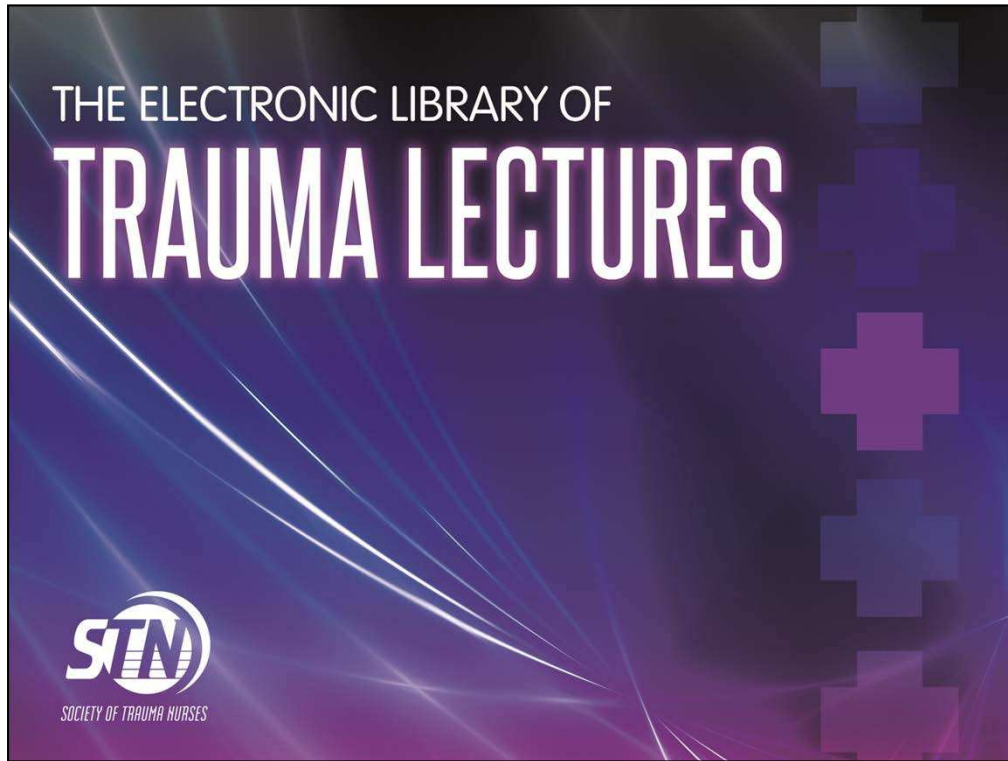
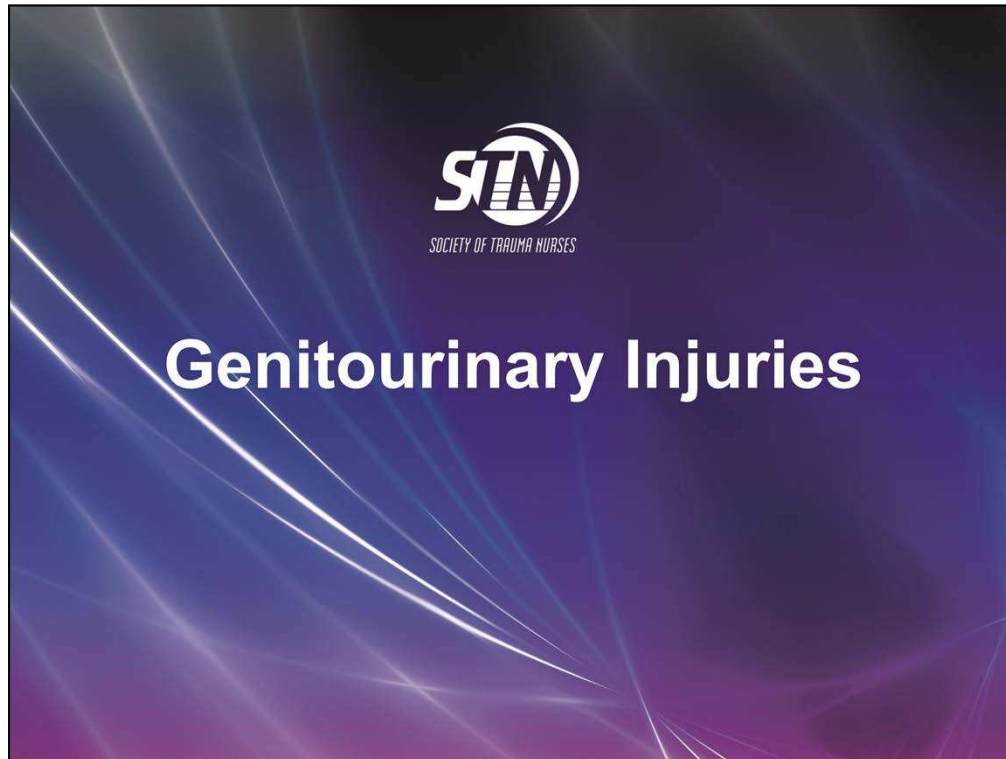






This lecture will focus on the GU system. There will be a brief anatomy and physiology review, a discussing on epidemiology and mechanism of injury. There will be a brief discussion of injuries and care to the kidneys, urethral, bladder, ureters and the reproductive system as well as the more common complications associated with them.

## Objectives

**At the conclusion of this presentation  
the participant will be able to:**

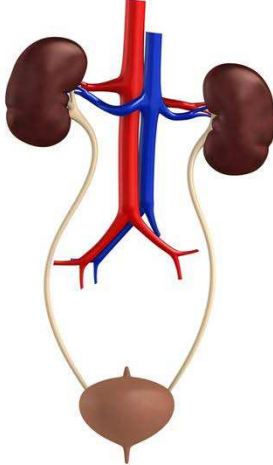
- Describe the mechanisms of injury for genitourinary (GU) trauma
- Identify the appropriate physical assessment and diagnostic studies for the initial and ongoing assessment of the GU injured patient
- Identify three complications that can occur during the hospitalization of a patient who has sustained a GU injury



Read objectives.

## GU Epidemiology

- Incidence
  - Accounts for 8-10% of abdominal injuries
- Organs affected
  - Kidney (84%)
  - Bladder, urethra (8% each)
  - Ureters and other organs – rare



**STN**  
SOCIETY OF TRAUMA NURSES

Isolated GU trauma is rarely life-threatening unless it is vascular (i.e.. Renal artery) or it is in combination with other injuries.

Urethral trauma is seen more commonly in males than females.

Renal injuries are more common in children than adults.

Geriatric trauma patients and those who pre-disposed renal issues are more prone to renal failure than younger patients.

The American Association for the Surgery of Trauma (AAST) has devised staging scales for injuries to the kidney, ureter, bladder, urethra, testis, scrotum, and penis.

# GU Epidemiology

Associated Injuries

Morbidity and Mortality



60-80% of GU injuries have associated injuries.

- Pelvic fractures
- Lower rib fractures
- L-spine transverse process fracture
- 5-10% of bladder injuries occur in patients with pelvic fractures;
- 1-11% have posterior urethral injuries

44% mortality is due to associated injuries

Morbidity is usually due to missed or delayed diagnoses

Multisystem trauma with renal injuries has a 6-12% mortality rate

Morbidity usually due to missed or delayed diagnoses

Renal failure is a complication that has been associated with some forms of GU trauma.

## Mechanisms of Injury-Blunt

Most common mechanism

- Forces
  - Compression forces
  - Shearing forces
  - Deceleration forces
- Sources
  - MVCs
  - Falls
  - Assaults
  - Blast



Blunt mechanisms for GU trauma are much more common than penetrating mechanisms. Blunt injuries account for 80-95% of GU injuries.

Compression injuries to the abdomen that do not result in a pelvic fracture can still result in an intraperitoneal bladder injury.

MVC is the source of majority of GU injury to children.

Seatbelts decrease GU injury, however the lap belt alone or impact with the steering wheel can result in bladder injury due to the sudden increase in pressure in the fluid filled organ.

Jet ski injuries due to the high velocity collision that the rider has with the water can cause significant injuries. The water acts as a solid object and when the rider strikes it, it causes renal artery thrombosis, renal injury; and external genitalia injury.

The kidneys are relatively attached or “fixed” around the pedicle. Blunt trauma to the renal area results from the pull or twist against this area resulting in injuries to the kidney itself along with the renal artery and /or vein.

## Mechanism of Injury - Blunt

- Suspect some type of renal injury if fractures of the posterior ribs or lumbar vertebrae are present
- Acceleration - Deceleration forces may cause damage to the renal vasculature



Acceleration-deceleration injury can produce disruption of the renal artery and tearing at the ureteropelvic junction. This injury is produced when a body in motion is halted abruptly.

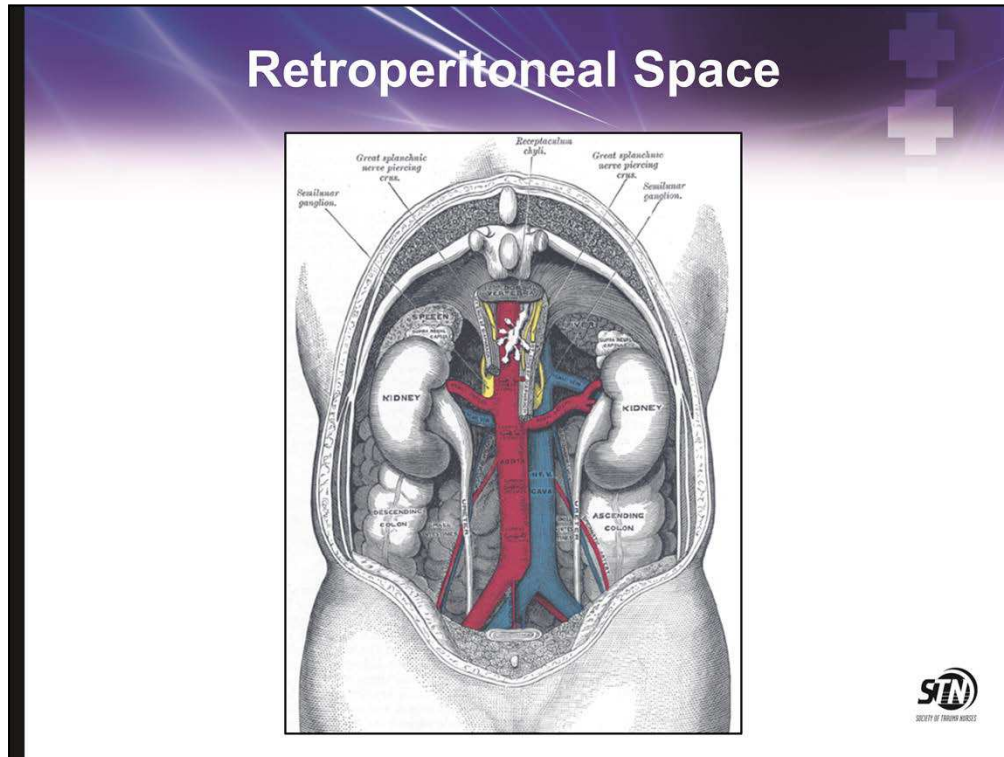


### Image is of GSW to kidney

Penetrating – GSW most common cause of urethral injury (5-15% of GSW have GU injury); 95% of urethral injuries have an associated abdominal injury.

Penetrating injuries can cause damage by either direct contact or by shock waves from bullets.

