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# Management of War-related Genitourinary Injuries

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**What's known on the subject? and What does the study add?**

Firearm injuries may cause severe injury to one or more systems and are high-energy traumas. The global increase in terrorism linked to easy access to firearms and explosives has led to an increase in the incidence of urological injuries and genitourinary injuries are reported to comprise 1-3% of all war injuries. Most of the injuries effected multisystems and isolated urological organ injury was observed in rare. However while many kidney injuries were observed in previous years, in recent periods external genital organs are more clearly affected among urological injuries. This study shows the necessity of using a multidisciplinary approach in surgery for patients evaluated in the emergency service due to war injury.

## Abstract

**Objective:** This study aimed to share the diagnosis and treatment results of patients who received genitourinary system interventions or surgeries for injuries sustained during the Syrian Civil War.
**Materials and Methods:** Patients who underwent surgery for firearm injury-related urological trauma and other system injuries accompanied by urological trauma in a border city hospital urology department between October 2012 and May 2016 were evaluated. In addition, patients were classified according to trauma area and presence of accompanying non-genitourinary trauma.
**Results:** Isolated genitourinary injuries were present in 7 of 37 patients (18.9%) who were brought to the emergency service due to war injuries. The most common accompanying damage to the genitourinary system was abdominal injury (56.7%), and 15 (40.5%) patients had intervention after intraoperative consultation. When urological injuries were classified, there were 19 (51.3%) major renal injuries, 3 (8.1%) ureteral injuries, 7 (18.9%) bladder injuries, 4 (10.9%) posterior urethral injuries, 3 (8.1%) testicular injuries, and 3 (8.1%) external genital organ injuries. The most common urological surgical procedure was nephrectomy, and the second was bladder perforation repair.
**Conclusion:** This study demonstrates the necessity of a multidisciplinary approach especially for patients with war-related injuries. Moreover, important information is given about the classification and type of genitourinary system injuries.
**Keywords:** Urogenital war surgery, urogenital trauma in war, urogenital war injury treatment

## Introduction

Firearm injuries (FI) are high-energy traumas that may cause severe injuries to one or more body systems (1). Damage caused by FI is proportional to the mass and square of the velocity of the kinetically moving projectile. They are classified as high-, moderate-, and low-velocity injuries (2). High velocity injuries caused by military weapons with high firepower increase the degree of organ injury due to the high velocity and mass effects and the ability to hit a target with multiple projectiles simultaneously (3).

The global increase in terrorism linked to easy access to firearms and explosives has led to an increase in the incidence of urological injuries, especially in war regions (4). Studies have reported that genitourinary injuries comprise 1-3% of all war injuries. While many kidney injuries were observed in previous

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years, external genital organs are more clearly affected by urological injuries in recent times (5).

Studies have shown that civilians are injured and exposed to life-threatening injuries more than military personnel in wars (6). For the majority of injuries in the Syrian Civil War, treatment was performed in Turkey. In this study, we planned to share the diagnosis and treatment outcomes of patients who received interventions or surgeries to the genitourinary system for injuries related to the Syrian Civil War, linked to our location close to this dangerous region.

## Materials and Methods

Patients who underwent surgery due to FI-related urological trauma and other system injuries accompanied by urological trauma in borderline city hospital urology department between October 2012 and May 2016 were evaluated. The average age of the patients was 26.7 (12-41) years, and there were 33 male and 4 female patients. Preoperative examinations and procedures were examined based on electronic records. Extensive biochemistry tests, direct urinary system radiography, scrotal Doppler ultrasonography, computed tomography (CT), and CT-assisted cystogram examinations were performed for patients examined in the emergency service. The diagnosis was made through intraoperative observation for 22 patients taken for urgent operation with FI-related shock presentation after we were called for consultation.

### Ethics

This retrospective study was approved by the institutional review board (decision no. HRU/20.04.01) The study was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (amended in October 2013).

Informed consent was not necessary because no patient data were included in the manuscript and because of the retrospective design.

