

STRADDLE INJURIES TO THE BULBAR URETHRA: MANAGEMENT AND OUTCOMES IN 78 PATIENTS

SANGTAE PARK AND JACK W. McANINCH*

From the Department of Urology, University of California School of Medicine and Urology Service, San Francisco General Hospital, San Francisco, California

ABSTRACT

Purpose: We describe our experience with blunt straddle injuries to the anterior urethra and identify factors that may affect patient outcome.

Materials and Methods: We reviewed the San Francisco General Hospital Urologic Trauma data base to identify men with blunt straddle injury. We analyzed presentation and initial management, location and length of urethral stricture, surgical options, and long-term outcome after reconstruction.

Results: Of 78 patients, 40% presented to the emergency department acutely and 60% presented 6 months to 10 years after injury complaining of obstructive symptoms, of whom 30% reported at least 1 episode of urinary retention. Initial acute management was suprapubic cystostomy in 81% of cases and primary realignment in 19%. Urethral strictures were predominantly located in the proximal bulb. Mean stricture length was significantly longer in men with delayed presentation (2.7 vs 1.8 cm, $p < 0.05$). No relationship was found between stricture length and the mechanism of injury or initial management technique. However, patients who had undergone primary realignment required complex flap or graft urethroplasty at a greater rate compared with men who had undergone suprapubic diversion ($p = 0.054$). Transperineal urethroplasty was required in 92% of patients with the majority undergoing end-to-end anastomosis. The success rate was 95% at a mean followup of 25 months (range 10 to 180). Recurrent stricture occurred in 4 men with prior urethral manipulation and it was managed successfully by direct vision internal urethrotomy alone.

Conclusions: After blunt straddle injury to the perineum the primary morbidity is anterior urethral stricture, for which suprapubic cystostomy is appropriate initial management. The majority of patients require surgery but with careful preoperative planning and adequate resection of fibrotic tissue the long-term success rate can approach 95%. If it arises, recurrent stricture responds well to direct vision internal urethrotomy alone.

KEY WORDS: urethra, urethral stricture, wounds and injuries, cystostomy

The anterior urethra is subject to blunt and penetrating injuries, although the former predominates.¹ Of these injuries straddle injury, in which the immobile bulbar urethra is crushed against the under surface of the pubic symphysis, is most common.²⁻⁶ In contrast to posterior urethral disruptions, straddle injuries are not usually associated with pelvic fracture, and the pendulous urethra is usually spared.^{7,8} The primary morbidity is urethral stricture formation.^{2,3,9}

When a patient presents acutely after injury, one should obtain a history of the mechanism of injury and of the post-injury voiding pattern. Suspicious clinical signs include blood at the meatus, gross hematuria, perineal hematoma, urinary retention and frank urethral extrusion through the skin.¹⁰ Before an attempt at transurethral catheterization, a dynamic retrograde urethrogram is indicated in all cases.⁵ It allows one to stage the injuries into 3 categories, namely contusions, incomplete disruptions and complete disruptions. Although contusions are successfully managed by temporary urethral catheterization, the optimal management of complete or partial disruption remains in question.^{5,6,11}

Because only a few small series have been published regarding straddle injury, we reviewed the urological trauma data base at our institution to define better the clinical sequelae of these injuries. In what to our knowledge is the

largest published series to date we describe the most common mechanisms of straddle injury, clinical presentation, natural history of stricture formation, surgical management and long-term outcome.

MATERIALS AND METHODS

We identified 78 male patients 13 to 73 years old who were eligible in the urological trauma data base at our institution from 1977 to December 2001. Men with anterior urethral injury were selected if they had presented or were referred to our institution with documented blunt straddle injury to the perineum. We analyzed the mechanism of and age at injury, acute versus delayed presentation, location and length of stricture, previous urethral manipulation, perioperative imaging, type of urethral reconstruction, duration of followup and clinical outcome. We determined whether the mechanism of injury and the resultant stricture differ when the presentation is acute or delayed, whether the mechanism of injury affects stricture length, whether a difference exists in stricture length and long-term outcome between patients who undergo suprapubic diversion and those with primary realignment, whether one can predict the need for complex flap or graft urethroplasty vs the simpler technique of end-to-end anastomosis and finally whether failures after urethral reconstruction form a discernible pattern.

