Learning Objectives

- List the wide gamut of causes of scrotal abnormalities in the pediatric age range
- Describe the ultrasound appearance of pathological processes that affect the pediatric scrotum
- Understand how to avoid pitfalls when imaging the scrotum

Cryptorchidism (undescended testes)

- Testes descend into scrotum 25 - 32 wk GA (93%)
- At birth, undescended
  - 30% premature M infants < 2500 gm testis
  - 5.8% FT M
- At 1 year
  - 1% true cryptorchidism
  - R>L (70%)
  - bilateral (10-30%)

Testicular migration

- Can be arrested anywhere along course of descent from retroperitoneum into scrotum
  - 80-90% inguinal canal or just proximal to inguinal ring
  - 10-20% abdomen

Cryptorchidism US findings

- Atrophy, smaller, more hypoechoic
- A small testis may mimic
  - lymph node
  - pars infravaginalis of gubernaculum testis
- Postop may see
  - lobulated contour
  - small calcifications suture site affixing testis to scrotal wall
Cryptorchidism

- US initial imaging procedure
- MRI w fat-suppression techniques more effective than CT for intraabdominal testes (nl testes – homogeneous high SI T2)
- Laparoscopic exploration has become preferable to higher tech imaging

Cryptorchidism treatment

- Orchiopexy
- Increased risk testicular neoplasm (10-40 x greater risk), e.g. seminoma
- Increased risk infertility
- Delayed 'til 18-24 months (spontaneous descent during 1st yr of life from endogenous surge of LH)
- Following orchiopexy 53%
  - abnormal position, structure, volume, perfusion

Hydrocele

most common cause of painless scrotal enlargement in children

- Abnormal collection serous fluid scrotal sac
- Congenital (neonates/infants) or acquired
- As testis descends into scrotum becomes invested w portion of peritoneum (processus vaginalis)
- Processus vaginalis closes off proximally at birth (50-75%) forming tunica vaginalis (others by end of 1st year)

Hydrocele etiology

- Most idiopathic
- Acquired following
  - scrotal trauma
  - complication epididymitis-orchitis
  - testicular torsion
  - intrascrotal neoplasm (reactive hydrocele)

Inguinoscrotal Hydrocele

- PV obliterated at internal inguinal ring
- hydrocele extends cephalad from scrotum into inguinal canal

Abdominoscrotal Hydrocele

- closure funicular process at internal inguinal ring
- dumbbell-shaped cystic mass protrudes into extraperitoneal space above inguinal area
Hydrocele
US findings

- Fluid-filled space around homogeneously echogenic testes
- Septations/debris suggest pyocele, hematocele
- Echogenic debris (cholesterol crystals in chronic)
- Occasional calcifications
- Increase in size wo intrascrotal cause
  - ? patent processus vaginal
  - ? Inguinal hernia

Acute Scrotal Pain
in children most likely due to
testicular torsion
epididymitis w/wo orchitis

- Duplex/color Doppler modality of choice for distinguishing between the 2 entities
- Testicular torsion → surgery
- Epididymitis → w/wo orchitis tx medical
- Must demonstrate absence of flow in painful testis & nl flow asymptomatic nl testis
- Presence of flow in painful testis does not exclude torsion

Testicular Torsion
symptoms

- 2 age peaks: infancy, adolescence
- Results when testis & cord twist 1 or more times obstructing blood flow
- Sudden acute scrotal pain
- N/V
- Change in testicular axis from vertical to horizontal
- Within hours
  - reddened scrotum
  - w/wo enlargement

Testicular Torsion
greyscale US findings

- Testicular size nl or enlarged
- Nl – decreased echogenicity (homogeneous)
- Due to venous congestion
- Epididymal enlargement may be early finding
- Reactive hydroceles 10%
- After 48 hours often
  - heterogenous hyperechoic testis
  - hemorrhage/hemorrhagic necrosis

Testicular Torsion
color or power Doppler
gold standard

- Always compare sides for blood flow asymmetry
- Venous flow lost before arterial flow ceases
- Flow nl or increased following spontaneous detorsion
- Image spermatic cord - should be straight
- Whirlpool sign (spiral twist)

Testicular Torsion
salvage rate following surgery*

- < 6 hours virtually 100%
- 6-12 hours 70%
- 12-24 hours 20%
- >24 hours not salvageable

* manual detorsion
**Testicular Torsion**

- **extravaginal**
  - Neonates (thought to occur in utero)
  - Twisting suprascrotal spermatic cord
  - Spermatic cord and testis loosely attached in inguinal canal
  - All the scrotal contents strangulated

- **intravaginal**
  - Twisting of excessively mobile testis
  - More common
  - Occurs in children and adolescents
  - Tunica vaginalis inserts abnormally high on spermatic cord
    ("bell clapper" deformity)

