{th}}$ percentile and 65% (17/26) patients had plateau/flat curve pattern. Majority of the patients in our study with preoperative plateau/flat curve (15/17) or bell-shaped curve (6/7) retained the curve characteristics postoperatively.

Role of preoperative ultrasound in hypospadias patients to detect associated urological abnormalities is limited as shown by our results. Interestingly, Gupta *et al.*^[23] observed 18% incidence of associated renal abnormalities on ultrasound in patients with hypospadias.

Limitations

The biggest limitation of the study is its short duration. Postoperative uroflowmetry assessment was done in all

the patients at 3 months, but only in few cases up to 6 or 9 months. It is mainly because of time constraints while some patients failed to come for follow-up during the study period. Further, selection bias for a particular operation depending on the surgeon's preference could not be excluded.

CONCLUSIONS

Both preoperative and postoperative uroflow evaluation is necessary to translate this information into clinical decision-making. Abnormal uroflow seems to be an inherent aspect of hypospadias in about 50% of cases. Obstructive flow rates are more common after TIP (Snodgrass) urethroplasty. The glans-meatus complex and circumferentially epithelialized neourethra seem to be the most important determinants of postoperative flow rates. If the preoperative flow had been good but postoperative flow is poor, it means subclinical or clinical obstruction and deserves careful follow-up. However, in most patients, the urinary flow rates improve with time.

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Conflicts of interest

There are no conflicts of interest.

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