TRANSRECTAL ULTRASOUND (T. R. U. S.) IN MALE INFERTILITY : SPECTRUM OF FINDINGS AND ROLE IN PATIENT CARE.

ESSAY

SUBMITTED IN PARTIAL FULFILMENT OF M.SC DEGREE IN RADIO-DIAGNOSIS.

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ACKNOWLEDGMENT

I find no words by which I can express my great and deep thanks to ***Professor Dr. Mostafa Fadel Sonbol***, professor of Radiodiagnosis ,El-Azhar Universiy,for his potince,continous support, guide, encouragment, and useful advices.

I would also like to express my great thanks to ***Assistant Professor Dr.Emad Ibrahim El-Basyouni***, Assistant Professor Dr.of Radiodiagnosis,El-Azhar University,for his great efforts nd continous guidance in iniating and completing this work.

My great thanks also to ***Assistant Professor Dr.Gouda Mohammed Khalifa***, Assistant Professor of Radiodiagnosis ,El-Azhar University,for his generous help and strenous efforts , to produce this work.

Last but not least ,sincere appreciation is attributed to all my colleagues who were never reluctant to offer their support in any way.

Thanks to my Professor, my colleagues, and my patients.

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INTRODUCTION

INTRODUCTION

Transrectal ultrasonography (T. R. U. S.) may be most effective applied to the evaluation of infertile patient (defined as the inability to conceive after one year of unprotected intercourse) with either low ejaculate volume < 1.5ml or azoospermia (complete absence of spermatozoa in the ejaculate.) to provide rapid accurate diagnosis while avoiding more costly procedures. (Kuligowska et al.,1998).

The sonographic evaluation of the male accessory glands has undergone evoluotionary changes over the past 20 years. In the early 1970 physicans were able to diagnose cyst lesions of the seminal vesicles using fairly crude Transabdominal Ultrasound equipment.

(Littrupe 1988)

The prostate and seminal vesicles were visualized through full bladder using low frequency transducers that have high penetration but low resolution.

Using the T. R. U. S. the anatomic proximity of the rectal orifice to these pelvic organs allows the use of the higher frequency transducers which provide much greater power of resolution .

Alternative studies used to visualize the pelvic male sex accessory organs include computed tomography, magnetic resonance and vasography. The advantages of the ultrasonography over these studies are significant. Ultrasonography provides higher resolution than C.T in imaging of the prostate , ejaculatory ducts and seminal vesicles. M.R.I has not been fully tested in this area but it is more costly and less readily available than ultrasonography. Although vasography is considered the gold standard in the diagnosis of ductal obstruction of the testis it remains an invasive procedure.

(Kneeland, 1985).

In T. R. U. S. patients usually examined in the left lateral decubitus positions with one of a variety of high frequency endorectal transducers (7.5 – 9.0 M.H.Z) . The terminal vas defrens , seminal vesicles , ejaculatory ducts and prostate must be examined in a systematic manner in both the axial and sagittal planes and measurements must be recorded in two dimensions. Careful attention must be paid to the internal echotexture and architecture of the vas deferens and seminal vesicles.

THE AIM OF THE WORK

The aim of the work is to assess the role of the transrectal ultrasound in the diagnosis and evaluation of the distal male reproductive tract that helps identify patients with potentially correctable causes of infertility. On the basis of the location and nature of the transrectal ultrasound findings patients were selected for either surgical or radiological intervention. For example patients with cysts of the vas deferens or seminal vesicles were offered treatment with transrectal ultrasound guided cyst aspiration by passing 18 gauge needle through the rectal mucosa into the cyst. Another example for surgical intervention is that infertile patient with unilateral absence of the vas accompanied by controlateral ejaculatory duct obstruction, confirmed by seminal vasography, Tranurethral resection of the distal ejaculatory duct,(TRUED)is the treatment of choice.

REVIEW OF LITERATURE:

(1) Lower Male Genitourinary Tract Embryology :

During fetal development, the male urinary and genital tracts are closely linked to each other. The excretory apparatus of the testis, namely the epididymis, vas deferens, and ejaculatory duct, is derived from the caudal end of the mesonephric or Wolffian duct, which also give rise to the ureteric bud. This close association is maintained throughout life, with the two tracts sharing a common outlet, the urethra, below the verumontanum. Fig. 4B.

Under the influence of testosterone, one of the male hormones secreted by the leydig cells of the testes, the mesonephric ducts differentiate into the paired deferens, which constitutes the path of sperm transport from the testis to the urethra. Associated with development of the male genital duct system (both the ductus deferens, and the urethra) is the formation of the male accessory sex glands, the seminal vesicles, the prostate and bulbo urethral glands. These glands arise as epithelial out growth from their associated duct systems (seminal vesicles from ductus deferens and the others from the urethra), and their formation involves epithelial-mesenchymal interactions similar to those of other glands, (Carlson et al., 1994) Fig.1,2,3.

1 - The Prostate Gland :

The prostate starts to develop at the 12th. week of embryonic life under the influence of androgenic hormones from the fetal testes. Numerous outpouchings from the urethra develop (Fig.4A). At that time, the urethra, which is the distal part of the urogenital sinus, has already acquired its own mesenchyme; this mesenchyme will later differentiate to a fibro-muscular wall. This epithelial budding occurs both above and below the level of the mullerian tubercle and the adjacent opening of the ejaculatory duct. The incorporation of a Wolffian element into this segment of the urogenital sinus could be a factor in the future development and differentiation of the adult prostate. The outpouching of these buds branches and rebranches to form the racemose glandular element; between them is entangled the fibromuscular tissue originally continues with the bladder and now the prostatic stroma proper, which is primarily sphincteric in function. All these urethral buds will become confluent and constitute one muscular glandular organ, which will acquire an outside capsule formed from the condensation of this fibromuscular tissue. Fig.4 -(A,B), (Emil , 1992).

2 - The Seminal Vesicles, Vas Deferens And Ejaculatory Ducts:

The normal embryological development of the lower genitourinary tract in the male towards the end of the fourth week of embryonic development, the ureteric bud (Ub) arises from the mesonephric duct. Between the fourth and ninth weeks, portions of the lower mesonephric duct (Lmd) become incorporated into the urogenital sinus and help form the bladder trigone and prostatic urethra (T & PU). During this period (approximately) 8 weeks, a rotation occurs between the ureteric orifice (UO) and lower mesonephric duct orifice (MDO) so that the ureteral orifice migrates superiorly and laterally and the mesonephric duct orifice migrates inferiorly. Thus the remaining portions of the lower mesonephric duct (LMD) is separated from the ureter (U). This portion of the lower mesonephric duct gives rise to the ejaculatory duct and the vas deferens. The seminal vesicles eventually arises as a bud from the vas deferens (VD). The upper portion of the mesonephric duct (UMD) does not contribute to any mature structures. (Fig. 4-B and 6) (Bernard et al., 1989).

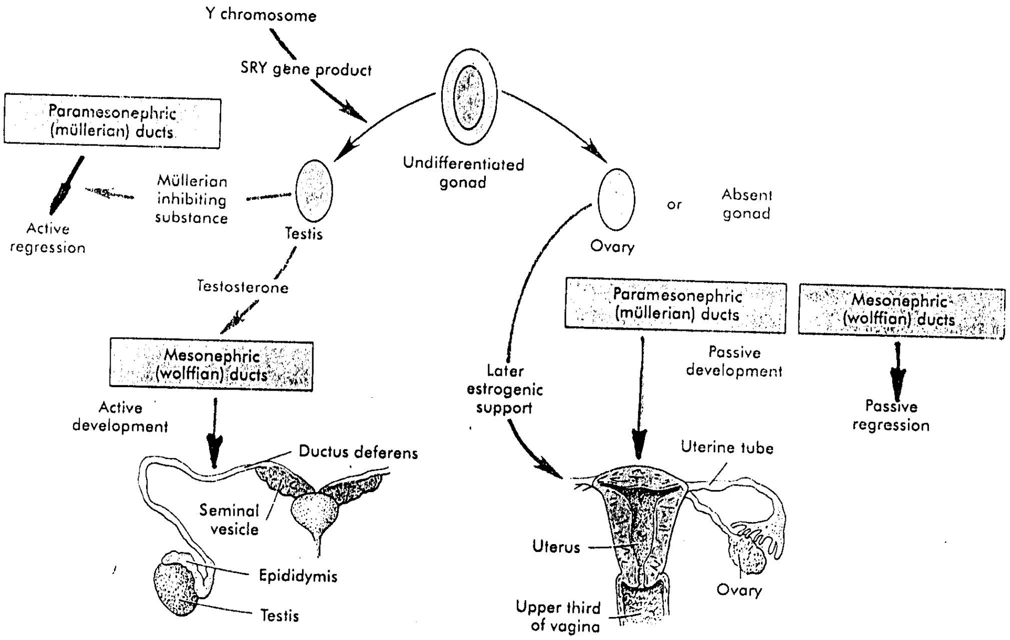


FIG. 1 Factors involved in sexual differentiation of the genital tract.
(Based on studies by Hutson and others, (1989).)

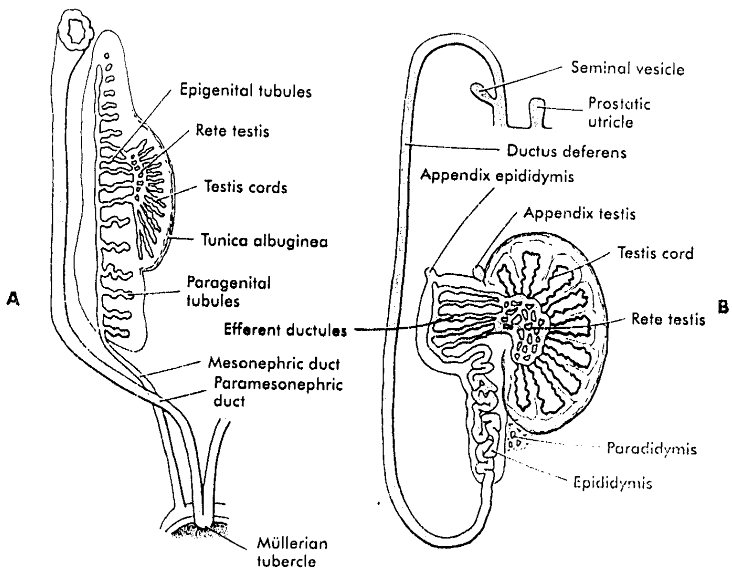


FIG. 2 Development of the male genital duct system. **A**, At the end of the second month. **B**, In the late fetus.
(Modified from Sadler T: *Langman's medical embryology*, ed 6, Baltimore, 1990, Williams & Wilkins.)

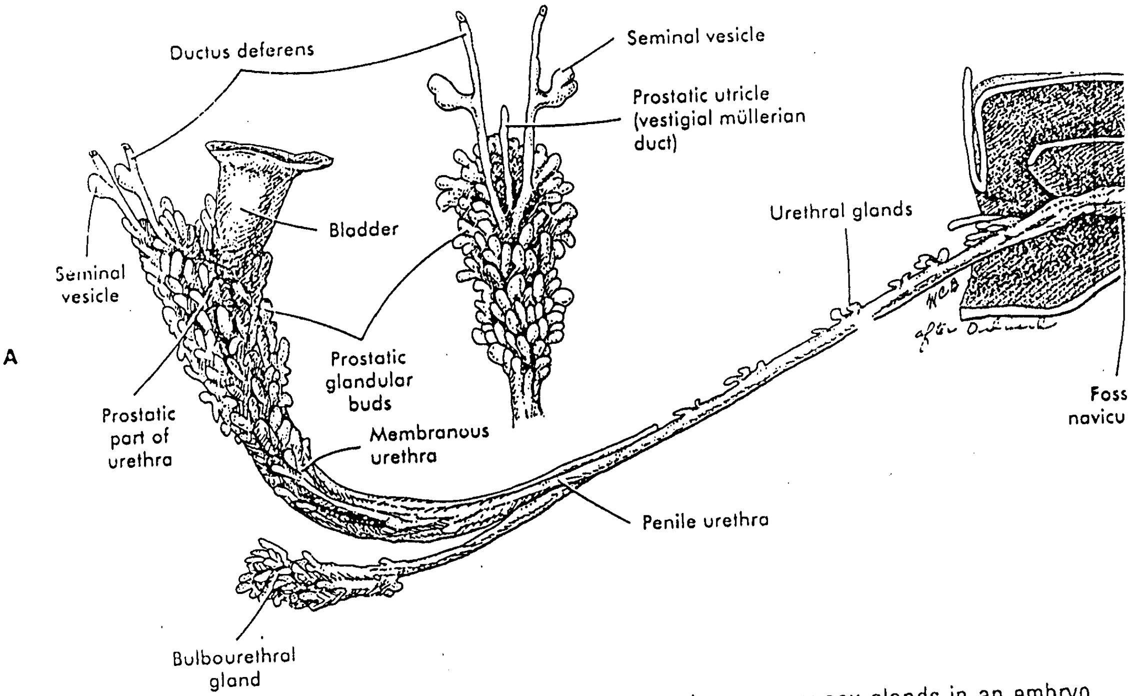
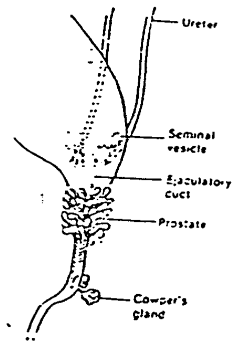
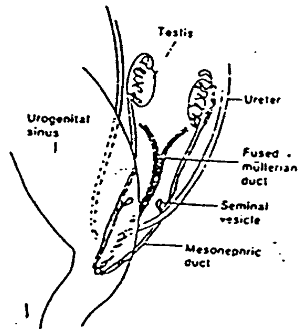


FIG. 3 Development of the male urethra and accessory sex glands in an embryo of approximately 16 weeks. A, Lateral view. B, Dorsal view of prostatic region. (After Didusch.)



