Inguinal Hernias and Hydroceles

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Inguinal hernia repair..

one of the most common operations performed by pediatric surgeons

INCIDENCE

*higher incidence of premature infants

1–5% of all children | 10-30% of premature infants

10% positive family history

M:F → 5:1 (1:1 in prematures) very rare in females

Right : Left : Bilateral → 60% : 30% : 10%

ASSOCIATIONS

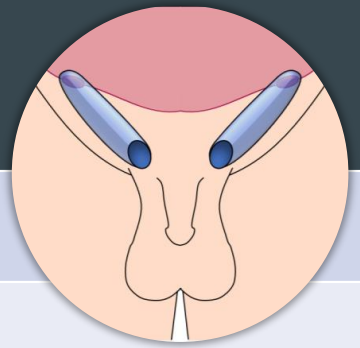
→ these factors either increasing intra abdominal pressure or factors interfere with obliteration of processus vaginalis

1. • **Cystic Fibrosis**
2. • **Hydrocephalus** (VP Shunts)
3. • **Peritoneal Dialysis**
4. • **Other:**
   - undescended testes
   - abdominal wall defects
   - connective tissue disorders (Ehlers–Danlos syndrome)
   - mucopolysaccharidoses (Hunter or Hurler syndrome)
   - ascites
   - congenital hip dislocation
   - meningomyelocele

→ factors affecting the patency of processus vaginalis

INGUINAL CANAL

- **Inguinal canal** is a six-sided cylinder:



Cephalad opening	internal inguinal ring
Caudal opening	external inguinal ring
Superior wall →	internal oblique & transversus abdominis muscles
Posterior wall →	transversalis fascia & the 'conjoint tendon'
Anterior wall →	external oblique aponeurosis
Inferior wall →	inguinal ligament + lacunar ligament (medial third) + iliopubic tract (lateral third)

INGUINAL CANAL

- Contents of inguinal canal include:
  - Males: ilioinguinal nerve + spermatic cord
  - Females: ilioinguinal nerve + round ligament

→ made of 6 structures starting from:
cremasteric muscles → testicular artery
→ testicular veins → lymphatics
→ genital branch of genitofemoral nerve → vas deferens

- Spermatic cord structures:
  - Cremasteric muscle
  - Testicular artery
  - Banbiniform plexus (testicular veins)
  - Lymphatic channels
  - Vas
  - Genital branch of Genitofemoral nerve
  - Processus vaginalis (if patent)

PROCESSUS VAGINALIS (PV)

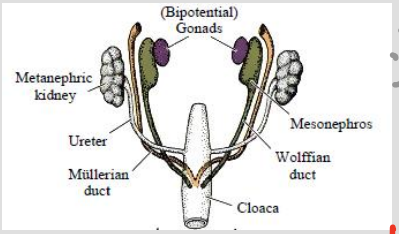
- A parietal peritoneal diverticulum extending through the internal inguinal ring into the inguinal canal..
  - beside the descending testicle in males
  - beside the elongated round ligament in females

retroperitoneal but while their descending they will slide the parietal peritoneal along with them

*located anterior and medial to the cord structures

The gonads form on the anteromedial nephrogenic ridges in the retroperitoneum..

- attached to the scrotum by the gubernaculum
- attached to the labia majora via the round ligament



start to get formed just beside the kidneys (mesonephros)

both start to form in the retroperitoneum but the gonads starts to descend

towards the scrotum (males) and for females to settle in the pelvis

PROCESSUS VAGINALIS (PV)

- In the inguinal canal → gradually obliterates after birth
- In scrotum → forms the tunica vaginalis around the testis

↳ contains small amount of liquids for lubrication

N.B.: The female anlage of the processus vaginalis is..

the canal of Nuck

PATHOPHYSIOLOGY

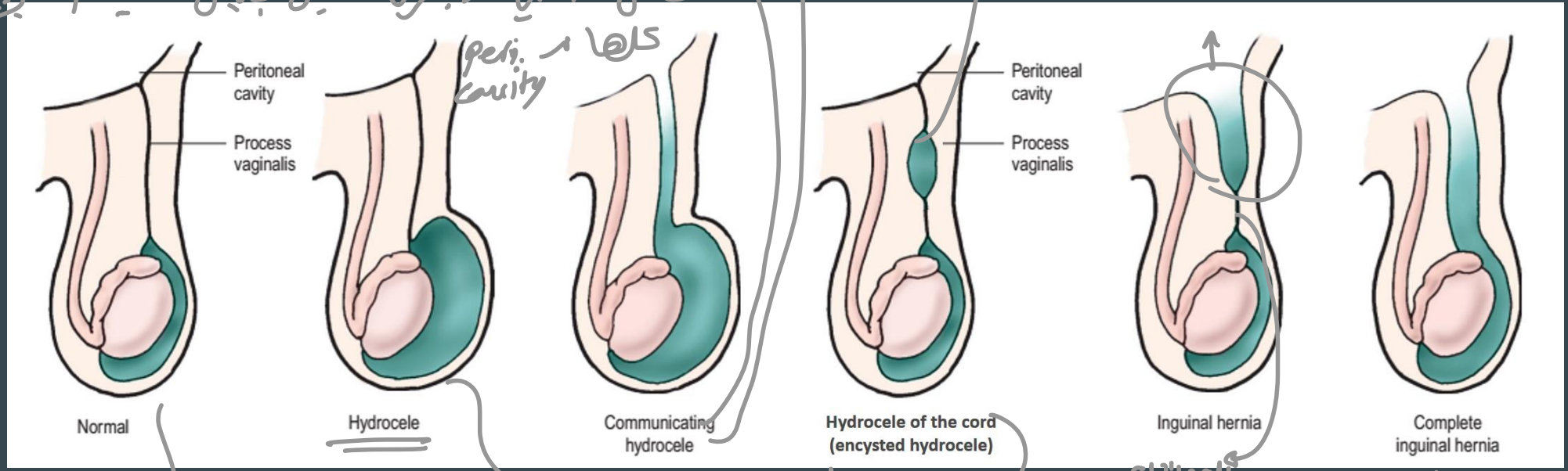
It is the failure of PPV to close that will result in indirect inguinal hernia in children

