Problems related to voiding pattern in patients with hypospadias repair: is the problem related to only operation?

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ABSTRACT

Background: Problems related to the urine flow are rather common in hypospadias patients. As these problems are detected during follow-up of urine flow in the post-operative period, it is difficult to determine whether it is a problem emerging secondary to the surgery or it is a congenital condition. **Objective:** The objective of this study was to evaluate the lower urinary tract functions in hypospadias patients with pre-operative and post-operative uroflowmetric examinations and to determine whether it is a complication of the surgery or a congenital condition. **Materials and Methods:** A total of 63 patients who underwent hypospadias surgery and were monitored postoperatively between January 2012 and January 2013 were enrolled in the study. Data about the pre- and post-operative uroflowmetry parameters were collected and compared. **Results:** Of total 83 patients, only 63 (76.8%) patients, whose parent's provided the written consent, were studied. The mean age was 6.9±2.4 years (3–14 years). The mean bladder volume estimated according to the age of the patients was 266.5±71.7 ml. The mean bladder volume before and after the surgery was 179±56 ml and 189±53 ml, respectively, and the bladder volumes were 67% and 71% of the estimated bladder volume, respectively. There was no significant difference between the bladder volumes measured before and after the surgery (p=0.159). Furthermore, no significant change in the measurements regarding the maximum flow rate, time to maximum flow rate, total time of the urine flow, mean flow rate, voided volume, voiding time, and post-void residual volume was observed. **Conclusion:** The uroflowmetry is an easy-to-use, non-invasive, and objective method, which can be used for the early diagnosis of the urethral stricture following the hypospadias surgery and the evaluation of the obstructions in the lower urinary tract.

Key words: *Hypospadias, Uroflowmetry, Voiding pattern*

The incidence of the hypospadias is one in every 300 live male births and is one of the congenital urogenital anomalies, which most commonly require a surgical intervention. The main goal of the hypospadias surgery is to establish a normal appearance and form a functional urethra [1,2]. Problems related to the urine flow are rather common in hypospadias patients. As these problems are detected during the monitoring of the urination in the post-operative period, it is difficult to determine whether the problem is related to the surgical intervention or is a congenital condition [2-5].

The uroflowmetry is an easy-to-use and inexpensive method for the evaluation of the urine flow [2,4,6,7]. In this study, the objective was to evaluate the lower urinary tract functions in hypospadias patients with pre-operative and post-operative uroflowmetric examinations and to determine whether it is a complication of the surgery or a congenital condition.

MATERIALS AND METHODS

A total number of 83 patients who were followed up due to the hypospadias in our clinic between 2012 and 2013, were included in our study with the approval of ethics committee (29/05/2012/41). Only the patients, who were older than 3 years, had no urinary incontinence and were able to feel a full bladder (urge), were enrolled in the study. Patients and their families were informed about the study, the planned intervention was explained in detail and the informed consents were obtained from the patients, who accepted to participate in the study. The participating patients underwent uroflowmetric examination for the urine flow before the surgery during the examination in the outpatient clinic and 2 months after the surgery. The urethral dilatation was performed in patients, who were diagnosed with urethral stricture and the uroflowmetry was repeated after the intervention.

In all patients, the medical history was recorded and physical examination was carried out. The place of the hypospadic meatus, concomitant urogenital anomalies, and the presence of the chordee were examined. The presence of a urinary tract infection was evaluated in patients with complaints related to the urine voiding. Patients, who had no toilet training, urinary incontinence, urine volume more than 100 ml, fistula after the surgery, and urinary tract infection, were excluded from the study, as the urine flow parameters measured with the uroflowmetry would have been affected.

The patients drunk sufficient amount of liquid and waited until they had an urge. After the bladder was full, the uroflowmetry measurements were carried out followed by measurement of the residual urine volumes with the ultrasonographic examination. The residual urine volume was calculated with the multiplication of the horizontal (D1), vertical (D2), and oblique (D3) lengths of the bladder with the coefficient 0.7. Residual urine volume up to 5 ml was defined as a normal volume, whereas a residual urine volume between 5 and 20 ml was defined as a volume over the normal limit. If the residual urine volume was over 20 ml, the measurement was repeated after which a residual urine volume over 20 ml was evaluated as incomplete voiding or abnormal voiding.

