

Cryptorchidism

Testicular descent • morphology • fertility • malignancy

Dr Abu Suraih Sakhri

MBBS, MD (Pathology)

www.abusuraihsakhri.com

Learning objectives

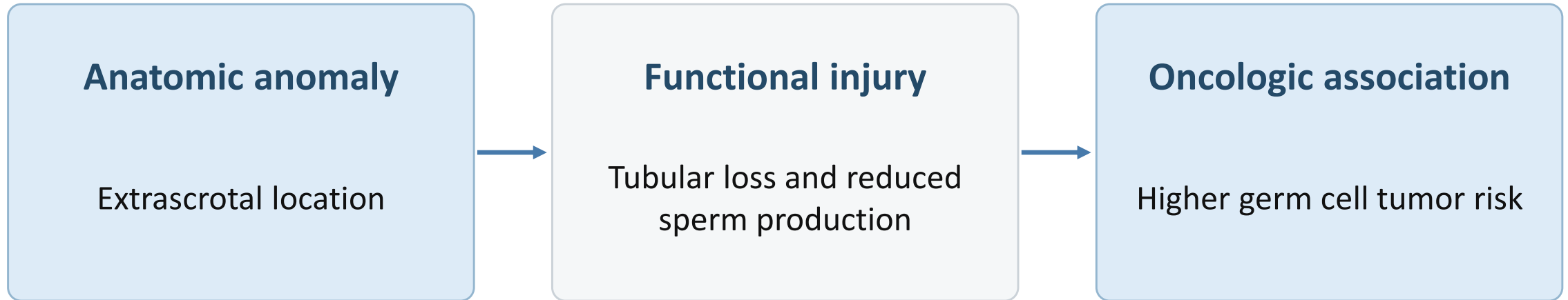
- Explain the phases and regulation of testicular descent.
- Relate undescended position to tubular pathology and fertility.
- Identify cancer risk, clinical presentations, and important differentials.
- Apply contemporary assessment and timing recommendations.

Cryptorchidism: Defining lesion

Failure of testicular descent

One or both testes fail to reach the scrotal sac completely or partially. The clinical problem is an abnormal position with functional and oncologic implications.

Why cryptorchidism matters



A congenital malposition can be a marker of underlying abnormal gonadal development.

A common congenital testicular abnormality

- Cryptorchidism is the main congenital anomaly of the testis discussed in this section.
- Absence of a testis and fusion of testes (synorchism) are much less frequent.
- An empty hemiscrotum requires distinction between undescended and absent testes.

Frequency at one year

~1%

Approximately 1% of male children have an undescended testis at one year of age,. This is a point prevalence, not incidence at birth.

Unilateral or bilateral?

25%

Bilateral cryptorchidism in approximately one quarter of affected patients; Most cases are unilateral.

Isolated and associated presentations

- Most cases occur as isolated anomalies.
- Coexisting genitourinary malformations should prompt wider assessment.
- Hypospadias is an example specifically mentioned.
- Associated findings can change the diagnostic pathway.

Syndromic associations

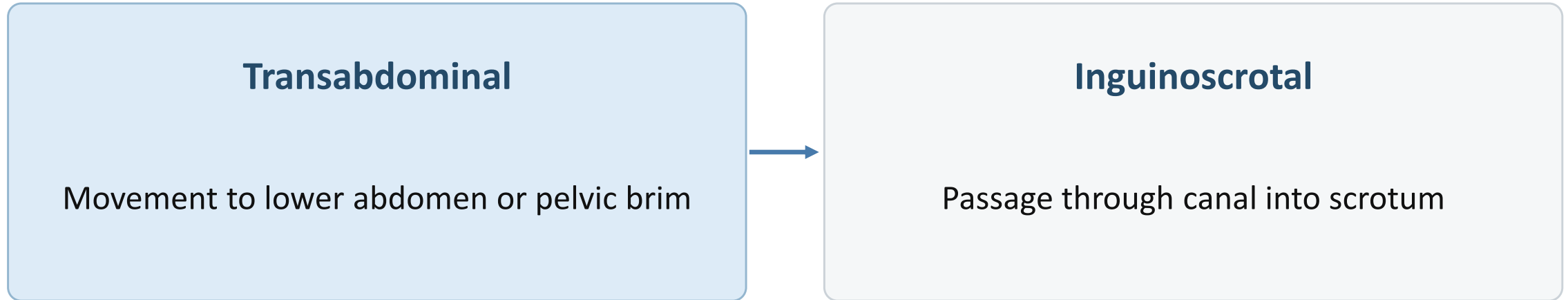
Prader–Willi syndrome

- Recognized inherited syndrome associated with undescended testes.
- Cryptorchidism is not sufficient alone for syndromic diagnosis.