Incidence of PPV in newborns is 40–60% (only 1-5% stay patent)

get resolved spontaneously without any surgery

There's a communication between the processus and the peritoneal cavity

small amount of fluid accumulates proximally
Feels like cyst



descends parallel to the testicle

(non communicating) accumulation of larger amounts of fluid

connection

because its location is at the level of inguinal canal

Obliteration only distally and patent Proximally → potential

patent of processus all the way through

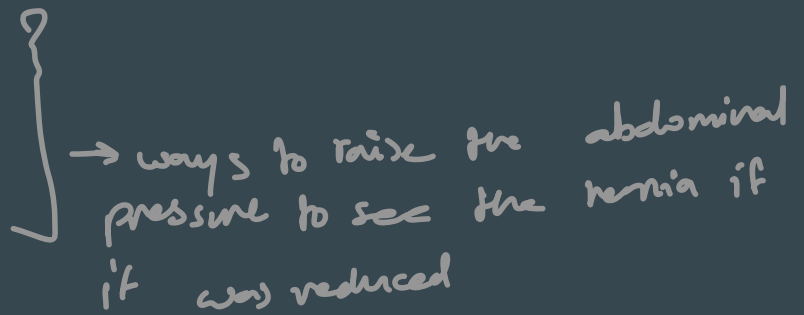
space for herniation

CLINICAL PRESENTATION

- Most are asymptomatic (except for bulging with straining)
  (incidental finding usually or mild swelling)
- Often found by the parents or pediatrician on routine physical examination
  → swelling
- The diagnosis is clinical (Hx & PEx)

CLINICAL PRESENTATION

- Maneuvers that may help demonstrate the hernia
  - raise the head while supine
  - blowing up a balloon
  - standing upright



CLINICAL PRESENTATION

- Cell phone picture documentation by the parents has become commonplace for Dx
- Good Hx is acceptable as an indication of operation
- Radiologic aids are not generally necessary or helpful

Common is common
- Hernia
- Retractile testis or hydrocele

DDx

testis is in the scrotum then this differential is X

- a retractile testis
- lymphadenopathy
- hydrocele
- prepubertal fat

examine other lymphnods in the body

if reduced → hernia
if not reduced → irreducible hernia or one of the other differentials

distal inguinal

*Transillumination isn't useful here (not reliable test in infants)

swelling

HYDROCELE

- Accumulation of peritoneal fluid in:
  - The tunica vaginalis (after PV being obliterated) — **Non-communicating H.**
  - The tunica vaginalis (due to a patent PV) — **Communicating H.**
  - A non-obliterated (proximal) portion of the PV — **Encysted H. of the cord**

NONCOMMUNICATING HYDROCELE

- If asymptomatic:
  - can simply be observed for 1-2 years of age
  - 90% resolve by 1 year of age

- Indications of surgery:
  - when fails to resolve
  - if a clinical hernia is apparent
  - If symptomatic (pain)

COMMUNICATING HYDROCELE

- 65% → complete resolution without operation by mean age of 1 year

- Indications of surgery:
  - when fails to resolve after 1-2 years of age
  - if a clinical hernia is apparent
  - If symptomatic (pain)

- Most surgeons repair hydroceles of the cord (encysted hydrocele)

ENCYSTED HYDROCELE (H. of the cord)

- Most surgeons repair hydroceles of the cord despite the age
  - as mostly don't resolve spontaneously

*Hydrocele in Adolscents &

① A complication of varicocelectomy (often)
② an inguinal hernia (but hydrocele instead of bowel)
③ an ichiopathic hydrocele

} → Different treatment than children

SURGICAL TREATMENT OF HYDROCELES

Evacuation

+

High ligation of PV or PPV

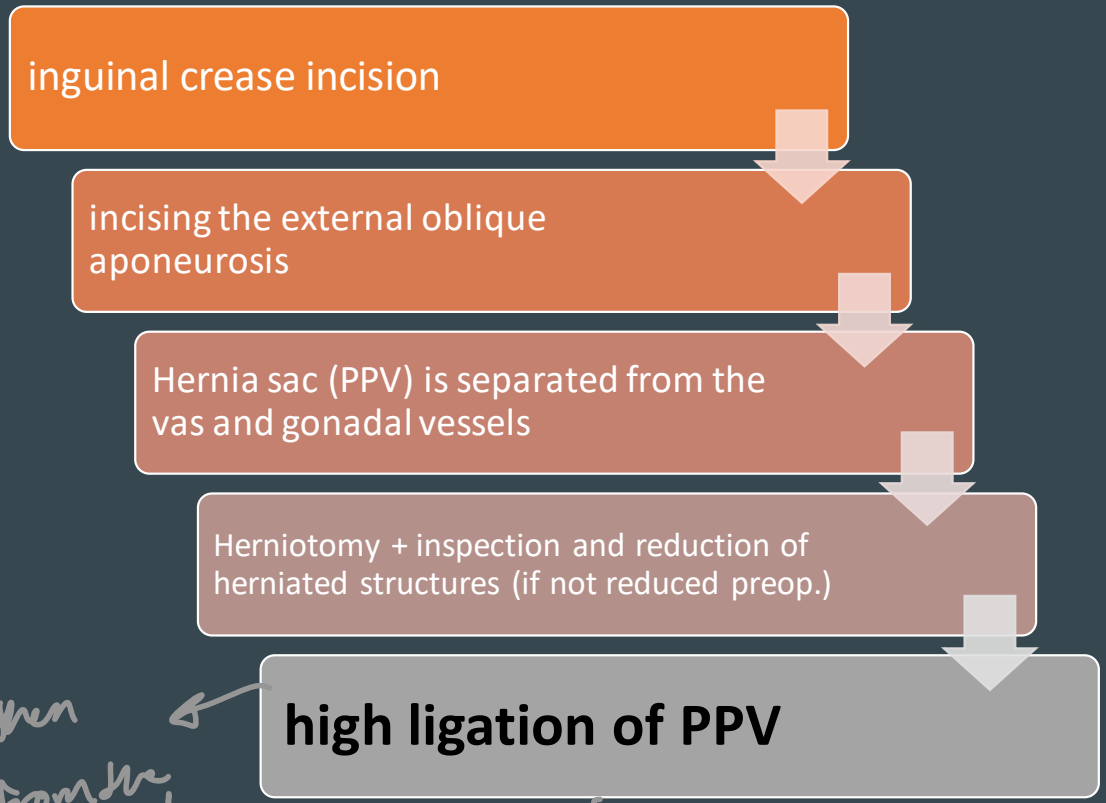
- Large or thick sacs may be everted behind the cord (Bottle procedure)

SURGICAL TREATMENT OF INGUINAL HERNIAS

Open Repair Technique

ideally called..

high ligation of PPV



part

adults we need to treat the underlying cause.

SURGICAL TREATMENT OF INGUINAL HERNIAS

Open Repair Technique

higher risk for incarceration

Open exploration of the clinically-free contralateral side is justified in:

- Prematurity → higher incidence of bilateral hernia than other babies
- Younger age
- Female gender → because most of bilateral inguinal hernia are female
- Left-sided unilateral hernia

SURGICAL TREATMENT OF INGUINAL HERNIAS

- Sliding hernias:
  - Uncommon (more frequent in females)
  - May contain: fallopian tube, ovary, or even side-wall of the urinary bladder

- Appendix if herniated → Amyand's hernia
- Meckel diverticulum if herniated → Littre's hernia

- Mesh is almost never required in children
  - Except in: recurrent hernias in children with connective tissue disorders or mucopolysaccharidoses

SURGICAL TREATMENT OF INGUINAL HERNIAS

* laparoscopic repair can check both sides.

