THE VALUE OF PENILE DUPLEX IN THE ASSESSMENT OF ERECTILE DYSFUNCTION

Thesis

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INTRODUCTION

Erectile dysfunction is one of the most common sexual dysfunction that in many people has a profound effect on their well being. It is defined as the constant inability to achieve or maintain an erection of sufficient rigidity for sexual intercourse *(Gotta et al., 2003).*

Benson and Vickers (2000) divided erectile dysfunction into two broad categories: psychogenic erectile dysfunction and organic erectile dysfunction. Up to 80 % of patients fall into the organic group, approximately 85 % of them have some degree of vascular origin.

The most common causes of psychogenic erectile dysfunction are performance anxiety, sexual inhibition, sexual abuse in childhood or fear of pregnancy or sexually transmitted diseases, premature ejaculation *(Araujo et al,2008).*

The history of psychogenic erectile dysfunction is definitive in most cases. Sudden, complete loss of function, situation or partner variability, and maintenance of morning or masturbatory erections are typical. Good rigid morning erections indicate an intact erection sufficient for sexual performance, hence circumstantial erectile capacity is psychogenic *(Schrader et al., 2007).*

Steckle (1972) stated that 90 % of all erectile dysfunction was psychogenic but when objective tests such as nocturnal penile tumescence and Doppler examination began to suggest a high frequency of organic diseases, the percentage of psychogenic causes decreased. It appears that organic causes can be recognized in more than 50 % of impotent patients and the vasculogenic erectile dysfunction is the most frequent organic cause *(Bookstien and Lang, 2007).*

It is believed that vasculogenic erectile failure is one of the most frequent causes of organic erectile dysfunction. Vasculogenic erectile dysfunction may be due to poor arterial inflow into the penis (arteriogenic erectile dysfunction) or to excessive venous leakage (venogenic erectile dysfunction) (*James, 2001).*

Evaluation of patients with suspected vasculogenic erectile dysfunction should begin with the assessment of corporal veno-occlusive mechanism and measurement of the perfusion pressure of the cavernosal arteries during erection *(Rosen et al., 2009).*

Duplex sonography was shown to be a useful non invasive method to evaluate men with suspected vasculogenic erectile dysfunction, particularly to select patients who benefit from further evaluation with more invasive studies. It has main diagnostic parameters with controversial in their values and has some evident fallacies in its usage *(Benson and Vickers, 2000).*

Duplex ultrasound combines Doppler flow information and conventional imaging information, sometimes called B-mode, to allow physicians to see the structure of your blood vessels. Duplex ultrasound shows how blood is flowing through your vessels and measures the speed of the flow of blood. It can also be useful to estimate the diameter of a blood vessel as well as the amount of obstruction, if any, in the blood vessel *(Nieschlag et al., 2010).*

Duplex sonography is used to evaluate blood flow, venous leak, signs of atherosclerosis, and scarring or calcification of erectile tissue. Injecting prostaglandin, a hormone-like stimulator produced in the body, induces erection. Ultrasound is then used to see vascular dilation and measure penile blood pressure. Measurements are compared to those taken when the penis is flaccid *(Patel et al., 2005).*

A duplex ultrasound scan is a quick, simple, painless, non-invasive method of looking at arteries and veins and measuring their size and the flow of blood through them. Duplex ultrasound scans are usually done as outpatient tests *(Rosen et al., 2005).*

AIM OF THE WORK

The aim of this work is to evaluate the role of penile duplex in cases with psychological erectile dysfunction, as well as in normal people and to demonstrate the parameters and fallacies of its usage.

Chapter 1

1. PENILE ANATOMY

The penis is essentially a tripartite structure, with bilateral corpora cavernosa and the midline ventral corpus spongiosum, the structures of its anatomy are described as the following (Fig. 1):

