SCROTUM

1

Objectives:

Upon completion of this presentation, students will be able to:

- Understand the embryology and normal scrotal anatomy.
- Explain the vascular supply to the scrotum.
- Discuss functions and indications for a scrotal ultrasound.
- Describe patient preparation, positioning, technical considerations, and scanning protocol of a scrotal ultrasound.
- Discuss the importance of color and spectral Doppler in scrotal imaging.
- Identify characteristics of scrotal pathology.

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ANATOMY

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EMBRYOLOGY

- About 9 weeks of development, the labioscrotal swellings fuse to form the scrotum.
- Testosterone (produced by Leydig cells) also induces development of the mesonephric (Wolfian) duct to form the epididymis, vas deferens and seminal vesicles.
- At week 12, testes moves from the genital ridge, across the pelvis, and into a cavity, which becomes the inguinal canals.
- Around 36 weeks, the gubernaculum directs the testes through the inguinal canals, into the scrotal sac, and anchors the testes externally from the pelvic cavity.

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Anatomy of the scrotum includes:

- Spermatic cord (Bilateral – suspends testes in the scrotum)
- Vas Deferens or Seminal Duct
- Epididymis (Head, Body, and Tail)

  -Functions as a storage, transport, and maturation place sperm
- Testes

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ANATOMY

LAYERS:

- Tunica Albuginea- dense fibrous tissue surrounding testes
  - Forms mediastinum testis
- Tunica Vaginalis- lines inner wall of scrotum
  - Parietal- outer layer
  - Visceral- inner layer

  *Hydroceles occur between parietal and visceral

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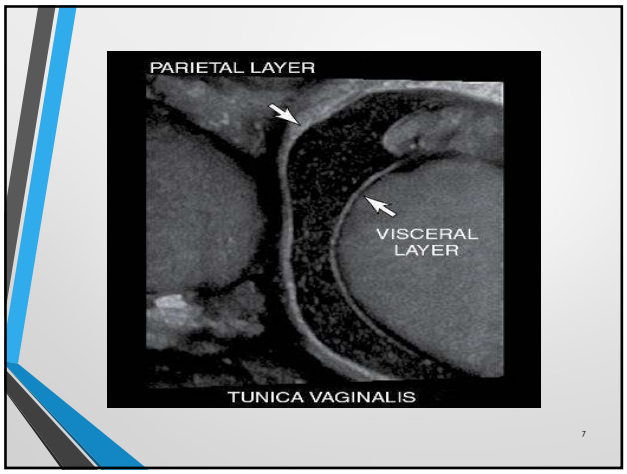
PARIETAL LAYER
VISCERAL LAYER
TUNICA VAGINALIS
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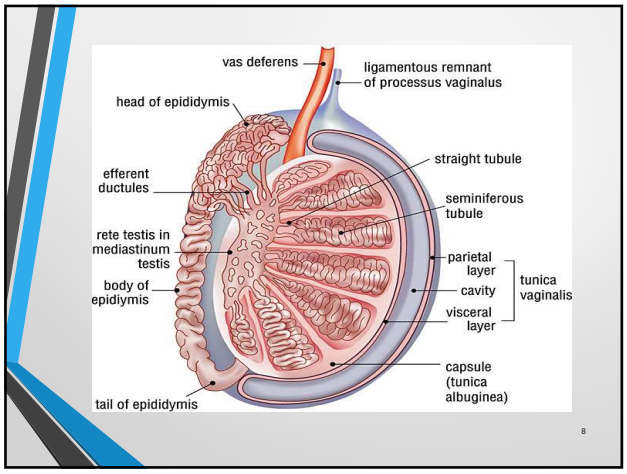
vas deferens
ligamentous remnant of processus vaginalus
head of epididymis
straight tubule
efferent ductules
seminiferous tubule
rete testis in mediastinum testis
parietal layer
tunica vaginalis
body of epidiymis
cavity
visceral layer
capsule (tunica albuginea)
tail of epididymis
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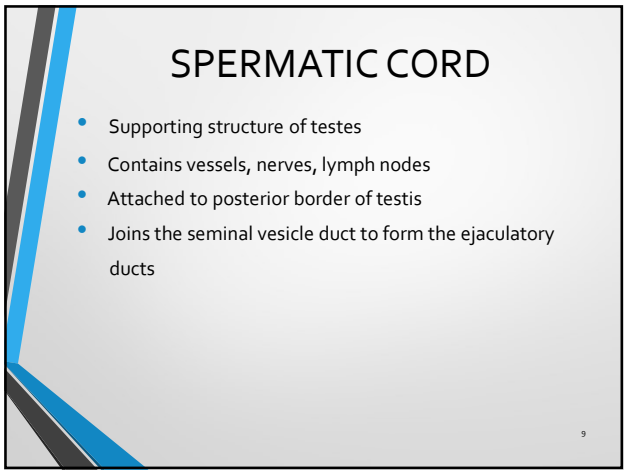
SPERMATIC CORD
Supporting structure of testes
Contains vessels, nerves, lymph nodes
Attached to posterior border of testis
Joins the seminal vesicle duct to form the ejaculatory ducts
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VAS DEFERENS/SEMINAL DUCT

- Muscular cord designed to pump sperm from the epididymis into the prostatic segment of the urethra
- Ascends along the posterior border of the testis
- Attaches to seminal vesicles to form ejaculatory ducts
- Stores sperm for up to several months
- Seminal vesicles produces fluid rich in fructose

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EPIDIDYMIS

- Stores sperm that is produced in the testicles
- Sonographic Appearance:
  - Varied appearance -triangular,crescent, or teardrop shape
  - Normally homogeneous
  - Color flow demonstrates very slight flow or no flow

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EPIDIDYMIS (cont'd)

- Head- Normally always seen (Superior to testicle)
- Body- Not always seen well
- Tail- Not always seen well

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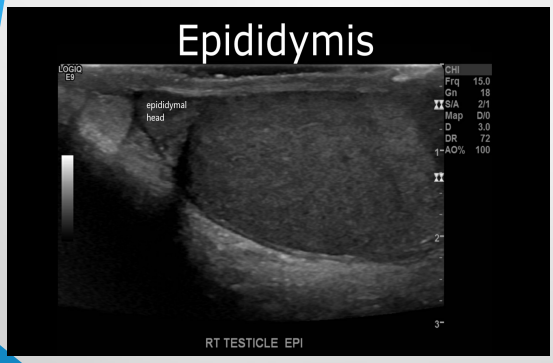
Epididymis



https://sonographictendencies.com/2021/03/23/testicular-scrotal-doppler-protocol/

