Introduction

Varicocele is an abnormal dilatation and tortuosity of the veins of the pampiniform plexus draining the testes ***(Masson and Brannigan, 2014).***

Varicoceles are found in approximately 15% of all adult males with average age of 15-25 years ***(Romeo and Santoro, 2009).***

They are more common on the left side of scrotum; right-sided varicoceles are extremely rare and raise concern about an underlying retroperitoneal mass ***(Masson and Brannigan, 2014).***

Usually varicoceles are symptomless. However, they may present with a dull-aching pain felt after prolonged standing and relieved in supine position. They may also present as a swelling or as visibly enlarged, twisted veins in the scrotum, where they are often described as a “bag of worms” ***(Dubin and Amelar, 1977).***

Diagnosis of varicocele depends mainly on physical examination of the patient which may be confirmed by ultrasonography ***(Watanabe, 2002).***

Varicocele is a frequent but correctable cause of infertility ***(Kullis et al., 2013).*** It has been identified in 30-50% of men with primary infertility and in up to 81% of men with secondary infertility ***(Gorelick et al., 1993).***

Elevated scrotal temperature and oxidative heat stress are considered as a prime pathophysiological determinant that impacts testicular function and spermatogenesis ***(Hikim et al., 2003; Eisenberg et al., 2011).***

Surgical correction, known as varicocelectomy, is the standardized operative procedure for varicocele. It can be done through 3 approaches: inguinal, subinguinal and retroperitoneal ***(Baazeem et al., 2011).***

Aim of the Study

The aim of the study is to compare between the ultrasonogrpahic findings and the operative findings in varicocele patients.

Chapter (I): Anatomy and Physiology of the Testis

I. Illustrated anatomy of the testis and related surrounding structures of the male reproductive system:

1. The testis

The 2 testes are ovoid organs suspended by the spermatic cord inside the scrotum (fig. 1 & 2). Each testis is about 4.5 cm long, about 3 cm wide and about 3 cm in its antero-posterior diameter ***(Bardin and Paulsen, 1981; Meacham et al., 1996).*** The volume of each testis ranges from 15-25ml ***(Prader, 1966).***

Each testis is surrounded by 3 tunicae: the outer one is the tunica vaginalis; the intermediate is the thick tunica albuginea and the inner is the tunica vasculosa (Fig. 3) ***(Hinman, 1995).***

Position of the testis is determined in the standing position. Normally both testes should be down in the scrotum and should be lying vertically in it (Fig. 2) ***(Hinman, 1995).***

The size of the testis is determined in the supine position so as to avoid syncope and the best method of measuring its size is by the orchidometer ***(Masson and Brannigan, 2014).*** Normal testis feels rubbery in consistency ***(Beddy et al., 2005).***

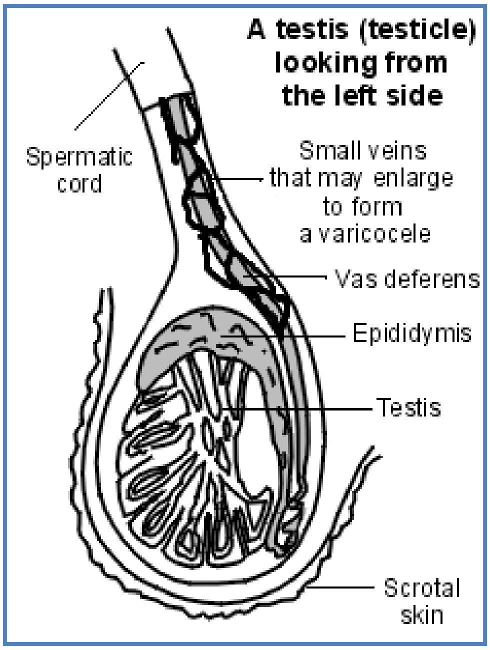

Fig. (1): Anatomy of the testis and related surrounding structures **(www.patient.co.uk)**

