

Descent of Scrotal Testes and Temperature Regulation

Importance of scrotal descent

- Failure of testis descent into the scrotum is one of the two most frequent male reproductive pediatric complications.
- Descent is essential for normal spermatogenesis.
- Undescended testes leads to an increased incidence in testicular cancer.
- Descent is essential for normal fertility as spermatogenesis can be greatly affected.

Phases of scrotal descent

- Intra-abdominal
- Inguino-scrotal

The gubernaculum and scrotal descent

- Thick ligamentous structure comprised of condensed mesenchymal cells.
- Peritoneal cells infiltrate the gubernaculum at the levels of the inguinal canal.
- Once the testes are in the inguinal region the first phase of testicular descent is complete.
- The gubernaculum begins to regress. This regression is the driving force pulling testes into the scrotum.
- Gubernaculum penetrates the inguinal ring and grows rapidly from the distal end.
- In 1973 scientists removed one or both testes from dogs and found abnormal gubernacular growth.
- Testes or testis extract must be present to stimulate gubernacular growth in vivo and in vitro.
- “descendin”

Insl-3

- Produced and secreted by Leydig cells prior to mesenchymal proliferation and gubernacular growth.
- Transgenic INSL3 -/- mice are cryptorchid with undeveloped gubernaculum
- LGR8 is a potential receptor for INSL3.
- Many labs have found implications for INSL3 in cryptorchidism...
- Very few clinical cases of cryptorchidism have been linked to mutations in INSL3 or LGR8.
- Many other factors have been implicated in the 1st phase of scrotal descent, especially other members of the insulin family

Role of Androgens

- Androgens have been implicated as the primary factors involved in the second phase of testis descent.
- Androgens are important for gubernacular bulb development.
- When given anti-androgens, gubernaculum growth and testis descent is inhibited. This is easily reversed by addition of androgens.

- Timing of the actions of androgens is critical.

Problems associated with testicular descent

Cryptorchidism

- Aetiology is multifactorial
- Risk factors include low birth weight when adjusted for gestational age, twinning, maternal exposure to estrogen in 1st trimester
- May be heritable, some breeds appear more at risk
- Surgical correction, prevent loss of germ cells in humans
- Induced: promotion of rapid, lean muscle growth; investigated as a form of contraception in humans...

Ectopic testes

Inguinal hernia

Thermoregulation and scrotal testes

- Maintenance of testicular temperature of 2-7°C below body temperature is essential for spermatogenesis
- Main anatomical features for thermoregulation:
 - Thin scrotal skin, often hairless, lots of sweat glands
 - Tunica dartos and cremaster muscle
 - Pampiniform plexus (countercurrent heat exchange)
 - Absence of fat

Testicular descent, thermoregulation and exceptions

Testicular descent allows testicles to be kept at lower than core body temperature, essential for normal spermatogenesis. Core body temperature is lethal for germ cells

- Approximately 1500 species of mammals are 'non-scrotal'
- Most of these still have a trans-abdominal migration phase
- Why is spermatogenesis still successful?
 - Some have testicles in a 'cooler' position
 - Some have specialized cooling systems
 - Some have a low core body temperature
 - Some we just don't know