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Risk Factors Associated with Lower Urinary Tract Injuries in Traumatic Pelvic Fractures

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Abstract

Background: Bladder and urethral injuries associated with pelvic fractures are uncommon and are missed at initial assessment in up to 23% of cases. Missed lower urinary tract injuries have a significant impact on patient morbidity, if not identified early. This study aims to associate mechanisms of traumatic pelvic ring fractures with bladder and/or urethral injuries to determine factors that may increase odds of injury.

Methods: In a retrospective cohort study, all patients 13 years and older admitted to Gold Coast Health Service from 2010 to 2016 with traumatic pelvic injuries and lower urinary tract injuries were identified. Mechanism of injury and types of pelvic fractures were evaluated and clinical symptoms and treatment analysed.

Results: 333 patients with pelvic fractures were identified: seven sustained urethral injuries, three bladder injuries and one with both. Common mechanisms included crush injuries (40%) with a statistical significant correlation (p=0.47), falls from height (30%) and road traffic accidents (30%). Associated types of pelvic fractures comprised of lateral compression (40%), anterior-posterior compression (40%) and vertical shear (20%).

Conclusion: As identified in this retrospective study, concomitant lower urinary tract injuries and pelvic fractures are rare. Although a significant correlation with types of pelvic fracture could not be determined, there is a clear association with high-energy trauma. Therefore, it is important to actively look for and exclude bladder and urethral injuries in this patient group. Further research with a larger prospective study could provide a greater insight into correlations.

Keywords: Trauma; Urethral injury; Bladder injury; Pelvic fracture; Lower urinary tract injury

Introduction

The incidence of pelvic ring fractures associated with lower urinary tract injury (LUTI) is rather rare, nevertheless some studies have found the combination of those two injury patterns in up to 10% of cases [1-5].

There are a number of proposed mechanisms of urethral injury resulting from, or associated with pelvic fractures, including direct laceration with bone fragments, disruption/avulsion from shearing forces, and crushing [3]. Bladder injuries have a similar mechanism and are most commonly extraperitoneal. Intraperitoneal bladder ruptures are believed to be associated with blunt force causing increased intravesical pressure on a distended bladder [4].

LUTI are suspected when signs such as macroscopic haematuria or blood at the meatus are present. Standard diagnostic imaging for bladder and urethral injuries is retrograde urethro-cystogram (RCUG) (Figure 1) [5]. This involves administration of contrast into the urethra and bladder via a Foley catheter, with direct fluoroscopy to identify extravasation of contrast indicating a breach in the urethra or bladder. This method of examination has been shown to be underutilised, with only 41% of patients with suspected LUTI receiving adequate imaging with RUCG [5]. Computed tomography (CT) is often a faster and easier method of imaging in trauma patients, however this has been shown to give an incomplete assessment of LUTI and can miss injuries in up to 30% of patients (Figure 2) [5].

Immediate management of urethral injury varies with degree of injury. Partial tears may be managed with urethral catheterisation; however insertion of suprapubic catheter is recommended for both partial and complete urethral ruptures, using transabdominal sonography if the bladder is not easily palpable [6]. Complete urethral rupture can be managed acutely, within the first ten days, with primary endoscopic realignment or immediate open urethroplasty [6]. Delayed treatment options include delayed primary urethroplasty, one to two weeks after injury, delayed formal urethroplasty, at or later than three months following injury, or delayed endoscopic incision, which carries a high failure rate [6].

Immediate management of bladder injury is also dependent on degree and type of injury. Bladder contusions may be managed with observation only or in dwelling catheter (IDC). Most extraperitoneal ruptures can be managed with IDC alone followed by cystogram to confirm resolution at day ten, whereas intraperitoneal ruptures require formal surgical repair [7].