A, Development of the prostatic gland in a 12-week-old embryo. Several buds originate out of the proximal part of the urethral segment of the urogenital sinus- Cowper's glands begin to appear slighthly more distally. The seminal vesicles develop from the caudal end of the mesonephric ducts. These changes are happening under the influence of testicular differentiation.

Fig. 4



B, Embryologic development of an 8-week-old male. The fused mullerian ducts have already met the urogenital sinus at Muller's tubercle. On either side is the opening of the mesonephric ducts. The ureteral buds have started their ascent on the orogenital sinus; the gonads have started to differentiate and now connect to the mesonephric duct.

(After Emil, 1992)

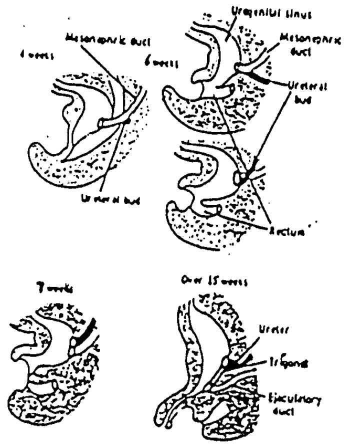


Fig. 5. Embryologic sequence of development of the urogenital sinus as it separates from the cloaca. Ureteral bud (first appearance at 4 weeks of gestation) at the bend of the mesonephric duct; the common nephric duct becomes incorporated into the urogenital sinus when the latter separates from the rectum. When this separation is complete, the cloacal membrane will rupture to form two independent openings for the urogenital sinus and the rectum. (From Tanagho, E.A.: in Raz, S. (Ed): Female Urology. Philadelphia, W.B. Saunders Co. 1983).

(From Emil, 1992)

NORMAL DEVELOPMENT

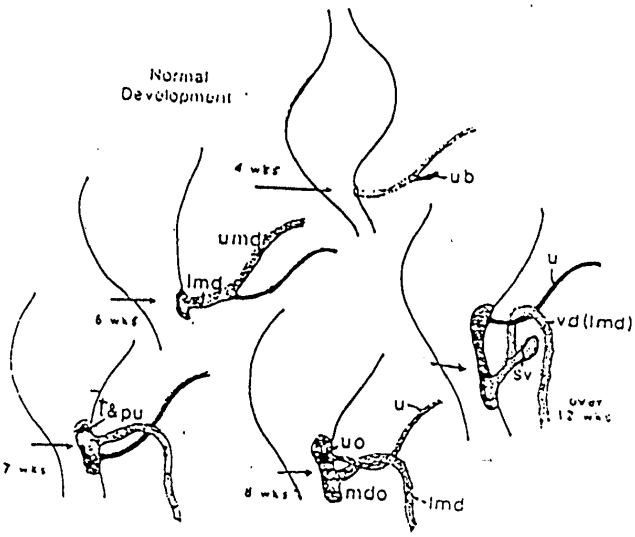
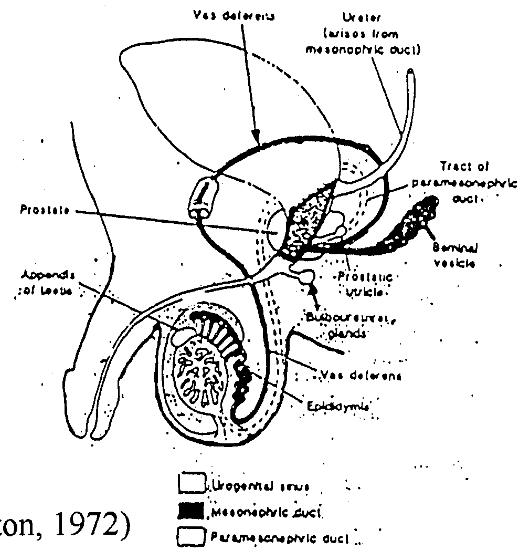


Fig. 6



(Fig 6,7 from Hamilton, 1972)

Fig. 7

(2) Anatomy Of The Distal Seminal Tract and Auxillary Genital Glands:

A. Gross Anatomy: (i.e. Lobar Anatomy)

The Prostate Gland:

The understanding of the gross and microscopic anatomy of the prostate has changed during the past few decades. The classic understanding of prostate anatomy was the division of the gland into five lobes, termed Lowsley's lobar concept of anatomy. This method has been used to identify the prostate and prostatic disease for close to 100 years. However, lowsley's concept of anatomy did not consider the different histologic components of the prostate but was based purely on anatomic position as defined in the embryonic and fetal gland. It has been emphasized in 1954 that those divisions were identifiable only in the embryo and that from the last months of gestation into postnatal life no divisions into separate glands were possible.

In this description the prostate was divided into five major lobes. The first, the anterior lobe, was in the anterior portion of the prostate. It was situated from the anterior margin of the gland to the level of the prostatic (also termed the posterior) urethra posteriorly. The middle or median lobe was a smaller area between the proximal prostatic urethra and the ejaculatory ducts. This lobe extended from the base (the cephalic margin of the prostate) caudal to the level of the verumontanum (where the ejaculatory ducts insert into the prostatic urethra) in the mid portion of the prostate. The posterior lobe encompassed the posterior portion of the prostate and was situated posterior to the ejaculatory ducts i.e.(in the superior half of the prostate) and the prostatic urethra i.e. (in the caudal portion of the gland). The posterior lobe extended to the posterior margins of the gland. The fourth and fifth lobes were the two large lateral lobes that extended from the lateral margin of the gland. None of the lobes had clearly defined medial margins. Fig.6 (Rifkin et al., 1990).

Since the 1960s, a zonal concept of anatomy has evolved, initially developed by (Mc Neal, 1965) and then modified over the post 25 years. (Mc Neal, 1988).

The prostate contains a number of individual glands composed of from 30-50 lobules, which then form 15 to 30 secretory ducts that open into the urethra lateral to the colliculus seminalis. The prostate shape is most often said to be analogous to a horse chestnut or an inverted cone, with the length of the anterior aspect being between 3 and 4 cm and its width between 3.5 to 5 cms. A normal adult human prostate weights approximately 20-25 gms $\pm$ 6 gms & > 20-25 ml, in volume (Coffey , 1992).

LOBAR ANATOMY OF THE PROSTATE

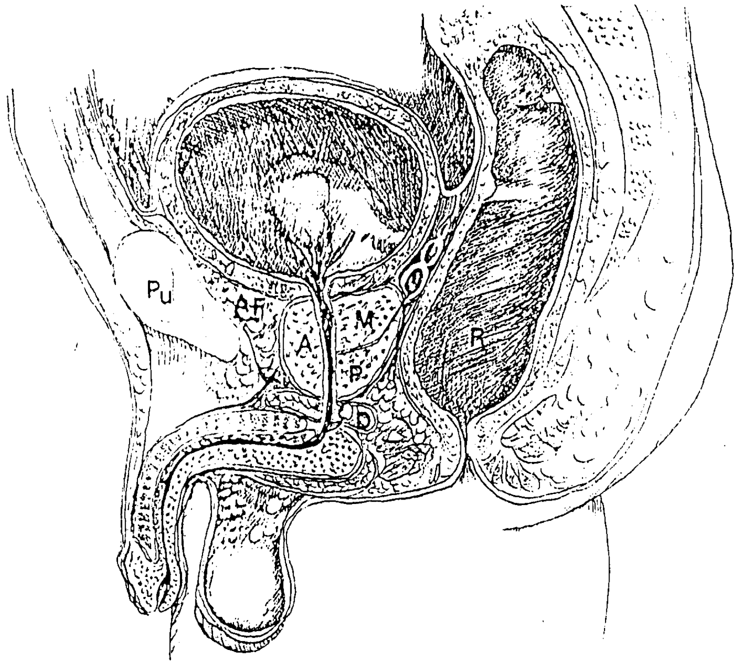


Figure 8. The prostate is divided into five lobes. The anterior lobe (A) is situated anterior to the prostatic urethra. The median lobe (M) is situated between the urethra and the ejaculatory ducts. The posterior lobe (P) is situated in the posterior portion of the prostate. The prostate is situated between the pubic bones (Pu) and anterior prostatic fat and fascia (AF) and posteriorly, the rectum (R). The base of the urinary bladder (B) abuts the superior portion of the prostate, the base of the gland, and the inferior or apical portion of the prostate is adjacent to the urogenital diaphragm (D).

(After Emil, 1992)

B. Zonal Anatomy:

According to (Mc Neal, 1988), the anatomic orientation defines the prostate in terms of its cellular components and is divided into three major areas. The anterior portion of the prostate, the central gland, and the peripheral gland. Fig. 9,10.

≈ Anterior Prostate:

The anterior portion of the gland is actually nonprostatic tissue. It is fibromuscular stroma, which is quite thick anteriorly. The thin, fibrous prostate capsule, laterally and posteriorly, is an extension of the thick anterior fibromuscular stroma.

≈ Central Gland:

The central or inner gland is the central (inner) area of the prostate and include a number of different structures. The proximal urethra (and its lining), the transition zone (T.Z.), and the smooth muscles of the internal sphincter. The thin lining of the proximal urethra (the periurethral glandular tissue) extends from the base (the superior portion of the prostate) cephalic- to the level of the verumontanum i.e.(seminal colliculus) caudad. The smooth muscle fibers of the internal sphinct are extensions of the base of the urinary bladder.

The transition zone is a bilobed structure situated just cephalad to the verumontanum. The T.Z. is acinar tissue and along with the periurethral glandular tissue is the only acinar tissue not part of the periurethral gland. The central gland encompasses about 5% of the volume of the glandular prostate in the young male.

≈ **Peripheral Or Outer Gland:**

The Peripheral gland is composed exclusively of prostatic acinar tissue. It is divided into C*entral Zone (C.Z.)* and *Peripheral Zone (P.z.)* The C.Z. is situated posterior to the bladder neck or internal sphincter and is distinctly separate from the central gland. It extends posteriorly from the central gland to surround the bilaterally paired ejaculatory ducts. Similar to the central gland, the central zone extends inferiorly to the level of the verumontanum. The peripheral zone (P.Z.) comprises the lateral, posterolateral, and anterolateral portions of the prostate (Fig. 7,8). It is the largest portion of the gland. Approximately 70% of the volume of the normal post pubescent prostate and 95% of the volume of the glandular prostate.

A Comparison of Lowsley's lobar and Mc Neal's zonal concepts of anatomy is possible and important because of the need to compare clinical findings (clinicians may still refer to lobar anatomy) to imaging studies (which should employ zonal anatomy :

AXIAL SAGITTAL

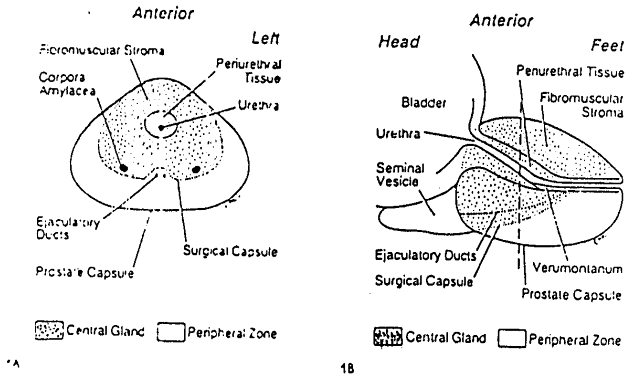
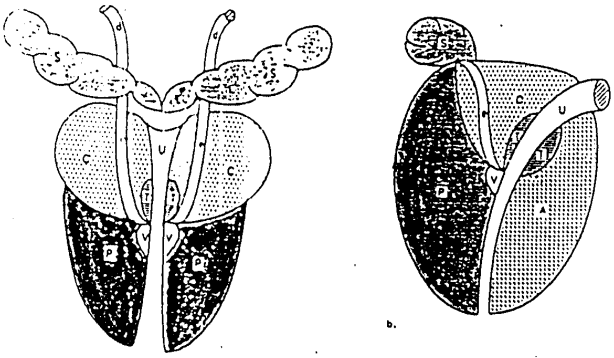


Fig. 9
Transaxial (A) and sagittal (B) schematic views of the prostate gland with anatomic nomenclature.