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TESTICLES

- Bilateral ovoid glands located in the scrotum
- Homogeneous texture (similar to liver and thyroid)
- Medium level echogenicity
- Responsible for the production of sperm (matures from the basal layer of spermatic tubules, to inner layer, then extruded)

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SIZE

- 3-4 cm in length
- 3 cm in AP
- 2-3 cm width

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FUNCTION

- Creation of sperm, which drains into the epididymis
- Secretion of hormones (testosterone)

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MEDIASTINUM TESTIS

- Formed by tunica albuginea
- Functions as a supporting system for arteries, veins, and lymphatics
- Echogenic line within the testes (hilum)

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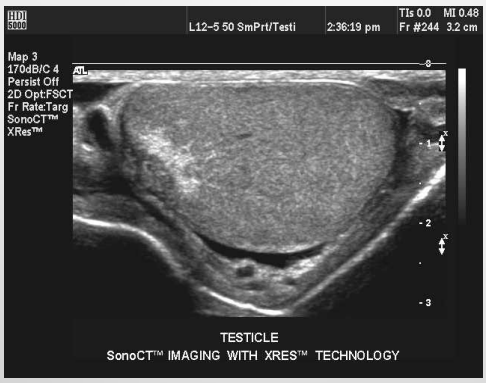

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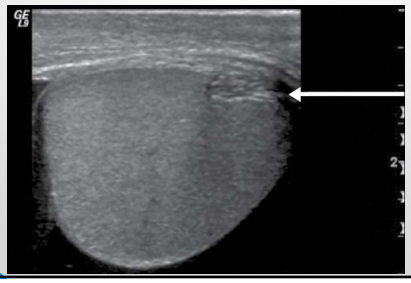
RETE TESTE

- Anastomosis of tubules/lobules at mediastinum teste



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APPENDIX TESTIS

- Hydatid of Morgagni
- Superior aspect of testicle beneath the epididymal head
- Isoechoic to testicle, homogenous
- Remanent of Müllerian duct

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ANATOMICAL VARIANTS

- Cryptorchidism (Undescended testicle)
  - Testicles or testis does not descent to normal position
  - May be located in lower abdomen or inguinal canal
  - Can be congenital anomaly
  - May lead to infertility (sperm exposed to abnormally high temperatures)
  - Increased risk of cancer (48 times > normal potential)
  - Increased risk for torsion (after puberty – testis larger than mesentery)
  - If brought down into the scrotum by age 6, decreases chances of sterility
- Retractile testicle- testicle moves freely from scrotal sac back into inguinal canal
- Polyorchidism
- Unilateral testis

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RETRACTILE TESTIS

- https://youtu.be/PJGdE3wgMx4?si=SkA3XN4HRBrHZS45

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VASCULAR SUPPLY

- Testicular arteries- (rt/lt) arise from the aorta just below level of renal arteries
- Capsular arteries give rise to centripetal arteries, which course from testicular surface toward mediastinum along septa.
- Before reaching the mediastinum, they curve backward forming recurrent rami (centrifugal arteries).
- Branch further into arterioles and capillaries.
- Venous drainage occurs through the pampiniform plexus which ascends as the testicular veins through the inguinal canal.
- The right testicular vein directly drains into the IVC while the left testicular vein drains into the left renal vein.

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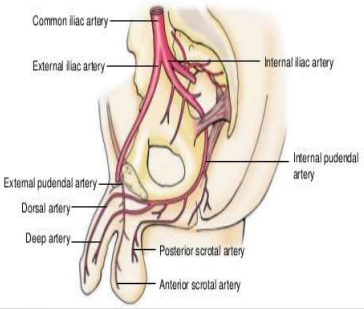
BLOOD SUPPLY OF THE PENIS AND SCROTUM



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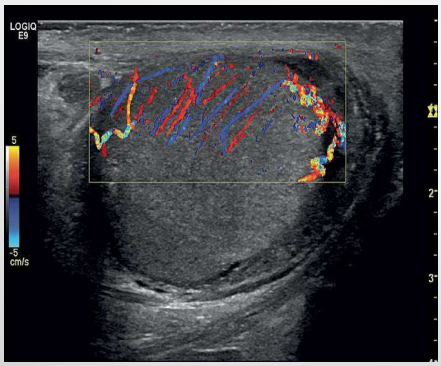

The centripetal artery is seen coursing from the testicular capsule.

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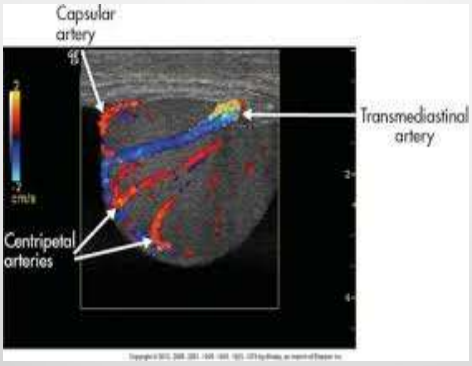

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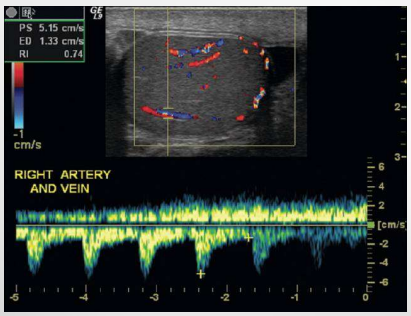

Spectral Doppler showing the normal low resistance pattern of the intratesticular arteries.

