

Surgical Anatomy of the Inguinal Region in Laparoscopic Varicocelectomy: A Review

Osama M.H. Khalil, Ahmed M. Sallam, Abdelrahman Mahmoud Ibrahim Azzam, Mohamed Negm

Department of General Surgery, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Ahmed Mohamed Farouk Abdel Aziz

Abstract

Background: A detailed understanding of the laparoscopic anatomy of the inguinal region is essential for safe surgical dissection. Important anatomical landmarks include the umbilical folds, internal inguinal ring, iliopubic tract, testicular vessels, inferior epigastric vessels, external iliac vessels, and major vascular danger zones. Recognition of these structures facilitates orientation during laparoscopic procedures and reduces the risk of vascular and surrounding tissue injury.

Aim: This review aims to describe the laparoscopic surgical anatomy relevant to varicocelectomy, with particular emphasis on the internal inguinal ring, spermatic and testicular vessels, iliopubic tract, inferior epigastric vessels, and vascular danger zones encountered during laparoscopic dissection.

Conclusion: Safe laparoscopic varicocelectomy depends on accurate recognition of the anatomical landmarks of the inguinal region. The internal inguinal ring provides an important reference for identifying the spermatic cord, while the inferior epigastric vessels and iliopubic tract assist in laparoscopic orientation. Knowledge of the relationship between the vas deferens, testicular vessels, external iliac vessels, and vascular danger zones is important for minimizing vascular injury and maintaining safe surgical dissection.

Keywords: Laparoscopic anatomy; Varicocelectomy; Internal inguinal ring; Testicular vessels; Iliopubic tract; Inferior epigastric vessels; Triangle of doom.

Introduction

Laparoscopic anatomy of the inguinal region is viewed from the posterior aspect of the anterior abdominal wall. Recognition of the peritoneal folds and the structures lying beneath them provides important landmarks for orientation during laparoscopic surgery. The median umbilical fold lies in the midline and extends from the apex of the urinary bladder to the umbilicus, while the medial umbilical folds are raised by the obliterated umbilical arteries (Mantas et al., 2020).

The lateral umbilical folds contain the inferior epigastric vessels and form the lateral border of Hesselbach's triangle. These folds distinguish indirect hernias, which occur lateral to the inferior epigastric vessels, from direct hernias, which occur medially. The medial inguinal fossa lies between the lateral and medial umbilical folds, while the lateral inguinal fossa lies lateral to the inferior epigastric artery (Irving et al., 2011).

Identification of the internal inguinal ring is essential for recognizing the spermatic cord and related anatomical structures. Laparoscopic identification depends on landmarks including the umbilical ligaments, a slight peritoneal indentation, and the junction of the vas deferens with the spermatic vessels. Knowledge of these anatomical relationships is important for safe dissection in the inguinal region (Standring, 2021).

Umbilical Folds and Inguinal Fossae

The posterior surface of the anterior abdominal wall contains the median, medial, and lateral umbilical folds. The median umbilical fold is produced by the obliterated urachus, while the medial folds are raised by the obliterated umbilical arteries (Mantas et al., 2020). The lateral umbilical folds contain the inferior epigastric vessels and represent an important landmark in laparoscopic identification of the inguinal region (Irving et al., 2011).

The medial umbilical folds mark the lateral extent of the urinary bladder and divide the posterior wall of the inguinal region into the supravescical fossa medially and the inguinal fossa laterally. The relationship of these folds to the inferior epigastric vessels provides a useful anatomical guide during laparoscopic orientation (Mantas et al., 2020; Irving et al., 2011).

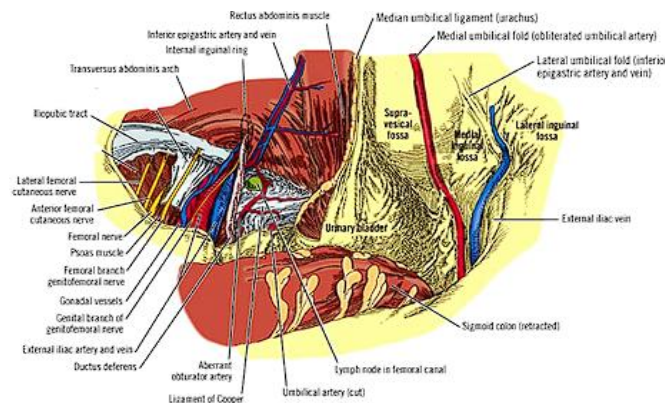


Figure 1. Umbilical folds and ligaments (Skandalakis, 2013).

