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Original Research Article

Role of intralesional platelet-rich plasma in enhancing outcomes after internal urethrotomy for short-segment bulbar stricture

Khandaker Mahadi-Ul-Haque[1]*, K. M. Faisal Harun[1], Mahmudul Hasan[1], Sheikh Nazibul Islam[1], Amiya Deb Bhatta[1], Gazi Arifur Rahman[1], Kanij Fatema[2], Mohammad Abdur Rahman[3]

[1]Department of Urology, Bangladesh Medical University, Dhaka, Bangladesh
[2]National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka, Bangladesh
[3]National Institute of Ophthalmology and Hospital (NIO), Sher-E-Bangla Nagar, Dhaka, Bangladesh

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***Correspondence:**
Dr. Khandaker Mahadi-Ul-Haque,
E-mail: dr.arahman41@gmail.com

ABSTRACT

Background: Internal urethrotomy is a minimally invasive treatment for urethral strictures, commonly caused by trauma or infection. Despite its simplicity, the procedure is often followed by stricture recurrence due to scar formation. Platelet-rich plasma (PRP), known for its regenerative properties in various medical fields, has shown promise in enhancing tissue healing and reducing fibrosis. This study aimed to evaluate the effect of intralesional PRP injection on stricture recurrence following internal urethrotomy. To assess the impact of submucosal intralesional PRP injection on recurrence rates after internal urethrotomy in patients with primary short-segment bulbar urethral stricture.

Methods: This prospective, quasi-experimental study included 54 patients equally divided into two groups. All underwent internal urethrotomy; Group A received intralesional PRP injection, while Group B did not. PRP was prepared from autologous blood via centrifugation. Patients were followed at 3-, 6- and 9-months post-procedure to evaluate urinary flow (Qmax), post-void residual (PVR) and stsricture recurrence.

Results: The mean age was comparable between groups. Inflammation was the predominant etiology. Preoperative Qmax and PVR values showed no significant differences. Postoperatively, changes in Qmax and PVR were also not statistically significant. However, stricture recurrence was significantly lower in the PRP group (0% vs. 22.2%, $p<0.05$). No major adverse effects were reported.

Conclusions: Intralesional PRP injection following internal urethrotomy appears to be a safe and effective adjunct, significantly reducing stricture recurrence in primary short-segment bulbar urethral strictures.

Keywords: Internal urethrotomy, Platelet-rich plasma, Short-segment bulbar urethral strictures

INTRODUCTION

Urethral stricture is a persistent urologic condition characterized by fibrotic narrowing of the urethral lumen, commonly resulting from trauma, infection or iatrogenic interventions such as prostate surgery or catheterization.[1,2] Despite being an ancient clinical challenge, its optimal management especially in the bulbar region remains a matter of evolving strategies due to high recurrence rates and variable patient outcomes.[3] The pathophysiology involves excessive collagen deposition and extracellular matrix remodeling, which impairs urinary flow and quality of life. Imaging techniques like retrograde urethrogram (RGU) and voiding cystourethrogram (VCUG) are critical for accurate assessment. Patients may present with recurrent urinary tract infections, LUTS or, in severe cases, complications like renal failure or Fournier's gangrene.[4]

Internal urethrotomy remains a frequently used technique for primary short-segment bulbar strictures but carries a recurrence rate of up to 60% depending on stricture length and etiology.[5] Several adjuvant therapies such as mitomycin-C, triamcinolone, colchicine and captopril have been trialed to reduce recurrence, yet outcomes remain inconsistent.[6-8]

Recently, intralesional PRP has emerged as a promising, autologous biological therapy with regenerative, anti-inflammatory and antimicrobial properties.[9,10] Studies in animal models have demonstrated reduced fibrosis and improved healing post-urethral injury with PRP administration.[11] Clinical research also suggests that PRP may significantly lower stricture recurrence and is generally well tolerated.[12,13]

To date, no published study has investigated the role of PRP injection following internal urethrotomy in the Bangladeshi population. This quasi-experimental study aims to assess the efficacy and safety of PRP as an adjunct to internal urethrotomy for primary short-segment bulbar urethral stricture, with a particular focus on stricture recurrence.

