

SPECIAL ISSUES OF PFUI  
ORIGINAL ARTICLE

# The spectrum of pelvic fracture urethral injuries and posterior urethroplasty in an Italian high-volume centre, from 1980 to 2013



Guido Barbagli <sup>a</sup>, Salvatore Sansalone <sup>b</sup>, Giuseppe Romano <sup>c</sup>, Massimo Lazzeri <sup>d,\*</sup>

<sup>a</sup> Center for Reconstructive Urethral Surgery, Centro Chirurgico Toscano, Arezzo, Italy

<sup>b</sup> Department of Experimental Medicine and Surgery, University of Tor Vergata, Rome, Italy

<sup>c</sup> Unit of Urology, Ospedale San Donato, ASL 8, Arezzo, Italy

<sup>d</sup> Division of Oncology, Unit of Urology, URI, IRCCS Ospedale San Raffaele, Università Vita-Salute San Raffaele, Milan, Italy

Received 13 July 2014, Received in revised form 21 July 2014, Accepted 6 August 2014

Available online 16 September 2014

## KEYWORDS

Trauma;  
Urethra;  
Treatment;  
Stricture

## ABBREVIATIONS

PFUI, pelvic fracture urethral injuries;  
PR, primary urethral realignment;  
SR, surgical realignment;

**Abstract Objective:** To describe the emergency and delayed treatment of patients with pelvic fracture urethral injuries (PFUI) presenting to an Italian high-volume centre.

**Patients and methods:** In a retrospective, observational study we evaluated the spectrum of PFUI and posterior urethroplasty in an Italian high-volume centre, from 1980 to 2013. Patients requiring emergency treatment for PFUI and delayed treatment for pelvic fracture urethral defects (PFUD) were included. Patients with incomplete clinical records were excluded from the study. Descriptive statistical methods were applied.

**Results:** In all, 159 male patients (median age 35 years) were included in the study. A traffic accident was the most frequent (42.8%) cause of PFUI, and accidents at work were reported as the cause of trauma in 34% of patients. Agricultural accidents decreased from 24.4% to 6.2% over the course of the survey. A suprapubic cystostomy was the most frequent (49%) emergency treatment in patients with

\* Corresponding author. Address: Division of Oncology, Unit of Urology, URI, IRCCS Ospedale San Raffaele, Università Vita-Salute San Raffaele, Milan (ML), Italy. Tel.: +39 02 26433357; fax: +39 02 26433342.

E-mail address: [lazzeri.maximus@gmail.com](mailto:lazzeri.maximus@gmail.com) (M. Lazzeri).

Peer review under responsibility of Arab Association of Urology.



Production and hosting by Elsevier

ER, endoscopic realignment;  
 PU, posterior urethroplasty;  
 SPC, suprapubic cystostomy;  
 PFUD, pelvic fracture urethral defects;  
 HLU, holmium laser urethrotomy

PFUI. The use of surgical realignment decreased from 31.7% to 6.2%, and endoscopic realignment increased from 9.7% to 35.3%. A bulbo-prostatic anastomosis was the most frequent (62.9%) delayed treatment in patients with PFUD. The use of the Badenoch pull-through decreased from 19.5% to 2.6%, and endoscopic holmium laser urethrotomy increased from 4.9% to 32.7%.

**Conclusions:** The spectrum of PFUI and subsequent treatment of PFUD has changed greatly over the last 10 years at our centre. These changes involved patient age, aetiology, emergency and delayed treatments, and were found to be related to changes in the economy and lifestyle of the Italian patients.

© 2014 Production and hosting by Elsevier B.V. on behalf of Arab Association of Urology.

## Introduction

The spectrum of pelvic fracture urethral injuries (PFUI) and the emergency treatment of these injuries vary worldwide, with a great difference reported between developing and developed countries [1]. This difference might influence the educational training programme for people intending to undertake reconstructive urethral surgery [2].