Laparoscopic Repair Technique

- no difference in recurrence (< 0.5%)
- ↓ incidence of metachronous hernia
- ↓ op. time for lap. bilateral repairs

- ↑ op. time with lap. unilateral repair

INCARCERATED INGUINAL HERNIA

- Incidence: 12–17%

- Risk factors:
  - Younger age
  - Prematurity

- Signs & Symptoms:
  - Inconsolable infant → crying all the time
  - Intermittent abdominal pain
  - Vomiting
  - Tender and erythematous irreducible mass in the groin
  - Abdominal distention (late sign)
  - Bloody stools (late sign)
  - Peritoneal signs (strangulation)

Incarceration → stuck of the hernia in the hernial sac but it doesn't mean gangrene or obstruction

* When we're suspecting complicated hernia it shouldn't be reduced

•Incidence: 12–17%

بدل ما يكون فيه local inflammatory process

•Risk factors:
• younger age
• prematurity

(if the complication is strangulation or gangrene but if it's incarceration only → reducible)


TREATMENT OF INCARCERATED INGUINAL HERNIA IN ER

- Trial of reduction:
  - Monitored conscious sedation
  - Firm and continuous pressure applied around the incarceration

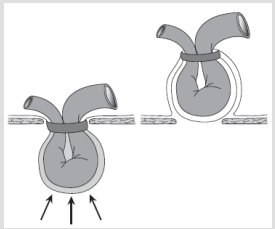
- Don’t attempt reduction if:
  - signs of peritonitis
  - septic shock

TREATMENT OF INCARCERATED INGUINAL HERNIA

- If reduced (90–95%):
  - Admit for **elective surgery** same or next day

- If reduction failed, questionable (reduction en masse*), incomplete, or contraindicated:
  - Admit for **emergent surgery**

* Reduction en masse occurs when the hernia contents are reduced into the peritoneal cavity but the bowel remains incarcerated internally in the hernia sac



COMPLICATIONS

of inguinal hernia & hydrocele surgical repair

- **Recurrence (<1%)**
  - Higher in:
    - premature infants
    - children with incarcerated hernias
    - associated diseases (e.g., connective tissue disorder, VPS)
- **Injury to the Spermatic Cord or Testis (rare)**
- **Wound infection (SSI)**
- **Hematoma**
- **Persistent hydrocele**
- **Chronic pain (uncommon in children)**
- **Loss of domain (due to a huge hernia)**
- **Iatrogenic cryptorchidism**

UNDESCENDED TESTES (UDT)

UNDESCENDED TESTES (UDT)

a common abnormality that carries fertility and malignancy implications

UNDESCENDED TESTES (UDT)

- Normal testicular descent relies on a complex interplay of numerous factors (INSL-3, androgens, and CGRP)
- Any deviation from the normal process can result in a cryptorchid or undescended testis (UDT)
- Majority of testes complete descending within the first 6 to 12 months of life

INCIDENCE OF UDT

3% of term male newborns (↓ to 1% at 1 year of age)

33–45% of premature or <2.5 kg male newborns

after 1 year descent is unlikely → surgery is indicated.

CLASSIFICATION & RELATED TERMS

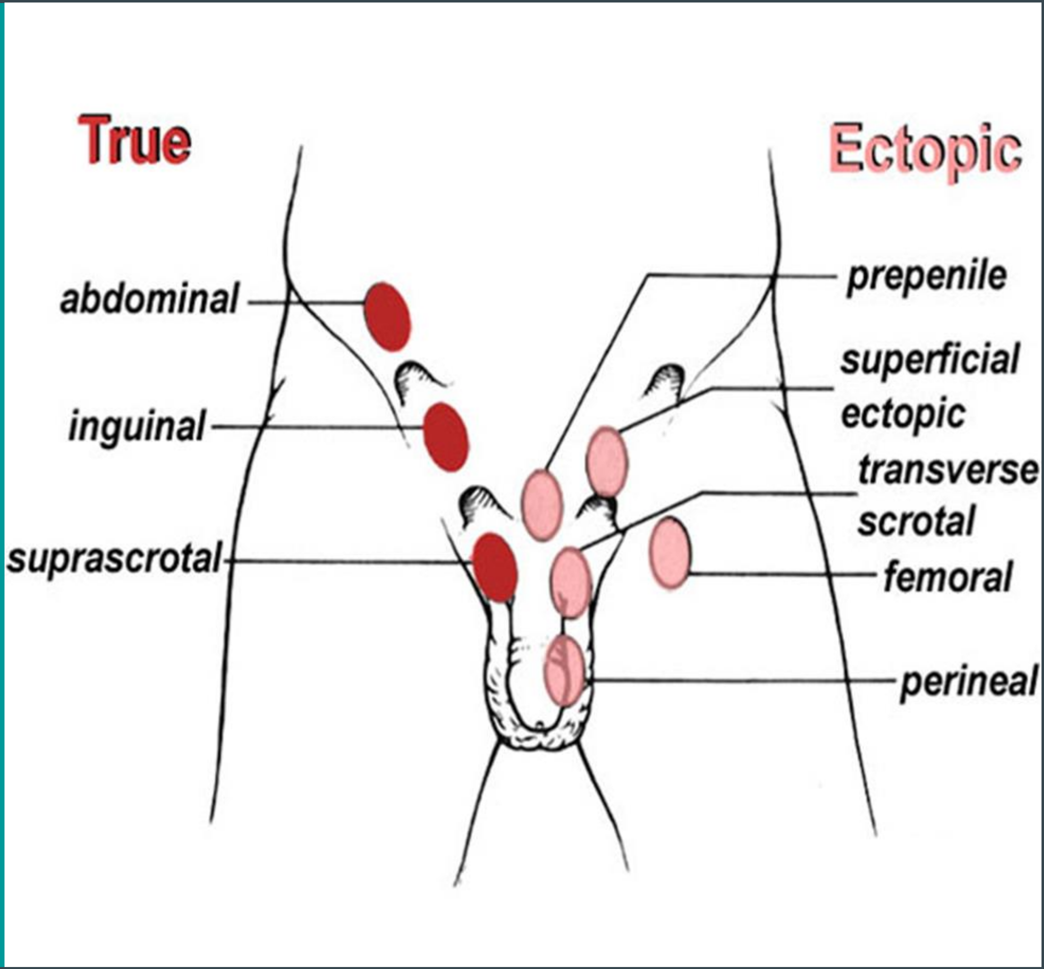
- Non-palpable UDT
  - Testicular agenesis
  - Intra-abdominal UDT
  - Peeping testis (when inside the abdomen)
  - Ectopic testis (non-palpable in the inguinoscrotal area)
  - Vanished testis (atrophied due to prev. vascular insult as perinatal torsion, trauma, or iatrogenic)
  - Small testis, obese child, or non-experienced examiner