Noonan syndrome

- Another inherited syndrome specifically listed.
- Assess other developmental findings if present.

Two phases of normal descent



Failure can occur at different points along the descent pathway.

First phase: Transabdominal descent

- Testis shifts within the abdomen toward the pelvic brim.
- Endocrine control to Müllerian-inhibiting substance.
- This phase precedes passage through the inguinal canal.

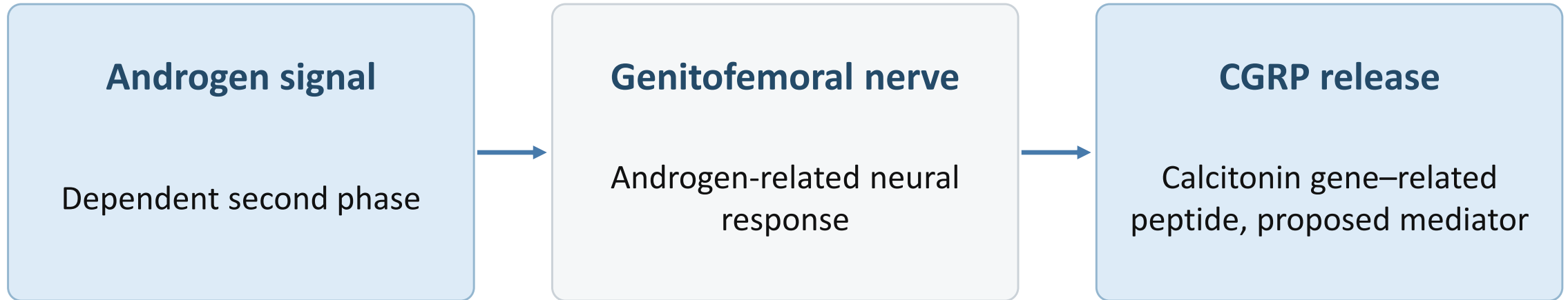
Müllerian-inhibiting substance

- Also termed anti-Müllerian hormone (AMH).
- It as a hormonal regulator of the transabdominal phase.
- Its role in descent should not be confused with later androgen-dependent inguinoscrotal movement.

Second phase: Inguinoscrotal descent

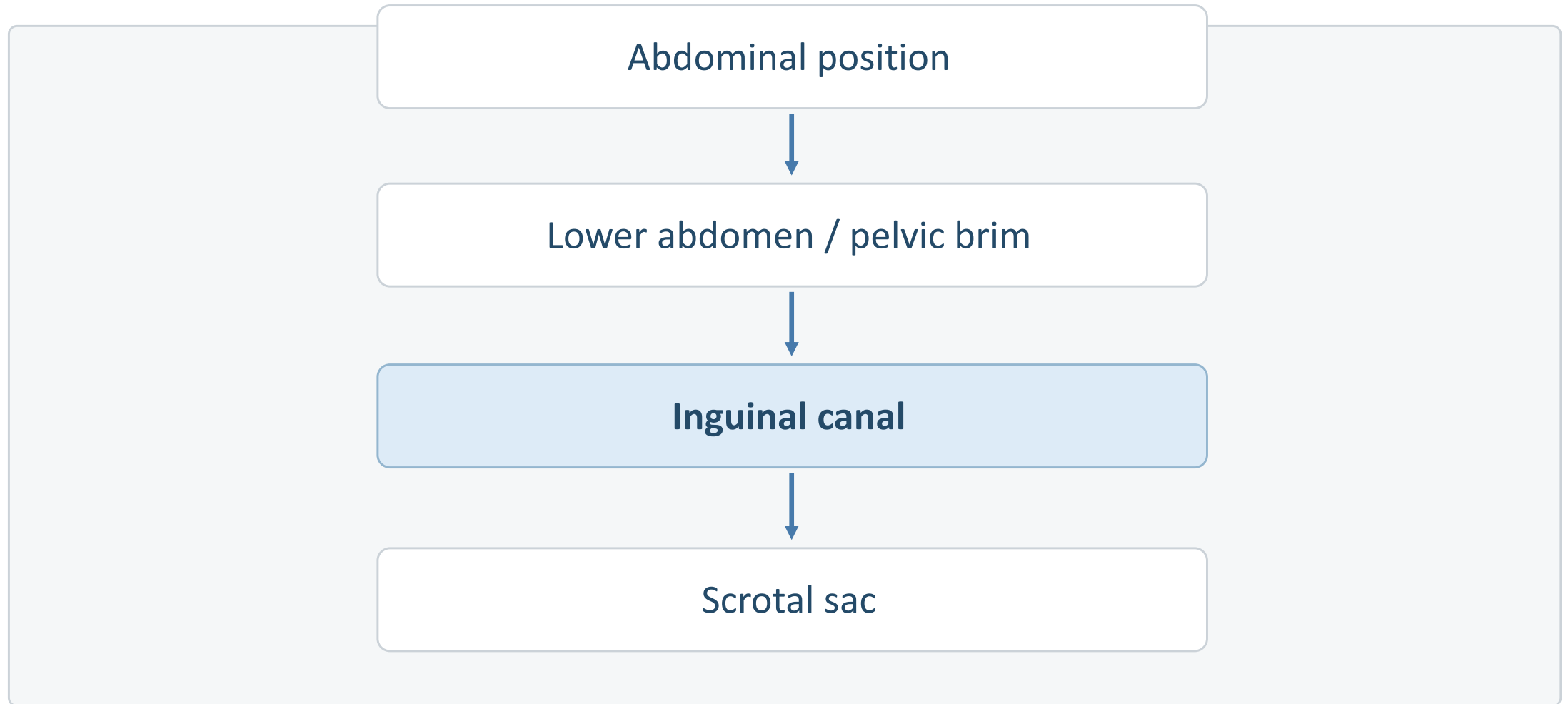
- Testis moves through the inguinal canal to the scrotum.
- This phase is androgen-dependent.
- Neural signaling is implicated in the pathway.

