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Early Outcome of Cold Knife Ablation and Diathermy Fulguration of Posterior Urethral Valve; A Comparative Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Posterior urethral valve (PUV) is the most common obstructive anomaly of the urethra. Urethral valves have a wide range of clinical and anatomical presentations and today most patients are diagnosed in the prenatal or early neonatal period. Cold knife and diathermy fulguration are two of the technique of PUV ablation.
Objective: To find out early outcome of posterior urethral valve ablation between cold knife and diathermy fulguration.
Methodology: This prospective comparative interventional study was conducted in the Department of Pediatric surgery in Dhaka Shishu Hospital (DSH), Dhaka. 54 patients with PUV, admitted for valve ablation during study period were included in this study. Patients were divided in to two group. Among them, 27 were in Group-A, whose PUV ablation were done by cold knife and 27 were in Group-B whose PUV ablation were done by diathermy fulguration. Successful ablation was confirmed under endoscopic vision as well as with the demonstration of good stream following supra pubic compression, at the end of the procedure. All patients were kept with 72 hours of urethral catheterization (All silicon self retaining Foley's catheter according to body texture) .Post PUV ablation pt. were given discharged with prophylactic antibiotics on 4th POD.

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Results: The mean age was found 18.37±16.13 months in cold knife ablation group and 12.70±11.03 months in diathermy fulguration group. Significant number (06/22.2%) of cases were associated with residual valve in diathermy fulguration group and non signicant number (301/3.7%) cases in cold knife ablation group . Significant number (04/14.8%) of cases were associated with post PUV ablation stricture urethra also in diathermy fulguration group and no stricture was found in cold knife ablation group . Significant hematuria. was present in 2(7.4%) in cold knife ablation group and 1(3.7%) in diathermy fulguration group.
Conclusion: This study concludes that use of cold knife in case of ablation of PUV causes less post ablation obstruction (residual valve and stricture urethra) than using diathermy fulguration and can be regarded a safe and better option for PUV treatment.

Keywords: Posterior urethral valve; valve ablation; early outcome; cold knife; fulguration.

1. INTRODUCTION

Posterior urethral valve (PUV) is the most common obstructive anomaly of the urethra , incidence between 1 in 5000 to 1 in 8000 male birth [1]. In 1717, Posterior urethral valves were first described by Morgagni and then by Langenbeck in 1802. They reported PUV as a valve-like folds in dissected cadavers. In inside and outside of the urinary system, it can lead to a spectrum of pathology including acute retention, chronic kidney disease, and in severe cases, pulmonary hypoplasia secondary to low amniotic fluid levels [2]. Being a spectrum of disease that ranges from mild forms that might be diagnosed in childhood and adolescence to severe forms of obstructive uropathy and massive bilateral hydro-ureteronephrosis that are diagnosed prenatally or immediately postnatally . Urethral valves have a wide range of clinical and anatomical presentations and today most patients are diagnosed in the prenatal or early neonatal period [3,4]. The concept of primary treatment for PUVs with endoscopic ablation was advocated in 1929 by Young and McKay [5].

Endoscopic ablation of a PUV is the current gold standard of therapy, but approximately 20% to 30% of patients require a second procedure to achieve satisfactory valve ablation [6]. Early valve ablation and subsequent cyclic bladder filling and emptying without outflow resistance may permit healing of the lower urinary tract and have no adverse effect on potential renal function. Modern pediatric endoscopic equipment allow safe and effective primary valve ablation even in low birth weight neonates [7]. A wide variety of techniques for PUV valve ablation have been reported. The valve leaflet may be ablated by infant loop resectoscope using diathermy hook or cold knife, a 3F bugbee electrode using cutting electrode, with a neodymium: YAG laser, rupture with a Forgarty balloon under fluroscopic control [8]. Cold knife ablation involves in only incision of valve leaflet at different position for relieving the obstruction without production of the thermal energy. Urethral stricture can be a significant complication of transurethral approach of valves ablation, occuring in up to 50% of cases. Due to urethral trauma of instrumentation and thermal heat production may damage to adjacent urethral mucosa or has the risk of energy dissipation to adjacent structures [2]. Cold knife incision of even fleshiest valve encountered minimal bleeding and allows safe, effective ablation of obstructive urethral lesion without risk of thermal injury to external sphincter [9]. Babu and Kumar (2013*)* showed that cold knife ablation is superior to diathermy in relieving PUV obstruction. In this study, author evaluated the early outcome of cold knife ablation over diathermy fulguration in PUV [10].

