The Egyptian Journal of Hospital Medicine (July 2024) Vol. 96, Page 2892-2895

Uroflowmetry As a Long-Term Urological Outcome Assessment of Proximal Hypospadias Cases Repaired by Mansoura Modification of The Koyanagi Technique

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ABSTRACT

Background: There are limited studies considering the long-term functional results following severe hypospadias reconstruction. The modification of Mansoura on the Koyanagi method has shown excellent cosmetic outcome along with reducing possibility of urethral stricture and urethrocutaneous fistulation.

Objective: This study examined whether uroflowmetry alone is sufficient for assessing the long-term functional urological outcome.

Patients and Methods: A review was conducted on 37 patients who underwent Mansoura modification of the Koyanagi technique between 2010 and 2015. Evaluations were carried out, on average of 8 years post-surgery using the "HOSE" questionnaire and uroflowmetry.

Results: The average flow rate was 18.92 ± 4.11 and the maximum flow rate was 26.55 ± 11.72, with a mean "HOSE" score of 15.2 out of a maximum of 16. A statistically significant correlation was noted between the total HOSE score and the maximum flow rate in uroflowmetry ($r=0.745$, $P<0.001$).

Conclusion: Uroflowmetry outcomes correlated with HOSE scores and reflected the long-term functional outcomes of proximal hypospadias repair.

Keywords: Proximal Hypospadias, Modified Koyanagi technique, Long-term follow-up, Uroflowmetry.

INTRODUCTION

What a good hypospadias surgeon wants is to mimic the normal anatomy, to achieve optimal functioning without compromising cosmetic result [(1)]. What is considered normal here is slit like meatus at glanular apex, single forward non-spraying urinary stream, and straight penis during erection [(1)].

Various approaches were attempted over the past years to achieve these goals, using different techniques by utilizing the urethral plate, harvesting buccal or skin grafts or using local flaps from scrotum or prepuce [(2)]. However, no technique showed dominating superiority over the other techniques. Complications like residual chordae or urethral stenosis are still occurring at a considerable rate highlighting the need for further research [(2)].

The Koyanagi technique, introduced in 1983, involves creating a new urethral tube from the parameatal skin. Initially, this method faced challenges due to high complication rates, leading to modifications aimed at improving outcomes [(3)]. The Mansoura modification, developed in the early 2000s, refined the Koyanagi technique to reduce the risks of fistula and stenosis [(4)].

This modified approach has shown promising results, with excellent cosmetic outcomes and a significant reduction in complications [(5)]. With best hands alongside long experience complications rates tend to decline. Our experience in Mansoura showed that over all fistula rate can be as low as 4.8% [(6)]. We usually tend to utilize the Hypospadias Objective Scoring Evaluation (HOSE) questionnaire in our work. Literature review demonstrates that it has strong validity with low interobserver variance.

Holland *et al.* [(7)] proposes that a score equal to or above 14 demonstrates good outcome, while scores from 11 to 13 are considered of moderate outcome. Scores below 11 stand for poor outcome [(8)].

More than half of the hypospadias patients examined by **Jonuzi *et al.*** [(9)] were unhappy about the general outcome. Notably, the severe cases who had more proximal sites of original meatus, were less satisfied than patients with less severe hypospadias [(7)]. Taking into consideration that most patients who underwent correction of their condition will experience normal erection and sexual life, worse cosmetic outcomes can affect their self-esteem and subsequently hinder their sexual experience [(10)].

This study presented the long-term results of 37 patients corrected by the Mansoura modification of the Koyanagi technique between 2010 and 2015. Evaluations were conducted on average 8 years post-surgery, using the "HOSE" questionnaire and uroflowmetry to determine whether uroflowmetry alone is sufficient for assessing long-term functional urological outcomes.

PATIENTS AND METHODS

This cross-sectional cohort study of both the medical and operative records of 37 male patients treated for proximal hypospadias by Mansoura modification of Koyanagi technique at Pediatric Surgery Department, Mansoura University Children Hospital.

During the study period, which was conducted between June 1st 2022 and June 30th 2023, we revised the clinical data of 37 children who went through corrective surgery for severe proximal hypospadias using the Mansoura modification of Koyanagi technique, at Mansoura University Children Hospital between January 2010 and December 2015.