Accepted September 5, 2003.

* Correspondence: Department of Urology, San Francisco General Hospital, 1001 Potrero Ave., Room 3A-20, San Francisco, California 94110 (e-mail: jmcaininch@urol.ucsf.edu).

RESULTS

Of the 78 patients, 31 (40%) presented to the emergency department acutely and 47 (60%) presented 6 months to 10 years after injury in frank urinary retention or with obstructive voiding symptoms. We stratified results in these 2 groups separately.

Acute presentation. The most common mechanism of injury in men who presented acutely was falling onto the perineum, followed by bicycle accidents (table 1). Some patients had experienced a high velocity fall (eg from the top of a ladder or from a rapidly moving skateboard onto a metal railing). However, when these more severe mechanisms were compared with bicycle accidents, the resultant strictures were not significantly longer.

Of these 31 patients presenting acutely after injury, 25 (81%) underwent suprapubic diversion and 6 (19%) were treated with primary realignment. Despite this therapy 28 patients (90%) subsequently had clinically significant urethral strictures and ultimately required anterior urethral reconstruction. We then compared these 2 initial management techniques to determine whether they affected mean stricture length, the ultimate need for urethral reconstruction and the need for complex flap or graft urethroplasty.

Mean stricture length was not significantly different between the 2 groups. However, 22 of the 25 patients (88%) treated with suprapubic diversion subsequently required urethral surgery, in contrast to 100% of the patients with primary realignment ($p = 0.37$, table 2). Furthermore, the rate of graft or flap urethroplasty was 9% in the former and 17% in the latter cases ($p = 0.054$). This difference approached but did not attain statistical significance, likely due to small sample size. However, this finding is interesting in light of our hypothesis that the inferior strategy would be associated more frequently with complex graft or flap urethroplasty than with the simpler technique of stricture excision and end-to-end anastomosis.

Delayed presentation. In this group bicycle accidents were the most common mechanism of injury, followed by falls onto the perineum (table 1). Of the 47 patients, 70% complained of obstructive voiding symptoms and 30% had had at least 1 episode of urinary retention. A total of 46 were found to have clinically significant urethral strictures, leading to a 98% operative rate.

As in those who presented acutely, in this group stricture lengths did not differ significantly after the 2 major mechanisms of injury (table 3). However, mean stricture length in this delayed group was significantly longer compared with that in patients who presented immediately after injury (2.7 vs 1.8 cm, $p < 0.05$).

Also, in this group we determined the existence of any predictors of the need for graft or flap urethroplasty vs end-to-end anastomosis. It is a clinically relevant question be-

cause the success rate after the latter procedure has been shown to be higher.¹²⁻¹⁷ We assessed biologically plausible causes of longer urethral strictures necessitating graft or flap urethroplasty, including complete urethral disruption, higher velocity mechanism of injury and previous urethral manipulation. Only a history of previous urethral manipulation correlated significantly with the need for flap or graft urethroplasty. Of the 52 men who underwent end-to-end anastomosis 18 (35%) had undergone prior urethral manipulation compared with 13 of the 20 (65%) treated with flap or graft urethroplasty ($p = 0.019$). This finding suggests that those who had previously undergone urethral manipulation tended to require more complex urethral reconstruction.

