International Surgery Journal
Bagchi PK et al. Int Surg J. 2020 Mar;7(3):774-780
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20200821

Original Research Article

An audit of management of male urethral stricture and it's outcome: a single centre retrospective review

Puskal Kumar Bagchi, Sarbartha K. Pratihar*, Rajeev T. P., Sasanka K. Barua, Debanga Sarma, Mandeep Phukan

Department of Urology and Renal Transplant, Gauhati Medical College and Hospital, Guwahati, Assam, India

Received: 01 February 2020
Revised: 13 February 2020
Accepted: 14 February 2020

***Correspondence:**
Dr. Sarbartha K. Pratihar,
E-mail: psarbarthakumar@gmail.com

ABSTRACT

Background: Anterior urethral stricture involves penile, bulbar or panurethra with varied aetiology. Direct vision internal urethrotomy (DVIU), stricture excision with primary end to end anastomosis, single stage or staged reconstruction with local flap or buccal mucosal graft (BMG) are surgical options.
Methods: This single centre retrospective study was conducted from April 2017 to March 2019. Patient underwent DVIU, stricture excision with primary end to end anastomotic, staged urethroplasty, BMG urethroplasty (BMGU) dorsal inlay Asopa technique, dorsal onlay Kulkarni technique and ventral onlay technique depending on site and extent of strictures. Preoperative, intraoperative, post-operative data were reviewed.
Results: Here, 51 patients underwent DVIU for single soft short segment bulbar urethral stricture with success rate 58.82%. 26 patients with post traumatic short segment bulbar urethral stricture underwent excision and primary end to end anastomosis with success rate 92.31%. Patients with long segment bulbar urethral stricture underwent either dorsal onlay (n=19) or ventral onlay (n=14) BMGU with success rate 89.47% and 85.71% respectively. Total 59 patients with long segment penile or pan urethral stricture underwent either single stage (n=27) or staged reconstruction (n=32) with success rate of 85.18% and 90.63% respectively. Patients with staged reconstruction had significantly longer hospital stay ($p<0.0001$) and poor quality of life due to laid opened urethra. Asopa's dorsal inlay (n=15) and Kulkarni's dorsal onlay (n=12) BMGU had equivalent success rate of 86.67% and 83.33% and comparable complications.
Conclusions: Surgery for urethral stricture differs according to site and extent of stricture. Single stage BMG urethroplasty is preferred modality for long segment bulbar, penile and panurethral stricture.

Keywords: Asopa's dorsal onlay BMGU, DVIU, Kulkarni's dorsal onlay BMGU, Stricture excision with primary end to end anatomosis, Urethroplasty, Ventral onlay

INTRODUCTION

Male urethral stricture is relatively common urological problem, with the highest prevalence in underdeveloped countries. It has an incidence rate as high as 0.6% in some susceptible populations.[1] Meta-analysis of the literature has shown that most anterior urethral strictures are iatrogenic (33%), idiopathic (33%) and, to a lesser extent, trauma (19%) and inflammation (15%).[2] For diagnosis and extent of the disease retrograde urethrogram (RGU) can be better combined with voiding cystourethrogram (VCUG) or micturating cysto-urethrogram (MCU).[3] There are many surgical procedures for urethral strictures like urethral dilatation, direct vision internal urethrotomy (DVIU), excision of stricture and primary end to end anastomosis, single stage

with graft or local flap and staged reconstruction. DVIU, a minimally invasive modality is employed in single, soft, short segment bulbar urethral stricture (<2 cm).[4] For traumatic bulbar urethral strictures ≤2 cm excision of the stricture and primary end-to-end anastomosis is the "gold standard, and is durable with 90-95% success rate.[5] For long- segment non traumatic urethral stricture, buccal mucosal graft urethroplasty (BMGU) is the standard of care.[6] Surgery for panurethral stricture, involving both penile and bulbar urethra, include a single- or a staged reconstruction.[7]

We performed this study to retrospectively review the spectrum of anterior urethral stricture. We also reviewed the treatment options, efficacy and complications associated with each procedure performed.

METHODS

This is a retrospective study and was carried out in the department of Urology, Gauhati Medical College Hospital, Guwahati, India after obtaining institution ethical committee clearance. Study period was from April 2017 to March 2019.

We reviewed the clinical records and follow up data of patients with urethral stricture. All patients who underwent surgical intervention for urethral stricture disease during this period were included except those mentioned in exclusion criteria.