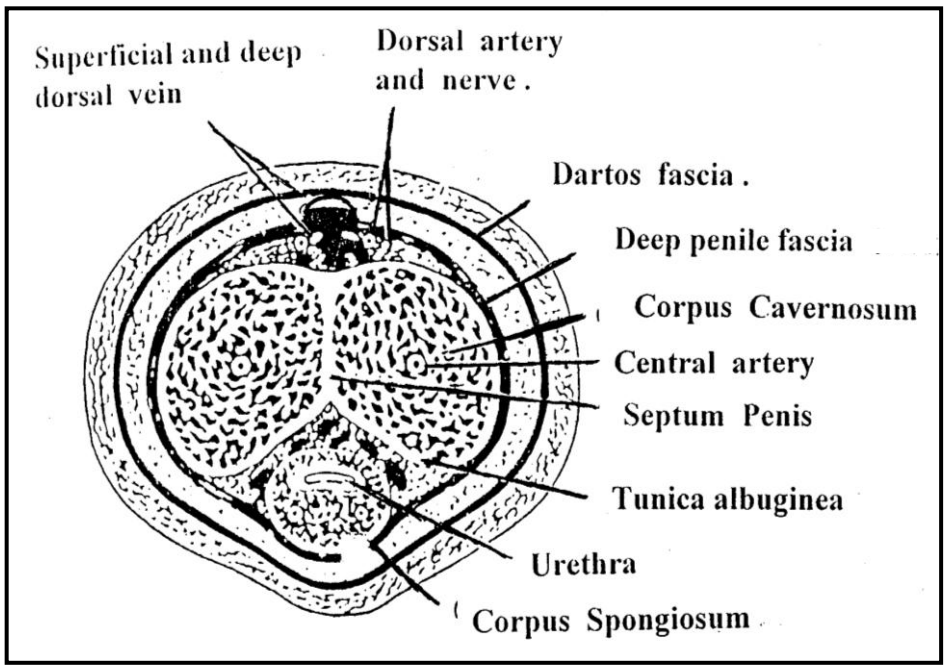


Figure (1): Cross section of the penis *(Lue et al., 1992)*

1.1. Skin and Fascia:

The two corpora cavernosa and the corpus spongiosum are surrounded by loose subcutaneous tissue and skin that can be moved freely over the erect organ. The corpora cavernosa function as the main

erectile bodies, while the corpus spongiosum contains the urethra *(Romans, 2006).*

Penile skin is continuous with that of the lower abdominal wall and continues over the glans penis; there it folds back on itself and attaches at the coronal sulcus. The folded portion is known as the prepuce (*Bookstein & Lang, 2007).*

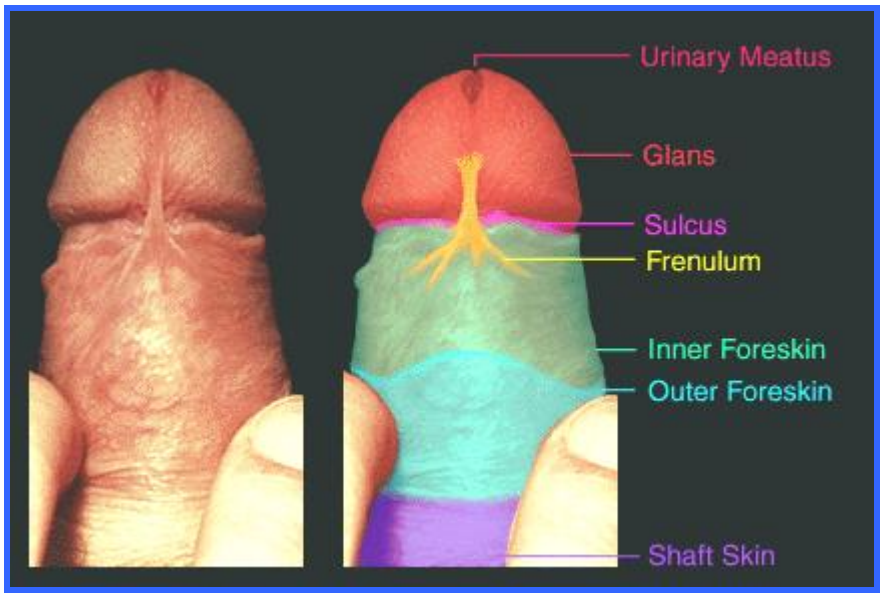


Figure (2): Outer strucrures of the penis (*Bookstein & Lang, 2007).*

There are two fascial layers.

1.1.1. **Dartos fascia,** which is the more superficial one, it is continuous with Scarpa's fascia of the abdomen. It continues caudally as the dartosfascial layer of the scrotum and Colles' fascia in the perineum.

1.1. 2. **Buck's fascia**, which is the deeper fascial layer it covers the corpora cavernosa and the corpus spongiosum in separate compartments, including coverage of the deep dorsal vein as well as the dorsal neurovascular bundles. Buck's fascia attaches to the perineal membrane proximally and to the coronal sulcus distally, where it fuses with the tips of the corpora. The fundiform and suspensory ligaments attach to the pubic symphysis and Buck's fascia, and allow the erect penis to achieve a horizontal or greater angle *(Lewis, 2004).*

1. 2. Tunica Albuginea:

The corpora are surrounded by tunica albuginea, a strong structure of heterogenous thickness and anatomy, the purpose of which is to both provide rigidity of the erectile bodies as well as to function in the veno occlusive mechanism The tunica albuginea consists of two layers, the outer of which is oriented longitudinally and the inner layer consisting of circular fibers. The inner layer contains struts that course the cavernosal space and serve to augment the support provided by the intracavernosal septum. The corpus spongiosum lacks both the outer layer as well as the struts *(Rosen et al., 2008).*

