

## Analysis of Renal Trauma in Adult Patients: A 6-Year Own Experiences of Trauma Center

Tomasz Ząbkowski,<sup>1\*</sup> Ryszard Skiba,<sup>1</sup> Marek Saracyn,<sup>2</sup> Henryk Zieliński<sup>1</sup>

**Purpose:** Abdominal trauma itself accounts for approximately 3% of all trauma cases. Among cases of multiple organ trauma, abdominal trauma accounts for 8-10% of cases. The frequency of genitourinary tract trauma is 10%. The renal trauma is 1-5% of all trauma cases. The aim of this study was to determine treatment's strategy according to analysis of renal trauma severity.

**Materials and Methods:** Since 2008, the Military Institute of Medicine, followed by the Trauma Center, treated 1119 trauma patients, of which 52 were renal trauma cases. In most cases, renal trauma was concomitant with multiple organ trauma.

**Results:** Of the 52 renal trauma cases, 35 (67%) were caused by transportation, 5 (10%) by falls, 8 (15%) by iatrogenic factors, 2 (4%) by batteries, and 2 by idiopathic factors. In our study cohort, 31 cases (60%) experienced renal trauma concomitant with multiple organ trauma. Renal trauma involved injury to both kidneys in 9 (20%) patients, and to only 1 kidney in 34 (80%) patients.

**Conclusion:** The use of computed tomography scan in combination with strict observation of conservative treatment protocols and intravascular techniques results in effective treatment of renal trauma.

**Keywords:** kidney; injuries; tomography, X-ray computed; epidemiology; Poland.

### INTRODUCTION

With the growing popularity of extreme sports, the prevalence of sport-related injuries, including renal trauma, is on the rise. Abdominal trauma itself accounts for approximately 3% of all trauma cases. Among cases of multi-organ trauma, abdominal trauma accounts for 8-10% of cases. The frequency of genitourinary tract trauma is 10%.<sup>(1)</sup> Some studies have reported that 1-5% of all trauma cases are renal trauma.<sup>(2)</sup> In 2011, the Trauma Center was established at the Military Institute of Medicine in Poland. The Trauma Center is the only center for comprehensive trauma treatment for the population of over 5 million individuals. The groups which are particularly exposed to renal injuries are young men doing sports, the injured of road accidents, victims of accidents in the house or at work, victims of fights and assaults. The results of conducted studies indicate that hematuria, pain, and ecchymosis in the lumbar region, fractured ribs, as well as abdominal mass may be the symptoms of renal injury. There are blunt and penetrating renal injuries as well as a 5-level classification of kidney injuries according to a degree of injuries, American Association for the Surgery of Trauma (AAST). This classification enables a standardization of different patient groups and a choice of a proper therapy and a prediction of the treatment's results.<sup>(3)</sup> The mechanism of injury, its placement and severity are the standard guidelines within a choice of diagnostic methods and indications for treatment's strategy. The imaging examinations are necessary in diagnostics of abdomen injuries with a suspicion of renal injury.

Among the imaging examinations used in diagnostics of injuries of urogenital system and renal injuries, it is to enumerate: ultrasonography, computed tomography (CT) scan, intravenous urography (IVU), arteriography, and angiography. CT scan of abdomen with contrast injected into an intravenous line is a gold standard in diagnostics of renal injuries.

If CT is not available, it is recommended to perform ultrasonography as an examination of first choice. The aim of the study was to determine treatment's strategy according to analysis of renal trauma severity.

### MATERIALS AND METHODS

This study was conducted from January 2008 to December 2013 at the Trauma Center, Military Institute of Medicine in Poland. Since 2008, the Military Institute of Medicine, followed by the Trauma Center, treated 1119 trauma patients, 43 of whom were cases of renal trauma. A total of 43 (3.84%) patients were enrolled into the study. Our study cohort included 70% (n = 30) male and 30% (n = 13) female patients. The patient's mean age was 39.5 years. In a population of 43 patients there were 9 cases, in which both kidneys were affected. According to the fact that the grade of trauma in both kidneys results in completely different treatment method, we consider these cases separately. For example, one of these patients suffers from grade II of right kidney trauma and grade V of left kidney trauma. Right kidney was treated conservatively and in left kidney trauma nephrectomy was performed. As a result, we collected 52 renal trauma cases. In most cases, renal

Departments of Urology,<sup>1</sup> and Nephrology<sup>2</sup> Military Medical Institute, Szaserów Street 128, 04-141 Warsaw, Poland.