### Statistical Analysis

Statistical analysis was performed with SPSS v. 23.0 statistical software (SPSS, Inc. Chicago, IL, USA). Chi-square tests were used to examine the distributions of categorical variables. Categorical variables are described as frequencies and percentages. Continuous variables are presented as mean and standard deviations. The one-sample t-test test was used for the evaluation of continuous variables.

## Results

Isolated genitourinary injuries were found in 7 of 37 patients (18.9%) who were brought to the emergency service because of war injuries. The most common accompanying damage to the genitourinary system was abdominal injury (56.7%), and 15 (40.5%) patients had interventions after intraoperative consultation. Urogenital system injuries and accompanying other system injuries are shown in Table 1.

The American Association for the Surgery of Trauma (AAST) organ damage scale committee was used to evaluate kidney injuries (7). When urological injuries were classified, there were 19 (51.3%) major renal, 3 (8.1%) ureteral, 7 (18.9%) bladder, 4 (10.9%) posterior urethral, 3 (8.1%) testicular, and 3 (8.1%) external genital organ injuries. The distribution and classifications of kidney injuries are given in Table 2. We were called for intraoperative consultation for 15 patients with kidney damage. These patients underwent surgery due to shock (hemodynamic instability), and 14 of these patients had macroscopic hematuria and one patient had intraoperative exitus (Figure 1).

The number of patients based on ureter damage class according to AAST is shown in Table 3 (7). The number of patients and classification of ureter injuries are given in Table 2. Type 2 and 3 urethral injuries were detected after urine was observed from the postoperative drains of two patients who had general surgery.

Intraperitoneal, extraperitoneal, and combined type of bladder injuries were recorded (7,8). The numbers of patients and classification are presented in Table 2. Macroscopic hematuria was observed in five patients with bladder injuries. The number and classification of patients with posterior urethra are given in Table 2. Urethrorrhagia was observed in two patients.

**Table 1. Distribution and classification of war injuries**

| **Type of abdominal injuries** | **Number of patients 27** | **72.9%** |
|---|---|---|
| Hepatic injury | **3** | **8.1** |
| Splenic injury | **4** | **10.8** |
| Gastric injury | **1** | **2.7** |
| Small intestinal injury | **8** | **21.6** |
| Colonic-rectal-anal injury | **9** | **24.3** |
| Gall bladder injury | **1** | **2.7** |
| Major vessel injury | **3** | **8.1** |
| Minor vessel injury | **6** | **16.2** |
| Type of thoracic injuries | **Number of patients 4** | **10.8%** |
| Hemothorax | **4** | **10.8** |
| Pulmonary injury | **2** | **5.4** |
| Diaphragm rupture | **2** | **5.4** |
| Type of orthopedic injuries | **Number of patients 5** | **13.5%** |
| Iliac bone injury | **1** | **2.7** |
| Symphysis pubis injury | **1** | **2.7** |
| Femoral muscle-bone injury | **3** | **8.1** |

Isolated urological organ injuries were observed in seven patients. Three patients had isolated kidney injury, two had isolated bladder injury, one had isolated scrotum injury, and one had glans penis injury. One patient had testicular and anterior urethral injuries, while another had bladder and distal urethral injuries. Another patient had testicular and scrotal injuries. Nephrectomy was the most common urological surgical procedure, followed by bladder perforation repair.

The distributions of all urological war injuries and procedures are shown in Tables 2 and 3.