Exclusion criteria

Pediatric age group, patients with previous history of urethral surgery, complex urethral stricture particularly with urethrocutaneous and rectourethral fistula and malignant urethral stricture

We evaluated the records of the patient as preoperative data, surgical procedure and intra-operative parameters and post-operative follows up data

Preoperative data

Preoperative evaluation included detailed clinical history with local examination, general and systemic examination including oral examination and investigations such as urinalysis to rule out any active urinary tract infection, renal function test, ultrasonography of kidney, ureter, bladder, prostate (KUBP) region with post void residual urine, uroflowmetry to document peak urinary flow rate (Qmax), retrograde urethrography and micturating cystourethrography (RGU and MCU) to evaluate the site and extent of urethral stricture.

Surgical procedure and intraoperative parameters

Non obliterative short segment bulbar urethral stricture (<1.5-2 cm) was managed with DVIU. Patients with short segment post traumatic urethral stricture (≤2 cm) underwent excision of stricture and primary end to end anastomotic urethroplasty. Patients with long segment bulbar urethral stricture needed either dorsal onlay BMGU as described by Kulkarni et al or ventral onlay BMGU as described by Wessells.[8,9] Patients with long segment penile and panurethral stricture underwent either single stage BMGU or staged urethroplasty. Staged reconstruction was done as described by Johanson (Figure 1).[10] In first stage structured part of urethra was laid opened and urethral margin sutured with skin margin. After 4-6 months second stage urethroplasty was performed with dorsal inlay BMG. In single stage reconstruction for penile or panurethral strictures either Asopa's technique dorsal inlay (Figure 2a) or Kulkarni's technique dorsal onlay (Figure 2b) BMGU was done.[8,11]

Figure 1: Laid opened urethra in Johansson stage 1 urethroplasty.

Intraoperative parameters were operative time, volume of blood loss. On table urethroscopy was done to evaluate stricture length, condition of urethra and any obliterative lumen.

All patients received broad spectrum antibiotic preoperatively 1 hour before induction of anesthesia and continued postoperatively. First dressing of the urethroplasty wound site was done at 48 hours of surgery and daily till discharge from hospital. Patients were discharged with per urethral catheter in situ and on oral antibiotic. All patients were advised to report for any wound related complications. Authors did per catheter RGU study at 21 days post operatively in all urethroplasty patients. Those without any extravasation, per urethral catheter (PUC) was removed while PUC was kept 1more week in case of extravasation. Patients with successful voiding trial were sent home with advice for follow up protocol.

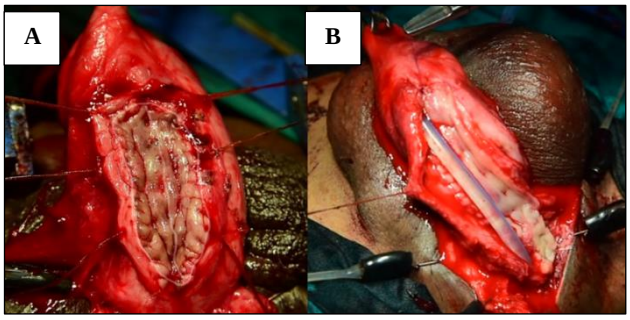

Figure 2: (a) Asopa's technique incorporation of BMG graft as dorsal inlay fashion in penile urethra (b) Kulkarni's technique incorporation of BMG graft as dorsal onlay fashion in penile urethra.

Post-operative follow up

We have follow up data upto 6 months of all the patients. Qmax was recorded at 3 and 6 months follow up. All patients underwent RGU and MCU at 6 months. Patients with recorded poor urinary flow (Qmax <15 ml/s) and typical box shaped curve in Uroflowmetry during the follow up underwent RGU+MCU and urethroscopy. Complications were recorded during each visit. Patients with redevelopment of stricture that required any surgical intervention was considered as failure.

Statistical analysis

Data received were plotted into excel sheet on MS Office Excel 2007. We used unpaired t-test to detect the difference between the intervention arms. The categorical data were analyzed by Fisher's exact test. The p value <0.05 was considered significant.

RESULTS

Total 51 patients underwent DVIU for short segment urethral stricture. Mean age of the patients was 39.8 years with range from 17 to 72 years. Mean stricture length was 1.6 cm ranging from 0.8 cm to 2 cm. Mean Qmax (ml/s) was 5.12 with standard deviation of 2.74. Patients were followed up at 3 month and 6 months post operatively. Success rate at 3rd month was 76.47% while at 6th month was 58.82% (Table 1). In this study 26 patients were found to have post traumatic short segment bulbar urethral stricture. They underwent stricture excision and primary end to end anastomotic urethroplasty. Crural separation was done in 11 (42.31%) patients (Table 2).