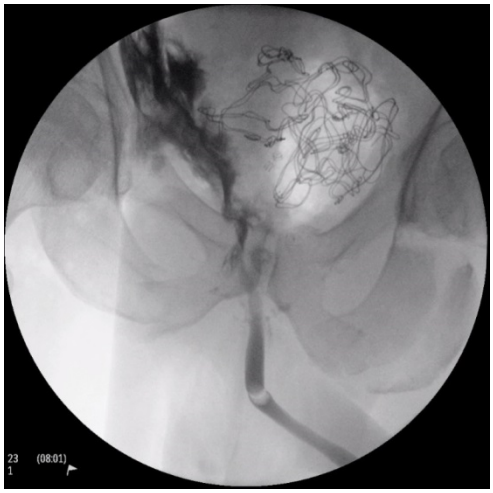

Figure 1: Retrograde urethrogram showing complete rupture of the proximal urethra with extravasation of contrast into the pelvic space, performed after extra peritoneal pelvic packing.

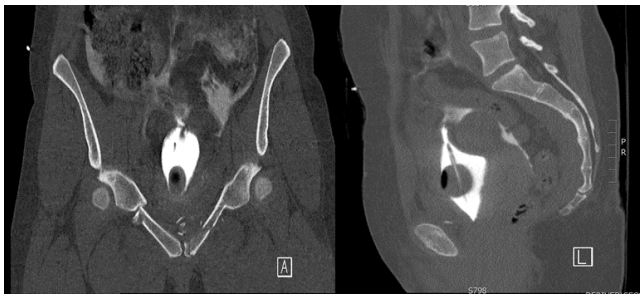

Figure 2: Delayed computed tomography post intravenous contrast with IDC clamped, showing intraperitoneal bladder rupture with extravasation of contrast within the peritoneal cavity.

A number of studies have been published analysing the association between pelvic fractures and LUTI, the majority are based on American data. Bjurlin et al. [8]. conducted one of the largest retrospective studies using the American National Trauma Data Bank, they identified 31,380 patients with pelvic ring fractures, of those 1,444 had genitourinary injuries (4.6%). An important conclusion drawn from this large study is that pelvic fractures associated with genitourinary injuries have an increase in morbidity, associated with high-energy mechanisms and often associated with injury to other internal organs. A number of other smaller studies have looked at the association between mechanism of injury and risk of associated LUTI. Basta et al. [9] demonstrated that urethral injuries were significantly associated with disruption of the anterior pelvic ring, and that severity of the symphyseal disruption correlated with the risk of urethral injury. In a similar study by Koraitim et al. [10] the association was found more commonly with Malgaigne's fracture, which is a vertical shear type of pelvic fracture. Based on this study10 the predominant fracture associated with urethral injury was Malgaigne's fractures (35%). The risk of suffering a urethral injury from a Malgaigne's fracture versus other types of pelvic fractures was 3.48 times.

The data in recent literature is limited and quite variable. This study aims to assess the incidence of LUTI in an Australian setting and expend knowledge on this topic.

Patients and Methods

In the timeframe from January 2010 to January 2016, 333 patients with pelvic fractures were admitted to the Gold Coast Health Service. All patients included were 13 years and older. The Gold Coast Health Service database consists of information from Gold Coast Hospital, which turned into Gold Coast University Hospital in September 2013, and Robina Hospital. Patients with penetrating pelvic trauma and children 12 years of age and under were excluded.

Variables such as patient age, mechanism of injury, pelvic fracture type, lower urinary tract injury, symptoms at presentation, and fracture as well as urological management were collected and analysed. Pelvic fractures were categorised by the Young-Burgess classification system [11]. Two medical officers were involved in the review of medical charts and radiological imaging for each patient, and the compilation of a data set.

The primary outcome was the incidence of pelvic injuries with concomitant LUTI as well as the correlation between the mechanisms and classification of pelvic ring trauma associated with bladder and/or, urethral injuries. Secondary outcomes included the orthopaedic and urological treatment (conservative, operative or staged), symptoms (blood at meatus, acute urinary retention, perineal bruising).