- Low velocity (i.e. knife, ice pick)
  - Injury/impalement usually limited to depth and path of weapon
  - injury usually limited to area near penetration
- Medium velocity (i.e. handgun, shotgun)
  - Bullet path can be difficult to ascertain if redirected
  - greater external soft tissue injury
- High velocity (i.e. high power hunting rifle or military weapon)
  - energy waves and cavitation occur
  - Damage can be difficult to ascertain



Peritoneum – a cavity lining that divides abdomen into two spaces

a) Retroperitoneal space

Pancreas, kidney, ureters, inferior vena cava

Abdominal aorta, urinary bladder, reproductive organs

b) Peritoneal cavity

Spleen, liver, stomach, gall bladder, bowel

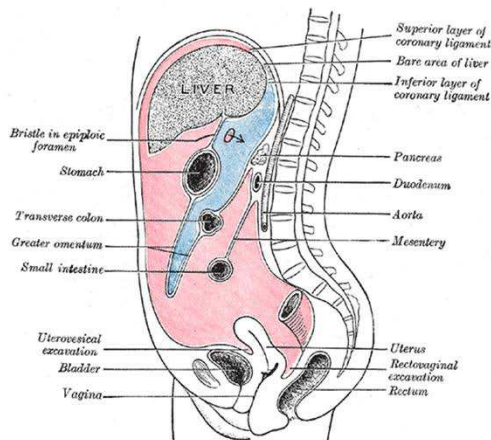
## Abdominal Organs

- **Hollow**

- Stomach, gall bladder, large and small intestines, ureters, urinary bladder
- Hollow organs can rupture which causes content spillage, inflammation of peritoneum

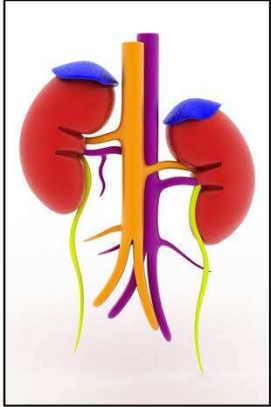
- **Solid**

- Liver, spleen, kidney, pancreas
- When solid organs are injured, they tend to bleed heavily and can eventually cause shock



## Kidneys

- Are bean-shaped highly vascular organs whose primary function is to eliminate waste products
- Protected by 12<sup>th</sup> ribs, fat pads, and anchored by Gerota's fascia
- Left: protected by spleen, chest wall, diaphragm, pancreatic tail, descending colon
- Right: lower than left due to position of liver; protected by diaphragm, liver, duodenum



Kidneys are bean-shaped highly vascular organs.

- 1) Each kidney is supplied blood by a renal artery which subdivides into several branches when it enters the kidneys.
- 2) Are highly vascular and receive approx. 20% of blood pumped by the heart
- 3) Function is to:
  - a) eliminate all wastes (urine)
  - b) Filtrate blood
  - c) Maintain fluid and electrolyte and acid-base balances
  - d) Makes and releases renin to promote angiotension II activation and the making of aldosterone in the adrenal gland



Bladder is a membranous sac that stores urine

Bladder is a hollow – triangle shaped muscular sac in the pelvis. It is a muscle that can stretch (become distended) and decompress itself by contracting.

- Protected by pubic arch
- Pelvic diaphragm and peritoneum offer support and protection
- When empty sits in pelvic cavity
- When full, it expands into the abdomen
- In females, it sits in front of the uterus and behind the symphysis pubis
- Normal bladder capacity in an adult is 500-600 ml.

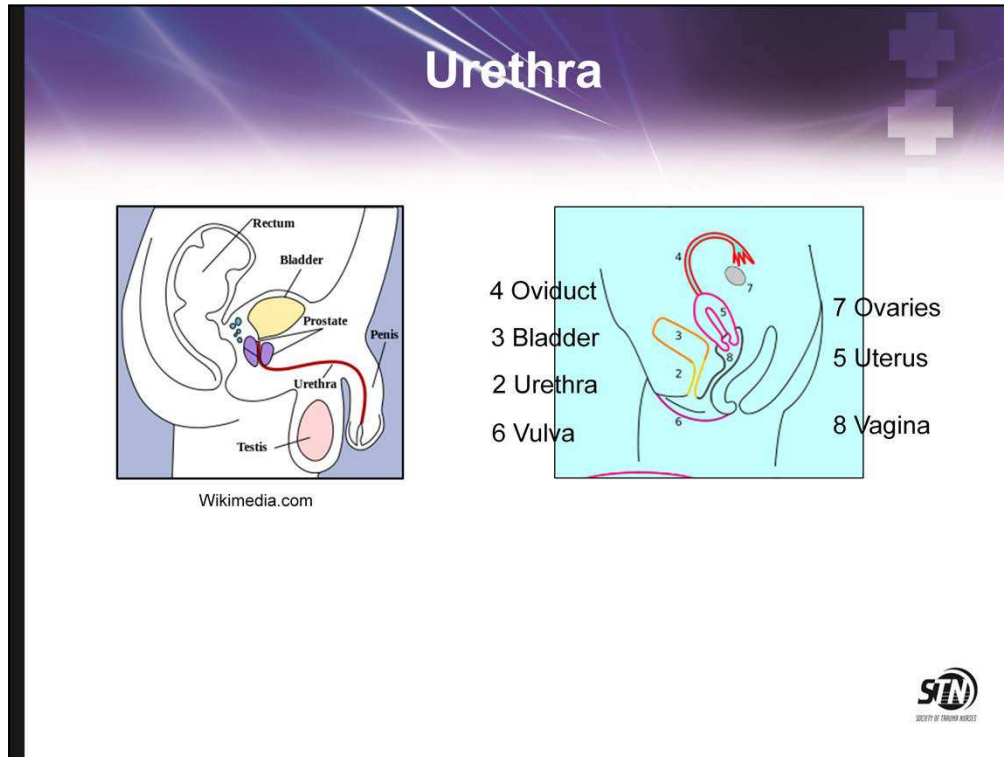
The male prostate surrounds the neck of bladder and is part of the urethra.

In women, the bladder is anterior to the uterus and behind the symphysis pubis

Ureters are membranous canals that carry urine from the kidneys to the bladder.

Each ureter is surrounded by a three-layered wall. It moves urine by peristalsis which push the urine along to the bladder.

- Cushioned by abdominal contents
- Surrounded by pelvic bones



## Male urethra

- Longer than female

- Fixed at symphysis

## Female urethra

- Anterior to vaginal opening

- Protected by symphysis pubis

- Shorter, more mobile than male version

Female urethra opens at the urethral meatus and is located anterior to the vaginal opening.

## Life Span Concerns

### Geriatric Renal

- Impaired ability to concentrate urine
- Decreased glomerular filtration rate
- Slight increases in blood urea nitrogen and creatinine expected; need to be cognizant of changes when using contrast media and certain drugs

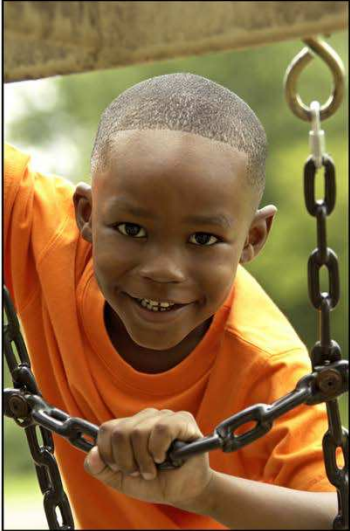


### Geriatrics

The injured older adult is much more likely to die than a younger patient. At lower injury severity scores, older adults do not die as a direct consequence of their injuries, but as a result of secondary complications. Listed on this slide are some of the renal considerations that need to be taken into account when caring for the geriatric trauma patient.

- Impaired ability to concentrate urine which makes urine output a poor indicator of intravascular volume.
- Decreased glomerular filtration rate, impaired water reabsorption, loss of ability to buffer acids or bases and delayed ability of the kidney to respond to stress. These changes in renal function should be considered when the nurse is thinking about drug dosages or the administration of contrast media in older adults.
- Slight increases in blood urea nitrogen and creatinine expected; changes considered when using contrast media and certain drugs

## Life Span Concerns



- Pediatrics
  - Bladder is abdominal organ in those less than 6 years
  - Kidneys have less protection and are larger



### Pediatrics

It has been suggested that pediatric kidneys are more vulnerable to trauma than adult kidneys. The kidneys are more mobile and not protected by fat. This is because children have less perirenal fat, a thinner capsule, weaker abdominal muscles, and a less ossified rib cage which contributes overall to less protection.

## General Concepts

- Follow ABC's, perform primary and secondary surveys and ATLS, ATCN, TNCC guidelines
- Consider the possibility of GU injuries when ordering diagnostic testing
- Talk to the patient and find out what happened, what bothers them, what feels better, is the pain the same or getting worse



Follow the primary and secondary assessment guidelines recommended by: ATLS (Advanced trauma life support), ATCN (Advanced trauma course nurse), TNCC (trauma nurse certification course).

Until the patient is stabilized, maintain high index of suspicion based on mechanism of injury.

Many GU injuries are not immediately life threatening.

Diagnostic testing involves both the clinical laboratory and radiologic studies.

If the patient is conscious, he/she may complain of costovertebral angle pain or renal colic as a result of clots obstructing flow.

The clinical exam may also reveal a flank hematoma, distended bladder, pelvic fracture

## Nursing Care – Past Medical History

- GU History
  - Congenital anomalies
  - Past injury; surgery
  - Chronic renal failure
  - Renal artery stenosis
  - When they last voided
  - Dialysis



AMPLE – Acronym for allergies, medications, past history of medical or surgical illnesses, last meal, and events preceding the injury.

Congenital kidney anomalies – higher incidence of severe injury from minor trauma.

Past injury; surgery – known anatomic differences guide interventions

Prior chronic renal failure and renal artery stenosis would govern both the initial treatment after an injury and long term management.

## Nursing Care - Physical Assessment

- Inspection
- Palpation
- Gray Turner's Sign
- Percussion



Your examination of the patient will include **inspecting** for the following:

- Bruising, ecchymosis, bleeding on abdomen, flank, pelvic and perineal areas
- Abdomen: Flat or distended
- Any signs of external injury including complex, open pelvis fractures; number of GSW or stabbing; impaled objects, Seat belt injury (from blunt trauma), Gunshot or stab wounds (from penetrating trauma)
- Grey Turner's sign – ecchymosis over the posterior aspect of the eleventh or twelfth rib or the flank may indicate renal trauma or retroperitoneal bleeding

**Percussion** of abdomen and flank area for hyperresonance and dullness.

- Hyperresonance indicates air
- Dullness indicates fluid accumulation
- Percussion tenderness constitutes a peritoneal sign and mandates further evaluation.

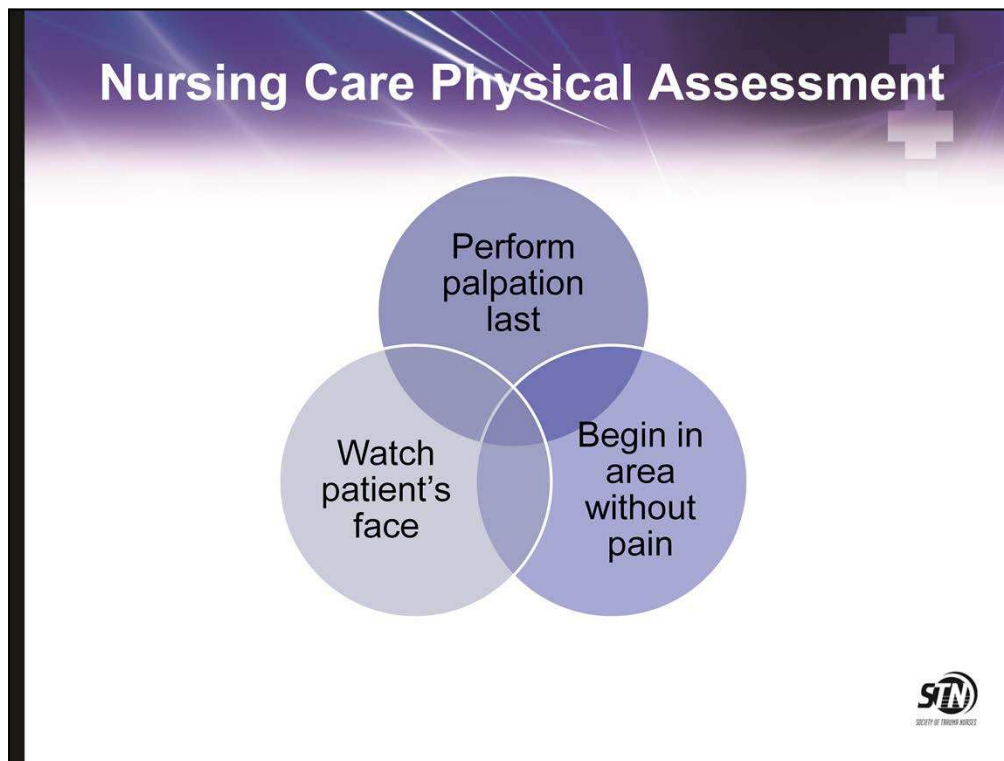
## Nursing Care - Physical Assessment

- **Perineal area**
  - Bleeding from urinary meatus
  - Butterfly pattern ecchymosis
  - Scrotal edema
  - Prostate



Signs and symptoms of GU trauma:

- Signs of urinary meatus tear. Bleeding indicates urethral injury. DO NOT place a foley catheter. Consultation with a Urology Specialist will probably be necessary.
- Evidence of an open pelvis fracture. If the patient is female be sure to check for vaginal injury.
- Examine the perineal area for lacerations, hematomas, swelling, etc. A butterfly pattern can possibly indicate classic urethral, pelvis, or retroperitoneal injury. Diffuse perineal bruising can be a late sign of a pubic rami/symphysis diastases fracture.
- Examine the prostate. A boggy, palpable, or displaced prostate may indicate urethral injury.



