The Testis

Anatomy

The average testis measure about (4*3*2.5 cm) . Average Wt.18-22 cm3. It is covered by dense tunica albugenia, which invaginated posteriorly to form the mediastinum, from the mediastinum, fibrous septa extend to separate the testis to 250 lobules.
The testis covered ant. And lat. by the vesiral layer of the tunica vaginalis, which continuo with the parietal layer that separate the testis from the scrotal wall.
At the upper pole a small pedinculated or sessile body called the appendix of the testis .The epididymis lies posterolaterally.
Histologically each lobule contain 1-4 convoluted tubule(90% of testis volume) each tubule 60 cm long. these converge at mediastinum and connect with efferent ducts that drain to the epididymis. The ducts lined by germinal epithelium(for sperm production) and supported by sertoli cells (nursing cell and as a blood testis briar), interstitial cell called lyding cell (testosterone production 5g/day). Average sperm production 300/g/second
Blood supply :(internal spermatic A). (A. of the vas from I. I. A.)and (cremasteric A. from INF. Epagasteric A.).Venous return through pampiniform plexus which at the internal inguinal ring form the spermatic vein.Lymphatic to lumber then to the mediastinal L. N.

Embryology

The primitive sex gland appears during 5-6 wk. at the urogenital ridge . during 7^{th} wk. begin to assume the characteristic of either testis or ovary. By 12^{th} wk. located retroperitoneal in the false pelvis.. The gubernaculums (a fibro muscular band) extend from the lower pole of the testis to the subcutaneous tissue of the scrotal wall. The peritoneum will herniat as diverticulum along the anterior aspect of the guberna+culum and celled processus vaginalis .
At the end of the 8^{th} month. reach scrotum. In order for normal spermatogenesis to occur, it is necessary for the testes to descend into the scrotum, a specialized, low-temperature environment that maintains a temperature 2° to 3°F lower than core body temperature

Cryptorchidism = Hidden Testis

Cryptorchidism is the most common genital problem encountered in pediatrics. Cryptorchidism literally means hidden or obscure testis and generally refers to an undescended or maldescended testis. By definition, cryptorchidism is a developmental defect in which there is failure of the testis to descend into the scrotum.
Incidence: Isolated cryptorchidism is one of the most common congenital anomalies at birth, affecting about 3% of full-term male newborns. Unilateral cryptorchidism is more common than bilateral cryptorchidism, which occurs in 2% of boys. Significantly more prevalent among preterm, small-for-gestational-age, low-birth-weight, and twin neonates. 70% to 77% of cryptorchid testes will spontaneously descend, usually by 3 months of age. By 1 year of age, the incidence of cryptorchidism declines to about 1% and remains constant throughout adulthood. The prevalence rate is 30% in premature boys.

Classification: The most useful classification is whether testes are palpable upon physical examination. If nonpalpable, testes may be intra-abdominal or absent. If palpable, testes may be undescended, ectopic, or retractile.

intra-abdominal, intracanalicular, extracanalicular (suprapubic or infrapubic), or ectopic.

- The ***intra-abdominal*** *testis* : anywhere along a line between the lower pole of the kidney and the internal ring.But is usually located just inside the internal ring,.
- The *intracanalicular testis* is occasionally difficult to palpate within the inguinal canal, between the internal and external ring.

- The emergent or ***suprapubic*** *testis* lies just beyond the external ring, above the level of pubic symphysis,
- ***infrapubic*** *testis* lies just below the pubic symphysis,
- The ***ectopic*** *testis* completes normal transinguinal migration but is misdirected outside the normal path of descent below the external ring. The most common ectopic location is within a superficial pouch between external oblique fascia and Scarpa's fascia, which has been termed the Denis-Browne pouch. Other abnormal locations include transverse scrotal, femoral, perineal, and prepenile ectopia.

The term "nonpalpable testis" implies that the testis cannot be detected on physical examination and therefore is either intra-abdominal, absent (vanishing), atrophic, or missed on physical examination. A vanishing or absent testis is usually encountered during exploration for a nonpalpable testis. The anatomic hallmark of the vanishing testis is blind-ending spermatic vessels that are found just proximal to the internal inguinal ring. An atrophic testis is a smaller than normal testis that may be cryptorchid. These testes can be encountered anywhere along the course of normal descent from within the abdomen to the scrotum.

