Cryptorchidism is a term used to describe the failure of descent of the testicle into the scrotum. This condition is common among premature boys, 33% of them, and can still be identified in full-term boys in approximately 5%. Ultrasonography can help localize inguinal testicles, while abdominal magnetic resonance imaging or laparoscopy can identify non-palpable intraabdominal testis. Hormonal treatment is indicated at 6 months of life and surgical correction is needed if hormonal therapy failed. Surgical treatment should be attempted before one year of life to achieve better fertility outcome.

Definition and Epidemiology of Cryptorchidism

failure of testicular descent into the scrotum. Several forms of undescended testis exist and true cryptorchidism means that the testicle is not palpable. The testicle can be either intra-abdominal or completely absent.

Embryology

The gonads initially develop from the mesothelial layer of the peritoneum as well as the mesonephros. At week 5-6, germ cells migrate from near the allantois and colonize the primordial gonads. The germ cells colonize the seminiferous cords of the medulla, becoming spermatogonia.
At first, the mesonephros and gonadal ridge are continuous, but as the embryo grows the gonadal ridge gradually becomes pinched off from the mesonephros. However, some cells of mesonephric origin join the gonadal ridge. Furthermore, the gonadal ridge still remains connected to the remnant of that body by a fold of peritoneum, namely the mesorchium.

The testis in its earliest stages consists of a central mass covered by a surface epithelium. In the central mass, a series of cords appear, and the periphery of the mass is converted into the tunica albuginea, thus excluding the surface epithelium from any part in the formation of the tissue of the testis. The cords of the central mass run together toward the future hilum and form a network which ultimately becomes the rate of testis at the hilum of the testicle.

On the other hand, the seminiferous tubules are developed from the cords distal to the hilum, and between them, connective-tissue septa extend. Via the rete testis, the seminiferous tubules become connected with outgrowths from the mesonephros, which forms the efferent ducts of the testis.

**Descent of the testes**

The descent of the testes consists of the opening of a connection from the testis to its final location at the anterior abdominal wall, followed by the development of the gubernaculum, which subsequently pulls and translocates the testis down into the developing scrotum. Ultimately, the passageway closes behind the testis.

A failure in this process causes an indirect inguinal hernia. Indirect inguinal hernias are common in children and are called as such because the defect follows the oblique course of the vas and testicular vessels inside the inguinal canal. A direct inguinal hernia is the result of a weakened area on the floor of the inguinal canal and in the transversals fascia, located medially to the course of the vas. All hernias are covered by parietal peritoneum.

**Opening of a connection**

At an early period of fetal life, the testes are placed at the back part of the abdominal cavity, behind the peritoneum, and each is attached by a peritoneal fold, the mesorchium, to the mesonephros. From the front of the mesonephros, a fold of peritoneum called the inguinal fold grows forward to meet and fuse with a peritoneal fold, the inguinal crest, which grows backward from the anterolateral abdominal wall. The testis thus acquires an indirect connection with the anterior abdominal wall. At the same time, a portion of the peritoneal cavity lateral to these fused folds is marked off as the future tunica vaginalis.

**Development of gubernaculum**

Also in the inguinal crest, a structure, the gubernaculum testis, makes its appearance. This is at first a slender band, extending from that part of the skin of the groin which afterward forms the scrotum through the inguinal canal to the body and epididymis of the testis. As development advances, the peritoneum enclosing the gubernaculum forms two folds, one above the testis and the other below it. The one above the testis is the plica vascular, and contains the upper part of the gubernaculum, and ultimately also the internal spermatic vessels; the one below, the plica gubernatrix, contains the lower part of the gubernaculum.
The gubernaculum grows into a thick cord. It ends below at the abdominal inguinal ring in a tube of peritoneum, the saccus vaginalis, which protrudes itself down the inguinal canal. By the fifth month the lower part of the gubernaculum still is a thick cord, while the upper part has disappeared. The lower part now consists of a central core of smooth muscle fibers, surrounded by a firm layer of striated muscle elements, connected, behind the peritoneum, with the abdominal wall.

Translocation

As the testes develop, the main portion of the lower end of the gubernaculum is carried, following the skin to which it is attached, to the bottom of this pouch. The tube of peritoneum constituting the saccus vaginalis projects itself downward into the inguinal canal, and emerges at the external inguinal ring, pushing before it a part of the Obliquus internus and the aponeurosis of the obliquus externus, which form respectively the cremaster muscle and the external spermatic fascia.

The saccus vaginalis forms a gradually elongating pouch, which eventually reaches the bottom of the scrotum, and behind this pouch the testis is drawn by the growth of the body of the fetus, for the gubernaculum does not grow proportionately with the growth of other parts, and therefore the testis, being attached by the gubernaculum to the bottom of the scrotum, is prevented from rising as the body grows, and is instead drawn first into the inguinal canal and eventually into the scrotum.

It seems certain also that the gubernacular cord becomes shortened as development proceeds, and this assists in causing the testis to reach the bottom of the scrotum.

Closing of connection

By the end of the eighth month, the testis has reached the scrotum, preceded by the saccus vaginalis, which communicates by its upper extremity with the peritoneal cavity. Just before birth the upper part of the saccus vaginalis, at the internal inguinal ring, usually becomes closed, and this obliteration extends gradually downward to within a short distance of the testis. The process of peritoneum surrounding the testis is now entirely cut off from the general peritoneal cavity and constitutes the tunica vaginalis.

In the testis, a network of tubules fuse to create the seminiferous tubules. Via the rete testis, the seminiferous tubules become connected with outgrowths from the mesonephros, which form the efferent ducts of the testis.