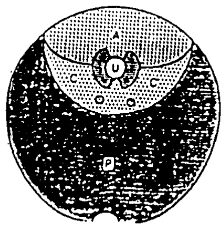


Figure 10 Line diagrams of normal prostate gland in coronal (a), midline sagittal (b), and transverse (c) orientations at level of transition zone (T) demonstrate different areas and zones of gland. P - peripheral zone, C - central zone, V - verumontanum. U - urethra. S - simenal vesicles, e - ejaculatory ducts, d - vas deferens. A - anterior fibromuscular stroma.

(Fig 9,10 from McNeal, 1988)

1) **The Anterior Lobe** :

Correlates with the anterior fibromuscular stroma;

2) **The Median Lobe And Central Zone** :

Are similar, but the later is larger extending slightly more posteriorly;

3) **The Sum of the posterior And Two Lateral Lobes** :

Correlates to a large extent with the peripheral zone (P.Z.).

The zonal concept of anatomy incorporated a clearer understanding of the development of disease. The development of cross- sectional imaging studies, endorectal prostrate sonography and MR imaging, the zonal concept of anatomy became a useful technique to apply to imaging because the different areas can be defined. (Rifkin et al., 1991).

Anatomical Relationships :

The prostate gland is classically described as a compressed inverted cone. It is a firm, partly glandular, and partly fibromuscular body surrounding the very beginning of the male urethra. It is situated in the true pelvis, behind the inferior border of the symphysis pubis and the pubic arch lying infront of the ampulla of the rectum.

The conical gland has its continuity with the neck of the urinary bladder, its apex is inferior, lying on the superior aspects of the superior fascia of the urogenital diaphragm, which is itself continuous with the fascial sheath of the prostate.

The gland has a posterior, an anterior, and two inferolateral surfaces. The posterior surface is flattened transversely and vertically is convex. It lies infront of the ampulla of the rectum, separated from it by its own capsule and by Denonvilliers fascia. The upper border of the posterior surface is the vesicoprostatic junction. The anterior surface is relatively narrow and convex and extends from the apex to the base. It is about 2 cm behind the pubic symphysis, separated from it by a rich plexus of veins and some loose adipose tissue. The santorinis plexus is a bilateral collection of veins situated anterolateral to the prostate gland. The most significant collections of vessels are the neurovascular bundled (also termed the lateral venous plexus), which are bilaterally paired and situated posterolateral to the prostate gland. Near the prostatic apex , it is connected to the pubic bone by the puboprostatic ligament.

The prostatic urethra traverses the substance of the prostate and emerges a little anterosuperior to the prostatic apex.

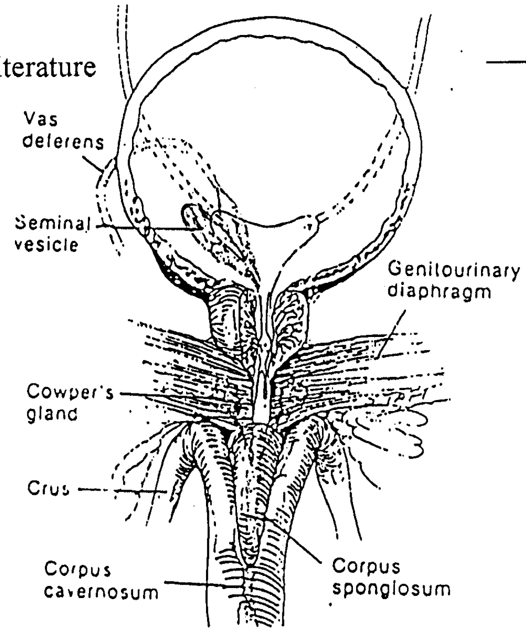


Figure 11 Anatomic relationship of the bladder, prostate, prostato-membranous urethra, and root of the penis. The prostate, situated just below the bladder base, has its apex resting on the genitourinary diaphragm, within which Cowper's glands, with their ducts extending distally, open into the bulbous part of the urethra, which is surrounded by the corpus spongiosum. Two corpora cavernosa diverge at this point. Each gaining fixation to the pubic arch.

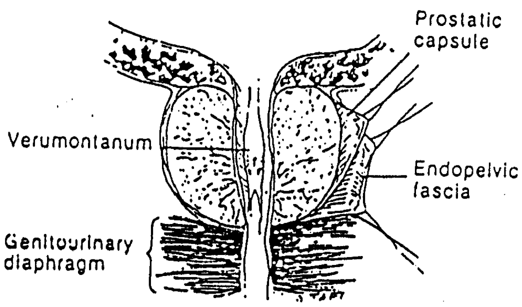


Figure 12 Section of the prostate gland shows the prostatic urethra, verumontanum, and crista urethralis, in additiuon to the opening of the prostatic utricle and the two ejaculatory ducts in the midline. Note that the prostate is surrounded by the prostatic capsule, which is covered by another prostatic sheath derived from the endopelvic fascia. The prostate is resting on the genitourinary diaphragm.

(Fig 11,12 from McNeal, 1988)

The inferolateral surfaces are prominent and are related to the anterior part of the levator ani muscles, which are separated from the gland, by a rich plexus of veins embedded in fibrous tissue forming the lateral part of the prostatic sheath. Fig.(11,12).
(Emil 1992 , Rifkin et al., 1991).

The bulbourethral glands or cowpers gland are located in the deep perineal compartment they lie on each side of the membranous urethra between the fascial layers of the urogenital diaphragm. They add a mucoid secretions to the seminal fluid. (fig.11).

Prostate Glandular volume :

Glandular volume can be determined accurately by volumetric techniques performed sonographically.

Volumes can be measured by using a stepping device, whereby areas of the prostate can be commulitely added to create a volume , or by using volume formulas, depending on the prostate shape.

Most often the prostatic is elliptical in shape, and using the formula for a prostate ellipse (L x w x H x 0.523) gives an accurate volume measurement.

For a sphere, use $4/3\ \pi\ R^3$, and for a cylinder use $\pi\ R^2 \times H$ (r = radius) volume can be converted to weight because 1 cc of prostate tissue is equivalent to 1 gm (Bree et al, 1991, Hendrik et al, 1989).

The Seminal Vesicles :

The two seminal vesicles are sacculated, contoured tubes, placed between the bladder and rectum. Each vesicle is about 4 to 5 cm long, weight 8 to 9 gm in the human and develop as paired pouches (capacity, 4.5 ml each), forming from the vas deferens. They are some what pyramidal the base being directed up and posterolaterlly, and is a singled coiled tube with irregular diverticula; the coils and diverticulae are connected by fibrous tissue.

The diameter of the tube is 3-4 mm and its uncoil length is from 10-15 cm; which is coiled to form the vesicle, like mass that lies between the fundus of the bladder and the rectum.

The paired seminal vesicles lies directly on the posterior basal side of the bladder, lateral to the ampullae of the vas deferens. Their upper poles are usually closely related in front to the intramural course of the ureter. From the upper poles to their duct they incline medially at about a 45 angle. Hence, they virtually parallel the oblique anteroinferior margin of the bladder trigone. (fig. 11,12).

The seminal vesicle and ampulla of the ductus deferens have a similar structure they are thin–walled and their mucous membranes have a honeycombed appearance. The superior ends of the seminal vesicles are covered with peritoneum

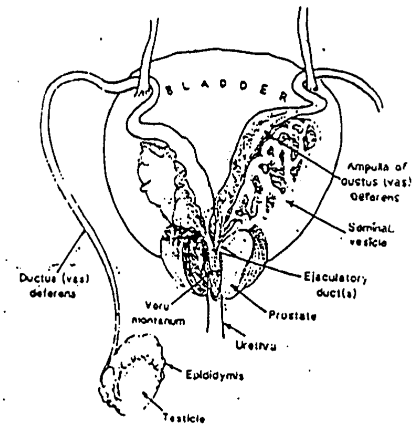


Figure 13
This drawing from a posterior perspective displays the anatomic relationships of seminal vesicles vasa deferentia ejaculatory ducts, prostate, urethra, and bladder.

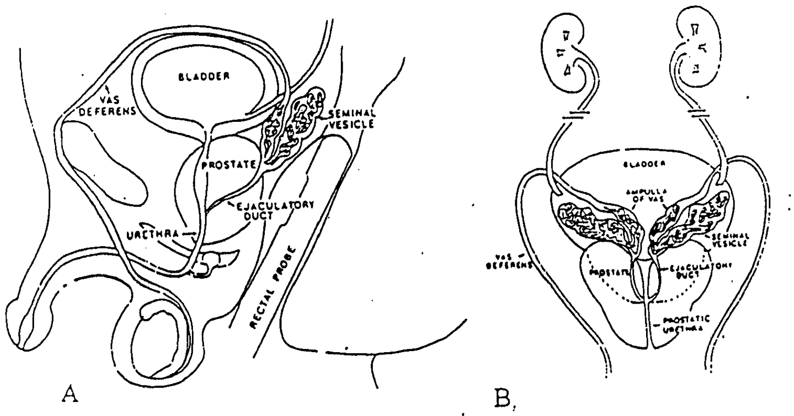


Fig. 14 Diagrams show normal anatomy in the sagittal (a) and coronal (b) views. (Courtesy of C.E. Baker. MD, Department of Radiology. Boston; University Medical School, Boston.).

(Fig 13,14 from Kuligowska, 1992)

and lies posterior to the ureters, where they are separated from the rectum by the peritoneum of the recto-vesical pouch. The inferior ends of the seminal vesicles are closely related to the rectum and are separated from it by the recto – vesical septum. The upper pole of both (SVS) is a cul-de-sac, the lower narrowing to straight duct, which joins the deferent duct to form the ejaculatory duct.

Each ejaculatory duct on either side opens into the posterior wall of the prostatic urethra near the opening of the prostatic utricle. (fig.13,14b).

The anterior surface of each seminal vesicle contacts the posterior surface of the bladder, extending from near the entry of the ureter, to the posterior base. Lateral are the veins of the prostatic venous plexus draining posteriorly to the internal iliac vessels.

The glands are composed of tubular alveoli containing viscous secretions, and the ducts can be highly variable, from a simple tube to the more common short main ducts with clusters of large side ducts. The seminal vesicle were so named because it was erroneously believed that they stored semen and sperm. Their secretion contribute to semen, but they do not store secretions made elsewhere.

The seminal vesicles are supplied by arteries derived from the inferior vesical and middle rectal arteries. The veins accompany the arteries and have similar names.

The Ductus Deferens (Vas Deferens) :

The ductus deferens (vas deferens), a thick – walled muscular tube, is the continuation of the duct of the epididymis, an irregularly twisted tube that forms the epididymis. The ductus deferens begins in the tail of the epididymis and ends by joining the duct of the seminal vesicle to form the ejaculatory duct (fig. 15).

The ductus deferens, about 35-45 cm long, ascends in the spermatic cord, passes through the inguinal canal, and crosses over the external iliac vessels to enter the pelvis minor. It passes along the lateral wall of the pelvis where it lies external but adherent to the parietal peritoneum and medial to the vessels and nerves.

The ductus then crosses the ureter near the posterolateral angle of the bladder running between the ureter and peritoneum. It reach the fundus (base) of the urinary bladder. At first it lies superior to the seminal vesicle and then it descends medial to the ureter and the vesicle.

The ductus deferens enlarges to form the ampulla of the ductus deferens as it passes posterior to the bladder. It then narrows and joins the duct of the seminal vesicle to form the ejaculatory duct, (fig. 12, 13 and 15). Only the ampullary portion of the ductus that is visualized on transrectal ultrasonography.

The muscular layers of the vas are both longitudinal and circular in orientation. The external diameter of the vas is 8mms with a luminal diameter of 0.4 to 0.5 mm, slightly wider at the ampullary portion of the vas.

The tiny artery of the ductus deferens is closely applied to its surface. It arises from the superior (or inferior) vesical artery and terminates by anastomosing with the testicular artery.

The Ejaculatory Ducts :

These are formed on each side by union of the duct of a seminal vesicles with a deferent duct. Each is almost 2- 2.5 cms in length and 1-1.5 mms in caliber.

It starts at the base of the prostate, runs anteroinferiorly between its median and right or left lobes i.e. (central zone). It traverses the glandular tissue of the prostate to open into the prostatic urethra at the crista urethralis on either side of the prostatic utricle to end on the colliculus seminalis (verumontanum). The crista urethralis (CU) are two slit-like orifices on, or just within the utricular opening. Fig. 16.