Neural mediator of inguinoscrotal descent



CGRP-mediated control is presented as a proposed mechanism, not proven exclusive causation.

Where descent can arrest



Stylized descent pathway — not to anatomical scale

Most frequent arrest site

Inguinal canal

A cryptorchid testis is most commonly arrested along the inguinal portion of the descent pathway.

Intra-abdominal arrest

5–10%

Only a minority of affected testes arrest within the abdomen; This figure refers to location among cases rather than all boys.

Hormonal regulation does not imply endocrine disease

- Normal descent depends on hormonal and neural signals.
- Yet a well-defined endocrine disorder explains only a minority of cryptorchid presentations.
- An isolated undescended testis does not establish an identifiable hormonal deficiency.

Two mechanisms worth distinguishing

Descent pathway problem

Testis remains outside scrotum



Gonadal developmental defect

Germ cell maturation may also be abnormal

The textbook argues that malposition alone does not explain all fertility and cancer risk.

Palpable versus nonpalpable testes

Palpable

- Often located along the inguinal route.
- Clinical examination identifies testis.
- Management usually begins with an inguinal surgical approach.

Nonpalpable

- Testis may be intra-abdominal, absent, or occasionally inguinal.
- Surgical evaluation establishes its status.
- Diagnostic laparoscopy can localize an intra-abdominal testis.

Undescended versus retractile testis

True undescended

- Cannot be maintained in a normal scrotal position on examination.
- Persistent abnormal position warrants specialist assessment.

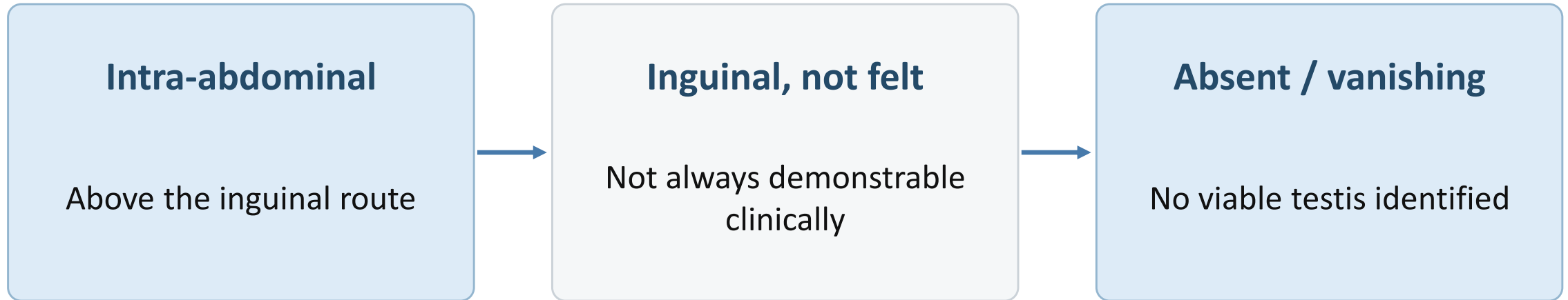
Retractile

- Can be positioned in the scrotum and remain transiently without tension.
- EAU advises observation and examination through puberty rather than routine surgery.