The estimated bladder volume was calculated according to the ages of the patients and the results were analyzed with the Siroky nomogram, which was preinstalled in the uroflowmetry device. The results of the pre- and post-operative uroflowmetry measurements were evaluated according to the maximum flow rate, time to maximum flow rate, total time of the urine flow, mean flow rate, voided volume, voiding time, and post-void residual volume.

Statistical analysis was done with the SPSS v15.0 software package, and the analysis of results was performed with the descriptive statistical methods (frequency, percentage, mean, and standard deviation) along with the examination of the normal distribution (Kolmogorov–Smirnov test). Data without a normal distribution were analyzed with the Mann–Whitney U-test, and the results were expressed as minimum and maximum values. Data with normal distribution were tested with Student's *t*-test and standard deviation values were calculated. Wilcoxon signed-rank test was used for the intergroup comparison of the parameters. The results were evaluated at a confidence interval of 95% and significance level of p<0.05.

RESULTS

Of total 83 patients, only 63 (76.8%) patients whose parent's provided the written consent were studied. The mean age was 6.9±2.4 years (3–14 years). According to the Barcat classification, 54 patients (85.6%) were evaluated as the distal group and 9 (14.4%) as middle and proximal group.

The mean bladder volume estimated according to the age of the patients was 266.5±71.7 ml. The mean bladder volume before and after the surgery was 179±56 ml and 189±53 ml, respectively, and the bladder volumes were 67% and 71% of the estimated bladder volume, respectively. The bladder volume was smaller than expected in the hypospadias patients (p<0.001). There was no statistically significant difference between the bladder volumes measured before and after the surgery (p=0.159). Furthermore, no significant change in the measurements regarding the maximum flow rate, time to maximum flow rate, total time of the urine flow, mean flow rate, voided volume, voiding time, and post-void residual volume was observed (Table 1).

Regarding the group with the distal location of the meatus, the maximum flow rate was 9.9±4.1 ml/s and 11.0±4.9 ml/s before and after the surgery, respectively. The increase in the maximum flow rate after the surgery was statistically significant in the same group (p=0.008).

The evaluation of the voiding curves calculated with the uroflowmetry showed that the curve had a bell shape in 35 patients (55.6%) before the surgery and in 44 patients (69.8%) after the surgery (Table 2). The comparison of the voiding curve pattern, pre- and post-operatively, revealed that the percentage of the patients with a plateau-shaped voiding curve declined after the surgery. However, the difference was not statistically significant (p=0.093). The evaluation of the uroflowmetry results with Siroky nomogram showed that 27 patients (42.9%) had an obstruction lower than two standard deviations (<−2 standard deviation); the rate of the patients with the suspicion of obstruction was 42.9% before the surgery and 25.4% after the surgery (Table 2). However, the difference was not statistically significant (p>0.05).

There was no statistically significant difference between the pre-operative and post-operative results in the patients with the proximally located meatus in respect of the maximum flow rate, time to maximum flow rate, total time of the urine flow, mean flow rate, voided volume, voiding time, and post-void residual volume (p>0.05), and the same observations were noted, among the 18 patients (28.6%), who had chordee.

The evaluation of the patients with a bell-shaped and bell-shaped voiding curve pattern before the surgery, both showed that there was no statistically significant difference between the uroflowmetry measurements before and after the surgery regarding the maximum flow time, time to the maximum flow rate, flow time, mean flow rate, voided volume, and residual urine volume (Table 3). In patients with a plateau-shaped curve, the maximum flow rate was 8.4±4.1 ml/s and 10.3±5.1 ml/s before and after the surgery, respectively. The increase was statistically significant (p=0.017), and the statistically significant (p=0.017) mean flow rate was 6.9±3.8 ml/s and 7.5±2.5 ml/s, before and after the surgery, respectively.

13 patients (20.6%) complained of "dar işeme" and strangury in the post-operative period. In the post-operative period, 16 patients (25.4%) were <2 standard deviations according to the Siroky nomogram and were considered in the stricture group. In these patients, the maximum flow rate, mean flow rate, and voiding time were significantly lower compared to the patients, who did not need dilatation (p<0.01). These patients underwent urethra dilatation under general anesthesia. Following the dilatation, the flow rate, mean flow rate, and voiding time improved significantly (p=0.003, p=0.004, and p=0.007). There was no statistically significant difference in the maximum flow (p=0.317) and mean flow rate (p=0.206) after the dilatation compared to the patients, who did not need dilatation.

