INTRODUCTION

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

Varicocele is defined as dilated pampiniform plexus of veins which drains the testicles, Normal caliber of the pampiniform plexus of veins ranges from 0.5 -1.5 mm, if the diameter exceeds 2 mm, the diagnosis of varicocele is made ***(Salam, 2013).***

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

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).***

The indications of non medical intervention for clinically significant varicocele include infertility or subfertility specially with impaired semen parameters, hypogonadism, scrotal pain, and testicular atrophy. Treatment options for varicocele can be divided into two major categories: (1) percutaneous occlusion, by intravenous injection of various materials to occlude the varicocele and (2) surgical ligation or clipping of the varicocele to prevent venous reflux ***(Chan, 2011).***

It is perhaps not surprising that there is some uncertainty as to the efficacy of repair. While some systematic reviews of available literature suggested no benefit of varicocelectomy, other reviews do suggest efficacy of surgical repair. The main difference in results involves inclusion criteria of the studies analyzed in the meta-analyses. The reviews suggesting benefit to varicocelectomy are limited to studies of men with clinical varicocele with abnormal semen parameters-the men most often offered varicocelectomy today ***(Agarwal, 2007).***

Surgical treatment, has represented the elective method of treatment of varicocele for decades , yet because of the high frequency of venous collaterals,The recurrence rate of scrotal varicocoele after varicocoelectomy has been reported to range from 0 to 35% depending on the type of surgery performed ***(Kim et al., 2012).***

Varicocele treatment by percutaneous embolization of the internal spermatic vein is a safe and effective minimally invasive procedure. Its very low morbidity and complication rates, high long-term rates of success and demonstrated cost effectiveness relative to surgery have led many authors to believe that it should have the upper hand over surgical option or at least a valuable alternative to it ***(Wunsch et al., 2005).***

The percutaneous varicocele embolization procedure usually is performed on an outpatient basis under local anesthesia, under aseptic conditions ***(Beecroft, 2007).***

In recent studies, technical success rates of varicocele embolization are 92.4%–96%. Recurrence rates are < 2%–4% among those suffering from infertility. In the pediatric and adolescent population, long-term recurrence rates in those for whom the procedure was initially technically successful are 7% and 11%. Most of the patients in those studies have unilateral left-sided varicocele, though right-sided varicocele are also included ***(Alqahtani et al., 2004).***

The complications of percutaneous therapy are infrequent and usually mild. Injecting sclerosants is infrequently associated with thrombophlebitis, while coil migration is a rare complication that is always linked to excessively distal release. Reported cases to date have been asymptomatic ***(Bittles and Hoffer, 2008).***

Varicocele embolization is a minimally invasive procedure, and because of that, 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

The aim of this study is to discuss the role of N-buty cyanoacrylate for gonadal vein embolization in treatment of varicocele causing testicular pain or infertility.

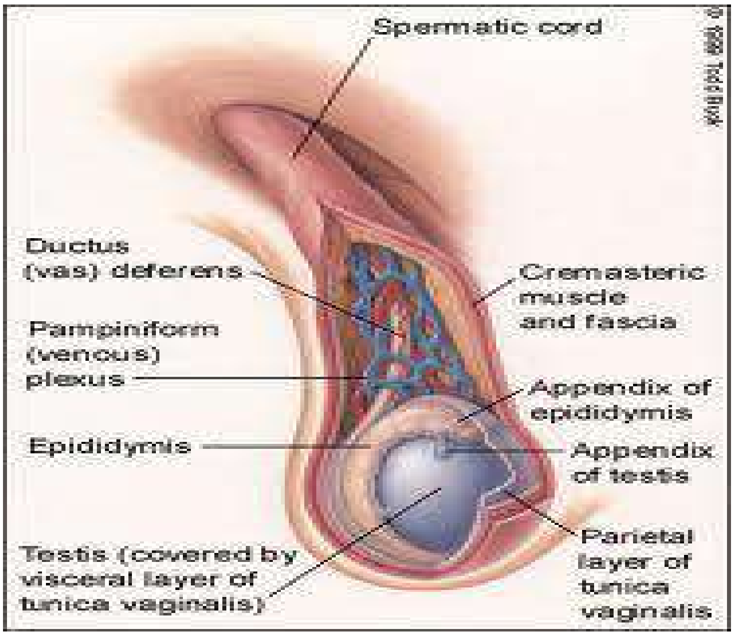
Chapter (1)

ANATOMY

Testis is a paired ovoid organ responsible for the male reproductive function, it measures approximately 25 ml in volume, with average dimensions being 3.5-5 x 3 x 3 cm. it is covered by a tough fibrous capsule called tunica albuginea, which invaginates posteriorly forming the mediastinum testis, from which multiple septa traverses the testicles dividing it into seminipherous tubule, the structure that is lined by cells responsible for the production of sperm and nutrient fluid **(Figure- 1)**.