Acquired ascending testis

- Some testes documented previously in the scrotum subsequently ascend.
- This is distinct from a congenital failure to reach the scrotum.
- Acquired cryptorchidism can also threaten germ cell development.

Why a testis may be nonpalpable



The examination answers “can it be palpated?” — not automatically “where is it?”.

Typical clinical discovery

- Cryptorchidism is often asymptomatic.
- A parent or clinician notices an empty scrotal compartment.
- The finding is usually made during routine physical examination.
- Symptoms are not required for meaningful long-term risk.

Focused clinical examination

- Inspect both hemiscrota for symmetry and testicular presence.
- Palpate systematically along the expected inguinal descent pathway.
- Document laterality, palpability, and associated penile/genital findings.
- Differentiate a retractile testis from persistent undescended location.

Clinical red flags

Isolated unilateral undescended testis

- Usually a focused pediatric urology problem.
- Record location and corrected postnatal age.

Bilateral nonpalpable testes or associated hypospadias

- Requires consideration of a disorder/difference of sex development.
- Endocrine and genetic evaluation may be indicated.

Routine imaging is not the central diagnostic step

- The pathway starts with careful examination and specialist referral.
- Ultrasonography cannot reliably establish absence of a nonpalpable testis.
- A nonpalpable testis may require examination under anesthesia and laparoscopy.

Nonpalpable testis: Clinical logic

An empty hemiscrotum is identified



Examination defines palpable versus nonpalpable status



Bilateral nonpalpable: Assess endocrine / DSD concerns



Specialist examination, often under anesthesia



Surgical localization / management when indicated

Stylized reasoning pathway; Individual evaluation depends on clinical findings.

Gross morphology of the cryptorchid testis

- Typically smaller than a normally descended testis.
- Parenchyma may be firm.
- Gross atrophy corresponds to progressive microscopic tubular injury.

When does germ cell injury develop?

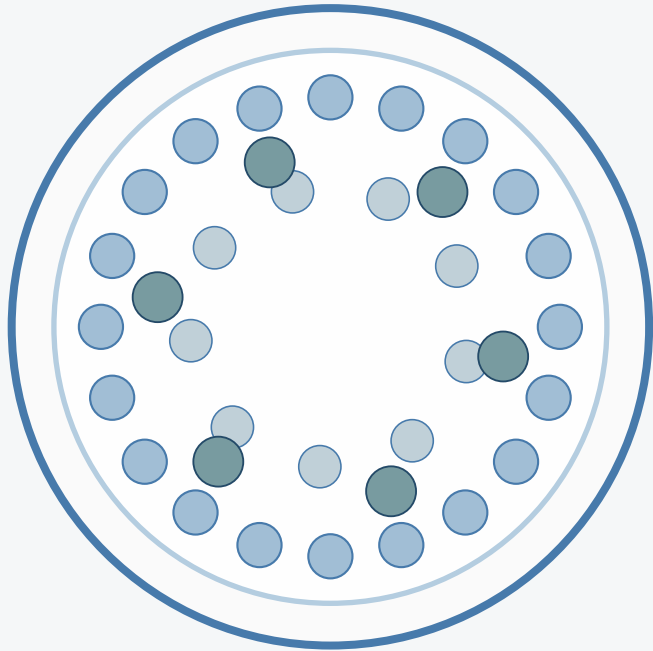
Robbins pathology description

- Histologic changes may become evident by approximately two years of age.
- Early lesion: Tubular basement membrane thickening.

Contemporary clinical evidence

- Subtle germ cell deterioration may occur earlier.
- Early correction is recommended to protect fertility potential.