Long-term outcome. The most important factor for successful urethroplasty is careful preoperative planning for a tension-free mucosa-to-mucosa anastomosis. In many patients with significant straddle injuries complete obliteration of the urethra can occur. In these cases the conventional combination of retrograde urethrogram and voiding cystourethrogram may be inadequate to determine the proximal extent of the stricture. For these patients sonourethrography¹⁸ has been found to be a critical tool in operative planning and it has changed the choice of reconstructive technique in up to 37%. Figures 1 and 2 show a representative patient preoperative urethrogram and sonourethrogram after complete urethral disruption due to a skateboarding straddle injury.

In our 72 patients who underwent urethroplasty performed by a single surgeon (JWM), the success rate was 95% at a mean followup of 25 months (range 10 to 180) (table 4). Strictures recurred in 4 patients (5%), of whom 2 had undergone end-to-end anastomosis and 2 were treated with penile fasciocutaneous flap urethroplasty (FCF). Each recurrence was treated successfully with direct vision internal urethrotomy (DVIU) alone. Nevertheless, we sought to identify reasons for operative failure.

The 2 failures in the 52 men who underwent end-to-end urethroplasty occurred in the subset of 22 who had previously undergone DVIU. This 9% rate vs 0% in the 30 men with no prior DVIU approached statistical significance ($p = 0.05$).

We then examined why strictures recurred in 2 men who had undergone penile FCF urethroplasty, whereas the other 7 had successful outcomes. In this group of 9 men 4 had undergone failed urethroplasty before referral, making FCF a salvage procedure, and the 2 failures were in this subgroup. When this 50% failure rate was compared with the 0% in the 5 patients for whom FCF was not a salvage procedure, the relationship again approached but did not attain statistical significance ($p = 0.073$).

DISCUSSION

To our knowledge this is the largest series to date of the natural history of blunt straddle injury. Our data are instructive in several respects.

The majority of patients have delayed presentation, which can occur months to years later. Up to 30% of these men have at least 1 episode of urinary retention and they have significantly longer urethral strictures than patients who present acutely. The probable explanation for these longer strictures is prolonged urine extravasation into the spongiosum, leading to more spongiofibrosis and greater length. We hypothesize that with early suprapubic diversion for total or partial urethral disruption the extent of the acute and chronic inflammatory cascade would be limited and the severity of residual stricture may be mitigated.

When we compared stricture lengths between the diversion and realignment groups, the difference was not statistically significant. When we evaluated the need for flap or graft urethroplasty, the rate of 9% in the diversion group and 17% in those with realignment closely approached statistical sig-

TABLE 1. Baseline characteristics in 78 patients

| | |
|-----------------------------|--------------|
| Mean age (range) | 35.5 (13-73) |
| No. acute presentation | 31 |
| No. initial management (%): | |
| Suprapubic cystostomy | 25 (81) |
| Primary realignment | 6 (19) |
| No. injury mechanism (%): | |
| Fall | 24 (77) |
| Bicycle | 5 (16) |
| Motor vehicle | 0 |
| Other | 2 (6) |
| No. delayed presentation | 47 |
| No. injury mechanism (%): | |
| Bicycle | 20 (43) |
| Fall | 10 (21) |
| Kick | 6 (13) |
| Motor vehicle | 3 (6) |
| Horse | 2 (4) |
| Other | 6 (13) |

TABLE 2. Outcome comparison in men presenting acutely after straddle injury

| | Suprapubic Diversion | Primary Realignment | p Value |
|-----------------------------------|----------------------|---------------------|-----------------|
| No. pts | 25 | 6 | |
| Mean cm stricture length (range) | 1.9 (0.5-6.0) | 1.9 (1.0-2.5) | Not significant |
| No. urethral reconstruction (%) | 22 (88) | 6 (100) | 0.37 |
| No. end-to-end/flap urethroplasty | 20/2 | 5/1 | 0.054 |