Palpation should always be the last part of the physical examination since it may cause the patient's pain to increase and distort the other findings of the physical assessment.

Begin in the area the patient indicates is without pain. Watch the patient's face for twitches or grimaces as you palpate.

Costovertebral angle tenderness – may indicate renal trauma or ischemia from renal artery thrombosis.

Renal colic – may indicate clots obstructing renal collecting system.

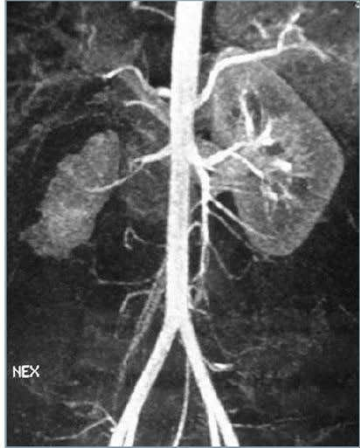
Suprapubic area – distended bladder, doughy swelling from extravasation of urine or blood.

Hypogastric area – severe tenderness may indicate ruptured bladder.

Rectal – exam for blood and tone as well as prostate position in the male.

## Renal Trauma and Diagnostic Imaging

- Discover fluid, foreign bodies and tissue damage
- demonstration of a functioning contralateral kidney
- evidence of ipsilateral renal function
- correlation of the assessed damage with the extent of hematuria



STN  
SOCIETY OF TRAUMA NURSES

The purposes of diagnostic imaging in renal trauma include:

- Discover fluid, foreign bodies and tissue damage
- Demonstrate a functioning contralateral kidney
- Evaluate ipsilateral renal function
- Correlate hematuria with parenchymal damage

This image shows that the right kidney is fully functioning but the left kidney has a large darkened area. This could be indicative of a laceration or hematoma.

## Diagnostic Imaging

### CT scan

- The preferred imaging study is contrast-enhanced CT
- Highly sensitive and specific (staging)
  - Extravasation of contrast-enhanced urine
  - Associated injuries



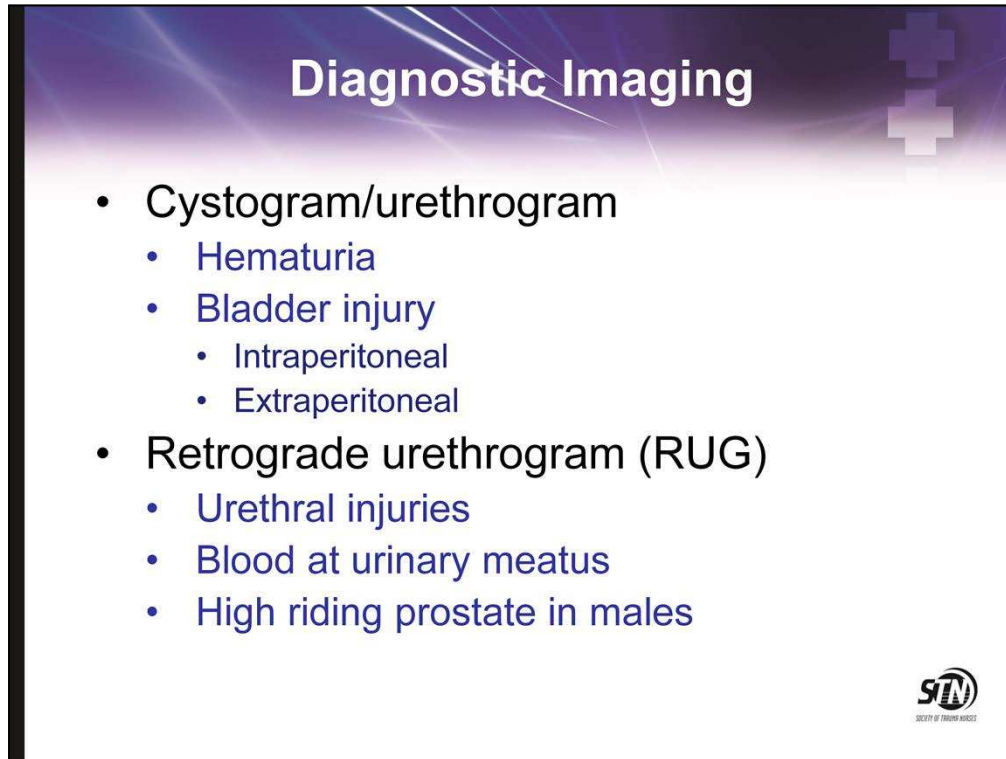
- Computerized tomography scan provides the most precise delineation of GU injury as CT imaging is both sensitive and specific and can accurately delineate segmental and arterial injuries.
- For stable patients, renal injury can be most accurately and completely imaged and staged using computed tomography (CT).
- CT imaging has largely replaced the once standard IVU and arteriography and has completely replaced arteriography in the acute setting.
- Renal artery occlusion and global renal infarct are noted on CT scans by lack of parenchymal enhancement or a persistent cortical rim sign but it is usually not seen until at least 8 hours after injury.
- Helical CT scanners have improved imaging over the past few years. Turnaround times are about 10 minutes for an abdominal trauma scan
- CT cystogram - One minute to 90 seconds before initiating helical CT scanning, intravenous contrast can be administered for evaluating the arterial and cortical phases which help delineate any renal artery injury, but the early cortical phase still misses parenchymal injuries and delayed images are needed to detect these injuries, venous injuries as well as urine and blood extravasation. One can distinguish the two in that urine extravasation accumulates whereas blood dilutes out after bolus stopped.

#### Advantages

- Reveals functional and anatomic assessment of the kidneys and urinary tract
- Establishes the presence or absence of 2 functional kidneys
- Assists in the diagnosis of concurrent injuries.

#### Disadvantages

- Requires intravenous contrast in order to maximize imaging
- The patient must be stable enough to go to the scanner
- Timing of contrast and scanning in order to view the bladder and ureters is important.



Cystogram/urethrogram – should be used in conjunction with CT scan to diagnose urethral or bladder injuries.

These tests are typically reserved for use after the initial evaluation and resuscitation have been completed.

- Cystogram – perform in cases of hematuria and with suspected bladder injury.
- Urethrogram  
Should be performed in all patients with suspected urethral injury PRIOR to foley insertion
- Done due to the presence of blood at the urethral meatus after blunt or penetrating trauma.
- Penile fracture with gross hematuria is also an indication for a RUG to rule out urethral injury.
- Another relative indication for a RUG is the finding of a “floating prostate” on digital rectal examination, which may indicate urethral disruption.
- Urethrography is most commonly performed via the retrograde injection of radiopaque contrast into the urethra to elucidate urethral pathology such as rupture of the urethra from trauma or urethral stricture.

## Diagnostic Imaging



### Angiography

- Role diminished
- Staging of injury
- Embolization as indicated



With the advent of accurate and quick CT imaging, the uses for arteriography with renal trauma have diminished.

Renal arteriography does provide the opportunity to stage the injury and, if necessary to embolize bleeding points at the same time.

Rarely used (renal arteriography and embolization for renal trauma) in the acute setting because it is time consuming and patients with active bleeding need to undergo immediate exploratory laparotomy.

In the OR, during laparotomy, the kidney can be explored and surgically reconstructed.

The present role of arteriography, however, is with delayed renal bleeding or delayed arteriovenous fistula formation, for which super-selective arterial embolization is used

## Diagnostic Radiologic Procedures for GU Trauma

- Excretory urography or intravenous pyelogram (IVP)
- Renal ultrasound



Wikimedia.com



### IVP

If emergency surgery or interventional radiology is to be done, a one-shot IVP can be done to ensure that there is a second kidney present and that it is functioning.

If the contralateral kidney does not function properly, efforts should be made to preserve renal function.

Intravenous pyelogram (IVP) – detects 80% of renal injuries. It should only be used as an alternative when CT is unavailable. It detects extravasation of the contrast media into surrounding tissues which indicates a disruption in the integrity of the kidney, ureters or bladder. A one-shot IVP may be valuable pre or during surgery to evaluate for pedicle injury and excretion of the contralateral kidney.

For a satisfactory study, a systolic blood pressure above 90 mm Hg is needed. In order to save time, the contrast can be injected at the time of the initial resuscitation. Unstable patients who are emergently taken to the operating room, should be stabilized first and undergo one-shot IVU in the operating room once they are stabilized.

Ultrasound has proven useful and reliable for evaluating blunt intra-abdominal injuries by detecting the presence of hemoperitoneum. It is used to direct patients to CT imaging when hemoperitoneum is noted and to observation in those with negative findings.

## Diagnostic Laboratory Procedures for GU Trauma

- Remember that the absence of either gross or microscopic hematuria does not rule out an injury
- Discover myoglobinuria which can result in Acute Tubular Necrosis
- Urine dipstick and UA are poor indicators of the degree of GU injury



There would not need to be any additional laboratory studies ordered since a routine urinalysis would have been ordered and sent with the regular panel of trauma labs that would usually be sent on a trauma patient (i.e. H/H, electrolytes, coagulation studies, base deficit, serum lactate, drug and alcohol screening, etc).

Urine electrolyte and creatinine

Renal function studies

Urinary output, creatinine clearance, free water clearance, urine sodium, specific gravity, osmolality, urinalysis, urine C&S, myoglobin, hemoglobin

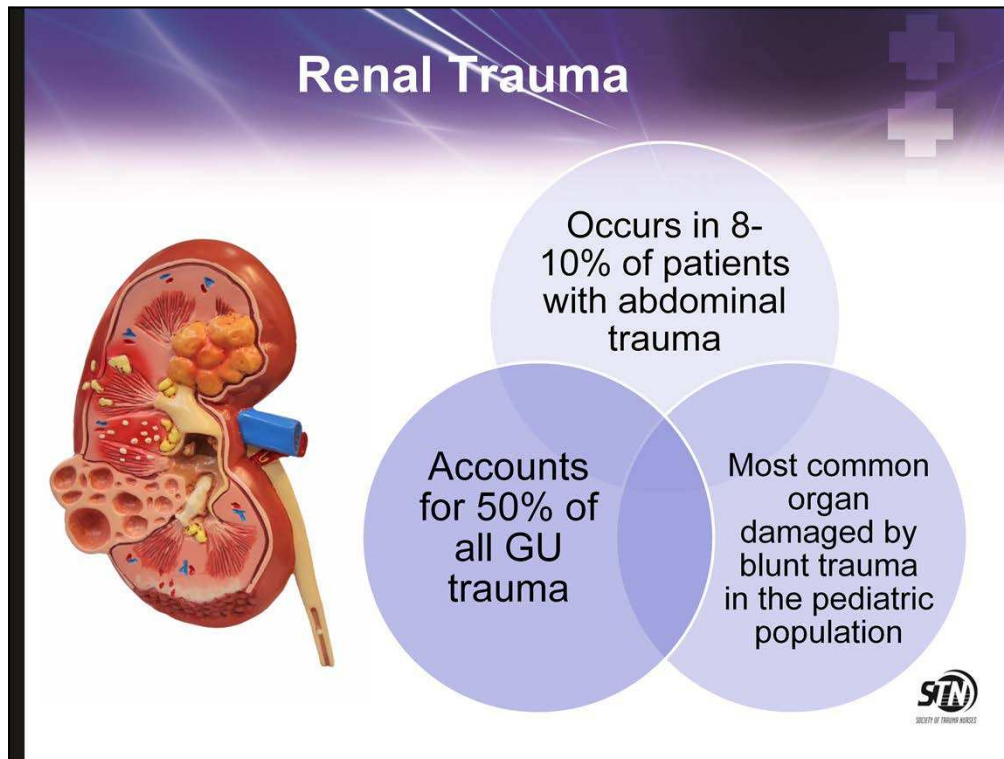
## Specific GU Injuries

- Pathophysiology
- Clinical Evaluation
- Diagnostics
- Management
  - Non operative
  - Operative
  - Complications