1.3. Corpora Cavernosa:

The paired corpora cavernosa originate separately underneath the ischiopubic rami, then merge as they pass under the pubic arch. The septum between them

is incomplete in humans, although complete in some other species. They are supported by several fibrous structures, including the surrounding tunica albuginea, the intracavernous struts radiating from the inner layer of tunica albuginea, and perineural periarterial fibrous sheaths *(Lewis, 2004).*

The spongy inner portion of the corpora consists mainly of interconnected sinusoids separated by smooth muscle trabeculae, which are surrounded by collagen and elastic fibers. These sinusoids are larger centrally and smaller towards the periphery. The corpus spongiosum and its distal termination in the glans penis are similar in internal structure to the corpora cavernosa except that the sinusoids are larger, and there is a lack of outer layer of tunica albuginea that is absent in the glans *(Aboseif et al., 2000).*

1.4. Corpus spongiosum

It is the mass of spongy tissue surrounding the male urethra within the penis. Behind, it is expanded to form the urethral bulb, and lies in apposition with the inferior fascia of the urogenital diaphragm, from which it receives a fibrous investment.

The urethra enters the bulb nearer to the superior than to the inferior surface. On the latter there is a median sulcus (groove), from which a thin fibrous septum (wall) projects into the substance of the bulb and divides it imperfectly into two lateral lobes or hemispheres *(Romans, 2006).*

The portion of the corpus spongiosum in front of the bulb lies in a groove on the under surface of the conjoined corpora cavernosa penis. It is cylindrical in form and tapers slightly from behind forward. Its anterior end is expanded in the form of an obtuse cone, flattened from above downward. This expansion, termed the glans penis, is moulded on the rounded ends of the corpora cavernosa penis, extending farther on their upper than on their lower surfaces.

At the summit of the glans is the slit-like vertical external urethral orifice, also known as the meatus. The circumference of the base of the glans forms a rounded projecting border, the corona glandis, overhanging a deep retroglandular sulcus, behind which is the neck of the penis *(Wessells et al., 1999).*

1.5. Associated Musculature:

The bulbospongiosal muscle originates at the central perineal tendon, covers the urethral bulb and corpus spongiosum, and inserts into the midline. The paired ischiocavernosus muscles originate from the ischial tuberosity, cover the proximal corpora, and insert into the inferiomedial surface of the corpora *(Romans, 2006).*

1.6. Vascular Anatomy: (Fig. 3)

1. 6.1. Arterial blood supply

The main source of blood supply to the penis is usually through the internal pudendal artery, a branch of the internal iliac artery. In many instances,

however, accessory arteries arise from the external iliac, obturator, vesical, and/or femoral arteries, and may occasionally become the dominant or the only arterial supply to the corpus cavernosum *(Breza et al., 1999)*.

Damage to these accessory arteries during radical prostatectomy or cystectomy may result in vasculogenic erectile dysfunction (ED) after surgery. The internal pudendal artery becomes the common penile artery after giving off a branch to the perineum. The three branches of the penile artery are the dorsal, bulbourethral, and cavernous arteries. The cavernous artery is responsible for tumescence of the corpus cavernosum and the dorsal artery for engorgement of the glans penis during erection *(Aboseif et al., 2000; Kim et al., 2004).*

The bulbourethral artery supplies the bulb and corpus spongiosum. The cavernous artery enters the corpus cavernosum at the hilum of the penis, where the two crura merge. Distally, the three branches join to form a vascular ring near the glans. Along its course, the cavernous artery gives off many helicine arteries, which supply the trabecular erectile tissue and the sinusoids. These helicine arteries are contracted and tortuous in the flaccid state and become dilated and straight during erection *(Malhotra, 1996).*

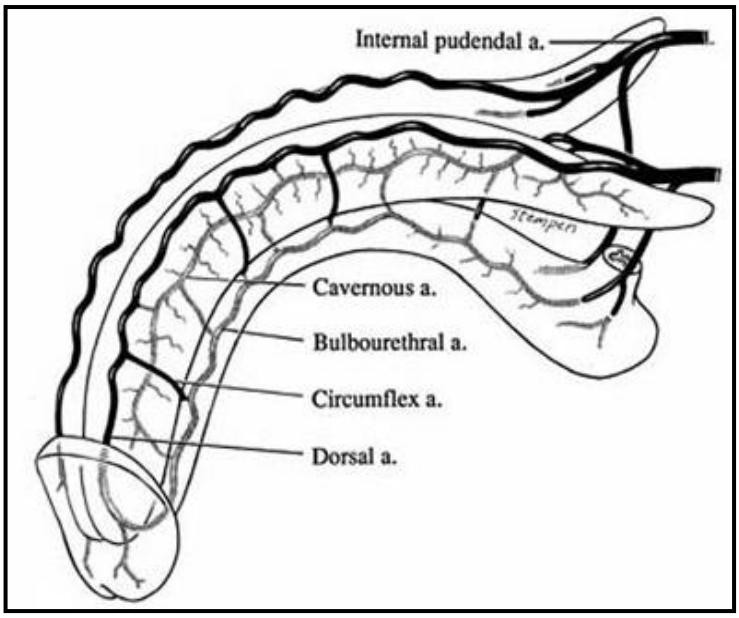
1.6.2. Venous drainage

The venous drainage from the three corpora originates in tiny venules leading from the peripheral

