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Brief Report

Mechanical Ablation of the Posterior Urethral Valve Omitting Thermal Energy: A Brief Report

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Abstract

Management of the posterior urethral valve (PUV) is a clinical challenge in pediatric urology. We report the results of a modified valve ablation method without using a pediatric resectoscope and thermal energy. Patients were selected from children with PUV who were referred to the pediatric urology clinic of Shahid Labbafinejad Hospital, Tehran, Iran, and have undergone endoscopic valve ablation surgery between May 2019 to May 2021. Ten male patients with PUV underwent mechanical valve ablation without the use of the conventional pediatric resectoscope, and thermal energy was replaced by a 6F semi-rigid urethroscope and 3Fr ureteral catheter. Patients were assessed both pre-and postoperatively using serum creatinine, urinary tract ultrasound imaging, and voiding cystourethrography. The mean age was 23.88±30.13 months (range= 25 days to 8 years). Four out of 10 patients (40%) had elevated serum creatinine, and seven had unilateral or bilateral hydroureteronephrosis (70%). No major complications were reported according to Clavien–Dindo Classification System. The level of serum creatinine, the grade of hydroureteronephrosis, and the ratio of the prostatic urethra to anterior urethra diameter in postoperative voiding cystourethrography were decreased. A decrease in serum creatinine level occurred in patients after valve ablation, but this decrease was not statistically significant (P=0.059). The decrease in hydroureteronephrosis grade on the right (P=0.006) and left (P=0.022) was statistically significant. There was no evidence of urethral stenosis or need for repeating resection. It can be concluded that our mechanical valve ablation method might be a safe and effective technique for PUV ablation.

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Keywords ● Ablation technique ● Posterior urethral valve ● Stricture ● Urethral

What's Known

• The valve ablation technique is a challenging issue in the management of the posterior urethral valve, and in some previous research, the possibility of urethral damage with thermal energy and the size of the used device has been raised. In some studies, the use of a cold knife has been preferred over diathermy.

What's New

• In this study, we performed a mechanical valve ablation technique using a 6F ureteroscope and metal guide of a 3F ureteral catheter. Normally, for mechanical ablation, a pediatric resectoscope and cold knife are used, which have a larger size and are not available in all centers. Our method was safe and effective due to the use of tools with a smaller diameter and no use of thermal energy.

Introduction

Posterior urethral valve (PUV) is a common reason for urethral obstruction in male infants and is a major cause of morbidity and end-stage renal disease in children.[1, 2] Management of PUV is a clinical challenge in pediatric urology, and its management requires a detailed treatment plan from infancy to adulthood to prevent kidney dysfunction and deterioration of the lower and upper urinary tract.[1, 2]

From the surgical aspect of PUV, the intravesical obstruction should be removed by valve ablation. Several methods have been described for valve ablation (cold knife ablation, Fogarty

balloon, hook diathermy electrode, hot loop resectoscope, and valve ablation using Bugbee electrode). Recently, laser ablation has received attention because of its controlled ablation and lower risk of urethral stricture.[3] The method used for valve ablation is chosen depending on the surgeon's opinion and institutional protocols; and so far, no randomized study has been done to compare these methods. The possibility of complications such as postoperative retention and urethral and bladder neck stricture is higher in valve resection with electrical energy and heat than in cold knife ablation.[4-6] Moreover, there are several limitations in the endoscopic resection of PUV, from lack of enough facilities to the very small size of the urethra and its susceptibility to iatrogenic trauma, which prohibits the passage of conventional pediatric resectoscope, especially in a critically ill patient.

In this study, we used a modified method for valve resection without the use of a resectoscope and heat by using the metal guide of a 3F ureteral catheter and a 6F semi-rigid urethroscope.

Patients and Methods

Between May 2019 to May 2021, patients who were referred to the pediatric urology clinic of Shahid Labafineghad Hospital, Tehran, Iran, with a diagnosis of PUV, who underwent mechanical valve ablation, were included in the study. The inclusion criteria were: boys under 10 years of old with radiological and endoscopic evidence of PUV who underwent mechanical valve ablation (thickened bladder wall and classically a dilated and elongated posterior urethra in his ultrasound with or without unilateral or bilateral hydronephrosis and thickened trabeculated bladder, dilatation, and elongation of the posterior urethra in voiding cystourethrography and typical view of valve leaflets in cystourethroscopy). The exclusion criteria were: patients whose urethral valve had previously been manipulated in any way before surgery and ill patients with sepsis and high creatinine level in whom anesthesia and surgery were not possible.

