

BLUNT URETHRAL TRAUMA: A UNIFIED, ANATOMICAL MECHANICAL CLASSIFICATION

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ABSTRACT

Purpose: We propose a simple, anatomically based classification of blunt urethral injury as a replacement for currently used classifications, which are not comprehensive, anatomically inconsistent or based on a mixed anatomical/mechanistic formula. The latter are difficult to learn and use, and have not been universally adopted.

Materials and Methods: We reviewed most of the currently used general urological, emergency radiological and urological textbooks to define the classification of urethral injuries that is most widely accepted. Most authors use the Colapinto and McCallum classification, modifications thereof or the older surgical classification of urethral injuries, which simply divides such injuries anatomically into anterior and posterior. However, there is little consensus about the best classification and none includes all of the blunt injuries of the urethra. To correct these difficulties we devised a comprehensive and anatomically consistent classification.

Results: The proposed classification categorizes blunt urethral trauma as I—posterior urethra intact but stretched (Colapinto and McCallum type I), II—partial or complete pure posterior injury with tear of membranous urethra above the urogenital diaphragm (Colapinto and McCallum type II), III—partial or complete combined anterior/posterior urethral injury with disruption of the urogenital diaphragm (Colapinto and McCallum type III), IV—bladder neck injury with extension into the urethra, IVA—injury of the base of the bladder with periurethral extravasation simulating a true type IV urethral injury and V—partial or complete pure anterior urethral injury.

Conclusions: The proposed classification is anatomically valid and includes all of the common types of blunt urethral injuries. Universal adoption of this system should permit comparison of various management/treatment modalities at various institutions.

KEY WORDS: urethra; wounds, nonpenetrating

Before 1977 urethral trauma was generally divided into anterior and posterior urethral injuries.^{1,2} This simple anatomical classification was based on the 2 major mechanisms of blunt urethral injury. Posterior urethral injuries are secondary to a crushed pelvis and they are most commonly associated with automobile accidents. Pelvic fractures are invariably present. On the other hand, anterior urethral trauma is due to straddle injuries. Such a classification is still used in 1 of the 2 current, commonly used urology textbooks.²

In 1977 Colapinto and McCallum challenged this simplistic approach to posterior urethral injuries by clearly demonstrating on urethrography that the classic posterior injury that transects the urethra above the urogenital diaphragm is the rarest form of posterior injury.³ Therefore, they suggested a classification of posterior urethral tears based on urethrographic findings that divides such injuries into 3 subtypes (see Appendix).

Several shortcomings of the Colapinto and McCallum classification have emerged. Most importantly the type III injury, which involves a tear of the membranous urethra and disruption of the urogenital diaphragm, and which was believed to be the most common of the 3 types, is not isolated to the posterior urethra but extends into the adjacent bulbous urethra. Therefore, the type III injury is not a pure posterior urethral injury but a combined anterior and posterior urethral injury. Another drawback of this classification is that it

does not include injuries of the bladder neck that extend into the proximal urethra. Such injuries require special attention because, if not properly repaired, they may result in incontinence or stricture. Also, none of the currently used classification systems includes injuries of the anterior urethra and, therefore, no single system can be considered comprehensive. Because of these difficulties and limitations, modifications of the Colapinto and McCallum classification have been proposed that mix the mechanism and anatomical location of injury but such schemes have not been universally adopted by radiological and urological authors.

METHODS AND MATERIALS

We reviewed several currently used urological,⁴⁻¹¹ emergency^{1,12-14} and general radiological,¹⁵ and urological^{2,16} textbooks. Most radiology authors use the Colapinto and McCallum classification of urethral injuries.³ However, the original classification has been modified by subsequent authors^{4,5,15,17,18} in an attempt to make it more comprehensive and internally consistent. Many urological authorities still use the original simple surgical classification of urethral injuries, which simply divides them anatomically into anterior and posterior. We postulated that the lack of consensus among urological and radiological authors is the result of limitations, inconsistencies and drawbacks of these classification schemes. Therefore, we developed a new, anatomically correct classification that corrects problems inherent to the

currently published classifications, and is designed to be easy to use and learn.

RESULTS

The proposed classification categorizes blunt urethral trauma as I—posterior urethra intact but stretched (Colapinto and McCallum type I, fig. 1), II—partial or complete pure posterior injury with tear of the membranous urethra above the urogenital diaphragm (Colapinto and McCallum type II, fig. 2), III—partial or complete combined anterior/posterior urethral injury with disruption of the urogenital diaphragm (Colapinto and McCallum type III, fig. 3), IV—bladder neck injury with extension into the urethra (fig. 4), IVA—injury of the base of the bladder with periurethral extravasation simulating a type IV urethral injury (fig. 5) and V—partial or complete pure anterior urethral injury (fig. 6).