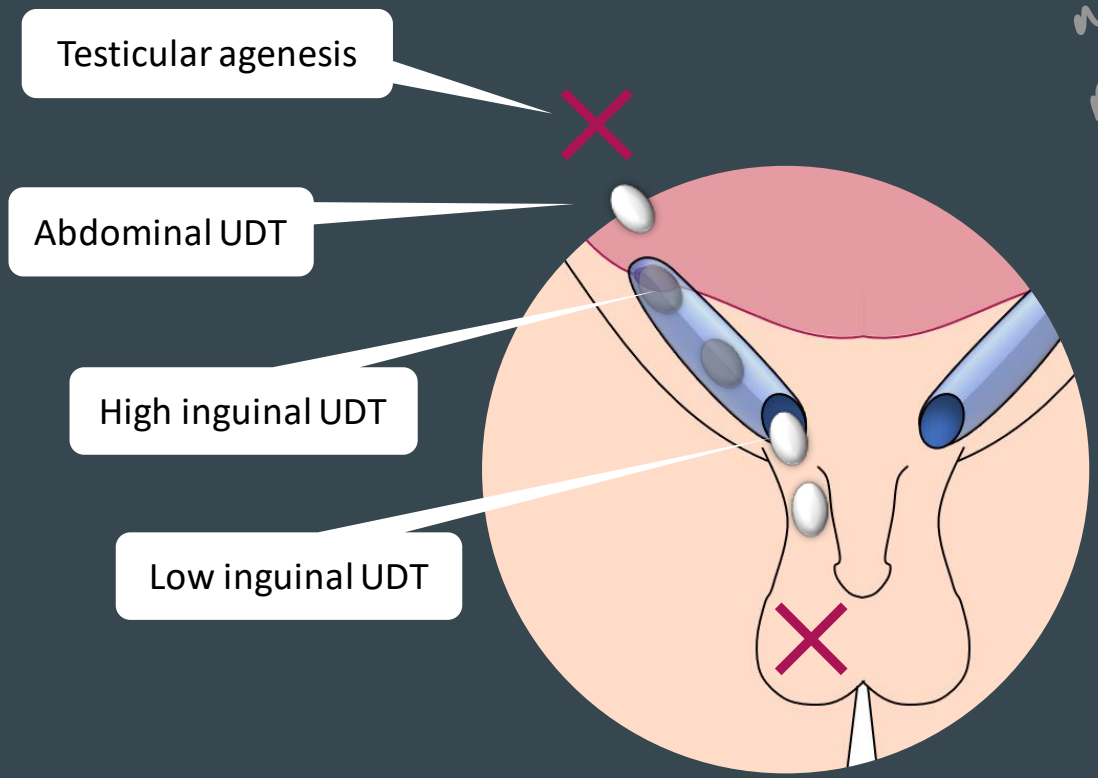
- Palpable UDT (70%)
  - Inguinal UDT (high or low)
  - Retractile testis (cremasteric overactivity)
  - Ascending testis (acquired UDT)
  - Peeping testis (when inside the inguinal canal)
  - Ectopic testis (could be palpable in the ectopic areas; inguinal outside the canal, femoral, perineal, penopubic, or contralateral hemiscrotum)

* 10% of retractile testes requires surgery:

1. تطلع لفوقه وما تقبل تنزل حتى بس أنا انزلها ب PG وبعد اسمها ascending acquired testes
2. symptomatic (pain)
3. Variable in size with the other normal one
4. Calm child, most of the time up

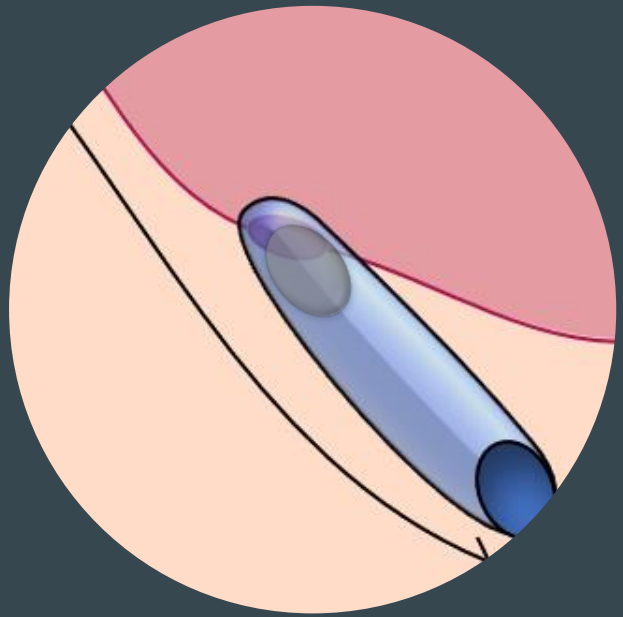
→ considered as unclassified testes



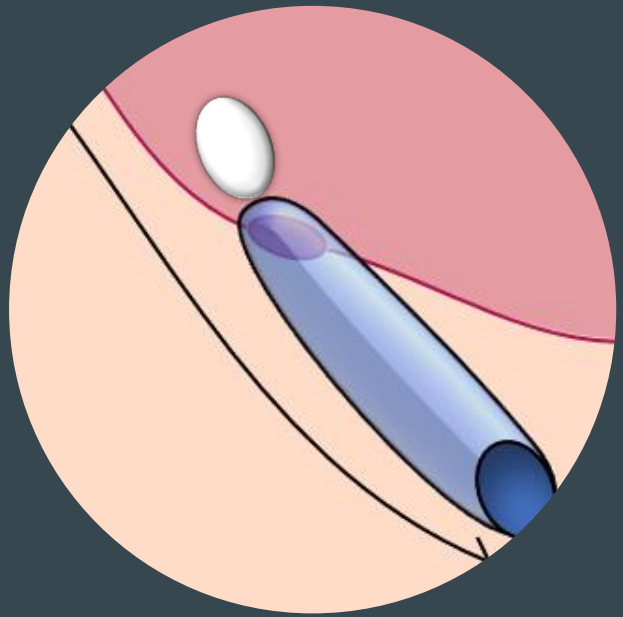


- Normal pathway of testis:

retroperitoneum → deep inguinal ring → inguinal canal → out of the superficial ring → neck of the scrotum → scrotum