2. PATIENTS AND METHODOLOGY

This prospective comparative interventional study was conducted in the Department of Pediatric surgery in Dhaka Shishu Hospital (DSH), Dhaka from From March ,2018 to September, 2020.

The protocol was passed from Ethical review committee and consent was taken for each population by informing in detail of the procedures and study. All patients ,admitted with PUV except neonate at Dhaka Shishu (Children) Hospital during study period were study population and 54 patients were included due to time limitation of study period and loss to follow up. Another 28 patients were excluded from the study due to lack of fulfilling inclusion criteria. Patients were divided in to two group. Among them, 27 were Group-A whose PUV ablation were done by cold knife and 27 were Group-B whose PUV ablation were done by diathermy fulguration. If the patient had associated UTI or

sepsis then patient were treated accordingly to resolve them first. Patients were excluded from the study in whom the resectoscope could not be negotiated and with complicated PUV (urinoma, urinary ascites).

Pre operatively initial catheter drainage (size according to body texture) and stabilization with intravenous fluids and antibiotics were started. Micturating cystourethrogram (MCU) was performed in all cases to confirm the diagnosis along with other investigations. If the patient was in dehydration or shock or other complication, then immediate resuscitation was done accordingly. No urinary diversion procedures (e.g: cutaneous vesicostomy,ureterostomy etc.) were needed to perform in pre and post operatively. Patient was positioned at lithotomy

a. b.

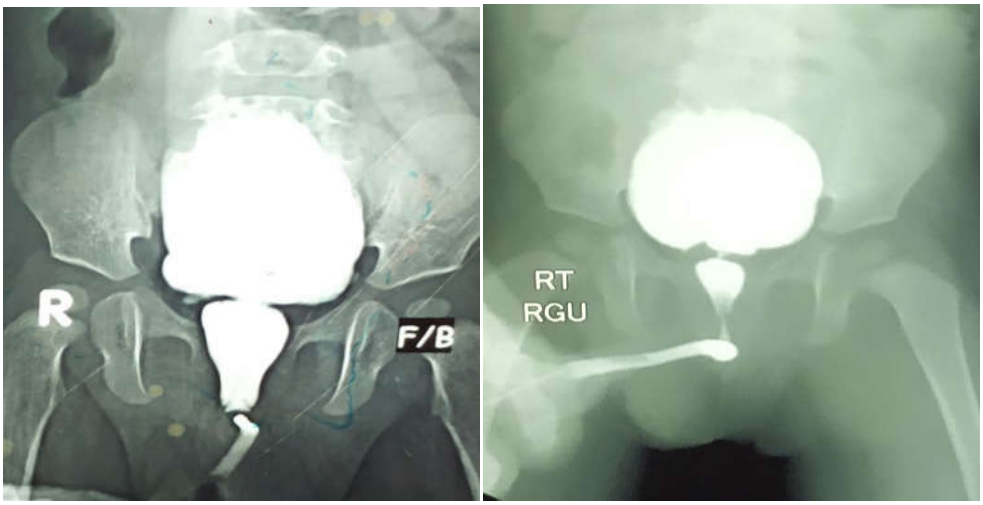

Fig. 1. (a) pre operative MCU showing PUV and (b) 3 months of post ablation MCU showing residual PUV

Fig. 2. Sickle shape cold knife

Fig. 3. Cold knife set with resectoscope working element

position after application of GA. Primary cystoscopic examination was done to see the PUV and UB condition. Then primary ablation was performed with an 10 size resectoscope using “sickle shape cold knife” and diathermy hook (cutting current; minimum power setting). PUV ablations was performed under glycine infusion and valve leaflets were ablated at 5,7 and/or 12 o’clock positions according to position of valve. Successful ablation was confirmed under endoscopic vision as well as with the demonstration of good stream following supra pubic compression, at the end of the procedure. All patients was kept with 72 hours of urethral catheterization (All silicon self retaining Foley’s catheter according to body texture) .Post PUV ablation pt. was given discharged with prophylactic antibiotics on 4th POD. Early complications (Residual valve, urethral stricture, significant haematuria) were documented. At least 3 follow up was given in all patient at 2 weeks,1 months and 3 months after operation. To see early outcome repeat MCU was performed in all patients at 03 months follow-up and patients with poor flow ,narrow stream and MCU having residual valve (dilated and elongated posterior urethra) were considered to have persistent obstruction and taken considered for repeat cystoscopy and intervention if needed. Stricture urethra was also diagnosed from MCU (also RGU) and obstructive symptoms at 03 months post operatively. Long term complications including renal function were not included in this study. Results were compared between 2 groups. Statistical analysis was carried out using the Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The quantitative observations were indicated by frequencies and percentages. Chi square test was used for categorical variables. Unaired t-test was used for continuous variables. P values <0.05 were considered as statistically significant.

