Renal Injury
About 10% of all injuries in the emergency room include the genito-urinary system. Renal injuries are the most common type of urinary system injury. In 80% of high grade renal injury there is associated abdominal visceral injury.

Mechanism
1. Closed: A diseased kidney (hydronephrosis, tumor or cyst) are more readily injured with minimal trauma. Blunt trauma, Fracture ribs
2. Penetrating
   - Sharp object, stab
   - Blast shrapnel's
   - Bullets, High & low velocity missiles
3. Surgical and Endoscopic causes.
   - In civil life: caused by blows, falls (FFH), RTAs & stab injuries, fights.
   - In wars: bullet & blast injuries

Penetrating injuries
- Almost always other organ affection
- Almost always needs surgical exploration
- Absence of hematuria does not rule out renal injury
- Vascular injury should not be missed

Blunt injuries
Usually the injury is extraperitoneal, very occasionally (in children) there is peritoneal injury & escape of urine in to the peritoneal cavity

Clinical features
- Pain: Local pain, tenderness
- Hematuria: is the most important symptom of renal injury. microscopic or gross, early or late.
The degree of hematuria does not reflects the severity of renal injury.
In severe hematuria clot retention may occur.
Absence of hematuria does not exclude renal injury

- Meteorism: abdominal distension occurs 24 – 48hr after injury, due to retroperitoneal hematoma implicating splanchnic nerves
- The hemodynamic status depends on the extent of the injury & other organ involvement
Signs of renal injuries

Ecchymosis, bruises in the flank, shell inlet and outlet, acute abdomen, palpable loin masses of hematoma or urinoma.

Intra-peritoneal leak may cause ileus.

Fracture lower ribs and transverse processes are indirect signs of renal injury.

Investigations

- GUE, CBC, Blood Grouping, cross matching, renal function test.
- Imaging Studies
  - Ultrasonography: retroperitoneal collection (Hematoma, urinoma).
  - KUB: Fracture rib or vertebral transverse process, and soft tissue shadow of blood or urine collection.

IVU:

- Arteriography
  - The preferred imaging study is contrast-enhanced CT-scan. If the patient condition is stable, it shows the extent of renal parenchymal laceration, urinary extravasation and extent of retroperitoneal hematoma, (staging).

Indications for Renal Imaging

- Hematuria is the best indicator of renal injury, and most authors accept 5 RBC/HPF as a significant level.
- All blunt trauma patients with gross hematuria.
- Those patients with microscopic hematuria and shock (systolic blood pressure of less than 90 mm Hg any time during evaluation and resuscitation) should undergo renal imaging, usually CT-scan with intravenous contrast.
- Penetrating injuries with any degree of hematuria should be imaged.

Computed tomographic scan of a right renal stab wound (grade IV), demonstrating extensive urinary extravasation and large retroperitoneal hematoma.

Staging of renal injuries refers to the use of appropriate imaging studies (CT scan) to define the extent of injury. Combining these findings with information gleaned at history and physical examination provides maximal guidance for management decisions.
Movement of the kidney from blunt trauma (deceleration injury) causes stretch on the renal artery, resulting in rupture of the arterial intima and formation of a thrombus.

Segmental renal infarction: blunt trauma
Classification of renal injury (staging)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Type</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Contusion</td>
<td>Microscopic or gross hematuria, urologic studies normal</td>
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<tr>
<td></td>
<td>Hematoma</td>
<td>Subcapsular, nonexpanding without parenchymal laceration</td>
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<tr>
<td>II</td>
<td>Hematoma</td>
<td>Nonexpanding perirenal hematoma confining to renal retroperitoneum</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>&lt;1 cm parenchymal depth of renal cortex without urinary extravasation</td>
</tr>
<tr>
<td>III</td>
<td>Laceration</td>
<td>&gt;1 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration</td>
<td>Parenchymal laceration extending through renal cortex, medulla, and collecting system</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>Main renal artery or vein injury with contained hemorrhage</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>Avulsion of renal hilum, devascularizing the kidney</td>
</tr>
</tbody>
</table>