**Neonatal Testicular Torsion**

- Usually presents painless, firm scrotal mass
- May have bluish-red scrotal discoloration
- Usually non-viable
- Asymmetric testicular sizes
- Heterogenous echotexture

**Torsion Testicular Appendages**

- Treatment
  - Self-limited
  - Non-steroidal anti-inflammatory meds
  - Limited activity
  - Warm compresses
  - As appendage infarcts and necroses, pain resolves
  - Surgery reserved for prolonged sx and if spontaneous resolution does not occur

**Epididymitis**

- Most common cause acute painful scrotum in postpubescent male
  - More gradual onset of pain than with torsion
  - Fewer constitutional symptoms than with testicular torsion
  - Pubertal > prepubertal
  - Usually bacterial
  - Pyuria, N, V, leukocytosis, enlarged painful epididymis, scrotal edema, tenderness
  - Adolescents: STD (chlamydia, Neisseria gonorrhoeae)
  - Younger pts: GU anomalies (ectopic ureter draining into vas deferens/seminal vesicles), bladder outlet obstruction; E.coli
  - Associated orchitis 20%
  - Abscess rare
  - Occ impedes testicular blood flow → focal, diffuse infarction
**Epididymitis**  
*mechanism of infection*

- Infection reaches epididymis via spermatic ducts
- Causative factors:
  - UTI
  - urethral instrumentation
  - indwelling catheter
  - distal urethral obstruction
  - reflux urine from urethra into seminal ducts (congenitally patulous orifice)
  - ectopic ureter draining into vas deferens
  - ectopic vas deferens draining into bladder or ureter

**Epididymitis**  
*US findings*

- Enlarged epididymis
- Reactive hydrocele or pyocele
- Epididymal echogenicity variable
- Retention nl shape epididymis, although enlarged
- Hyperemia epididymis
- Hypoechoic hypervascular area testis adjacent to epididymis w epididymo-orchitis
- VCUG prepubescent M w congenital anomaly (reflux into vas deferens)

**Epididymitis**  
*US findings*

- Nl appearing testes w nl flow
- Marked edema scrotal wall
- Surgery not indicated

**Testicular Tumors**  
*germ cell & non-germ cell origin*

- Uncommon in infants & children
- 1% - 1.5 % all childhood malignancies
- Tend to occur in very young children < 2 yrs (60% < 2 yrs)
- Present painless, non-tender, firm scrotal mass
- Often weeks-months duration
- Scrotal pain/tenderness if associated torsion
- Occasionally bilateral

**Testicular Primary Neoplasms**  
*classification*

- Germ cell tumors
  - yolk sac carcinoma (endodermal sinus tumor)
  - teratoma (mature/immature)
  - embryonal, teratocarcinoma, choriocarcinoma
  - seminoma (pure histologic pattern or mixed germ cell)
- Gonadal stromal tumors
  - Sertoli-granulosa cell
  - Leydig cell
  - Granulosa cell
- Tumors of supporting tissues
  - fibroma
  - leiomyoma
  - hemangioma

**Testicular Tumors**  
*germ cell tumors*

- Most childhood testicular tumors germ cell (60% - 75%)
- Yolk sac most common malignant pediatric germ cell tumor (80% - 90%)
- ¾ diagnosed by age 2 yrs
- Painless scrotal or testicular enlargement
- May have associated ipsilateral hydrocele (15-20%) or IH
- Pain in some due to torsion or hemorrhage into tumor
- 80% limited to scrotum at presentation
- 20% lymphatic spread regional/retroperitoneal LN or distant sites
- Elevated alpha-fetoprotein 90%
**Testicular Tumors**

**teratoma**

*principai benign germ cell tumor testis*

- **Prepubertal** (< 4 yrs)
  - almost always benign
- **Postpubertal**
  - potentially malignant
  - may develop components of other germ cell tumors resulting in teratocarcinoma
  - serum hCG level usually elevated

**Testicular Tumors**

**germ cell tumor**

**teratoma** *(10-15%)*

- More aggressive in pubertal patients
- < age 4 yrs
- Well differentiated elements from all 3 germ layers
- May contain
  - cartilage
  - bone
  - epidermal elements (keratin, fibrous tissue, smooth muscle, fat)
- Complex mass
  - bony, dental elements brightly echoic w post shadowing
  - fat - brightly echoic wo shadowing

**Testicular Tumors**

**embryonal carcinoma**

**teratocarcinoma**

**choriocarcinoma**

- Adolescence or young adulthood
- Highly malignant
- Spreads to retroperitoneal/mediastinal LN
- Hematogenous metastases lungs, liver, brain
- Elevated ß-hCG

**Testicular Tumors**

**germ cell tumors**

**seminoma**

- Most common testicular tumor adults
- Rare in pediatric pts
- Adolescence
- Is neoplasm most associated with cryptorchid testes
- Hypoechoic, rarely contain areas necrosis & hemorrhage