DISCUSSION

The patients with hypospadias may have an abnormal voiding pattern depending on the dysfunctions of the lower urinary tract,

Table 1: The uroflowmetry results before and after the surgery and ultrasonographic residual urine volumes

Residual urine volume	n	Mean±SD	Minimum	Maximum	p
Maximum flow rate (ml/s)					
Pre-operative	63	10.1±4.1	3	23	0.180
Post-operative	63	10.8±4.8	3	30	
Time to maximum flow (s)					
Pre-operative	63	9.6±5.4	3	31	0.715
Post-operative	63	9.8±8.1	2	48	
Flow duration (s)					
Pre-operative	63	19.2±13.2	7	91	0.829
Post-operative	63	20.5±16.6	7	84	
Flow rate (ml/s)					
Pre-operative	63	8.0±3.3	3	23	0.135
Post-operative	63	8.2±3.0	3	19	
Voided volume (ml)					
Pre-operative	63	169±59	9	377	0.168
Post-operative	63	181±53	87	315	
Voiding time (s)					
Pre-operative	63	21.5±28.9	5	223	0.819
Post-operative	63	19.9±15.9	7	84	
Residual urine volume (ml)					
Pre-operative	63	6±4	0	23	0.093
Post-operative	62	7.1±4.4	0	22	

SD: Standard deviation

Table 2: The voiding curves before and after the surgery and the Siroky nomograms

Voiding curves n (%)	Pre-operative n (%)	Post-operative n (%)	p
Voiding curve pattern			
The bell curve	35 (55.6)	44 (69.8)	0.093
Plateau	28 (44.4)	19 (30.2)	
Siroky nomogram			
<−2 SD	27 (42.9)	16 (25.4)	>0.05
>−2 SD	26 (41.3)	33 (52.4)	
>−1 SD	8 (12.7)	10 (15.9)	
>0 SD	2 (3.2)	4 (6.3)	

SD: Standard deviation

the anomalies of the vesicoureteral junction, prostatic utricle, and abnormally located external urethral meatus. Regarding the post-operative period, in addition to these disorders, the absence of a normal spongy supports to the urethra, the development of stricture in the urethra, particularly in the external urethral meatus may have an adverse effect on the voiding pattern [8]. Urethral stricture is the second common complication in the hypospadias surgery after urethral fistula. Barbagli *et al.* reported in their 19-year series consisting of 1176 patients that 25.5% of the patients developed urethral stricture after the hypospadias surgery. The strictures tend to emerge on the suture line of the proximal anastomosis following the closure of the urethral meatus and glans. This condition manifests itself with the weakening of the urine flow force, strangury, or urinary tract infection within 2 months after the hypospadias repair. Furthermore, the patient may apply with complaints of split stream, urethral fistula, and urinary retention [8-10].

The uroflowmetry is an easy-to-use, non-invasive, and objective test, which can be used for the early diagnosis of the urethral stricture following the hypospadias surgery and the evaluation of the obstructions of the lower urinary tract [8] natural micturation. Uroflowmetry is a method based on the measurement of the change of the urinary flow rate during the natural micturition and its visualization with a two-dimensional graphic [11]. The urine flow is visualized with a graphic of flow rate and time axes (ml/s)/s in the uroflowmetry. The urine flow is a result of the detrusor pressure, the pressure created by the abdominal muscles and applied on the bladder, urethra and sphincter resistance, and other factors impairing or facilitating the urine flow [12].

As far as the reliability of uroflowmetry measurements is concerned, reaching half of the estimated bladder volume at the time of the full bladder according to the age of the patient provides important information about the maximum flow rate, mean flow rate, and the voiding pattern. There are studies demonstrating the significance of the voided urine volumes at least over 100 ml for expressing the maximum flow rate regardless of the age of the patient [11,12]. The maximum flow rate declines in urethral stricture and the bell-shaped flow pattern, which is expected in normal conditions, is not observed. The urinary flow rate enables the mutual evaluation of the urethra and bladder functions. If the bladder functions are normal after the hypospadias surgery, a decrease in the urinary flow rate and the emptying curve pattern are important parameters for the urethral stricture [5,8,13].

