In a traumatic pelvic fracture, the forces of the trauma or pieces of the broken pelvic bones can lacerate or tear the urinary system. This type of trauma can range in its severity and some injuries can require immediate or delayed urinary reconstruction. In addition to direct trauma to the lower urinary system (bladder, prostate and urethra), pelvic trauma can disrupt nerves to the bladder and penis and lead to urinary problems like leakage and erectile dysfunction.

Bladder rupture is rare and is often associated with other serious injuries and a high mortality rate. The bladder can also be torn or burst during a pelvic fracture. If these tears are large or urine spills into the abdomen around the intestine, they have to be fixed surgically.

Key words: pelvic fracture, urinary trauma, bladder, trauma, rupture, evaluation, management

INTRODUCTION

The close anatomical relationship between the skeletal and connective systems, neurological and vascular structures, and pelvic organs are the predisposing factors for structural and functional damages of the urogenital system.

Epidemiologically speaking, motor vehicle traffic collisions are the most common cause of blunt bladder injuries, followed by fall, industrial trauma/pelvic crush injuries and blow to the lower abdomen. The aim of this paper is to point out the characteristics of the bladder injuries in pelvic fracture related trauma with the literature review. Between 60-90% of the patients with the bladder injuries caused by blunt trauma have associated pelvic trauma, and 44% of patients with bladder injuries have at least one other intra-abdominal injury.

Bladder injuries after blunt trauma are overwhelmingly associated with pelvic fracture: 83-100% of such patients have pelvic fracture, and 6-10% of patients with pelvic fracture have bladder injuries. Not surprisingly, fracture of the pubic arch is often specifically associated.

Most (95%-100%) of these patients with bladder injury will have gross hematuria, although in some studies a minority (5%) have had only microscopic hematuria. Gross hematuria is felt to be associated with more significant injuries (rupture), while microhematuria has been seen more commonly with bladder contusion.

MATERIAL AND METHODS

This is a review of current literature that is gathering a data from orthopedic, urological, and trauma literature. To address the goals, the review was based on PUBMED and MEDLINE search using terms “pelvic ring trauma, bladder injury”.

EPIDEMIOLOGY

The damages of the pelvic organs are often complicated by urinary leaks, phlegmonas, peritonitis, and urosepsis. The probability of damage increases along with the degree of disturbance of integrity of the pelvic ring. In the most severe cases of pelvic damages, intra-abdominal lesions occur in approximately 30% of cases, and the most frequently affected organs are the bladder and the urethra, making up to 16%.

Reviewing the literature, almost 25% of patients with pelvic ring trauma have any type of urinary tract lesions that were either documented radiologically, or were found during surgery. Moreover, among 30% of the men who have urinary tract lesions, the isolated damage of the urinary bladder was observed in 7% of cases, 17% had partial damage of the urethra, and complete urethral rupture was diagnosed in 5% of cases. Some patients with a fracture of the acetabulum had a complete rupture of the urethra (2%), others (7%) had partial urethral damage. According to the data of other authors, the probability of urogenital injuries in complex vertical pelvic injuries reaches to 29%.
The most important risk factor of urogenital injuries is the rupture of the symphysis\textsuperscript{15}. Among patients with the rupture of the symphysis almost 42% have had urological injuries\textsuperscript{10}.

A retrospective study of 721 blunt trauma pelvic fractures published by Avay and co–authors was looking for potential associations between pelvic fracture pattern, degree of hematuria, and bladder injury. Pelvic injuries that were independently associated with bladder injury included diastasis of the pubic symphysis $>1$ cm, and fracture of the obturator ring with displacement $>1$ cm. No patient with isolated acetabular fractures sustained bladder injury\textsuperscript{14}. At the same time Hayes published a rare a case report of blunt trauma with pelvic ring disruption and an extraperitoneal bladder rupture that communicated with the hip joint through an acutabular fracture\textsuperscript{15}.