The walls of the ejaculatory ducts are thin, containing an outer fibrous layer and a thin layer of muscular fibers, which has an outer circular and inner longitudinal layer. (Carson , 1991 , Murphy 1987, Williams et al, 1989, Moore 1992.)

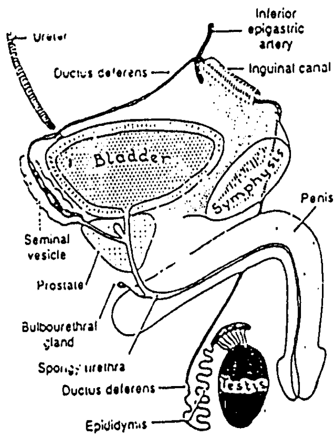
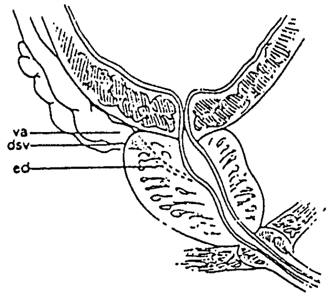
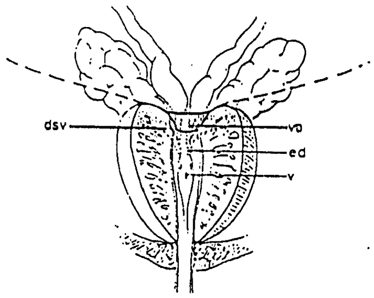


Fig. 15, The male urogenital system. Note that the ductus deferens passes superiorly from the testis, enters the superficial inguinal ring, and passes through the inguinal canal. Sperms (spermatozoa) are produced in the testis and enter the epdidymis where they are stored and undergo maturation. Thery are then propelled through the ductus deferens and ejaculatory duct into the urethra.





A

Figure 16 Anatoms at the ejaculatory ducts A. Anteroposterior views. B. Sagittal views. The terminal vasal ampulla (va) and duct of the seminal vesicle (dsv) converge as the ejaculatory duct (ed) and drain into the posterior urethra, proximal and lateral to the veromontanum.

B

(Fig 15,16 from Carson, 1991)

(3) Imaging of the Distal Seminal Tract:

Methodes of imaging of the distal seminal tract including:

- **Plain x ray**
- **Vasography**
- **U.S.(abdominal&transrectal)**
- **C.T.**
- **M.R.I.**

The clinical evaluation of male infertility was limited until recently by the inability to visualize directly and noninvasively distal parts of the vas deferens, seminal vesicles, ejaculatory ducts, and prostate.

Plain radiography: Seminal vesicles and prostatic calcification subsequent to chronic inflammation can be detected by plain radiography.

Vasography: Seminal vesiculography is in itself an invasive procedure used most often to define the level of obstruction within the vas in the investigation of infertile man with azoospermia or extreem oligospermia. Also it is limited in the evaluation of seminal inflammation.(Dunnick et al .,1982)

Computed tomography: has been useful because the whole genitourinary tract can be investigated simultaneously. It was found useful in detecting seminal vesicle cysts and associated congenital anomalies of the genitourinary tract. However, other seminal vesicular pathology, C.T. seems to be inconclusive .C.T can diagnose congenital absence of a kidney or renal dysplasia in the cases of unilateral agenesis of S.V. and V.D. with contralateral seminal vesicle cysts. (Kneeland et al., 1985).

Magnetic resonance has the additional advantage of providing cross-sectional information in the coronal and sagittal planes. The newest diagnostic modality used is scanning by M.R.I. in selected cases, when transrectal ultrasound is equivocal; MRI studies of the pelvis can provide a highly detailed depiction of the seminal vesicle and prostatic region. It has recently been shown that the resolution of prostatic and seminal vesicular anatomy on MR and the ability to evaluate abnormalities of the seminal vesicles and ejaculatory dysfunction including ejaculatory duct obstruction are significantly improved particularly when an endorectal surface coil is used.
(Schnall et al., 1989).

Technique Of M.R. Imaging

Patients are imaged with a 1.5 T MR unit . Adisposable endorectal coil is placed in the rectum and insufflated, and 1 mg of glucagon is administered intramuscularly. After obtaining a sagittal T1 – weighted localizer image with a phased-array coil, 4-mm-thick contiguous sections are acquired in the axial, sagittal, and coronal planes. The following parameters are used; 500/12 (repetition time m sec /echo time m sec) for t1-weighted images and 4,000/150 for fast spin echo (SE) images . (Rosaleen et al., 1997).

Transabdominal ultrasonography has a role in the definition of abnormal anatomy of the upper urinary tract and cystic structures lying close to the bladder but cannot adequately demonstrate the fine anatomic details of the prostate gland.

Transrectal ultrasonography. Has now become widely available because of its well -demonstrated value in the evaluation of the prostate and distal seminal tract. It is commercially available at most hospitals and many urologists as well as sonologists offices, and the validity of such scanning has been well established .(Littrup et al, 1988)

Congenital abnormalities of the seminal vesicles and the vas deferens are best approached with TRUS. MRI is only reserved for problematic cases as in conditions associated with Hemospermia and inflammatory conditions, which are best, demonstrated on T 1 with fat suppression for cases presenting with Hemospermia. Also in indeterminant cases of infertile males. Caused by low ejaculatory volume or azoospermia. (king et al., 1989)

MRl offers superior anatomic depiction of the testes, epididymis, spermatic cord, and fluid analysis of anatomic relationships between the seminal vesicles, bladder, prostate and rectum is optimal. Diagnosing hemorrhagic conditions of the distal seminal tract in cases with hematospermia as well as cystic changes is unquestionable. Another advantage is lack of operator dependence (Foran et al., 1992)

However, its disadvantages are that it is considered a time consuming modality, expensive with a lot of technical preparations and modifications to obtain optimal scanning criteria to visualize the seminal vesicles and prostate.

Vasography remains the standard for the diagnosis of ejaculatory duct obstruction but it should be deferred until definitive surgical repair is scheduled.

Aproposed algorithm for the sequance of diagnostic modalities used is demonstrated in (Fig.17A) (Weintraub et al.,1993).

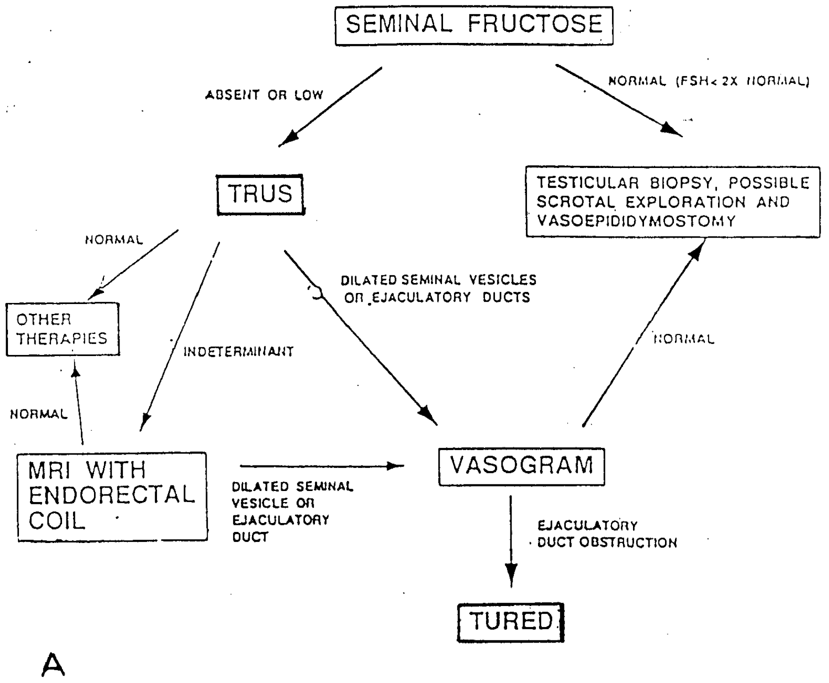


Fig. 17 suggested approach to patients presenting with infertility and/or perineal / ejaculatory pain who have azoospermia or severe oligospermia on repeated semen analyses. TRUS, transrectal ultrasound. FSH, folicle-stimulating hormone. TURED, transurethral resection of the ejaculatory duct. 71

(4) Male Infertility : (Definition)

Although most couples achieve conception within a-year , approximately 15 percent of couples are unable to do so. In the past, most efforts were placed on the evaluation and treatment of the female. More recently, data have determined that approximately 20 percent of these cases are entirely due to a male factor. An additional 30 percent of cases involve both male and female factors (Mosher, 1985).

Therefore, approximately one half of infertile unions involve male factor infertility. A basic, simple, cost-effective evaluation of both the male and female should be initiated at the time of presentation.

The approach to the evaluation of the infertile male should be similar to that used to evaluate other medical problems. A thorough history should be taken, with particular attention to these areas that may affect fertility. This should be followed by a physical examination. Appropriate laboratory testing will then complete the evaluation. Many tests are available to evaluate different aspects of male infertility, but not all patients need all tests. Thorough knowledge of the advantages and limitations of available laboratory procedures allows a cost-effective evaluation.

Ideally, the evaluation of the infertile male should result in the identification of the specific abnormality responsible for infertility. Although this is possible in some instances, many men demonstrate abnormal semen analyses for which no etiology can be identified. When possible, specific treatment is directed towards a specific etiology (mark et al., 1992).

Infertility in Males:

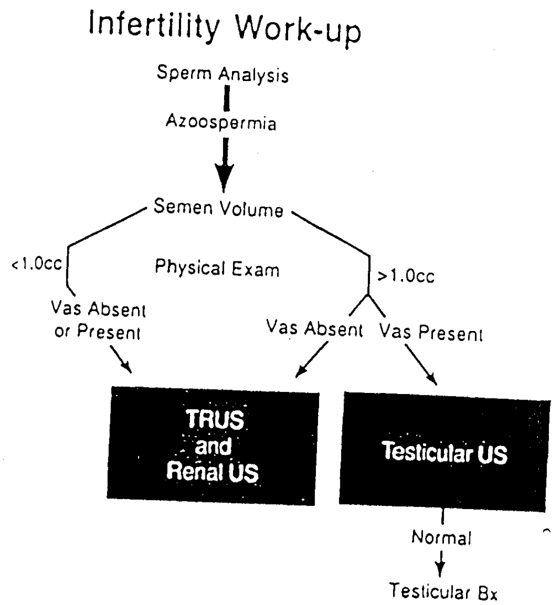
Male infertility is a broad field summarized by the inability of the male partner to initiate a pregnancy successfully. A man must be capable of complete and adequate:

1. **Spermatogenesis.**
2. **Ductal transport of sperm.**
3. **Erection.**
4. **Emission.**
5. **Ejaculation.**

The details of both normal and abnormal testis functions and disorders of both erectile and ejactile functions are not covered in this study. Male infertility is caused by many diverse conditions from reparable obstructive disorders to noncorrectable intrinsic testicular failure. This article discusses the clinical applications of (T.R.U.S) in the evaluation and management of male infertility. A proposed algorithm of evaluating male infertility, including use of sonography, is shown in (Fig 17B).

Transrectal U.S was employed to confirm congenital abnormalities and to identify potential obstructive conditions of the distal ductal sperm transport system when the history, physical examination, or semen analysis results suggested this possibility. The delineation of congenital and acquired obstructive abnormalities of the distal urogenital tract, with transrectal U.S enables an accurate diagnosis of certain cases of male infertility those with azoospermia or severe oligospermia and a general low ejaculatory volume.

To define the causes of azoospermia, it is helpful to subclassify patients into either a low volume ejaculate (<1 ml) or anormal volume ejaculate (>1ml).patients in the low volume groupe may result from stenosis, obstruction, or anomalies of the distal sperm transport system. Conditions that produce low volume ejaculate with azoospermia or oligospermia include agenesis of the vas deferens or seminal vesicles, inflammatory strictures or obstruction of the vas deferens and seminal vesicles, ejaculatory duct obstruction, and urethral strictures. Low volume ejaculate can also be caused by retrograde ejaculation. Retrograde ejaculation is secondary to neurologic conditions such as spinal cord injury, multiple sclerosis, or diabetes mellitus. With this disorders, the seminal fluid flows in a retrograde fashion from the prostatic urethra into the bladder.



B

Figure 17 Proposed algorithm for the evaluation of male infertility, indicating the role of testicular and transrectal sonography in the diagnosis of potential anatomic lesions responsible for the infertility.