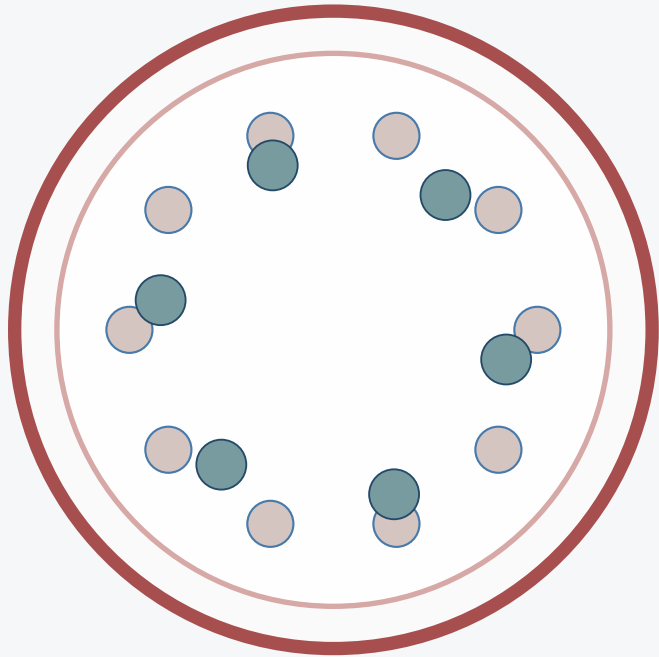
Normal seminiferous tubule: Structural baseline



Schematic — not a histologic specimen

- Germ cells occupy multiple stages of differentiation.
- Sertoli cells support developing germ cells.
- The tubule maintains organized spermatogenesis.

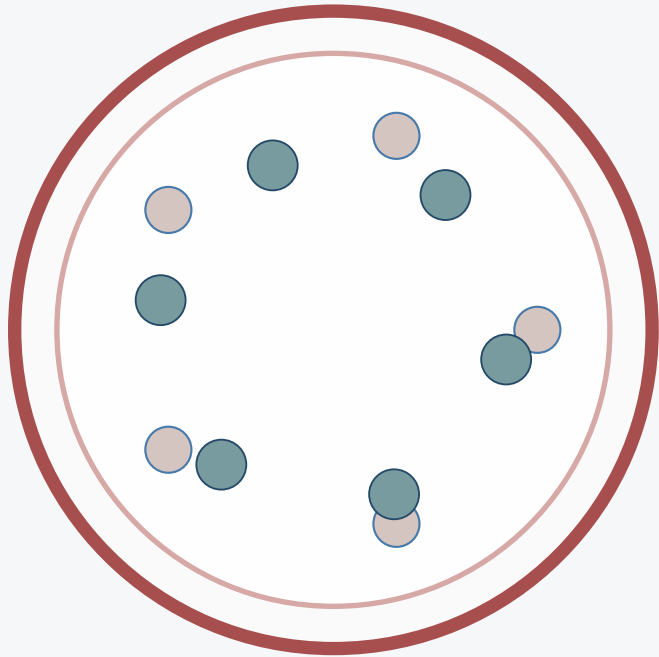
Early atrophy: Basement membrane thickening



Schematic — not a histologic specimen

- Basement membrane thickening can be an early microscopic change.
- Tubular remodeling accompanies abnormal testicular position.
- The tubule may still retain some germ cells at this stage.

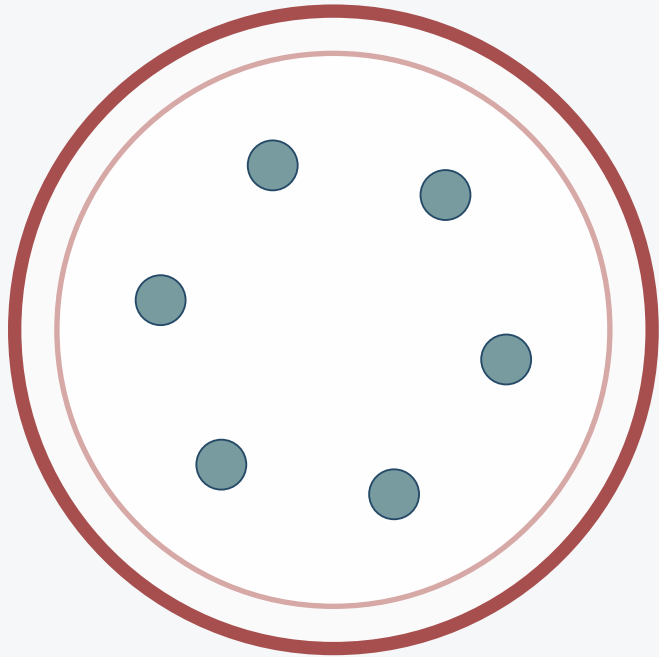
Progressive loss of spermatogonia



Schematic — not a histologic specimen

- Germ cell depletion reduces future spermatogenic capacity.
- The luminal germ cell population becomes sparse.
- The seminiferous epithelium loses its normal multilayered appearance.