DISCUSSION

Before the mid 1970s a surgical classification that divided urethral injuries into tears above an intact urogenital diaphragm (posterior) and those below it (anterior) was commonly used and it is still used in 1 of the 2 major urological textbooks.² During the mid 1970s urethrography was increasingly advocated as the most desirable method to diagnose urethral injuries before attempted Foley catheter placement. However, instead of the classically expected pattern of injury (contrast material extravasation into the pelvic extra-

peritoneal space above an intact urogenital diaphragm), urethrography clearly demonstrated posterior urethral injuries commonly involving a complex tear extending through the urogenital diaphragm into the proximal bulbous urethra. This condition results in contrast material extravasation into the perineum, termed a type III injury. In addition, Colapinto and McCallum described a stretching injury of the posterior urethra, type I, which they attributed to rupture of the puboprostatic ligaments but which did not result in frank urethral rupture. The classic injury was termed type II. Types I and II were believed to be rare and in the original series of Colapinto and McCallum no cases involved type II extravasation. This type was included only because it was the classically described injury. We subsequently confirmed the validity of the Colapinto and McCallum classification in a series of 18 patients.¹⁷ To date it has been adopted by most radiological^{5,6,8} and some urological¹⁸ authors. Approximately 15% of our patients had types I and II injuries, respectively, and the remainder had type III extravasation.¹⁷

Unfortunately although this classification adequately explains the pattern of contrast extravasation on urethrography, it introduced a new inconsistency in that the most common form of posterior urethral injury associated with a pelvic fracture type III is not a pure posterior injury, since extension through the urogenital diaphragm into the proximal bulbous urethra is present. Despite this fact Colapinto and McCallum as well as others described this system as a

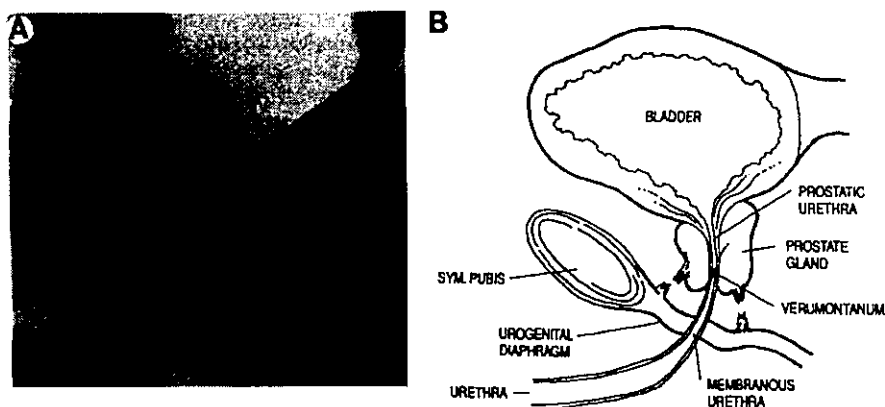


FIG. 1. Type I injury with posterior urethra stretched but intact. A, retrograde urethrogram reveals hematoma indenting bladder base (arrow). B, posterior urethral stretching after rupture of puboprostatic ligaments. SYM., symphysis.

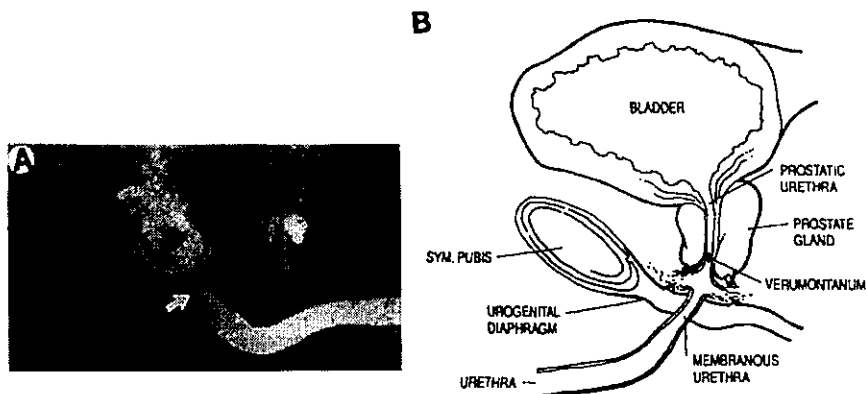


FIG. 2. A and B, type II injury with urethra ruptured above intact urogenital diaphragm. Retrograde urethrogram demonstrates extravasation above intact membranous urethra (arrow). SYM., symphysis.

