The Role of Postoperative Imaging after Ventral Onlay Buccal Mucosal Graft Bulbar Urethroplasty

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Abbreviations and Acronyms

AAU = augmented anastomotic urethroplasty

BMG = buccal mucosal graft

EPA = excision and primary anastomosis

pcRUG = pericatheter retrograde urethrogram

RUG = retrograde urethrogram

SPT = suprapubic tube

VCUG = voiding cystourethrogram

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Purpose: Our primary objective was to determine the incidence of extravasation on imaging at the time of catheter removal after ventral onlay buccal mucosal graft urethroplasty.

Materials and Methods: This is a single center retrospective cohort study of patients who underwent ventral onlay buccal mucosal graft bulbar urethroplasty from 2007 to 2017. Patients with imaging at the time of catheter removal were included. Urethroplasty success was defined as the ability to pass a 17Fr cystoscope at the time of followup cystoscopy.

Results: A total of 229 patients met the inclusion criteria, including 110 with a ventral onlay buccal mucosal graft and 119 with an augmented anastomotic urethroplasty with a mean stricture length of 4.4 cm. Imaging consisted of a voiding cystourethrogram in 210 and retrograde urethrogram in 19 patients at a median of 21.7 days after surgery. The incidence of extravasation was 3.1% (7/229). Of patients who had a documented followup cystoscopy (60%, 137/229), those with extravasation on imaging had a worse urethroplasty success rate (60%, 3/5) compared to those who did not (94%, 117/130) ($p=0.047$). On multivariate analysis those who had 5 or more endoscopic interventions were 9.6 times more likely to demonstrate extravasation (OR 9.6, $p=0.0080$).

Conclusions: The incidence of radiological extravasation after ventral onlay using a single buccal mucosal graft, with or without augmented anastomotic urethroplasty, is 3.1%. Given this low rate it is reasonable to omit routine imaging at the time of Foley removal in this population. It appears that extravasation may be associated with a worse cystoscopic patency rate but does not lead to more complications.

Key Words: urethral stricture, postoperative complications, diagnostic imaging, urography

IMAGING, either in the form of a voiding cystourethrogram, pericatheter retrograde urethrogram or retrograde urethrogram, is commonly performed 2 to 4 weeks after urethroplasty for urethral stricture disease. However, there are no formal guidelines to support this practice. The majority of these images are normal, allowing for safe removal of the urethral catheter. Current literature suggests imaging is unnecessary after EPA.[1,2] However, the data are less clear regarding the role of imaging following more complex graft onlay repairs. The primary objective of this study is to determine the incidence of extravasation on imaging at the time of catheter removal after ventral onlay buccal mucosal graft bulbar urethroplasty. Secondary objectives include assessing

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factors that predict extravasation and if extravasation leads to a worsened complication profile and urethroplasty success rate.

METHODS

This is a retrospective cohort study of patients who underwent ventral onlay BMG bulbar urethroplasty at a single tertiary level institution from 2007 to 2017. During this time period all patients undergoing bulbar urethroplasty underwent imaging prior to catheter removal. Patients who had a ventral onlay BMG, with or without an augmented anastomotic urethroplasty, and imaging at the time of catheter removal were included in the study. All images were interpreted by a radiologist and reviewed by one of the authors. Urethroplasty success was defined as the ability to easily pass a 17Fr cystoscope at the time of followup cystoscopy.

Surgical Technique

The patient is placed in a high lithotomy position and a midline perineal incision is made. Dissection is carried down to the bulbospongiosus muscle, which is then divided and the urethra exposed with the assistance of a modified Denis-Browne retractor. A 24Fr bougie-à-boule is placed through the meatus and passed up to the level of the stricture. A midline ventral urethrotomy is made overtop the bougie and extended proximally until a healthy proximal urethra is reached. The urethra is assessed and if there is a particularly narrow portion of the urethral plate, it is excised with a partial thickness layer of underlying spongiofibrosis. The ends are reapproximated with interrupted 5-zero polydioxanone sutures to complete the AAU. Five to 7 proximal anastomotic sutures are placed with 4-zero polydioxanone sutures. The length of the defect is measured and the BMG harvested. The graft is brought into the field and the pre-placed proximal anastomotic sutures are placed through the corresponding positions on the graft. The distal anastomosis is then completed with interrupted 5-zero polydioxanone sutures. The lateral edges are closed with running 5-zero polydioxanone sutures. A leak test is performed with lidocaine jelly and an 18Fr Foley catheter is inserted. The spongiosum is closed overtop the graft with running 4-zero polydioxanone suture. The perineal incision is then closed after a perineal channel drain is laid adjacent to the spongiosum.