The mechanisms of urethral injury in fractures of the pelvic ring, and the consequent management of these distraction lesions, are still debated [3–10]. Recently, a systematic review and meta-analysis compared primary urethral realignment (PR) with suprapubic cystostomy (SPC) for managing PFUI in relation to the rates of stricture, erectile dysfunction and urinary incontinence [9]. That study concluded that PR appears to reduce the incidence of stricture formation after PFUI as compared to SPC [9]. Unfortunately, that study was not clear about the significance of ‘primary realignment’, and included the evaluation of patients who underwent PR using significantly different techniques, i.e., realignment through a flexible cystoscope, gentle insertion of a urethral Foley catheter, open cystostomy and catheter pull-through, interlocking sounds and ‘sound-to-finger’ [9]. Although all articles included in the meta-analysis were related to the early management of PFUI, the definition of ‘early’ varied significantly between studies [9]. Only two studies provided the precise range of the time from trauma to realignment, one reporting times of 1 h to 2.8 days, and one within 2 weeks [9]. The other studies provided only rough descriptive estimates of the time to realignment, including ‘immediate’, ‘early’, ‘at time of injury’, ‘night of injury’, and ‘initial management’ [9]. Unfortunately, these important limitations, as reported by the authors, greatly restrict the conclusions of that study [9]. The recommendations on PFUI from the International Consultation on Urethral Strictures are clear and important:

- Due to a high morbidity rate, early open retropubic primary suture or open retropubic catheter realignment is not recommended [10].

- Early endoscopic/endourological catheter realignment by a urologist should be considered, providing that the patient is stable and the proper instruments and equipment are available [10].
- Realignment can be done with a variety of procedures that include the use of a flexible cystoscope and retrograde passage of a guidewire, or a combination of flexible and rigid cystoscope passed anterogradely or retrogradely through a suprapubic tract [10].

The aim of the present study was to describe the emergency and delayed treatment of patients with PFUI, and to investigate the factors (patient age, aetiology of trauma, and emergency treatment) influencing the changes over time.

## Patients and methods

In a retrospective observational study we evaluated the spectrum of PFUI and posterior urethroplasty in an Italian high-volume centre from 1980 to 2013, and investigated the development of emergency treatments for PFUI and the delayed treatment of the subsequent pelvic fracture urethral defects (PFUD). Before starting the study, the observational study protocol was submitted to the competent authority. The Institutional Review Board authorised the chart analysis for a descriptive analysis. The threshold date for the analysis was 30 May 2014. Patients requiring emergency treatment for PFUI and delayed treatment for PFUD were included in the study. Patients with incomplete clinical records were excluded from the analysis. The primary outcome of the study was to evaluate patient age at the time of injury, the aetiology of PFUI, the type of emergency treatment for PFUI and the type of delayed repair of the PFUD. A secondary outcome of the study was to investigate the factors influencing the changes in the emergency and delayed treatments. To evaluate this, patients were stratified into three different periods according to the time that the trauma was treated. Descriptive statistical methods were applied.

## Results

In all, 159 male patients (median age 35 years, range 12–78) were included in the study. Five patients (3.1%) were treated in 1980–90, 41 (25.8%) in 1991–2000, and 113 (71.1%) in 2001–2013. Of the 159 patients, four (2.5%) were children (1–12 years old), 19 (11.9%) were adolescents (13–18 years) and 136 (85.6%) were adults (> 18 years).

### *Aetiology of PFUI*

An automobile accident was the most frequent (42.8%) cause of PFUI, and accidents at work were reported as the cause of trauma in 34% of patients; the incidence of these two causes of trauma remained stable over time. Agricultural accidents (e.g., tractor accident) comprised 24.4% of traumas in 1991–2000, and noticeably decreased to 6.2% in 2001–2013. By contrast, the incidence of motorcycle accidents as a cause greatly increased from 4.9% to 11.5% throughout the years. Interestingly, in this series only one patient had a PFUI due to a bicycle accident.

### *Emergency treatment of PFUI*

In any given period the SPC was the most frequent (49%) emergency treatment in patients with PFUI. The use of surgical realignment (SR) decreased markedly from 31.7% in 1991–2000 to 6.2% in 2001–2013. By contrast, the use of endoscopic realignment (ER) greatly increased from 9.7% (1991–2000) to 35.3% (2001–2013). At present, 7% of patients with PFUI are managed using non-conventional procedures (i.e., combined open repair and ER, catheterisation under TRUS, combined realignment using magnetic metallic sounds, etc.). The data on the emergency treatment of PFUI are summarised in [Table 1](#).

### *Delayed treatment of PFUD*

In any given period the bulbo-prostatic anastomosis was the most frequent (62.9%) delayed treatment in patients with PFUD. In 1991–2000 we used the Badenoch pull-through method in 19.5% of patients, but in 2001–2013 the use of this technique decreased markedly to 2.6%. By contrast, the use of endoscopic holmium laser urethrotomy (HLU) increased greatly, from 4.9% (1991–2000) to 32.7% (2001–2013). The data on delayed treatment of PFUD are also summarised in [Table 1](#).

