Role of Interventional Radiology in Gonadal Vein Embolization

Submitted for PARTIAL FULILMENT OF M.D. DEGREE IN RADIOLOGY

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Introduction

A varicocele consists of abnormally dilated and tortuous veins within the pampiniform plexus of the spermatic cord **(Wein et al., 2012).**

Varicocele is a common clinical condition with a growing importance in reproductive medicine practice , being Found in about 15% of male population ,35% in those presented with primary infertility , and 80 % in those with secondary infertility **(Alsaikhan et al., 2016).**

The World Health Organization (WHO) reported a relatively higher incidence of varicocele in men presented originally with abnormal sperm analysis to be considered a treatable cause of infertility; it is also a well-known cause of chronic testicular pain and discomfort **(Sigman et al., 2011).**

It is likely due to many factors. Recent studies showed that it is mainly a result of high levels of reactive oxygen species (ROS) **(Zini et al., 2011).**
This excess ROS is usually accompanied by sperm DNA fragmentation, which may be resulting in the clinical manifestation of poor sperm function and fertilization outcome related to varicocele **(Cho et al., 2016).**

Varicocele diagnosis is a multi-disciplinary process , involving both physical examination via palpating the scrotal sac and color Doppler examination which is sensitive in about 97% of cases and finally by the assessment of varicocele effect on semen analysis and other laboratory parameters ***.(Choi et al. , 2013).***

Accordingly, varicocele treatment can arrest the continued decrease in the testicular functions, as well as improving semen parameters and serum testosterone **(Tanrikut et al., 2011).**

Varicocele is potentially treatable with wide range of treating modalities. Early detection and treatment had been proved to have a positive impact on fertility rate, one or more semen parameters and a significant improvement in sperm DNA. (***Tiseo et al, 2016).***

Surgical ligation of the dilated veins and embolization of the internal spermatic vein are the main therapeutic lines of management reported for a male complaining from varicocele. In comparison to surgical repair of the dilated veins, embolization is found to be a cheaper and less invasive option, as it only requires local anesthesia and allows us to visualize the internal spermatic vein through its whole course and detect all the possible collaterals **(Urbano et al, 2014).**

Radiographic approaches involve venography to identify the internal spermatic and collateral veins **(Wein et al., 2012).** Then, occluding these veins using various embolization techniques which results in improvement of semen parameters including sperm motility and sperm count, semen testosterone level, and pregnancy rates. The main aim of varicocele embolization if the complaint was pain is to reduce the pain **(Halpern et al., 2016).**

Among all the available options, Percutaneous varicocele treatment is considered to be the least invasive. Percutaneous interventional approaches do not require surgical incisions as the surgical approach and thus, can be done using only local anaesthesia. Surgical failure may be due to pre-existing collateral gonadal veins, Varicocele embolization is therefore better done after venography to identify the collaterals **(Jargiello et al., 2015).**
Moreover, the trans-venous method eliminates any risk to damage to the testicular artery.

Varicocele embolization is a minimally invasive procedure, so major complications are rare. Despite the fact that venous vascular perforation is common during the procedure , it's rarely associated with any clinical symptoms .Multiple studies stated that there's 0-12% risk of developing post-operative hydrocele , 3-3.7% risk of developing epididymitis and 0% risk of developing chronic scrotal pain .(***Halpern et al., 2015).***

Aim of work

This study aims to enhance the role of interventional radiology in gonadal vein embolization in males in the management of varicocele causing testicular pain or infertility.

CHAPTER ONE

ANATOMY

Chapter one

Anatomy

Testes are two oval-shaped organs in the male reproductive system. They are contained in a sac of skin called the scrotum, measuring approximately about 25ml in volume, with average dimensions being 3.5-5 x 3 x 3 cm. with the epididymis situated on the posterolateral aspect of each testicle. it is covered by a tough fibrous capsule called tunica albuginea **(Figure - 1).** Which invaginates posteriorly forming the mediastinum testis, seminiferous tubule is divided by the multiple septa traversing the testicle, the seminiferous tubules are lined by Sertoli cells that aid the maturation process of the spermatozoa. In the interstitial tissue lie the Leydig cells that are responsible for testosterone production. **(Figure - 2)**.

The next layer is the tunica vaginalis being composed of two layers, the visceral layer being in contact with the testis, epididymis and vas deference, The parietal layer being in contact with the internal spermatic fascia.

The epididymis consists of a single heavily coiled duct measuring about 6 meters. It can be divided into three parts: head, body and tail.