TABLE 3. Urethral stricture length stratified by mechanism of injury and timing of presentation

| | Mean Cm Presentation (range) | | p Value |
|-------------------|------------------------------|---------------|-----------------|
| | Acute | Delayed | |
| Fall | 1.8 (0.5-6) | 2.9 (1.0-6) | Not significant |
| Bicycle | 1.5 (1-2) | 2.6 (0.1-8) | Not applicable |
| Motorized vehicle | 0 | 2.1 (1.5-2.7) | Not applicable |
| Kicks | 0 | 2.2 (0.5-3.5) | Not applicable |
| Horse | 0 | 1.2 (1-1.4) | Not applicable |
| Overall | 1.8 (0.5-6) | 2.7 (0.1-8) | <0.05 |



FIG. 1. Simultaneous retrograde urethrogram and voiding cystourethrogram 2 months after acute straddle injury leading to complete urethral disruption. Proximal extent of stricture is not identifiable with certainty.

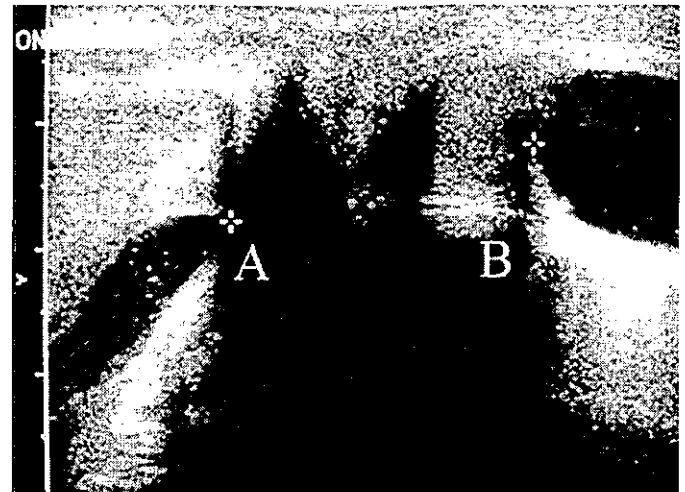


FIG. 2. Immediate preoperative sonourethrogram reveals 2.4 cm, completely obliterated urethral segment. Imaging was performed with 13 MHz linear array transducer with distal urethra (A) to left and proximal segment (B) to the right. Posterior shadowing of echoes was due to dense fibrotic tissue in this segment.

TABLE 4. Surgical management of urethral stricture after straddle injury

| | No. Pts (%) |
|-----------------------------|-------------|
| No surgery | 4 (6) |
| DVIU | 2 (3) |
| Urethroplasty: | |
| End-to-end | 52 (72) |
| Buccal graft | 5 (7) |
| Penile fasciocutaneous flap | 9 (13) |
| Penile skin graft | 6 (9) |

nificance ($p = 0.054$). We now uniformly perform suprapubic diversion in patients with significant blunt anterior urethral injury at our level 1 trauma center.

Most surgeons would agree that a first patient operation is the one with the highest likelihood of success in reconstructive cases. This statement was confirmed many times in our analysis of the data on straddle injuries in 78 men. In those who presented acutely after injury flap or graft urethroplasty tended to be required more frequently in men who had undergone primary realignment. In those who presented in a delayed manner again a history of invasive urethral manipulation correlated with the need for more complex graft or flap urethroplasty. Finally, when we examined possible reasons for failure in the 4 of our 72 patients who underwent urethroplasty, previous urethral manipulation was common to all. Although statistical significance at the 0.05 level was not achieved, a strong trend toward significance was found and a study with more statistical power might have uncovered differences if one truly exists.

CONCLUSIONS

The primary morbidity of blunt straddle injury is bulbar urethral stricture disease. These men can present acutely or months to years after initial injury. Suprapubic diversion is appropriate for acute disruption and in patients in frank urinary retention. Mean stricture length is longer with de-

layed presentation. Up to 90% of patients need urethroplasty. Although the majority are amenable to stricture excision and end-to-end anastomosis alone, patients with a history of urethral manipulation require complex flap or graft urethroplasty at a significantly higher rate.

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