Managing and Reconstructing urogenital injuries in war casualties

DR RAMI WAJIH NASR MD, FACS

Assistant Professor of Clinical Surgery
American University of Beirut Medical Center
Outline

- Introduction.
- Kidney, Ureter, Bladder injuries.
- Genital injuries.
Introduction:

• During the last decade, the conflicts in the Middle East have changed the face of the traditional war.

• This is evident from the following observations:
  
  ➢ The adoption of the whole enemy’s society as a battlefield.
  
  ➢ The indiscernibility between war and peace.
  
  ➢ The indistinction between military and civilian, and blitzing off the civilian facilities.

The unprecedented heavy use of ground-implanted improvised explosive devices (IEDs) has resulted in the frequent occurrence of a devastating combination of:

- The lower extremity
- Pelvic
- Urogenital
- Abdominal injuries
• Three recent wartime trauma experiences suggest that modern body armor may be protective of:
  --- GU or abdominal injuries
  --- Chest injuries

• However, Gondusky demonstrated that significant renal trauma necessitating nephrectomy can still occur even if protective body armor is worn.

• Nowadays of battle wounds:

- 70% involved the extremities,

- 10% were to the head and neck,

- 15% bullets or shell fragments stuck or penetrated the chest, abdomen or pelvis.

• Of particular interest is the role of modern body armor in reducing GU injuries. A recent article by Poleg has shown a decreased rate of intra-abdominal and thoracic injuries.

<table>
<thead>
<tr>
<th>GU injuries in OIF and comparison to previous conflicts</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. OIF-Current Study (%)</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Kidney</td>
</tr>
<tr>
<td>Ureter</td>
</tr>
<tr>
<td>Bladder</td>
</tr>
<tr>
<td>Urethra</td>
</tr>
<tr>
<td>Scrotum</td>
</tr>
<tr>
<td>Testicle</td>
</tr>
<tr>
<td>Penis</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

* Testicular trauma categorized as scrotal trauma in these studies.
† Testicular and penis trauma categorized as scrotal trauma in this study.


• Injury to GU organs occurs in 0.5% to 4.2% of all war injuries.

• In one study by Edmond L. Paquette:

  ➢ Explosive devices (mostly IEDs) were responsible for 50% of the injuries.
  ➢ Individual firearms caused 37%.
  ➢ Blunt injury, 13% primarily motor vehicle accidents.


GU Trauma

OIF operative GU wound patterns. *Paquette, Paquette2*
Urinary Tract Injuries

• Renal injuries:

- Penetrating gunshot wounds resulted in 22.9% of cases of kidney injury.

> Always remember that Kidney shot wounds can be often associated with fatal wounds of the stomach, liver, spleen, diaphragm, intestines or spine.

In the management of kidney injuries:

---There is a major shift toward non-operative management of the \textit{blunt} renal injuries.

The non-operative management of \textit{high grades injury}, especially during combat, is still controversial; and its concomitant occurrence with other injuries warrants exploration.

Bjurlin MA, Jeng EI, Goble SM, Doherty JC, Merlotti GJ. Comparison of nonoperative management with renorrhaphy and nephrectomy in penetrating renal injuries. Journal of Trauma and Acute Care Surgery. 2011 Sep 1;71(3):554-8
• The reported incidence of nephrectomy in the military literature ranges between 63%-68% especially if exploration was needed.

• The goal in the management of renal injury is to fulfill the **trifecta** of:
  --- Hemorrhage control,
  --- Parenchyma preservation,
  --- low surgical complications.

• There are reports of kidney salvage surgery in the combat setting, such as partial nephrectomy and renorrhaphy.

Figure 1: A 32-year-old young man victim of a stab injury presented with grade IV injury of the left kidney; the patient was managed expectantly.
• Complication of conservative management:

-- **Urinary Extravasation** Urinoma is observed in 1-7% after renal injury.

-- **Delayed Hemorrhage** which occurs most commonly in the first two weeks after the trauma (0-25%).

-- **Renal Insufficiency**, The rate of dialysis according to the data from the National Trauma Data Bank (NTDB) is 0.46%.