The Retractile testis

Is withdrawn out of the scrotum by an active cremasteric reflex but can easily be brought down into an orthotopic position within the scrotum and remains there after traction has been released. The retractile testis can be found anywhere along the course of descent, but it is usually palpable in the groin. Retractile testes most commonly present clinically between the ages of 3 and 7 years of age. The retractability of the testes is caused by an overactive cremasteric reflex. A cremasteric reflex, initiated by stroking the skin of the inner aspect of the thigh, it is probably retractile and does not require therapy The testis usually is located in a superficial inguinal pouch and declares itself undescended with somatic growth.Therefore, children with retractile testes should be monitored regularly at least until puberty, until the testes are no longer retractile and remain intrascrotal.

Theories of Descent and Maldescent: Endocrine Factors :A normal hypothalamic-pituitary-gonadal axis is usually a necessary prerequisite for testicular descent to occur.

Androgens, Müllerian Inhibiting Substance ,.Estrogen, Descendin , *Gubernaculum, Genitofemoral Nerve , Calcitonin Gene-Related Peptide, Epididymis, and Intra-abdominal Pressure*

Histopathology

The histopathologic hallmarks associated with cryptorchidism are evident between 1 and 2 years of age and include decreased numbers of Leydig cells, degeneration of Sertoli cells, and reduced total germ cell counts. The earliest postnatal histologic abnormality in cryptorchid testes was hypoplasia of the Leydig cells, which was observed from the first month of life

Consequences of Cryptorchidism

1. *Infertility*
2. *Neoplasia*: The incidence of a testicular tumor in the general population is 1 in 100,000, and the incidence of a germ cell tumor in men formally cryptorchid is 1 in 2550; therefore, the relative risk is approximately 40 times greater. The most common tumor that develops from a cryptorchid testis is seminoma
3. *Hernia*: A patent processus vaginalis is found in more than 90% of patients with an undescended testis
4. *Testicular Torsion*

Work-up

the testis is palpable in approximately 80% and the remainder are nonpalpable. Approximately 20% of nonpalpable testes are absent, and 30% are atrophic. Determination as to whether the testis is present on physical examination is critically important, because it guides further work-up and treatment

Elements of the medical history should include the following:

- Determination of whether the testis has ever been palpable in scrotum
- History of prematurity, birth weight, prior inguinal surgery, maternal vegetarian or soy formula in infancy
- Prenatal history, ie, assisted reproductive technique, maternal hormonal treatment, multiple gestations, prematurity
- Family history, ie, cryptorchidism, hypospadias, intersex, precocious puberty, infertility, consanguinity

Elements of the physical examination should include the following:

- Warm, relaxed patient, Observation prior to examination, Frog-leg position
- Milk down, palpating from iliac crest to scrotum (soap or lubrication on fingertips may help)
- Scrotum, ie, hypoplastic, bifid, rugae, transposition, pigmentation
- Contralateral testicular hypertrophy
- Ectopic sites, ie, superficial inguinal pouch or transverse scrotal, femoral, prepenile, perineal, or contralateral hemiscrotum
- Presence of hypospadias/chordee, normal stretched penile length
- Serial examinations, if equivocal

Lab Studies:

For unilateral undescended testis without hypospadias, no lab studies are needed.

- For unilateral or bilateral undescended testes with hypospadias or bilateral nonpalpable testes, tests include the following:,Testing to rule out intersex condition (mandatory),17-hydroxylase progesterone., (LH), (FSH),
- To determine anorchia in cases of bilateral nonpalpable gonads, perform the following: LH testing,FSH testing.Testosterone level testing before and after stimulation with human chorionic gonadotropin (hCG): If both elevated basal gonadotropin levels and a negative testosterone response to hCG stimulation are observed, then congenital bilateral anorchism is suggested.
- Radiologic studies to localize the testis.To date, examination by a pediatric urologist has proven to be more valuable than ultrasound, CT scan, or MRA findings.

Management of Cryptorchidism

The important points for the treatment of a child who presents with an undescended testis include the following:

1. Proper identification of the anatomy, position, and viability of the undescended testis
2. Identification of any potential coexisting syndromic abnormalities
3. Placement of the testis within the scrotum in a timely fashion to prevent further testicular impairment of either fertility potential or endocrinologic function

4. Attainment of permanent fixation of the testis with a normal scrotal position that allow for easy palpation
5. Definitive treatment of the undescended testis should occur before 1 year of age

Hormonal Therapy

exogenous hCG and exogenous GnRH or LHRH. The mechanism of action in both cases increases serum testosterone production by stimulation at different levels of the hypothalamic-pituitary-gonadal cascade. the overall efficacy of hormonal treatment is less than 20% for cryptorchid testes.