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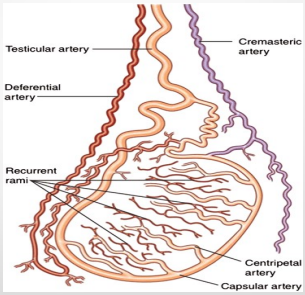
TESTICULAR ARTERIAL BRANCHING

- Testicular artery
- Capsular artery
- Centripetal artery
- Recurrent rami



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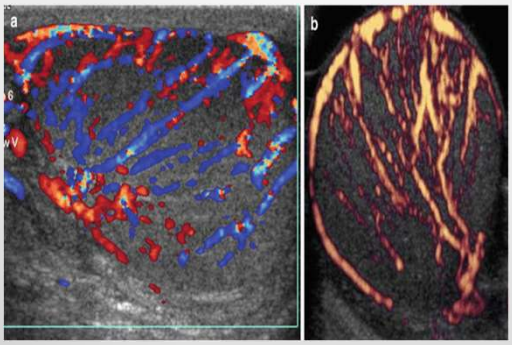

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COMPARATIVE BLOOD FLOW

- Doppler (color/spectral) evaluation should start from the asymptomatic hemiscrotum to adjust Doppler settings and then to assess symmetrical vascularity by comparing flow findings with the pathological side.
- Comparative evaluation acquires crucial importance in case of testicular torsion or acute inflammation.

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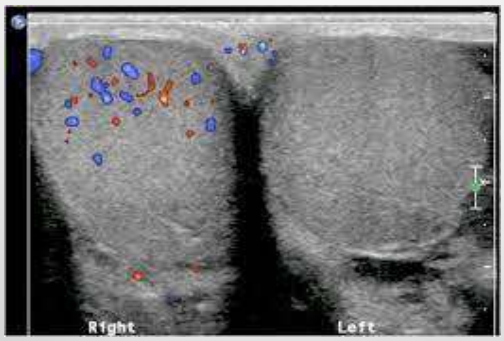

https://aliemcards.com/cards/testicular-ultrasound/

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INDICATIONS FOR A SCROTAL ULTRASOUND

- Pain
- Enlargement
- Palpable mass
- Undescended testis
- F/U from orchiectomy
- Trauma
- Infertility

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ROLE OF ULTRASOUND

- Detect masses
- Characterize masses (cystic, solid, mixed) (size & location)
- Determine blood flow (normal, absent, or increased)

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PATIENT POSITION/PREPARATION

- Supine
- Scrotum is supported on either a rolled towel or use a towel as a drape across the legs.
- The penis is lifted onto the abdomen and covered with a towel

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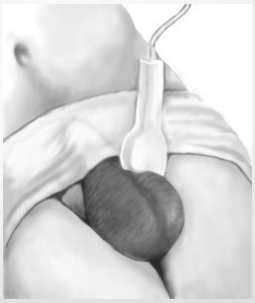

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TRANSDUCER

- Select highest-frequency transducer available
- 15 MHZ if available
- 7.5 MHZ or higher

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PROTOCOL

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SCAN PLANE- LONGITUDINAL

- Scan through the entire testicle (lateral to medial)
- Take images at each level (lat, mid, med)
- Measure in mid-sagittal longest axis
- Image epididymis-head (measure in longest axis), body, and tail (if visualized)

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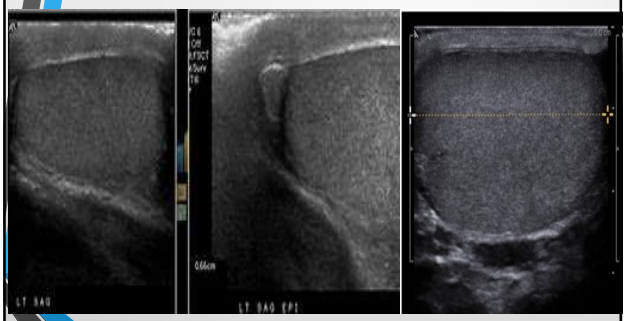
SAGITTAL



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SCAN PLANE-TRANSVERSE

- Scan through the entire testicle (superior to inferior)
- Take images at each level
- Measure mid portion (AP and trans)
- Epididymis- head (measure AP and transverse)
- Transverse view showing both testes
- Color Doppler of epididymal head
- Color Doppler of mid testis
- Spectral Doppler of artery
- Spectral Doppler of vein

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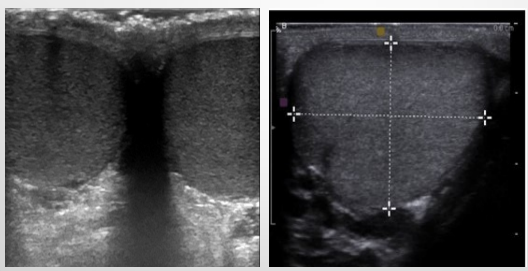
TRANSVERSE



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RAPHE (RA'FE)

- Fibrous band of tissue
- Divides the scrotal sac into two compartments
- SHOULD INCLUDE THIS IMAGE WHEN SCANNING

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PATHOLOGY

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ACUTE SCROTUM

- Scrotal trauma may be challenging because scrotum often painful and swollen
- Trauma may be result of MVA, athletic injury, direct blow to scrotum, or straddle injury
- Determine if rupture present

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ACUTE SCROTUM (CONT'D)

- If surgery performed within 72 hours following injury, up to 90% of testes can be saved, but only 45% can be saved after 72 hours
- Hydrocele and hematocele are both complications of trauma
- Hematoceles contain blood; found in advanced cases of epididymitis or orchitis

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ACUTE SCROTUM (CONT'D)

Sonographic findings associated with scrotal rupture:

- Focal alteration of testicular parenchymal pattern
- Interruption of tunica albuginea
- Irregular testicular contour
- Scrotal wall thickening
- Hematocele

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ACUTE SCROTUM (CONT'D)

- Hematomas associated with trauma may be large and cause displacement of the associated testis
- Hematomas appear as heterogeneous areas within scrotum
- Become more complex with time, developing cystic components
- Hematomas may involve testis or epididymis, or they can be contained within scrotal wall

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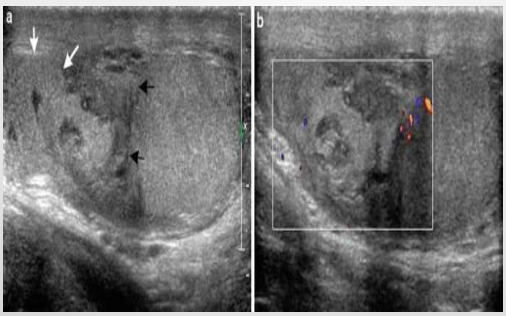
HEMATOMA