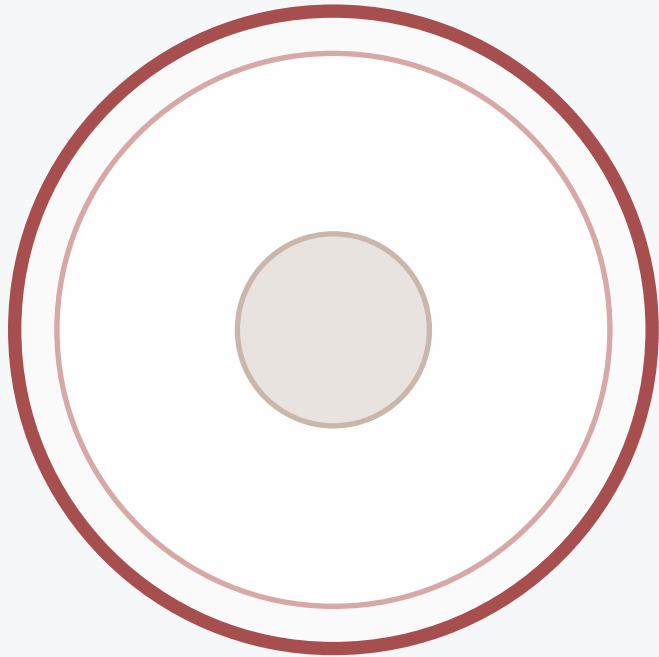
Sertoli-cell-only tubular profiles



Schematic — not a histologic specimen

- Sertoli cells remain while the germ cell population is lost.
- Spermatogenesis is absent in affected tubules.
- This pattern helps explain impaired fertility.

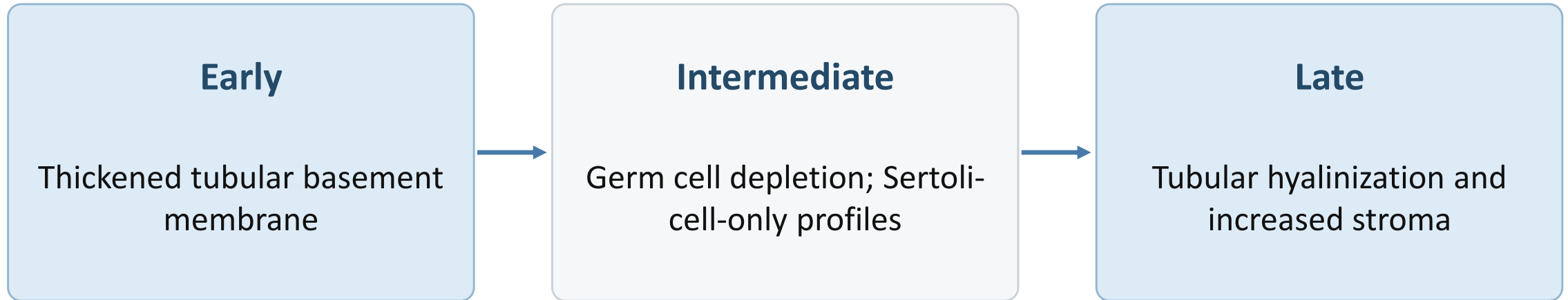
Advanced lesion: Tubular hyalinization



Schematic — not a histologic specimen

- Severely damaged tubules may resemble hyaline connective tissue cords.
- Basement membrane and stromal remodeling become prominent.
- Such tubules are no longer functional units of spermatogenesis.

Tubular evolution in persistent cryptorchidism



A schematic continuum; Findings vary between patients and tubules.

Interstitial changes

- The interstitial stroma becomes more conspicuous as tubules atrophy.
- Leydig cells are relatively spared compared with germ cells.
- Relative Leydig prominence need not imply a primary Leydig-cell neoplasm.

Histologic features: Normal and cryptorchid testis

Germinal epithelium	Active spermatogenesis → depletion or absence of germ cells
Tubular wall	Ordinary basement membrane → thickening / hyalinization
Tubular profile	Functioning seminiferous units → Sertoli-cell-only tubules
Interstitial compartment	Relatively increased stroma and prominent spared Leydig cells

Germ cell neoplasia in situ

- GCNIS may occur in a cryptorchid testis.
- It is a precursor associated with postpubertal-type testicular germ cell tumors.
- Its presence cannot be inferred from atrophy alone.
- Diagnosis requires appropriate histologic assessment rather than clinical location alone.

The descended contralateral testis may be abnormal

- Tubular changes are not always confined to the undescended side.
- Similar histologic alterations in the contralateral scrotal testis.
- This observation argues against a purely local position-dependent mechanism.