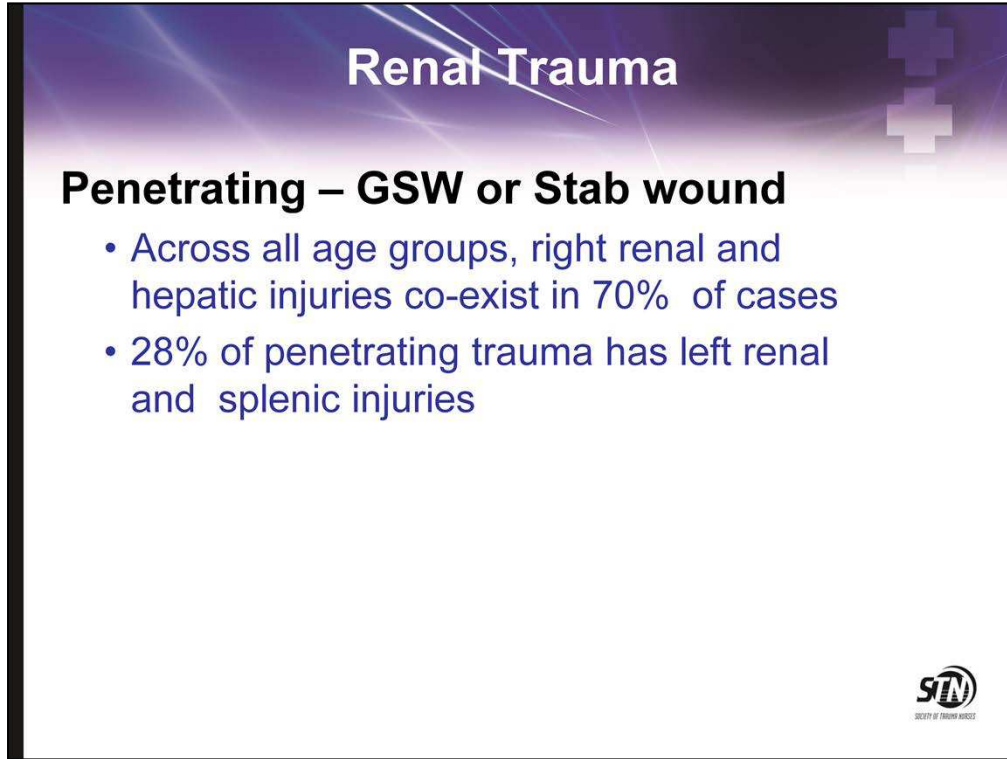
We will now proceed with a look at certain specific GU injuries. Remember that this is a brief overview and when the trauma nurse has a question involving their patients, they should seek additional references and resources.

**Image is a Grade 4 kidney injury as seen on angiogram**



Blunt mechanism is the cause of 70-80% of all traumatic injuries to the kidney

- Co-existing injury will occur in 14-34% of cases
- Direct blow to back, flank, upper abdomen
- Suspect in Fx of 10th - 12th ribs or T<sub>12</sub>, L<sub>1</sub>, L<sub>2</sub>
- Acceleration/Deceleration
- Shearing of renal artery/vein



## Renal Trauma

- **Penetrating – GSW or Stab wound**
- Across all age groups, right renal and hepatic injuries co-exist in 70% of cases
- 28% of penetrating trauma has left renal and splenic injuries



STN  
SOCIETY OF TRAUMA NURSES

6-14% of penetrating abdominal wounds have renal trauma  
Co-existing injuries will occur in 50-80% of cases

## Clinical Evaluation Signs and Symptoms

- Ecchymosis over flank
- Flank and abdominal tenderness during palpation
- Gross or microscopic hematuria, absence does not rule out injury
- Depending on extent of injury/injuries, may display signs and symptoms of shock



Signs and symptoms of injury to the kidney. Absence of hematuria does not rule out injury

Depending on extent of injury/injuries, may exhibit shock like symptoms

## Hematuria



- Gross microscopic hematuria following abdominal trauma indicates renal injury.
- 80% of all renal trauma cases have it
- It is common even with minor renal trauma (i.e. contusions)
- Absence of hematuria does not exclude a renal injury
- Gross hematuria usually diminishes dramatically 2-6 hours after injury



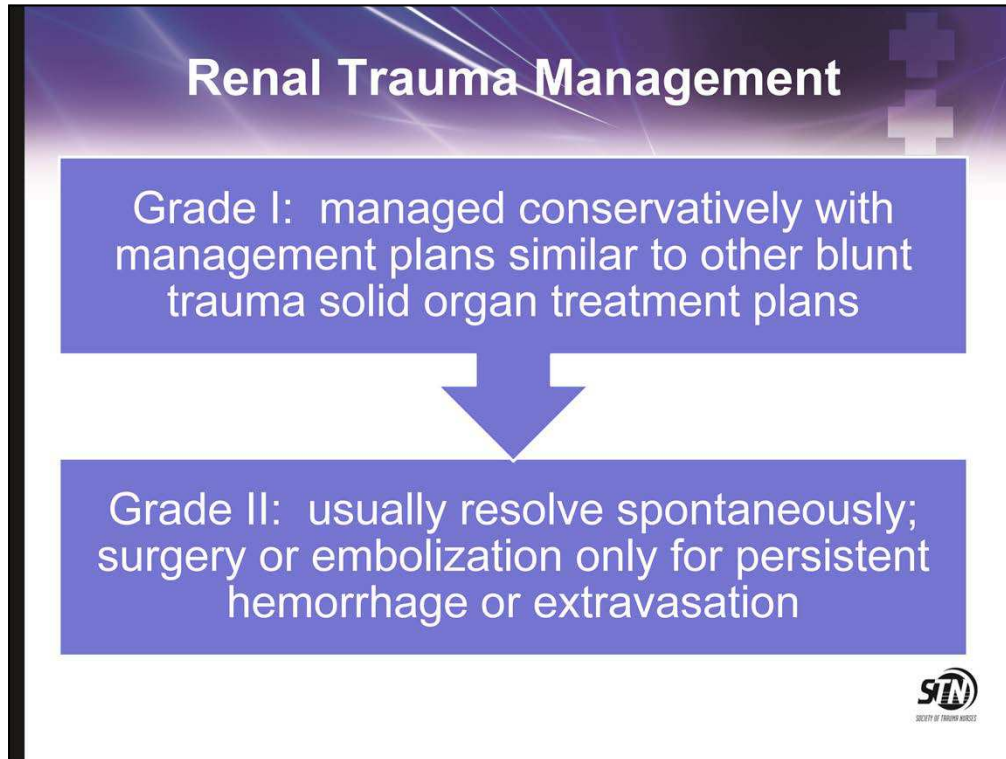
Hematuria is not present in all patients with a renal injury. The degree of hematuria present also in no way related to the degree of injury. The presence of hematuria does however correlate with the likelihood of another intra-abdominal injury.

Urine dipstick and UA are poor indicators of the degree of GU injury.

| Renal Injury Scale |            |                                                                                                      |
|--------------------|------------|------------------------------------------------------------------------------------------------------|
| Grade              |            | Injury Description                                                                                   |
| I                  | Contusion  | Microscopic or gross hematuria, urologic studies normal                                              |
|                    | Hematoma   | Subcapsular, nonexpanding without parenchymal laceration                                             |
| II                 | Hematoma   | Nonexpanding perirenal hematoma confined to the renal retroperitoneum                                |
|                    | Laceration | < 1 cm parenchymal depth of renal cortex without urinary extravasation                               |
| III                | Laceration | > 1 cm parenchymal depth of renal cortex without collecting –system rupture or urinary extravasation |
| IV                 | Laceration | Parenchymal laceration extending through the renal cortex, medulla and collecting system             |
|                    | Vascular   | Main renal artery or vein injury with contained hemorrhage                                           |
| V                  | Laceration | Completely shattered kidney                                                                          |
|                    | Vascular   | Avulsion of renal hilum which devascularizes kidney                                                  |

Renal injuries are graded on a scale of I to V. Minor injuries are Grades I and II and are the majority of renal injuries. Examples of these types are contusions, subcapsular hematomas and superficial lacerations through the renal capsule. There is limited retroperitoneal bleeding and usually no associated injuries.

Because renal trauma is the most common type of GU trauma, we will now discuss the specifics for each grade in the following slides.



Grade I-II injuries usually are managed non-operatively; monitoring of renal function and hemodynamic stability is essential. Non-operative management for renal trauma is similar to that of splenic and liver management. It includes but is not limited to:

- Frequent monitoring of vital signs and hematocrit
- Reassessment of abdomen a(pt should be alert and cooperative during abdominal and flank examinations)
- Bed rest with a gradual increase in activity and diet
- Pain control

## Renal Trauma

**Grade III:**

- Shattered kidneys may be removed to control hemorrhage
- Kidneys with pedicle injuries may be removed but non-removal does not routinely result in late sequelae (i.e. pain, HTN)



Grades III, IV, and V injuries are considered major renal injuries. Kidney function is threatened by nephron damage or accumulation of free urine and blood in collecting ducts and around the kidney. Grade III injuries may be treated with non-operative management depending on how the patient is clinically. They are at risk for delayed hemorrhage and need to be close monitoring, bed rest and a slow return to physical activity until healed.

Grade III: The shattered kidney that is able to demonstrate perfusion and requires minimal transfusion may be repaired. Embolization is being utilized more and more with this injuries with mixed results.

Image is of shattered kidney

## Grade IV and V Injuries

- **Renal damage**
  - Partial nephrectomy
  - Renorrhaphy
  - Nephrectomy
- **Renovascular Injury**
  - Shattered kidney, renal pedicle damage
  - Intimal tears-thrombosis in renal pedicle



Grade IV and V injury usually requires surgical intervention due to hemorrhage. Every effort should be made to preserve the kidney if possible.

- Partial nephrectomy - performed when there is damage to upper and lower pole.
- Renorrhaphy – performed when there is damage to midportion.
- Nephrectomy – before one considers performing a nephrectomy one must evaluate the function of uninjured kidney first.

Renal trauma results in a 20-43% incidence of the patient requiring a nephrectomy. If a nephrectomy needs to be done, a one-shot IVP should be done to ensure that there is a second kidney present and that it is functioning. If the contra lateral kidney does not function properly, efforts should be made to preserve renal function.

Renovascular injury – repair is essential to prevent ischemia, necrosis, loss of function.

Grade IV injuries involve the pedicle or vascular injury and require surgical repair. In the higher graded injuries, devitalized renal tissue is a common result despite appropriate interventions. When devitalized (necrotic) tissue develops, the patient has a 85% chance of serious complications such as an urinoma, or an abscess developing in the pancreas or small bowel. Any devitalized tissue needs to be removed surgically to improve the outcome.

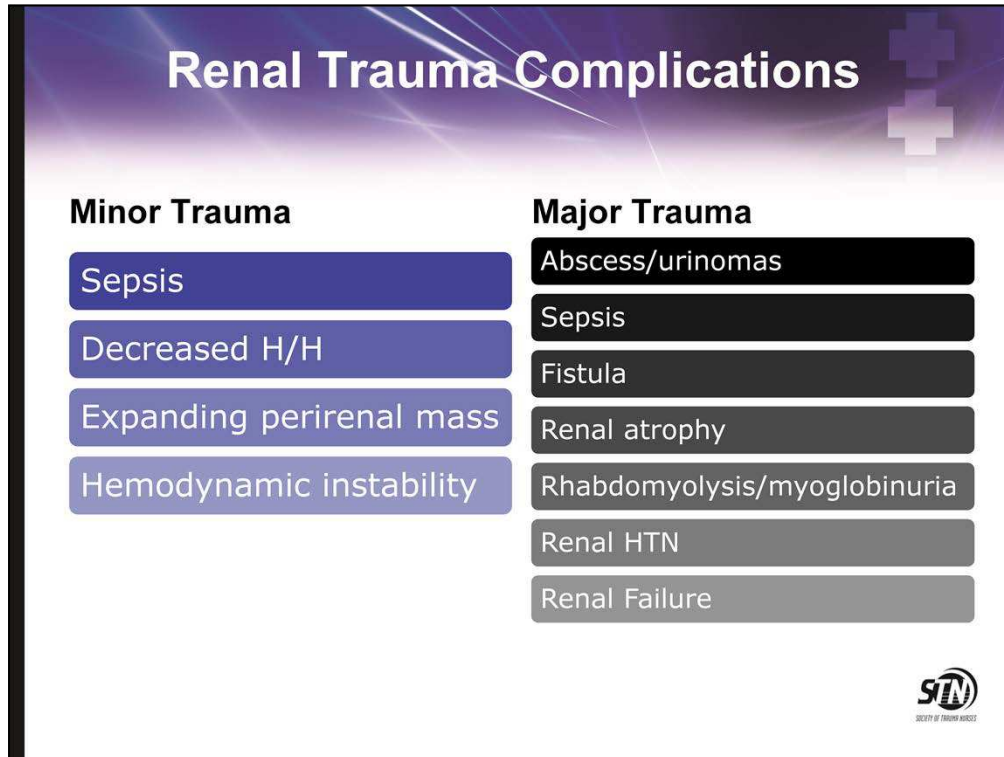
**Image is of bullet in kidney.**

## Nonoperative Management

-  Hemodynamic stable with an injury well staged by CT can usually be managed nonoperatively
-  98% of renal injuries can be managed nonoperatively
-  Grade IV and V injuries more often require surgical exploration

STN  
36  
OF TRAUMA INJURIES

To review...