Patients were followed up at 3month and 6 months postoperatively. Success rate at 3rd month was 96.15% while at 6th month it was 92.31% (Table 2).

In this study total 33 patients had long segment bulbar urethral stricture. BMG urethroplasty in the form of dorsal onlay and ventral onlay were done in 19 (57.58%) and 14 (42.42%) patients respectively. Preoperative and intraoperative parameters did not differ significantly between the two groups (Table 3).

Table 1: Preoperative and intra operative parameters, follow up data of patients undergoing DVIU.

Parameters	Values
Number of patients	51
Mean age (years)	39.8 (17-72)
Mean stricture length (cm)	1.6 (0.8 -2)
Mean preoperative Q_{max} (ml/s) ±SD	5.12±2.74
Q_{max} at 3 months (ml/s) (mean±SD)	18.12±5.02
Q_{max} at 6 months (ml/s) (mean±SD)	16.41±4.69
Success rate at 3 months (n=39)	76.47%
Success rate at 6 months (n=30)	58.82%
Failure rate at 3 months (n=12)	23.53%
Failure rate at 6 months (n=21)	41.18%

DVIU was performed for short soft single bulbar urethral stricture. DVIU: direct vision internal urethrotomy; Qmax: peak urinary flow rate by uroflowmetry; SD: standard deviation.

Table 2: Preoperative, intraoperative and postoperative parameters of patients with short segment bulbar urethral stricture.

Parameters	Values
Number of patients	26
Mean age (years)	47 (17-62)
Patient needed crural separation	11 (42.31%)
Q_{max} at post-operative 3 months (ml/s) (mean±SD)	16.78±3.15
Q_{max} at post-operative 6 months (ml/s) (mean±SD)	16.36±3.57
Success rate at post-operative 3 months (n=25)	96.15%
Success rate at post-operative 6 months (n=24)	92.31%

Qmax: peak urinary flow rate by uroflowmetry; SD: standard deviation.

On follow up of these patients Qmax and success rate at 3rd and 6th month were not statistically significant between the groups. Complications like donor site complication, wound infection, wound hematoma were also comparable between the two groups. Infection was presumed to be the main cause of failure (2 in dorsal onlay group and 1 in ventral onlay group) at 3rd month (Table 4).

In this study 59 patients had long segment penile urethral or panurethral stricture. 27 patients (45.76%) among them underwent single stage BMGU, 32 patients (54.24%) underwent staged reconstruction. The two groups didn't differ significantly in mean Qmax, mean stricture length, length of the harvested graft. Staged reconstruction group patients had double hospital

admission for surgery. So mean hospital stay was significantly higher in this group (p<0.0001). Quality of life was significantly affected due to brunt of laid opened urethra for 4-6 months (Table 5).

Table 3: Preoperative and intraoperative parameters of dorsal and ventral onlay BMGU groups.

Parameters	Dorsal onlay	Ventral onlay	P value
Number of patients	19	14	
Mean age (years) (mean±SD)	46.7±24.67	42.5±22.30	0.51
Mean stricture length (mean±SD)	3.92±1.45	4.14±1.34	0.45
Mean Q_{max} (ml/s) (mean±SD)	5.12±2.74	5.45±2.83	0.33
Duration of surgery (minutes) (mean±SD)	124.75± 20.67	121±19.89	0.52
Length of harvested graft (cm) (mean±SD)	6.09±1.56	6.17±1.32	0.15

Qmax: peak urinary flow rate by uroflowmetry; SD: standard deviation; p<0.05 significant difference.

Table 4: Post-operative follow up data and complications of dorsal and ventral onlay BMGU groups.

Parameters	Dorsal onlay	Ventral onlay	P value
Number of patients	19	14	
Q_{max} at 3 months (ml/s) (mean±SD)	18.34±4.38	17.95±3.94	0.26
Q_{max} at 6 months (ml/s) (mean±SD)	17.23±3.87	17.76±3.56	0.40
Success rate at 3 months	94. 73% (n=17)	92.86% (n=13)	0.82
Success rate at 6 months	89.47% (n=16)	85.71% (n=12)	0.74
Complications			
Donor site complication	1 (5.26%)	1 (7.14%)	0.82
Wound infection	2 (10. 53%)	1 (7.14%)	0.74
Wound hematoma	0 (0%)	1 (7.14)	0.24

Qmax: peak urinary flow rate by uroflowmetry; n: number of patients; SD: standard deviation; p<0.05 significant difference.