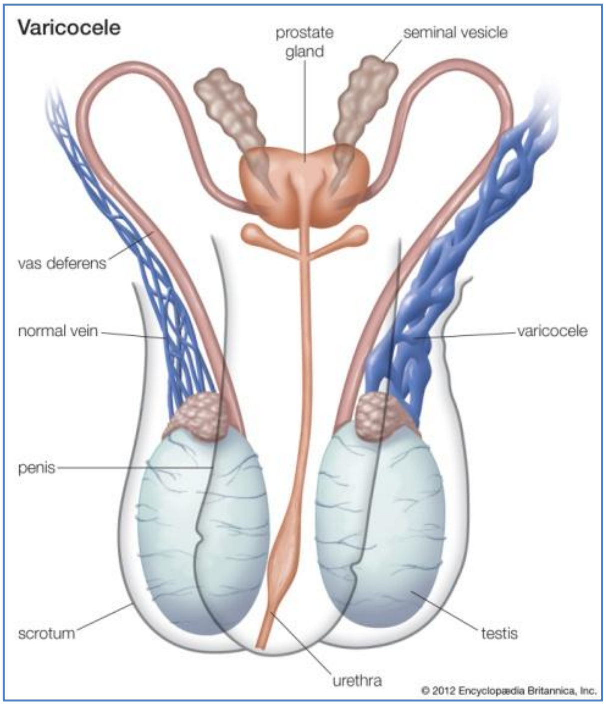

Fig. (2): Normal veins and varicocele ***(www.britannica.com)***

Each testis has 2 components:

a) The tubular component formed of the semineferous tubules which contain the germ cells and Sertoli cells on its basement membrane and

b) The interstitial component which consists of spaces among the semineferous tubules. These spaces contain blood vessels, lymphatics, supporting cells, macrophages and the Leydig cells (Fig. 3) ***(Hutson, 1994).***

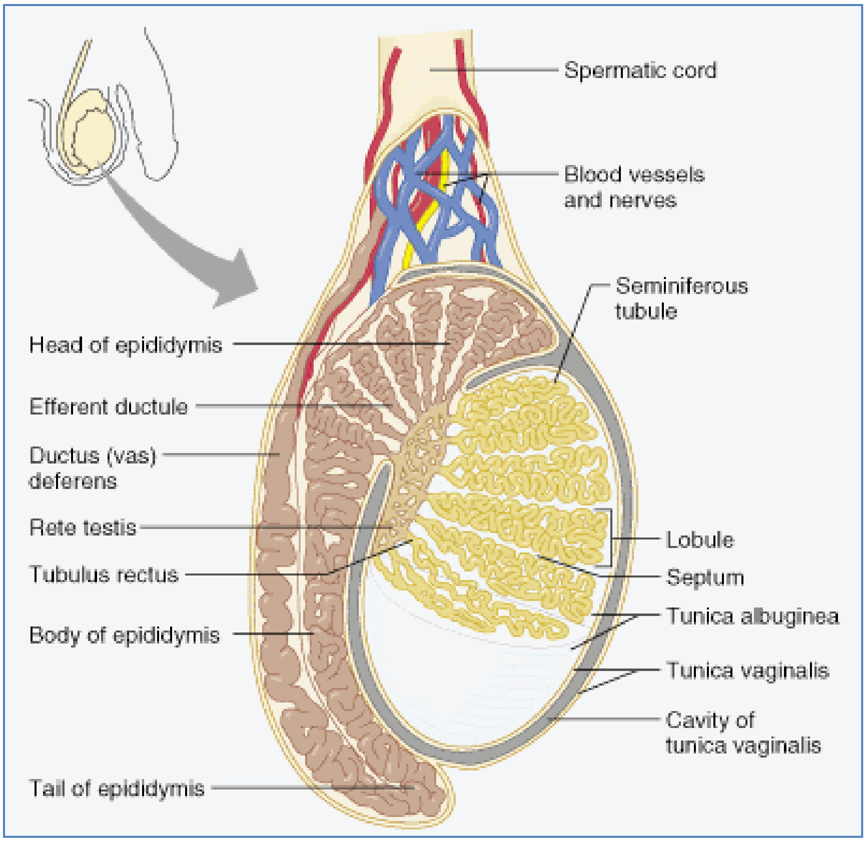

Fig. (3): Layers and components of the testis
(http://legacy.owensboro.kctcs.edu)

