

# Operative Management of Wartime Genitourinary Injuries at Balad Air Force Theater Hospital, 2005 to 2008

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## Abbreviations and Acronyms

AFTH = Air Force Theater Hospital

GSW = gunshot wound

GU = genitourinary

IED = improvised explosive device

OIF = Operation Iraqi Freedom

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**Purpose:** We detail the 3-year experience of operative combat urology of genitourinary surgeons stationed at Balad Air Force Theater Hospital, Balad, Iraq.

**Materials and Methods:** We performed an institutional review board approved, retrospective review of operative logs of the 9 urologists deployed to Balad Air Force Theater Hospital from June, 1 2005 to June 1, 2008. All operative cases performed by the urologists deployed to this facility were reviewed. Patients were grouped by injury location and operative approach. Analysis included the calculation of relative injury rates by location and the incidence of organ preservation.

**Results:** During the 36 months reviewed 273 patients underwent a total of 361 operative and 25 endoscopic procedures for 1 or more genitourinary injuries. Of the patients 227 (83.1%) had wounds to the lower genitourinary tract, 39 (14.3%) had wounds to the upper genitourinary tract and 7 (2.6%) had upper and lower genitourinary injuries. Exploration, débridement and repair of soft tissue injury to the external genitalia were the most commonly performed procedures. Of the 88 testicular injuries explored testicular salvage was achieved in 45 (51.1%). Nephrectomy was required in 17 of the 27 operative renal injury cases (63.0%).

**Conclusions:** Most genitourinary injuries treated at Balad Air Force Theater Hospital involve the lower genitourinary tract. The high frequency of genital trauma often requires staged reconstructive procedures. Acceptable renal and testicular salvage rates are attainable. This study highlights the diverse array of surgical treatment modalities needed to manage genitourinary trauma during Operation Iraqi Freedom.

**Key Words:** wounds and injuries, urogenital system, war, reconstructive surgical procedures, Iraq

THERE is a paucity of data regarding the management of wartime GU trauma during the last 40 years. A recent comprehensive review revealed little information on GU trauma during United States related conflicts since the 1960s.<sup>1</sup> Data on GU trauma during OIF have been limited to a 1-year retrospective review of the United States Army trauma registry.<sup>2</sup> While this registry provides valuable data on combat injuries, it does not record data specific to each GU organ, nor does it detail what treatment modal-

ities were used by urologists to manage GU trauma.

The 332nd Expeditionary Medical Group in Balad, Iraq is the first AFTH since the Vietnam War. It is 1 of only 2 level III facilities in Iraq, the highest level of care available, and it is responsible for all United States casualty evacuations out of the theater of operations. There has been a urologist as part of the trauma team since its inception in 2004. We report management for GU trauma at Balad

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AFTH from 2005 to 2008. We define the patterns of GU injury and the surgical management required in a modern wartime setting.

## MATERIALS AND METHODS

Institutional review board approval was obtained to review the operative logs from United States Air Force urologists deployed to Balad AFTH. We retrospectively reviewed these operative logs, which were obtained during 36 consecutive months from June 1, 2005 to June 1, 2008. Records from 2004 and early 2005 were not available. The records reviewed included individual logs from 7 of the 9 urologists and the hospital computerized surgical scheduling system database for the remaining 2. All operative cases performed by the 9 urologists deployed to this facility during this time were reviewed. GU procedures performed by nonGU surgeons were not included in analysis.

All patients with operative GU trauma were included in the study, comprising allied and insurgent forces as well as Iraqi military forces, police and noncombatants. Data on nonoperative management for GU injury, ie low grade renal trauma, were not available. Data on the presence or absence of personal body armor were not available. When available, data on injury to other organ systems were noted. Patients were stratified by injury location (upper and/or lower GU tract). Operative procedures were stratified as open vs endoscopic and appropriately grouped for review. Reoperative procedures for the same injury were excluded from study, so that the totals listed adequately reflect the incidence of GU injury observed in this theater of war.

## RESULTS

During the 3-year study period 273 patients underwent a total of 361 operative and 25 endoscopic procedures for 1 or more GU injuries. Of the patients 227 (83.2%) had wounds to the lower GU tract (bladder, urethra and/or external genitalia). Wounds to the upper GU tract (kidney and/or ureter) were found in 39 patients (14.3%). Seven patients (2.6%) had upper and lower GU injuries. Of the 215 patients with adequate surgical records 169 (78.6%) required surgical treatment for concomitant injuries to other organ systems.