Table 5: Preoperative and intraoperative parameters of single stage and staged reconstruction groups.

Parameters	Single stage	Staged reconstruction	P value
Number of patients (N)	27	32	
Penile stricture (N)	20	22	
Panurethral stricture (N)	7	10	
Mean age (years) (mean±SD)	38.34±12.30	43.5±15.67	1.38
Mean Q_{max} (ml/s) (mean±SD)	5.72±2.39	4.13± 1.98	0.15
Mean stricture length (cm) (mean±SD)	6.7± 2.34	7.21± 2.38	0.82
Length of harvested graft (cm) (mean±SD)	7.57 ± 1.56	8.25 ± 1.32	0.96
Mean hospital stays (days) (mean±SD)	4.23±1.41	10.38 ± 1.26	<0.0001

Qmax: peak urinary flow rate by uroflowmetry; n= number of patients; SD: standard deviation; p<0.05 significant difference.

On follow up of these patients Qmax and success rate at 3rd and 6th month were statistically not significant between the groups. Complications like donor site complication, wound infection, wound hematoma were also comparable between the two groups. Infection was presumed to be the main cause of failure (2 in single stage group and 2 in staged reconstruction group) at 3rd month (Table 6).

Table 6: Post-operative follow up data of single stage and staged reconstruction groups.

Parameters	Single stage	Staged reconstruction	P value
Q_{max} at 3 months (ml/s) (mean±SD)	17.75±4.05	17.14±3.34	0.74
Q_{max} at 6 months (ml/s) (mean±SD)	16.82±3.42	16.40±4.75	0.32
Success rate at 3 months	92.59 (n=25)	93.75% (n=30)	0.86
Success rate at 6 months	85.18% (n=23)	90.63% (n=29)	0.52
Complications			
Donor site complication (N)	1 (3.70%)	2 (6.25%)	0.82
Wound infection (N)	3 (11. 11%)	2 (6.25%)	0.51
Wound hematoma (N)	1 (3.70%)	1 (3.12%)	0.90

Qmax: peak urinary flow rate by uroflowmetry; n: number of patients; SD: standard deviation; p<0.05 significant difference.

Table 7: Preoperative and intraoperative parameters of Asopa dorsal inlay and Kulkarni dorsal onlay groups.

Parameters	Asopa's dorsal inlay BMGU	Kulkarni's dorsal onlay BMGU	P value
Number of patients (N)	15	12	
Mean age (years) (mean±SD)	36.56±13.40	39.43±12.67	0.289
Mean Q_{max} (ml/s) (mean±SD)	5.36±2. 23	5.98±2.45	0.248
Mean stricture length (cm) (mean±SD)	6. 82±2.54	7.15±2.16	0.82
Length of harvested graft (cm) (mean±SD)	7.57±1.56	8.25±1.32	0.28
Mean hospital stays (days) (mean±SD)	4.04±1.54	4.41±1.36	0.26

Qmax: peak urinary flow rate by uroflowmetry; n= number of patients; SD: standard deviation; p<0.05 significant difference.

Table 8: Post-operative follow up data and complications of Asopa dorsal inlay and Kulkarni ventral onlay groups.

Parameters	Asopa's dorsal inlay BMGU	Kulkarni's dorsal onlay BMGU	P value
Q_{max} at 3 months (ml/s) (mean±SD)	18.35±3.89	17.67±4.15	0.67
Q_{max} at 6 months (ml/s) (mean±SD)	17.02±3.87	16.89±4.24	0.53
Success rate at 3 months	93.33% (n=14)	91.67% (n=11)	0.87
Success rate at 6 months	86.67% (n=13)	83.33% (n=10)	0.81
Complications			
Donor site complication (N)	1 (6.67%)	0 (0%)	0.37
Wound infection (N)	2 (13.33%)	1 (8.33%)	0.68
Wound hematoma (N)	1 (6.67%)	0 (0%)	0.37

Qmax: peak urinary flow rate by uroflowmetry; n: number of patients; SD: standard deviation; p<0.05 significant difference.

Among 27 patients who had undergone single stage urethroplasty for long segment penile urethral and panurethral stricture, 15 patients (55.56%) underwent Asopa dorsal inlay BMGU and 12 patients (44.44%) underwent dorsal onlay BMGU as described Kulkarni et al. The two groups didn't differ significantly in mean age, mean preoperative Qmax, mean stricture length, length of the harvested graft, mean post-operative hospital stay (Table 7).