Surgical Treatment : Orchiopexy

surgery remains the gold standard in the management of the undescended testis.

It is very useful to examine the child after the induction of general and regional anesthesia to reaffirm testicular position, or to attempt to establish testicular position in the case of a previously nonpalpable testis.

1. Standard Orchiopexy
2. Ancillary Techniques For The High Undescended Testis
3. Reoperative Orchiopexy

Management of Intra-abdominal Testis:

1. Laparoscopy
2. Fowler-Stephens Orchiopexy
3. Microvascular Autotransplantation

Complications of Orchiopexy .include:

1. testicular retraction,
2. hematoma formation,
3. ilioinguinal nerve injury,
4. postoperative torsion (either iatrogenic or spontaneous),
5. damage to the vas deferens,
6. testicular atrophy.

Hernias and Hydroceles

The differential diagnosis of acute and chronic swelling of the inguinal and scrotal area is of daily concern to the urologist who deals with children. Although there has been a trend toward imaging of the groin in some circles, physical examination and a history of the clinical findings remain the hallmarks of physical diagnosis .

Hydrocele

Is an accumulation of fluid within the tunica vaginalis. All hydroceles in infants and children result from persistence of or delayed closure of the processus vaginalis.As the testis descends into the scrotum from its abdominal position, it carries with it a tongue of peritoneum (the processus vaginalis).

A simple (scrotal) hydrocele, in which the processus appears to be obliterated and fluid trapped within the tunica vaginalis of the scrotum persists, are commonly seen at birth, are frequently bilateral, and may be quite large. Not painful. No fluid is evident in the groin in most cases, but

occasionally a large, simple hydrocele extends toward the internal inguinal ring. most resolve during the first 2 years of life. Aspiration of infant hydroceles is contraindicated because of the risk of infection,

Communicating Hydrocele and Inguinal Hernia

Persistence of the processus vaginalis allows peritoneal fluid to freely communicate with the scrotal limits of the processus, and a communicating hydrocele results. The classic description of a communicating hydrocele is that of a hydrocele that vacillates in size, usually related to activity. Most communicating hydroceles are smaller in the morning and become more prominent as the day progresses, enlarging in response to the upright position, activities that increase intra-abdominal pressure, and, in many cases, fever. The scrotal swelling may be soft or tense, and it may change in consistency. Small intestine, omentum, bladder, or genital contents may be found in the sac. Communicating hydroceles may be diagnosed by history or by physical examination.Communicating hydroceles are by definition congenital in origin

All communicating hydroceles should be explored through an inguinal incision

Hydrocele of the Cord

segmental closure of the processus, which leaves a loculated hydrocele of the cord that may or may not communicate with the peritoneal cavity (communicating hydrocele of the cord). Hydrocele of the cord usually presents as a painless groin mass contiguous with the cord structures and located at any position from just above the testis to the inguinal canal. Differential diagnosis of inguinal masses also includes sarcomas of the cord and paratesticular tissues and inguinal hernia (especially with impacted omentum).

Abdominoscrotal Hydrocele

Abdominoscrotal hydrocele is a rare clinical entity in which a large, bilobed hydrocele spans the internal inguinal ring, consisting of a large inguinoscrotal component and a large intra-abdominal component.

Diagnostic Procedures:

- No interventional or invasive diagnostic procedures are recommended in the evaluation of hydroceles. Specifically, diagnostic aspirations should be avoided.

Medical therapy: Asymptomatic adults with isolated noncommunicating hydroceles can be observed indefinitely or until they become symptomatic. However, if the diagnosis is in question or underlying pathology cannot be excluded, operative exploration is warranted.

Surgical therapy: Surgical therapy can be divided into 3 approaches:

inguinal approach,scrotal approach and scrotal aspiration and sclerotherapy of the hemiscrotum using tetracycline or doxycycline solutions.

Spermatocele

Is a benign cystic accumulation of sperm often found in the head of the epididymis that usually presents as a smooth, firm, well-circumscribed mass of the scrotum. Spermatoceles are considered in the differential diagnosis of any scrotal mass and must be differentiated from hydroceles, varicoceles, epididymal cysts, and other scrotal masses.

Acute Scrotum

The presentation of a child or adolescent with acute scrotal pain, tenderness, or swelling should be looked upon as an emergency situation requiring prompt evaluation, differential diagnosis, and potentially immediate surgical exploration. Adolescent males do not always understand the

potential significance of acute scrotal conditions, and presentation in many cases is delayed. As a result, the presentation of a subacute or even chronic scrotal condition may in certain situations merit prompt evaluation and intervention.