Objectives

General objective

To assess the impact of intralesional submucosal platelet-rich plasma (PRP) injection on stricture recurrence following internal urethrotomy in primary short-segment bulbar urethral stricture.

Specific objectives

To compare Qmax between patients with and without PRP injection post-urethrotomy. To compare PVR urine volumes in both groups. To evaluate and compare procedure-related complications (e.g., bleeding, hematuria, epididymo-orchitis, urethral pain, UTI). To compare the rate of stricture recurrence between the two groups.

METHODS

Study design and setting

This quasi-experimental study was conducted at the Department of Urology, BSMMU, from September 2021 to February 2023.

Study population and sample

The study included male patients aged 18–55 years diagnosed with primary, short-segment (≤1.5 cm) bulbar urethral strictures. Patients were selected for optical internal urethrotomy (OIU) based on inclusion and exclusion criteria.

Inclusion criteria

Male patients aged 18–55 years. Primary short-segment bulbar urethral stricture (≤1.5 cm)

Exclusion criteria

Prior urethrotomy or urethral reconstruction. Concomitant bladder outlet obstruction. History of hypospadias or neurogenic disorders. Suspected or confirmed prostate/bladder cancer. Bleeding diathesis

Ethical approval

Ethical clearance was obtained from the Institutional Review Board (IRB) of BSMMU.

Study groups

Group A

OIU with submucosal autologous PRP injection.

Group B

OIU without PRP injection.

Sampling and sample size

Purposive sampling was used. The calculated sample size was 29 per group. However, due to pandemic-related constraints, 54 patients (27 per group) were enrolled and followed for 9 months.

Data collection

The demographic information, relevant history, examination findings, investigation reports and outcome of PRP of all the study subjects were recorded in the data collection sheet. The data sheets were filled up after taking a brief interview and documents from the patients of both groups. Patients were evaluated for any adverse events associated with CISC.

Data processing and analysis

After completion of data collection, the data were checked and edited manually and verified before tabulation. Data were coded, entered and analyzed on a computer. The 17 statistical analysis was conducted using IBM SPSS (statistical package for social science) Windows version 20 statistical software. After compilation, the data were presented in the form of tables and figures as necessary. Data were expressed as means, median, range and standard deviations for continuous variables and as frequency and percentage for categorical variables. For statistical analysis, The Chi-Square Test and Fisher's exact test were applied to compare categorical data. Student's unpaired t-test (for normally

distributed numerical data) and Mann-Whitney U test (data in skewed distribution) were done to compare continuous data between two groups. P value <0.05 was considered statistically significant.

Research tools:

Patient's treatment records and investigations report, consent form. Data collection sheet.

Ethical consideration

The protocol was submitted to the technical committee of the Department of Urology, Bangabandhu Sheikh Mujib Medical University and was approved. Ethical clearance for the study was taken from the Institutional Review Board of BSMMU before the commencement of this study. The aims and objectives of the study along with its procedure, risks and benefits of this study were explained to the study subjects in an easily understandable local language. Written informed consent was taken from all the study subjects without exploiting any of their weakness. All the study subjects were assured of adequate treatment of any complications developed concerning the purpose of the study. All the study subjects were assured about their confidentiality and freedom to withdraw themselves from the study at any time.

RESULTS

According to Table 1 the age distribution of patients in both groups was comparable. In Group A (PRP group), the majority of patients (33.3%) were in the 35–44 years age range, followed by 29.6% in the 25–34 years group, 25.9% in the 18–24 years group and 11.1% in the 45–54 years group. In Group B (non-PRP group), the highest proportion (40.7%) fell within the 25–34 years range, followed by 29.6% in the 35–44 years group, 14.8% each in the 18–24 and 45–54 years groups.