Postoperative Care

Patients are kept on bedrest for 24 hours, then the perineal drain is removed and they are discharged home. The catheter is removed at 3 weeks after the operation for a VCUG or RUG if a VCUG cannot be obtained for logistical reasons. The VCUG studies are performed by radiology at our institution. The bladder is retrograde filled with contrast dye until the patient indicates they feel full enough to void. The catheter is then removed and fluoroscopic images are intermittently taken until the patient indicates they have completed voiding. Patients are then assessed with a symptom check at 6 months and a flexible cystoscopy, using a 17Fr cystoscope, at 12 to 18 months postoperatively.

Statistical Analysis

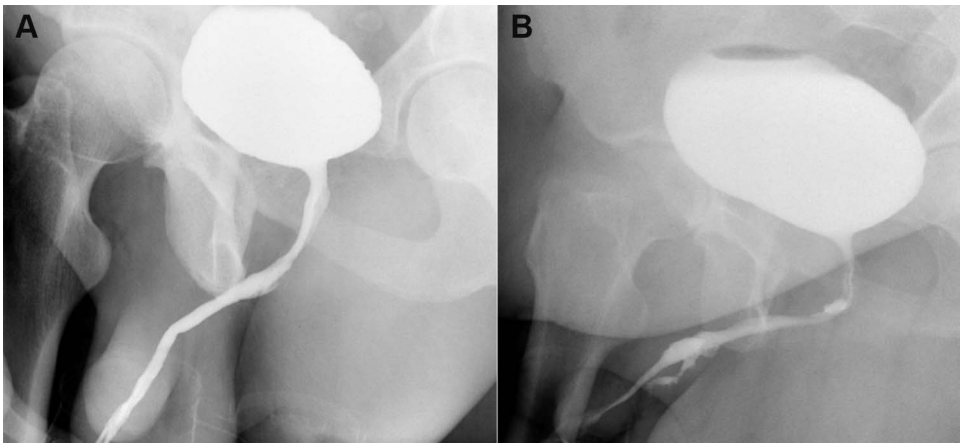
For between group comparisons the Wilcoxon rank sum test was used on continuous variables and chi-squared test on categorical variables. For predictors of or associations with leak, logistic regression analysis was used on individual variables in univariate analysis and multivariable analysis with variables showing potential relationships ($p < 0.2$) in the univariate analysis. All analyses were done using the statistical package R (version 3.3.2, R Development Core Team, www.r-project.org). Results were considered significant if the p value was less than 0.05.

RESULTS

Overall 229 patients met the inclusion criteria and the incidence of extravasation on postoperative imaging was 3.1% (7/229) (see figure). Table 1 outlines the baseline patient and stricture characteristics for the entire cohort and for the no extravasation (222) and extravasation (7) subgroups. There was no significant difference in mean stricture length, or number of patients who had prior endoscopic treatments, were performing intermittent self-catheterization before urethroplasty, had previous radiation or who had previous urethral reconstruction between the no extravasation and extravasation groups. Similarly, no differences were noted in stricture etiology. The most common was idiopathic in both groups (74.3%, 165/222 vs 71.4%, 5/7), followed by traumatic (12.2%, 27/222 vs 14.3%, 1/7).

Slightly more patients had a ventral onlay BMG with an AAU (118, 15.5%) compared to a ventral onlay BMG alone (111, 48.5%). Postoperative imaging consisted of a VCUG in 210 patients (91.7%) and a RUG in 19 (8.3%) at a mean of 21.7 days (SD 2.5 days) after surgery (table 2). There was a significant difference in the type of imaging between the 2 groups, with slightly more patients in the extravasation group having a RUG (28.6%, 2/7 vs 7.7%, 17/222, $p = 0.048$).