All patients' records including ultrasound, voiding cystourethrography (VCUG), and laboratory tests were evaluated. Serum creatinine level and grade of hydroureteronephrosis were checked and recorded before surgery. The diagnosis confirmation of PUV was done by the pediatric urology fellowship, based on the evaluation of the patient's documents.

At the time of surgery, cystourethroscopy was performed in all cases with a 6Fr semirigid ureteroscope under general anesthesia to confirm the diagnosis of the PUV. Then, we cut the distal end of the 3F ureteral catheter by 1 cm and bent over the end of the metal guide making a hook shape that was easily passed through the 6Fr semirigid ureteroscope (figure 1) (video 1).

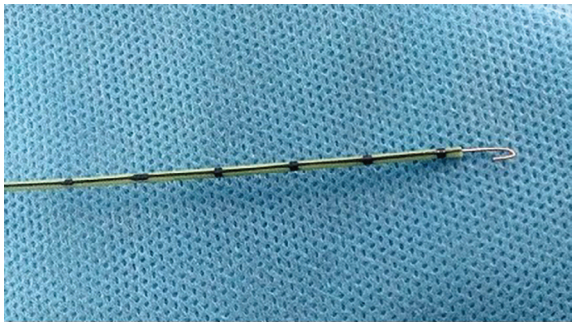

Figure 1: The metal guide head of the 3F ureteral catheter was bent until it became like a hook and could easily pass through the ureteroscope.

After entering the urethra, the most prominent portion of the valve was cut under direct vision by the backward movement of the hook-like guide, at 5 and 7 o'clock, and 12 o'clock without the use of thermal energy and cautery (video 2). A suitable-size Foley catheter was inserted. Patients received oral antibiotics to prevent probable urinary tract infections and were discharged 24 hours after the surgery. The Foley catheter was removed on the third postoperative day, and the patients were visited in an outpatient clinic three weeks later.

Patients were followed by measuring the level of serum creatinine, sonography, and VCUG three weeks after surgery. To evaluate the response to treatment, the ratio of the diameter of the prostatic urethra to the anterior urethra according to VCUG was calculated. Clavien–Dindo Classification System was used to report the complications of surgery.[7]

The authors certify that they have obtained consent forms from patients' guardians. According to the hospital rules, the consent of all the patients was obtained, the consent form was completed, and the benefits and possible side effects of the surgical intervention were explained to the parents of all the patients. All these documents are recorded in the patient's files. This study was approved by the Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran (IR.ARI.MUI.REC.1401.212).

Statistical Analysis

All analyses were performed using IBM SPSS Statistics 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Quantitative variables were expressed as mean±SD, and qualitative variables were expressed as numbers and

percentages. Paired *t* test was used to compare the mean of quantitative variables before and after surgery. P<0.05 was considered statistically significant.

Results

As indicated in table 1, 10 cases were treated. The mean age of patients was 23.88±30.13 months (range=25 days to 8 years). No major complications were reported in patients according to Clavien–Dindo Classification System. In one patient, mild scrotal edema was presented and resolved two days after the surgery. In 90% of cases, the ratio of the prostatic urethra to anterior urethra diameter decreased in postoperative voiding cystourethrography, and there was no evidence of residual valvular obstruction in any patient (figures 2 and 3). Seven patients had bilateral hydroureteronephrosis before the intervention, and in all of them, the grade of hydronephrosis decreased after surgery. The decrease in hydroureteronephrosis grade on the right

Table 1: Pre- and postoperative patient characteristics R/L

Patient	Age at Surgery (months)	Baseline creatinine (mg/dL)	Postoperative creatinine (mg/Dl)	Preoperative hydronephrosis grade (R/L)	Postoperative hydronephrosis grade (R/L)	Results of voiding cystourethrogram
1	0.8	2.5	0.8	4/2	2/1	No obstruction
2	2	0.5	0.5	4/3	2/2	No obstruction
3	3	0.6	0.5	0/0	0/0	No obstruction
4	6	0.5	0.4	3/3	1/3	No obstruction
5	18	1.5	0.5	0/0	0/0	No obstruction
6	24	1.9	0.6	4/2	2/0	No follow-up
7	38	0.7	0.5	¾	½	No obstruction
8	46	0.5	0.5	0/0	0/0	No obstruction
9	50	2	2.1	4/4	4/2	No obstruction
10	96	0.7	0.6	3/0	0/0	No obstruction
Mean±SD	23.88±30.13	1.14±0.76	0.7±0.50			