Based on Koraitim's figures10, a sample size of 130 patients will be required to detect an OR of 3.5 with statistical significance (power=80%; significance 95%).

While this study did not investigate the risk associated with suffering a bladder injury, the prevalence of suffering a bladder injury was rare (2.5%). As such a sample size up to 50% higher (N=260) was determined necessary to obtain a similar OR.

The proportions and 95% confidence intervals associated with different types of pelvic fractures, urological injuries associated with the different types of pelvic fractures and mechanisms of injury were determined using Microsoft Excel. Risk estimates (OR) and 95% confidence intervals were calculated using crosstab analysis in SPSS version 23. Categorical data were analysed in Stata by a biostatistician

Results

333 patients sustained pelvic fractures admitted to Gold Coast Health Service, and ten (3%) with concomitant LUTI were identified. The median age was 31.5 years ranging from 21 to 67 years. Bladder injuries were identified in three patients, while eight patients had urethral injuries, one patient sustained both, a bladder and a urethral injury. Only one patient identified was female, and she sustained a bladder injury. Table 1 summarizes the different pelvic fracture types and the mechanisms of injury for included patients' cohort.

Pelvic fractures associated with urological injury comprised of lateral compression (40%), anterior-posterior compression (40%) and vertical shear (20%) type injuries. The correlation between types of pelvic fracture and risk for bladder or urethral injury was not statistically significant.

In terms of the correlation between mechanism of injury and risk of LUTI, the crush injuries were the most common cause (40%). All of those four patients were crushed by very heavy weights of more than

350 kilograms. This mechanism was found to have a statistically significant correlation with LUTI. Logistic regression analysis showed that crush injuries are at least 7.8 × more likely to cause a LUTI in pelvic injuries compared to the other injury mechanisms (p=0.047). This was followed by road traffic accidents, two cases involving restrained drivers involved in high speed motor vehicle accidents at approximately 80 km/hour requiring extrication, and one motorbike accident where the rider was thrown 30 m from his bike. Fall from height of greater than 4 meters accounted for 30% of the LUTI.

		Total numbers	Bladder injury	Urethral injury
Pelvic Fracture Type	APC I	3	0	0
	APC II	9	1	3
	APC III	0	0	0
	LC I	29	0	0
	LC II	23	0	1
	LC III	3	1	2
	VS	2	1	1
	Pubic rami	264	0	0
Mechanism of Injury	Crush injury	5	1	3
	Fall from height (>4 m)	71	2	1
	Motor vehicle	26	0	2
	Motorbike	41	0	1
	Fall from standing	135	0	0
	Other	55	0	0

APC: Anterior-posterior compression; LC: Lateral Compression; VS: Vertical Shear

Table 1: Distribution of pelvic fracture types and injury mechanisms.

No statistically significant correlation between type of pelvic fracture and mechanism of injury was identified.

Interestingly age was found to have a statistical significance in predicting risk of LUTI. As age increases probability of LUTI decreases, with each year in age decreasing the odds of LUTI by 10%. This is likely related to the lower impact pattern of injury found in older patients, such as fall from standing.

At presentation, in the initial assessment, seven out of ten patients had documented blood at the meatus; of which five sustained urethral tears. Macroscopic haematuria was found in three cases (two urethral injuries, one bladder rupture). Presence or absence of perineal bruising was documented in six cases, and present in five (four urethral injuries, one bladder rupture). In two cases acute urinary retention was diagnosed.

50% of patients with LUTI received urological operative management (two with bladder ruptures, three with urethral injury). Patients who sustained bladder ruptures received open exploration, repair and insertion of a suprapubic catheter (SPC) at time of orthopaedic repair of pelvic fracture. One patient who sustained a urethral injury initially required insertion of SPC with a delayed urethroplasty six months post injury. The remaining two patients with urethral injury initially underwent a cystoscopy and insertion of SPC and then had routine SPC changes thereafter.