The next outer layer is the tunica vaginalis with its two layers, the visceral layer which is in contact with the testis , epidiymis and vas deference, The other layer is the parietal layer which is in contact with the internal spermatic fascia.

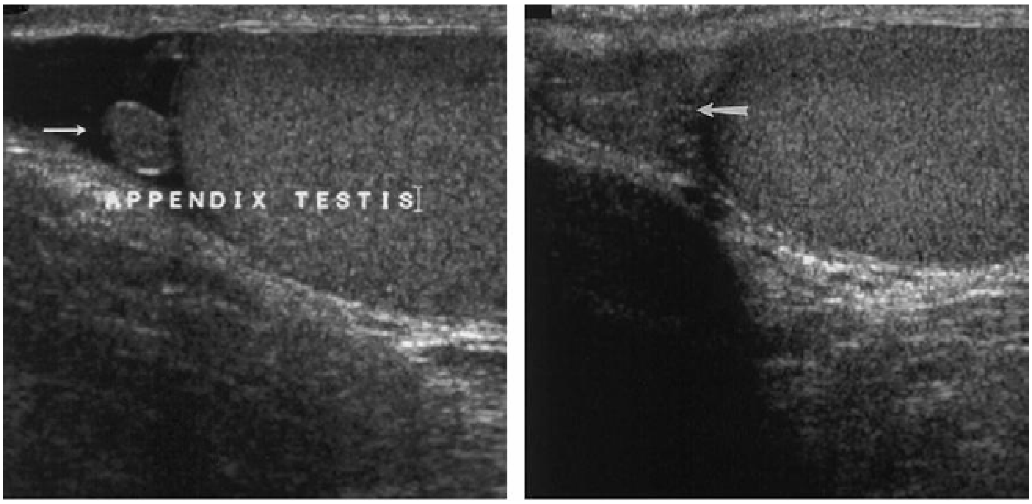
The epididymis is shaped like a comma, a single fine tubular structure averaging around 6 meters in length. It is highly convoluted and compressed to the point that it appears solid. It is situated on the posterior border of the testis, and is composed of 3 parts: the head, body, and tail. The epididymal head lies at the upper pole of the testis, receiving these minimal fluid from the ducts of the testis, then allows the passage of the sperm into the distal portion of the epididymis. The epididmyis serves to allow space for storage and maturation of sperm. The narrow tail continues as the vas deference ***(Swartz et al., 2006).***



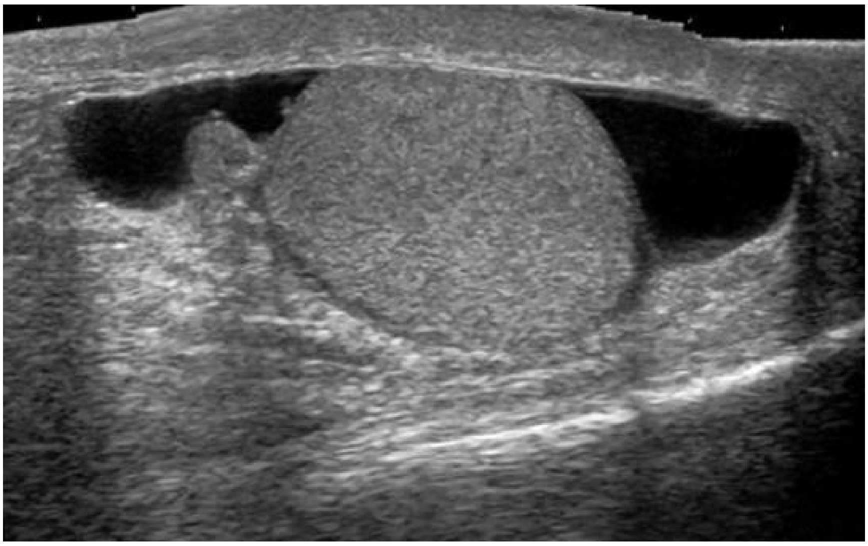
(Figure- 1): Testicular anatomy ***(Agur and Dalley, 2009).***

The appendix testis is a pear-like shaped structure that is the remnant of the cranial end of the paramesonephric duct. It is an embryonic genital duct partly forming the uterus in females. It is found approximately in 92% of all testes. It is located typically in the superior testicular pole **(Figure-2)**.