R/L: Right/left

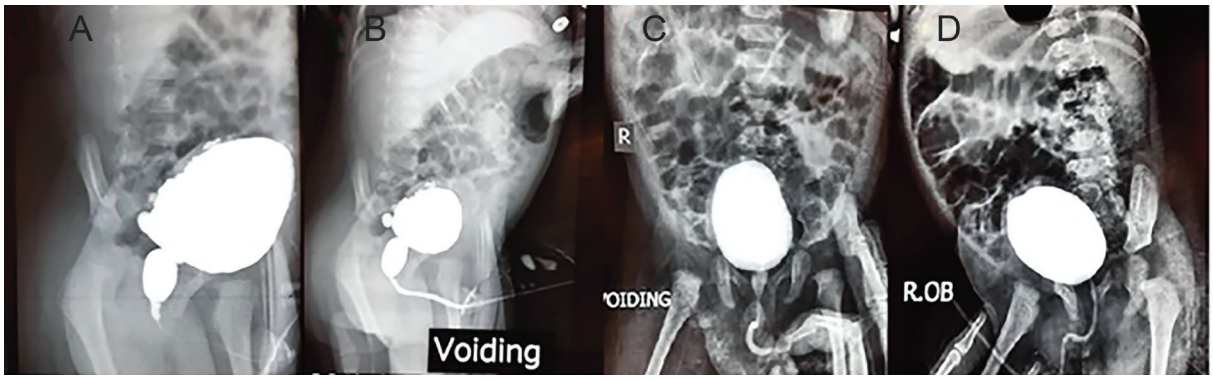

Figure 2: Voiding cystourethrography was performed (A, B) before and (C, D) after surgery in patient number 3.

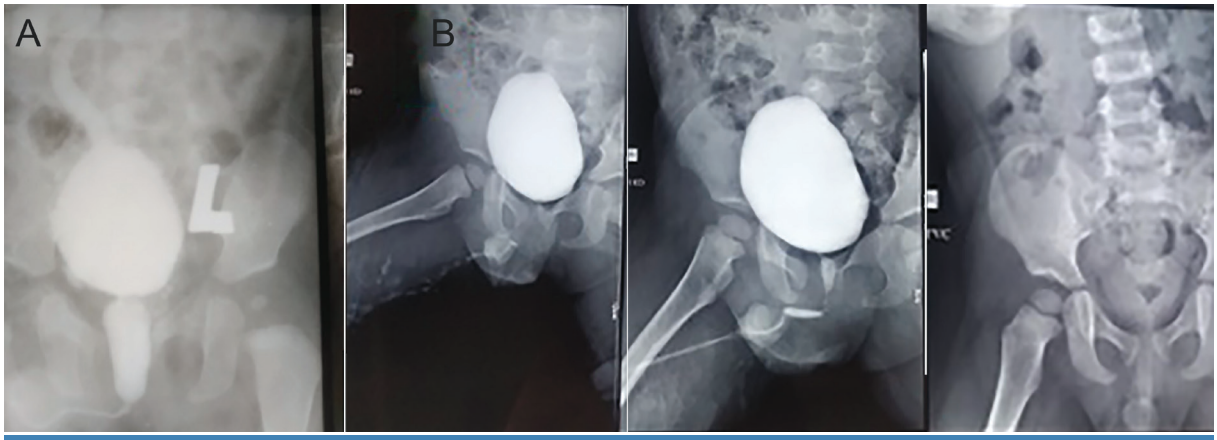

Figure 3: Voiding cystourethrography was performed (A) before and (B) after surgery. The reflux disappeared and the diameter of the posterior urethra decreased significantly.

Table 2: Comparison of creatinine level and hydroureteronephrosis grade before and after surgical intervention (Paired Samples Test)

Variable	Before surgery (mean±SD)	After surgery (mean±SD)	P value
Serum creatinine level (mg/dL)	1.14±0.76	0.7±0.50	0.059
Grade of Left side hydroureteronephrosis (1-5)	2.5±1.78	1.2±1.31	0.006
Grade of right side hydroureteronephrosis (1-5)	1.8±1.68	1±1.15	0.022

(P=0.006) and left (P=0.022) was statistically significant. The serum creatinine level was high in four patients before surgery (mean=1.14±0.76, range=0.5 to 2.5), and in three of them decreased after intervention (mean=0.7±0.50, range=0.4 to 2.1). As shown in table 2, a decrease in serum creatinine level occurred in patients after valve ablation, but this decrease was not statistically significant (P=0.059). There was a dramatic improvement in force and caliber of voiding in all cases, and there was no evidence of urethral stenosis or need for re-resection. No significant bleeding occurred in any of the patients after valve ablation, and there was no need to check hemoglobin in the patients after the surgery.