Of patients who had a documented followup cystoscopy (57%, 130/229), those with extravasation on imaging had a worse urethroplasty success rate (60%, 3/5) compared to those who did not (94%, 117/125) at a mean cystoscopic followup of 8.5 months ($p = 0.0057$). There was no difference in complication rates between the extravasation (29%, 2/7) and non-extravasation (7%, 15/229, $p = 0.087$) groups (table 2). Extravasation was deemed to be minimal in 4 and these patients were monitored without further intervention. Of the 4 patients 3 had a followup cystoscopy and all were patent. Of the other 3 patients 2 had a suprapubic tube that was left to drainage and capped twice per day to allow voiding per urethra, and 1 had a urethral Foley catheter reinserted. One patient had the SPT removed after 3 days as he had minimal extravasation on initial



A, normal VCUG 3 weeks after bulbar urethroplasty with ventral onlay BMG. *B,* contrast extravasation at distal anastomosis on VCUG 3 weeks after bulbar urethroplasty with ventral onlay BMG.

imaging but required a prolonged trial of void. The other 2 patients had the SPT and Foley catheter removed after 14 and 11 days, respectively. Both of these patients had stricture recurrence on cystoscopy at 5 and 14 months, respectively.

On univariate analysis stricture etiology, postoperative suprapubic tube, days to followup imaging, augmented anastomosis and prior radiation were nonsignificant predictors of extravasation. On multivariate analysis the 38 patients (16.6%) with 5 or more endoscopic treatments were 9.6 times more likely to demonstrate extravasation on postoperative imaging (OR 9.6, p=0.0080, table 3).

DISCUSSION

Rates of Urinary Extravasation on Imaging

This is the largest study to date assessing the rate of extravasation on postoperative imaging following ventral onlay BMG urethroplasty. Our extravasation rate of 3.1% is consistent with the available literature focusing on graft repairs. Terlecki et al assessed the extravasation rate on VCUG in 110 anterior urethroplasties, and 59 had EPA, 28 had AAU and 23 had an onlay with either a graft or flap.[1] They found an extravasation rate of 1.8% (2/110), with 1 extravasation after AAU and 1 after a ventral onlay procedure. Granieri et al published a larger series of urethroplasties evaluated with a pcRUG postoperatively.[2] The overall extravasation rate was 5.12% (21/407), and in the subgroups that mirrored our population it was 4.67% (7/150) following AAU and 4% following onlay repair (1/25). In the EPA group pcRUG was performed a mean of 16 days after surgery versus 22 days after AAU and onlay repairs, which potentially explains the higher extravasation rate (5.6%, 13/232). Another center published their results in 10 ventral onlay BMG cases.[3] VCUG was performed on postoperative day 7 in 5 patients and approximately postoperative day 12 in another 5 patients. Extravasation was noted in 10% (1/10), which is the highest reported rate, albeit in a limited sample size study. These low extravasation rates need to be considered in the context of specialized, high volume urethral reconstruction centers. These findings

Table 1. *Baseline patient and stricture characteristics*

	Overall	No Extravasation	Extravasation	p Value
No. pts	229	222	7	
Mean cm stricture length (SD)	4.4 (1.6)	4.4 (1.6)	4.6 (1.8)	0.81
No. prior endoscopic treatment (%)	194 (84.7)	188 (84.7)	6 (85.7)	0.94
No. performing intermittent self-catheterization (%)	33 (14.4)	32 (14.4)	1 (14.3)	1.00
No. previous radiation (%)	5 (2.2)	5 (2.3)	0 (0)	1.00
No. previous urethral reconstruction (%)	23 (10.0)	22 (9.9)	1 (14.3)	0.53
No. ventral onlay BMG without AAU (%)	111 (48.5)	107 (46.7)	4 (57.1)	0.64
No. ventral onlay BMG with AAU (%)	118 (51.5)	115 (51.8)	3 (42.9)	0.64
No. stricture etiology (%):				
Iatrogenic	20 (8.7)	20 (9.0)	0 (0)	1.00
Idiopathic	170 (74.2)	165 (74.3)	5 (71.4)	1.00
Traumatic	28 (12.2)	27 (12.2)	1 (14.3)	1.00
Congenital/hypospadias	2 (0.87)	2 (0.90)	0 (0)	1.00
Lichen sclerosus	7 (3.1)	6 (2.7)	1 (14.3)	0.20
Other	2 (0.87)	2 (0.90)	0 (0)	1.00

