

## Genitourinary Trauma at a Combat Support Hospital During Operation Iraqi Freedom: The Impact of Body Armor

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**Purpose:** This report details the occurrences of genitourinary trauma experienced during Operation Iraqi Freedom at a United States Army Combat Support Hospital, and determines if wearing body armor decreases the frequency of genitourinary and specifically kidney trauma.

**Materials and Methods:** The Joint Theater Trauma Registry was used to conduct a retrospective study of 2,712 trauma admissions to a United States Army Combat Support Hospital in Baghdad, Iraq from April 1, 2005 to February 28, 2006. There were 1,216 casualties who were wearing body armor and 1,496 casualties not wearing body armor.

**Results:** Of the 2,712 trauma admissions 76 (2.8%) had 1 or more genitourinary injuries for a total of 98 genitourinary injuries. Of the 29 kidney injuries 2 (6.9%) were explored without any treatment, 7 (24.1%) were observed, 1 (3.4%) was repaired and 19 (65.5%) casualties required nephrectomy. Casualties wearing body armor had a 2.1% rate of genitourinary injury versus 3.4% not wearing body armor ( $p = 0.037$ ). Casualties wearing body armor had a 0.5% rate of kidney injury compared to 1.4% not wearing body armor ( $p = 0.017$ ).

**Conclusions:** The percentage of casualties with genitourinary injuries and the distribution of these injuries appear similar to previous conflicts. The percentage of casualties undergoing nephrectomy appears to be greater than that observed in other recent conflicts. There was a significant reduction in overall genitourinary injuries and specifically kidney injuries in those casualties wearing body armor.

*Key Words: wounds and injuries, urogenital system, protective devices, war, nephrectomy*

Injury to GU organs occurs in 0.5% to 4.2% of all war injuries.<sup>1-7</sup> The pattern of GU injury in OIF, the most recent conflict the United States Military has been engaged in, is described. The standard in civilian renal trauma series is for nonoperative management for most nonpenetrating trauma. If a surgery is performed (more likely for penetrating injury) débridement and repair are the norm.<sup>8,9</sup> Unique characteristics of this conflict and our evacuation procedures resulted in a lower rate of renal salvage than expected and this topic is discussed in detail.

Of particular interest is the role of modern body armor in reducing GU injuries. A recent article has shown a decreased rate of intra-abdominal and thoracic injuries in Israeli soldiers wearing body armor.<sup>10</sup> To my knowledge this current series is the first to demonstrate a statistically significant reduction in overall GU and specifically renal injury in casualties wearing body armor.

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## MATERIALS AND METHODS

### Study Subjects

The Joint Theater Trauma Registry is a United States Military trauma registry that follows the American College of Surgeons Committee on Trauma inclusion and exclusion criteria. The registry prospectively collects data on trauma patients in Operation Iraqi Freedom and Operation Enduring Freedom (Afghanistan). Data in the JTTR are obtained from a systematic review of available inpatient medical records from levels III through IV (a CSH is a level III facility) of the United States Army Health Services Support System. Casualty medical records are reviewed by JTTR nursing personnel and information is abstracted to a standardized data collection form. There are 48 data elements that are extracted from each medical record ranging from type of injury to time of tourniquet to method of evacuation. The complete JTTR is located at Fort Sam Houston, Texas. The raw data elements from the CSH were searched for groin or abdominal injuries (the JTTR does not specifically record data on each GU organ). The medical records were then reviewed by the author to determine if the abdominal wounds included any upper tract GU injury and if the groin wounds included any lower tract GU injuries.

The population observed is casualties admitted to the 10th and 86th CSH in Baghdad, Iraq from April 1, 2005 to February 28, 2006, excluding detainees or prisoners of war. There were 2,794 trauma admissions during this 11-month period. Of these admissions 82 charts were unavailable or incomplete resulting in a total of 2,712 charts that were

available for review. From this population 76 patients were identified as having a GU injury.

Of particular interest is the use of body armor in this population. Modern body armor is a KEVLAR® vest with anterior and posterior ceramic plates that primarily cover the thorax and upper abdomen. A KEVLAR helmet is also part of the personal protective equipment of a coalition soldier. A detachable, lightweight groin protector made of KEVLAR hangs down from the anterior vest and gives some protection to the penis and scrotum, but would be of no benefit for high velocity missiles. It was not documented in our database if this groin protector piece was worn at the time of injury. Of the 76 patients treated for a GU injury 26 were coalition forces, and 50 were Foreign National civilians, police or military. All but 1 of the coalition forces was wearing protective body armor at the time of injury. None of the civilians were wearing body armor and our experience demonstrated that body armor was rarely worn by Foreign National police or military admissions to the CSH. A total of 1,216 casualties were wearing body armor and 1,496 were not wearing body armor at the time of their injury. In terms of statistical analysis Fisher's exact test (1 tail) was used to determine the significance of GU and kidney injuries between casualties wearing and not wearing body armor.