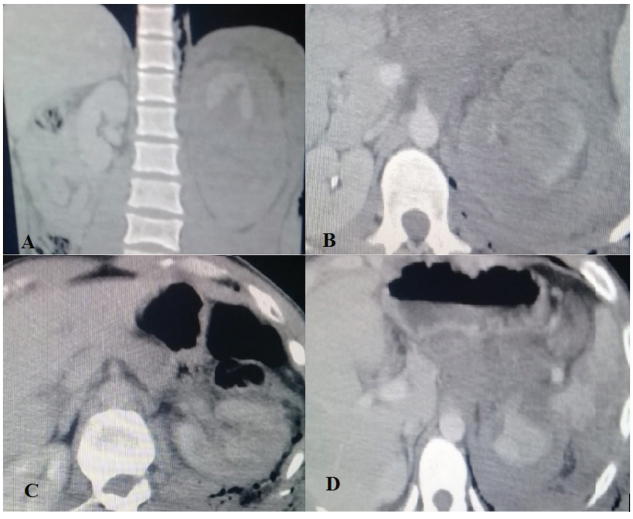


**Figure 1.** Computed tomography images of renal injuries. A) Grade 5 left renal injury and hematoma. B) Grade 5 left renal injury. C) Renal artery injury. D) Left renal and spleen laceration

**Table 2. Distribution and classification of urologic war injuries**

| | Number of patients | % |
|---|---|---|
| **Major renal injuries** | 19 | |
| 1. Type 4 injury | 6 | 51.3 |
| 2. Type 5 injury | 13 | |
| **Urethral injuries** | 3 | |
| 1. Type 2 injury | 1 | |
| 2. Type 3 injury | 1 | 8.1 |
| 3. Type 5 injury | 1 | |
| **Bladder injuries** | 7 | |
| 1. Extraperitoneal type | 3 | |
| 2. Intraperitoneal type | 3 | 18.9 |
| 3. Combined type | 1 | |
| **Posterior urethral injuries** | 4 | |
| 1. Partial rupture | 1 | 10.8 |
| 2. Complete rupture | 3 | |
| **Anterior urethral injury** | 1 | 2.7 |
| Glans penis injury | 1 | 2.7 |
| Testicular injury | 3 | 8.1 |
| Scrotal injury | 2 | 5.4 |

**Table 3. Type of surgical interventions and number of patients**

| Operation type | Number of patients |
|---|---|
| Nephrectomy | 15 |
| Renography | 4 |
| Ureteral stent application | 2 |
| Bladder perforation repair | 5 |
| Ureteroneocystostomy + bladder repair + ureteral stent location | 1 |
| Percutaneous cystostomy | 3 |
| Anterior urethroplasty + orchiectomy | 1 |
| Orchiectomy | 1 |
| Glans penis repair | 1 |
| Scrotal repair | 1 |
| Cystoscopy + locating urinary catheter with sliding technique | 1 |

## Discussion

The etiology and anatomical distribution of injury change according to the development of weapon systems, use of individual protective materials such as body shields, and nature of war (9). When average system injuries were considered, in this study, 19 thoracic, 15 head, 60 extremity, and 10 abdominal injuries occurred in all wars after World War I. The ratio of multiple organ injuries was 18% in the 1991 Gulf War and 23% in the Yugoslavian war in 1993 (10). The prevalence of urogenital system injuries was 2-4% (11). The urogenital injury rate was approximately 5% according to a study completed with 696 patients in ICR Sahra Hospital in Beirut in 1976. The distribution of injured urological organs was not stated in the study (10). The number of patients was the same in our study, and we examined urological organ injury distribution.

Kidney injuries are the most common injuries in patients taken to emergency services because of urological trauma (11-13). The presence of hematuria is significant for kidney trauma, but it may not always be present (14). The lack of hematuria especially in renal vascular injuries does not eliminate this diagnosis (15). Kidney injuries in trauma cases are mostly minor injuries with surgery performed in less than 10%, and recovery was observed with conservative treatment (12,16). Conservative treatment is more important for blunt kidney trauma. Surgical exploration is suggested in penetrating injuries if a major kidney injury is present (17). According to Salvatierra et al. (18) who investigated the Vietnam War in 1969, the kidney was the most commonly injured organ at a rate of 35%. They performed nephrectomies that were highly related to major injuries (18). In a 1991-1992 Croatian study, the authors also performed a high number of nephrectomies (19). Renal trauma had the highest prevalence in our study, and macroscopic hematuria was observed in 14 patients. Major kidney injuries were detected in all patients, and

nephrectomy and renography were performed in 40.5% and 10.8% of the patients, respectively.