Received: 11/03/2024
Accepted: 08/05/2024

An individual meeting with each patient was arranged. After revision of their personal, medical, and operative history, Uroflowmetry was done and recorded, post voiding volume was assessed by bed side sonography. They were asked to fill in our questionnaire, then the main author assessed every patient and applied the HOSE score on each patient.

Ethical approval

Mansoura Medical Ethics Committee, Mansoura Faculty of Medicine approved this study. After being informed of all the details, each participant' parent provided written consent. Throughout the course of the investigation, the Helsinki Declaration was adhered to.

Statistical analysis

The coded, processed, and analyzed data were done using SPSS version 22.0 for Windows®.

To find out if the data were regularly distributed, the Shapiro Walk test was utilized.

We presented the qualitative data using relative percentages and frequencies. The X^2-test may be used to compare two or more sets of qualitative variables to find their differences. To express quantitative data, the mean ± SD was employed. The independent samples t-test was utilized to compare normally distributed variables (parametric data) between two independent groups. Significant data were defined as having a p-value ≤ 0.05.

RESULTS

The mean age at operation for our group was 14.53 ± 4.46 months with a range from 10 to 38 months. The average follow-up period was 8.31 ± 2.13 years. The distribution of hypospadias was: 72% proximal penile, 11% penoscrotal, 11% scrotal and 6% perineal. "Bell shaped curve" dominated in our study group as 83% of patients had this shape. The average flow rate was 18.92 ± 4.11.

In comparison with normal population's parameters, about 90% of our patient fell within the normal range.

The average HOSE score was 15.19 ± 0.46, with scores ranging from 13 to 16 points. The distribution of HOSE scores was as follows: 87.7% fell into the "good" category with scores of 14 or higher, 47 patients (12.3%) were classified as "average" with scores between 11 and 13, and no patients scored below 11 indicating no poor outcome (Table 1).

Table (1): Hypospadias patient's data

Patient number	Birth year	Original site of the meatus	Maximum urinary flow (ml/s)
1	2015	Proximal penile	31.76
2	2015	Proximal penile	18.60
3	2015	Proximal penile	35.48
4	2015	Proximal penile	34.93
5	2015	Penoscrotal	22.37
6	2015	Proximal penile	34.67
7	2014	Penoscrotal	26.91
8	2014	Proximal penile	33.34
9	2013	Proximal penile	22.52
10	2013	Proximal penile	24.28
11	2013	Penoscrotal	19.21
12	2013	Proximal penile	24.06
13	2014	Proximal penile	16.20
14	2015	Proximal penile	23.56
15	2015	Proximal penile	36.40
16	2015	Proximal penile	22.52
17	2015	Proximal penile	20.57
18	2009	Proximal penile	25.26
19	2009	Proximal penile	34.48
20	2009	Proximal penile	19.80
21	2010	Proximal penile	22.92
22	2011	Penoscrotal	16.20
23	2010	Proximal penile	23.67
24	2010	Proximal penile	36.40
25	2010	Penoscrotal	16.20
26	2015	Penoscrotal	36.40
27	2015	Proximal penile	33.43
28	2015	Proximal penile	32.13
29	2010	Penoscrotal	16.20
30	2012	Proximal penile	26.10
31	2015	Proximal penile	31.70
32	2015	Penoscrotal	36.40
33	2013	Proximal penile	16.20
34	2012	Proximal penile	16.20
35	2015	Proximal penile	28.40
36	2015	Penoscrotal	36.40
37	2010	Penoscrotal	35.98

The distribution of flowmetry findings among the group was briefed in table (2). Majority of our cases exhibited a bell-shaped curve, accounting for 82.7% of the cases. The absence of tower-shaped and staccato-shaped curves was noted, while plateau-shaped curves were present in 9.8% of the subjects. Interrupted curves were observed in 7.5% of the subjects.