\*Correspondence: Departments of Urology, Military Medical Institute, Szaserów Street 128, 04-141 Warsaw, Poland.

Tel: +48 791 533 555. Fax: +48 791 533 555. E-mail: urodent@wp.pl.

Received September 2014 & Accepted February 2015

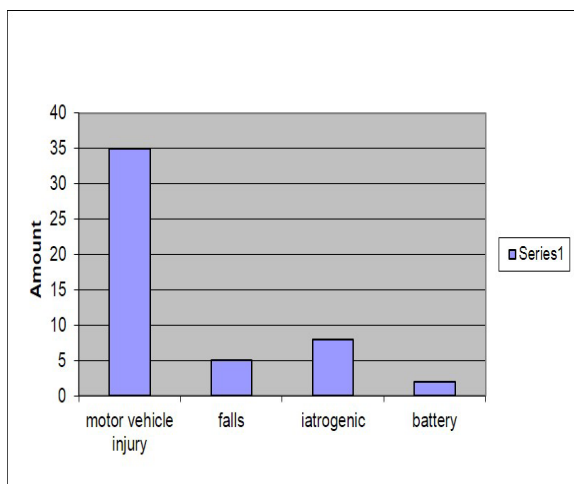


Figure 1. Mechanisms of injury in study subjects.

trauma was concomitant with multiple organ trauma. We conducted a retrospective study using computer databases. The database was searched using the ICD-10 codes, and S37.0 and S35.4 for renal trauma and trauma of renal vessels. We included renal trauma cases from all departments of the Military Institute of Medicine. We assessed the following features of the renal trauma cases: etiology of trauma, stage of trauma, treatment method, prevalence of hematuria, and need for blood transfusion. In addition, we analyzed the prevalence of coincidental trauma using the structure of the Trauma Center, Military Institute of Medicine. The grade of renal trauma was assessed by performing imaging examinations using 64-slice computed tomography and operation protocols. The grade of renal trauma was defined using the kidney injury scale developed by the AAST.<sup>(3)</sup> The data were collected in a designed data bank and were analyzed with AAST scale. This strategy enables a further management based on European Association of Urology (EAU) guidelines.

**RESULTS**

Between 2008 and 2013, 52 cases of renal trauma were treated at the Trauma Center, Military Institute of Medicine in Poland. Our study cohort included 70% (n = 30) male and 30% (n = 13) female patients. The mean patient age was 39.5 years. Of the 52 renal trauma cases, 35 (67%) were caused by transportation, 5 (10%)

by falls, 8 (15%) by iatrogenic factors, 2 (4%) by batteries, and 2 by idiopathic factors (Figure 1). Among the iatrogenic trauma cases, 3 (6%) resulted from extracorporeal shock wave lithotripsy (ESWL), 3 (6%) from percutaneous nephrolithotomy (PCNL), and 2 (3%) from percutaneous renal biopsy (PCRB). In our study cohort, 31 cases (60%) experienced renal trauma concomitant with multiple organ trauma. Renal trauma involved injury to both kidneys in 9 (20%) cases, and to only 1 kidney in 34 (80%) cases. Trauma cases were classified into groups according to the AAST trauma scale as follows: grade I, 25 patients (48%); grade II, 10 patients (19%); grade III, 10 patients (19%); grade IV, 4 patients (8%); and grade V, 3 patients (6%) (Figure 2). Hematuria occurred in 16 cases (30%), including 2 (3%) with grade I injury, 3 (6%) with grade II injury, 7 (14%) with grade III injury, 2 (3%) with grade IV injury, and 2 (3%) with grade V injury.