Taking into consideration the above mentioned, omission or late reveal of bladder and urethral damages, the most common comorbidities of pelvic fractures with disturbance of integrity of the pelvic ring, may cause long–term problems and increased mortality that raises the need for more thorough examination of the pelvic organs in case of pelvic fractures with disturbance of integrity of the pelvic ring\textsuperscript{7}. Bladder injuries are divided into two main groups according to the type of injuries: bladder non–penetrating and penetrating traumas. The more frequently used classification of the bladder trauma is simplified to intraperitoneal, extraperitoneal, and combined injuries. Gross hematuria detected after emptying of the bladder or after introducing of the urinary catheter is the most common symptom suggestive to bladder damage. Other signs of bladder lesions are limited mainly to painful bladder at palpation, bloating, suprapubic discomfort, and voiding difficulties. Due to possible spinal injuries and subsequent neurological deficit, the physical examination in these patients might be uninformative, thus, a high level of vigilance in these cases is needed\textsuperscript{8}. In women, the history of bladder rupture or anteroposterior compression injury was associated with poor musculoskeletal functional assessment scores\textsuperscript{9}. The occurrence, relation to a particular type of fracture of the pelvis, and the possible mechanism of early urinary complications were studied in 186 consecutive patients with fracture of the pelvis\textsuperscript{10}. Many patients showed different urinary complications. These complications were minor in 32.9% of patients and major in 8.1% of all pelvic fractures. There was retention of urine in 15.6% of cases, hematuria in 15.6%, and oliguria in 1.6%. The latter comprised rupture of the posterior urethra and was found in 4.8%, rupture of the bladder – 5.7%, and combined injury to the bladder and posterior urethra in 1.1% of cases.

**CHARACTERISTICS OF THE NON-IATROGENIC BLADDER TRAUMA**

Extraproteritoneal ruptures are almost always associated with pelvic fractures\textsuperscript{4}. The injury is usually caused by distortion of the pelvic ring, with shearing of the anterolateral bladder wall near the bladder base (at its fascial attachments), or by a "counter-coup" that bursts opposite the fracture site. Occasionally, the bladder is directly perforated by a sharp bony fragment\textsuperscript{18,19}. The highest risk of bladder injury was found in disruptions of the pelvic circle with displacement $>1$ cm, diastasis of the pubic symphysis $>1$ cm and fractures of the rami pubis\textsuperscript{19,20}. An isolated acetabular fracture is not likely to be associated with bladder injury\textsuperscript{20}.

Intraperitoneal ruptures are caused by a sudden rise in intravesical pressure, secondary to a blow to the pelvis or lower abdomen. The bladder dome is the weakest point of the bladder and ruptures will usually occur there\textsuperscript{21}. A full bladder is a risk factor for intraperitoneal ruptures. Penetrating injuries, mainly gunshot wounds, are rare in the civilian setting\textsuperscript{22}. Diagnostic evaluation Local Signs and SymptomsLower abdominal pain, tenderness, and bruising are often found in patients with bladder injury. However, these signs and symptoms can be difficult to differentiate from the sequelae of pelvic fracture. Some bladder injuries (usually intraperitoneal) are discovered because a urethral catheter does not return urine. In patients with a delayed diagnosis of bladder injury, fever, absence of voiding, peritoneal irritation, and elevated blood urea nitrogen (BUN) can be present. Any patient with this constellation of signs and symptoms should have formal cystography to rule out bladder injury.

**BLOOD AT THE URETHRAL MEATUS**

Inspection for blood at the urethral meatus is mandatory in all trauma patients, as this sign should be present in about half of significant urethral injuries\textsuperscript{6}. It is our policy not to attempt passage of a urinary catheter (Foley) in these patients, but rather to obtain an immediate retrograde urethrogram to rule out urethral injury. A significant percentage (10-17%)\textsuperscript{8,23} of patients with bladder injuries will have associated rupture. If findings on urethrogram are normal, a Foley catheter is placed; if abnormal, the patient is brought to the operating room for placement of a suprapubic urinary catheter, bladder exploration, and repair of bladder injuries. Although we usually place a suprapubic tube when urethral disruption is present, we also often place one in patients with isolated extraperitoneal bladder injury to maximize bladder drainage. We believe that large-caliber suprapubic drainage improves patient outcome, although a single recent report suggests that this may not be true\textsuperscript{22}. We typically place a large-bore 20-24F Foley or catheter suprapublically and opt for 16-20F Foley catheter drainage\textsuperscript{8}. Static Cystography Retrograde cystography with plain abdominal x-ray imaging (including drainage films) has proved 100% accurate in large series\textsuperscript{8}. Only standard anteroposterior (AP) views of the pelvis are usually needed, although oblique films or fluoroscopy is used in rare cases when standard films are difficult to interpret.

Computed Tomography (CT) Cystography- Despite the efficacy of standard plain film cystography, our preferred method entails retrograde placement of contrast material through a urethral catheter followed by CT scanning of the pelvis. Because most of these patients already require CT scans to evaluate pelvic fracture or intraabdominal injury, CT cystography saves time. Dilution of the contrast
solution is mandatory because undiluted contrast material is so dense that the CT quality is compromised.