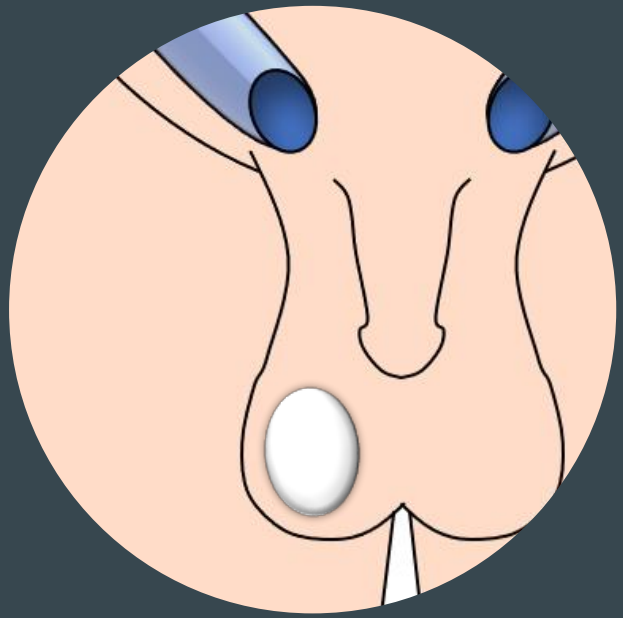


Peeping UDT (inguinal)



Peeping UDT (abdominal)

Retractile testis



Vanishing testis

ASCENDING TESTIS (ACQUIRED UDT)

- a testis that was previously descended on examination, but at a later time can no longer be brought down into the scrotum.

Possible causes:

- secondary to a retractile testis
- change in position with growth of the child
- iatrogenic after inguinal surgery

ASSOCIATIONS

- Associated anomalies:
  - patent processus vaginalis
  - epididymal abnormalities

- Specific syndromes with higher rates of UDT:
  - prune-belly syndrome
  - gastroschisis
  - bladder exstrophy
  - Prader–Willi, Kallman, Noonan syndromes
  - Testicular dysgenesis
  - Androgen insensitivity syndromes

PRESENTATION

- Empty hemiscrotum
  - Since birth
  - Later in life
- Mobile testis (moving upward)

HISTORY

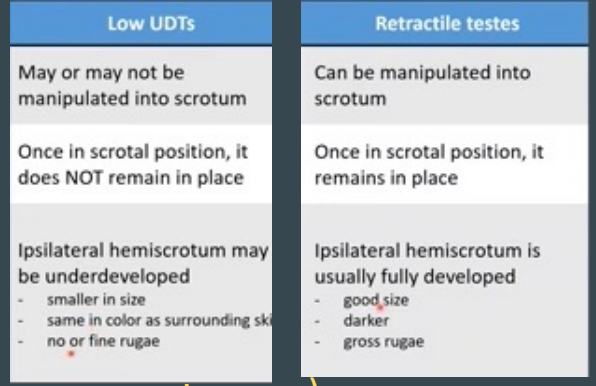
- History
  - Age
  - Whether present at birth
  - Hx of acute scrotum or trauma
  - Hx of inguinal surgery

Diagnosis

- Imaging studies:
  - **Experienced surgeon/examiner** has a higher sensitivity in locating the UDT than does US, CT, or MRI
  - **US** for nonpalpable testes
  - **CT/MRI** for nonpalpable testes not found on US

أفضل

PHYSICAL EXAMINATION



Low UDTs	Retractile testes
May or may not be manipulated into scrotum	Can be manipulated into scrotum
Once in scrotal position, it does NOT remain in place	Once in scrotal position, it remains in place
Ipsilateral hemiscrotum may be underdeveloped - smaller in size - same in color as surrounding ski - no or fine rugae	Ipsilateral hemiscrotum is usually fully developed - good size - darker - gross rugae

- Inspection
  - Signs of scrotal development (darker skin color and presence of rugae)
  - Scrotal size
  - Phallic size

- Palpation
  - Scrotum:
    - whether testicle is in position
    - testicular size and consistency
    - compare both sides
  - If not in scrotum:
    - palpate the inguinal area
    - assign the testicular location
    - try to manipulate the testis down toward the scrotum
  - If not palpable:
    - palpate possible areas of ectopic testis
    - ask for ultrasound (abdominal & inguinoscrotal)

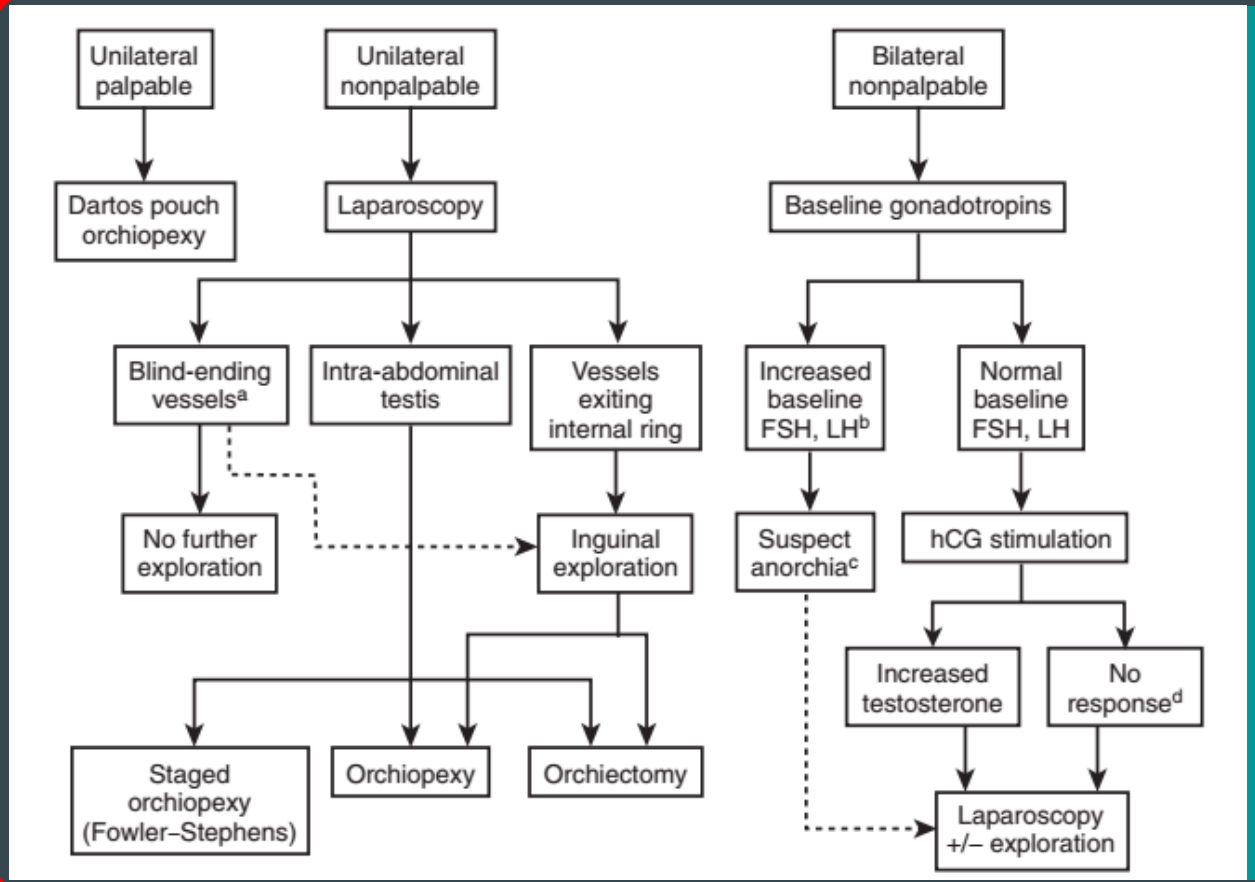
from ASIS, press with the palms of your fingers, sweep your hand toward the superficial ring while keep pressing over the inguinal canal, then try to catch the manipulated testis in the scrotum with your other hand