Table 2. *Postoperative imaging and urethroplasty outcomes*

	Overall	No Extravasation	Extravasation	p Value
No. postop suprapubic tube (%)	54 (23.5)	51 (23)	3 (42.9)	0.36
Mean days to imaging (SD)	21.7 (2.5)	21.7 (2.5)	21.1 (2.2)	0.52
No. VCUG (%)	210 (91.7)	205 (92.3)	5 (71.4)	0.048
No. RUG (%)	19 (8.3)	17 (7.7)	2 (28.6)	0.048
No. complication experienced (%)	17 (13.2)	15 (6.8)	2 (28.6)	0.087
No. followup cystoscopy (%)	130 (57)	125 (56.3)	5 (71.4)	0.43
No. urethroplasty success (%)	120 (87.6)	117 (93.6)	3 (60)	0.0057

indicate that routine imaging after onlay repair is relatively low yield.

Choice of Imaging Modality after Urethroplasty

There is debate among published studies as to the ideal imaging test to detect extravasation at the time of catheter removal. VCUG evaluates the urethra at physiological voiding pressures, while RUG or pcRUG tests the urethra at a higher pressure. While theoretically VCUG more closely resembles physiological pressure in the urethra, proponents of RUG and pcRUG argue that this may result in false-negative studies.[4] An argument in favor of pcRUG over RUG and VCUG is that it avoids premature removal of the catheter. In the event of extravasation the potential trauma of repeat catheterization is avoided.[2,5] We believe there is no significant difference between the different imaging techniques and institutional access to resources is likely the most influential factor in which test patients receive. We routinely have radiology perform the VCUG, and then we see the patients in clinic for a same day appointment to review the images and determine the next course of action. There are some instances where a patient cannot obtain a VCUG in a timely manner and we perform a RUG after Foley removal, explaining the relatively low rate of RUG imaging in this study (8%, 19/2,291). Although there was a slightly higher percentage of extravasation cases having a RUG compared to the non-extravasation group, this is likely attributable to the much smaller sample size of the extravasation group. Practically, there have been no issues with re-catheterizing patients, who are deemed to require it, in clinic after they have undergone imaging earlier that day.

Duration of Urethral Catheterization

The duration of urethral catheterization was 21.7 days in this series. One study assessing this issue reviewed 219 urethroplasties divided into a short catheter duration group with a median length of 8 days and a longer catheter duration group with a median of 14 days. VCUG extravasation rates were 3.5% in the shorter versus 8.3% in the long group. The cohort was comprised of 57% (127/219) graft urethroplasties and 42% (92/219) anastomotic repairs. The longer catheterization group had longer strictures, longer grafts and more complex strictures, making accurate inter-group comparisons difficult. Based on these findings 14 days may be too short a duration for graft urethroplasty with a higher than expected extravasation rate.[6] In the series by Granieri et al a second pcRUG was performed for patients with extravasation on the initial 3-week postoperative pcRUG.[2] Extravasation rates dropped from 4.7% to 2% for AAU cases, with the mean time from first imaging of 11 days, and from 4% to 0% in the onlay group, with the mean time from first imaging of 7 days. These data support a practice of leaving the catheter for at least 3 weeks, balancing the benefits of reducing extravasation with the discomfort and morbidity of prolonged catheterization.