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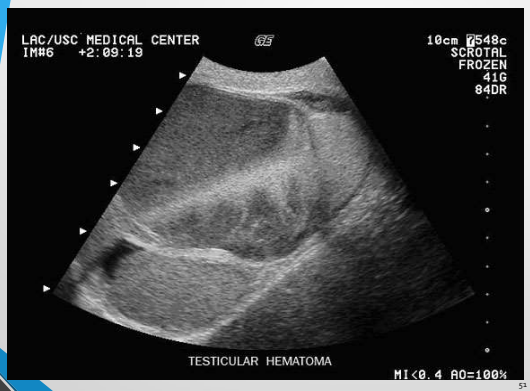

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RUPTURE

- Torn by trauma
- Rare
- Associated with athletic injuries and car accidents
- Surgical treatment within 72 hours to save testicle

Sonographic Appearance:

- Hematoma – mixed Echogenicity
- Can be cystic early then become complex

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EPIDIDYMITIS

- Inflammation of epididymis

*Most common of inflammatory process in the scrotum

*Most common cause of acute scrotal pain in adults

- Spreads to testis in 20-40% of cases (epididymo-orchitis)
- Caused commonly from bacterial infections arising from the spread of organisms from a lower urinary tract infection via spermatic cord (especially prostatitis)
- May cause abscess formation with pain, swelling, and fever

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EPIDIDYMITIS (CONT'D)

- Less frequently caused by trauma
- Frequently seen in the head but can move to body and tail and testis
- Treatable with antibiotics
- Normal epididymis shows little flow with color Doppler
- Amount of color flow signal should be compared between sides
- Affected side shows significantly more flow than asymptomatic epididymis (hyperemic flow)
- Important to use same color Doppler settings when comparing amount of flow between sides

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EPIDIDYMITIS (CONT'D)

- Clinical findings:
  - Fever
  - Pain
  - Dysuria
  - Urethral discharge

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EPIDIDYMITIS (CONT'D)

- Sonographic findings:
  - Enlarged epididymis, usually head
  - Thickened scrotal skin
  - Decreased echogenicity with coarse echotexture
  - Hyperemic
  - May have hydrocele

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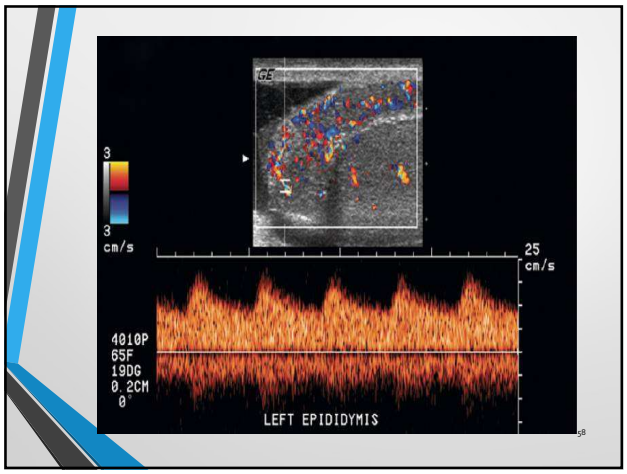
GE
3
3
cm/s
25
cm/s
4010P
65F
19DG
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0°
LEFT EPIDIDYMIS

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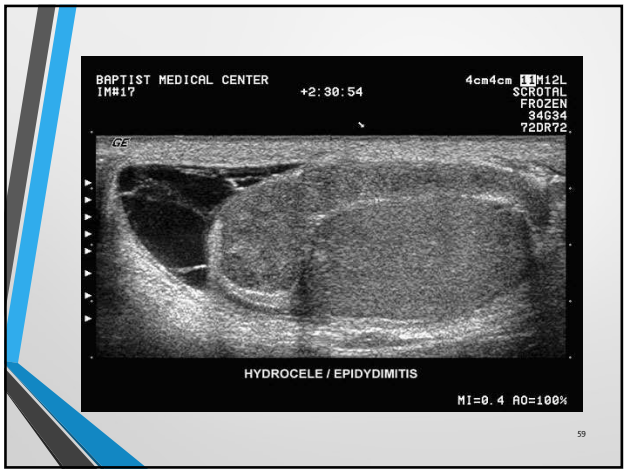
BAPTIST MEDICAL CENTER
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M12L
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Mallinckrodt Radiology
L12-5 50 SmPrt/Testi
11:25:52 am
TIs 0.1
MI 0.55
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3.9 cm
Map 3
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SonoCT™
XRES™
ATL
EPIDIDYMITIS
SonoCT™ IMAGING WITH XRES™ TECHNOLOGY

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TORSION

- Results when the testis and epididymis twists within the scrotum, cutting off vascular supply within the spermatic cord
- Bell-clapper deformity is most common cause of torsion
  - Occurs when tunica vaginalis completely surrounds testis, epididymis, distal spermatic cord, allowing them to move and rotate freely within scrotum
  - Up to 60% of torsion patients have anatomic anomaly on both sides
- Undescended testes are 10 times more likely than normal testes to be affected by torsion.

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TORSION (CONT'D)

- Surgical emergency – arterial flow is occluded, need to restore blood flow to prevent loss of the testicle
- Three phases:
  - Acute – within 24 hours
  - Sub acute – 24 hours to 10 days
  - Chronic – more than 10 days

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TORSION (CONT'D)

Symptoms:

- Sudden onset of severe pain (usually begins when patient is asleep or at rest)
- Nausea and vomiting (50% of the time)
- May have swelling of affected side
- Can occur at any age- peak age is 14

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SONOGRAPHIC APPEARANCE

- Acute
  - Varied and nonspecific
  - ABSENCE of color flow
  - Enlarged testicle and epididymal head with decreased echogenicity
  - Twisting or looping of arteries in spermatic cord in inguinal canal
- Sub acute
  - Enlarged with varying echogenicity
- Chronic
  - Becomes small and hypoechoic
  - Scrotal wall thickening and possible hydrocele
  - No arterial flow
  - Increased flow in peritesticular soft tissues