Internal Inguinal Ring

The internal inguinal ring is a rounded defect in the transversalis fascia and represents an important laparoscopic landmark for identification of the spermatic cord. It can be recognized by the umbilical ligaments, a slight peritoneal indentation, and the junction of the vas deferens with the spermatic vessels. The ring appears as an inverted U-shaped structure formed by two pillars of the transversalis fascia sling (Standring, 2021).

The relationship of the vas deferens and spermatic vessels at the deep inguinal ring is particularly important because these structures converge toward the spermatic cord. Accurate identification of this relationship facilitates orientation and limits unnecessary dissection around adjacent vascular structures (Standring, 2021).

Iliopubic Tract

The iliopubic tract is a key surgical landmark, particularly in laparoscopic varicocelectomy. It is a thickened aponeurotic band extending from the iliopectineal arch to the superior pubic ramus, forming the inferior margin of the deep musculoaponeurotic layer composed of the transversus abdominis muscle and transversalis fascia (Standring, 2021).

Laparoscopically, it is seen along the inferior border of the deep inguinal ring. It appears as a fascial condensation running parallel and posterior to the inguinal ligament, extending from the iliac crest and anterior superior iliac spine, crossing anterior to the femoral vessels, and attaching medially to Cooper's ligament (Standring, 2021).

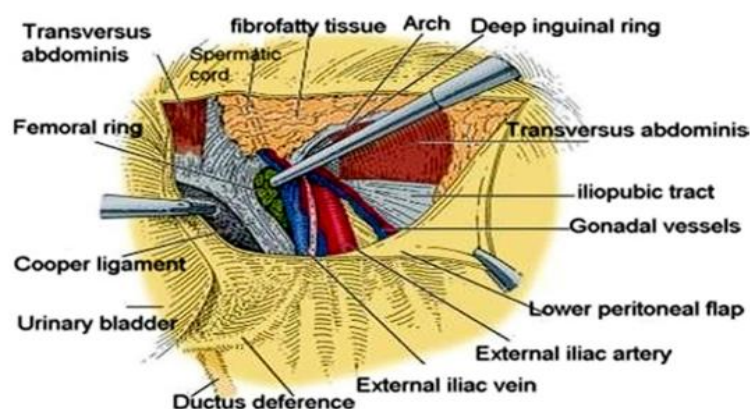


Figure 2. Iliopubic tract (Skandalakis, 2013).

Vascular Anatomy of the Groin

External Iliac Vessels

The external iliac vessels course along the medial border of the psoas muscle and pass beneath the iliopubic tract and inguinal ligament to become the femoral vessels. The external iliac artery runs retroperitoneally along the pelvic brim over the psoas muscle and enters the femoral sheath beneath the inguinal ligament. Its main branches, the inferior epigastric and deep circumflex iliac arteries, arise just above the inguinal ligament. The external iliac vein lies medial to the artery and joins the internal iliac vein to form the common iliac vein (Agresta et al., 2019; Standring, 2021).

Testicular Vessels

The testicular arteries arise from the abdominal aorta below the renal arteries at approximately the L2 level. They descend retroperitoneally, cross the ureter, and course along the lateral aspect of the external iliac artery before entering the spermatic cord through the deep inguinal ring. Rich collateral circulation exists through anastomoses with the deferential and cremasteric arteries (Standring, 2021).

Venous drainage occurs through the pampiniform plexus. Multiple venous tributaries coalesce along the spermatic cord to form the testicular vein. The right testicular vein drains into the inferior vena cava, whereas the left testicular vein drains into the left renal vein (Standring, 2021).

Inferior Epigastric Vessels

The inferior epigastric vessels arise from the external iliac vessels just proximal to the inguinal ligament and ascend superomedially. Their branches include the cremasteric artery, pubic branch, and communicating obturator branch. The inferior epigastric vessels are important landmarks during laparoscopic dissection and assist in orientation within the preperitoneal space (Standring, 2021; Agresta et al., 2019).

Corona Mortis

The communicating obturator branch may anastomose with the obturator artery, forming the corona mortis. This vascular connection is surgically important because injury near Cooper's ligament may result in significant bleeding (Standring, 2021).

The corona mortis, or "circle of death," represents an anastomosis between an aberrant obturator vessel and the normal obturator artery. Injury during laparoscopic procedures may cause profuse bleeding from both ends because of its connection with major arterial sources (Skandalakis, 2013).

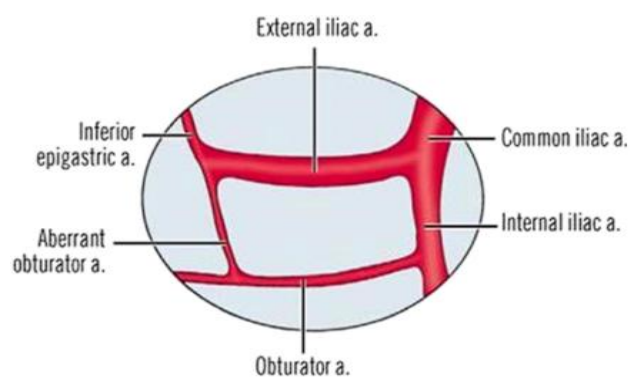


Figure 3. Circle of death (Skandalakis, 2013).