Blunt trauma cases usually have more issues than penetrating cases because the penetrating cases have had a surgical intervention and structures have been visualized

Examples of common complications seen with minor renal trauma are the following.

- 5% require surgical exploration due to an expanding perirenal mass or hemodynamic instability
- There are rare incidences of sepsis, loss of renal function, and hemorrhage.

Examples of some common complications seen with major renal trauma are:

- Abscesses to pancreas and small bowel.
- Sepsis from infections, abscesses, UTI, pyelonephritis
- Fistulas to almost any part of the abdomen or pelvis
- Urinomas: Grade III and IV renal injuries are associated with urinomas (a cyst filled with urine). They are caused by the extravasation of urine during the injury. Percutaneous drainage is essential to prevent further injury to the renal collecting ducts. Usually during surgery for Grade IV and V injuries, drainage of any urinomas is done. Persistent extravasation of urine is a problem that can result in sepsis.

Renal atrophy, Urethral stricture and obstructive hydronephrosis and loss of renal function are all complications that can occur. They are rare but they can occur up to 4 weeks after injury.

Rhabdomyolysis/myoglobinuria is a complication that can occur with burns, orthopedic/soft tissue damage, crush injuries, patients who were immobile for long periods of time. It will be discussed more in detail in the burn lecture. It is discussed briefly here since it can contribute to renal failure.

## Renal Trauma Complications

- **Rhabdomyolysis-Myoglobinuria**
  - From direct or indirect muscle injury
  - Myoglobinuria is a marker of rhabdomyolysis
  - Renal tubulotoxic effect
  - Manage with diuresis and alkalinization of urine



The trauma nurse should:

Monitor the color of the patient's urine if myoglobinuria is suspected after injury. In the presence of myoglobinuria, urine may be pigmented. If the urine is dark, pink, or red, myoglobinuria may be present. The administration of sodium bicarbonate may be considered to facilitate the excretion of these substances because they are excreted more readily in alkaline urine. Myoglobin, if not excreted, can precipitate in the renal tubules, which may result in renal failure.

To summarize the key points: injured muscle releases myoglobin; if there is more than 4 hours of ischemia, it can lead to irreversible injury. If greater than 6 hours, necrosis of the tubules occurs.

Dark tea colored urine, dipstick + for blood but without RBC on UA.

Goal is to prevent acute renal failure through intravenous fluid administration to flush the kidneys, diuresis to act as a scavenger of the free radicals, and alkalinization of the urine to prevent the breakdown of myoglobin and cast formation.

## Complications of Renal Trauma

### Post-Traumatic HTN

- Caused by excess of renin excretion, infarct, and renal scarring
- Can occur in 0-33 % of renal trauma cases
- Most are managed conservatively with a low-dose medication regimen



Blunt trauma cases usually have more issues than penetrating cases because the penetrating cases have had a surgical intervention and structures have been visualized.

HTN after renal injury is caused by excess of renin excretion, infarct, and renal scarring. The incidence varies in range from < 1% to 33 % of patients and can occur as late as 10 years after injury. In most patients, the HTN will resolve on its own or with a low-dose medication regimen. It is usually associated with renal pedicle injuries; occurrence 1-40%; can occur 2 weeks to 10 years after injury.

Long term follow-up of patients after renal injury is necessary as to promptly identify and manage hypertension early.

## Acute Renal Failure (ARF) Prerenal Failure

| Prerenal ARF                                                                                                                                                                                       | Diagnostics                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Etiology<ul style="list-style-type: none"><li>• Profound hypotension</li><li>• Inadequate kidney perfusion without actual renal damage</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Urine sodium &lt; 10 mEq/L</li><li>• Fractional sodium excretion &lt; 1%</li><li>• Specific gravity &gt; 1.020</li><li>• Increase BUN &gt; creatinine</li><li>• Minimal or no proteinuria</li><li>• Possible myoglobinuria</li></ul> |



The pathophysiology of acute renal failure is complex and our understanding remains limited. There is usually not one single thing that can ARF but it is actually complex interaction of vascular, cellular and immunologic alterations that ultimately leads to renal failure.

It is usually diagnosed by observing a rise in the patient's BUN (blood urea nitrogen) and plasma creatinine and a decrement in urine production.

**Management is to restore renal perfusion.**

## Acute Renal Failure (ARF) Intrarenal Failure

| Etiology                                                                                                                                                                                                                                                                                                    | Diagnostics                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Direct insult to renal parenchyma</li><li>• Cortex injury due to infection, autoimmune disease, hypertension</li><li>• Medullary injury due to nephrotoxins, prolonged ischemia, rhabdomyolysis</li><li>• Acute damage to renal capillary bed and tubules</li></ul> | <ul style="list-style-type: none"><li>• Abnormal specific gravity</li><li>• Fractional excretion of sodium &gt; 1%</li><li>• Elevation BUN and creatinine</li><li>• Decreased creatinine clearance</li><li>• Proteinuria</li><li>• High urine sediment</li><li>• Possibly myoglobinuria</li></ul> |



### Causes of Intrarenal Failure due to cortex injury

Infection – glomerulonephritis, pyelonephritis.

Autoimmune – systemic lupus erythematosus (SLE), malignant hypertension.

Nephrotoxins – aminoglycosides, cephalosporins, tetracycline, X-ray contrast dye, heavy metals, pesticides.

Ischemia – burns, crush injuries, prolonged hypotension, sepsis, transfusion reactions.

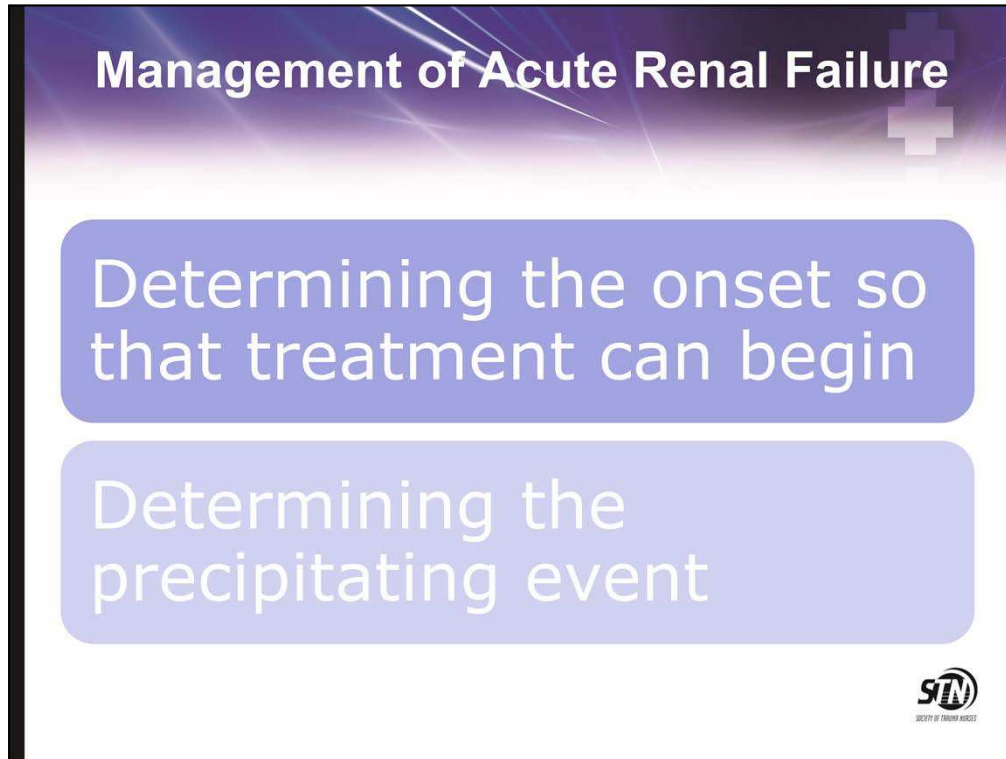
Diagnostics:

$\text{Creatinine clearance} = \frac{\text{urine creatinine}}{\text{serum creatinine}} \times \text{urine volume} \times \frac{1.73}{\text{BSA}}$

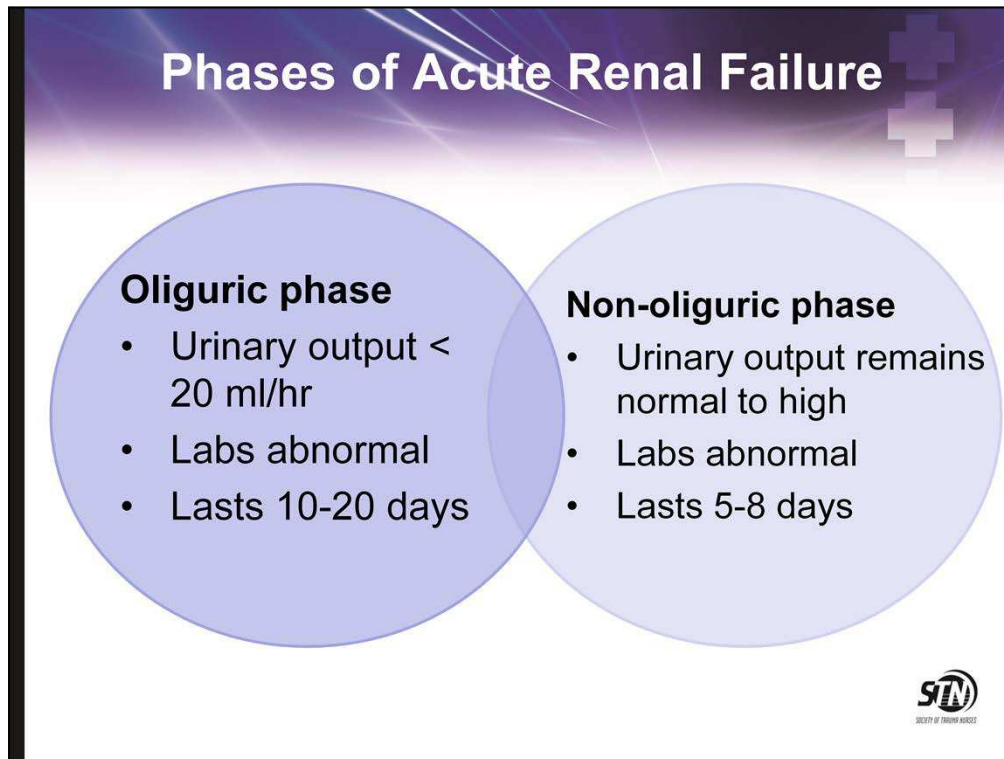
## Management

**Treat underlying cause**

**Support with dialysis if needed**



We will briefly discuss the management of acute renal failure.



ARF is classified as oliguric when the urinary output is less than 400 ml/24 hours.

Non-oliguric phase is an alternate presentation to oliguric phase; but filtration is still impaired.

The non-oliguric phase is when the urinary output is more than 400 ml/24 hours. It results from a less severe insult to the tubules.

Anuria is defined as urinary output of less than 100 ml/24 hours.

## Phases of Acute Renal Failure

| Diuretic Phase                                                                                                                                                                        | Recovery                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• After both oliguric and non-oliguric</li><li>• As renal function returns</li><li>• Urinary output elevated</li><li>• Labs normalize</li></ul> | <ul style="list-style-type: none"><li>• Can take up to 12 months</li><li>• Degree determined by amount of damage</li></ul> |



Degree of recovery determined by amount of damage to nephrons.

## ARF Management Goals

|                                                                                                                                                                                                                                                            |                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Maximize renal perfusion</li><li>• Correct acidosis, electrolyte, and fluid imbalances</li><li>• Minimize hypercatabolic state</li><li>• Maintain adequate nutrition</li><li>• Hemodialysis if indicated</li></ul> | <p><b>Prevention</b></p> <ul style="list-style-type: none"><li>• Maintain renal perfusion and intravascular volume</li><li>• Avoid nephrotoxins</li><li>• Avoid and treat myoglobinuria</li></ul> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



There may be a need for temporary dialysis until healing occurs.