### Injury Management

**Lower GU tract.** Of the 361 operative procedures performed 258 (71.5%) involved the external genitalia, 20 (5.5%) involved the urethra and 36 (10.0%) involved the bladder. A total of 314 procedures (87.0%) involved the lower GU tract (see [table](#)). Exploration, débridement and repair of isolated soft tissue injuries to the penis and/or scrotum were the most commonly performed procedures (127 of 314 or 40.4%). Scrotal exploration and/or repair for penetrating injury not involving the testis or adnexa was performed in 80 patients. Of the 88 testicular injuries testicular salvage was achieved in 45 (51.1%). Of the 87 penile injuries 40 (46.0%) required penoplasty and/or cor-

### Surgical management for GU injury at Balad AFTH, 2005 to 2008

Operation	No. Procedures
Renal surgery:	
Renorrhaphy	10
Nephrectomy	17
Ureteral surgery:	
Ureteroneocystostomy	6
Ureteroureterostomy	6
External ureteral drainage	7
Transureteroureterostomy	1
Total No. upper GU operations	47
Bladder exploration/repair	36
Urethral surgery:	
Urethroplasty	17
Primary urethral realignment	3
Genital surgery:	
Orchioplasty	45
Orchiectomy	43
Exploration +/- or scrotal injury repair, no testicular injury	80
Exploration +/- or penile injury repair, no glanular/urethral/corporal injury	47
Glanular +/- or corporal repair	40
Testicular adnexa repair	3
Total No. lower GU operations	314

poroplasty, while 47 (54.0%) required débridement and the repair of superficial injuries alone.

Repair of urethral injury was performed in 17 patients. Of interest, most urethral injuries were caused by direct injury to the genitalia, often requiring concomitant repair of the other superficial and deep structures of the penis. Primary realignment of posterior urethral distraction was successful in 1 of the 3 patients in which it was attempted. Suprapubic tubes were placed in patients with a devastating urethral injury not amenable to primary repair or realignment.

Exploration and/or repair of bladder injury was performed in 36 patients. Injury to nonGU organs was particularly common in this group. Six distal ureteral injuries required ureteral reimplantation. The use of urethral and/or suprapubic catheters after bladder injury repair was at the discretion of the operative surgeon.

**Upper GU tract.** There were 47 operative cases (13.0%) involving the upper urinary tract (see [table](#)). Of the 27 operative renal injury cases nephrectomy was required in 17 (63.0%). Renorrhaphy was completed successfully in 10 patients. Low grade renal injury was typically managed nonoperatively by observation and serial imaging but these patients were not included in this review.

There were 20 ureteral injuries requiring open repair, comprising 5.5% of all GU operative procedures (see [table](#)). Primary reconstruction was achieved in 13 cases and temporary ureteral externalization was required in 7. Ureteroscopy was done to rule out occult ureteral injury in 3 patients.

## DISCUSSION

OIF is the first sustained military conflict involving the United States since the Vietnam War. To our knowledge this is the first comprehensive report of urological trauma experience at Balad AFTH, the largest and busiest level III medical facility in Iraq. This 3-year experience provides new insight into the GU injuries observed in a modern wartime setting.

There was a high rate of lower GU injury. More than 80% of the trauma cases in our series involved the bladder, urethra or external genitalia. In particular injury to the external genitalia accounted for more than 70% of all GU injuries. As the conflict progressed, genitourinary surgeons made the recurrent observation that the visible appearance of the scrotum was not a reliable predictor of the presence or absence of testicular injury. Patients with tiny lacerations were often found to have occult testicular rupture. Therefore, scrotal exploration became a routine practice to stage penetrating scrotal trauma. Fortunately, aggressive scrotal exploration resulted in testicular salvage in almost 75% of all scrotal injuries and in more than 50% of damaged testes.

Civilian data on scrotal injury reveal comparable testicular salvage rates. In a 10-year review of 51 patients with penetrating scrotal trauma due to GSW Brandes et al reported a 45% rate of testicular injury.<sup>3</sup> Orchiectomy was required in 52% of all injured testes. In a 30-year review of penetrating genital injury Phonsombat et al reported a 51% orchiectomy rate in 47 testicular injuries.<sup>4</sup> However, when stratified by injury mechanism, testicular salvage was achieved in 75% of GSW cases but in only 23% of stab wound cases.

Penile injury was similarly common at Balad AFTH and it frequently presented in the context of extensive genital skin and soft tissue loss (fig. 1, A). Staged reconstruction using vacuum assisted wound closure devices and/or split-thickness skin grafts were often required in these cases (fig. 1, B and C). Injury to the deep structures of the penis (urethra and/or corpora) was present in about half of all penile injuries. These

injuries were diagnosed using retrograde urethrography, cystourethroscopy, and/or penile degloving and exploration at the discretion of the attending urologist. Urethral and corporeal injuries were then repaired primarily when feasible.

While most injuries observed during OIF and Operation Enduring Freedom are due to IEDs and other explosive ordinance,<sup>2,5</sup> GSWs to the penis are also seen. Three patients in particular had high velocity GSWs to the dorsum of the penis without urethral involvement, which despite adequate reconstruction of the corpora and skin coverage subsequently showed delayed penile necrosis. After initial repair serial wound débridements were required due to progressive necrosis and all 3 patients eventually underwent partial penectomy.

