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THE ROLE OF ULTRASONGRAGHY IN THE EVALUATION OF INFERTILE MALE

Thesis

Submitted in partial fulfillment of requirement of master degree in urology

By

Mohamed Abdel Atty Elbakery

(M.B.B.Ch.)

Supervisors

Prof. Dr.

SHAWKY ABDEL AZIZ ELABD

Prof. of Urology Department

Faculty of Medicine

Tanta University

Ass. Prof. Dr.

KHALED SALEM

Ass. Prof. of Urology

Tanta University

Ass. Prof. Dr.

SAMIR ELGAMAL

Ass. Prof. of Urology

Tanta University

FACULTY OF MEDICINE

TANTA UNIVERSITY

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بسم الله الرحمن الرحيم

وإن من شيء إلا عندنا خزائنه وما ننزله إلا بقدر معلوم

صدق الله العظيم

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Introduction

Primary infertility means failure to conceive after a period of one year of regular unprotected intercourse. However, individual circumstances will differ and couples should be seen when ever they think there is a problem.[1]

Infertility affects about 15 % of couples, about one-third of infertility is caused by a male factor alone and about 20 % is due to combined male and female factors. Therefore, a male factor is responsible for approximately 50 % of these couples.[2]

For instance, fertile and infertile men are not separated by World Health Organization (WHO) criteria because pregnancy may occur as long as motile sperm are evident. Some identifiable defect or functional failure related to sperm occurs in 20% to 30% of couples investigated for infertility subject .Abnormal semen analysis parameters such as count, motility and percentage of normal forms are reliable indicators of subfertility. [3]

Color doppler ultrasonography is an accurate, rapid, safe and non-invasive tool in evaluation of scrotal contents. The combination of structural and flow information provided by color doppler ultrasonography allows a specific diagnosis of scrotal abnormalities in infertile men, in particular testicular and epididymal anomalies. [4]

Infertility secondary to abnormalities in the distal genital tract has been previously thought uncommon; however using transrectal ultrasonography (TRUS) in their diagnosis has resulted in an increase in their incidence.[5]

High resolution transrectal ultrasonography is a relatively non-invasive, effective and office based modality that will detect abnormalities in the prostate and seminal vesicles in men with normal digital rectal examinations and may reveal the anatomy of the prostate, seminal vesicles and the ejaculatory ducts in excellent details.[6]

Embryology of male genital system

At the 8th week of gestation, the ductal system is the same in both sexes. It is formed of the mesonephric (Wolffian) duct on the lateral aspect of each gonadal ridge and paramesonephric (Mullerian) duct on the lateral aspect of each mesonephric duct. The Wolffian duct ends by opening into the urogenital sinus dividing it into an upper part that will give rise to the bladder and a lower part that will give rise to the urethra, prostate and the external genitalia(Fig.1-B).The first event is Mullerian duct regression which is under control of the Mullerian inhibitory substance (MIS) secreted by the fetal sertoli cells.the Mullerian ducts undergo regression except for two small rudimentary portions: the appendix testis and the prostatic utricle (Fig.1-A).[7-8]

The seminiferous tubules are formed from lines of epithelial cells derived from the proliferating coelomic epithelium. The epithelial cords encroach on the medulla, where they unite with the network derived from the mesenchyme forming the testicular rete. The primordial germ cells are incorporated into the cords, which later become enlarged and canalized to form the seminiferous tubules. The cells derived from the surface of the early gonad form the cells of Sertoli. The interstitial cells of the testis are derived from mesenchyme and possibly also from coelomic epithelial cells which do not become incorporated into the tubules; they form the cells of Leydig which secrete testosterone. A later migration of mesenchyme beneath the coelomic epithelium forms the tunica albuginea of the testis. [9-10]

The rete cords become connected to the mesonephric duct by the twelve to twenty most cranial persisting mesonephric tubules and these become convoluted and form the lobules of the head of the epididymis. The mesonephric duct, which was the primitive 'ureter' of the mesonephros, becomes the canal of the epididymis and the ductus deferens of the testis at the 12th week of gestation. The seminiferous tubules do not acquire lumina until the seventh month, but the tubules of the testicular rete do somewhat earlier. Remnants of the mesonephric tubules related to the head of the epididymis form the appendix epididymis. [10]

By the 12th week the prostate develops below the bladder from the endoderm of the urogenital sinus as endodermal buds from the prostatic urethra. At first these buds are solid then they begin to canalize into ducts and alveoli. [10-11]

Anatomy of male genital system

The testes:

The testes are the reproductive glands in male.They are 4 to 5 cm long, 2 to 3 cm wide, and 2 to 3 cm deep and have a volume of about 30 ml. Each testis has an ellipsoidal shape, the upper extremity is titled anterolaterally and lower extremity is titled posteromedially. They are enclosed in a tough capsule including: the visceral tunica vaginalis, tunica albuginea and the tunica vasculosa. [12]