Differential Diagnosis
The list of differential diagnoses for the acute scrotum is extensive. In all instances, it is imperative to rule out torsion of the spermatic cord, the clinical diagnosis requiring emergency surgical intervention

Torsion of the Spermatic Cord
Torsion of the testis, or more correctly, torsion of the spermatic cord, is a surgical emergency because it causes strangulation of gonadal blood supply with subsequent testicular necrosis and atrophy. Acute scrotal swelling in children indicates torsion of the testis until proven otherwise. In approximately two thirds of patients, history and physical examination are sufficient to make an accurate diagnosis. Irreversible ischemic injury to the testicular parenchyma may begin as soon as 4 hours after occlusion of the cord.

- Extravaginal torsion: This type manifests in the neonatal period and most commonly develops prenatally in the spermatic cord, proximal to the attachments of the tunica vaginalis. Extravaginal torsion comprises approximately 5% of all torsions. The condition is most often a prenatal (in utero) event and is associated with high birth weight.
- Intravaginal torsion: This type occurs within the tunica vaginalis, usually in older children. Intravaginal torsion is related to an anomalous testicular suspension that has been referred to as the bell-clapper anomaly. In many instances, this anomaly may be bilateral. Intravaginal torsion comprises approximately 16% of patients with torsion presenting in emergency departments with acute scrotum. Peak incidence occurs in adolescents aged 13 years, and the left testis is more frequently involved. Bilateral cases account for 2% of all torsions.

Etiology:

- Extravaginal torsion: The testes may freely rotate prior to the development of testicular fixation via the tunica vaginalis within the scrotum**.**
- Intravaginal torsion: Normal testicular suspension ensures firm fixation of the epididymal-testicular complex posteriorly and effectively prevents twisting of the spermatic cord. In contrast, the bell-clapper deformity allows torsion to occur because of a lack of fixation, resulting in the testis being freely suspended within the tunica vaginalis. A large mesentery between the epididymis and the testis can also predispose itself to torsion, although this is rare. Contraction of the spermatic muscles shortens the spermatic cord and may initiate testicular torsion.The degree of torsion may vary from 180-720°.

Clinical: Prenatal torsion manifests as a firm, hard, scrotal mass, which does not transilluminate in an otherwise asymptomatic newborn male. The scrotal skin characteristically fixes to the necrotic gonad. In older boys, the classic presentation of testicular torsion is the sudden onset of severe testicular pain followed by inguinal and/or scrotal swelling. Pain may lessen as the necrosis becomes more complete. Approximately one third of patients also have gastrointestinal upset with nausea and vomiting. In some patients, scrotal trauma or other scrotal disease (including torsion of appendix testis or epididymitis) may precede the occurrence of subsequent testicular torsion. A physical examination may reveal a swollen, tender, high-riding testis. The absence of the cremasteric reflex in a patient with acute scrotal pain supports the diagnosis of torsion. In time, a reactive hydrocele, scrotal wall erythema, and ecchymosis become more striking.

Differential diagnosis:

- Torsion of testicular or epididymal appendage

    - This condition usually occurs in children aged 7-12 years.
    - Systemic symptoms are rare.
    - Usually, localized tenderness occurs but only in the upper pole of the testis.
    - Occasionally, the blue dot sign is present in light-skinned boys.
- Epididymitis, orchitis, epididymo-orchitis
    - These conditions most commonly occur from the reflux of infected urine or from sexually acquired disease caused by gonococci and *Chlamydia.*
    - Patients occasionally develop these conditions following excessive straining or lifting and the reflux of urine (chemical epididymitis).
    - These conditions may be secondary to an underlying congenital, acquired, structural, or urologic abnormality and are often accompanied by systemic signs and symptoms associated with urinary tract infection.
    - Pyuria, bacteriuria, or leucocytosis is possible.
    - A complete urological evaluation (ie, renal sonography, urodynamic study) is necessary in prepubertal boys with acute epididymitis.
- Hydrocele (usually associated with patent processus vaginalis)
    - Painless swelling is usually present.
    - Scrotal contents can be visualized with transillumination.
    - Incarcerated hernia may be diagnosed by careful examination of the inguinal canal.
- Testis tumor
    - Scrotal enlargement occurs, only rarely accompanied by pain.
    - Presentation is rarely acute.
- Idiopathic scrotal edema
    - Scrotal skin is thickened, edematous, and often inflamed.
    - The testis is not tender and is of normal size and position.