Among the 52 cases, 6 (11%) had penetrating injuries, and the remaining had blunt injuries. According to EAU guidelines, 31 cases (60%) were treated conservatively, 7 cases (13%) were treated with organ-sparing therapy using surgical techniques (suturing of the kidney or hemostatic agents), and 6 cases (11%) were treated with transcatheter super-selective embolization (TSE) of the renal arteries. Two patients (4%) required pigtail catheter installation because of urine leakage caused by injury to the pyelocaliceal system. Nephrectomy was performed in 6 cases (11%) (Figure 3). Laparotomy was performed in 16 cases because of coexisting injuries; however, after abdominal revision, only 4 patients required nephrectomy. During the laparotomy procedures, 13 splenectomies were performed, and 1 patient required surgical management of the liver. Two patients needed persistent renal replacement therapy (RRT), because of vital injury to the kidney (Figure 4). One patient, required temporary renal replacement therapy, including repeated hemodialysis every third day, because of acute tubular necrosis (ATN) caused by rhabdomyolysis after trauma. Five patients required neurosurgical intervention because of intracranial hemorrhage, and 7 patients required orthopedic management. Among the 52 cases, there were 6 deaths associated with intracranial hemorrhage or large vessels injuries, all unrelated to renal or abdominal injury. Twenty-one patients required blood transfusion. The minimum transfusion was 2 units of blood (600 mL), and the maximum transfusion was 21 units of blood (6300 mL).

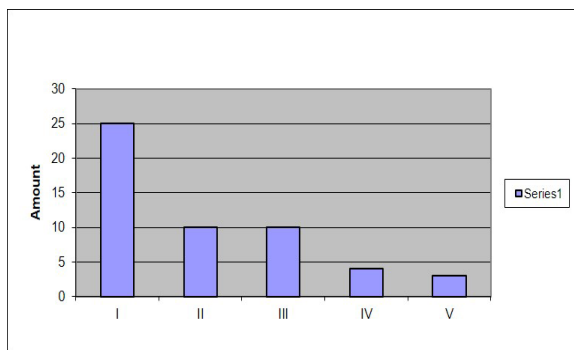


Figure 2. Grade of injury according to American Association for the Surgery of Trauma (AAST).

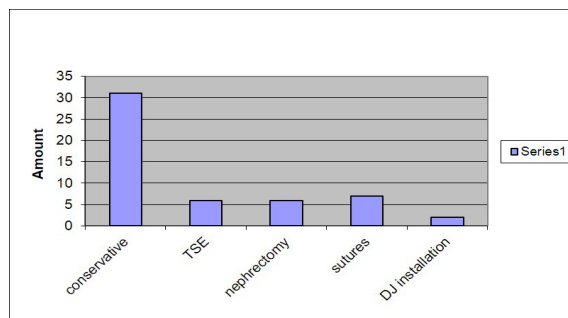
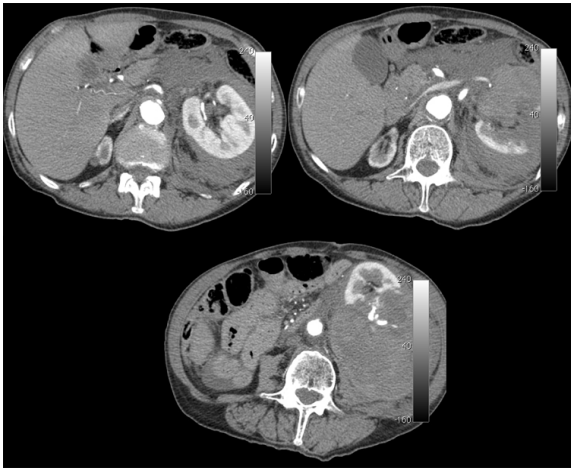


Figure 3. Treatment modalities in study subjects.