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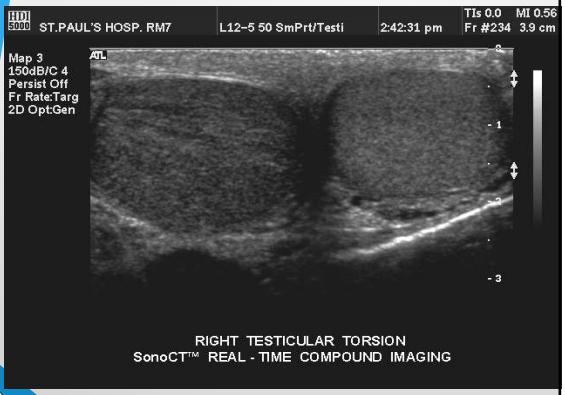

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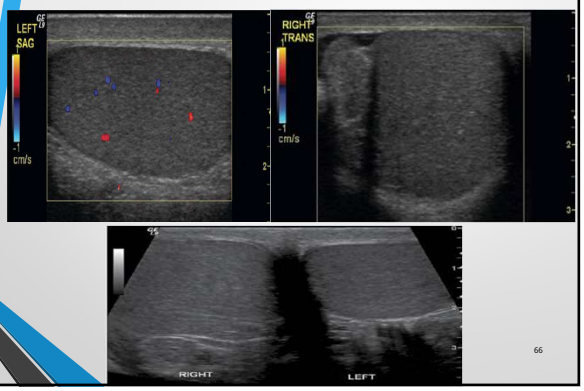
Pt presents with sever right testicular pain and N&V since early morning.



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INTERMITTENT TORSION

- Mobile testis with bell-clapper deformity with recurrent acute scrotal pain and rapid spontaneous resolution
- Sonographic findings:
  - Acute- similar to torsion
  - After acute- nonspecific, with hydrocele most common

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PARTIAL TORSION

- Sonographic findings:
  - May show increased blood flow due to reactive hyperemia
  - Make comparison to contralateral side

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POST-VASECTOMY

- Enlargement of the epididymis can occur
- Cysts can develop in the epididymis
- Inhomogeneous echo pattern can be seen
- These appearances can mimic epididymitis
- Remember!!! post-vasectomy – slight or no flow

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TESTICULAR ATROPHY

- Small testicle
- Caused by infertility or a symptom of a pituitary tumor (tumor may stop testicle-stimulating hormones)
- Other causes:
  - testicular torsion
  - trauma

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EXTRATESTICULAR MASSES

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EPIDIDYMAL CYST

- Contains serous fluid
- Similar in appearance to spermatocele
- Usually seen in the head
- Single or multiple
- Often seen following vasectomy

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EPIDIDYMAL CYST (CONT'D)

- Sonographic Appearance:
  - Anechoic – no echoes
  - Smooth walled with posterior enhancement

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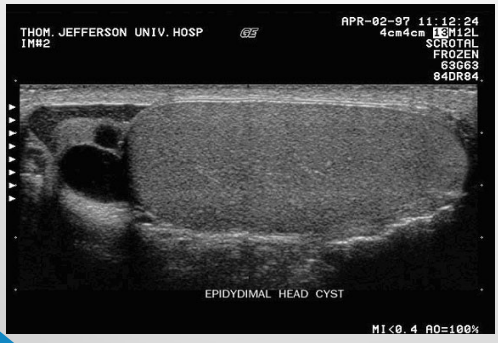

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SPERMATOCELE

- Retention cyst of small tubules that contain sperm
- Occurs following vasectomy, surgery, or epididymitis
- Most common location – head of epididymis
- May displace the testicle anterior whereas a hydrocele surrounds testicle

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SPERMATOCELE (CONT'D)

Symptoms:

- Scrotal mass (enlargement) – usually painless

Sonographic Appearance:

- Cystic mass that displaces testicle anteriorly
- May have septations, debris
- Unilateral or bilateral
- Unilocular or multilocular
- No Color flow will be seen

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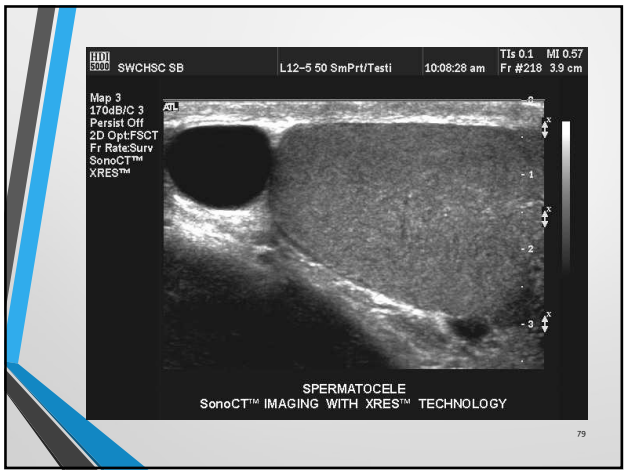

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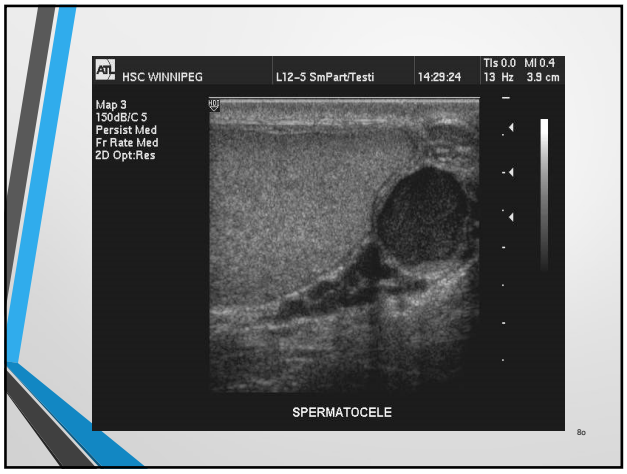

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VARICOCELE

- Dilatation of veins of pampiniform plexus (within spermatic cord)
- 2 Types:
  - Primary – idiopathic and occurs between 15-25 year old due to incompetent valves in the spermatic veins
  - Secondary – may result from elevated pressure in spermatic vein produced by tumor, hydronephrosis, or muscle strain

*Most common cause of infertility in men

- Majority occur on left side due to venous drainage into left renal vein
- Large, right-sided varicocele may be due to renal or retroperitoneal tumor

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VARICOCELE (CONT'D)

Symptoms:

- Scrotal mass
- Infertility
- Abnormally warm scrotum (due to increased blood flow)

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VARICOCELE (CONT'D)

Sonographic Appearance:

- Prominent veins
- Usually left side
- Varices – enlarged, tubular anechoic structures
- Color flow in prominent veins
- Valsalva maneuver or having patient stand will make them dilate by increasing venous pressure, reversal of flow occurs when intra-abdominal pressure increases

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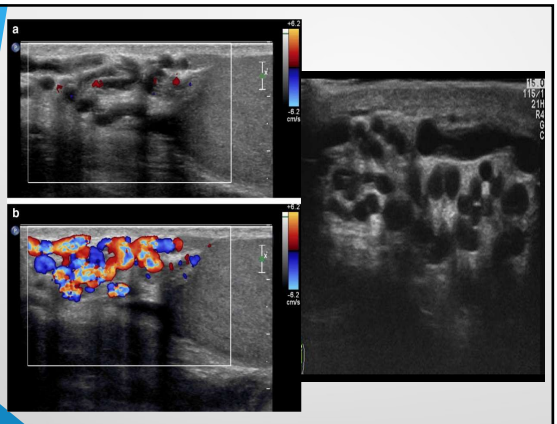

https://link.springer.com/article/10.1007/s00330-019-06280-y

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HYDROCELE

- Abnormal accumulation of fluid in scrotum (tunica vaginalis)

* Most common fluid collection in scrotum

- Common to see a small amount of fluid surrounding the upper pole and epididymal head (physiologic)
- Most common in newborns (congenital hydrocele) because the area of scrotum to peritoneum is still open
- Often idiopathic
- Often due to epididymitis
- Can also be seen with orchitis, spermatic cord torsion, and trauma

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HYDROCELE (CONT'D)

Symptoms:

- Scrotal mass (enlargement) – may or may not be painful

Sonographic Appearance:

- Fluid collection around testicle
- Unilateral or bilateral
- Variable size
- Some can contain septations resulting from old hemorrhage or infection
- Chronic hydroceles can compress testicle, causing atrophy
- No Color flow seen

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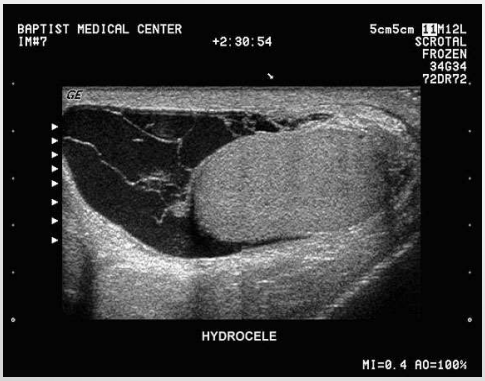

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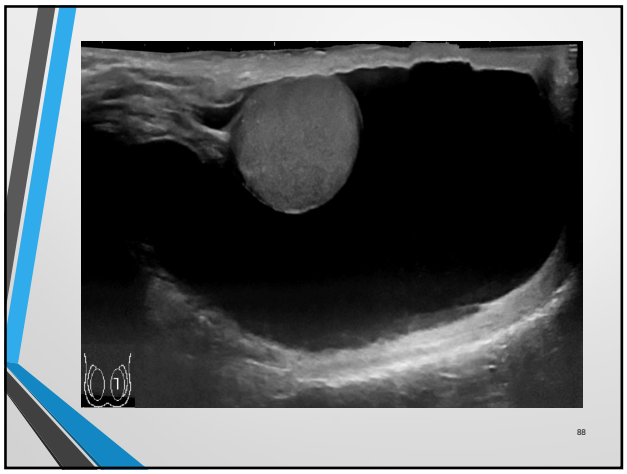

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PYOCELE/HEMATOCELE

- Pyocele is a collection of pus
- Occur with untreated infection or when an abscess ruptures into space between layers of tunica vaginalis, usually with epididymitis -orchitis
- Hematoceles are collections of blood associated with trauma, surgery, neoplasms, or torsion

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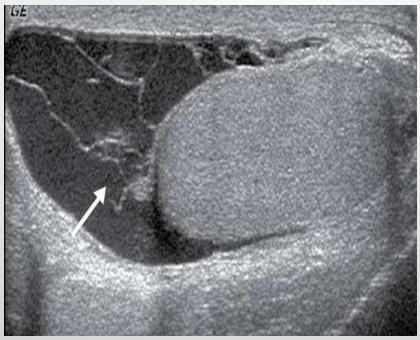
PYOCELE



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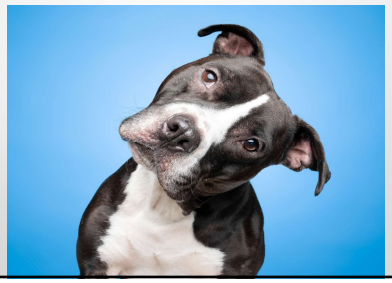
CASE REVIEWS

- https://youtu.be/AS8v2YFQ67E?si=AYVvYz2JGDuyoWcn



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SCROTAL HERNIA

- Inguinal hernias that descend into the scrotum

Symptoms:

- Persistent or intermittent scrotal mass
- Abdominal pain
- May have blood in stool

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SCROTAL HERNIA (CONT'D)

Sonographic Appearance:

- Echogenic and anechoic areas representing air and fluid filled loops of bowel, which can be traced to the inguinal canal

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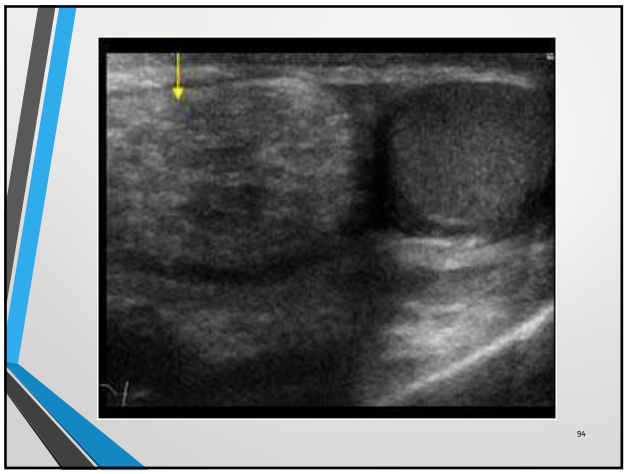