Table (2): Flowmetry finding

	Min – Max	Mean ± SD
Time	8.0 – 50.0	22.90 ± 7.93
Volume	50.0 – 246.0	114.99 ± 37.10
Time to max	4.0 – 17.0	6.91 ± 2.29
q average	13.82 – 24.10	18.92 ± 4.11
q max	16.2 – 36.4	26.55 ± 11.72

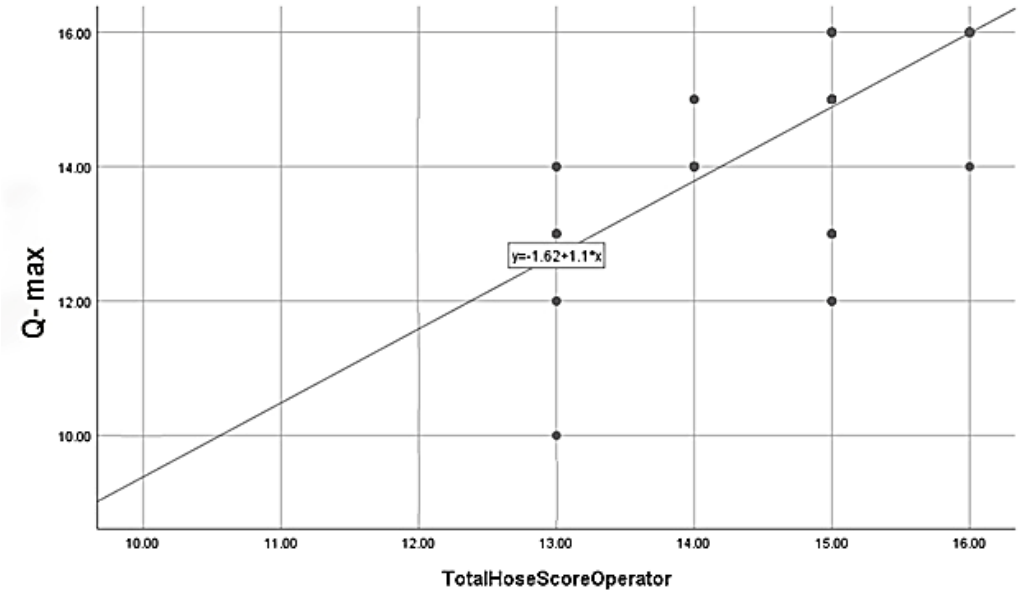

Figure (1): The figure demonstrated a strong positive statistical correlation (r=0.745, P < 0.001) between assessor HOSE scores and Q_{max} values, reinforcing the objectivity and reproducibility of the scoring criteria.

DISCUSSION

Noninvasive objective assessment of the neourethra can only be carried out by uroflowmetry [(11)].

In our study 89% of patients were above the lowest normal range for normal population, with 44% falling above the 50th percentile for age-matched uroflowmetry results. **Malyon *et al.*** [(12)] reported that most hypospadias patients who had surgery fell below the 5th percentile, including those who underwent two-stage hypospadias "Bracka" repair, or even less complex surgeries like MAGPI [(13)]. Similarly, our findings indicated that patients treated with the modified Koyanagi method exhibited normal maximum urinary flow rates [(4)].

Early detection and management of urethral stenosis even if asymptomatic is mandatory. Uroflowmetry represents an ideal tool of accomplishing this job [(14)]. Literature suggests that a low Q_{max} value in comparison with normal parameters of same age and weight is a red flag of meatal stenosis [(15)].

Some authors suggest that scarring from urethral plate manipulation in previous hypospadias repair might theoretically reduce neourethral maximum diameter and rate of flow [(16)].

We believe that this is not a significant issue with the modified Koyanagi technique as scarring of neourethra was very limited due to rich blood supply [(17)]. Comparative analysis of flow rates and quality with other reconstruction methods is needed before drawing conclusions about different techniques [(11)].

Although the long-term effects of asymptomatic stenosis are uncertain, early detection and treatment are advisable. Our study showed that para-meatal skin flap urethroplasties have a generally low risk of stricture formation.

We selected uroflowmetry for evaluating the reconstructed urethra due to its non-invasive, cost-effective, and objective nature. It has proven reliable in assessing children with lower urinary tract symptoms and post-urethroplasty outcomes. Key parameters such as flow pattern and peak flow rate are crucial, with factors like age, body surface area, gender, and voided volume influencing results. Repeated measurements are essential, as flow rates between consecutive tests vary minimally [(11)].

CONCLUSION

Mansoura modification of the Koyanagi technique provides promising results, especially with long learning curve and expert hands. History taking of the shape and intensity of urinary stream and clinical examination of the operative outcome are helpful, but objective assessment using Hose score for anatomical outcome, and uroflowmetry for functional outcome are essential nowadays. In our experience, the Mansoura modification of Koyanagi repair remains a valid option for one-stage repair of severe hypospadias cases, although it entails deep experience and training.

- **Conflict of interest:** None.
- **Fund:** None.

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