Testicular dysgenesis: An interpretive model

In utero gonadal development is disturbed



Testicular descent and germ cell maturation may both be affected



Contralateral testis may share a developmental vulnerability



Reduced spermatogenesis and increased germ cell tumor susceptibility

Model derived from the textbook explanation; Not a proof of one exclusive mechanism.

Why spermatogenesis becomes deficient

- Germ cell attrition reduces the spermatogonial reserve.
- Tubular atrophy compromises the architecture needed for spermatogenesis.
- The underlying developmental abnormality may affect both testes.
- Earlier treatment may mitigate injury but cannot reverse all prenatal abnormalities.

Unilateral and bilateral fertility consequences

Unilateral cryptorchidism

- The ipsilateral testis can have severe tubular atrophy.
- The contralateral descended testis may also be affected.
- Adult paternity may be relatively preserved in many treated patients.

Bilateral cryptorchidism

- Both testes may show compromised germ cell maturation.
- Greater risk of impaired fertility and lower paternity rate.
- Evaluation of nonpalpable bilateral testes needs added care.

Persistent spermatogenic deficit

10–60%

Deficient spermatogenesis after correction in 10%–60% of patients across cited observations. This broad range should not be treated as a single pooled estimate.

Associated inguinal hernia

10–20%

Inguinal hernia in approximately 10%–20% of cryptorchidism cases, linking the descent anomaly with inguinal morbidity.

Inguinal trauma and vulnerability

- An inguinal testis may be vulnerable to external compression.
- Crushing injury as a possible complication.
- Abnormal position creates a risk independent of infertility or neoplasia.

Relative testicular cancer risk

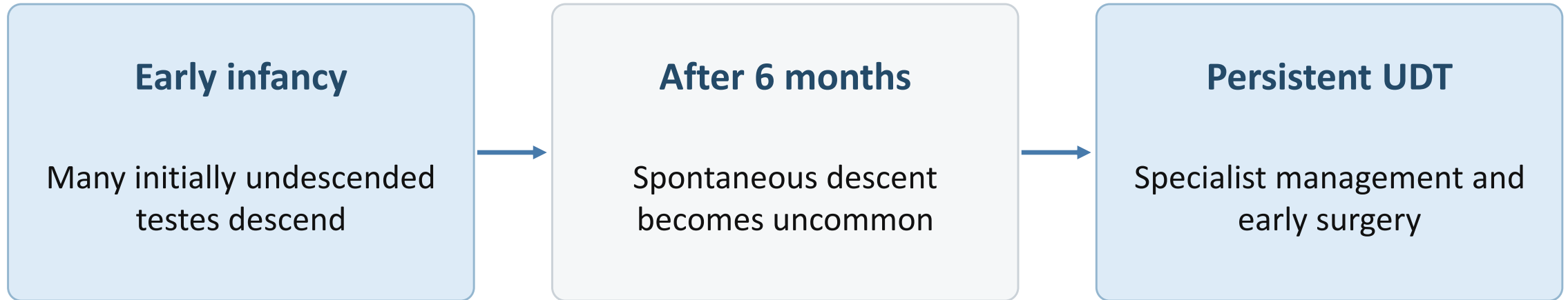
4–10×

A four- to tenfold higher testicular cancer risk in cryptorchidism. This is a relative risk range, not an absolute lifetime probability.

Why orchiopexy does not abolish cancer risk

- The malpositioned testis remains at elevated risk even after relocation.
- The descended contralateral testis may also show increased vulnerability.
- A prenatal or developmental component is therefore plausible.
- Correction improves access to examination but is not a cancer guarantee.