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ADENOMATOID TUMOR

- Most common extratesticular tumor (30%)
- Usually an incidental finding or slow-growing mass
- Small in size (rarely exceeds 2cm)
- Usually ages 20-50 yrs
- Sonographic Appearance:
  - Usually hyperechoic and homogeneous
  - Unilateral (lt > rt)

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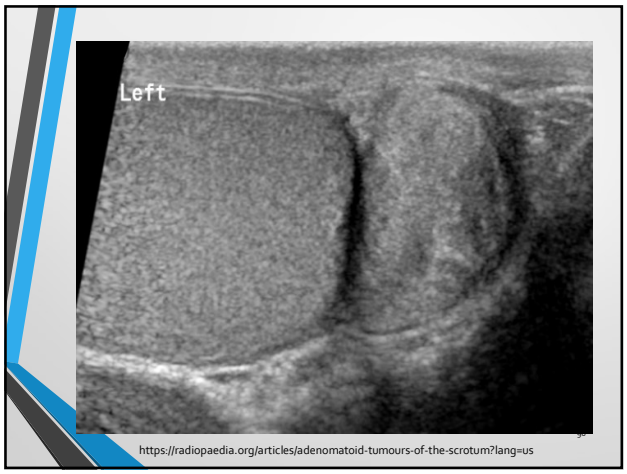

https://radiopaedia.org/articles/adenomatoid-tumours-of-the-scrotum?lang=us

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SPERM GRANULOMA

- Occur as chronic inflammatory reaction to extravasation of spermatozoa
- Most frequently seen in patients with history of vasectomy
- May be located anywhere within epididymis or vas deferens

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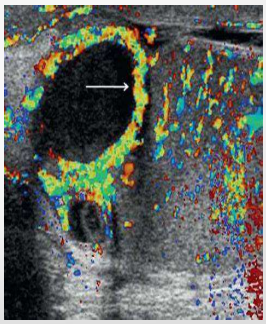

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BENIGN TESTICULAR MASSES

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TUBULAR ECTASIA OF THE RETE TESTIS

- Uncommon, benign condition
- Usually age 45 and up
- Associated with presence of a spermatocele, epididymal, or testicular cyst, or other epididymal obstruction on same side as dilated tubules

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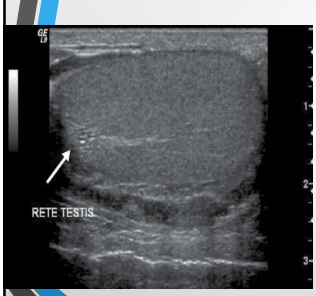
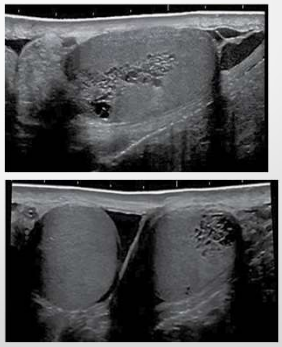
TUBULAR ECTASIA OF THE RETE TESTIS





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CYST

- Intratesticular or epidermoid
- Epidermoid cyst
  - non-vascular, well-marginated intratesticular mass
  - may demonstrate a characteristic lamellated "onion skin" or "whorled" appearance with alternating hyperechoic and hypoechoic rings
  - some lesions may show a target appearance with a halo of hypoechogenicity and a central hyperechoic region
- More common in men over 40
- Associated with extratesticular spermatoceles
- Located near mediastinum
- Single or multiple and of variable size

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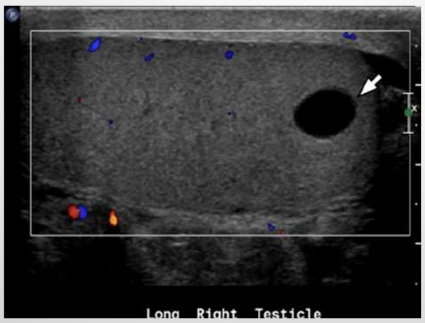
CYST



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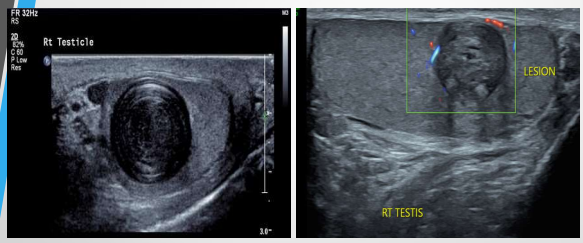
EPIDERMOID CYST



https://radiopaedia.org/articles/testicular-epidermoid-cyst?lang=us

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MICROLITHIASIS

- Multiple tiny calcifications throughout the testes (<3mm)
- Usually bilateral
- Seen in normal patients
- Associated with:
  -malignancy
  -cryptorchidism
  -Klinefelter syndrome
  -infertility
  -varicoceles
  -testicular atrophy
  -pseudohermaphroditism
- Sonographic Appearance:
  - Multiple echogenic non-shadowing areas throughout the testis, may obscure other pathologic conditions

105

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BAPTIST MED CTR
IM#8
+1:30:32
3cm3cm L3M12L
SCROTAL
FROZEN
44G44
78DR78
GE
MI=0.4 AO=100%

106


SWCHSC SB
L12-5 50 SmPrt/Testi
3:39:56 pm
TIs 0.0 MI 0.49
Fr #161 3.0 cm
Map 3
170dB/C 4
Persist Off
2D Opt:FSCT
Fr Rate:Surv
SonoCT™
XRes™
TESTICULAR MICROLITHIASIS
SonoCT™ IMAGING WITH XRES™ TECHNOLOGY

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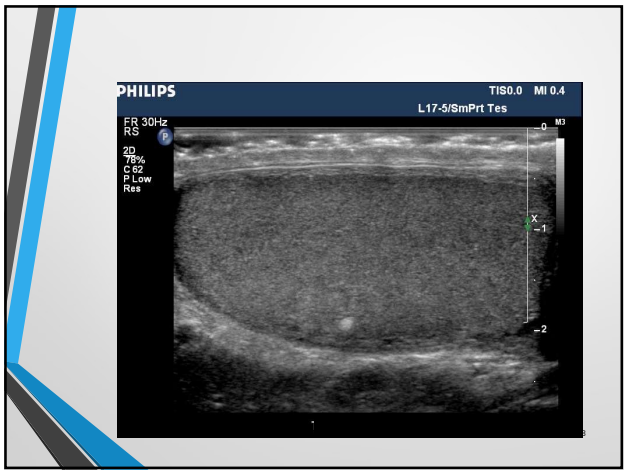
PHILIPS
TIS0.0 MI 0.4
L17-5/SmPrt Tes
FR 30Hz
RS
2D
78%
C 62
P Low
Res