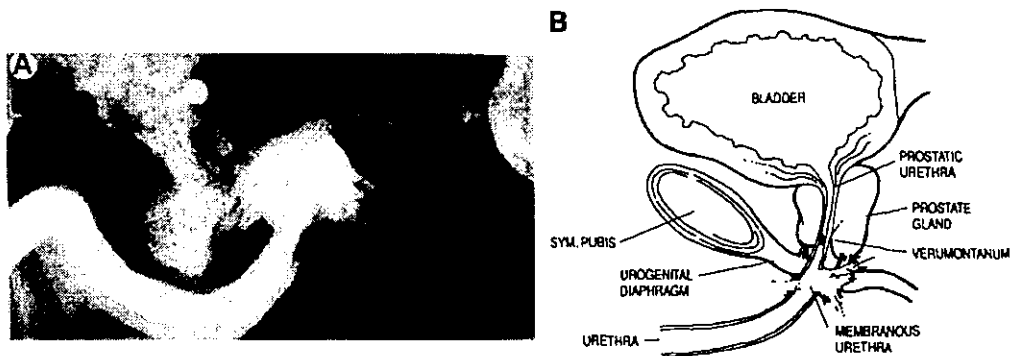


FIG. 3. A and B, type III injury extending through urogenital diaphragm to involve proximal bulbous urethra. Retrograde urethrogram reveals contrast extravasation below urogenital diaphragm into perineum surrounding proximal bulbous urethra. *SYM.*, symphysis.

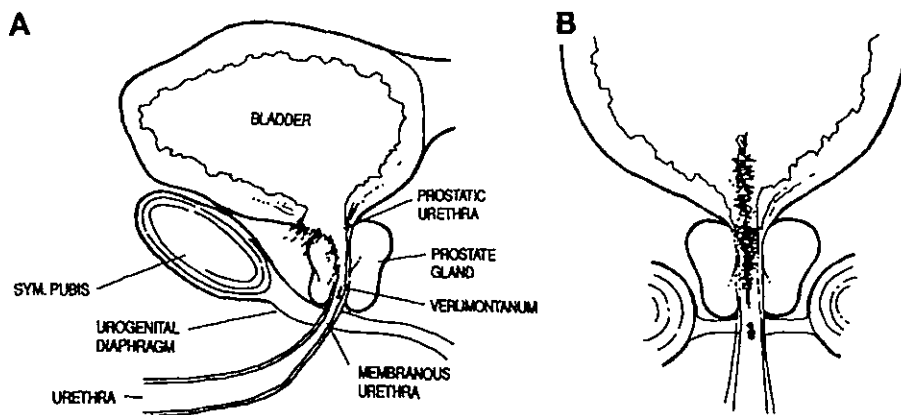


FIG. 4. Type IV injury. A, lateral view. *SYM.*, symphysis. B, anteroposterior view

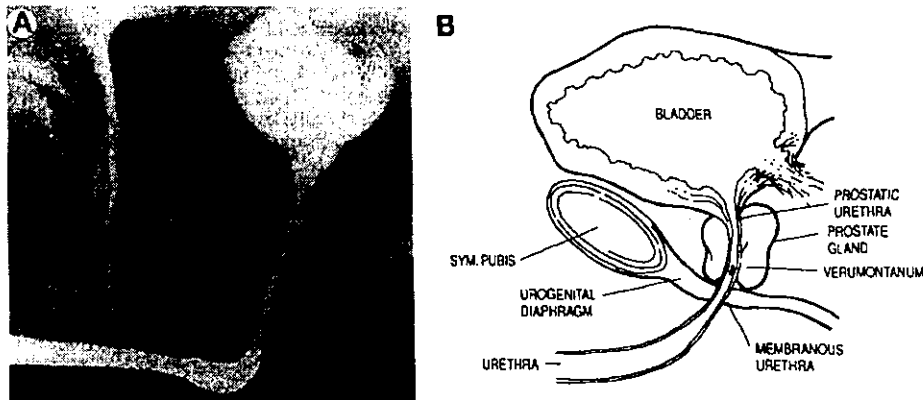


FIG. 5. A and B, type IVA injury. Retrograde urethrogram shows contrast extravasation from bladder base surrounding proximal prostatic urethra and diastasis of the symphysis pubis. This injury represents extraperitoneal bladder rupture but extension of injury into proximal urethra cannot be excluded on radiographic study. *SYM.*, symphysis.

classification of posterior urethral injuries.^{5,6,8,17} To rectify this inconsistency subsequent authors^{2,17} modified the original Colapinto and McCallum classification by describing it, not as a classification of posterior urethral injuries, but as a classification of urethral injuries associated with pelvic fracture. Thus, a combined anatomical/mechanistic classification was introduced, which was consistent anatomically but has not been widely adopted and does not address other limitations of the Colapinto and McCallum classification.