3. RESULTS

Majority patients belonged to age 7-12 months in both groups (Table 1), the mean age was found 18.37±16.13 months in cold knife ablation group and 12.70±11.03 months in diathermy hook fulguration group. This is showed in Table 1. The difference was not statistically significant (p>0.05).. Table 2 showing 03 months post operative residual valve. Significant number (06) of cases were associated with residual valve among 27 patients in diathermy fulguration group, which was statistically significant (p value=0.04).In Table 3, 03 months after surgery, significant number (04) of cases were associated with stricture urethra in diathermy fulguration group. Significant hematuria presented in 02 patients in cold knife ablation group and 01 patient in diathermy fulguration group. The difference is not statistically significant, showed in Table 4.

4. DISCUSSION

To see early outcome of PUV ablation ,it is important to see persistent obstruction assessing by the MCU at least 3 months post operatively. If PUV is incompletely ablated which will give obstructive voiding symptom featured and can be confirmed radiologicaly . Obstructive residual valve remnants and stricture urethra can be confirmed by careful clinical, radiological and endoscopic evaluation after surgery [11]. Although, there is no consensus on the cut-off, measurement of the ratio of posterior to anterior urethral ratio from MCU has been reported in many study. A postoperative ratio of more than 1.92 was be taken as alarrning for persistent residual valve, showed by Menon et al. [12] while Gupta et al. [13] Bani Hani et al. [6] considered the ratio value more than this in their study. Type 1,PUV were 94.44%(51/54) , type 3 were 05.56% (03/54) and no case of type 2 PUV was found.

In this study, majority patients were belonged to age between 7-12 months in both groups, the mean age was found 18.37±16.13 months in cold knife ablation group and 12.70±11.03 months in cystoscopic fulguration group. The difference was not statistically significant (p>0.05) between two groups. So,the patient of different age group didn’t have impact on the result of the study group. Babu and Kumar reported, Group II (Cold knife) included 41 (mean age 3.4 months; 12 days to 5 years) while Group I (diathermy hook) included 42 patients (mean age 6.2 months; 10 days to 9 years). The difference was not statistically significant (p>0.05) between two groups [10]. Lal et al. reported all newborns and infants were treated initially on a temporary tubeless diversion and subsequently fulgurated around the age of 9 to 12 months [14]. Shirazi et al. observed that the median ages at the time of ablation for groups A and B were 15 and 7 months, respectively [15].

It was observed in this study that residual valve was presented in 1(3.7%) in cold knife ablation group and 6(22.2%) in diathermy fulguration group, that was statistically significant (p<0.05)

Table 1. Age group distribution of the study population (n=54)

Age group (months)	Cold knife ablation (n=27)		Diathermy fulguration (n=27)		P value
	n	%	N	%	
2-6 months	4	14.8	8	29.6	
7-12 months	10	37.0	9	33.3	
13-24 months	7	25.9	7	25.9	
> 24 months	6	22.2	3	11.1	
Mean±SD	18.37(±16.13)		13.70(±11.03)		0.13

Table 2. Association of residual valve after 3 months of post operatively between study group (n=54)

Residual valve	Cold knife ablation (n=27)		Diathermy fulguration (n=27)		P value
	N	%	n	%	
Present	1	3.7	6	22.2	0.04
Absent	26	96.3	21	77.8	

Table 3. Association of stricture urethra between study group (n=54)

Stricture	Cold knife ablation (n=27)		Diathermy fulguration (n=27)		P value
	n	%	n	%	
Present	0	0.0	4	14.8	0.03
Absent	27	100.0	23	85.2	

Table 4. Association of significant hematuria between study group (n=54)