Indications for dialysis are:

- Severe fluid overload
- Refractory hypertension
- Uncontrollable hyperkalemia
- Nausea, vomiting, poor appetite, gastritis with hemorrhage
- Lethargy, malaise, somnolence, stupor, coma, delirium, asterixis, tremor, seizures,
- Pericarditis (risk of hemorrhage or tamponade)
- bleeding diathesis (epistaxis, gastrointestinal (GI) bleeding and etc.)
- Severe metabolic acidosis
- Blood urea nitrogen (BUN) > 70 – 100 mg/dl

## Acute Renal Failure (ARF) Post-Renal Failure

### Etiology

- Functional or total obstruction between kidneys and ureters
- Back pressure from urine increases renal interstitial pressure
- Leads to imbalance of filtration pressures at the glomerulus

### Diagnostics and Management

- Elevation in BUN and creatinine is possible
- Urine electrolytes less helpful
- Positive urine cultures
- Radiographic evidence of obstruction
- Relieve obstruction



## Ureter Trauma

- Occur in 1-4% of GU trauma
- 80% of ureter injuries are from GSW
- 90% of GSW and 60% of stab wounds that injure ureters also injure the bowel, colon, liver, spleen, blood vessels or pancreas
- Adjacent structures protect ureters from blunt trauma
  - Injury to the distal ureter can occur from Fx of the posterior pelvic ring



Ureter injuries are relatively uncommon and occur in approximately 1-4% of patients with penetrating abdominal injuries. There is frequently a wound to the lower back with urine escaping.

Less than 1% patients with a ureter injury are from blunt abdominal trauma. When the injury is from blunt trauma, it is usually from devascularization and or rupture.

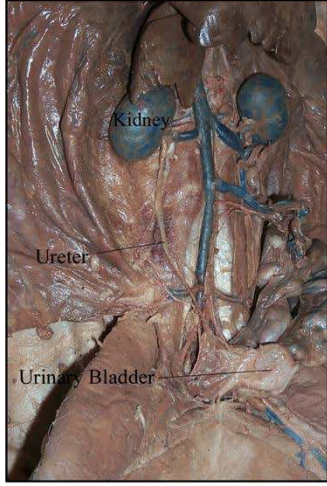
It may be missed on both an IVP and on laparotomy because of the ureters position in the retroperitoneum.

In penetrating trauma, other organs are likely to be injured, the bowel, colon, liver, spleen, blood vessels or pancreas

## Ureter Injuries

### Signs and Symptoms

- Often no presenting symptoms
- Pain only in obstructed ureter
- No symptoms with transection
- Possible loss of renal function
- Microscopic hematuria
- Index of suspicion



Kidney

Ureter

Urinary Bladder



**This picture is a picture of the urinary system of a dissected cat.**

If loss of kidney function in unilateral injury; the patient may remain asymptomatic if the contralateral kidney maintains function.

Hematuria – 80-90% of penetrating injury.

Consider in all penetrating abdomen, flank, lumbar, chest injuries.

Unilateral ureteral obstruction may produce a transient increase in serum creatinine and BUN without a decreased urine output.

## Ureter Trauma and Diagnostic Imaging



- Hematuria is usually microscopic so it is usually not seen
- IVP
- Urethrogram
  - double dose excretory urography
  - RUG (retrograde urethrogram)
- CT with delayed images



Hematuria is usually microscopic so it is not usually seen. It can be an important sign if seen but 15-45% it will not be present.

IVP: identify 90% of ureter injuries. If IVP inconclusive, perform a urethrogram

Urethrogram (only insert foley 2-3 cm into penile meatus) Double dose excretory urography within 24-35 hours identifies up to 90% of injuries

Urethrogram and double dose excretory urography if done within 24-35 hours usually identify 90% of injuries

Modern spiral CT Scanners move rapidly thru the abdomen following administration of contrast and unless a delayed excretory phase is specifically requested, extravasation can be missed. A RUG retrograde urethrogram is another study worth considering

**Image shows extravasation of contrast.**

**[http://radiographics.rsna.org/content/24/suppl\\_1/S195.figures-only](http://radiographics.rsna.org/content/24/suppl_1/S195.figures-only)**

A CT scan with delayed images up to 5-8 minutes after contrast injection may increase sensitivity to ureter injury.

| Ureter Injury Scale |            |                                                     |
|---------------------|------------|-----------------------------------------------------|
| Grade               |            | Injury Description                                  |
| I                   | Hematoma   | Contusion or hematoma without devascularization     |
| II                  | Laceration | $\leq 50\%$ transection                             |
| III                 | Laceration | $\geq 50\%$ transection                             |
| IV                  | Laceration | Complete transection with 2 cm devascularization    |
| V                   | Laceration | Avulsion of renal hilum which devascularizes kidney |

92% of patients require surgery due to associated injuries. It is not the ureteral injury which leads them initially to the OR. Frequently the ureter injury is an incidental finding when other injuries are being repaired.

Repair – uretero-ureterostomy; transuretero-ureterostomy, reimplantation into bladder.

Goal – preserve renal function and restore continuity of the collecting system.

Delayed diagnosis can result in loss of renal function.

## Ureter Trauma Management

- OR
- Ureterostomy
- Irrigation and Drainage
- Antibiotics
- Stenting



Stab wound and iatrogenic traumatic injuries are taken to the Operating Room due to need for minor debridement and suture approximation

GSW and blast injuries can cause microvascular deficits and produce delayed necrosis and extravasation

Ureter transection requires surgical repair and ureterostomy to divert urine flow, wound irrigation, competent drainage and prophylactic antibiotic

Internal stenting is usually done for those injuries that have the potential to be complicated by contamination, ischemia or associated vascular injury

## Complications of Ureter Trauma

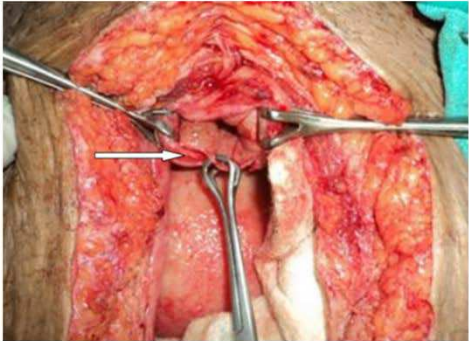
| Missed injuries usually manifest by                                                                                                                                                                                                         | Complications                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Fever</li><li>• Flank mass or discomfort</li><li>• Ileus</li><li>• Leukocytosis</li><li>• Lethargy</li><li>• Urinary fistula to skin or vagina</li><li>• Sepsis</li><li>• Wound infection</li></ul> | <ul style="list-style-type: none"><li>• Fistula</li><li>• Stricture or ureteral obstruction</li><li>• Retroperitoneal urinoma</li><li>• Infection</li><li>• Obstructive hydronephrosis</li></ul> |



Stricture or obstruction causes hydronephrosis. This can be determined with a follow-up IVP at 6 weeks post-op and again at 3 months.

## Bladder Injury

- Most often injured due to blunt trauma
- Full bladder will increase risk of injury
- Two types of bladder injuries
  - Extraperitoneal Bladder
  - Intraperitoneal Bladder



The photograph shows a surgical field with a large, open incision in the abdominal wall. The bladder is visible, and a white arrow points to a specific site of injury or repair on its surface. Surgical instruments are used to hold the incision open.



5-10 % of pelvic fx's have a bladder injury

Most commonly occurs from blunt trauma rather than penetrating trauma. Usually the sudden compression of the full bladder, shear forces or a pelvic fx will result in a bladder rupture. If associated with penetrating trauma, usually to lower abdomen or perineum (pelvic floor)

Having a full bladder greatly increase the risk of injury by making it a larger target as well as increasing the likelihood of rupture. The probability of bladder injury varies according to the degree of bladder distention; therefore, a full bladder is more likely to become injured than an empty one. The bladder when full is more susceptible to rupture from seatbelt injuries. In children, the bladder is in the intra-abdominal cavity and susceptible to rupture from any type of blow.

70-83% of bladder injuries are the result of a pelvic fx's

- More frequent with fx's of the pubic arch adjacent to the symphysis
- More common with bilateral parasymphyseal fx's (than unilateral)

There are two types of bladder injuries:

- 1) Extraperitoneal
- 2) Intraperitoneal **Image is an intraperitoneal bladder rupture**

Both of these will be discussed in detail in a few slides from now.

## Bladder Injuries

| Signs and Symptoms                                                                                                                                                                                                                                          |                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Blood at meatus and/ or in scrotum</li><li>• Lower abdominal injury</li><li>• Pelvic fracture</li><li>• Suprapubic pain</li><li>• Inability to void despite the urge to urinate</li><li>• Gross hematuria</li></ul> | <ul style="list-style-type: none"><li>• Rebound tenderness</li><li>• Abdominal wall muscle rigidity, spasm, or involuntary guarding</li><li>• Displacement of prostate</li></ul> |



Here are some of the signs and symptoms of a bladder injury.

Suprapubic pain can also be described as pelvic or abdominal in nature

## Extraperitoneal Bladder Injury Signs and Symptoms



- Urine found in umbilicus, anterior thighs, perineum
- Dysuria
- Hematuria
- Suprapubic swelling, redness, tenderness



The bladder has both intraperitoneal and extraperitoneal components. The most common bladder injury is an extraperitoneal bladder injury. This is a rupture of the bladder wall. In fact, 95% of all bladder injuries are extraperitoneal injuries and are from a laceration by a bone associated with a pelvic fx.

Listed are some of the more common signs and symptoms.

Image is Extraperitoneal bladder rupture

## Intraperitoneal Bladder Injury

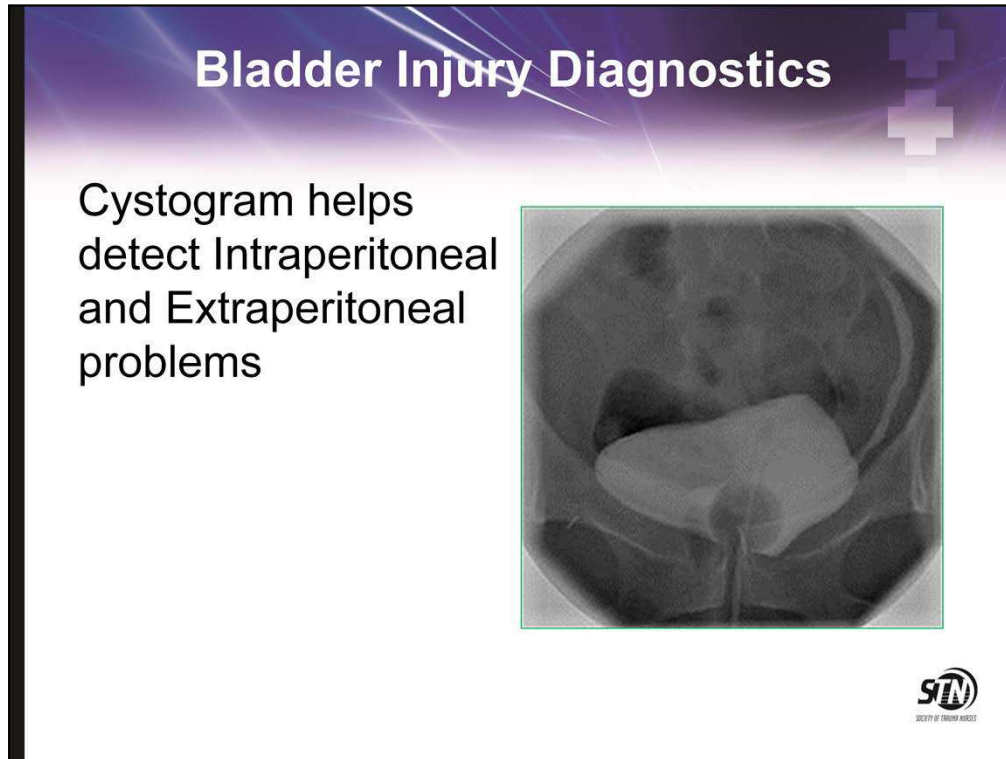


- Occurs with penetrating or blunt rupture of distended bladder
- 15-45% of bladder trauma
- Urgency and inability to void
- Signs and symptoms of shock
- Abdominal distension



Intraperitoneal bladder injuries usually involve the dome of the bladder. They result from a sudden increase in intravesicular pressure.

Image is intraperitoneal bladder rupture



No matter what type of bladder injury, your patient has, they will diagnostic studies to confirm the diagnosis.