**MENAGEMENT OF THE INJURIES**

Conservative treatment comprises clinical observation, continuous bladder drainage and antibiotics prophylaxis. This is the standard treatment for an uncomplicated extraperitoneal injury due to blunt trauma, after TURB or after other operations in which the injury was not recognised during surgery. It is an option for an uncomplicated intraperitoneal injury after TURB or not recognised during surgery, but only in the absence of peritonitis and ileus. In addition to conservative treatment, placement of an intraperitoneal drain has been advocated, especially when the lesion is larger.

**Surgical management** - The preferred method is two-layer vesicorraphy (mucosa-detrusor) with absorbable sutures.

Blunt non-iatrogenic trauma - Although most extraperitoneal ruptures can be treated conservatively, bladder neck involvement, bone fragments in the bladder wall, concomitant rectal injury or entrapment of the bladder wall will necessitate surgical intervention (LE: 3). There is an increasing trend to treat pelvic ring fractures with open stabilisation and internal fixation with osteosynthetic material. During this procedure, an extraperitoneal rupture should be sutured concomitantly in order to reduce the risk of infection. Similarly, during surgical exploration for other injuries, an extraperitoneal rupture should be sutured concomitantly in order to reduce infective complications. Intra-peritoneal ruptures should always be managed by formal surgical repair because intraperitoneal urine extravasation can lead to peritonitis, intra-abdominal sepsis and death (LE: 3). Abdominal organs should be inspected for possible associated injuries and urinomas must be drained if detected. In the absence of other intra-abdominal injuries, laparoscopic suturing of the intraperitoneal rupture is possible.

Penetrating non-iatrogenic trauma - This requires emergency exploration, debridement of devitalised bladder muscle and primary bladder repair. A midline exploratory cystotomy is advised to inspect the bladder wall and the distal ureters. In gunshot wounds, there is a strong association with intestinal and rectal injuries, requiring faecal diversion. Most gunshot wounds are associated with two transmural injuries (entry and exit wounds) and the bladder should be carefully checked for those two lesions. Non-iatrogenic bladder trauma with avulsion of lower abdominal wall or perineum and/or bladder tissue loss In these cases, direct closure of the traumatised bladder will lead to excessive tension, resulting in ischaemia and eventually breakdown of the repair. A bladder wall substitute is needed to repair the bladder defects and to restore the lower abdominal wall or perineum. A pedicled vastus lateralis myocutaneous flap has been proposed for this.

**DISCUSSION**

With an increase in survival after severe pelvic trauma the number of long-term consequences of these injuries increases. Although published data on the follow-up of patients is limited, however, in general it should be noted that patients with a history of pelvic fracture and combined lesion of the urogenital organs, remain hospitalized longer, spend more time in the intensive care unit, and have a higher mortality rate compared to patients without urogenital complications. Although urogenital damages are not the cause of mortality by themselves, they used to be an important risk factor for further complications. An age older than 65 years, high systolic blood pressure, high degree of severity of pelvic injuries (Injury Severity Score (ISS) > or = 25), coma (Glasgow coma score <or = 8), and female gender are independent predictors of higher mortality. Late urogenital complications are rare, at the same time the membranous urethral injuries may lead with high probability to the development of strictures and sexual dysfunctions, as well as to the urinary incontinence. Other potential causes of urinary disturbances are post-traumatic urinary fistulas. If the injuries of the genitourinary system remain unfixed within 1 year after the injury, there is higher probability of irreversible changes. Generally the isolated bladder trauma has a good prognosis, but in some cases can cause development of chronic pelvic pain. Functional disorders, such as neurogenic overactive bladder, are usually well controlled by anticholinergic drugs. Thus, the injuries of the urogenital system in pelvic fractures have important prognostic value in terms of morbidity and quality of life. A prerequisite for a successful therapeutic outcome in case of pelvic fractures with disturbance of pelvic ring integrity is cooperation of orthopedists and urologists, with possible early diagnosis and treatment of injuries of the urogenital system.

**SUMMARY**

Kod traumatskih preloma karlice, snage traume ili koma smoljene karlini kosti mogu dovesti do povredjivanja urinarnog sistema. Ove vrste trauma mogu da imaju različit stepen težine i neke povrede mogu zahvatiti hitnu ili odloženu rekonstrukciju mokraće bešike. Pored direktnih trauma donjeg urinarnog sistema (mokraće bešike, prostate i uretre), trauma karlice može dovesti do oštećenja nerava bešike i penis i dovesti do probleme poput inkontinencije i erektile disfunkcije. Ruptura mokraće bešike je retka, a često se povezuje sa drugim ozbiljnim povredama i povezana je sa visokom stopom smrtnosti. Bešika takođe može biti lacerirana ili perforirana tokom fraktura male karlice. Ako su ove laceracije velike ili se urin izliva u stomak oko creva, povrede moraju biti hirurški zbrinite.
REFERENCES