Of the 39 patients who underwent HLU, in 20 (51%) it was successful after the first treatment and in 19 (48.7%) it failed. The subsequent treatments of the failures are summarised in [Fig. 1](#).

## Discussion

In Italy, from 1980 to 2013, there were great changes in the spectrum of PFUI and its emergency and delayed treatments. These changes involved the aetiology, the mechanism and the seriousness of the urethral trauma, and consequently the type of delayed repair of PFUD.

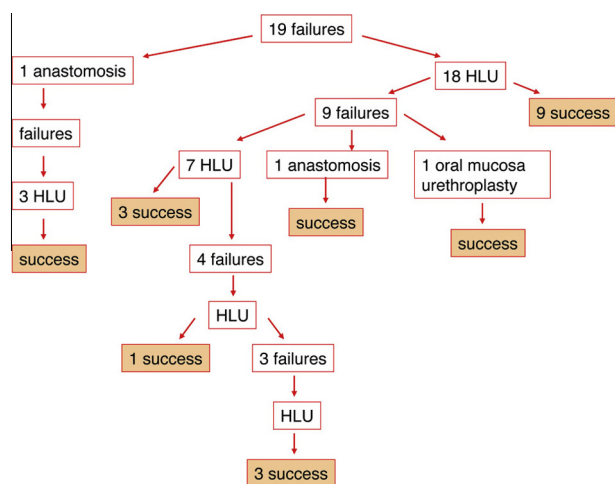
The present study clearly showed that in Italy children (2.5%) and adolescents (11.9%), compared to adults (85.5%), do not often sustain PFUI. This is mainly because young people generally travel in the safety of cars driven by their parents, and are not pedestrians, or on bicycles or motorcycles in traffic. In developing countries, children and adolescents are frequently involved in serious traffic accidents and sustain significant PFUI. In a comparative study of the spectrum of PFUI and PFUD between India and Italy, we reported that in India 9.4% of patients were children and 16.2% were adolescents, but in Italy only 1.5% were children and 6.5% adolescents [1]. In Nepal, of the 21 patients with complex PFUI, 10 (48%) were prepubescent boys [11]. In China, of 24 children (7–14 years old) treated for PFUD, 9 (38%) required complex transpubic-perineal repair [12]. One of the largest series reporting on children with PFUI is from Egypt, and of 68 boys (aged 3–15 years) 36 (53%) required a complex repair by a transpubic approach, or a two-stage urethral-scrotal inlay [13]. Posterior urethral strictures after PFUI have special features in children and adolescents that must be considered in their management [13–16]. PFUI in children, more so than in adults, tend to develop into complex defects in the prostatic tract and bladder neck, because the gland and the pubo-prostatic ligaments are rudimentary [13,14]. Moreover, prepubescent patients might have too few vascular connections in the glans, which is smaller than in adults, resulting in an insufficient retrograde blood flow to the distally based bulbar urethral flap (as a result of bulbar urethral transection and full mobilisation) [14]. This compromised retrograde blood flow to the anastomotic site might explain the lower success rate (73%) of this technique in prepubescent boys than in the adult population (95%) [14].

### *Aetiology of PFUI*

In the present series the incidence of agricultural accidents (tractor accidents) decreased from 24.4% to 6.2% because of the large changes in the Italian economy, passing from agricultural to industrial. The reduction of PFUI caused by tractor accidents also decreased the incidence of serious pelvic and urethral distraction defects, as it is well known that the being crushed by agricultural machines has serious consequences. In Italy most PFUI are caused by car accidents, but with the safety equipment in the modern car (air bags, anti-intrusion