Success rate of Asopa technique at post-operative 3rd and 6th month were 93.33% and 86.67% respectively, while for Kulkarni technique it was 91.67% and 83.33% respectively. The two groups did not differ significantly in terms of post-operative mean Qmax, complications like donor site complications, wound infection and wound hematoma (Table 8).

DISCUSSION

Urethral stricture is defined as a narrowing of the urethra due to spongiofibrosis. It has a great impact impact on patient's quality of life. Management of urethral stricture is complex and requires careful evaluation.[12] Most commonly performed procedures are dilation (93%) and DVIU (86%).[13] Failure rates of these minimally invasive strategies are well documented. One study found that the initial success rate of DVIU was only 9% after 1 to 3 years of follow-up.[14] In this study success rate of DVIU at 3 and 6 months post operatively was 76.47% and 58.82% respectively. Urethroplasty is the definitive surgical treatment and gold standard for penile urethral and panurethral stricture. It has success rates of between 85 and 90% for simple procedures and about 80% for extremely complex repairs.[15] Excision and primary anastomotic urethroplasty is typically employed in bulbar urethral stricture of short segment <2 cm.[16] In this study success rate of this procedure is 92.31% at 6th post-operative month. Several literatures have reported durable success rate of >90% of this procedure.[17-21]

Buccal mucosal graft for urethral reconstruction was first described by Humby in 1941 in cases of hypospadias repair.[22]

The dorsal onlay technique was popularized by Barbagli et al in 1998; it involves dissection of the urethra from the corpora cavernosa and its rotation of 180°.[23] Ventral onlay technique is technically easier and requires less dissection than dorsal grafting.[24] In this study at 6 months post operatively success rate of dorsal onlay and ventral onlay BMGU for long segment bulbar urethral stricture were 89.47% and 85.71% respectively. No significant difference between the success rate and both groups had similar complications like wound infection, wound hematoma. Several studies have reported similar success rate between dorsal onlay and ventral onlay BMGU.[25,26] But one difference is that all those studies employed dorsal BMGU as described by Barbagli et al and this procedure of dorsal BMG urethroplasty was that described by Kulkarni et al.[8,23]

Long segment penile and panurethral stricture can be managed as single stage procedure or staged procedure. In this study although the success rate of staged procedure (90.63%) was higher than single stage procedure (85.18%), difference is not statistically

significant. But in staged procedure patient's mean hospital stay (10.38 days) was significantly higher ($p<0.0001$) than the single stage group (4.23 days). This along with long term bearing of laid opened urethra had significant impact on their quality of life. Literature has reported that use of BMG as single stage repair in these patients is an excellent option and also employs staged Johanson urethroplasty in cases of absent or obliterative urethral plate.[7,27] Studies has reported that utilization of BMG increases the success rate from 33 to 85%.[28]

Kulkarni et al in their study showed that success rate of new procedure dorsal BMGU by one sided mobilization had success rate of 92% and mean stricture length in their series was 4.2 cm for bulbar urethral stricture and 10 cm for pan urethral stricture.[8] This study showed that patients who underwent this method of BMG urethroplasty had mean stricture length of 7.15 cm with success rate of 83.33% with short follow up.