2. The epidiymis

Normally, this is felt as a soft structure formed of a head, a body, and a tail overlying the upper pole, the posterior surface and the lower pole of the testis respectively (Fig. 3) ***(Hinman 1995).***

3. The spermatic cord

a) The spermatic cord includes 3 fascial layers that are derived from the 3 layers of the anterior abdominal wall as follows ***(Hinman, 1995).***

(i) External spermatic fascia derived from the external oblique aponeurosis.

(ii) Cremasteric muscle and fascia derived from the internal oblique and transversus abdominis muscles, and

(iii) Internal spermatic fascia derived from the transversalis fascia (Fig. 4 & 5).

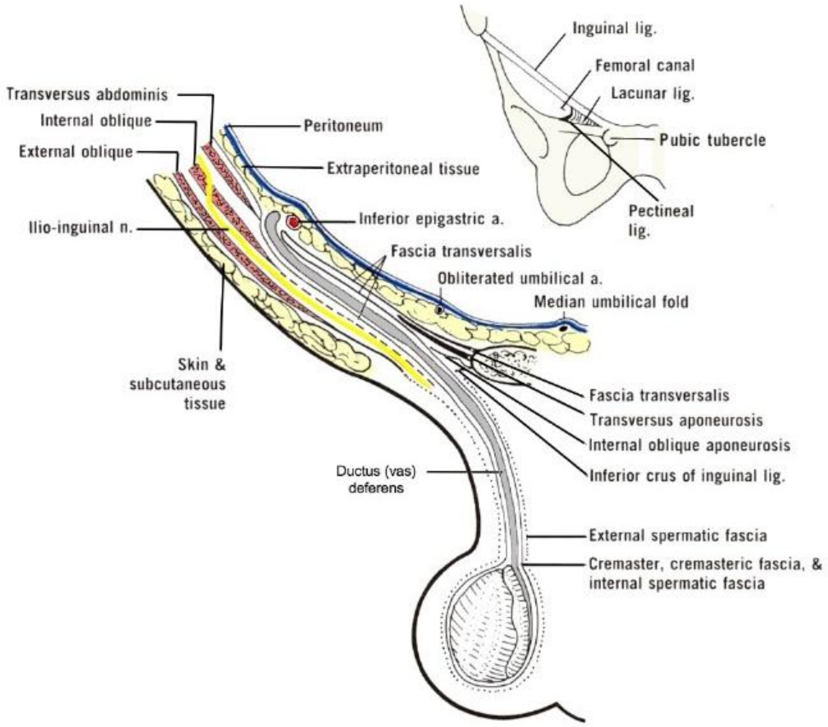

Fig. (4): Anatomy of spermatic cord ***(www.herniamasters.com)***

b) The spermatic cord contains testicular, vasal, and cremasteric blood vessels and lymphatics ***(Hinman 1995).*** The spermatic cord also contains 3 important structures: the vas deferens, the cremasteric muscle and the testicular nerves ***(Glover et al., 1990).***

4. <u>The scrotum:</u> It is the sac inside which the testis is suspended outside the abdominal cavity by means of the spermatic cord. It is formed of the following 3 layers; (i) The skin (the outermost layer which is very thin and contains sebaceous glands and hairs but is devoid of subcutaneous fat), (ii) The dartos muscle; and (iii) The dartos fascia. The latter is formed of the fascial layers of the spermatic cord (Fig. 6) ***(Hinman, 1995).***