Significant Hematuria	Cold knife ablation (n=27)		Diathermy fulguration (n=27)		P value
	n	%	n	%	
Present	2	7.4	1	3.7	0.55
Absent	25	92.6	26	96.3	

between two groups. It is the fact that cold knife precisely hold and cut the total valve at a single stroke. On the other hand, diathermy fulguration, there is use of thermal energy at low current and minimum power setting. As there is a chance of inadequate passage of equal current to the total valve, may result inincomplete valve ablation. Babu and Kumar found 2(4.8%) residual valve in cold knife (group II) group and 1(2.4%) in diathermy hook group (group I). The difference was not statistically significant (p>0.05) between two groups [10]. Shirazi et al. observed that decrease the effect of technical components of the initial resection may be the cause of the presence of residual valves [15]. Smeulders et al. reported that micturating cystourethrography alone is inexact for excluding residual valve tissue [16]. We performed cystoscopy in some of our patients. There are no quantitative guidelines for the adequacy of valve ablation . The slightly higher rate of residual valves in our patients (22.2%) in gr-II is as like as most cited studies (20% to 30%) [6].

In this study, stricture was presented in 4(14.8%) in diathermy fulguration group and not found in cold knife ablation group, that was statistically significant (p<0.05) between two groups. Cold knife only incised the valve without use of thermal energy, whereas in diathermy fulguration, there is chance of dissipation of energy to surrounding tissue which may result in increase chance of post operative stricture formation. The stricture occurred in the membranous urethra or at the site of valve fulguration. In the study of Babu and Kumar stricture was found 9(21.4%) in diathermy hook group (group I), but not found in cold knife (group II) group, that was statistically significant (p=.02) between two groups [10]. The incidence of strictures or residual valve causing persistent obstruction ranges from 2% to 50% in various reports [8,13]. Stricture formation after valve ablation occurs infrequently ranging from 0% to 25% [17,18]. Urethral strictures were reported after fulguration in 7 (25%) of 28 patients by Myers and Walker, 3 (8%) of 36 patients by

Crooks , 4 (13%) of 30 patients by Bruce et al. and 3 (3.6%) of 82 by Lal et al. [19,20,21,14]. The outcome were handicapped by confounding factors such as multiple surgeons, techniques or protocols. Sarhan et al. reported urethral strictures developed in 6 patients (2%) mainly after endoscopic loop resection (4/6) [21]. Sudarsanan et al. observed five (8.2%) urethral strictures (all five in fulguration group), eight residual valves (four in each group), and three recurrent urinary tract infections [22]. On the other hand, Nijman and Scholtmeijer in their series of 85 patients including newborns and infants reported a 0% incidence of urethral stricture [17]. Lal et al. reported a post fulguration urethral stricture developed in three of the 82 patients (3.6%) [14]. In this study,it was showed that significant hematuria presented in 2(7.4%) in cold knife ablation group and 1(3.7%) in cystoscopic fulguration group. The difference was not statistically significant ($p>0.05$) between two groups. Significant haematuria were more in cold knife group as cold knife is a sharp instrument and due to injury to urethra by technical fault may result in haematuria. Cold knife incision of even fleshiest valve encountered minimal bleeding [9]. In the study of Babu and Kumar, significant hematuria was found 2(4.8%) in cold knife group and 1(2.4%) in diathermy group. The difference was not statistically significant ($p>0.05$) between two groups. Sarhan et al. observed significant hematuria from urethral bleeding occurred in 2 patient out of 120 patients [8,10].

There was no differences among intra operative complication. Significant haematuria was managed by using catheter traction and I/V hemostatic(amino caproic acid) agent. No further procedure was needed for hemostasis besides these as catheter tube urine was found clear within few hours post operatively. Residual valve cases were re-operated and and stricture were managed by gradual urethral dilatation (n-3) and OIU (optical internal urethrotomy) (n-1). The study was done to see the early outcome and no difference was seen in the view of renal function in between two group.

5. CONCLUSION

This study concludes that, use of cold knife in case of ablation of PUV causes less post ablation obstruction (residual valve and stricture urethra) than diathermy fulguration. This procedure can improve the post PUV ablation outcome which will eventually improve the management of PUV patient and therefore cold knife ablation can be regarded as a better and safe treatment option for PUV.

6. LIMITATION

A number of patients did not full fill the follow up schedule. Majority could not manage to come for schedule follow up due to “CORONA outbreak”. Again, some of the patient’s MCU was done in district level and photo was received via internet technology. So, there is question of those MCU. Resectoscope could not be negotiated in many patients so that a large number of was excluded from this study. This is also a limitation that this study was conducted at a very short period of time.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, patients’ written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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