Undescended testis is a common condition, especially in preterm boys. One-third of preterm boys are expected to have undescended testis while only 5% of full-term boys have cryptorchidism.

At 3 months of age, only 1% of full-term boys still have an undescended testis. Endogenous production of testosterone is believed to be responsible for the descent of the testis in the first three months of life in 80% of the cases. At six months of age, boys who still have an undescended testis are highly unlikely to have spontaneous descent.

Etiology of Cryptorchidism

The exact cause of cryptorchidism is still unknown; however, several risk factors have been linked to the condition. The most common risk factor is premature birth and/or a birth weight that is lower than 2.5 kg. The testes are formed intra-abdominally and
they undergo a highly regulated descent process to eventually reside in the scrotum. Premature boys simply did not complete this normal descent process.

**Placental insufficiency** and **low maternal estrogen levels** have also been linked to the development of cryptorchidism.

**Environmental factors include:**
- Organochlorine
- Mono-esters of phthalates
- Maternal smoking
- Maternal diabetes mellitus

They all have been linked to an increased risk of undescended testis and maldevelopment of the **male reproductive system.**

### Pathophysiology of Cryptorchidism

Several theories exist to explain how cryptorchidism might happen. An anatomical structure called the **gubernaculum testis** is responsible for widening the **inguinal canal** and guiding the descent of the testis into the **scrotum**. This structure should be normally attached to the scrotum and **tunica vaginalis**. Any abnormality in the attachment or configuration of this structure can lead to cryptorchidism.

Additionally, patients with **gastroschisis** and other conditions with malfunctioning or absence of abdominal wall muscles are known to have **low intra-abdominal pressure**. This is hypothesized to be responsible for maldescent of the testis in this group of patients.

The undescended testis can have anatomical or functional abnormalities which can be confirmed by **histologic examination**. These abnormalities might cause the testis to fail to descend and are also responsible for the increased risks of **infertility** and **testicular cancer** in the affected testis.

Finally, premature boys can have undescended testis because the testes simply did not start or complete their course to the scrotum. The testes remain inside the abdominal cavity, **retroperitoneally**, until 28 weeks of gestation.

### Clinical Presentation of Cryptorchidism

**Testicular examination** is the key to diagnose patients with cryptorchidism. Cold hands, sudden palpation, and anxiety can activate the **cremasteric reflex** causing the testis to retract upwards and into the inguinal outer opening. Therefore, an examination should be performed with two hands to push the testis downwards, should be gentle and with warm hands. Even with these measures, testicular examination in this age group remains a challenge and should be performed by an experienced pediatric urologist if possible.

During an examination, it is important to differentiate between **gliding testicle** and **hypermobile testicle**. Once the testicle is pushed down to the scrotum, the examining doctor can remove his or her hand from the inguinal opening. If the testicle returns immediately to the inguinal canal and disappears from the scrotum without activating the cremasteric reflex, the term gliding testicle is used.

If the testicle does not go back to the inguinal opening until the cremasteric reflex is
activated, the term hypermobile testicle is used and is thought to be a normal phenomenon. Several forms of undescended or maldescended testis exist and the table below summarizes them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryptorchidism</td>
<td>The testis is completely not palpable because it is either inside the abdominal cavity or because it is completely absent.</td>
</tr>
<tr>
<td>Undescended testis</td>
<td>The testis can be palpated in the inguinal canal or intra-abdominally visualized by other means such as ultrasonography, and the gubernaculum is normally attached between the lower border of the tunica vaginalis and scrotum.</td>
</tr>
<tr>
<td>Ectopic testis</td>
<td>The testis is not on its normal descent pathway. It can be under the skin, on the thigh or on the shaft of the penis.</td>
</tr>
</tbody>
</table>

Table 1: Definition of different forms of undescended or maldescended testis.

Diagnostic Work-up for Cryptorchidism

Laboratory investigations are not needed unless the patient has bilateral undescended testicles. In this case, karyotyping is indicated to exclude a female karyotype with adrenogenital syndrome.

Patients with a non-palpable unilateral undescended testis should undergo ultrasonography, magnetic resonance imaging or laparoscopy to determine the presence and structure of the testis.

Ultrasonography has good sensitivity and specificity for detection of an inguinal undescended testicle but might prove to be more difficult for intra-abdominal testicles. Magnetic resonance imaging can visualize non-palpable intra-abdominal testicles but laparoscopy is recommended because it can be both diagnostic and therapeutic.

Treatment of Cryptorchidism

Treatment of undescended testis is dependent mainly on the location of the testis. The first step is to wait and see until the infant is six months old because as we have explained, 4 out of 5 patients might have spontaneous descent.

The next step in the management of inguinal testis that is palpable is to prescribe hormonal therapy. Either human chorionic gonadotropin or gonadotropin releasing hormone can be used as both of them lead to increased testosterone production by Leyding cells of the testis. Increased testosterone production is thought to be responsible for the descent of the testis in some patients.

At one year of life, if the testis is not yet in the scrotum, hormonal therapy is deemed to be unsuccessful and surgical treatment is indicated. Surgical treatment involves an orchidopexy in which the testis is fixated to the scrotum.

Patients with non-palpable intra-abdominal testis are recommended to undergo a laparoscopy which is both diagnostic and therapeutic. During laparoscopy, the testis should be identified and fixated on the scrotum. The success rate of laparoscopic orchidopexy is 90%.

Unfortunately, a significant proportion of patients with the previous history of cryptorchidism develop subfertility. Additionally, men with the previous history of cryptorchidism have a 32-fold increase in the risk of testicular malignancy in the
affected testicle. This risk is highest for intra-abdominal testicles.

References


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