The epididymis attaches to the posterolateral aspect of the testis. Beneath it, the tunica albuginea projects inward to form the mediastinum testis, where the vessels and ducts traverse the testicular capsule. Septa radiate from the mediastinum to attach to the inner surface of the tunica albuginea to form 200 to 300 cone-shaped lobules, each lobule contains one or more convoluted seminiferous tubules. Each tubule is U-shaped and has a length of nearly 1 m. Interstitial (Leydig) cells lie in the loose tissue surrounding the tubules and are responsible for testosterone production (Fig.2-A). Toward the apices of the lobules, the seminiferous tubules become straight (tubuli recti) and enter the mediastinum testis to form an anastomosing network of tubules lined by flattened epithelium. This network, known as the rete testis, forms 12 to 20 efferent ductules that pass into the largest portion of the epididymis, the caput. Here, the efferent ductules enlarge, become more convoluted, and form conical lobules. The duct from each lobule drains into a single epididymal duct, which moves approximately 6 m within the fibrous sheath of the epididymis to form its body and tail (Fig.2-B). As the duct approaches the tail, it thickens and straightens to become the vas deferens. [12-13]

Arterial supply of the testes:

The testicular arteries arise from the front of the aorta a little below the renal arteries and travel downward in the retroperitoneum to reach the internal inguinal ring where they enter the spermatic cords.The testicular artery branches into an internal artery, an inferior testicular artery and a capital artery to the head of the epididymis. [14]

The level of this branching varies and has been noted to occur within the inguinal canal in 31% to 88% of cases. A rich arterial anastomosis occurs at the head of the epididymis, between the testicular and the capital arteries, and ?? at the tail between the testicular, the epididymal, the cremasteric, and the vasal arteries. The testicular arteries enter the mediastinum and ramify in the tunica vasculosa, principally in the anterior, medial, and lateral portions of the lower pole and the anterior segment of the upper pole. Thus, placement of a traction suture through the lower pole tunica albuginea risks damaging these important superficial vessels and devascularizing the testis. Testicular biopsy should be carried out in the medial or lateral surface of the upper pole, where the risk of vascular injury is minimal. [15]

Venous drainage of the testes:

The testicular veins form a several anastomotic channels that surround the testicular artery as the pampiniform plexus. This arrangement allows countercurrent heat exchange, which cools the blood in the testicular artery. The veins ascend along the cord in front of the ductus deferens .At the level of the inguinal canal, the veins unit to form two or three veins and then a single vein that drains into the inferior vena cava on the right side at an acute angle and the renal vein on the left side at a right angle. The left vein passes retroperotineum behind lower part of the descending colon and is crossed by left iliac vessels; the right vein passes retroperotineum behind the terminal part of the ileum and the horizontal part of the duodenum and is crossed by the root of the mesentry, ileocolic and right colic vessels. The testicular veins are provided with valves. The testicular veins may anastomose with the external pudendal, cremasteric, and vasal veins. These connections can allow varicoceles to recur after ablative procedures.[16]

Lymphatic vessels:

Testicular lymphatic vessels drain to the para-aortic lymph nodes at the origin of testicular arteries (L2). [16]

Nerve supply:

Sympathetic innervation to the testis and epididymis travels by two routes. A portion arises in the renal and aortic plexuses (from Th.10 segment of the cord) and travels with the gonadal vessels. [17] Additional gonadal afferent and efferent nerves pass from the pelvic plexus in association with the vas deferens. Some afferent and efferent nerves cross over to the contralateral pelvic plexus. This neural cross-communication may explain how pathologic processes in one testis (e.g., tumor or varicocele) may affect the function of the contralateral testis. The genital branch of the genitofemoral nerve supplies sensation to the parietal and visceral tunica vaginalis and the overlying scrotum.[18]