Another limitation of the McCallum and Colapinto classification is that it does not include injuries of the bladder neck

or base that extend into the proximal urethra. Perry and Husmann noted such injuries in 4.6% of women with a pelvic fracture after high speed motor vehicle accidents.¹⁹ Such injuries may also occur in male individuals. Since the urogenital diaphragm is the site of the internal urethral continence mechanism, this injury may lead to incontinence or stricture formation when not properly repaired. We classified such injuries as type IV.

Another confusing diagnostic problem occurs in patients with injury near the bladder base, which results in periurethral contrast extravasation on urethrography. Such injuries

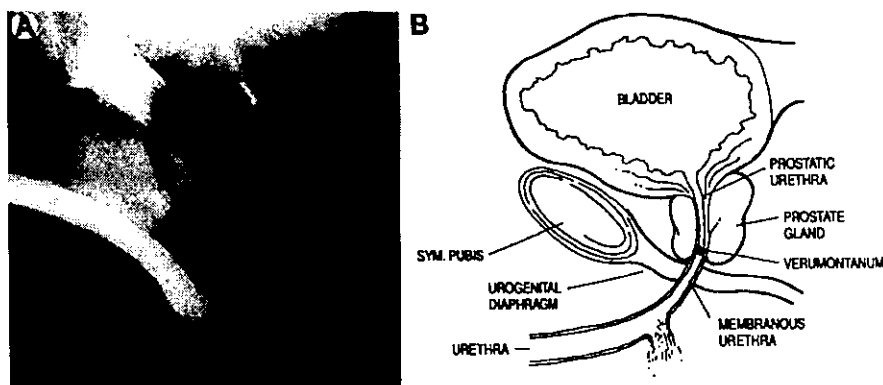


FIG. 6. A and B, anterior urethral injury. Retrograde urethrogram demonstrates partial injury involving proximal bulbous urethra. SYM., symphysis.

represent a form of extraperitoneal bladder rupture but because of the periurethral location of extravasation, they are frequently confused with injury of the proximal urethra, particularly on static image urethrography. The true site of injury can often be determined when the urethrogram is repeated under fluoroscopic control. In our experience such injuries are common and frequently associated with diastasis of the symphysis pubis or straddle fracture. Although not true urethral injuries, they may be confused with type IV injuries on radiographic study. Thus, we included them in our classification as type IVA. Clinicians who treat such patients must be particularly careful to differentiate between these 2 injuries, since patients with type IV injuries require operative repair while those with extraperitoneal bladder rupture do not.

Pure anterior urethral injuries (straddle injury) generally occur as a result of a crush injury of the perineum without an associated pelvic fracture. They are usually incomplete and result in a characteristically short stricture in the proximal bulbous urethra. Therefore, they are distinct from other forms of urethral injuries and were not addressed by the Colapinto and McCallum classification. However, it is not uncommon for physicians to confuse anterior urethral injuries with Colapinto and McCallum type III injuries, since both demonstrate contrast extravasation below the urogenital diaphragm. By including all urethral injuries in this classification we hope to avoid such confusion.

CONCLUSIONS

The classification that we propose retains the desirable feature of the Colapinto and McCallum classification but extends its usefulness. Unlike most current commonly used classifications or the modifications thereof, this classification is more appropriate because it is anatomically correct. It does not mix anatomical grouping with categorizations based on the mechanism of injury. Consequently we believe that our approach is easy for physicians in urology, radiology and emergency medicine to understand, use and remember. Also, because it is an anatomical rather than mixed anatomical/mechanistic based approach, it is much easier to compare readily different patient treatment strategies and outcomes.

We believe that this classification is easy to remember because it is logical and consistent with the Colapinto and McCallum scheme. It includes all of the blunt urethral injuries common in clinical practice. Our comprehensive approach should facilitate universal adoption of this scheme.

APPENDIX: COLAPINTO AND McCALLUM CLASSIFICATION OF URETHRAL INJURIES²

- Type I The urethra is stretched because of rupture of the puboprostatic ligaments and hematoma surrounds the urethra. Although stretched, the urethra remains intact.
- Type II The membranous urethra is ruptured above an intact urogenital diaphragm. On urethrography contrast material extravasates into the pelvic extraperitoneal space.
- Type III The membranous urethra is ruptured but the injury extends into the proximal bulbous urethra because of a tear in the urogenital diaphragm. On urethrography contrast material extravasates into the perineum.

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