The mean age was 31.63±8.95 years in Group A and 33.78±9.09 years in Group B. The difference in mean age between the two groups was not statistically significant (p=0.87). Table 2 shows that the mean baseline length of urethral stricture was slightly shorter in Group A (PRP group) compared to Group B (non-PRP group). Specifically, the mean stricture length in Group A was 0.88±0.31 cm, while in Group B it was 0.97±0.30 cm. This difference was not statistically significant, indicating that both groups were comparable in terms of initial stricture length.

Bar diagram showing the locations of stricture in both groups. Eleven patients (40.7%) in group A and 16 patients (59.3%) in group B had proximal bulbar urethral strictures. On the other hand, 16 patients (59.3%) in group A and 11 patients (40.7%) in group B had distal bulbar stricture. There was statistically non-significant difference (p=0.17) in location of stricture between two groups (p value obtained from Chi-square Test). Table 3 shows the etiology of stricture in both groups. The etiology of urethral strictures among study participants showed no statistically significant difference between the two groups (p=0.37). In Group A (PRP group), the most common cause was inflammatory (51.9%), followed by idiopathic (25.9%) and traumatic (22.2%). Similarly, in Group B (non-PRP group), inflammatory causes were also predominant (63%), with traumatic and idiopathic etiologies accounting for 25.9% and 11.1% respectively. These findings suggest that both groups were comparable in terms of underlying causes of stricture formation.

Table 4 shows the comparison of the study subjects by preoperative PVR and Qmax. The baseline PVR urine volume and maximum urinary flow rate (Qmax) were comparable between the two groups. In Group A (PRP group), the mean PVR was 129.59±76.65 ml, while in Group B (non-PRP group), it was 107.52±24.30 ml. The difference was not statistically significant (p=0.15). Similarly, the mean Qmax was 6.83±3.03 ml/sec in Group A and 6.39±2.62 ml/sec in Group B, with no significant difference observed (p=0.57). These findings indicate that both groups had similar baseline urinary function prior to intervention.

Table 5 shows comparison of Qmax of study subjects during follow up. The postoperative Qmax values at 3, 6 and 9 months were comparable between the two groups, with no statistically significant differences observed at any time point. At the 3rd month, the mean Qmax was 22.21±5.74 ml/sec in Group A (PRP group) and 23.74±6.27 ml/sec in Group B (non-PRP group) (p=0.35). At the 6th month, Qmax declined slightly to 20.24±4.67 ml/sec in Group A and 20.88±5.67 ml/sec in Group B (p=0.65). By the 9th month, the mean Qmax further decreased to 17.53±3.67 ml/sec in Group A and 17.63±6.09 ml/sec in Group B (p=0.94). These findings indicate a gradual reduction in urinary flow over time in both groups, but without significant intergroup differences.

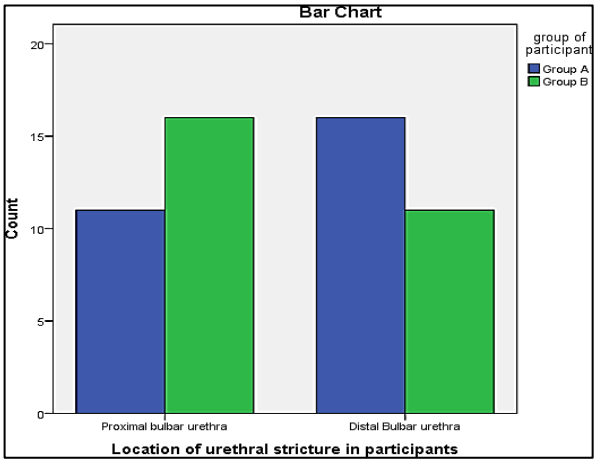

Figure 1: Location of stricture between two groups (n=54).

Table 6 shows a comparison of PVR of study subjects during follow- up. The postoperative PVR values at 3, 6 and 9 months showed no statistically significant differences between the two groups.