Discussion

According to the results of our study, in this valve ablation method, the possibility of urethral damage and secondary stenosis is less due to the lack of using thermal energy, and this method is effective in reducing the grade of hydroureteronephrosis and diameter of proximal urethra. PUV is a considerable cause of mortality, morbidity, and persistent renal loss in infant boys.[1, 2, 8, 9] Valve ablation remains a clinical challenge in young boys whose urethra does not accommodate the scope for valve ablation, and in centers where pediatric endoscopic facilities are limited.[1]

Vesicostomy in severely low birth weight is another option. However, it is considered more invasive, and there will be a need for second surgical undiversion and general anesthesia. The prevalence of reduced bladder capacity, impaired compliance, elevated end-filling pressure, and urodynamic detrusor overactivity is higher at an older age in children who were treated initially with diversion or valve ablation than boys who were treated with primary valve ablation. Early treatment enhances the quality of life and prevents constant renal damage.[1, 5] Due to the delicate and accessible instruments used in our method, this technique can be performed even in neonates with PUV and reduces the need for vesicostomy.

The success rate of our method in reducing creatinine and grade of hydroureteronephrosis and vesicourethral reflux was similar to most studies that used other ablation methods.[3, 10] In our study, there was no case of urethral stenosis after mechanical valve ablation. Urethral stricture is a significant complication that occurs in boys treated with transurethral approaches.[4-6] The incidence of urethral strictures or remaining valves causing persistent obstruction ranges from 2% to 50% in various studies. It is due to thermal injury and electro-coagulation of urethral tissue and trauma secondary to instrumentation.[4, 6] In the study of Babu and colleagues in 2013, comparing the results of diathermy and cold knife, the rate of urethral stricture was clearly higher in patients who underwent diathermy ablation.[4] In another study in which a seven-year follow-up was performed on 61 PUV patients, all cases of urethral stricture were patients for whom resectoscope and fulguration were used for valve ablation.[5]

To avoid the risk of thermal ablation, several investigations were done, and successful valve ablation with only mechanical disruption of the valve leaflets has been proved.[9-13] However, sometimes the urethra is very fragile, and even the passage of a specially designed pediatric resectoscope and ablation of the valve with a cold knife is not possible. Several valvulotomes have been used for mechanical valve ablation in different studies, which are smaller in size and perform better in terms of ergonomics of the surgeon's hand. However, these pediatric endoscopic facilities are not available in all centers.[10, 13] In such a conditoion, the current method of using a pediatric ureteroscope and 3F ureteral catheter for mechanical valve ablation could be helpful.

Recently, laser ablation has gained attention because of its controlled ablation and lower risk of urethral stricture due to limited tissue penetration compared to thermal ablation.[3, 14] In the study of Gastaldi and colleagues, a comparison was made between the use of Holmium: YAG laser and fulguration in valve resection. As reported, urethral stenosis was higher in the fulguration group than in the laser group in their study.[3] In cases of laser ablation, the risk of thermal injury does not disappear completely. On the other hand, laser access is not available in all centers. The results obtained by the present method were similar to laser, and

the tool we usedutilized is available in almost all centers. However, the laser is more expensive and not available everywhere.

There are some limitations in our study that should be addressed, including the small sample size and the absence of long follow-up of patients.

Conclusion

Based on our center's experience in the treatment and surgery of these patients, using a resectoscope and heat to destroy the valve can be associated with serious urethral injury, both due to the large size of the equipment and the use of thermal energy. Over time, we found a tendency to use smaller devices and mechanical methods, and we believe that in this safe and effective method, urethral damage and subsequent complications are less likely.

Authors' Contribution

F.Sh: performed experiments, collection and extraction of data, writing the primary draft of the manuscript, providing revisions to scientific content of manuscript and stylistic editing of the final draft; N.S: Conceived the idea and experimental design of the study, performed experiments, collection and extraction of data, analysis and interpretation of data, writing the primary draft of the manuscript, providing revisions to scientific content of manuscript and stylistic editing of the final draft. Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Conflict of Interest: None declared.

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