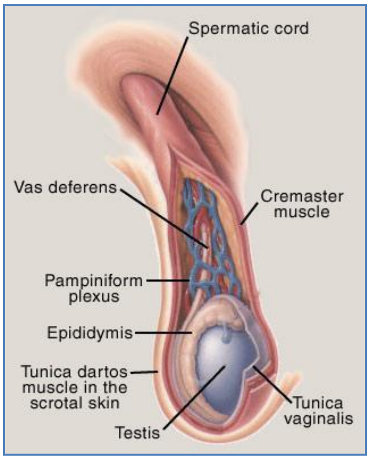

Fig. (5): Testis, spermatic cord and other related structures ***(www.studyblue.com)***

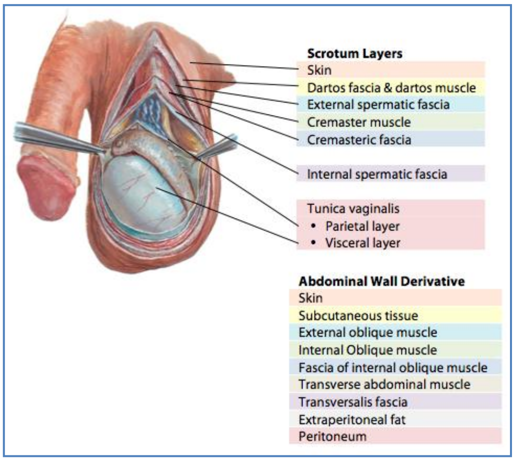

Fig. (6): Anatomy of the scrotum ***(www.studyblue.com)***

II. Venous drainage of the scrotal contents: formation of the pampiniform plexus.

3 groups of veins drain the scrotal contents (Fig. 7):

1. The anterior group (testicular veins). Formed of about 10 tributaries that anastomose to form the pampiniform plexus which is closely associated with the testicular artery. The tributaries are reduced in number gradually till they pass through the external inguinal ring where they become the single testicular vein. The left testicular vein drains into the left renal vein while the right testicular vein drains into the inferior vena cava ***(Hinman, 1995).***

2. The middle group (vasal or deferential veins). These veins drain the vas deferens and the epididymis. They accompany the vas and drain into the prostatic plexus and the vesical plexus ***(Hinman, 1995).***

3. The posterior group (cremasteric veins). The cremasteric veins become separated from the spermatic cord at the external inguinal ring and drain into the inferior epigastic vein ***(Hinman, 1995).***

There are anastomotic sites between the right and left venous systems at the level of the inguinal region which are of surgical importance ***(Etriby et al., 1975).***