Head – The most proximal part of the epididymis. Formed by efferent tubules which transport sperm from the testes to the epididymis.

Body – Formed by the heavily coiled duct of the epididymis.

Tail – The most distal part of the epididymis. Marking the origin of the vas deferens, which transports sperm to the prostatic portion of the urethra for ejaculation **(Kim et al., 2010).**

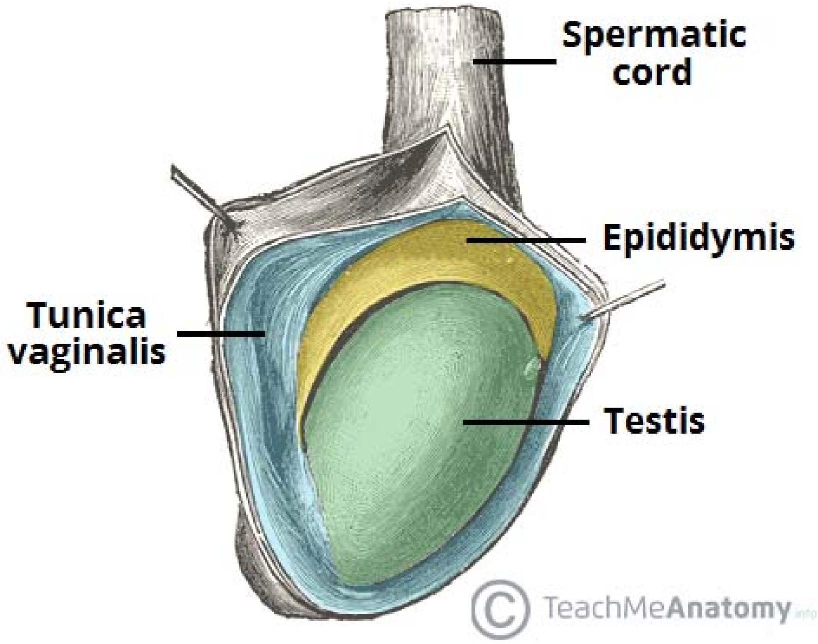

Figure 1- Testicular anatomy (Teach me anatomy 2019).

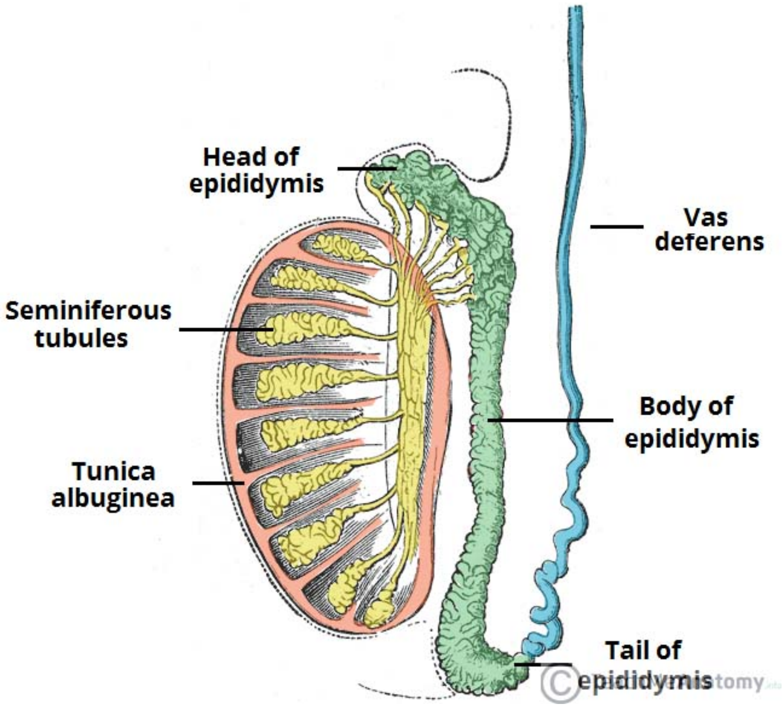

Figure 2 - Structure of the testes and epididymis (Teach me anatomy 2019).

The testicular appendix (alternatively called appendix of testis or appendix testis), historically also known as hydatid of Morgagni) being a developmental remnant of the paramesonephric duct (Müllerian duct) and is situated in the upper pole of the testis inside a groove between the testicle and the head of epididymis

(Figure -3).