Spontaneous descent: Timing matters

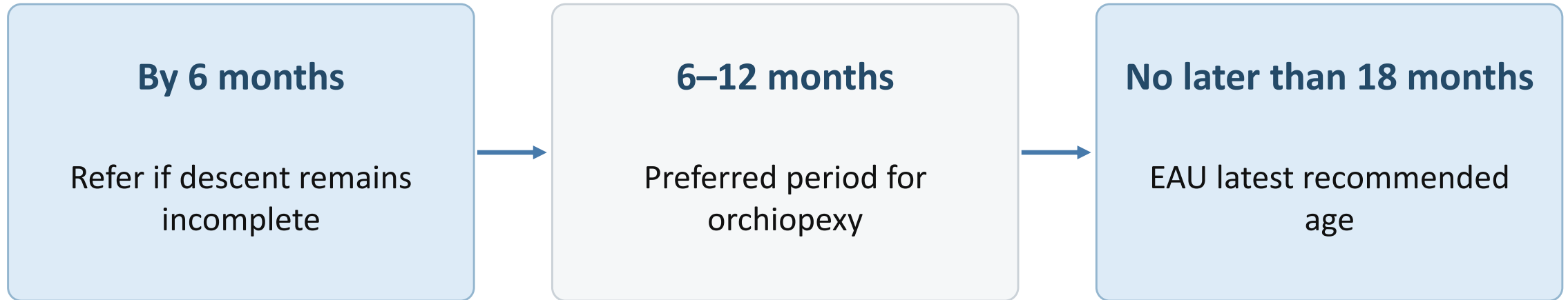


The EAU uses age corrected for gestation when making the 6-month decision.

Why early correction is recommended

- Preservation of germ cell potential motivates intervention before later childhood.
- Germ cell loss and abnormal maturation may precede obvious advanced atrophy.
- Positioning the testis in the scrotum facilitates later surveillance.

Contemporary timing of orchiopexy



Recommendations apply to persistent undescended testes, with gestational age correction.

Orchiopexy: Pathologic purpose and limits

- Surgical fixation places the testis within the scrotum.
- It can reduce later fertility and malignancy risk relative to prolonged untreated retention.
- The procedure does not guarantee normal spermatogenesis.
- A pre-existing developmental cancer susceptibility may remain.

Hormonal treatment: Source versus current guidance

Robbins text (2026 edition)

- Describes hormone injections followed by early orchiopexy if medical treatment fails.
- This is the treatment sequence as written in the supplied chapter.

Contemporary EAU guidance (2026)

- Do not routinely use hormones for unilateral descent.
- Orchiopexy is the treatment of choice.
- Specialist consideration of endocrine therapy for bilateral cases is a separate weak recommendation.

Long-term follow-up and counseling

- The patient and caregivers should understand residual neoplasia risk.
- Examination becomes easier once the testis is in the scrotum.
- EAU recommends self-examination and surveillance awareness during and after puberty.
- Fertility counseling should reflect unilateral/bilateral status.

Clinical application I: Persistent inguinal testis

A 9-month-old child has an empty left hemiscrotum. A testis is palpable in the inguinal canal and cannot be maintained in the scrotal position. The other testis is in the scrotum.

How should an undescended testis be classified and managed?

Clinical application I: Reasoning

- This is a unilateral palpable undescended testis, not a retractile testis.
- Persisting undescended position beyond 6 months supports referral and treatment.
- Early orchiopexy is recommended, ideally in the first year of life.

Clinical application II: Bilateral nonpalpable testes

A newborn has an empty scrotum bilaterally. Neither testis can be palpated; External genital findings also raise a concern for a disorder of sex development.

What additional diagnostic priority is present?

Clinical application II: Reasoning

- Bilateral nonpalpable testes require assessment beyond the unilateral algorithm.
- Consider endocrine and genetic evaluation for a possible disorder/difference of sex development.
- Specialist evaluation precedes definitive localization and surgery.

Pathology application: Interpreting a biopsy

An undescended testis shows small seminiferous tubules, prominent thickened basement membranes, no recognizable spermatogenesis, and relatively visible interstitial Leydig cells.

Which changes support cryptorchid-associated tubular atrophy?

Pathology application: Interpretation

- The dominant lesion is seminiferous tubular atrophy with germ cell depletion.
- Sertoli-cell-only tubules and peritubular thickening explain absent spermatogenesis.
- Relative Leydig cell prominence reflects sparing of interstitial endocrine cells.
- These findings do not establish or exclude GCNIS without specific histologic evaluation.

Core clinicopathologic synthesis

Definition	Incomplete descent of one or both testes into the scrotum
Mechanism	Abnormal descent with possible intrinsic gonadal developmental defects
Microscopy	Germ cell depletion, Sertoli-only tubules, basement thickening
Clinical risk	Impaired fertility, inguinal morbidity, germ cell malignancy
Management	Early orchiopexy; Continued fertility/cancer awareness

References and evidence boundaries

Robbins, Cotran & Kumar. Pathologic Basis of Disease. 11th ed. 2026. Chapter 21, pp. 879–880; Fig. 21.15.

European Association of Urology. EAU Guidelines on Paediatric Urology. 2026. Section 4: Management of Undescended Testes.

Thorup J, et al. The fate of germ cells in cryptorchid testis. Front Endocrinol. 2024;14:1305428. doi:10.3389/fendo.2023.1305428.

Textbook morphology and statistics are kept distinct from updated clinical recommendations.