**Testicular Primary Neoplasms**

**US primary imaging modality**

- Most hypoechoic
- May be complex w cystic areas most often due to necrosis
- If hyperechoic, may be hemorrhage
- May have calcifications
- Hyperemic mass
- Reactive hydroceles 15% - 20%
- Abd US, CT or MRI for pelvic/retroperitoneal lymphadenopathy & solid organ metastases
- Chest X-ray & CT for pulmonary metastases

**Testicular Tumors**

**gonadal stromal tumors**

- **Leydig cell tumor** *(60% non-germ cell tumors)*
  - typically 2 - 9 yrs (peak incidence 4 yrs)
  - painless
  - produce testosterone - precocious virilization
  - if produces estrogen - gynecomastia
- **Sertoli cell tumors** *(40% non-germ cell tumors)*
  - 50% diagnosed 1st yr of life
  - painless
  - most hormonally inactive, although some produce estrogen leading to gynecomastia
  - bilateral may occur w Peutz-Jeghers syndrome
**Testicular Gonadal Stromal Tumors**

*US findings*
- Slow growing
- Virtually always benign in prepubertal pts
- Usually small, well circumscribed hypoechoic
- Larger lesions cystic spaces due to hemorrhage/necrosis
- Orchiectomy curative
- Tissue sparing surgery possible for Leydig cell tumors

**Testicular Tumors**

*color flow Doppler imaging helpful in depicting tumor*
- Disorganized hypervascular blood flow may be only clue to presence of tumor as echo pattern may be normal
- Hyperemia may also be only clue to dx w orchitis (orchitis wo epididymitis is uncommon especially in prepubertal children)

**Testicular Cyst**

- Uncommon testicular mass
- Present w painless scrotal enlargement
- Benign
- Anechoic mass w smooth walls, no nodular or solid elements, incr sound transmission
- In infants may compress and replace testicular parenchyma
- Enucleation – testis sparing surgery

**2° Testicular Neoplasms**

- Testicular metastases rare in children (1% all testicular tumors)
- *Leukemia/lymphoma most common causes*
  - 25% newly dx ALL clinically silent
  - enlarged testes, homogeneously hypoechoic, or focal hypoechoic masses
  - enlarged testes may be 1st sign relapse after bone marrow remission
  - bilateral most common
  - focal or diffuse areas decreased echogenicity
  - hyperemia w disorganized vascularity
  - uncommonly epididymis involved (enlarged, hyperemic mimicking inflammatory process)

**2° Testicular Neoplasms**

- Neuroblastoma
- Wilms' tumor
- Langerhans cell histiocytosis
- Retinoblastoma
- Rhabdomyosarcoma
- Sinus histiocytosis

- Metastasize by
  - lymphatic
  - hematogenous
  - direct extension from contiguous tumor
  - painless & firm or diffuse testicular enlargement

**Adrenal Rests**

- Simulate intratesticular tumors
- Fetal adrenal cortical cells migrate coincidentally w gonadal tissue during embryological development
- Rests may enlarge forming tumor-like masses in response to
  - high levels adrenocortical hormones
  - CAH
  - Cushing syndrome
Paratesticular Tumors

- Rare
- Usually arise from spermatic cord
- Less commonly arise from epididymis, appendix testis, or testicular tunics
- Spermatic cord tumors
  - 30% malignant
  - embryonal rhabdomyosarcoma most common

Paratesticular Rhabdomyosarcoma

- Rapidly growing painless intrascrotal mass
- Frequently large at presentation
- Up to 40% present w/ regional/retroperitoneal lymph nodes
- Venous invasion distant metastases to lungs not uncommon
- US findings
  - well-circumscribed homogeneous or heterogeneous solid mass w/ variable echogenicity
  - cystic spaces due to necrosis/hemorrhage
  - hyperechoic foci due to calcification or fat
  - often hyyperemic
  - May be difficult to differentiate from lesion of intratesticular origin if testis, epididymis &/or tunica vaginalis invaded

Other Paratesticular Malignant Tumors

- Metastatic NBL
- Lymphoma
- Leukemia
- Leiomyosarcoma
- Fibrosarcoma

Benign Paratesticular Tumors

- Spermatocele
- Epididymal cyst
- Tunica albuginea cyst
- Adenomatoid tumor
- Epididymal cystadenoma
- Splenogonadal fusion

Varicoceles

US findings

- Small, serpentine, anechoic structures (99% left)
- Flow w/ color Doppler imaging
- Venous waveforms w/ pulsed Doppler imaging
- Augmentation Doppler flow w/ Valsalva & upright position
- Graded according to their size
  - I: 65% small (mild thickening spermatic cord)
  - II: 24% moderate (mass of vv up to 2 mm cross-sectional diameter)
  - III: 10% individual vv >2 mm in diameter

References