**Table 1** Treatment of PFUI and PFUD.

Treatment	n (%) patients			Total
	1980–90	1991–2000	2001–2013	
<i>Emergency PFUI</i>				
SPC	4/5	19 (46.3)	55 (48.7)	78 (49)
SR	1/5	13 (31.7)	7 (6.2)	21 (13.2)
ER	–	4 (9.7)	40 (35.3)	44 (27.7)
Open urethroplasty	–	2 (4.9)	3 (2.7)	5 (3.1)
Other	–	3 (7.3)	8 (7.1)	11 (7)
Total	5 (3.1)	41 (25.1)	113 (71.1)	159
<i>Delayed for PFUD</i>				
Bulbo-prostatic	5/5	27 (65.8)	68 (60.2)	100 (62.9)
<i>Anastomosis</i>				
Badenoch	–	8 (19.5)	3 (2.6)	11 (6.9)
<i>Pull-through</i>				
Definitive perineal	–	2 (4.9)	–	2 (1.2)
<i>Urethrostomy</i>				
Two-stage repair	–	2 (4.9)	5 (4.5)	7 (4.4)
HLU	–	2 (4.9)	37 (32.7)	39 (24.6)
Total	5	41	113	159

**Figure 1** Treatment of 19 failures after the first HLU.

protections) the rupture of the pelvic ring and urethra is less serious than it was many years ago.

#### Emergency treatment of PFUI

The most important development in the emergency treatment of PFUI is the use of ER, which has increased from 9.7% to 35.3% in recent years. Simultaneously, the use of aggressive SR has decreased from 31.7% to 6.2%. After the rupture of the pelvic ring and posterior urethra, a wide haematoma develops in the pelvic cavity. When a patient undergoes SPC alone, the development of the haematoma results in the prostatic apex being pushed upward and fixed to the pubic bone by aggressive scar tissue. A further development is the formation of complex posterior urethral strictures. These PFUD require perineal or transpubic pubectomy for repair.

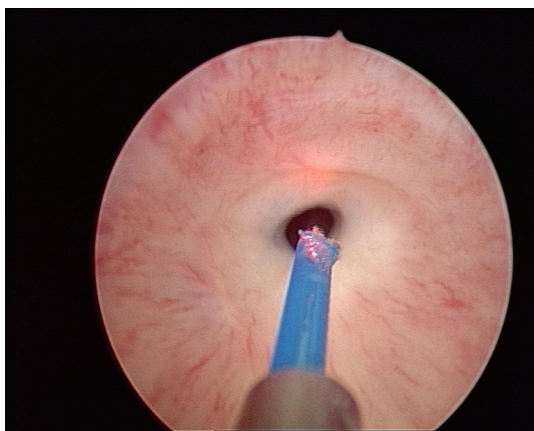
By contrast, when a patient has an ER, the result will be a simple, non-obliterative posterior stricture.

#### Delayed treatment of PFUD

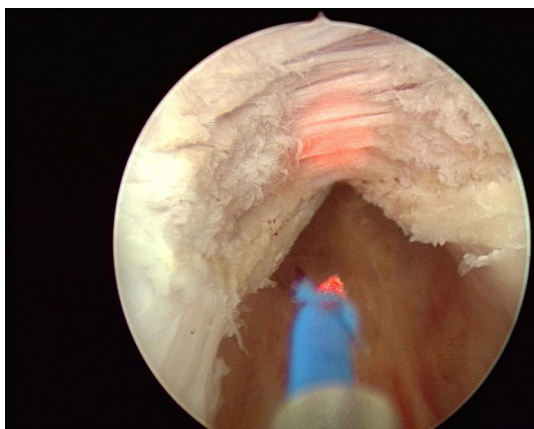
In the last 10 years our approach to repairing a PFUD has been greatly influenced by the concepts and concerns discussed in the previous sections. The use of HLU increased from 4.9% to 32.7%, and was mainly related to the changes in patient age (no children), cause of PFUI (no aggressive crash effects) and early management (ER). The use of HLU should be reserved for patients with non-obliterative strictures (Fig. 2) which are opened by cutting the scar tissue at the 12 o'clock position (Fig. 3) without vaporising the border of the urethra. However, patients should be informed that the success rate of this procedure is low (51.3%), and that repeated procedures will be required to stabilise the results over time. The main advantage of this procedure is that it conserves the residual sexual function after the PFUI.

In recent years the development of the Italian economy and changes in lifestyle have also produced significant changes in the spectrum of PFUI. In 1984 we reported our Italian experience of the repair of posterior urethral strictures at the AUA Congress in New Orleans, and in 116 patients who had undergone transpubic repair of complex PFUD, 20 (17.2%) of whom were children aged < 13 years [17]. A large series including 33 children was later reported [18].