At the 3rd month, the mean PVR was 10.59±12.99 ml in Group A (PRP group) and 11.59±14.14 ml in Group B (non-PRP group) (p=0.86). At the 6th month, PVR increased slightly to 12±10.96 ml in Group A and 17.56±19.75 ml in Group B (p=0.48). By the 9th month, the mean PVR was 16.63±10.80 ml in Group A and 23.89±24.41 ml in Group B (p=0.43). Although there was a gradual rise in PVR over time in both groups, the differences remained statistically non-significant throughout the follow-up period.

Table 7 shows no statistically significant differences in the proportion of UTI, hematuria, urethral bleeding, urethral pain and epididymo-orchitis between groups. Postoperative complications were generally minor and did not differ significantly between the two groups. The most common complication was urinary tract infection (UTI), occurring in 48.1% of patients in Group A (PRP group) and 29.6% in Group B (non-PRP group) (p=0.16). Hematuria was reported in 7.4% of Group A and 11.1% of Group B. Urethral bleeding occurred in 14.8% of Group A and 11.1% of Group B, while urethral pain was noted in 11.1% of Group A and 14.8% of Group B. Epididymo-orchitis was observed in 11.1% of Group A and 18.5% of Group B. None of these differences were statistically significant, indicating a similar safety profile between the two groups.

Table 8 shows the comparison of recurrence of urethral stricture between the two groups. At the end of the 9-month follow-up period, a significant difference in stricture recurrence was observed between the two groups.

In Group A (PRP group), none of the patients (0%) experienced recurrence, whereas in Group B (non-PRP group), 6 patients (22.2%) developed recurrent strictures. This difference was statistically significant (p=0.02), suggesting a potential protective effect of intralesional PRP injection in preventing stricture recurrence following internal urethrotomy.

Table 1: Age distribution of patients in two groups (N=54).

Age (in years)	Group A, n=27 N (%)	Group B, n=27 N (%)	P value
18-24	7 (25.9)	4 (14.8)	
25-34	8 (29.6)	11 (40.7)	
35-44	9 (33.3)	8 (29.6)	0.87^{ns}
45-54	3 (11.1)	4 (14.8)	
Mean±SD	31.63±8.95	33.78±9.09	

N=Total number of patients n=Observed number of patients.

Table 2: Comparison of baseline length of urethral stricture in participants (n=54).

Groups	Stricture length Mean±SD
Group A	0.88±0.31
Group B	0.97±0.30

N=Total number of patients.

Table 3: Comparison of etiology of urethral stricture between groups (n=54).

Stricture etiology	Group A, n=27 N (%)	Group B, n=27 N (%)	P value
Idiopathic	7 (25.9)	3 (11.1)	
Inflammatory	14 (51.9)	17 (63)	0.37^{ns}
Traumatic	6 (22.2)	7 (25.9)	

Chi-square Test was done, ns=Not significant, N=Total number of patients, n=Observed number of patients. Figure within parenthesis indicates percentage.

Table 4: Comparison of preoperative PVR and Qmax between study groups (n=54).

Variables	Group A, n=27 Mean±SD	Group B, n=27 Mean±SD	P value
PVR (ml)	129.59±76.65	107.52±24.30	0.15^{ns}
Qmax (ml/sec)	6.83±3.03	6.39±2.62	0.57^{ns}

Unpaired-t-test was done N=Total number of patients ns=Not significant, IPSS=International prostate symptom score, PVR=Post void residue, Qmax=Maximum urinary flow rate.

Table 5: Comparison of maximum urinary flow rate (Qmax) of the study groups during follow-up.

Qmax	Group-A, n=27	Group-B, n=27	P value
At 3rd month (Mean±SD)	22.21±5.74	23.74±6.27	0.35
At 6th month (Mean±SD)	20.24±4.67	20.88±5.67	0.65
At 9th month (Mean±SD)	17.53±3.67	17.63±6.09	0.94

Unpaired-t-test was done N=Total number of patients ns=Not significant, Qmax=Maximum urinary flow rate.

Table 6: Comparison of post void residual urine between study groups during follow-up.