The appendices of the epididymis are remnants of the cranial end of the mesonephric (Wolffian) duct, the embryonic duct that forms the vas deference in males. This is located in approximately 23% of testes. Its location may vary, but it usually projects from the head of the epididymis **(Figure-3).**



(Figure- 2): (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)***.



(Figure- 3): Gray-scale high resolution ultrasound with linear-array transducer of the scrotum reveals appendages of the upper pole of the testis and a smaller in the head of epididymis ***(Sellrs, 2003)***.

Testicular Blood Supply

<u>Arterial blood supply:</u>

<u>1-Testicular artery :</u>

It originates from the abdominal aorta just below the level of renal arteries (L2-L3) with a straight course down to the testes in most of the cases, yet a tortuous, more curved course has been mentioned in the literature ***(Skowronski et al., 2003)***.

Its pattern of termination varies with the majority of cases terminating at the upper mediastinum testis, it might also terminate4-8 cm above the mediastinum testis, or it even might descend along it without division.

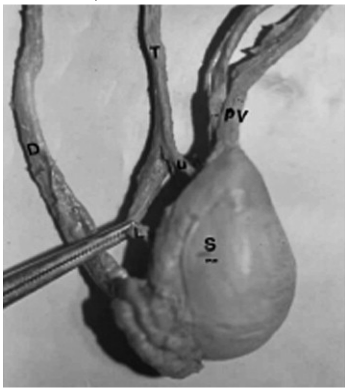
The branching pattern of it varies, it can branch in any of these patterns:

1- 70% of the cases, two main terminal branches; (upper polar) branch directed toward the upper anterior aspect of the testis and a lower polar (segmental) branch directed toward its lower posterior aspect. In 80% of this pattern the lower polar branch gave branches anastomosing with branches from the cremasteric artery **(Figure- 4).**

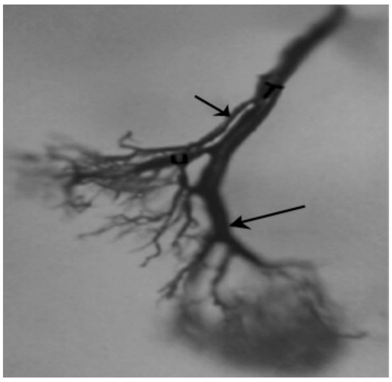
2- 16% of the cases, the upper polar branch gives the middle segmental branch near the middle of the mediastinum testis then continued to the lower end of the testis supplying it and the epididymis then it recourses upward and forward **(Figure- 5).**

3- 8% of the cases, it descended along the mediastinum testis giving three extra-testicular terminal branches: upper polar or segmental, middle segmental, and lower polar or segmental branches.

4- 6% of the cases, it gives an upper polar branch before reaching the upper pole of the testis then continued along the mediastinum testis to reach the lower end of the testis and curves forward and upward to supply its anterolateral part ***(Mostafa et al., 2008).***



(Figure- 4): Dissected right testis (S) and its spermatic cord showing the first pattern (70%) of testicular artery (T) termination with upper polar (U) and lower polar (l) branches. D = vas deferens; PV = venous plexus ***(Mostafa et al., 2008).***



(Figure- 5): Second pattern of testicular artery (16%) with single upper polar branch(Short arrow) and then descends by itself (long arrow) ***(Mostafa et al., 2008).***

2-Cremasteric artery:

The cremasteric artery originates from the inferior epigastric artery in relation to the deep inguinal ring entering the inguinal canal and supplying the cremasteric contents ***(Mostafa et al., 2008)***.

3-Artery of Vas:

The artery of the vas originates as a branch from the inferior vesical artery giving several branches to supply the vas deferens along its course and terminates by giving several capsular branches close to the mediastinum testis. Vasal branches anastomose freely with branches of the testicular artery along the mediastinum testis close to the lower end of the testis ***(Mostafa et al., 2008).***

Testicular venous drainage

There is dual venous drainage for the testis and epididymis : the deep or primary system, and the superficial or secondary system ***(Hinman, 2010).***

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

The veins emerging from the testis and from the superficial plexus overlying the anterior part of the epididymis form the anterior portion of the deep venous network. These vessels typically provide as many as 10 branches, which anastomose to form a mesh like complex of large veins, the pampiniform plexus **(Figure- 6)** ***(Hinnman, 2010).***

This plexus courses around the testicular artery and in front of the vas deferens in the spermatic cord. as noted, the pampiniform plexus is closely associated with the tortuous branches of the testicular artery below the external inguinal ring, a relationship that may act as a heat exchange mechanism. They ascend in front of the vas deferens then unite to three or four veins at the external inguinal ring then ascend through the inguinal canal till they enter the abdomen from the deep inguinal ring, they form two veins which ascend on the psoas major muscle till they unite to form a single testicular vein on each side ***(Hinnman, 2010)***.