Extraperitoneal bladder rupture is demonstrated by a flame-shaped extravasation of contrast on the cystogram. It is usually managed nonoperatively. A cystogram should be repeated later to determine closure of the rupture. A foley catheter is adequate management for urine removal and results in few days of catheterization in comparison with management with a suprapubic tube.

A stress cystography is commonly obtained using a CT technique

Gross hematuria without extravasation of urine indicates a bladder contusion

CT scan which also utilizes stress cystography is commonly obtained demonstrates

Intraperitoneal bladder rupture requires operative repair and drainage of the extravasated urine.

Image is a normal cystogram.

| Bladder Injury Scale |            |                                                                                                                |
|----------------------|------------|----------------------------------------------------------------------------------------------------------------|
| Grade                |            | Injury Description                                                                                             |
| I                    | Hematoma   | Contusion, intramural hematoma                                                                                 |
|                      | Laceration | Partial thickness                                                                                              |
| II                   | Laceration | Extraperitoneal bladder wall laceration $\leq 2$ cm                                                            |
| III                  | Laceration | Extraperitoneal ( $\geq 2$ cm) or intraperitoneal ( $\leq 2$ cm) bladder wall lacerations                      |
| IV                   | Laceration | Intraperitoneal ( $\geq 2$ cm) bladder wall lacerations                                                        |
| V                    | Laceration | Intra or extraperitoneal bladder wall laceration extending into the bladder neck or urethral orifice (trigone) |

Bladder contusion – catheter drainage until gross hematuria has subsided

Penetrating: managed according to the type and site of injury

With exception of large or stellate lacerations, intraperitoneal bladder injuries are managed by foley catheter drainage

Extraperitoneal bladder is usually managed non-operatively. A cystogram should be repeated later to determine closure of the rupture. A supra pubic foley catheter is adequate management for urine removal and results in few days of catheterization in comparison with management with a suprapubic tube. The patient is also given a repeat cystogram to ensure closure of the rupture.

Intraperitoneal bladder rupture requires operative repair and drainage of the extravasted urine. Operative management usually involves over sewing the large, stellate tears in the dome of the bladder due to the sudden rise in the pressure within a full bladder. Urine is temporarily drained via a foley catheter drainage system.

## Complications of Bladder Trauma

- Mortality associated with bladder injury is reported to be 11-44%. Higher mortality associated with intraperitoneal rupture.
- Death from a bladder injury is usually attributed to hemorrhage, sepsis or anorectal injury.



Death from a bladder injury is usually attributed to hemorrhage, sepsis and anorectal injury. These causes of death are usually associated with missed injuries or an appreciation of how sick the patient was either due to their age, an underlying medical condition or their ability to compensate.

Catheter care/perineal care prevents infection from the indwelling and suprapubic catheters. Adequate fluid intake to maintain urine output also prevents bladder infections. Antispasmodic medication may help should the patient experience bladder spasms.

Catheter care/perineal care prevents infection from the indwelling and suprapubic catheters. Adequate fluid intake to maintain urine output also prevents bladder infections. Antispasmodic medication may help should the patient experience bladder spasms.

## Urethral Trauma

- More common in males than females
- Urethra is divided into the anterior and posterior sections
- The following will all impact on the selection of management for urethral trauma
  - nature of the injury (blunt vs. penetrating)
  - location of the injury (ant vs. post)
  - completeness (partial vs. complete circumferential laceration)
  - presence and seriousness of associated injuries
  - the stability of the patient



Urethral trauma is more common in males than females because the male urethra is longer and less protected. The female urethra is shorter and more mobile urethra.

Urethral trauma in females is almost always associated with pelvic fractures. Prostatic (posterior) urethral injuries are usually caused by pelvic fractures too.

Male urethral anatomy divided into anterior (distal) and posterior (proximal) compartments.

Anterior: glandular, pendulous and bulbar segments

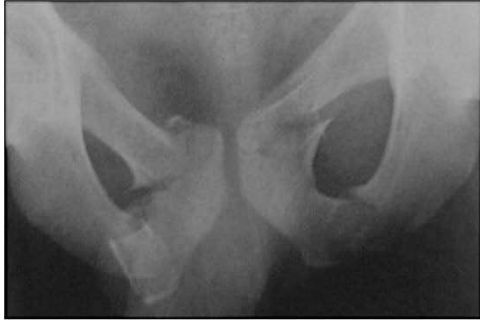
Posterior: membranous sphincteric and prostatic

Complete rupture of the urethra is more common in children due to there being a thin, delicate membrane, at prostatic urethra or bladder neck.

Unilateral pubic ramus fracture associated with 15% GU injury; 40% if bilateral.

## Urethral Trauma Mechanism of Injury

- Posterior injury usually accompanies pelvic fx's
- Trauma to anterior urethra usually isolated
- Trauma to posterior urethra usually co-exists with damage to other structures
- Sudden deceleration injuries (bladder shears off urethra)



Posterior urethral injuries are most often associated with pelvic fractures, although anterior urethra injuries are associated with straddle, GSW/penetrating, industrial and self-inflicted instrumentation events.

Straddle injury was originally described in horseback riders and is the result of direct trauma. Urethral injury is a known complication.

**AP radiograph of the pelvis. This shows bilateral inferior and superior pubic rami fractures**

Bilateral superior and inferior rami fractures are known mechanism of injury.

Other mechanisms include:

- GSW
- Blunt force
- Impalement
- Assaults
- Self-inflicted injuries

Prostatic urethral trauma is occasionally encountered in preadolescent males because of their immature prostatic volume.

Associated injuries include:

- Pelvic fracture
- Bladder neck injuries
- Vaginal injuries

## Signs and Symptoms of Urethral Trauma

- Suprapubic pain
- Urge to urinate but are unable to
- Hematuria (may be microscopic)
- Blood at external meatus
- Perineal bruising – aka butterfly pattern bruise

- Scrotal Hematoma
- Rebound tenderness upon palpation
- Abdominal wall muscle rigidity, spasm or involuntary guarding
- Displaced/boggy prostate gland (in males) during rectal exam



Urinary catheters should not be passed if these are present.

The way to determine if the prostate has been displaced is to perform a rectal exam. A rectal exam should be performed before passing a urinary catheter in a patient whose urethra may be disrupted, displaced bladder and who has a fistula.

The rectal exam in a male is looking for a high-riding or palpable, boggy prostate in addition to occult/frank blood.

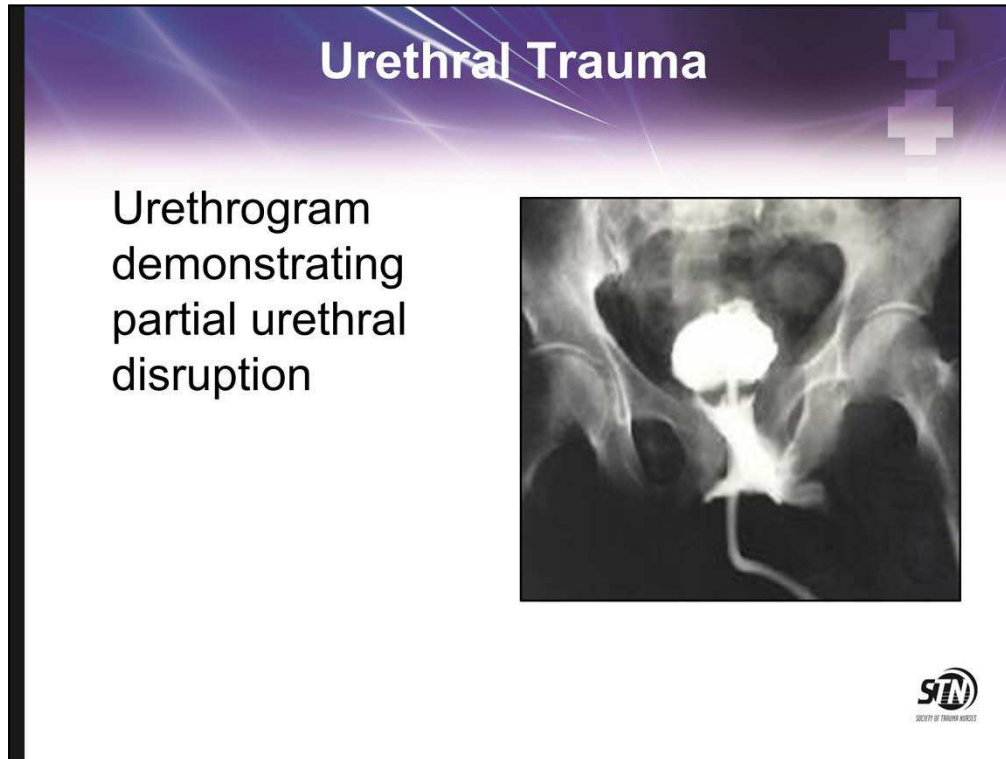


Image is one of a partial urethral disruption in a male.

## Complete Urethral Disruption

Urethrogram  
demonstrating  
complete urethral  
disruption



This image demonstrates a complete urethral disruption in a male.

## Urethral Trauma

### **Missed injuries usually manifest by**

- Fever
- Flank mass or discomfort
- Ileus
- Leukocytosis
- Lethargy
- Urinary fistula to skin or vagina
- Sepsis
- Wound infection



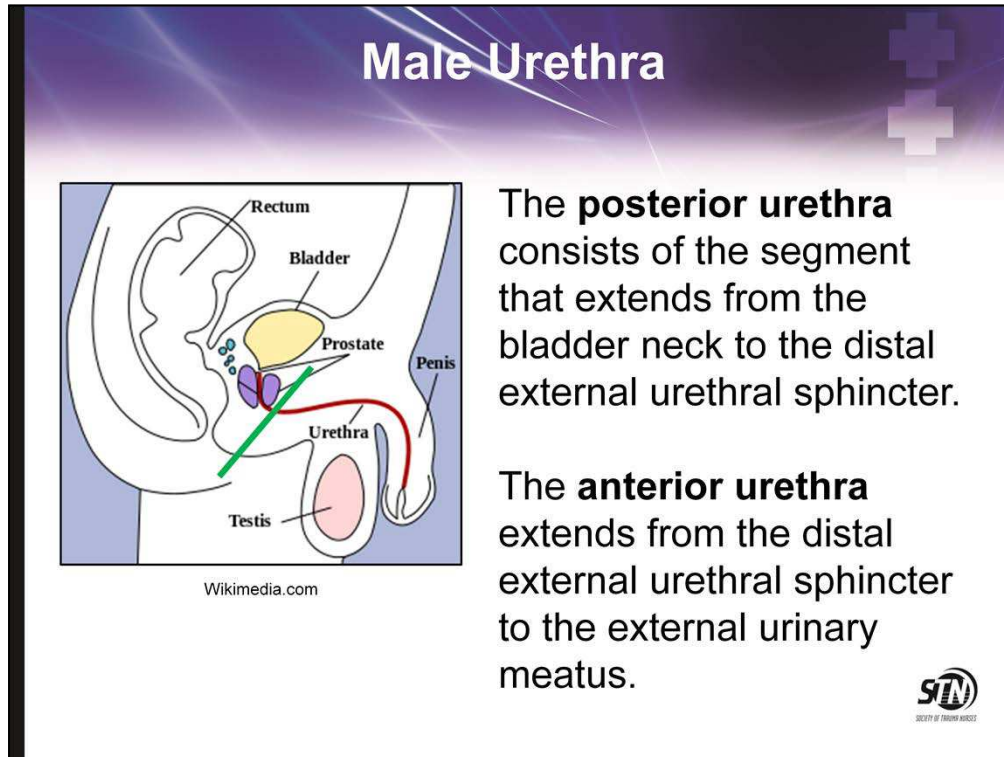
## Urethral Trauma Complications

- Impotence
  - 13-30% of patients with pelvic fracture and urethral distraction injury
- Incontinence
  - Most with significant urethral distraction injury have injury to the external (striated) sphincter, continence is then provided by the bladder neck.
- Stricture



| Urethral Injury Scale |                     |                                                                                                                                    |
|-----------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Grade                 |                     | Injury Description                                                                                                                 |
| I                     | Contusion           | Blood at urinary meatus, urethrography normal                                                                                      |
| II                    | Stretch Injury      | Elongation of urethra without extravasation on urethrography                                                                       |
| III                   | Partial Disruption  | Extravasation of urethrographic contrast medium at injury site, with contrast visualized in the bladder                            |
| IV                    | Complete Disruption | Extravasation of urethrographic contrast medium at injury site without visualization in the bladder, < 2 cm of urethral separation |
| V                     | Complete Disruption | Complete transection with > 2 cm urethral separation or extension into the prostrate or vagina                                     |

This slide discusses the urethral injury scale. We will also discuss some specific injuries such as the anterior and posterior urethral injuries in the next few slides.