Triangle of Doom

The triangle of doom is bordered medially by the vas deferens and laterally by the spermatic vessels, with its base formed by the peritoneal edge and its apex at the deep inguinal ring. The external iliac vessels lie on its floor, covered by the peritoneum and transversalis fascia (Skandalakis, 2013; Agresta et al., 2019).

Its contents, from lateral to medial, include the genital branch of the genitofemoral nerve, external iliac artery, external iliac vein, and deep circumflex iliac vein. Injury to structures within this region may cause severe

vascular complications; therefore, the triangle represents an important danger zone during laparoscopic surgery (Skandalakis, 2013).

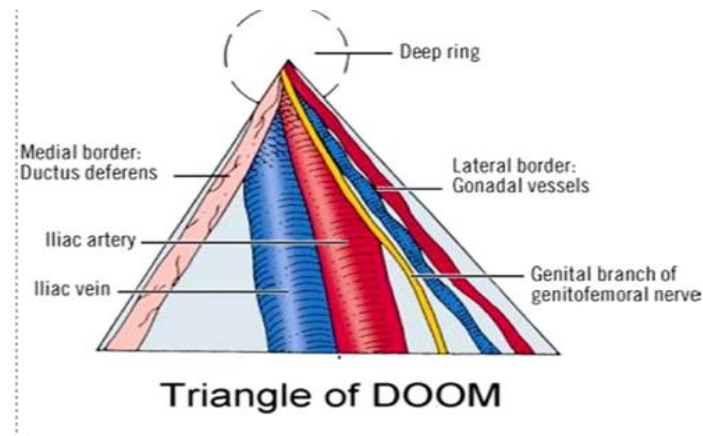


Figure 4. Triangle of Doom (Skandalakis, 2013).

Surgical Relevance to Laparoscopic Varicocelectomy

The anatomical relationship between the vas deferens, spermatic vessels, deep inguinal ring, inferior epigastric vessels, external iliac vessels, and iliopubic tract provides the basis for safe laparoscopic orientation. The inferior epigastric vessels serve as a key landmark during preperitoneal dissection, while the internal inguinal ring identifies the point at which the testicular vessels and vas deferens converge toward the spermatic cord (Standring, 2021; Agresta et al., 2019).

The testicular vessels pass in close relationship to major pelvic vascular structures before entering the deep inguinal ring. Awareness of these relationships, particularly the external iliac vessels and corona mortis, is important to avoid potentially significant hemorrhage during laparoscopic dissection (Standring, 2021).

The iliopubic tract provides an additional landmark along the inferior border of the deep inguinal ring, while the triangle of doom defines a region in which major vascular structures must be protected. Together, these landmarks provide a practical anatomical framework for safe laparoscopic dissection in the inguinal region (Skandalakis, 2013; Standring, 2021).

Conclusion

Detailed knowledge of laparoscopic inguinal anatomy is essential for safe varicocelectomy. The umbilical folds, internal inguinal ring, iliopubic tract, inferior epigastric vessels, testicular vessels, and external iliac vessels provide important landmarks for orientation. Recognition of the corona mortis and triangle of doom is particularly important because injury to the vascular structures within these regions may result in significant hemorrhage. A clear understanding of these anatomical relationships facilitates safe dissection and reduces the risk of vascular injury during laparoscopic surgery.

References

1. Mantas D, Kostakis ID, & Garoufalia Z. (2020): Types of Colon Surgery and Anatomy. In *Laparoscopic Colon Surgery: Milestones, Education, & Best Practice* (pp. 15-39). Cham: Springer International Publishing.
2. Irving SO, Ghosh A, O'Dwyer PJ (2011): Laparoscopic anatomy of the inguinal region. *Hernia*, 15(5), 531-538.
3. Standring S (Ed.). (2021): *Gray's anatomy: The anatomical basis of clinical practice* (42nd ed.). Elsevier.
4. Agresta F, Campanile FC, Podda M, Cillara N, Pernazza G, Ansaloni L (2019): Laparoscopic groin anatomy and its surgical relevance. *Updates in Surgery*, 71(1), 1-12.
5. Skandalakis JE. (2013): *Surgical anatomy and technique: A pocket manual* (4th ed.). Springer.
6. McIntyre (2013): Figure source cited in Chapter 2 of the thesis; full bibliographic details were not provided in the thesis reference list.