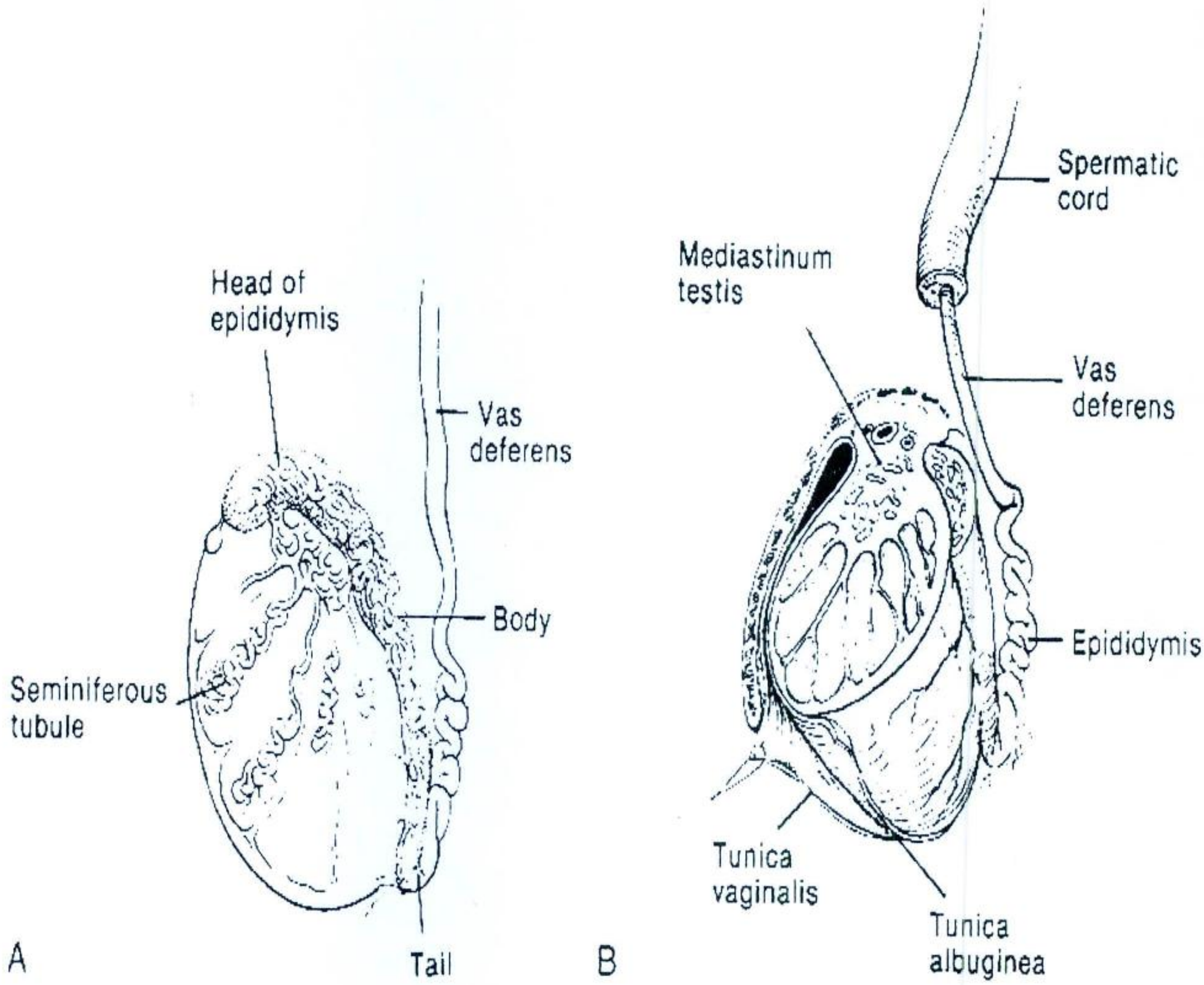

Figure (2).Testis and epididymis: (queted from Cambell's urology; 124, 1998)

A, One to three seminiferous tubules fill each compartment and drain into the rete testis in the mediastinum. Twelve to 20 efferent ductules become convoluted in the head of the epididymis and drain into a single coiled duct of the epididymis. The vas is convoluted in its first portion.

B, Cross section of the testis, showing the mediastinum and septations continuous with the tunica albuginea. The parietal and visceral tunica vaginalis are confluent where the vessels and nerves enter the posterior aspect of the testis.

Tunica vaginalis:

It is the inferior extremity of the processus vaginalis from the peritoneum .after the testis has reached the scrotum, the cranial part becomes obliterated and the distal part remains as a closed sac invaginating the testis. [19]

The visceral layer covers the testis leaving most of the posterior border uncovered. At the medial side of posterior border, it is reflected forward to be continuous with the parietal layer. At the lateral side of the posterior border ,it is reflected on the medial side of the epididymis lining the it's sinus to become continues with the parietal layer anteriorly.The parietal layer covers the testis and extends upwards for some distance in front and medial aspect of the spermatic cord.[13]

Tunica albugina:

It is a fibrous covering of the testis; it is applied to the tunica vasculosa. At the posterior border of the testis it's projected into the interior of the testis forming incomplete septa, called mediastineum testis.[19]

Epididymis:

It is a firm structure, attached behind the testis, with the ductus deferens on its medial aspect. It's consists of a single tube six meters long (20 Ft) that is highly coiled. It's formed of a large head (upper pole, globus major) and a small tail (lower pole, globus minor) connected by intervening body. The head is attached to the testis receiving the vas efferentia from the rete testis. The sinus of the epididymis (digital fossa) is anarrow slit between the epididymis and the testis. The tail of the epididymid is continuous with the vas deferens. Histologically its wall is a thin fibrous tissue, lined by tall columnar epithelium with long non-motile cilia.[20]

Vas deferens:

It's a muscular tube, 45 cm long and about 2.5 mm wide. It begins as a continuation of the epididymis and ends by uniting the duct of the seminal vesicle to form the ejaculatory duct. As it arises from the tail of the epididymis, the vas (ductus) deferens is somewhat tortuous for 2 to 3 cm. It runs posterior to the vessels of the cord and through the inguinal canal and emerges in the pelvis lateral to the inferior epigastric vessels. At the internal ring, it diverges from the testicular vessels and passes medial to all structures of the pelvic side wall to reach the base of the prostate posteriorly. The terminal vas is dilated and tortuous (ampulla of the vas) and is capable of storing spermatozoa.[21]