Note the green line that separates anterior from posterior urethra.

## Urethral Injury: Male Mechanism

| Anterior                                                                                                                                                                                                                         | Posterior                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Straddle injury</li><li>• Crushing of urethra against symphysis pubis</li><li>• GSW-stab wound</li><li>• Self inflicted instrumentation</li><li>• Industrial or farm incidents</li></ul> | <ul style="list-style-type: none"><li>• Shearing in pelvic disruption pulls prostate and puboprostatic ligaments while membranous urethra and urogenital diaphragm are pulled in opposite direction</li><li>• Falls</li><li>• Crush</li><li>• Sports</li></ul> |

Most common mechanisms for an urethral injury in a male.

| Urethral Injury: Male Assessment                                                                                                                                                                                                                                                         |                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Anterior</b> <ul style="list-style-type: none"><li>• Localized pain in perineum</li><li>• Perineal or penile swelling</li><li>• Extravasation may cause scrotal, lower abdomen, penile swelling</li><li>• Butterfly-shaped hematoma under scrotum</li><li>• Painful Voiding</li></ul> | <b>Posterior</b> <ul style="list-style-type: none"><li>• Displaced prostate</li><li>• Blood at urinary meatus</li><li>• Distended bladder</li><li>• Inability to void</li></ul> |

•Most common locations for an **anterior** urethral injury in a male are below or extending into the urogenital diaphragm with disruption in the bulbous and penile urethra.

- The symptoms of anterior injury may include:
  - Soft boggy mass felt on rectal
  - Painful voiding which may become dysfunctional from progressive tissue suffusion with blood or urine
  - Urethral bleeding is variable but there may be blood at the urinary meatus
  - Inability to catheterize which indicates the need for a suprapubic cystostomy

## Urethral Trauma: Male Treatment

| Anterior                                                                                                                                                                                                         | Posterior                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Bladder and suprapubic catheter</li><li>• Primary end to end anastomosis if no infection</li><li>• Contamination requires debridement, I&amp;D and antibiotics</li></ul> | <ul style="list-style-type: none"><li>• Retrograde urethrogram (RUG) before catheter placement</li><li>• Abdomen and pelvic films</li><li>• IVP, cystogram</li><li>• Suprapubic catheter</li><li>• Surgical intervention</li></ul> |



### **Anterior urethral injuries are usually managed**

**non-operatively with the placement of a catheter and suprapubic tube.**

- The suprapubic catheter is left in for 10-14 days.
- Surgical diversion and drainage usually unnecessary for minor perineal bruising
- End to end urethral anastomosis requires debridement, irrigation and 5-7 days of cystostomy drainage.
- Presence of infection or necrosis contradict primary anastomosis and diversion is recommended until infection cleared up
- Penetrating wound and closed wounds with tissue necroses are classified as contaminated

Need antibacterial therapy

Debridement, irrigation and drainage are crucial components

Anterior abdominal drainage is only required for obvious infection or necrosis

### **Posterior management**

RUG first prevents complete urethral transection due to catheter placement.

Suprapubic catheter diverts urine from injury.

Posterior urethral injuries can be managed with delayed perineal reconstruction or primary endoscopic realignment.

Primary realignment is simpler, provides a shorter time to spontaneous void and a decreased incidence of stricture, thus avoiding future surgical urethroplasty.

Surgery dependent upon surgeon preference.

Goals – maintain patency, continence, potency

## Urethral Trauma: Male Complications

| Anterior                                                                                                                                                                                                               | Posterior                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Urethral reconstruction can have reanastomosis defects</li><li>• Urethral strictures</li><li>• Infection from extravasated blood or urine which can lead to necrosis</li></ul> | <ul style="list-style-type: none"><li>• Permanent impotence</li><li>• Permanent incontinence</li><li>• Cellulitis</li><li>• Sepsis</li><li>• Urethral stricture</li></ul> |



Posterior:

Urethral strictures

Post-traumatic impotence up to 80% has been reported but 10% resolve after ligation

Urinary incontinence rate reported 0-33%

Impotence – due to damage to parasympathetic and sympathetic nerves.

Incontinence – damage to urinary sphincter.

Early realignment establishes continuity, avoids delayed urethroplasty and long-term suprapubic cystostomy.

Psychosocial support is needed for alterations in self-image and sexual function.

## Urethral Trauma Female - Posterior

- Female urethral trauma usually coexists with vaginal lacerations resulting in a urethrovaginal communication
- Delay in diagnosis may result in:
  - Incontinence - Necrotizing fasciitis, sepsis
  - Uretero-vaginal fistula
  - Dyspareunia, recurrent urethritis
  - Hematuria, cystitis



For a female is there is a delay in diagnosis or a missed urethral injury, the delay in diagnosis and treatment can result in these complications

## Reproductive System Trauma

- Can occur to both external and internal reproductive system
- External
  - Most common
  - Pain, extensive bleeding due to vascularity
- Internal
  - Rarely injured
- Management of specific injuries based on type and severity of trauma



Male Genitalia – the testes, scrotum, and penis are rarely injured although they are susceptible to penetrating trauma.

Rapid identification of testicular injury is essential to the salvage of the testicle itself. Injury to the penis, is rare but it can occur from strangulation, sexual intercourse and trauma.

## Perineum Injuries: Male Genitalia

- **Testes**
  - Usually spared from injury
  - Direct blow impinges testes against symphysis pubis
- **Penis/Scrotum**
  - Zipper
  - Foreign body
  - Avulsion/Amputation
  - Fracture
    - Strangulation
    - Suction
    - Penetrating injury



Most times the male genitalia is spared from injury due to mobility, contraction of the cremaster muscle, tough capsular covering.

Fracture – rupture of tunica albuginea, hemorrhage, hematoma formation, possible urethra injury.

10-30% of penile fractures also have urethral injury.

## Assessment

- **Testes, Penis, Scrotum**
  - Hematocele
  - Large tender, swollen scrotal mass
  - Failure to transilluminate
  - Avulsion injury may be present
  - Pain
  - Swelling, discoloration
  - Deviation away from lesion
  - Possible urethral bleeding, hematuria, extravasation



Is a Hematocele present? – Tunica vaginalis sac filled with blood.  
Failed transillumination? – may indicate hematoma.



Orchiectomy is least desired outcome of injury or complication.

If the scrotum has been avulsed, the salvage rate for testes in this situation is 35%.

Management:

**Testes:**

- Immediate surgical intervention
- Evacuation of blood clots
- Delayed treatment may increase infection or cause testicular atrophy
- Orchiectomy

**Scrotum:**

- Surgical intervention for early debridement and primary repair
- Avulsion
  - Reconstruction
  - If unable to reconstruct, testes may need implanted into thigh area for preservation

Image is of reconstruction

## Perineum Injuries: Male Genitalia

- **Penis Management**
- **Non-operative management**
  - Catheter or suprapubic catheter
  - Elevation and ice
  - Anti-inflammatory medications, analgesics
- **Surgical management**
  - Evacuation of hematoma and repair
  - Surgical reattachment
- **Complications**
  - Infection of hematomas
  - Painful lumps
  - Inadequate erection
  - Permanent deformity



Reattachment if ischemia time < 18 hours.

Management

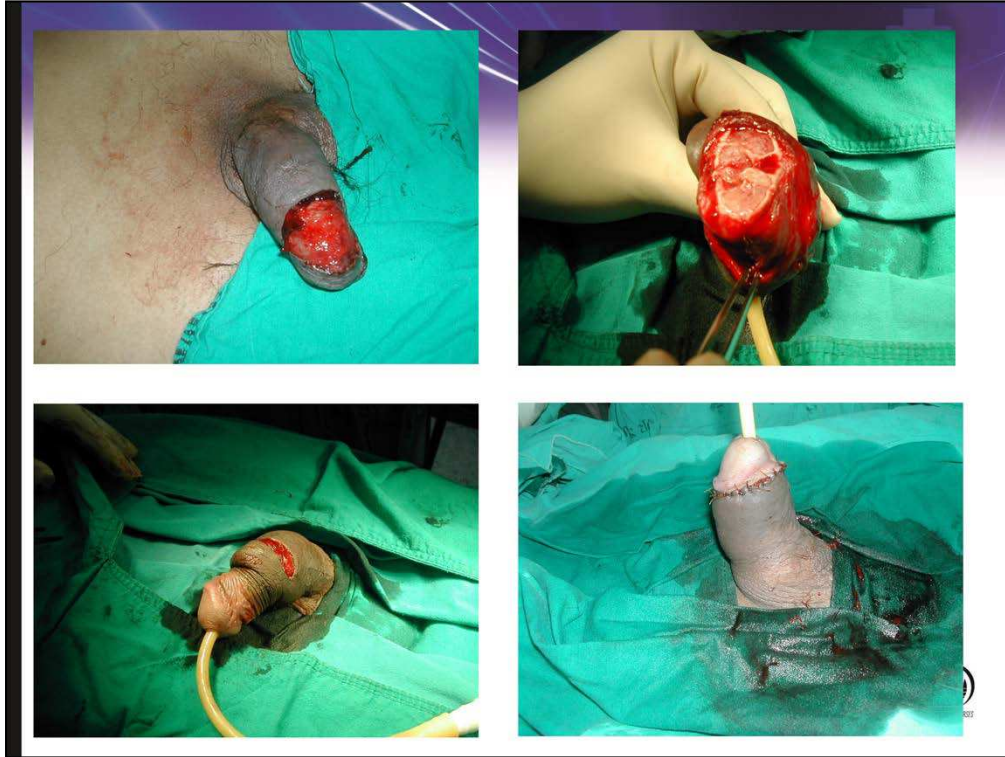
Control bleeding / Indirect ice / Analgesia

Psychological and Modesty Concerns

## Perineum Injuries: Male Genitalia

- Avulsion of skin of penis, scrotum
  - Cover with a moist, sterile dressing
- Complete amputation of penis
  - Treat as any amputated part





Most authors have agreed that every attempt should be made to reattach an amputated or avulsed penis

## Perineum Injuries: Female Genitalia

- Usually well protected by location deep within the pelvis except when pregnant
- In younger girls most common injuries to external genitalia:
  - Straddle injuries
  - Accidental penetration
  - Tearing due to sudden forced stretching of the perineum when the legs are forced apart (i.e. gymnastics, falls)



Usually missed due to an incomplete examination

Internal

Rarely injured

External

Can cause pain, extensive bleeding

Usually not life-threatening

## Perineum Injuries: Female Genitalia

### Vagina

- Mechanism
  - Pelvic fractures with vaginal and/or perineal injury
  - Penetrating injury to uterus and/or ovaries
- Assessment
  - Vaginal bleeding
  - Speculum exam essential with pelvic fractures
- Management
  - Surgical repair



Bleeding may be hidden due to vaginal spasm.

## Perineum Injuries: Female Genitalia

### Perineum/ Sexual assault

- Straddle injury
- Sexual assault
- May also result in injury
  - Introitus laceration
  - Anorectal lacerations
  - Urethra
- Use colposcope
- Evidence preservation
- Protect safety and psyche



Usually perineum injuries are from blunt trauma and frequently from intentional sexual assault

Primarily soft tissue injury

Hemorrhage likely - Look for other injuries

Managed as other soft tissue bleeding

control hemorrhage

Ice and other comfort measures

facilitate with trained personnel (sexual assault)

Colposcope allows for better visualization through magnification.

**Discuss your hospital's protocols and procedures for rape victims**

## Perineum Injuries: Female Genitalia

### Uterus, Ovaries

- Assessment
  - Signs of peritonitis
- Management
  - Surgical repair of minor lacerations
  - Hysterectomy and/or oophorectomy for major disruptions
- Complications
  - Abscess
  - Sepsis



Discuss slide.

## General Management

- Monitor for bleeding and renal function
- Teach catheter care to family and patient
- Medications
  - Antispasmodics – bladder spasm
  - Phenazopyridine hydrochloride (Pyridium) - cystitis
- Support for sexual function, disfigurement
- Provide information



Pyridium – analgesia effect on mucosa of urinary tract relieves burning, urgency, and frequency.

## Summary

- The GU system has both solid and hollow organs
- Injuries are often accompanied by other system injuries, so a high level of suspicion is needed
- Kidney injuries can lead to renal failure
- There is a wide array of injuries than can occur to the male and female internal organs and genitalia