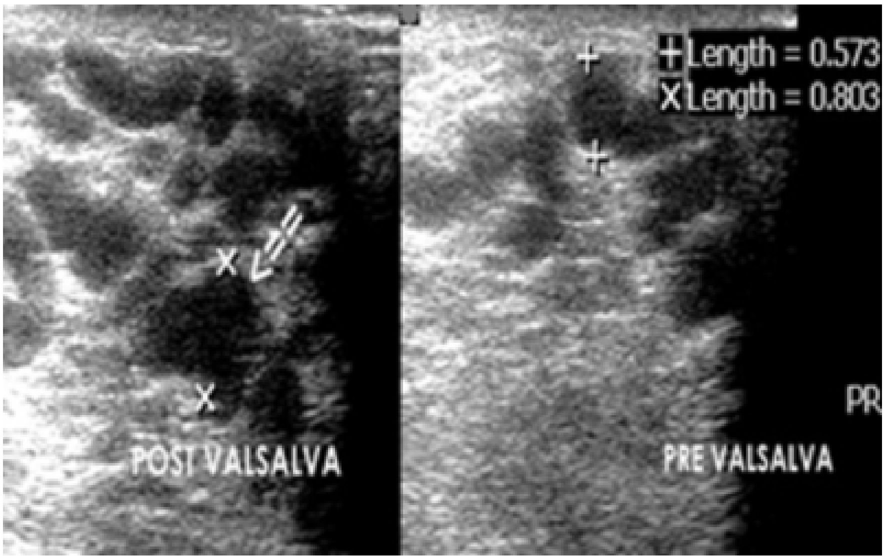
There is cross communication between the right and left pampiniform plexuses above the external inguinal ring, this anastomosis exist at several levels, including the pubic bone, inguinal canal and above the internal inguinal ring ***(Mundy, 2005)***.

b) Middle set

This set is made up of the funicular and deferential veins. The funicular veins drain the posterior part of the epididymis into the inferior epigastric and external iliac veins. The deferential veins accompanying the vas deferens drain into the pampiniform plexus as well as the prostatic plexus and vesical plexus ***(Hinman, 2010)***.

c) Posterior set

This set collecting from the cremasteric veins becomes separated from the cord near the external ring. It drains into the internal saphenous or the inferior epigastric vein ***(Hinman, 2010)***.



(Figure- 6): Paminiform plexus of veins Pre-Valsava (Right) and post Valsalve(left) notice the increase in diameter of the veins ***(Bahaskar et al., 2009).***

2. Superficial venous network

The scrotal veins drain through the external pudendal veins into internal saphenous vein or through the superficial perineal veins into the internal pudendal vein. Within this system, the cremasteric vein joins the venous plexus of the spermatic cord and the inferior epigastric vein ***(Hinman, 2010).***

The veins of the superficial system communicate freely with each other and with the deep system through the cemasteric branches of the external spermatic vein at the level of external inguinal ring by communicating veins that connect the three cord plexuses. They are abundant between pampiniform and cremasteric plexus. The cremasteric plexus can cope with extra blood from the pampiniform plexus via the communicating veins, when the venous pressure rises and the pampiniform plexus dilatation and varicosities occur early in varicocele ***(Sinnatamby, 2012).***

Testicular Veins (Figure- 7)

The diameter of the testicular veins ranges from 4 to 12 mm. an average length of about 42 cm , but differs from right and left and left veins being 40-42 cm on the left but (4-5 cm) shorter on the right. One or more sets of valves are, present along its course**.**

The testicular veins exhibit some sort of anatomical asymmetry. The left testicular vein drains in the left renal vein forming a straight angle with it , whereas the right testicular vein drains directly in the inferior vena cava (IVC) at an oblique angle . This anatomical difference is responsible for relatively weak hemodynamic in the left testicular vein and is considered to be a cause of frequent left-sided varicocele ***(Itoh et al., 2001).***

A valve at the junction with the renal vein on the left or at the junction with the inferior vena cava on the right side. Sometimes valves occur in the middle or distal third of the spermatic vein. Values are noted more in fetus and children than in adults ***(Snell, 2004).***

Studies show that absence or insufficiency of these valves is an important factor in the pathogenesis of varicocele.