Of the ten patients with LUTI, eight received orthopaedic operative management of their pelvic fractures – seven with internal fixation and one with external fixation. The two patients who received conservative management of their pelvic fractures also received conservative management of their urethral injury with temporary IDC only.

Discussion

Although traumatic bladder and urethral injuries combined with pelvic ring fractures are uncommon, our study shows that certain fracture patterns and certain mechanisms of injury tend to be associated with lower urinary tract injury. Previous studies suggest that bladder injuries are more prevalent in patients with pubic symphysis widening and ilio-sacral joint involvement, and urethral injuries with pubic symphysis widening and inferior pubic fractures [12] our findings are consistent with previous studies undertaken and an association between symphysis widening and anterior ilio-sacral joint diastasis can be seen. Additionally, injuries involving lateral compression and antero-posterior compression have been identified in this study as some of the more commonly associated pelvic fractures.

In a study by Alwaal et al. [13] motor vehicle accidents (MVA), were found to be the most common cause of pelvic fractures (68%), and these were four times more likely to have an associated urethral injury, in that study the highest risk mechanism. In contrast, our study shows that despite the difference in prevalence of mechanisms of injury, the highest cause of LUTI was crush injuries. This may reflect a difference in patient population on a demographic and cultural level.

Bladder ruptures have been accounted for by MVA (47.3% cases) and pedestrians hit by a car (29.1% cases) [13-15]. Contrary to this, no patients in our dataset showed bladder injuries from MVA, all cases resulting from fall from height (more than four metres) or crush injury.

LUTI associated with bicycle trauma is an infrequent occurrence, involving only 2% of bicycle injuries [16]. This is consistent with our data, where no associations with this rare mechanism were identified.

Like many conditions in medicine, diagnosis of LUTI is based on history taking and clinical signs and symptoms; in the trauma setting this must occur in a succinct and prompt manner. As commonly applied in trauma management, the mechanism of injury plays a crucial and important part of the history, and clinical examination as well. Widely recognised signs and symptoms of LUTI include blood at the meatus, perineal bruising, haematuria and acute urinary retention. As demonstrated by this study these signs are not always present. The most reliable being blood at the meatus (in 50% of cases) and perineal bruising (in 50% of cases). These signs are an important part of assessment and should prompt progression to further assessment with adequate retrograde urethro-cystogram.

Outcomes of this study have been limited by several factors: since the period of time for the study spans over two different hospital characteristics, from the Gold Coast Hospital as regional hospital to the Gold Coast University Hospital as a tertiary facility including Major Trauma Centre dedication, the assessed trauma patient population has changed in terms of severity with distinctly more multi-trauma patients, and also overall in trauma patient numbers.

Moreover, variations in data may be explained by the small patient population identified in this study. Additionally, the presence of certain clinical signs and symptoms may be biased due the lack of consistent documentation. In order to overcome this, further research with a larger prospective study could provide a greater insight into these correlations.

Conclusions

Although pelvic ring fractures associated with bladder and/or urethral injuries are rare, there is a clear correlation with high-energy trauma. A significant correlation was found with crush injuries and therefore, index of suspicious must be high to diagnose or rule out these injuries. It is important to actively seek for and exclude bladder and urethral injuries early in high-energy mechanisms, in particular in the patient cohort with crush mechanism. Delay in identification, diagnosis and appropriate management can lead to increased morbidity for these patients, resulting in complications such as urethral stricture and infection [6]. Other documented complications include pelvic abscess/sepsis, urethrocutaneous fistulae, severe pelvic inflammation, septic shock, peritonitis, necrotising fasciitis, as well as bladder entrapment [6,17,18]

Early detection and management of bladder and urethral injuries is thus a vital part in the care of the trauma patient. Unfortunately due to the nature of these presentations this is not always achievable due to prioritisation of life-threatening injuries. Thus, recognising high-risk mechanisms and pelvic fracture patterns may allow for early identification of patients with bladder and urethral injuries and improve patient outcome.

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