**Abbreviations:** TSE, transcatheter super-selective embolization; DJ, double J ureteral catheter.

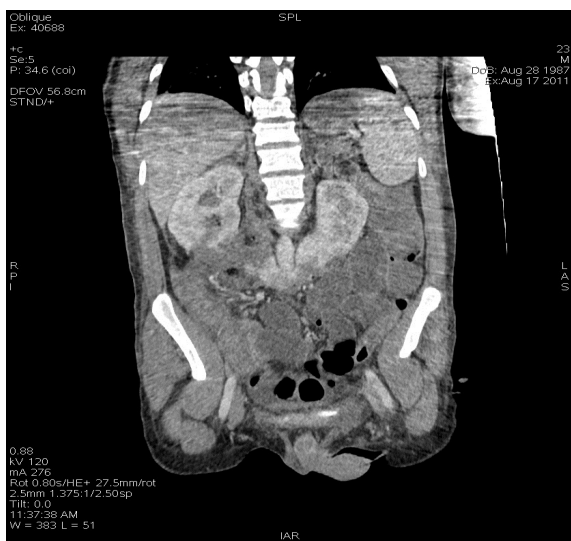


**Figure 4.** Severe left kidney injury, which resulted in nephrectomy.

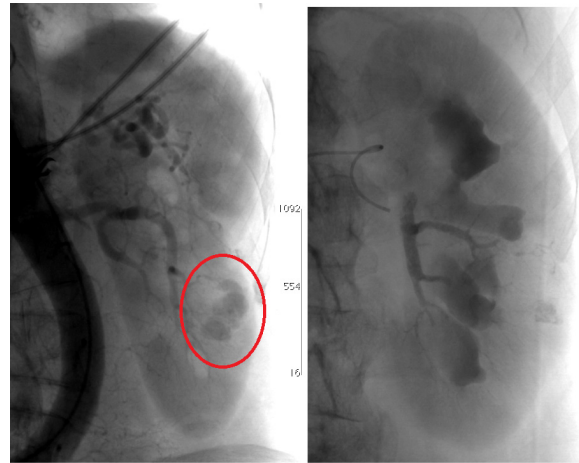
## DISCUSSION

Renal trauma is one of the most frequent injuries observed in urological practice.<sup>(4)</sup> A basic diagnostic tool of renal trauma is CT scan. Using contrast medium, it allows for precise assessment of the scope of renal injury and the functioning of the uninjured kidney, and furthermore, can determine injuries to other organs. The use of helical CT scan is recommended for rapid renal diagnosis.<sup>(5)</sup> Short examination time requires a careful evaluation of pyelocaliceal system injury, because of the time required for the contrast medium to pass from the cardiovascular system to urine. The CT scan technique has an established position in the diagnosis of renal trauma, and its value has been well documented in the literature.<sup>(6)</sup> In case of hemodynamic instability forcing immediate surgical intervention, intraoperative IVU is recommended.<sup>(7)</sup> This allows the determination of the function of the second kidney, which can affect surgical decision-making. The rule of thumb for renal trauma treatment should be an organ-sparing treatment (Figure 5).

Most cases in our cohort were treated conservative-



**Figure 5.** This patient underwent organ-sparing treatment.



**Figure 6.** This patient underwent transcatheter super-selective embolization.

ly with good results. Treatment consisted of bed rest, monitoring of vital signs (blood pressure, heart rate) and laboratory parameters (complete blood count, creatinine), and repeated evaluation of trauma scale in imaging examinations.<sup>(8)</sup> This conservative treatment had good outcomes for the 27 cases of grade I and II trauma in our cohort. The main issue is the treatment of grade III and grade IV renal trauma cases. It is worth mentioning that in our study, 1 of 10 grade III injuries and 1 of 4 grade IV injuries were successfully managed conservatively.