-- **Urinary fistulas**

-- **Hypertension**: Goldblatt's kidney is still the plausible theory that explains hypertension after renal trauma the highest incidence of hypertension was as high as 40%.
Ureteral Injuries

- Ureteral trauma accounts for less than 1% of all urologic traumas.
- The proximal ureter is more often injured in 59.7% of the cases.
- The intimate anatomy of the ureter with other structures has made isolated ureteral injuries implausible.
- Concomitant injuries to other organs are noted in 90.4% of the cases.


• Hematuria is a poor indicator of ureteral injury.

• A Recent meta-analysis showed that hematuria is present in only 44% of patients with ureteral injury.

• In combat injury to the ureter, it may be affected by the blast effect, can become ischemic but is unlikely to cause of hematuria.

• The most important step in diagnosing ureteral injury is:
  1. High clinical suspicion based on the mechanism of injury,
  2. The trajectory of the missile,
  3. Intraoperative finding.
Figure 2: A 23-year-old young man sustained a stab injury to his abdomen. Delayed images demonstrate seepage of the contrast through the trajectory of the stab. At the time of exploration, the ureter was repaired by an end-to-end anastomosis.
• Ureteral injuries can be missed in 38% of the patients and this has been associated with high morbidity and mortality.

• One of the main contributing to this high figure of missed injuries is delayed necrosis phenomena after blast injuries.

• The temporary cavity effect associated with the blast injuries may jeopardize the blood supply to the ureter; this cannot be evident at the time of laparotomy or initial imaging.

• The principles of ureteral repair are:

-- Adequate ureteric debridement and careful mobilization,

-- Spatulated, tension-free, water-tight anastomosis,

-- Adequate drainage of the retroperitoneum and quarantine the anastomosis from other organs by omental wrap.

Brandes S, Coburn M, Armenakas N, McAninch J. Diagnosis and management of ureteric injury: an evidence-based analysis. BJU international. 2004 Aug 1;94(3):277
• In the acute phase, the decision to proceed with the primary repair of the injured ureter depends on:

--- The stability of the patient,

--- Presence of other organ injuries, fecal contamination of the field,

--- The extent of the ureteral injury,

--- Also, the involvement of the upper and mid ureter in injury may require a complex repair.

Brandes S, Coburn M, Armenakas N, McAninch J. Diagnosis and management of ureteric injury: an evidence-based analysis. BJU international. 2004 Aug 1;94(3):277

In the scenario where the primary repair of the injured ureter is not feasible:

-- The ureter should be ligated and marked with a radio-opaque surgical clip, which can help in the planning of surgical repair.

-- The drainage of the kidney can be achieved by inserting a nephrostomy tube.
<table>
<thead>
<tr>
<th>Uretero-pelvic junction</th>
<th>Proximal and Mid Ureter</th>
<th>Distal Ureter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short defect</td>
<td>Short defect</td>
</tr>
<tr>
<td></td>
<td>Long defect</td>
<td>Long defect</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>End to End anastamosis</td>
<td>Reimplantation</td>
</tr>
<tr>
<td></td>
<td>Vesico Psoas hitch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boari Flap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transureterureterostomy</td>
<td></td>
</tr>
</tbody>
</table>
Bladder Injury

• According to The Joint Theater Trauma Registry of all US military between October 2001 and January 2008, bladder injury occurred in 21% of the patients; 29% of them had concomitant pelvic fractures.

• This rate is higher than during the Vietnam war (10%).

• Every case of pelvic fracture, a workup should be directed to rule out an associated bladder injury.

• There increase use of CT-cystogram to rule out bladder injury especially in:

1. Multiple injuries,
2. Gunshot for the pelvis,
3. Penetrating injuries below the umbilicus,

CT-Cystogram is more accurate than conventional cystogram, associated with better delineation of the location and extent of the injury, and easiness in imaging interpretation.
Intraperitoneal extravasation

CT cystogram

Extraperitoneal extravasation

bladder

cystogram

Intraperitoneal extravasation
• Intra-op identification of bladder injury can be achieved by inflating the bladder with 300-400cc saline with methylene blue.

• Most of the times primary repair of the injury is encouraged and the decision to leave suprapubic catheter is based on surgeon discernment.

• The presence of simultaneous rectal injury and bladder injury make patients more prone for rectovesical fistula and urinoma so omental flap must be put between the two if feasible
Foley balloon inside the bladder

Leak to the wound

Dr Nasr
Injuries to the External Genitalia

- External genitalia injuries compromise 70% of all genitourinary injuries.