Normal volume ejaculate with azoospermia or oligospermia is caused by testicular, or other scrotal abnormalities, or post testicular pre-ampullary vasal obstruction.(papanicolaou 1992)

Semen Analysis:

The semen analysis remains the counterstone of the laboratory evaluation of the infertile male despite this it is important to realize that the measurement of semen parameters does not constitute a measure of fertility. Except in cases of azoospermia, the semen analysis does not allow for separation of patients into sterile and fertile groups. As semen parameters decrease in quality, the statistical chance of conception decreases but rarely reaches zero. Nevertheless, an accurately performed semen analysis remains an important tool for the evaluation of the infertile male.

- **Physical Characteristics:**

Freshly ejaculated semen is a coagulum that liquefies over 5 to 25 minute's period. The seminal vesicles secrete the substance responsible for coagulation. Patients with congenital bilateral absence of the vas usually have absent or hypoplastic seminal vesicles. Semen in these patients does not coagulate and has a low volume.

Secretions from the testis, epididymis, bulbourethral glans (Cowper's glands), glands of Littre (Periurethral glans), prostate, and seminal vesicles compose the seminal fluid. (Mark et al., 1992).

The secretions from Cowper's gland account for 0.1 to 0.2 ml, prostatic secretions account for 0.5 ml, and the seminal vesicles account for 1.5 to 2.0ml. (Amelar et al., 1973).

The seminal vesicles are responsible for the formation of a coagulum; proteinase secreted by the prostate is responsible for semen liquefaction. (Eliasson et al., 1972).

Other measurements have been made of many semen components. For the most part, however, these have not proved to be of clinical value. The PH of semen varies between 7.05 and 7.80. The PH of seminal vesicle secretions is usually greater than 7 (Alkaline), whereas the PH of prostatic secretions is usually less than 7 (6.4-6.7) i.e. (Acidic). Thus, semen specimens from patients with absence or dysfunction of the seminal vesicles will have a low PH. (Raboch J, 1965). This condition is more readily and accurately diagnosed by the evaluation of seminal volume by transrectal ultrasonography.

Other semen parameters include semen fructose level. Normal semen fructose concentrations range from 120-450 mg /dl.

The seminal vesicles produce fructose in an androgen-dependent process. Patients with obstructed, hypoplastic, atrophic or absent seminal vesicles, which is usually associated with bilateral absence of the vas deferens, demonstrate fructose-negative semen and small-volume ejaculate of low PH that do not coagulate. T. R. U. S. is the modality of choice usually to diagnose the absence or anatomical abnormalities of the seminal vesicles and ejaculatory ducts. (Mark et al., 1992).

Patients and physicians are often confused as to the difference between an average semen analysis and the minimal seminal parameters required for normal fertility. In general, the minimal parameters that are considered acceptable for potential fertility are mean sperm density between 70 and 80 million /ml, i. e. (minimal adequacy should be greater than 20 million /ml) (Rehan et al., 1975), and sperms should show at least 60% motility (Pedigo et al, 1989), seminal volume of 1.5 to 5 ml, forward progression greater than 2.0

and more than or equal to 60% of sperms having normal morphology. See table (1) (Fisch ,1992).

The patient's history and physical examination together with laboratory and radiological studies are complementary in the evaluation of the infertile male.

(Fred et al 1987).

Table 1 – Semen Analysis Minimal Standards Of Adequacy	
Analysis	Standard
On at least 2 occasions	
Ejaculate volume	1.5-5.0 ml
Sperm density	>20 million /ml
Motility	>60%
Forward progression	>2 (scale, 0-4)
Morphology	>60% normal
And	
No significant Sperm agglutination	. . .
No significant Pyospermia	. . .
No hyperviscosity	. . .

(5) T.R.U.S.

History of TRUS and endorectal transducer

(A) Background and histroy of T.R.U.S.

The principle of that early endorectal U. S. device was identical to that of modern transrectal ultrasonography, although the investigators obtained only a square picture, presumably though to represent part of the rectum. In the following decade series of reports were proposed using transrectal scanner of the A-mode type.

After careful evaluation, however, they omitted the function of linear scanning from their new commercialized chair-type equipment (Fig. 19). The diagnostic accuracy of linear scanning for sagittal imaging obtained at that time was thought to be less than that achieved using horizontal sections obtained by radial scanning.

The technique of scanning using the chair-type scanner to T.R.U.S was, the patient sits on the chair, the anus is positioned over a hole in the Chair and a specially designed transducer, 12 mm in diameter with a double tube system ,is pushed up into the rectum.

Scanner for both transurethral and transrectal imaging was reported by Gammelgaard J, and Holm, in 1980 also. It was used mainly to evaluate the urinary bladder and ureteral orifices as well as the urethra. The seminal vesicles are seen as lucent oblong, paired structures. The prostatic capsue can be seen but clear definition of internal structures by this device was difficult unless the transeducer is positioned within the prostatic urethra.

In recent years, transrectal probe having functions of both radial and linear scanning have been reintroduced. In the mid 1980s, further refinement was made so the Biplane probes Fig. 19 were developed. These instruments used a variety of techniques to image the prostate in multiple orientations. These probes have two series of electronic transducer (a sector scan for the horizontal images and a linear scan for the sagittal images), which are set in parallel on the probe, whereas others employed a mechanical switching system for a single oscillating disk that can be used for either of the two directions, and its single crystal can be rotated in a variety of positions. This has been termed an'omnidirectional transducer. A single crystal placed at the end of the probe, an end fire orientation, can also be used but requires manipulations and manual rotations of the probe during scanning. Fig 22.

Multiple images can be obtained by a variety of techniques regardless of the type or types of transeducer used, there are three major planes for transrectal U.S. The axial, the sagittal and the oblique ie (coronal axial orientation).

Transducers nowadays used are the Biplane, oblique end fire and the curved array end fire probes. The latter is the most recent probes
(Rifkin et al., 1990).

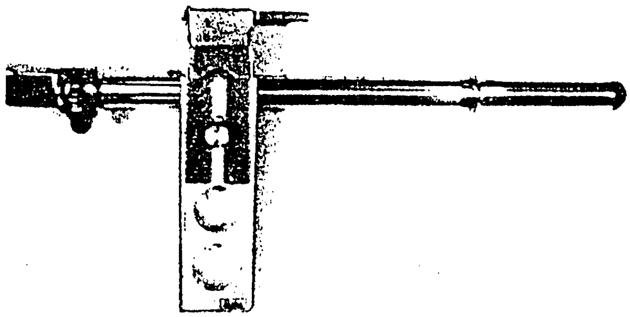


Figure 18. Speical unit for international ultrasound consisting of a transrectal electonic linear scanner and an attachment for needle guidance. (From Saiton M. Watanable II, Ohe H: Ultrasonically guided puncture for the prostate and seminal vesicles with transrectal real-time linear scanner, J Kyoto Pref Univ Med. 90:47, 1981).

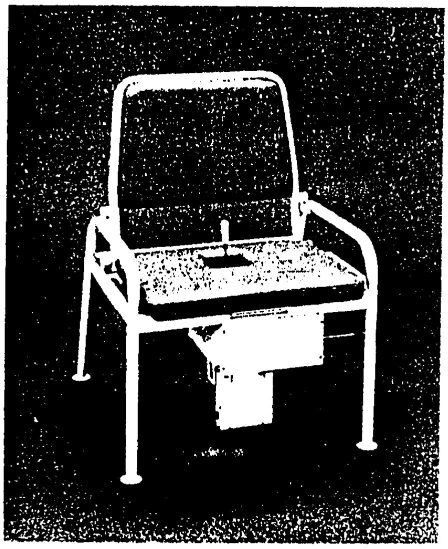


Figure 19 Chair for transrectal sonogrpahy

Other probes are coupled with doppler and colour flow that recently opened new dimensions and horizona for prostate evaluation (Carter etal, 1989).

(B)- Endorectal Transducer:

Old endorectal probes as the mechanical 360 rotating sector array and linear array scanners were very helpful those days. Initially scanners used 3.5 MHZ transducers, which were not optimal for evaluation of superficially placed structures. Those scanners, have been replaced by 5-8 MHZ transducer with sharply focused near-field thus permitting higher resolution of the prostate gland. Fig 22 A.

Old endorectal probes had small field of view and produced images of low resolution, compared to the recent, small electronically steered sector scanners and high-frequency linear, phased sector and phased convex array scanners. These modern scanners are particularly useful in scanning the prostate.

Recent T.R. probes configurations do not differ a lot neither in shape nor in caliber. They are all adapted and designed to scan the prostate via the rectal route. All what differs is the plane of the crystal head assembly on the probe. Those transducers may be arranged in

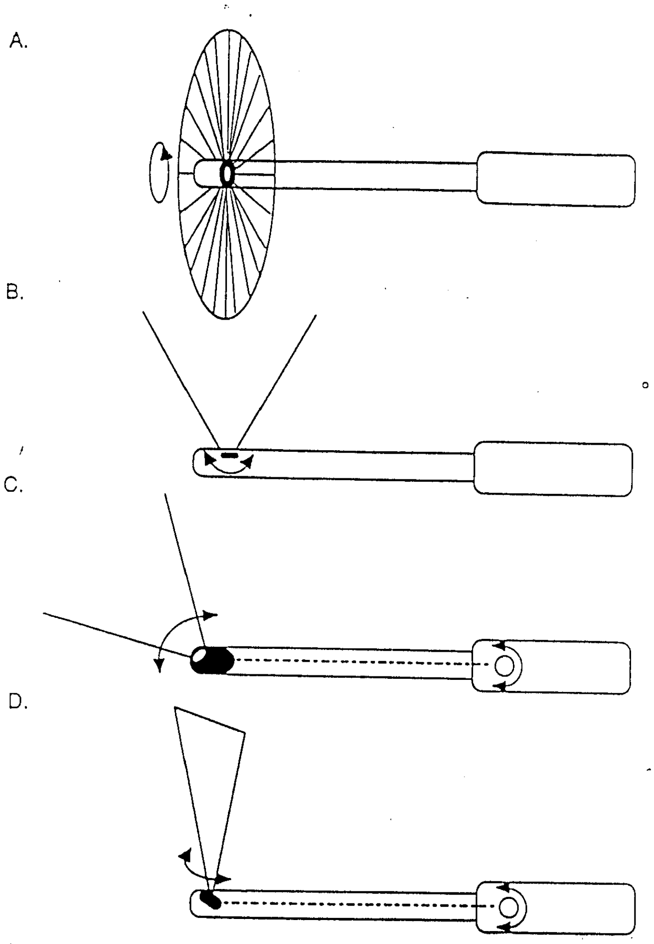


Figure 20 Mechanical endorectal real time sector scanner. A. Radial sector scanner rotating 360° giving a 360° field of view, used in rectal imaging and transurethral bladder imaging. B, Axial sector scanner for sagittal prostate imaging. C, Axial sector with adjustable scan plane. D. Mechanical sector scanner with a transducer that can be adjusted between axial and radial planes for sagittal and transversly oriented imaging. (Multiplanner) scanner.

radial, axial, transverse and curved end fire planes. Image orientation thus differs accordingly.

The latest advent in endorectal technology is the Biplane probes. Those probes are able to image the prostate in both sagittal and axial orientations. This ability is achieved by utilizing two crystal head assemblies in different planes. Fig. 21 (C, D). Another probe showing the same inherted ability in multidirectional scanning is manufactured quite similar to the old manually adjusted multidirectional probe seen in Fig. 20 (D), but it utilized a single crystal head that can be rotated electronically in a variety of positions. These abilities of those newer probes, has been termed "omnidirectional transducers". The true biplane probe however was the most current technology in the late 1980s and is still used. Its only disavantage is that it is replaced with another probe for endorectal is biopsy application. Another minor obsticle of these probes is their need of balloon water paths in scanning and in biopsy. (fig. 21 C,D) and (fig. 22, A).