108

ABSCESS

- Most commonly caused by untreated epididymo-orchitis
- Usually extra-testicular
- Clinical findings:
  - Fever
  - Scrotal pain
  - Swelling
- Sonographic Appearance:
  - Anechoic or complex mass
  - Increased blood flow around periphery of mass
  - No flow within mass

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NON-GERM CELL TUMORS

- Usually benign
- Types:
  - Leydig cell tumor
  - Sertoli tumor
  - Cystadenoma
  - Dermoid cyst

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MALIGNANT NEOPLASMS

- 95% of testicular tumors are germ cell type and highly malignant
- Usually painless- may have unilateral enlargement
- Types:
  - Seminoma
  - Embryonal Cell Carcinoma
  - Teratoma
  - Choriocarcinoma
  - Lymphoma and Leukemia
  - Metastases

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SEMINOMA

- Most common – 40-50 %
- Occur in men between 30-40 years old
- Most common to arise from undescended teste
- Almost always unilateral

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SEMINOMA (CONT'D)

- Symptoms:
- Gradual enlargement usually of 1 testicle
- Small percentage experience pain

Sonographic Appearance:

- Hypoechoic mass possibly with hyperechoic areas
- Echogenic band surrounding the mass (pseudocapsule)
- Hypervascular – increase of blood flow compared to teste

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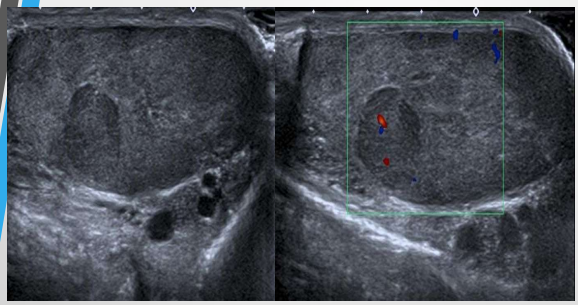

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EMBRYONAL CELL CARCINOMA

- Second most common – 25%
- Occurs in men between 25-35 years old

**Most Aggressive

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EMBRYONAL CELL CARCINOMA (CONT'D)

Sonographic Appearance:

- Hypoechoic mass (less homogeneous than seminoma)
- Focal or diffuse with indistinct borders and possible capsular distortion
- Can have varying degrees of echogenicity

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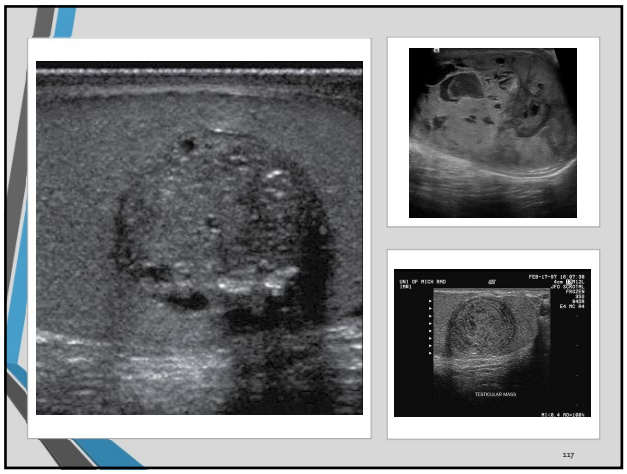

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TERATOMA

- Account for 5-10%
- Occurs in men between 25-35 years old
- More common in infants and children
- Contain multiple tissue elements – bone, soft tissue, skin

Sonographic Appearance:

- Mixed echogenicity reflecting various tissue elements

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CHORIOCARCINOMA

- Rare – Less than 3%
- Occurs in men between 20-30 years old
- No palpable mass
- All patients have elevated levels of hCG (human chorionic gonadotropin)

  -Not always a good indicator – other testicular neoplasms elevate hCG)

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CHORIOCARCINOMA (CONT'D)

- HCG – increased pituitary secretion of FSH (follicle-stimulating hormone) or production of gonadotropin by tumors can raise levels in the blood.

Sonographic Appearance:

- May be small with mixed echogenicity
- Appearance determined by the dominant cell type but typically has irregular boarders

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STROMAL SEX-CELL TUMORS

- Rare (4%)
- Types:
  - Leydig cell
  - Sertoli
  - Granulosa (theca cell)

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MIXED GERM CELL TUMORS

- Second most common tumor after seminoma
- Rare

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LYMPHOMA & LEUKEMIA

- Accounts for 5%
- Most commonly occurs in men over 60 years old
- 50% are bilateral

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LYMPHOMA & LEUKEMIA (CONT'D)

Sonographic Appearance:

- Nonspecific can have diffuse or focal hypoechogenicity
- Enlargement of testis with uniform decreased echogenicity
- Diffuse inhomogeneous
- Hypervascular – increase of blood flow compared to teste

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METASTASES

- Rare
- Occurs in men over 50 years old
- Primary site – prostate and kidney
- Less frequent sites – bowel, bladder, lungs, pancreas, thyroid and skin

Sonographic Appearance:

- Solid, hypoechoic mass, less often hyperechoic

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COLOR FLOW DOPPLER

- Color Flow Doppler should always be utilized to detect normal, absent, or increased blood flow
- USE A LOW FLOW SETTING
- Increased blood flow usually indicates infection:
  - Epididymitis
  - Orchitis
  - Epididymo-orchitis
- Absent or reduced blood flow
  - Torsion
  - Atrophy

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TUMOR CRITERIA

- Color flow findings are more dependent on the size of the lesion than on its histologic nature
- Lesions > 1.5 cm tend to be hypervascular and small lesions tend to be hypovascular

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WATCH THIS!

- https://youtu.be/DZgK3l78PCA
- https://youtu.be/OCYyGL9Y908

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