CONCLUSION

Urethral stricture is a complex disease affecting the quality of life and its treatment is challenging. Different urethroplasty techniques have implications depending on different site, cause of stricture and length of the stricture with varied success rate. Wherever feasible single stage reconstruction is always preferred than staged urethral reconstruction.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Santucci RA, Joyce GF, Wise M. Male urethral stricture disease. J Urol. 2007;177(5):1667-74.
2. Pansadoro V, Emiliozzi P. Iatrogenic prostatic urethral strictures: classification and endoscopic treatment. Urology. 1999;53(4):784-9.
3. Maciejewski C, Rourke K. Imaging of urethral stricture disease. Trans Androl Urol. 2015;4(1):2.
4. Rourke KF, Jordan GH. Primary urethral reconstruction: the cost minimized approach to the bulbous urethral stricture. J Urol. 2005;173(4):1206-10.
5. Jezior JR, Schlossberg SM. Excision and primary anastomosis for anterior urethral stricture. Urolog Clin. 2002;29(2):373-80.
6. Pathak HR, Jain TP, Bhujbal SA, Meshram KR, Gadekar C, Parab S. Does site of buccal mucosa graft for bulbar urethra stricture affect outcome? A comparative analysis of ventral, dorso-lateral and dorsal buccal mucosa graft augmentation urethroplasty. Turkish J Urol. 2017;43(3):350.
7. Martins FE, Kulkarni SB, Joshi P, Warner J, Martins N. Management of long-segment and panurethral stricture disease. Advan Urol. 2015;2015.
8. Kulkarni S, Barbagli G, Sansalone S, Lazzeri M. One-sided anterior urethroplasty: a new dorsal onlay graft technique. BJU Int. 2009;104:1150-5.
9. Wessells H. Ventral onlay graft techniques for urethroplasty. Urolog Clin North Am. 2002;29(2):381-7.
10. Johanson B: Reconstruction of the male urethra in strictures. Acta Chir Scand. 1953;179:19.
11. Asopa HS, Garg M, Singhal GG, Singh L, Asopa J, Nischal A. Dorsal free graft urethroplasty for urethral stricture by ventral sagittal urethrotomy approach. Urology. 2001;58(5):657-9.
12. Gallegos MA, Santucci RA. Advances in urethral stricture management. F1000 Res. 2016;5:2913.
13. Bullock TL, Brandes SB. Adult anterior urethral strictures: a national practice patterns survey of board certified urologists in the United States. J Urol. 2007;177(2):685-90.
14. Santucci R, Eisenberg L. Urethrotomy has a much lower success rate than previously reported. J Urol. 2010;183(5):1859-62.
15. Palminteri E, Berdondini E, Verze P, De Nunzio C, Vitarelli A, Carmignani L. Contemporary urethral stricture characteristics in the developed world. Urology. 2013;81(1):191-7.
16. Jordan GH, McCammon KA. Surgery of the Penis and Urethra. Oxford: Elsevier Saunders; 2012: 956-1000.
17. Micheli E, Ranieri A, Peracchia G, Lembo A. End-to-end urethroplasty: long-term results. BJU Intern. 2002;90(1):68-71.
18. Santucci RA, Mario LA, Aninch JW. Anastomotic urethroplasty for bulbar urethral stricture: analysis of 168 patients. J Urol. 2002;167(4):1715-9.
19. Andrich DE, Dunglison N, Greenwell TJ, Mundy AR. The long-term results of urethroplasty. J Urol. 2003;170(1):90-2.
20. Eltahawy EA, Schlossberg SM, McCammon KA, Jordan GH. 315: Long Term Follow Up for Excision and Primary Anastomosis in Anterior Urethral Strictures. J Urol. 2005;173(4S):87.
21. Morey AF, Watkin N, Shenfeld O, Eltahawy E, Giudice C. SIU/ICUD consultation on urethral strictures: anterior urethra–primary anastomosis. Urology. 2014;83(3):23-6.
22. Humby G, Higgins TT. A one-stage operation for hypospadias. Bri J Surg. 1941 Jul;29(113):84-92.
23. Barbagli G, Palminteri E, Rizzo M. Dorsal onlay graft urethroplasty using penile skin or buccal mucosa in adult bulbourethral strictures. J Urol. 1998;160(4):1307-9.
24. Kellner DS, Fracchia JA, Armenakas NA. Ventral onlay buccal mucosal grafts for anterior urethral strictures: long-term followup. J Urol. 2004;171(2):726-9.
25. Barbagli G, Selli C, Di Cello V, Mottola A. A one-stage dorsal free-graft urethroplasty for bulbar urethral strictures. Bri J Urol. 1996;78(6):929-32.

26. Elliott SP, Metro MJ, McANINCH JW. Long-term followup of the ventrally placed buccal mucosa onlay graft in bulbar urethral reconstruction. J Urol. 2003;169(5):1754-7.
27. Selim M, Salem S, Elsherif E, Badawy A, Elshazely M, Gawish M. Outcome of staged buccal mucosal graft for repair of long segment anterior urethral stricture. BMC Urol. 2019;19(1):38.
28. Warner JN, Malkawi I, Dhradkeh M, Joshi PM, Kulkarni SB, Lazzeri M, et al. A multi-institutional evaluation of the management and outcomes of long-segment urethral strictures. Urology. 2015;85(6):1483-8.

Cite this article as: Bagchi PK, Pratihar SK, Rajeev TP, Barua SK, Sarma D, Phukan M. An audit of management of male urethral stricture and it's outcome: a single centre retrospective review. Int Surg J 2020;7:774-80.