The extensive soft tissue loss seen with blast and high velocity bullet injuries necessitated a staged approach to genital reconstruction in many patients. While these data were not present in all cases, review of the operative logs of 2 surgeons showed that reoperation comprised 46.3% and 44.9% of their total number of GU operative procedures, respectively.

Surgical management for upper GU trauma was required much less frequently. Renal trauma necessitating surgical exploration was present in 27 cases (7.5%). Unfortunately the operative logs reviewed did not detail the mechanism of injury (GSW, blast or motor vehicle collision). However, a previous study indicated that trauma due to motor vehicle collision was responsible for only 2% of 1,452 combatants injured during OIF and Operation Enduring Freedom.<sup>5</sup> Therefore, we presume that most operative renal injuries in this series were caused by penetrating trauma from GSW or blast injury.

Of the 27 cases of operative renal injury in this series nephrectomy was required in 17 for a 63% nephrectomy rate when exploration was needed. This renal salvage rate compares favorably to that in a recent report from a large volume civilian trauma center, where nephrectomy was required in 60.7% of 89



**Figure 1.** A, genital trauma from IED. B, sponge dressing placement for staged management of genital soft tissue loss. C, completed placement of vacuum assisted closure device.

patients who underwent surgical exploration for renal trauma.<sup>6</sup>

Operative treatment for ureteral injuries was uncommon (5.5%) but comparable to the rate in other wartime series during the last 70 years.<sup>2,7-9</sup> Initial ureterocutaneous diversion was done in unstable cases and primary reconstruction was performed when feasible. In patients with pelvic blast injury to the lower ureter requiring ureteroneocystostomy débridement of 1 to 2 cm of normal ureter above the visible injury was necessary due to anticipated necrosis from the blast effect.

Few other published reports of GU injury from OIF exist. Paquette retrospectively reviewed 11 months of combat wound data from a United States Army trauma registry.<sup>2</sup> While detailed data on the extent and nature of GU injury were not present in the database, subsequent chart review showed a relatively higher rate of upper GU injury than that in our report (31.6% vs 13%). Excluding patients with nonoperative renal injury, the differences between the 2 series remain substantial (fig. 2). The inclusion of nonoperative renal injuries by Paquette

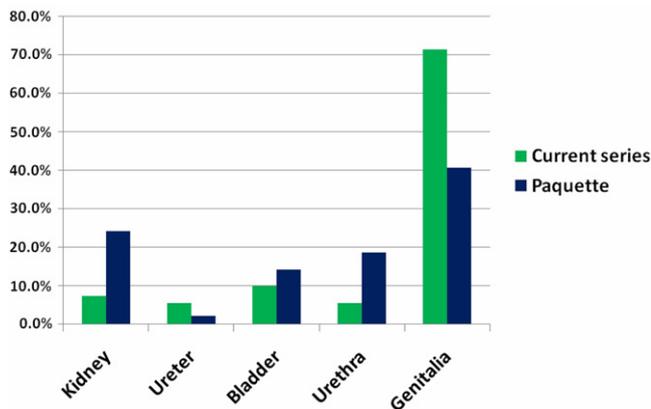


Figure 2. OIF operative GU wound patterns. Paquette, Paquette<sup>2</sup>

is a key difference between the 2 series. Furthermore, the database reviewed in that report is maintained by nonurologists and retrospective chart review by Paquette was required to discover all GU injuries. This introduced a bias that is not present when each operating GU surgeon prospectively logs his or her surgical experience, as in our series.

This study is limited by its retrospective design, and the lack of preoperative wound data and postoperative outcome data. The mechanism of injury, the presence or absence of body armor, and deaths and complications were not reported in the operative logs reviewed. Furthermore, Iraqi patients rarely returned for followup and injured American combatants were evacuated out of theater after stabilization. Additionally, a reporting bias may have been present, given the method of data acquisition. However, the urologists contributing to this report remained on station at all times and were always on call for consultation purposes. It was under only the most exceptional of circumstances when nonurologists needed to treat operative GU injury, ie the urologist on duty was operating simultaneously on a different patient. Therefore, we estimate that patients in whom GU injury was treated exclusively by other providers were uncommon and impact this data set in a negligible way.

## CONCLUSIONS

Most GU trauma noted during OIF involves the lower GU tract. The high frequency of genital trauma, predominantly from IED blast injury, requires complex and often staged reconstructive procedures. Despite austere battlefield conditions and a high rate of multisystem injury an organ salvage rate comparable to that in civilian series is attainable. To our knowledge this report is the most comprehensive study to date on GU injury in OIF. It highlights the diverse array of surgical treatment modalities needed to manage GU trauma in a modern wartime setting.

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