sinusoids immediately beneath the tunica albuginea. These venules travel in the trabeculae between the tunica and the peripheral sinusoids to form the subtunical venular plexus before exiting as the emissary veins *(Breza et al., 1999).*

Outside the tunica albuginea, the skin and subcutaneous tissue drain through multiple superficial veins that run subcutaneously and unite near the root of the penis to form a single (or paired) superficial dorsal vein, which in turn drain into the saphenous veins. Occasionally, the superficial dorsal vein may also drain a portion of the corpora cavernosa. In the pendulous penis, emissary veins from the corpus cavernosum and spongiosum drain dorsally to the deep dorsal, laterally to the circumflex, and ventrally to the periurethral veins. Beginning at the coronal sulcus, the prominent deep dorsal vein is the main venous drainage of the glans penis, corpus spongiosum, and distal two thirds of the corpora cavernosa. Usually, a single vein, but sometimes more than one deep dorsal vein, runs upward behind the symphysis pubis to join the periprostatic venous plexus *(Walsh and Donker, 1997).*

Emissary veins from the infrapubic penis drain the proximal corpora cavernosa and join to form cavernous and crural veins. These veins join the periurethral veins from the urethral bulb to form the internal pudendal veins *(Montorsi et al., 2001).*



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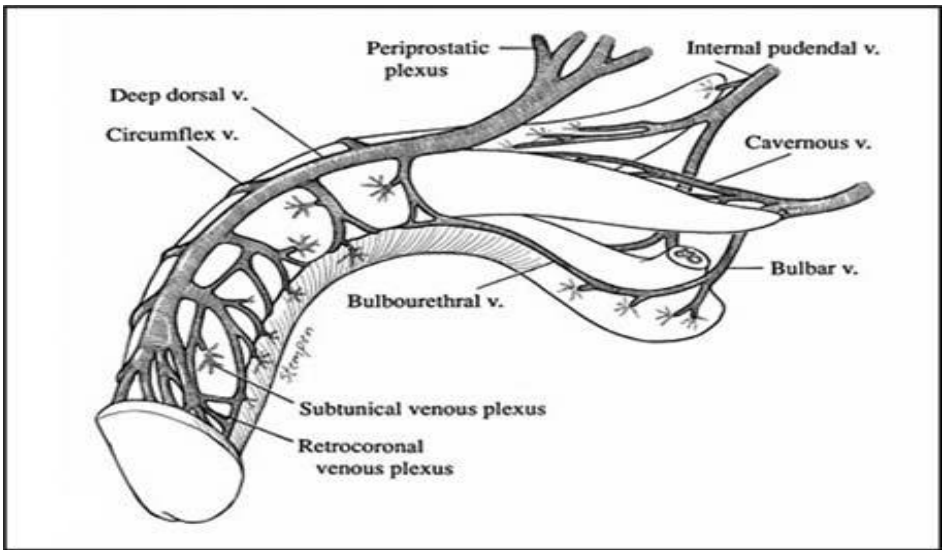

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Figure (3): Arterial (A) and venous (B) anatomy of the penis *(Montorsi et al., 2001).*

1. 7. Lymphatics:

Lymphatics of the prepuce and penile shaft converge dorsally, and then drain into both right and left sided superficial inguinal lymph nodes via channels alongside superficial external pudendal vessels. Lymphatics of the glans and penile urethra pass deep to Buck's fascia and drain into both superficial and deep inguinal nodes *(Lue, 1998).*

1. 8. Innervation:

The innervation consists of somatic part through the dorsal nerve and autonomic one through the cavernous nerves.

1. 8.1. Somatic Innervation of the penis:

The somatic nerve supply comes principally from spinal nerves S2-S3 and S4 by way of the pudendal nerves which passes through the pudendal canal then it continuous as the dorsal nerve of the penis. It runs on the deep layer of the urogenital diaphragm where it gives off a branch to the crus. It runs along the dorsolateral surface of the penis accompanied by the dorsal artery and terminates in multiple branches in the glans *(Romans, 2006).*

1. 8.2. Autonomic innervation of the penis:

Autonomic innervation of genitalia arises from the pelvic plexus which is formed by parasympathetic