Ureteral injuries very rarely occurred. They are mostly iatrogenic and include the lower ureters (17). No specific physical examination can indicate the presence of a ureteral injury. Therefore, ureteral injury is difficult to detect and diagnose (20). Ureteral injuries are usually diagnosed postoperatively. Prolonged ileus, sepsis, elevated serum creatinine, leukocytosis, and long drainage time indicate suspicion of ureteral injuries (12). In a Croatian study, ureteral injuries were observed in 11 of 115 patients. Successful results were achieved in patients who had primary repair through the excision of the injured ureteral ends (19). In the present study, ureteroneocystostomy was performed in one patient, and DJ catheter was inserted in three patients. Ureteral stricture was not observed during postoperative follow-ups.

Macroscopic hematuria occurs in 95% of bladder injury cases (11). Cystogram was suggested; however, recent studies proposed that CT cystography is more effective in diagnosing bladder injuries (21). In the present study, macroscopic hematuria was detected in five patients, and bladder perforations were observed on cystograms taken, excluding those in two patients who underwent emergent surgery. In studies about blunt and penetrating war injuries, the bladder and external genital organs are the most commonly injured organs after the kidney (18). These were the second most commonly injured organs in our study.

External genital organ injury was the most common urological organ injury in some studies. External genital injuries most commonly affect the scrotum, testicle, penis, and urethra, in this order (2,22,23). These injuries, especially penis-related ones, cause long-term sexual and psychiatric damage and personality disorder (11). In scrotal trauma, testicular rupture and penetrating injuries through the Dartos fascia require surgical exploration (24). The prevalence of external genital organ injuries was 19.8% in our study.

Urethral ruptures are often seen after blunt trauma. The incidence of urethral rupture with pelvic fracture varies between 5% and 25% (25). Urethrorrhagia is a significant finding of posterior urethral rupture. Retrograde urethrography was recommended. Suprapubic catheterization was suggested in complete posterior urethral ruptures (17). In the present study, urethrorrhagia was observed in two patients. As urinary catheter was attempted for these patients in the operating room and emergency service by health professionals, they were transferred to other centers for elective treatment after insertion of a direct percutaneous cystofix catheter.

Urological organ injuries occur with abdominal, thoracic, and extremity injuries. Urological organ injuries accompanied by abdominal organ injuries are the most common (11,12,18). Urological system injuries were observed in 10-15% of abdominal injuries (11). In our study, other system injuries accompanied urological organ injuries in 81.1% of the patients. Abdominal organ injuries are the most common among these system injuries, with a prevalence of 56.7%. In our study, we intraoperatively evaluated patients (59.4%) taken for emergency surgery because of hemodynamic instability.

As the results suggest, a multidisciplinary approach is necessary when performing surgery on patients evaluated in the emergency service due to war injuries or taken for emergency surgery because of shock.

## Conclusion

In this study, we tried to show the necessity for a multidisciplinary approach for patients requiring emergency intervention due to multisystem injuries. Moreover, important information was given about the classification and type of genitourinary system injuries. We think that countries, international organizations, and research and development associations should be more active, supportive, and instructive to prevent, ease, and treat war-related injuries.

### Ethics

**Ethics Committee Approval:** This retrospective study was approved by the institutional review board (decision no. HRU/20.04.01) The study was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (amended in October 2013).

**Informed Consent:** Informed consent was not necessary because no patient data were included in the manuscript and because of the retrospective design.

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### Authorship Contributions

Surgical and Medical Practices: E.Ö., A.A., E.D., H.F.Ö., İ.K., R.S., Concept: E.Ö., A.A., Design: E.Ö., A.A., M.G.S., Data Collection or Processing: E.D., Analysis or Interpretation: H.F.Ö., İ.K., Literature Search: E.Ö., A.A., R.S., Writing: E.Ö., A.A., M.G.S.

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