--- The majority of these injuries are caused by high-velocity missiles due to IED (improvised explosive devices) which result in greater damage than those seen in low-velocity gunshot wounds in civilian injuries.

Penile injuries:

Penile injuries during military conflicts are common.

--- Up of 50% of these injuries entail deeper structures of the penis; explicitly: the urethra and/or corpora.

• Superficial injuries:

---- Superficial injuries of the penile skin are usually debrided and irrigated and then closed in a delayed fashion either primarily or using skin grafts.

*Delayed necrosis of the penis after primary repair of high velocity to the penis has been reported, and the consequences can be devastated.*

• For corporal injuries, debridement, irrigation and monitoring for tissue necrosis are needed which might necessitate multiple visits to the operating room. Extensive loss of corporal tissue might need fasciocutaneous or myocutaneous flaps.

Urethral injuries:

- Are rare comprising 0.8% of patients with combat-related genital injuries.

- Frequently the anterior urethral injury is associated with other external genitalia injuries.

- Here the rule of staged reconstruction also applies if there is extensive penile or perineal tissue loss.
  - The majority of the patients require composite reconstruction with **buccal mucosal or skin graft** as a first stage repair to be followed by a second stage urethroplasty after three months especially if the defect is more than 1.5 cm in the anterior urethra.


• In the case of glans involvement in penile injury, special consideration should be given to the aesthetic aspect of the planned repair.

• In injuries that involve less than 50% of the glans, a primary closure can be attempted.

• However, in injuries with a significant loss of the glans, staged repair of the glans with skin or buccal mucosa grafting of the defect is advisable, or one of the naval reconstructive techniques.
Iatrogenic penile glans amputation: major novel reconstructive procedure.

Nasr R¹, Traboulsi SL¹, Abou Ghaida RR¹, Bakhach J².

Author information

¹Division of Urology, Surgery Department, American University of Beirut, P.O. Box 11-0236 Riad El Solh, Beirut 1107 2020, Lebanon.
²Division of Plastic Surgery, Surgery Department, American University of Beirut, P.O. Box 11-0236 Riad El Solh, Beirut 1107 2020, Lebanon.
Scrotal and testicular injury

- The incidences of the scrotal and testicular injuries have soared up in the modern conflicts, and this can be attributed to the use of IED and unavailability of genital protector in most of the body armors.

- All scrotal military injuries need to be explored because even a tiny laceration can mask an occult testicular rupture.

- The testis salvage rate is 75% of scrotal injury and 50% of testis rupture and these figures are comparable to what observed in a low-velocity gunshot.

• **Superficial scrotal** injuries are treated with:
  
  --- Debridement of the devitalized tissues and irrigation of the wounds,

  --- loose approximation of the edges with the insertion of drains and application of vacuum devices to the area.

• **Testicular rupture** necessitates:
  
  --- Debridement and closure of the tunica albuginea to preserve the testis for fertility and testosterone production.

  --- If primary tunical repair is not feasible, then a tunica vaginalis graft can be used to close the defect.


• Recently, an approximation of both testicles to each other creating one single function testis has been described. (Yap et. al.)
• Acute androgen deficiency in the setting of trauma has been described, and the symptoms can be confused with sepsis.

• Main symptoms are intermittent fever, sweating and hot flushes.
• This is why always avoid orchiectomy if possible.

• Those with extensive soft tissue loss seen due to blast and high-velocity injuries necessitated staged genital reconstruction with a reoperation rate of 44%.

• The skin grafts used are of 0.014-0.016 split thickness unmeshed skin grafts.

• The graft is laid down after ensuring a mature graft bed and stabilized using a vacuum-assisted closure device at a pressure of 80 mmHg.

Placement of vacuum assisted closure device.

Adopted from Steven J. et al
Conclusion

• Most GU trauma noted during OIF involves the lower GU tract. Most Uro-genital trauma, predominantly from IED blast injury, requires complex and often staged reconstructive procedures.

• Despite battlefield conditions and a high rate of multisystem injury an organ salvage rate comparable to that in civilian series is attainable.

• For a casualty with a renal injury who goes to the OR, there was a 71% nephrectomy rate.

• As recently noted by Waxman et al., the incidence of battlefield GU injuries warrants deploying general surgeons who receive a review of the management of GU injuries as part of their predeployment training.