PHYSICAL EXAMINATION

	Hemiscrotal development	Hemiscrotal size	Testis is palpable	Palpable testis can be manipulated to scrotum	Testis stays in scrotum after manipulation
Testicular agenesis (rarest)	No	Small	No	-	-
Abdominal UDT (uncommon)	No	Small	No	-	-
Peeping UDT (uncommon)	No	Small	Yes (when inside the inguinal canal) No (when inside the abdomen)	No	-
High inguinal UDT (uncommon)	No	Small	Yes	No	-
Low inguinal UDT (common)	No	Small	Yes	Yes	No
Retractile testis (common)	Yes	Good (if in scrotum most of time) Small (if upward most of time)	Yes	Yes	Yes
Ascending testis (uncommon)	Yes	Small	Yes	Yes	No
Ectopic testis (rare)	Yes (near place) No (far place)	Small	No Yes (when palpating possible areas of ectopic testis)	No	-
Vanishing testis (rare)	Yes (if vanished after complete descent) No (if vanished before complete descent)	Small	No	-	-

MANAGEMENT ALGORITHM

Read only



Don't memorize this slide

SURGICAL TREATMENT

	Treatment	Age at intervention
Testicular agenesis	• Diagnostic laparoscopy to confirm Dx	At any age of Dx
Abdominal UDT	• Diagnostic laparoscopy • Primary or staged orchidopexy	At any age of Dx
Peeping UDT	• Lap. or open primary or staged orchidopexy	At any age of Dx
High inguinal UDT	• Observe till 12 months of age for possible further descent • Open primary or staged orchidopexy (if didn't descend completely)	At 12 months of age
Low inguinal UDT (common)	• Wait till 12-18 months of age for possible further descent • Open primary orchidopexy (if didn't descend completely)	At 12-18 months of age

Retractile testis (common)	• Observe till puberty for possible spontaneous resolution (90%)
	• Orchidopexy (10%) if any of the following:
	  • Painful
	  • Not growing
	  • Upward most of the time
	  • Became ascending testis
		At any age when becoming painful, not growing, upward most of time, or ascending

Ascending testis	• Open primary orchidopexy	At any age of Dx
Ectopic testis	• Lap. or open primary or staged orchidopexy	At any age of Dx
Vanishing testis	• Diagnostic laparoscopy +/- inguino-scrotal exploration to confirm Dx	At any age of Dx

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SURGICAL TREATMENT 1–1.5 years old

Benefits of orchidopexy

- reduces the risk of malignancy and infertility
- reduces the risk of torsion
- facilitates testicular examination
- improves endocrine function of the testis
- creates a normal-appearing scrotum

HORMONAL TREATMENT

?? Controversial

- Buserelin (LHRH agonist)
- Low-dose hCG

FERTILITY

- Patients with a history of UDT → subnormal semen analyses

- Infertility rate of men with a history of:
  - unilateral UDT → equivalent to normal population (10%)
  - bilateral UDT → 6 times more

FERTILITY

- Delayed orchiopexy at 3 years versus 9 months resulted in impaired testicular catch-up growth
- Abdominal testes had lower fertility than those with inguinal testes

MALIGNANCY

- UDT appears to be associated with x2-x8 increased risk of malignancy

- Among men with testicular cancer, up to 10% have a history of UDT

MALIGNANCY

- Incidence varies with location:
  - 1% with inguinal testes
  - 5% with abdominal testes (mainly seminomas)

- Malignancies arising after successful orchidopexy (regardless of original location) are most frequently nonseminomatous germ cell tumors

MALIGNANCY

Orchidopexy facilitates subsequent testicular examination and cancer detection

The Acute Scrotum

DEFINITION

Acute scrotal pain

with or without swelling and erythema

DDx

- Torsion of the testis (most serious)
- Torsion of the appendix testis/epididymis (most common)
- Epididymitis/orchitis
- Hernia/hydrocele
- Trauma/sexual abuse
- Tumor
- Idiopathic scrotal edema (dermatitis, insect bite)
- Cellulitis
- Vasculitis (Henoch–Schönlein purpura)

MANAGEMENT

- Most DDx are nonemergent..

however, it's critical to differentiate between them & testicular torsion

- Age at presentation is an important clue
  - prepubertal boys → torsion of the appendix testis/epididymis
  - neonates and adolescents → testicular torsion

not 100% there's exceptions

TESTICULAR TORSION

Twisting of the spermatic cord
→compromises testicular vasculature
→ testicular infarction