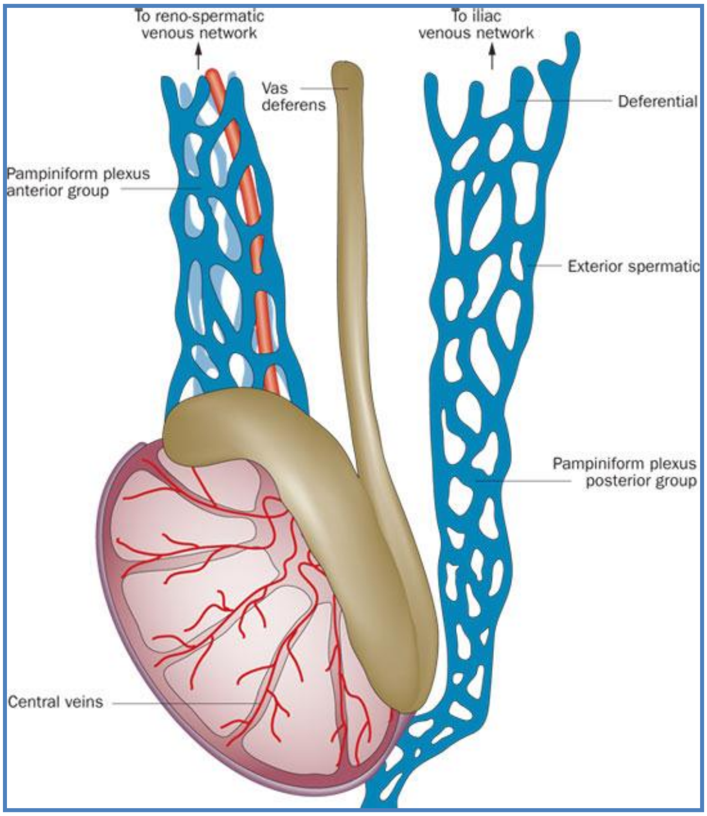

Fig. (7): Venous drainage of the testis ***(Cimador et al., 2012).***

III. Regulation of testicular temperature

Normally the testicular temperature is about 35-36°C (approximately 1-2 degrees below the body temperature) ***(Mieusset and Bujan, 1995).*** This relatively low temperature is maintained through the following mechanisms:

1. The scrotal skin is very thin, with no subcutaneous fat. In addition, it is richly supplied with sweat glands and has a large surface area that is controlled by contraction and relaxation of the dartos muscle ***(Waites, 1970).***
2. The countercurrent heat exchange system which depends upon the specialized arrangement of the pampiniform plexus around the testicular artery. This arrangement helps cooling of the arterial blood before reaching the testis by the surrounding coiled veins ***(Waites, 1970).***

The low testicular temperature is essential for the process of spermatogenesis as the spermatocytes and spermatids are heat sensitive and may degenerate upon exposure to high testicular temperatures ***(Nakamura et al., 1988).*** Furthermore, some proteins such as the androgen – binding protein and the G-protein that are essential for FSH actions are active only at 34°C to 35°C ***(Liri et al., 1994; Holt, 1997).***

Chapter (II): Aetiology of varicocele

Varicocele is a dilatation of the pampiniform venous plexus within the spermatic cord ***(Kullis et al., 2013).***

Aetiologically, varicocele is divided into primary (idiopathic) and secondary types; where primary varicocele is more common ***(Nagler et al., 1997).***

a) Primary varicocele

- Some studies had been performed on patients with varicocele in order to know the basic mechanism of this problem. The summary of results of those studies is as follows:

  1) The testicular veins in general are liable to venous compression because of their long free course along the retroperitoneal space and the lack of the supporting muscle pump. This helps the backward flow of blood (reflux) inside them leading to varicosity ***(Nieschlag et al., 1997).***

  2) Complete absence of valves or presence of incompetent valves in the spermatic veins ***(Bradel et al., 1994).*** It was found that absence of valves is more common in the left internal spermatic vein (Fig. 8) ***(Masson and Brannigan, 2014).***

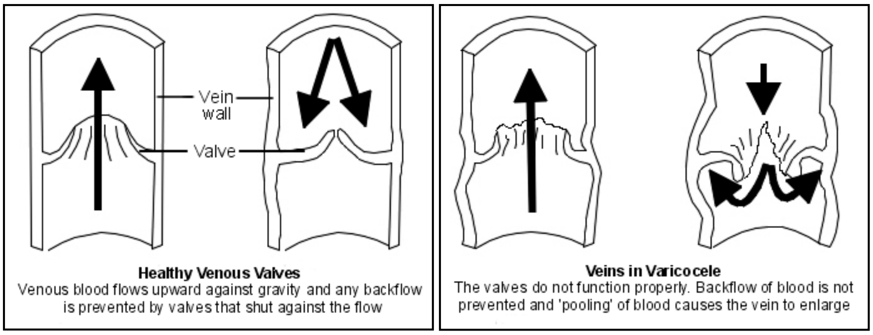

Fig. (8): Mechanism of varicocele: healthy venous valves vs. incompetent valves ***(www.patient.co.uk)***

There may also be a genetic basis to the valvular dysfunction leading to varicocele development, specifically found in first degree relative of patients with varicocele ***(Raman et al., 2005).***

There are some data to suggest that dilated "external" spermatic veins (also known as the cremasteric veins) can also contribute to primary or recurrent varicoceles ***(Coolsaet et al., 1980; Murray et al., 1986; Chehaval and Purcell, 1992).***