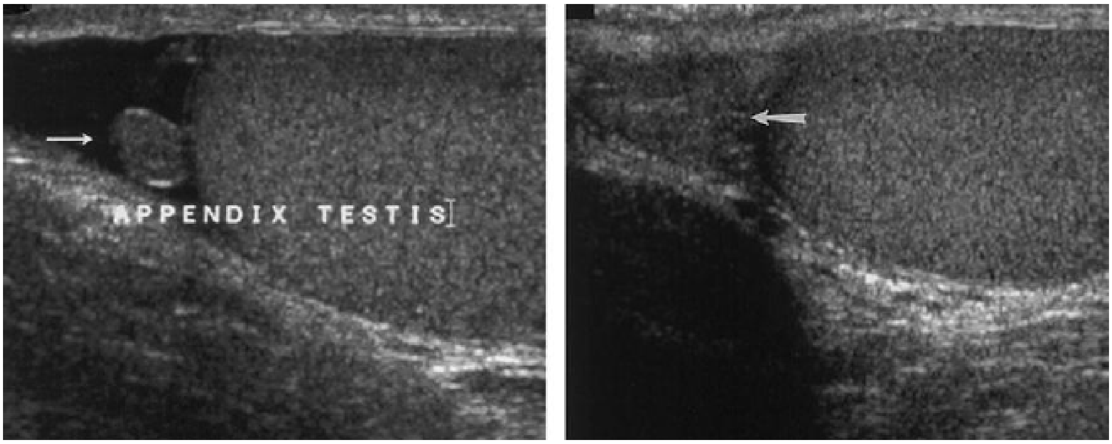

Figure 3-(a)Longitudinal US scan of a normal testis in a 26-year-old man shows the appendix testis (arrow) as a hypoechoic structure. The presence of hydrocele renders the appendix testis visible. (b) Longitudinal US scan of a normal epididymis in a 24-year-old (Dorga et al., 2003).

TESTICULAR BLOOD SUPPLY

Arterial blood supply :

1-Testicular artery :

It rises from the abdominal aorta just inferior to the level of renal arteries, then it has either a straight or a tortuous course down to the testes **(Skowronski et al., 2003).**

In most cases it terminates at the upper mediastinum testis, with less frequently terminating 4-8 cm above the mediastinum testis.

The branching pattern varies as follows:

1- In 69.7% of the cases, there is two main terminal branches: An upper polar branch running toward the upper anterior aspect of the testis and a lower polar branch running toward its lower posterior aspect. In about 80% of this type, the lower branch gives another terminal branch to anastomose with the cremasteric artery and in the remaining 20% both the upper and lower branches anastomose with the cremasteric artery **(Figure 4).**

2- In 15.8% of cases, the upper segmental branch gives rise to the middle branch at the middle of the mediastinum testis then supply the lower end and epididymis **(Figure 5).**

3- In 7.9% of cases, it runs downwards along the mediastinum testis giving rise to three extra testicular terminal branches: upper, middle and lower segmental branches.

4- In 6.6% of cases, it gives out upper segmental branch before the upper edge of the testis then continues further downwards along the mediastinum testis curving forward and upward to supply its anterolateral part. The most terminal part of the testicular artery anastomosed with branches from the cremasteric artery.

(Asala et al. 2001).

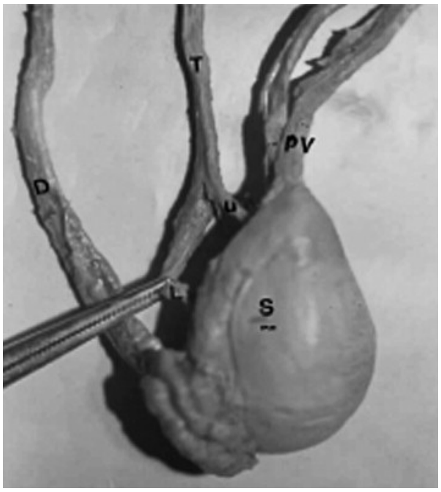

Figure 1-Dissected right testis (S) and its spermatic cord showing the first pattern (69.7%) of testicular artery (T) termination with upper polar (U) and lower polar (L) branches. D = vas deferens; PV = venous plexus.