**Facility**

The CHS was located in a former Iraqi hospital which is similar in capabilities to an American community hospital. Electricity and running water were available. Computerized tomography, plain films and basic laboratory studies were available. Blood bank activity was reflective of the high volume and severity of injury of our casualties, transfusing more than 50 units of packed red blood cells per day. Interventional radiology was not available. Four operating rooms could be used. United States casualties were evacuated out of theater as soon as they were clinically stable. Nearly all casualties were flown to Germany, which is a more than 8-hour flight from Baghdad. On this flight there was critical care nursing but no operative treatment available. Foreign National casualties were transferred to Iraqi medical facilities after they were treated and stabilized. These Iraqi facilities had limited resources. These evacuation and transfer policies coupled with limited followup for casualties precluded any analysis of mortality, and contributed to the decision to perform nephrectomy vs a renal sparing procedure on some casualties.

Computerized tomography or on table excretory urography was usually done before nephrectomy. If no radiological imaging was done the contralateral kidney was palpated before nephrectomy. Limited retrospective access to radiographs and complete operation reports made accurate staging of renal injuries difficult. The majority of the GU injuries were treated by 1 of the 3 urologists who were sequentially stationed at the CSH. However, there were several GU injuries treated by general surgeons because a urologist was not available.

**RESULTS**

There were 76 (2.8%) patients from the population of 2,712 trauma admissions that were treated for 1 or more GU injuries in OIF. The mechanism of these GU injuries can be accounted for as 10 (13.2%) blunt trauma, 28 (36.8%) bullet and 38 (50%) explosive ordinance. A total of 98 GU injuries

were recorded. The breakdown of the injuries incurred in OIF is summarized in the table, which also includes the rates of GU injuries in prior conflicts.

Of the 29 kidney injuries in this study shown in the table, 2 were explored without any treatment (6.9%), 7 (24.1%) were observed, 1 (3.4%) was repaired and 19 (65.5%) were removed. Of the 29 kidney injuries 7 occurred in patients wearing modern body armor. Of these 7 patients 5 had nephrectomy, 1 was repaired and 1 was explored without treatment. The mechanism of injury of these 7 casualties was 1 blunt motor vehicle accident (nephrectomy was done), 4 by IEDs and 2 by bullets. Of these 7 patients wearing modern body armor with renal trauma all had significant associated injuries, including 1 with a diaphragm injury and the other with a chest injury.

There were 1,216 casualties wearing body armor and 1,496 casualties not wearing body armor at the time of injury. Casualties wearing body armor had a 2.1% (25 of 1,216) rate of GU injury versus 3.4% (51 of 1,496) for those not wearing body armor (p = 0.037). Casualties wearing body armor had a 0.5% (7 of 1,216) rate of kidney injury compared to 1.4% (22 of 1,496) not wearing body armor (p = 0.017).

**DISCUSSION**

This study demonstrates that 2.8% of all trauma admissions sustained a GU injury. The number of casualties having GU trauma during war has varied during the last 70 years. During the Iran-Iraq conflict it was the lowest at 0.51%.<sup>1</sup> In the wars of Bosnia and Croatia it varied from 2.4% to 3.6%.<sup>5,7</sup> During Vietnam it was 3% to 4.2%.<sup>3,4</sup> and studies from World War II demonstrated a rate ranging from 0.7% to 2.6%.<sup>6,11</sup>

OIF is a conflict involving high velocity weapons, primarily M16 and AK-47 automatic rifles and IEDs. IEDs cause injury from a combination of the blast effect of the explosion as well as airborne debris that can cause penetrating as well as blunt trauma.<sup>12</sup> In this study explosive devices (mostly IEDs) were responsible for 50% of the injuries, individual firearms caused 37%, and the remaining 13% was due to blunt injury, primarily motor vehicle accidents. Wettlaufer and Weigel's extensive experience during Vietnam revealed that 80% of GU injuries were due to penetrating missiles (combined explosive ordinances and bullets) and 20% were due to blunt trauma.<sup>2</sup> Hudolin and Hudolin from Bosnia-Herzegovina described 53% of casualties being injured by explosive ordinances and 47% had bullet wounds (no GU injuries were due to blunt trauma).<sup>7</sup> Vuckovic et al from

	No. OIF-Current Study (%)	% Bosnia-Croatia <sup>5</sup>	% Vietnam <sup>2</sup>	% WWII <sup>6</sup>
Kidney	29 (29.6)	39.6	19.1	40
Ureter	2 (2.0)	7.8	5.2	3.3
Bladder	13 (13.3)	17.2	10.4	11.6
Urethra	17 (17.3)	4.6	12.0	15
Scrotum	19 (19.4)	22.7	32.8	30
Testicle	12 (12.2)	*	*	†
Penis	6 (6.1)	8.1	18.5	†
Total	98			

\* Testicular trauma categorized as scrotal trauma in these studies.  
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