Table 3: Pre-operative voiding pattern in patients with bell-shaped and plateau-shaped curves

Pre-operative voiding pattern	Before the surgery		
	Bell curve	Plateau curve	p
Maximum flow rate (ml/s)	11.5±3.5	8.4±4.2	0.001
Time to maximum flow rate (s)	6.6±2.4	13.3±5.8	<0.001
Total urine flow time (s)	14.6±5.8	24.9±17.3	<0.001
Mean flow rate (ml/s)	8.8±2.7	6.9±3.8	0.02
Voiding time (s)	15.9±8.8	24.9±20.9	<0.001

In several studies, with large subject sizes, it was reported that a maximum flow rate under 10 ml/s and below two standard deviations or 5 percentile according to the nomograms may be consistent with the urethral stricture [4,5,13]. The main concern, whether the abnormal flow rate is a component of the malformation and whether the post-operative flow rate is related to the success of the surgery, still persists [5]. Some studies compared the bladder volume, which corresponds to the volume at the time of full bladder in hypospadias patients, with the bladder volume measured in healthy children and found that the bladder volume of hypospadias patients was relatively smaller, and this finding was consistent with our findings [2,6]. The pre- and post-operative mean bladder volumes were 67% and 71% of the estimated bladder volume according to the age, respectively. We believed this finding depended on two factors: The intervention was carried out under the conditions of the outpatient clinic, and the children in this age group have difficulty to feel and express the full bladder.

Gutierrez Segura had conducted a study on 1361 healthy children and analyzed their urination patterns. He demonstrated that the maximum flow rate and mean flow rate increased parallel to the increases in the age and body surface. In the healthy children, who had minimum 100 ml urine volume and a body surface of 1.1^2 m, the maximum flow rate was 17.5±4.5 ml/s, mean flow rate was 10.8±2.7 ml/s, voiding time (flow time) 14.1±4.2 s, and time to the maximum flow rate was 5.8±1.7 s [14]. Holmdahl *et al.* performed a uroflowmetry test on 126 hypospadias patients 2 months after the surgery and measured a maximum flow rate of 10.6 ml/s in patients with distal hypospadias. The maximum flow rate was <10 ml/s in 23 of the patients (49%). The mean flow rate was 6.6 ml/s in 15 patients, who had proximal hypospadias and the maximum flow rate was under 10 ml/s in 87% of the patients [15]. In our study, the maximum flow rate was 10.8±4.8 ml/s in the uroflowmetry analysis, and this result was consistent with the literature. The comparison of this result with the pre-operative maximum flow rate (10.1±4.1 ml/s) showed no statistically significant difference. This finding indicated that the low maximum flow rate in the hypospadias patients might depend on the deformity itself and might not be related to the surgical intervention.

Malyon *et al.* determined that the mean value of the maximum flow rate was 20 ml/s in healthy children and 11 ml/s in patients with hypospadias and demonstrated that the voiding curves of the hypospadias patients were under the curves of the normal population. In the same study, it was shown that the maximum flow rate was lower, flow pattern and its curve and the plateau and urination time were longer in the patients with hypospadias compared to the normal population [7]. In another study, it was demonstrated that in 1/3 of the hypospadias patients, the maximum flow rate was already decreased and the urination curve was plateau-shaped before the surgery [3]. In our study, 44.4% (n=28) of the patients had a plateau-shaped urination curve before the surgery and this percentage dropped to 30.2% (n=19) in the uroflowmetry analysis after the surgery. The urination curve had improved in the remaining nine patients. The results of our study showed that in the hypospadias patients, the maximum flow rate was already lower than normal. Almost half of the patients had an abnormal urination curve which pointed at the necessity of a uroflowmetry analysis before the surgery.