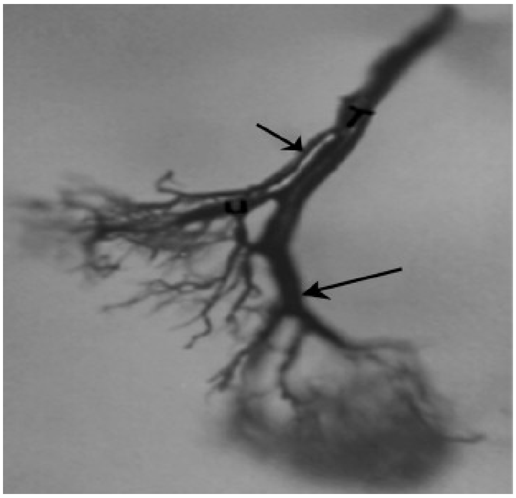

Figure 2 : Plastic cast of second pattern of testicular artery (15.8%) with single upper polar (U) branch and then descends by itself (long arrow).

2-Cremasteric artery:

It originates from the inferior epigastric artery near the inguinal ring to entering the inguinal canal to supply the cremasteric contents. It then terminates close to the lower end of testis, anastomosing either with the lower branch of the testicular artery in 80% of the cases and with both upper and lower branches in 20% of the cases.

3-Artery of Vas:

It arises from the inferior vesical artery giving several branches supplying the vas and terminating into capsular branches near the mediastinum testis. These branches anastomose with the testicular artery **(Mostafa et al., 2008)**.

Testicular venous drainage

The venous circulation of the testes comprises two major intrascrotal drainage networks, the deep or primary system and the superficial or secondary system **(Figure 6). (Chatel et al. 1992).**

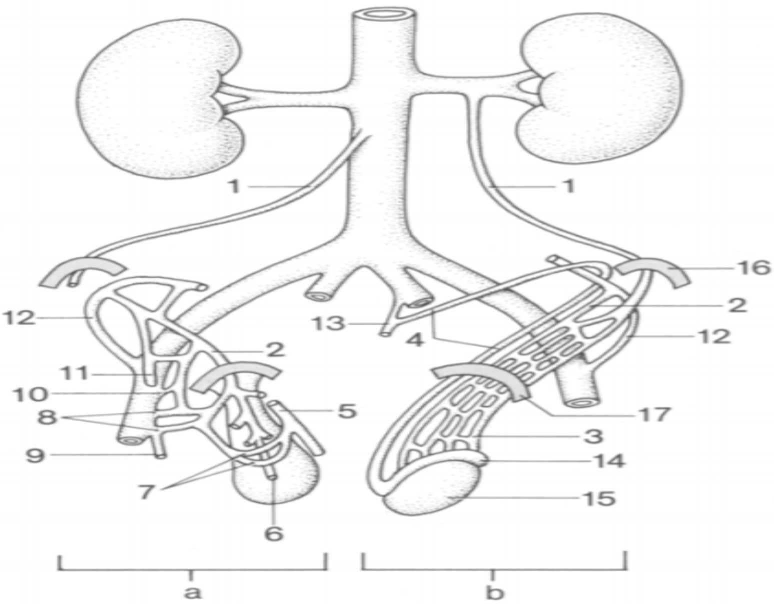

Figure 6: Normal anatomy of the testicular vein. a Superficial, b deep network. 1. Testicular vein (internal), 2 testicular vein (external), 3 pampiniform plexus, 4 vein of vas deferens, 5 internal pudendal vein, 6 cremasteric vein, 7 scrotal veins, 8 superficial and deep external pudendal veins, 9 internal saphenous vein,10 circumflex iliac vein, 11 superior epigastric vein, 12inferiorepigastric vein, 13 superior vesical vein, 14 epididymis, 15 testis,16 deep inguinal ring, 17 superficial inguinal ring.

1. Deep venous network

The most common pathway has three components:

a) Anterior set composed of the pampiniform plexus and the testicular vein.

b) Middle set composed of the differential vein.

c) Posterior set composed of the cremasteric vein.

a) Anterior set

These veins emerge from the testis and superficial plexus over the epididymis forming the anterior part of the deep venous network. These veins usually anastomose to form a mesh like complex of large veins, the pampiniform plexus **(Figure 7) (Hinman 2010).**

The anterior set runs around the testicular artery and in front of the vas deferens in the spermatic cord. The pampiniform plexus is usually accompanied by tortuous testicular artery branches below the external inguinal ring, which may act as a heat exchange mechanism. They unite to three or four veins at the external inguinal ring then passes from the inguinal canal till reaching the deep inguinal ring , then unites to form two veins which runs on the Psoas major muscle till finally forming a single testicular vein on each side **(Hinman 2010).**