The extensive need for a single application endorectal probe, forced the manufacturers to develop the latest 1990s currently used "end fire" probes. They provide single transducer option for imaging and biopsy, they do not need water balloon paths for scanning and

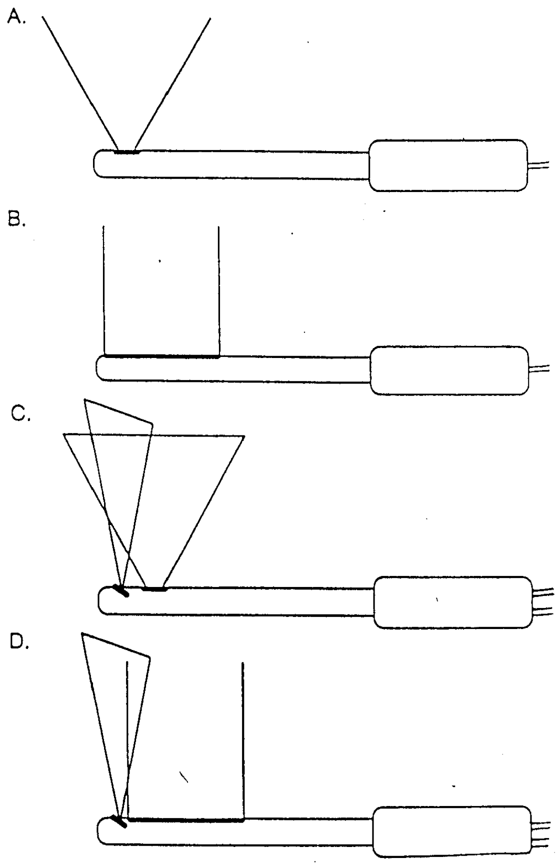


Figure 21 Electronic phased array scanners used for endorectal sonography. A. Axial phased array sector scanner for sagittal orientation. B, Axial linear array scanner C, Biplanar phased array sector, one axial transducer for sagittal and another radial transducer for transverse orientation imaging. D. Biplanar probe, A phased sector array linear array hybrid, with the linear array providing the sagittal (axial) scan plan. Both C and D types or called side-fire biplane probes.

other capabilities, opening new field for research and enhances their diagnostic abilities. For example they provide wider field of view if compared to the biplane probes ranging form 121 – 150, supports pulsed Wave and color doppler imaging, multihertz (5-9 MHZ) broad band operations providing better imaging resolutions in various depth ranges equally in both near field and far field pathology. Also they support easy applicable transrectal biopsy guide compatible with all automatic biopsy systems.

Every transrectal probe has its own advantages, limitations and disadvantages. Manufacturers are still competing for further probe development, trying to eleminate the limitations and updating the capabilities of their products, providing by this an increase in the probes flexibility to meet the clinical requirements with a single transducer.

▪ **Transrectal Uitrasound Imaging: (Orientation)**

Endorectal ultrasound transducers have variable techniques for real time ultrasound imaging. Regardless of the type of transducers used there are three major imaging (orientation) planes that should be obtained in a transrectal Ultrasonography Study. The axial, the sagittal and the coronal axial orientations. At least two of them allows prostate visualization in three dimensions, thus permitting more accurate localization of abnormalities, extent of disease and also to obtain an accurate measurement of the prostate volume.

Nowadays, a single transducer placed the end of the probe "end-fire" orientation probes are the latest advents of modern endorecta technology. Transducers are either curved arrayed. (Fig. 24. C), or phased array with straight foot print, eg. (Fig. 23C). Those designes are capable of producing, axial, sagittal and (oblique-axial) coronal images. The later is due to the obliquety of the end fire-scanning plane. The true axial plane permits rapid assessment of the size, shape and asymmetry of the prostate and seminal vesicles. The end fire probes are termed (omnidirectional) for their unique capabilities of multiorientational imaging. Furthermore, they are all adapted for biopsy, thus imaging and biopsy are done simultaneously in the same sitting without changing the probe. This ability gives the probe futher advantage over biplane probes.

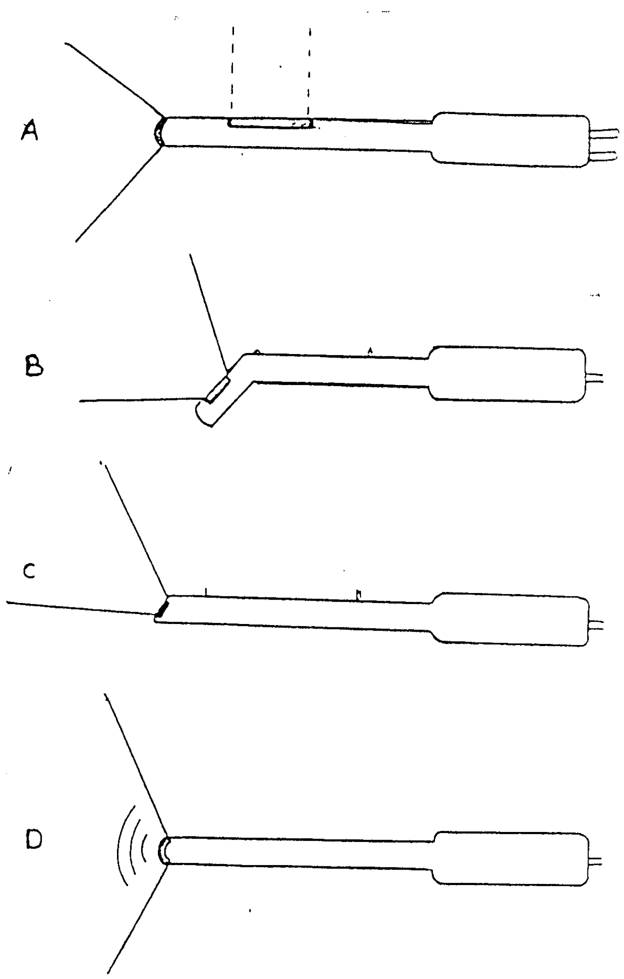
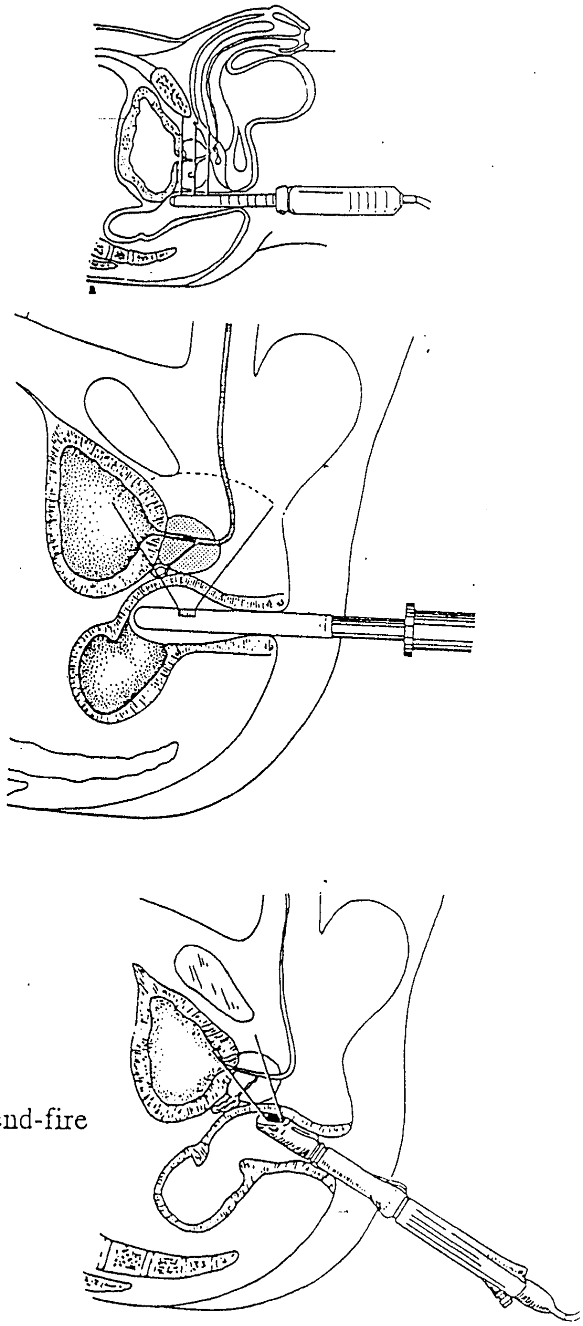


Figure 22 Recent endorectal phased array scanner adapted for biopsy application. A- Multiplaner probe incorporating two transducer assemblies - One end fire transducer for omnidirection multiplaner imaging providing 121° field of view and another linear phased array transducer for sagittal imaging. B- oblique-fire endorectal probe. A sector scanner adapted for biopsy. C- An end-fire longitudinal sector with forward angulatic providing 112° degree sector image. D- Wide angle 150 field of view end-fire curved array scanner providing an omnidirectional wide field scanning capabilities.



Axial

A- Side-fire

Linear

B- Side-fire

Fig. 23

C- Omnidirectional end-fire

Flat foot print

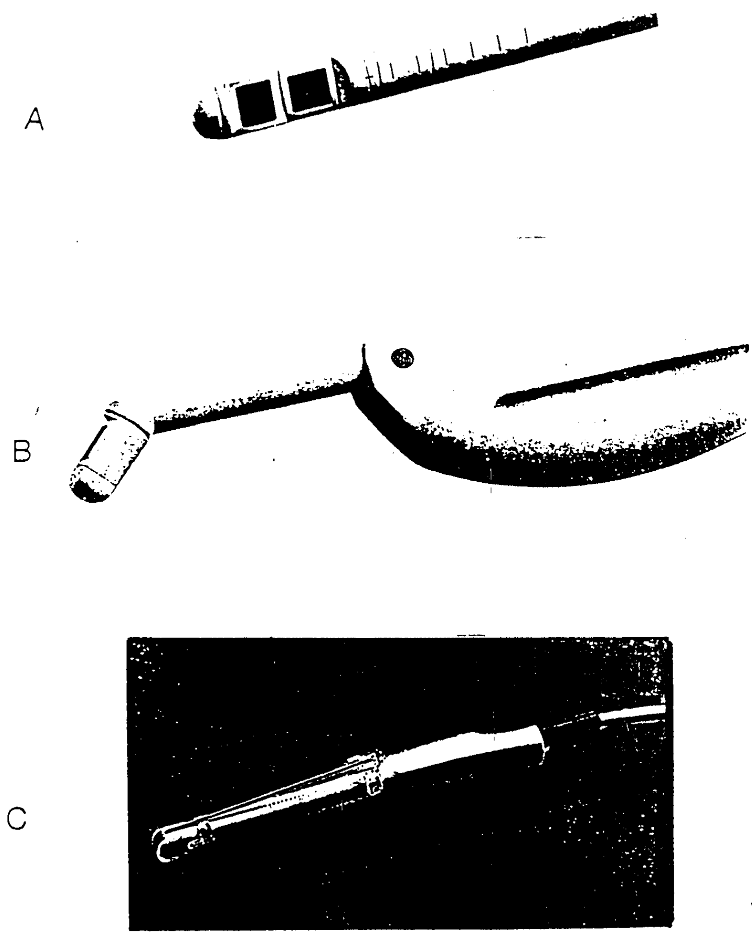


Figure 24 A-C. General electric endorectal probes. A- Biplanar electronic phased array sector probe 6.2 MHZ, 90° field of view for axial and sagittal imaging. B- oblique side fire sector probe, 6.2 MHZ, for sagittal imaging and biopsy. C- recent model, 7 MHZ end-fire transrectal probe with biopsy attachment eleminates the need for water paths. As any other end-fire probes they eleminates extensive setup procedures.

Every year, new equipments and highly sophisticated medical technology are brought to medicine in virtually every category in diagnostic and therapeutic medical fields. Now a new technology for prostate and rectal vascular assessment had evolved. Prostatic angiodynography, using endorectal probes providing colour flow and doppler are available in the market, introducing a major breakthrough in medical ultrasonography, and pushing the limits of diagnostic ultrasound to new levels of excellence. The new endorectal probe with colour coded duplex opened new horizons, improving the diagnostic confidence by delineating lesions involving the prostate, seminal vesicles, rectal and perirectal space, that are difficult to see at grey scale scanning. This facilitate recognition of the abnormality, particularly. Those equivocal subtle areas involving the prostate with greater confidece . (Rifkin et al,1993).