The clinical state of the patient should be crucial in this case. Surgical intervention should be performed in hemodynamically unstable patients (tachycardia, hypotension), with symptoms indicating hypovolemic neurogenic shock or with blood loss without shock symptoms, identified with repeated complete blood count examinations or observation of hematoma in imaging examinations. Advancement of intravascular techniques (TSE), has allowed for effective treatment of renal trauma associated with vessel trauma. In this study, embolization was successfully performed in 6 patients, achieving patient stabilization (Figure 6). In the literature, the effectiveness of TSE has been established, and it has been described as a good alternative to surgical treatment.<sup>(8)</sup> In case of pyelocaliceal system injury, the treatment must be adjusted to the scope of the injury. For minor injuries with involution, an expectant approach is recommended. Urine leakage with a tendency of continuing or increasing, should be treated by temporary (4-6 weeks) urine drainage using a double J (DJ) ureteral catheter.<sup>(9)</sup> Severe injury of the renal pelvis requires surgical intervention. The treatment of grade V renal trauma is associated with a high rate of surgical intervention,<sup>(10)</sup> though selected cases may be treated conservatively. In our study, all grade V cases required surgical intervention. In all cases, urgent nephrectomy was performed in the Hospital Emergency Department because of hypovolemic shock. Among the iatrogenic causes of renal trauma in our cohort, some were associated with ESWL, PCNL, and PCR. The frequency of complications of the above-mentioned interventions in our center did not deviate from that reported in the literature. In PCR, the rate of surgical intervention requiring a urological intervention is approximately

0.5–1%, and the rate of surgical intervention resulting in nephrectomy is only 0.1–0.2%.<sup>(11)</sup> One of the main limitations of this study was its retrospective design.

### CONCLUSIONS

In summary, we highlight the use of precise methods for the evaluation of trauma range. The use of CT scan in combination with strict observation of conservative treatment protocols and intravascular techniques results in effective treatment of renal trauma. Surgical intervention is necessary in only 2% of cases, of which the frequency of nephrectomy is 11%.<sup>(12)</sup> The right renal trauma classification according to AAST scale enables a further management based on EAU guidelines. Renal injuries are incidental to multiple organ trauma, therefore, it is necessary to be treated in specialized health center. In vast majority of patients, conservative treatment is preferred and efficient.

### CONFLICT OF INTEREST

None declared.

### REFERENCES

1. Salimi J, Nikoobakht MR, Zareei MR. Epidemiologic study of 284 patients with urogenital trauma in three trauma center in Tehran. *Urol J*. 2004 Spring;1:117-20.
2. Aragona F, Pepe P, Patanè D, Malfa P, D'Arrigo L, Pennisi M. Management of severe blunt renal trauma in adult patients: a 10-year retrospective review from an emergency hospital. *BJUI Int*. 2012;110:744-8.
3. Buckley JC, McAninch JW. Revision of current American Association for the Surgery of Trauma Renal Injury Grading System. *J Trauma*. 2011;70:35-7.
4. Salimi J, Nikoobakht MR, Khaji A. Epidemiology of urogenital trauma in Iran: results of the Iranian National Trauma Project. *Urol J*. 2006 Summer;3:171-4.
5. Morey AF, Brandes S, David Dugi III D. Urotrauma: AUA Guideline. *J Urol*. 2014;192:1-9.
6. Ortega SJ, Netto FS, Hamilton P, Chu P, Tien HC. CT scanning for diagnosing blunt ureteral and ureteropelvic junction injuries. *BMC Urol*. 2008;8:3.
7. Morey AF, McAninch JW, Tiller BK, Duckett CP, Carroll PR. Single shot intraoperative excretory urography for the immediate evaluation of renal trauma. *J Urol*. 1999;161:1088-92.
8. Santucci RA, Fisher MB. The literature increasingly supports expectant (conservative) management of renal trauma – a systematic review. *J Trauma*. 2005;59:493-503.
9. Alsikafi NF, McAninch JW, Elliott SP, Garcia M. Nonoperative management outcomes of isolated urinary extravasation following lacerations due to external trauma. *J Urol*. 2006;176:2494-7.
10. Davis KA, Reed RL, Santaniello J, et al. Predictors of the need for nephrectomy after renal trauma. *J Trauma*. 2006;60:164-9.
11. Mohsen T, El-Assmy A, El-Diasty T. Long-term functional and morphological effects of transcatheter arterial embolization of traumatic renal vascular injury. *BJU Int*. 2008;101:473-7.
12. Centers for Disease Control and Prevention: Injury prevention & control: data & statistics. 2010; <http://www.cdc.gov/injury/wisqars/LeadingCauses.html>. Accessed September 8, 2013.