LabStudies:
If the patient does not show clinical evidence of testicular torsion, a urinalysis and culture may help exclude urinary tract infection and epididymitis as the etiology of the scrotal complaints.
If testicular torsion is clinically suggested, perform immediate surgical exploration, regardless of laboratory studies because a negative finding upon exploration of the scrotum is more acceptable than the loss of a salvageable testis.

ImagingStudies:
The following diagnostic tests may be useful when a low suspicion of testicular torsion exists:
1.Scrotal color Doppler sonogram is usually diagnostic by verifying arterial flow.
2.Nuclear testicular scan can help differentiate torsion from acute epididymitis by demonstrating cold spot and ring signs

Medical therapy: Manual detorsion of the torsed testis may be attempted but is usually difficult because of acute pain during manipulation. This nonoperative detorsion is not a substitute for surgical exploration. If successful (ie, confirmed by color Doppler sonogram in a patient with complete resolution of symptoms), perform definitive surgical fixation of the testes before the patient leaves the hospital as an urgent—rather than emergent—procedure.

Surgical therapy: Treatment of testicular torsion is surgical exploration and the techniques vary according to patient age and the time since the attack .

- Perform the operation through the midline scrotal raphe.
- Enter the ipsilateral scrotal compartment; then, deliver and untwist the testis.
- Evaluate the testis for viability.
- Remove the necrotic testis to avoid prolonged, debilitating pain and tenderness. Retention of a necrotic testis may exacerbate the potential for subfertility, presumably because of development of an autoimmune phenomenon.

- To prevent subsequent torsion, fix viable gonads to the scrotal wall with 3-4 nonabsorbable sutures. Perform both exploration and orchiopexy of the contralateral testis through the same incision.
- Intraoperative details**:** Signs of a viable testis after detorsion include a return of color, return of Doppler flow, and arterial bleeding after incision of tunica albuginea.

Intermittent Torsion of the Spermatic Cord

A significant percentage of adolescents who present with acute torsion of the spermatic cord give a history of prior episodes of acute, self-limited scrotal pain that appear clinically to have been episodes of intermittent torsion with spontaneous detorsion

Torsion of the Testicular and Epididymal Appendages

The appendix testis, a müllerian duct remnant, and the appendix epididymis, a wolffian remnant, are prone to torsion in adolescence, presumably as a result of hormonal stimulation that increases their mass and makes them more likely to twist on the small vascular pedicle upon which they are based.

The presentation of torsion of an appendage is extremely variable, from an insidious onset of scrotal discomfort to an acute presentation identical to that seen with torsion of the cord. When the diagnosis of a torsed appendage is confirmed clinically or by imaging, nonoperative management allows most cases to resolve spontaneously.

Epididymitis

Inflammation or infection of the epididymis is an important part of the differential diagnosis of the acute scrotum. Epididymitis is a rare clinical diagnosis in the pediatric age .The clinical presentation classically an indolent process, in contrast to the rather acute onset of torsion of the spermatic cord. .The presence of dysuria and fever is more common in the epididymitis group, although many boys with clinical epididymitis present have neither. A past history of urinary tract infections, urethritis, urethral discharge, sexual activity, urethral catheterization, or urinary tract surgery may indicate a higher likelihood of epididymitis. Epididymitis has also been associated with Henoch-Schönlein purpura, presumably on a systemic inflammatory basis, and has been noted in boys treated with the antiarrhythmic agent amiodarone. Physical examination may reveal localized epididymal tenderness, a swollen and tender epididymis, or a massively swollen hemiscrotum with absence of landmarks. The cremasteric reflex should be present in epididymitis, and its absence is highly suggestive of torsion of .

The presence of pyuria, bacteriuria, or a positive urine culture is important evidence.Scrotal imaging may be an important part of making the diagnosis of epididymitis, Color flow Doppler and radionuclide imaging reveal increased blood flow;

Epididymitis in adolescents should be treated aggressively, whether in an early or advanced stage.

Miscellaneous Causes of Acute Scrotal Swelling

Acute idiopathic scrotal edema is a self-limited process of unknown cause that usually is not associated with scrotal erythema. Fever is not present, and scrotal tenderness is usually minimal, but pruritus may be significant. Henoch-Schönlein purpura is a systemic vasculitis that can cause scrotal swelling secondary to involvement of the testis, epididymis, or both