TESTICULAR TORSION

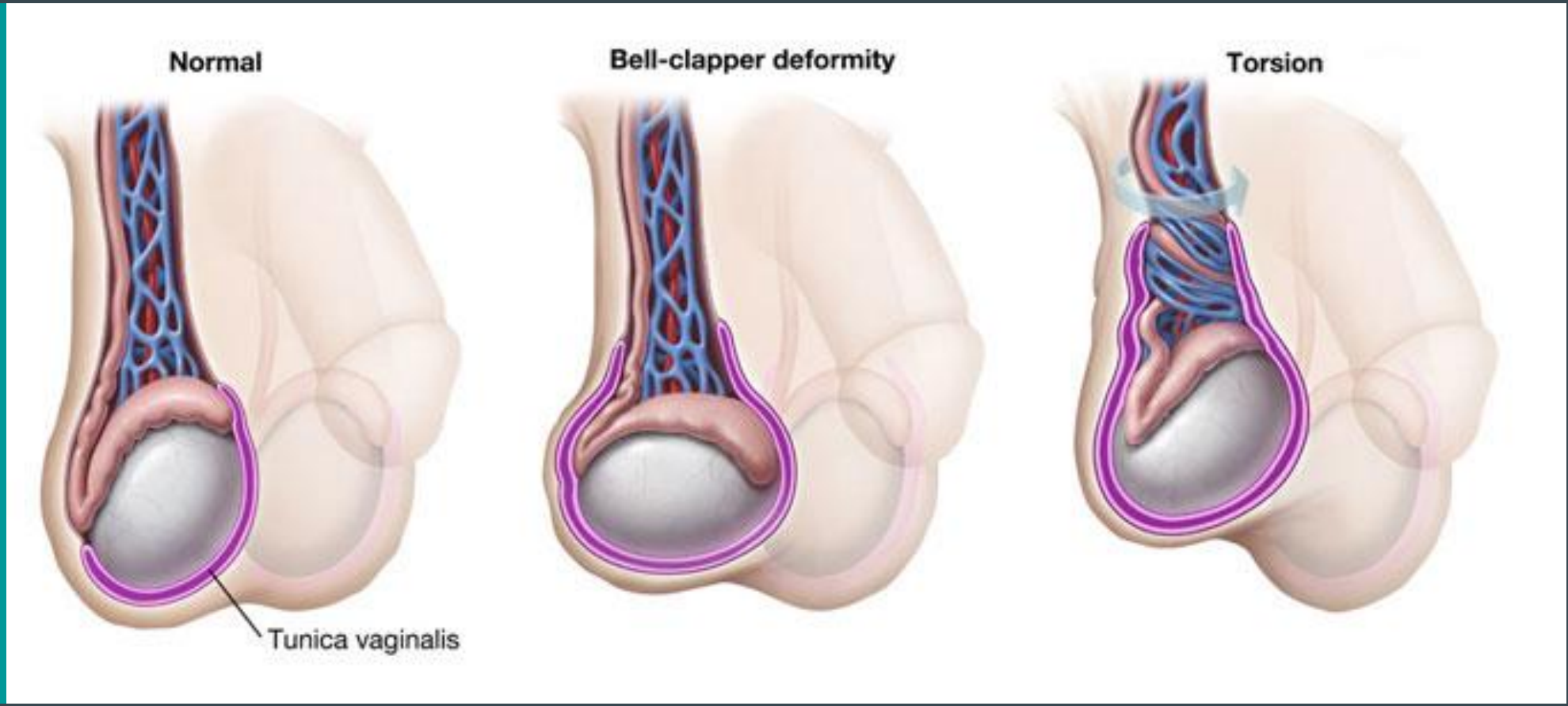
Two types of torsion:

tunica vaginalis

- **intravaginal**
  - more common in children and adolescents
  - spermatic cord twists within the tunica vaginalis
  - 'bell-clapper' deformity

- **extravaginal**
  - occurs perinatally
  - spermatic cord twists proximal to the tunica vaginalis
  - the tunica and testis spin on the vascular pedicle

Intravaginal Torsion



TESTICULAR TORSION

- Prenatal torsion:
  - hard, **nontender** scrotal mass
  - noted at birth
  - discoloration and fixation of the skin to the mass

- Postnatal torsion:
  - acutely inflamed scrotum
  - erythema and **tenderness**
  - scrotum is reported as normal at delivery
  - requires emergent exploration

TESTICULAR TORSION

- typically occurs:
  - before age of 3 years
  - after puberty
- less common in:
  - prepubertal boys
  - after age of 25 years

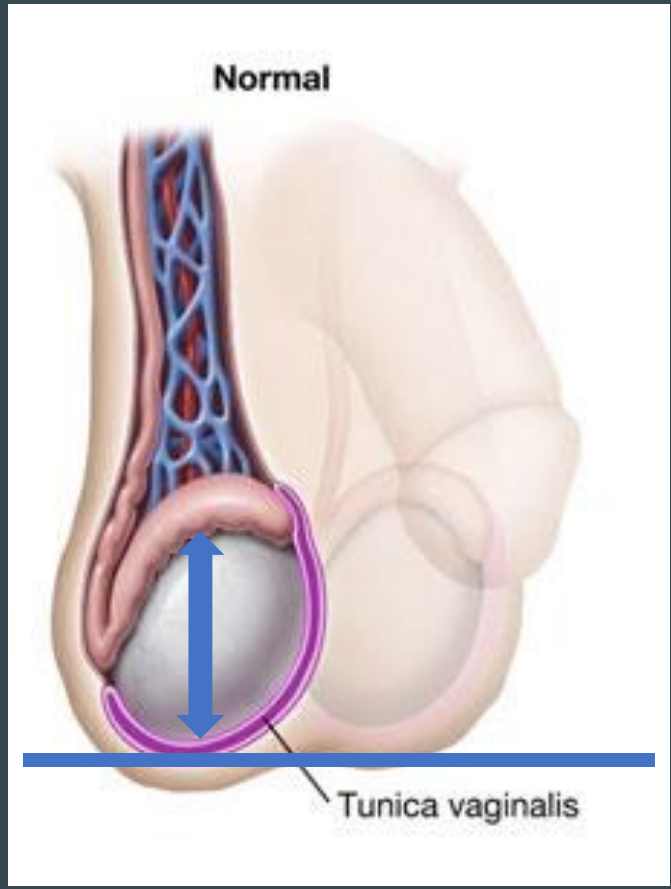
TESTICULAR TORSION

- Presentation:
  - sudden onset of severe, continuous unilateral testicular pain
  - lower thigh, or lower abdominal pain
  - nausea and vomiting