PVR	Group-A, n=27	Group-B, n=27	P value
At 3rd month (Mean±SD)	10.59±12.99	11.59±14.14	0.86^{ns}
At 6th month (Mean±SD)	12±10.96	17.56±19.75	0.48^{ns}
At 9th month (Mean±SD)	16.63±10.80	23.89±24.41	0.43^{ns}

Mann-Whitney U test was done, N=Total number of patients ns=Not significant, PVR=Post void residue.

Table 7: Comparison of complications associated with CISC in study participants.

Complications	Group A n=27, N (%)	Group B n=27, N (%)	P value
UTI	13 (48.1)	8 (29.6)	0.16
Hematuria	2 (7.4)	3 (11.1)	1.00
Urethral bleeding	4 (14.8)	3 (11.1)	1.00
Urethral pain	3 (11.1)	4 (14.8)	1.00
Epididymo-orchitis	3 (11.1)	5 (18.5)	0.70

Fisher's Exact test was done ns=not significant, N=Total number of patients, n=Observed number of patients, UTI=Urinary tract infection, Figure within parenthesis indicates percentage.

Table 8: Comparison of recurrence of stricture in study participants (N=54).

Recurrence of stricture	Group A n=27, N (%)	Group B n=27, N (%)	P value
Recurrence	0 (0)	6 (22.2)	0.02^{ns}
No Recurrence	27 (100)	21 (77.8)	

Fisher's Exact test was done s=significant, N=Total number of patients, n=Observed number of patients, Figure within parenthesis indicates percentage.

DISCUSSION

Optical internal urethrotomy (OIU) remains a commonly used minimally invasive procedure for short-segment bulbar urethral strictures, however, recurrence remains a major limitation due to secondary intention healing and fibrosis.[1-5] Various adjunctive agents including mitomycin-C, steroids, colchicine and captopril have been trialed with inconsistent outcomes.[6-8] This study evaluated intralesional PRP as a regenerative adjunct to OIU to reduce stricture recurrence.

There were no significant differences in age, baseline stricture length or urinary parameters between groups, consistent with findings from Rezaei et al.[12] Stricture etiology in this study was predominantly inflammatory, differing from instrumentation-related etiologies reported elsewhere.[12] Baseline urinary flow measures were comparable between groups. Across the 3, 6 and 9 months follow-up, postoperative Qmax and PVR remained statistically similar between PRP and non-PRP groups. Although minor deterioration in urinary parameters occurred over time, the pattern did not differ significantly. Earlier studies did not evaluate serial Qmax and PVR post-OIU, making this dataset a useful contribution. Complications, primarily minor in nature such as UTI and urethral discomfort, were comparable between groups and consistent with prior PRP studies.[12,13] Importantly, no major postoperative events were observed, reaffirming the safety profile of PRP.

The most important finding is the significantly lower recurrence rate in the PRP group (0% vs. 22.2%). This aligns with Rezaei et al, who demonstrated reduced recurrence at 12 months among patients treated with PRP.[12] Biological plausibility is supported by PRP's high concentration of growth factors including PDGF, VEGF and TGF-β which modulate inflammation, promote tissue regeneration and reduce fibroblast-mediated collagen deposition.[9,11] Preclinical studies have shown reduced collagen I/III ratios in PRP-treated urethral injury models, supporting its anti-fibrotic mechanism.[11] Additional clinical work demonstrates enhanced graft vascularity and improved healing with PRP.[14]

This study is limited by its reduced sample size, restricted follow-up period and lack of long-term recurrence assessment beyond 9 months. Prior research suggests

recurrence may rise after 12–24 months, highlighting the need for extended observation.[5] Future multicenter randomized trials with standardized PRP protocols and longer follow-up are warranted.

Due to the pandemic situation calculated sample size could not be reached and follow-up of participants was difficult. Standard quality of PRP couldn't be ensured.

CONCLUSION

Based on study results, it can be concluded that submucosal intralesional PRP injection at the time of internal urethrotomy for short-segment bulbar urethral stricture is safe and effective in the prevention of stricture recurrence.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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