**Trauma classification**

- **Grade I:**
  - Subcapsular hematoma non-expanding
  - Contusions and small infarcts
  - No parenchymal laceration

- **Grade II:**
  - Less than 1 cm laceration
  - Non-expanding perirenal hematoma

- **Grade III:**
  - Greater than 1 cm laceration
  - Not extending to collecting system

- **Grade IV:**
  - Laceration with urinary extravasation
  - Main renal artery or vein injury with contained bleed

- **Grade V:**
  - Main renal artery thrombosis
  - Shattered kidney
  - Renal hilar injury with devascularization of kidney
  - Avulsion at UPJ
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Pelvicalysial laceration

Renal vascular pedicle laceration
**Renal vascular pedicle avulsion**

**Minor renal injury**
- Cortical contusion
- Superficial cortical laceration
- Subcapsular hematoma
- Collecting system involvement

**Major renal injury**
- Shattered kidney
- Vascular pedicle injury
- Medial perirenal hematoma
Management
The minor grades = 85% of the cases = conservative treatment
98% of renal injuries can be managed non operatively
10-15% need surgical intervention
The renal vascular injuries needs urgent surgical care.
Grade IV and V injuries more often require surgical exploration

Management

A: Airway & cervical spine protection.
B: Breathing.
C: Circulation & control of external bleeding.
D: Disability or neurological status.
E: Exposure (undress) & environment (temperature control)

Conservative care
Hospital admission & complete Bed rest: Once the gross hematuria clears ambulation is allowed, should gross hematuria recur, bed rest is reinstated. Ambulation without any sequel allows hospital discharge with close clinical follow-up.
Correct & maintain the hemodynamic status, Repeated clinical assessment (Continuous vital signs check).

Conservative care (Cont.)
Analgesia
IV fluid hydration & blood replacement (Blood group & cross matching).
Antibiotics to prevent secondary infection of the hematoma or urinoma.
Watch the urine for the depth of hematuria. (Save last urine sample to compare it with previous sample regarding hematuria).

Flow chart for adult renal injuries to serve as a guide for decision making.
**Indications for Exploration**

**Absolute indications**
- progressive blood loss
- expanding perinephric hematoma
- pulsatile perirenal hematoma
- perirenal infection
- Hemodynamically is not recoverable
- The renal vessels are injured
- other organ involvement cannot be excluded.

**Relative indications**
- urinary extravasation
- nonviable tissue
- delayed diagnosis of arterial injury
- segmental arterial injury
- incomplete staging.

**Surgery**
- In all cases the peritoneum should be opened to exclude damage to other organs
- Surgical repair.
- Simple tears should be sutured
- Partial nephrectomy if one pole severely lacerated.
- **Nephrectomy for:** Damaged kidney pedicle
  Shattered kidney.

A radiologist may be able to stop the haemorrhage by embolisation if a bleeding vessel can be identified.
- The possibility of damage to other abdominal organs is checked during a transperitoneal approach.
- Release of the tamponading effect of the perirenal haematoma can result in massive haemorrhage and the surgeon must be fully prepared for this.
- When the kidney is irretrievably ruptured or avulsed from its pedicle, nephrectomy is the only course.
complications

**Early complications:**
1. Bleeding. Hematuria or retroperitoneal bleeding. (resolve in >85%).
2. Urine extravasation resulting in urinoma.
3. Infection (Urinoma or infected hematoma) resulting in perinephric abscess formation.
4. Loss in renal function.
5. Clot retention
**Late complications**
1- Hypertension after 3 months, due to renal scarring.
2- Hydronephrosis.
3- Arteriovenous fistula
4- Delayed renal bleeding can occur several weeks after injury, but it usually occurs within 21 days
5- Aneurysm of the renal artery
6- Calculus formation, repeated UTI