The present study has important limitations. The data were derived from only one referral centre in Italy, but we believe that it could be representative of the spectrum of PFUI in Italy. We report no data on sexual function and incontinence in this series of patients. Moreover, only five patients were included in the study



**Figure 2** Endoscopic view of a simple non-obliterative posterior stricture.



**Figure 3** Stricture is opened, cutting the scar tissue at the 12 o'clock position.

from 1980–90, because unfortunately most of the clinical reports of patients who were treated for PFUI or PFUD in 1980–90 were lost to flooding. Finally, full data on the results of our posterior urethroplasty are not reported here, as they were detailed previously [1].

In conclusion, the spectrum of PFUI and subsequent PDUD has changed in Italy in the last 10 years. These changes, which were related to economic and lifestyle changes in Italy, involved patient age, aetiology and emergency and delayed treatments.

#### Conflict of interest

None.

#### Source of funding

None.

#### References

- [1] Kulkarni SB, Barbagli G, Kulkarni JS, Romano G, Lazzeri M. Posterior urethral stricture after pelvic fracture urethral distraction defects in developing and developed countries, and choice of surgical technique. *J Urol* 2010;**183**:1049–54.
- [2] Barbagli G. History and evolution of transpubic urethroplasty: a lesson for young urologists in training. *Eur Urol* 2007;**52**:1290–2.
- [3] Koraitim MM. Pelvic fracture urethral injuries: the unresolved controversy. *J Urol* 1999;**161**:1433–41.
- [4] Chapple C, Barbagli G, Jordan G, Mundy AR, Rodriguez-Netto V, Pansadoro V, et al. Consensus statement on urethral trauma. *BJU Int* 2004;**93**:1195–202.
- [5] Andrich DE, Greenwell TJ, Mundy AR. Treatment of pelvic fracture-related urethral trauma: a survey of current practice in the UK. *BJU Int* 2005;**96**:127–30.
- [6] Andrich DE, Day AC, Mundy AR. Proposed mechanisms of lower tract injury in fractures of the pelvic ring. *BJU Int* 2007;**100**:567–73.
- [7] Mundy AR, Andrich DE. Pelvic fracture-related injuries of the bladder neck and prostate: their nature, cause and management. *BJU Int* 2009;**105**:1302–8.
- [8] Martínez-Piñero L, Djakovic N, Plas E, Mor Y, Santucci RA, Serafetinis E, et al. EAU guidelines on urethral trauma. *Eur Urol* 2010;**57**:791–803.
- [9] Barret K, Braga LH, Farrokhyar F, Davies TO. Primary realignment vs suprapubic cystostomy for the management of pelvic fracture-associated urethral injuries: a systematic review and meta-analysis. *Urology* 2014;**83**:924–9.
- [10] Jordan G, Chapple C, Heynes C. Urethral strictures – an international consultation on urethral stricture. Marrakeck, Morocco, October 13–16, 2010, SIU, 2012.
- [11] Pratap A, Agrawal CS, Tiwari A, Bhattarai BK, Pandit RK, Anchal N. Complex posterior urethral disruptions: management by combined abdominal transpubic perineal urethroplasty. *J Urol* 2006;**175**:1751–4.
- [12] Zhang J, Xu YM, Qiao Y, Jin SB, Wu DL, Gu BJ. An evaluation of surgical approaches for posterior urethral distraction defects in boys. *J Urol* 2006;**176**:292–5.
- [13] Koraitim MM. Posttraumatic posterior urethral strictures in children: a 20-year experience. *J Urol* 1997;**157**:641–5.
- [14] Flynn BJ, Delvecchio FC, Webster GD. Perineal repair of pelvic fracture urethral distraction defects: experience in 120 patients during the last 10 years. *J Urol* 2003;**170**:1877–80.
- [15] Boone TB, Wilson WT, Husman DA. Postpubertal genitourinary function following posterior urethral disruptions in children. *J Urol* 1992;**148**:1232–4.
- [16] Onen A, Subasi M, Arslan H, Ozen S, Basuguy E. Long-term urologic, orthopedic, and psychological outcome of posterior urethral rupture in children. *Urology* 2005;**66**:174–9.
- [17] Lenzi R, Barbagli G, Stomaci N. Transpubic urethroplasty in traumatic posterior urethral strictures: 11 years experience. *J Urol* 1984;**131**:374A, abstract 1082.
- [18] Barbagli G, Stomaci N, Delle Rose A, Selli C, Trippitelli A, Lenzi R. Posterior urethroplasty in children. *Eur Urol* 1987;**13**:110–5.