Management and Outcomes of Urinary Extravasation

Interestingly, there are minimal data on the clinical significance of a urine leak detected on imaging after urethroplasty. Herein lies the crux of the question of whether or not to obtain imaging. Does it even matter if we see a leak? Most urologists would agree that a large leak should be diverted due to the risk of infection, but management of smaller leaks is more controversial. Further complicating the matter is the subjective nature of determining the severity of extravasation on imaging. In this series 4 of 7 leaks were deemed to be minimal and these patients were left without a catheter. In patients

Table 3. *Univariate and multivariate analysis of predictors of extravasation*

	OR	95% CI	p Value
Univariate analysis:			
5 or More endoscopic treatments	7.37	1.58–34.4	0.011
Stricture etiology	8.2	0.51–130.7	0.14
Postop SPT	2.51	0.54–11.6	0.60
Days from surgery to followup imaging	0.83	0.44–1.58	0.58
AAU	0.70	0.15–2.71	0.55
Length of stricture	1.18	0.52–2.71	0.53
Prior urethroplasty	1.52	0.17–13.2	0.52
Prior radiation	0.01	0–3.69	0.51
Intermittent self-catheterization	0.99	0.12–8.49	0.50
Multivariate analysis:			
5 or More endoscopic treatments	9.57	1.8–50.8	0.0080
Stricture etiology	1.83	0.97–3.46	0.063

with a SPT and extravasation, we cap the SPT twice per day and allow the bladder to fill and void per urethra. This allows some urethral distension, while diverting the urine from the leak the majority of the time. If there is no SPT, and the extravasation is considered significant, a urethral Foley catheter is reinserted for 7 to 14 days and VCUG repeated.

Urinary extravasation was associated with a significantly lower urethroplasty success rate at 60% (3/7) vs 94% without extravasation (117/130). Although this finding is limited by the small number of leaks overall, it does suggest that urinary extravasation may have a detrimental effect on urethroplasty success. In the series of Terlecki et al the 4 cases with extravasation were managed with immediate re-catheterization for a mean of 8 days.[1] In contrast, there was no increase in complications or stricture recurrence with this group. Granieri et al reported 21 patients with postoperative extravasation on pcRUG who were all catheterized a mean 8.6 days longer.[2] Of these, 4 had persistent extravasation after repeat pcRUG. These were managed with another week of catheterization and a third pcRUG which resolved the extravasation in 3 of the patients. It was unclear if these patients went on to have complications or stricture recurrence. We performed a univariate analysis of predictors of leak, and did not find stricture etiology, use of a concomitant SPT, AAU, length of stricture, prior radiation or prior urethroplasty to be associated with an increased risk of extravasation. Having 5 or more endoscopic interventions prior to urethroplasty was associated with an increased risk of extravasation on univariate (OR 7.37, $p=0.011$) and multivariate analysis (OR 9.57, $p=0.0080$). It may be that this recalcitrant population represents particularly fibrotic urethral strictures with significant corporal spongiofibrosis that does not heal as well, leading to a higher risk of anastomotic leaks.

Limitations

Despite representing the largest reported series of imaging after graft repairs for bulbar urethral strictures, the number of extravasation events was low, which limits the analysis of this cohort. In addition, only approximately 60% (130/229) had a followup cystoscopy to evaluate urethroplasty success. This reflects the tertiary referral nature of our practice where many of the patients travel from a distance and prefer to have their followup care with a local urologist. Followup is limited to 1 cystoscopy at 12 to 18 months in many patients for a similar reason and precludes analysis of the long-term effects of extravasation on urethroplasty outcomes.

CONCLUSION

The incidence of radiological extravasation after ventral onlay bulbar urethroplasty using BMG, with or without an AAU, is 3.1%. Given this low rate, it is reasonable to omit routine imaging at the time of catheter removal 3 weeks after ventral onlay single BMG bulbar urethroplasty. The benefits of avoiding postoperative imaging include elimination of a potentially uncomfortable procedure for patients, avoidance of unnecessary radiation, decreased costs to the medical system and patient convenience. It appears that radiological extravasation may be associated with a worse cystoscopic patency rate but does not lead to more complications. Patients who have undergone 5 or more endoscopic interventions prior to urethroplasty may be considered for postoperative imaging, as this is an independent predictor of extravasation.

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