- Intermittent testicular pain → incomplete torsion with spontaneous detorsion

TESTICULAR TORSION

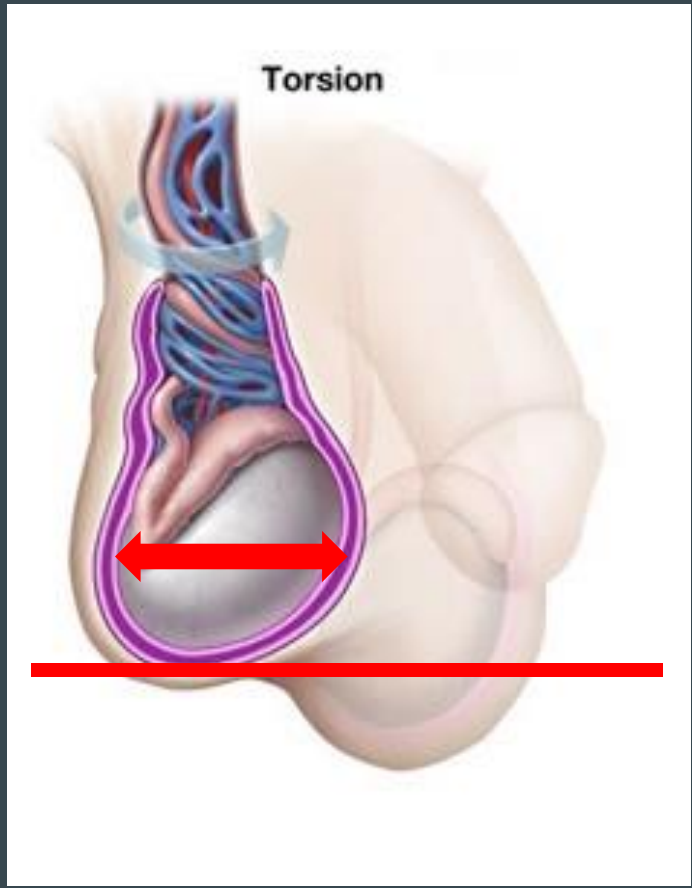
Physical examination of torted testis:



TESTICULAR TORSION

Physical examination of torted testis:

- Enlarged
- Retracted up
- In transverse orientation
- Anteriorly located epididymis
- Severe generalized testicular tenderness
- Scrotal swelling and erythema
- Absent cremasteric reflex



TESTICULAR TORSION

- Labs:
  - Urinalysis revealing pyuria and bacteriuria → infectious epididymitis/orchitis (does not r/o torsion)

- Imaging:
  - US with color flow Doppler
  - Radionuclide imaging
  - can detect testicular blood flow +/- coiling of the spermatic cord

TESTICULAR TORSION

Surgical Treatment

- **Emergent exploration:**
  - Under GA
  - Detorsion
  - Placement in warm moist sponges
  - Fixation (orchidopexy)

- If the testis is clearly nonviable, it should be removed to avoid potential damage to the contralateral testis from the formation of antisperm antibodies

TESTICULAR TORSION

Duration of Torsion and Testicular Salvage Rates

Duration of Torsion (Hours)	Testicular Salvage (%)
<6	85–97
6–12	55–85
12–24	20–80
>24	<10

Torsion of Testicular Appendages

- Torsion of the *appendix testis* or *appendix epididymis* is the most common cause of an acute scrotum

- Most commonly between ages 7 and 10 years

(? prepubertal hormonal boost)

Torsion of Testicular Appendages

- Presentation:
  - sudden onset of pain and nausea
  - normal urinalysis
  - appendage can be palpated & **focally tender**
  - '**blue dot**' sign (ischemic appendage seen through the scrotal skin as a blue-colored mass)
  - edema and erythema

- Self-limited
- Rx: NSAIDs, restricted activity, and warm compresses

Epididymitis

- Bacterial epididymitis (rare in children)
  - Scrotal pain and swelling typically have a **slow onset**, worsening over days
  - PEx: induration, swelling, and tenderness of the hemiscrotum
  - A positive urinalysis and culture suggest the diagnosis
    - *Neisseria gonorrhoeae* and *Chlamydia* → found in sexually active boys
    - Common urinary pathogens (*coliforms* and *Mycoplasma sp.*) → in younger children
  - **Rx: antibiotic therapy**

Epididymitis

- Viral epididymitis
  - Mumps orchitis (rare)
  - Adenovirus, enterovirus, influenza, and parainfluenza virus infections
  - **Rx: supportive (self-limited)**

Idiopathic Scrotal Edema

- Scrotal swelling of unknown etiology | Boys 5 to 9 years of age

- The syndrome is characterized by:
  - **Insidious onset** of swelling and erythema
  - begins in the perineum or inguinal region, and spreads to the hemiscrotum
  - **Pruritus**
  - Testis is **not tender**
  - Normal testicular blood flow on US

- DDx:
  - Contact dermatitis
  - Insect bites
  - Minor trauma
  - Cellulitis from an adjacent infection (Rx: Antibiotics)

- **Rx: anti-histamines or topical corticosteroids**

Idiopathic Scrotal Edema

Henoch–Schönlein Purpura (HSP)

- A vasculitis syndrome that can involve the skin, joints, GI and GU systems

- S&S:
  - scrotal & spermatic cord pain, erythema, and swelling
  - skin purpura, joint pain, and hematuria

- Doppler US: normal blood flow to the testis

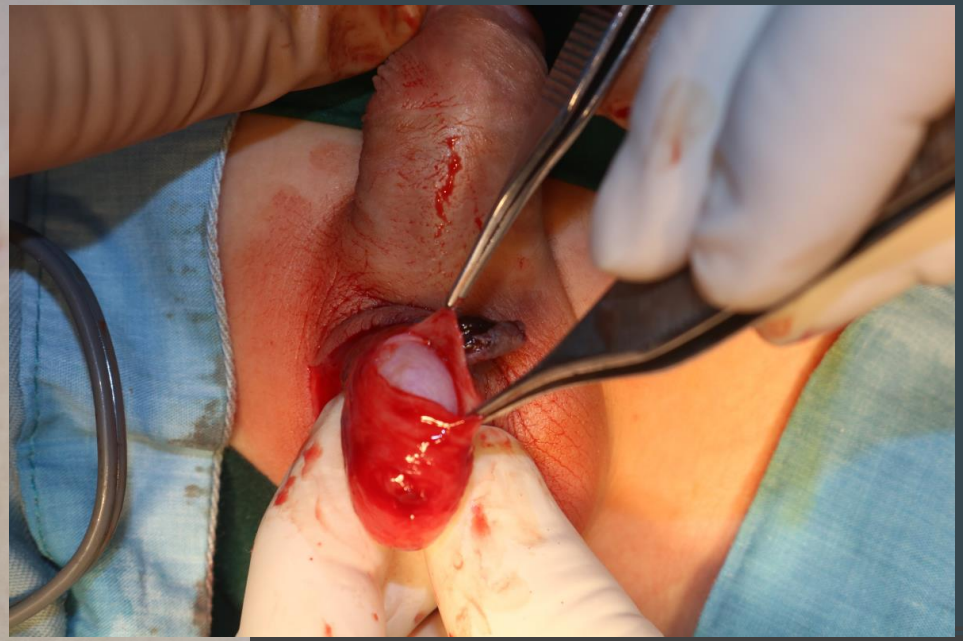
- **Rx: supportive measures | systemic corticosteroids**

TESTICULAR TRAUMA

- Rare

- Dx:
  - History (check for sexual abuse)
  - PEx:
    - injured testis is swollen and tender
    - swelling and bruising of the scrotum
  - US: evaluate for rupture of the tunica albuginea

- Rx: exploration +/- repair of the ruptured tunica albuginea



TESTICULAR TRAUMA

These slides are available on..

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