Thus standard inguinal or subinguinal varicocelectomy calls for routine inspection and ligation of these external spermatic collaterals ***(Chehval and Purcell, 1992).***

In addition, scrotal collaterals may lead to varicocele recurrence. This finding forms the basis for delivery of the testicle during varicocelectomy and ligation of all gubernacular veins exiting from the tunica vaginalis (Fig. 9) ***(Kaufman et al., 1983, Goldstein et al., 1992).***

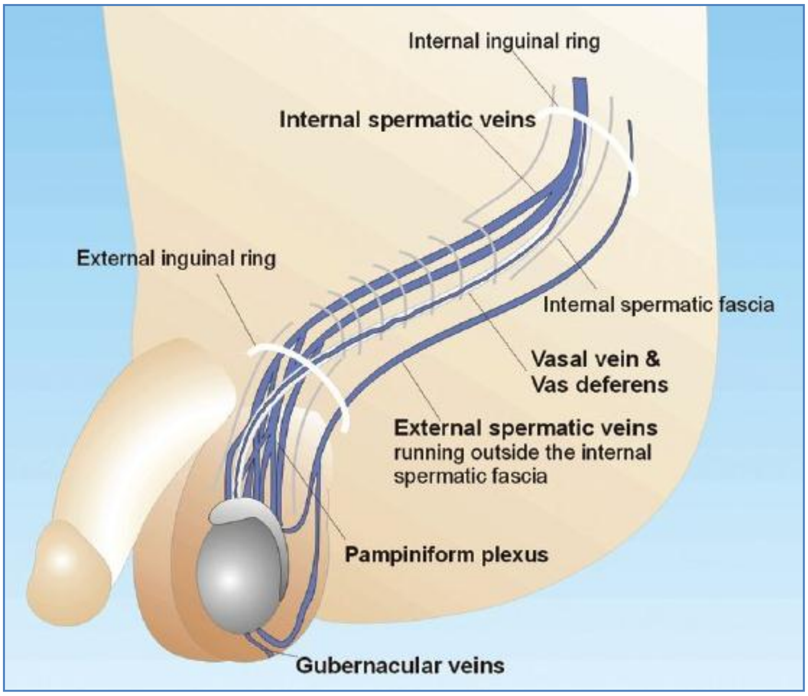

Fig. (9): Internal and external spermatic veins, vasal vein and the gubernacular veins ***(Chan, 2011).***

Varicocele is more common on the left side of scrotum than on the right side. Isolated left sided varicocele occurs in 75-95% of the patients. Bilateral varicocele may occur in 30-80% of the patients ***(Gat et al., 2004).***

Isolated right sided varicocele is extremely rare and raises the possibility of thrombosis/occlusion of the inferior vena cava, presence of a retroperitoneal mass, e.g., sarcoma, lymphoma, renal tumor ***(Nieschlag et al., 1997),*** or presence of what is called "situs inversus, i.e., transposition of the abdominal viscera" ***(Grillo-Lopez, 1971).***

The reason for the prevalence of left varicocele can be clarified by retroperitoneal anatomy. The left internal spermatic vein drains perpendicularly into the left renal vein, whereas the right internal spermatic vein drains obliquely into the inferior vena cava (Fig. 10). This basic finding has two consequences that contribute to the left-sided predisposition ***(Nagler et al., 2009).***

First, the course of the left internal spermatic vein results in a length of approximately 8 to 10 cm more than its right-sided counterpart. This added length, coupled with upright posture, results in increased hydrostatic pressure, which can overcome valvular mechanisms in certain men and leads to dilatation and tortuosity of spermatic veins ***(Nagler et al., 2009).***

Second, the perpendicular insertion of the left internal spermatic vein into the left renal vein exposes the spermatic vein to pressure elevation within the left renal vein. The oblique insertion of the right internal spermatic vein into the vena cava, on the contrary, protects the right internal spermatic vein from the increased pressures within the vena cava ***(Nagler et al., 2009).***