Biplane (Oblique Side Fire) Probe

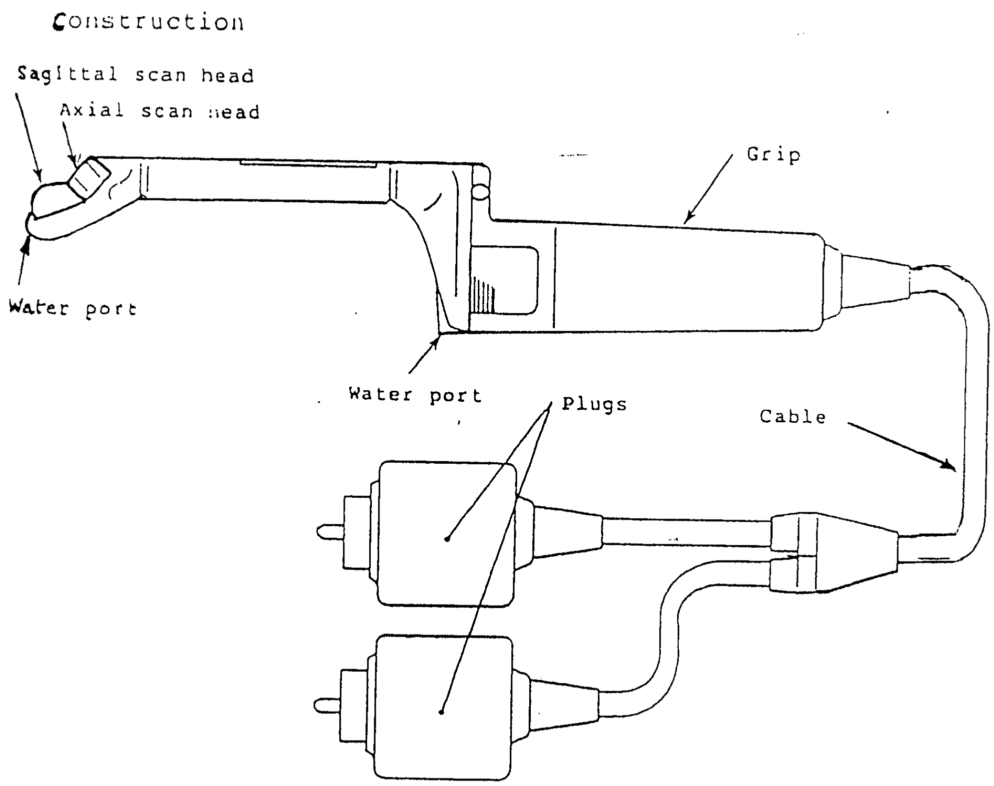
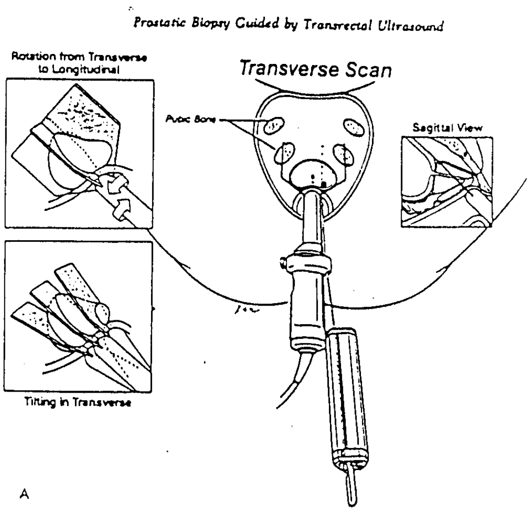


Fig. 25 External View of the Probe

Transverse Scan



Longitudinal Scan

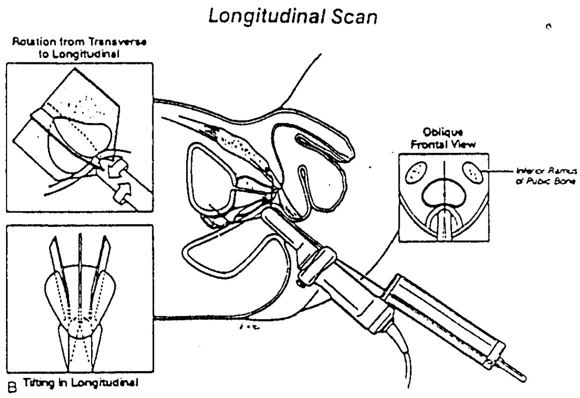


Fig. 26 Biplanar (End-fire) probe for biopsy. The ability to scan and perform biopsy utilizing the transverse and sagittal (longitudinal) planes.

(C) Patients Preparation, Positioning and Technique Of Examination :

- **Preparation :**

No patients preparation is required for a diagnostic endorectal sonographic examination. However, in certain instances, aself-administered cleansing enema is routinely used before scanning, when extensive fecal meterial is noted on the pre-ultrasound digital rectal examination. The urinary bladder should be emptied perior to the examination using the recent probes.Occasionally, slight distention of the urinary bladder will help delineate the gland. Previously, the indwelling of a catheter and inflating a balloon was a useful landmark of the bladder neck when using the old endorectal probe designs with relatively low frequencies ie (3-5 MHZ). In modern endorectal sonography, inflating a balloon and filling the bladder prior to the examination is considered a dissadvantage particularly when using the recent high resolution, high frequency probes ie (6.6 – 9 MHZ). Since the distended bladder will displace the prostate gland out of the probes, depth range.

It is advantageous to perform a rectal examination before probe insertion to correlate the imaging with any abnormality on physical examination and to ensure that there are no rectal abnormalities that could interfere with the scan.

- **Positioning :**

Patients may be examined in many positions including the lithotomy, knee-chest and left lateral decubitus.

All positions are appropriate, however the decubitus position is the most popular for transrectal prostate and seminal vesicle examination. Also for biopsy application lithotomy position is performed for transperineal scanning and biopsy (Rifkin, 1991).

- **Technique Of Endorectal Scanning :**

As previously mentioned, the use of at least two imaging planes allows visualization of the prostate and seminal vesicles in three dimensions, thus permitting more accurate localization of abnormalities and extent of disease.

Multiple images can be obtained by a variety of techniques, and instruments including multiple single-plane transducers; incorporation of two fixed transducers into a single probe (biplane probes), multi or omnidirectional imaging in which a single transducer rotates within the probe or a single oblique or end-fire transducer that can be rotated to allow omnidirectional imaging.

Regardless of the type or types of transducers used, three major planes are imaged, the axial, sagittal, and oblique coronal-axial. All orientations view the cross-sectional anatomy in slightly different presentations, although axial and oblique coronal-axial planes may appear similar. The true axial plane permits rapid assessment of the size, shape and symmetry of the prostate. (Rifkin, 1990).

(D) Normal endorectal sonogram:

(Prostate and seminal vesicles sonographic Anatomy)

The normal endorectal ultrasound (which is usually seen only in men under the age of 40) will have sonographic appearances different from pathological appearances.(Fig.27)

The normal inner prostate is generally low level in echogenicity (hypoechoic) compared to the outer gland. This is well seen in all views.

- **Prostate :**

A- Axial:

When scanning the prostate using the axial orientation, the transducer is usually placed deep within the rectum, just cephalad to the seminal vesicles. The initial scans will demonstrate the vas deferens either just superior to the seminal vesicles or at the same level, just anterior to the two paired ribbon shaped seminal vesicles (Fig.28A). As the transducer is withdrawn slightly to the level of the base of the gland, a hypoechoic area (the inner gland) will be identified anteriorly placed and in the midline. The central (CZ) and

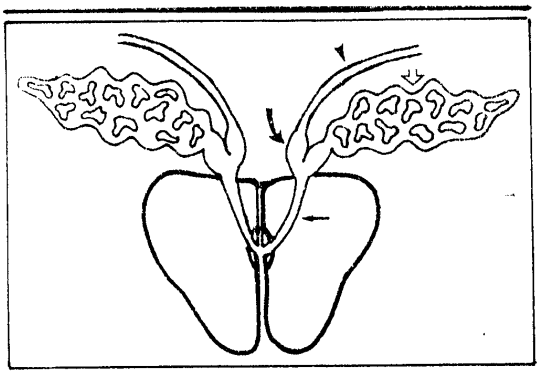


Figure 27 Diagram of the distal male reproductive system. Note paired vas deferens (arrowhead), vasal ampulla (curved arrow), seminal vesicles (open arrow), and ejaculatory ducts (straight solid arrow).

peripheral zone (PZ) have similar sonographic appearances. They exhibit an isoechoic, homogenous, relatively hyperechoic to the inner gland. They are difficult to distinguish by U.S. As the probe is withdrawn progressively caudad, another subtle anterior hypoechoic area may be identified, (the anterior fibromuscular stroma).The apex of the gland is usually poorly identified, homogenous and surrounded by the levator ani muscles .

B- <u>SAGITTAL PLANE</u> :

When scanning in the longitudinal orientation with a side viewing transducer, the probe is placed into the rectum to the level of the prostate. At that point, a midline image will be obtained. In the midline,the hypoechoic center will be identified.Asmall amount of fluid within the urinary bladder helps delineate the base of the prostate more accurately. The hypoechoic area extends to the level of the veromontanum, where the central zone and the central ie. (inner) prostate terminate .

The peripheral prostate is relatively homogenous in echogenidity. Parasagittal images can be obtained by gently rotating the transducer clockwise or counter clockwise from the midline sagittal plane. The sminal vesicles are seen as more rounded structures situated at the posterior superior portion of the prostate between the urinary bladder and the rectum. As the transducer is rotated slighty to either side. The central gland and urethra are not identified. Occasionally, both ejaculatory ducts are identified traversing the C.Z. obliquely towards the veromontanum, they appear as thin luscent tracks < 1mm in calibre. (Fig.28B)

C- <u>CORONAL PLANE</u>:

When using an oblique or end-firing transducer, both longitudinal and oblique axial ie (coronal) images can be obtained by rotating the transducer a full 180. Althought the conventional sagittal images will be produced, the axial scans will be oriented more obliquely. The probe is placed in the rectum and angled towards the urinary bladder. This will evaluate the base of the prostate. When the probe is angled less steeply, towards the anterior abdomen, an oblique axial orientation of the body and apex of the gland is obtained. These images are very similar in appearance to the true axial scans but have an elongated appearance.

On both the coronal and axial images, the prostate is surrounded by the highly echogenic periprostatic fat. This may be normally disrupted in the posterolateral margin of the prostate, where

A

B

(*Figure 28*) Normal anatomy as shown at transrectal us. (a) Axial view shows paired vas deferens (straight arrows) and seminal vesicles (curved arrows). Note normal fine internal echotexture, which corresponds to tubular epithelium. (b) Sagittal view of the prostate depicts a normal right ejaculatory duct (arrows)(Kuligowska and Fenlon 1998).

the neurovascular bundles are situated bilaterally. Symmetry should be preserved.

Anterior to the prostate in all orientation, tubular fluid filled structures, the vessels of santorinis plexus, may be identified.
(Rifkin, 1990).

▪ SEMINAL VESICLES :

The seminal vesicles, the ampullary part of the vasa and the ejaculatory ducts are best examined with a multi plane or sagittal scanning probe so that the ultrasound beam can be aligned with the ducts.

An "end-fire" probe has the advantage of being able to distinguish the superior part of the vesicles easily, whereas it can be difficult to reach the top of the seminal vesicles with an axial probe (Carter et al., 1989).

The seminal vesicles are seen as flat or fusiform paired structures lateral to the ampullae of the vas deferens. They are also situated between the bladder base and the rectum. On the sonograms the vas deferens and seminal vesicles have a bow tie appearance. The outline is usually smooth, although the saccular nature of the gland can sometimes be appreciated.(Fig.29)

The center of the gland is echopenic, with areas of increased echo density corresponding to the folds of the excretory epithelium. If the seminal vesicle is distended, the wall can be seen to be composed of two thin layers. Caudally, the vesicle spreads laterally and can be

seen ramifying in the perivesicular fat. The SVS, and VD typically appears less echogenic than the prostate
(Sanders 1984, Schneck 1991).

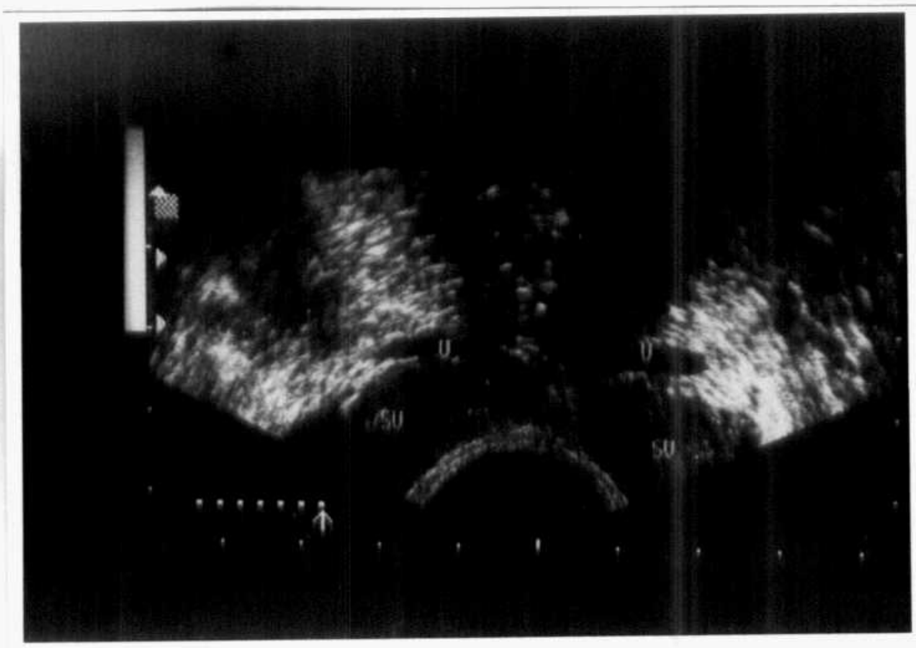
The normal size of the seminal vesicles has been measured in cadaver specimens and by radiologic techniques. (Tanahashi , et al., 1975). The length as determined from vasograms has been given as 2.5 –5 cms in length and 1-2 cms in width (AP diameter) with an average of 3.1 cms in length and 1.5 cms in width. Determination of seminal vesicle volume using planimetric method and the silhouette seen on vasography showed an average range of 17.3- 19.5 c.c (Kigowska , et al., 1989).