Holmdahl *et al.* performed urethral calibration and dilatation to 26 of 126 patients (20.6%), as they considered urethral stricture in these patients according to the results of the uroflowmetry. In this study, low maximum flow rate and plateau-shaped voiding curve were considered as urethral stricture. These patients underwent urethral calibration and dilatation under general anesthesia. No stricture was determined in 8% of these patients during the examination under general anesthesia [15]. In our study, 25.4% of the post-operative patients (n=16) underwent dilatation - according to the Siroky nomogram in the uroflowmetry, and this rate was consistent with the literature. We determined urethral stricture with the uroflowmetry in three patients, although they had no clinical complaints. Following the dilatation, the maximum flow rate and mean flow rate increased up to the level of the patients, who did not need such an intervention. In our study, the maximum flow rate was 9.9±4.1 ml/s and 11.0±4.9 ml/s in the pre-operative and post-operative periods, respectively, and the difference was statistically significant. The maximum flow rate dropped from 11.7±3.9 ml/s to 9.7±4.2 ml/s after the surgery; however, the difference was not statistically significant. Some studies in the literature reported that the urethral stricture was more common in the patients with proximal hypospadias and the length of the tubularized urethra affects the flow rate, and these findings explained the decline in the post-operative maximum flow rate in our patient group [8,16,17].

CONCLUSION

We conclude that the pre- and post-operative uroflowmetry evaluation is critically important in children with hypospadias. It should be kept in mind that the urine flow parameters and the urination curves are lower in the patients with hypospadias compared to the healthy children. The pre-operative uroflowmetry analysis is important for the evaluation of a suspected urethral stricture. Even though urethral dilatation provides satisfactory result for the treatment of the urethral stricture at the early stage, in patients with a delayed diagnosis urethroplasty may be required.

REFERENCES

1. Snodgrass W, Bush N. Primary hypospadias repair techniques: A review of the evidence. Urol Ann 2016;8:403-8.
2. Van der Werff JF, Boeve E, Bruse` CA, van der Meulen JC. Urodynamic evaluation of hypospadias repair. J Urol 1997;157:1344-6.
3. Jayanthi VR, McLorie GA, Khoury AE, Churchill BM. Functional characteristics of the reconstructed neourethra after İsland flap urethroplasty. J Urol 1995;153:1657-9.
4. Garibay JT, Reid C, Gonzalez R. Functional evaluation of the results of hypospadias surgery with uroflowmetry. J Urol 1995;154:835-6.
5. Wolffenbuttel KP, Wondergem N, Hoefnagels JJ, Dieleman GC, Pel JJ, Passchier BT, *et al.* Abnormal urine flow in boys with distal hypospadias before and after correction. J Urol 2006;176:1733-7.
6. Nevéus T, von Gontard A, Hoebeke P, Hjälmås K, Bauer S, Bower W, *et al.* The standardization of terminology of lower urinary tract function in children and adolescents: Report from the standardisation committee of the international children's continence society. J Urol 2006;176:314-24.
7. Malyon AD, Boorman JG, Bowley N. Urinary flow rates in hypospadias. Br J Plast Surg 1997;50:530-5.
8. Belman AB. Hypospadias. In: Welch KJ, Randolph JG, Ravitch MM, O'Neill JA, Rowe MI, editors. Pediatric Surgery. 4th ed. Chicago: Yearbook; 1986. p. 1286-302.
9. Barbagli G, Perovic S, Djinovic R, Sansalone S, Lazzeri M. Retrospective descriptive analysis of 1,176 patients with failed hypospadias repair. J Urol 2010;183:207-11.
10. Husmann DA, Rathbun SR. Long-term follow up of visual internal urethrotomy for management of short (less than 1 cm) penile urethral strictures following hypospadias repair. J Urol 2006;176:1738-41.
11. Siroky MB. Interpretation of urinary flow rates. Urol Clin North Am 1990;17:537-42.
12. AbdelMagid ME, Gajewski JB. Critical review of the uroflowmetry. Can J Urol 1998;5:569-75.
13. Tuygun C, Bakirtas H, Gucuk A, Cakici H, Imamoglu A. Uroflow findings in older boys with tubularized incised-plate urethroplasty. Urol Int 2009;82:71-6.
14. Gutierrez Segura C. Urine flow in childhood: A study of flow chart parameters based on 1,361 uroflowmetry tests. J Urol 1997;157:1426-8.
15. Holmdahl G, Karström L, Abrahamsson K, Doroszkiewicz M, Sillén U. Hypospadias repair with tubularized incised plate. Is uroflowmetry necessary postoperatively? J Pediatr Urol 2006;2:304-7.
16. Long CJ, Canning DA. Hypospadias: Are we as good as we think when we correct proximal hypospadias? J Pediatr Urol 2016;12:196.e1-5.
17. Snodgrass WT, Bush NC. Management of urethral strictures after hypospadias repair. Urol Clin North Am 2017;44:105-11.

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