A decrease in size of the seminal vesicles directly after ejaculation has been reported. The mean lengths was 34-35 mms before and 29-30 after ejaculation which the mean width decreased from 13 mm to 11 mms in the post ejaculation measurements. No significant differences was seen between patient who had recently ejaculated and those who had abstained for 24 hours or longer (Hernan dez AD, et al., 1990) However fuse H et al., 1992) stated in his report that the S.V. volume significantly diminished after ejaculation.(Fuse et al .,1992) (Hernandez et al.,1990)

The junction of the seminal vesicle with the ejaculatory duct usually lies well within the prostate.

THE VASA DEFERENTIA :

The vasa deferentia, including the ampullary portions, are well imaged in both axial and sagittal planes. In the axial plane, they are seen as a pair of oval, convoluted, tubular structures located medial to the seminal vesicles and just cephalad to the prostate gland. They have the same echotexture as the seminal vesicles. In the sagittal plane, they can be identified as tubular structures projecting medially to the seminal vesicles.(Fig.29)



(Figure 29) T.R.U.S. axial view shows paired vas deferens (V) located medial to seminal vesicles (SV) and have the same echotexture(By Author and Others)

THE EJACULATORY DUCTS :

The ejaculatory ducts are formed by the confluence of the seminal vesicles and the terminal ampullary portions of the vasa dererentia. Each ejaculatory duct crosses the prostate gland obliquely and terminates in the prostatic urethra, lateral and proximal to the veromontanum. The ejaculatory duct complex from each side lies in a communal muscular envelope, which is clearly seen by ultrasonography.

Normal ejaculatory ducts have a 1.5 –2 mms lumen that is not normally visible however their path can be traced to an area of slightly increased echo density, which correlates with the veromontanum.

When congenital absence of the vasa deferentia and seminal vesicles is identified, ejaculatory ducts may not be formed and, therefore, may not be seen at T.R.U.S. (Kuligowska et al., 1992, Carter et al., 1989).

(6) PATHOLOGICAL BACKGRPOUND

(A) THE PROSTATIC GLAND :

1)- Prostatitis and Infertility:.

During recent years, interest has grown concerning the possible reaction of infections of the prostate and seminal vesicles to male subfertility and marriages. Despite extensive investigative study, however, controversy prevails.

A review of most studies shows that the addition of live microorganisms to normal fresh ejaculates causes decreased sperm viability (impaired motility and agglutination). (Fowler, 1981).

Since spermatozoa are not likely exposed to such massive concentrations of pathogens as a result of chronic Prostatitis, subfertility in such cases probably does not occur on the basis of a direct effect of the pathogen on spermatozoa. Many clinicians, however, believe that the secretory dysfunction of the prostate that accompanies CBP ie. (Chronic bacterial Prostatitis) leads to adverse effects on spermatozoa and resultant subfertility
(Caldamone et al, 1980).

▪ T.R.U.S. in Inflammatory Prostatic Disease:

The ultrasound features of chronic inflammatory prostatic disease have caused confusion from the earliest days of prostatic ultrasonography. Despite technologic improvements, certain sonographic features of inflammatory prostatic disease and prostatic cancer continue to be similar, (Rifkin , 1987) although the patients age and the clinical presentation may make the later condition less likely.

T.R.U.S. Features Of Chronic Prostatitis:

Three main significant sonographic features were identified , namely:

1. Low amplitude “halo” around a slightly echogenic central area in the Periurethral zone.
2. Multiple low amplitude (hypoechoic) focci in the peripheral zone of the prostate with an ill-defined capsule.
3. Curvilinear, tubular, echo frees regions immediately adjacent to the prostate on the anterolateral aspect.

Other features may include heterogeneous echopatterns, solitary and diffuse prostatic calculi, high-density and mid range echoes in the central zone and or the peripheral zone, capsular irregularities and thickening. (Griffiths et al., 1984), chronic granulomatous Prostatitis has been described to mimic prostatic Ca (Bree Robert L 1991), (Bude 1990).

1- Acute Prostatitis:

Acute Prostatitis is a rare condition, and clinical diagnosis usually is not difficult. The sonographic features of acute prostatitis include an enlarged, rounded, and usually symmetric capsule with decreased echogenicity and increased sound transmission within the gland parenchyma. The latter appearance is thought to represent oedema. After treatment the gland may revert to a normal configuration.(Peeling et al.,1988)

2- Chronic Prostatitis and prostatic Abscess :

A rare sequela of bacterial Prostatitis is formation of a prostatic abscess that may be difficult to diagnose clinically. With T.R.U.S imaging, abscesses can be identified readily as irregular hypoechoic masses containing diffuse mid-range echoes within an enlarged gland (Spirnack , et al, 1984, peeling , et al, 1984).

Abscesses may be solitary or multiple. When central liquifications occur, the center of the abscess becomes echoluscent with internal echoes. Sometimes of high achoustic density producing posterior reverberations likely representing micro-gas bubbles when a gas producing organism is the causative agent. (Doble , et al, 1989).

Prostatitis usually involves the peripheral zone with time; diffuse inhomogeneous echogenicity may develop as a result of atrophy, fibrosis or infarctions, and prostatic ductal obstruction, prostatic acquired simple cysts, ductal ectasea, and occasionally stone formation. The latter may occur in the ejaculatory ducts producing obstruction to semen flow and infertility. Dense calcifications of the ejaculatory ducts my occur as a sequela of chronic Prostatitis. (Papanicolaou , et al, 1992).

Colour duplex T.R.U.S. is a new modality nowadays, used to identify abnormal flow patterns with Prostatitis. In a study done by Rifkin et al., 1993; he reported 33 lesions with inflammation or Prostatitis, five had no flow visible at color doppler scanning, but an area of abnormal flow seen at gray scale scanning correspond to areas of chronic inflammation seen at pathological analysis. The rest 28 lesions with visible abnormal flow at both color Doppler and grey-scale scanning were seen to be a combination of acute and /or chronic Prostatitis at pathological examination. (Rifkin , et al 1993).

Duplex T.R.U.S. scanning enhance the power of detection of abnormalities within the prostate without being specific in defining them.

2)- Prostatic Cysts :

The classification of cysts within the prostate is complex and depends on their position and on their embryologic origin. (Currarino , 1986). The sonographic features of cysts are variable. The cysts are easy to identify, although it may be difficult or impossible to classify those cysts without the aid of further investigations.
(Carter. et al, 1989).

Prostatic cysts are either situated in midline or eccentrically located i.e. (lateral to the midline).

a- Midline Cysts :

- **Prostatic Utricle Cysts:**

The utricle is a normal structure but is usually no more than a 6 mm dimple on the surface of the veromontanum. In as many as 10 percent of normal men, the utricle is larger and forms a slit-like operture lying between the ejaculatory ducts and extends in a cephalade direction for a variable distance. (Felderman et al., 1987). The seminal vesicle and vas deferens do not communicate with a dilated utricle however; a tense utricular cyst may obstruct the nearby ejaculatory duct.

Large and persistent utricular structures are associated with various congenital anomalies, particularly proximal hypospadias. (Currarino , 1986). Other associated congenital anomalies are listed in (Table 2).

The prostatic utricle has been called the homologue of the uterus or the "utricuts masculinus." Prostatic utricle enlargement is usually found in younger patients. It appears usually small tubular and does not extend outside the prostate; it communicates with the posterior urethra in the majority of cases. (Carter. et al 1989).

(Table 2)

Posterior ureth1ral valve	
Prune belly syndrome	Down's syndrome
Imperforate anus	Pseudo hermaphrodism

From: (Carter et al, 1989)

▪ Mullerian Duct Cyst:

Mullerian duct cysts are derived from remnants of the paranephric ducts. It is an embryological remnant lying between the ejaculatory ducts, displacing them laterally.
Embryological, Mullerian duct cysts represent a local failure of the Mullerian duct to regress.

The Mullerian duct cyst, usually seen in young adults (third or fourth decade), is typically round, large, and often extends above the prostate gland i.e. (unlike utricle cysts). It does not communicate with the posterior urethra. It is not associated with hypospadias or intersex problems, and most often an isolated abnormality, although it may rarely be associated with unilateral renal agenesis similar to seminal vesicle cysts (Nghiem et al, 1990).

Mullerian duct cyst may obstruct the ejaculatory ducts or vas deferens; alternatively, the ejaculatory ducts may open into the cyst cavity. The ejaculatory ducts normally terminated on both sides of the urogenital sinus at the level of the veromontanum.

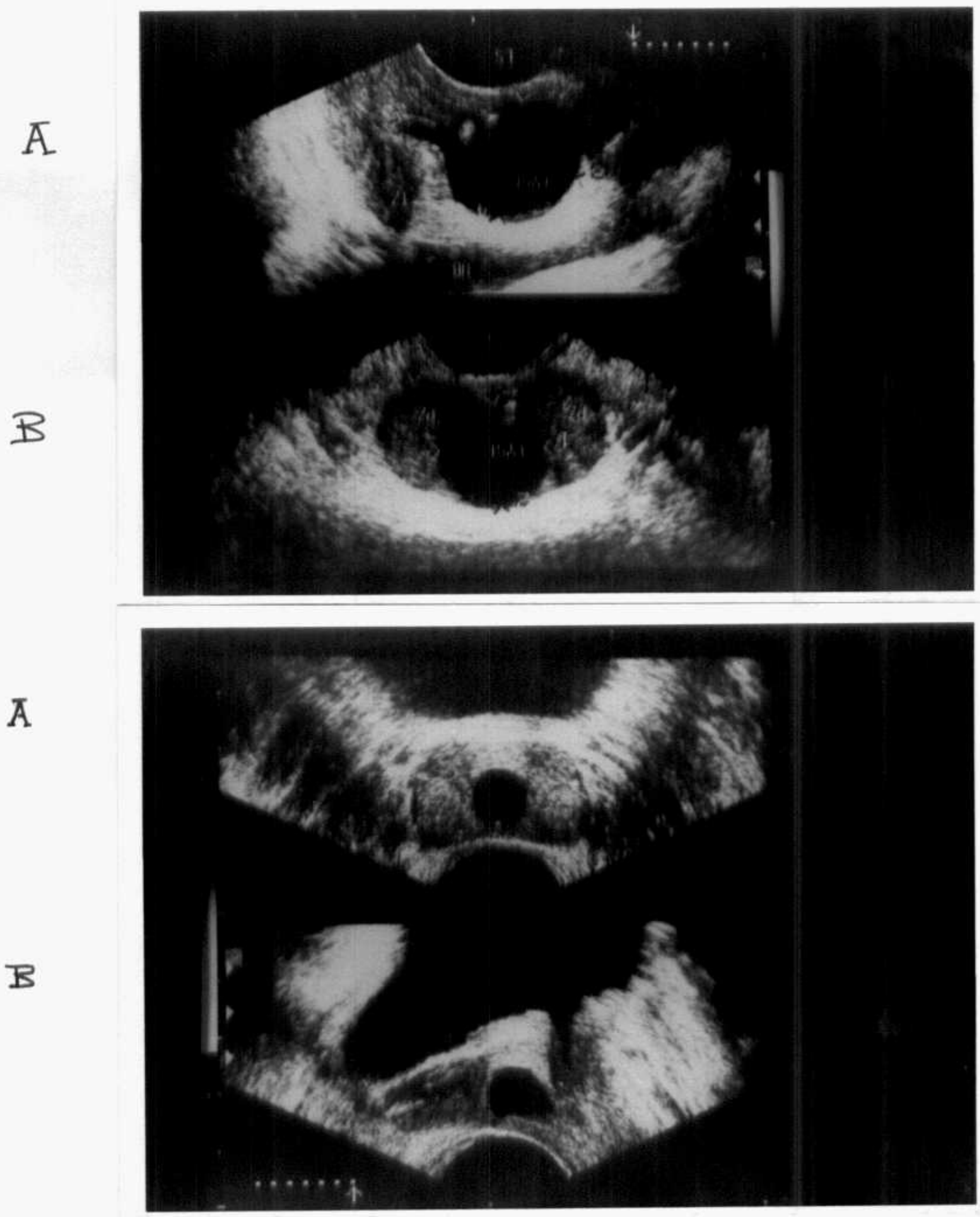
The veromontanum frequently is absent or the enlarged Mullerian duct cyst may disrupt its anatomy; either situation prevents the ejaculatory ducts from reaching their normal insertion into the veromontanum. (Ardill et al, 1990, Francis et al, 1983).

Both Mullerian ducts and utricular cysts do not contain sperms. The basic clinical features of these two entities are summarized in (Table 3), (Fig. 30).

Secondary infection, hemorrhage and intracystic stone formation may complicate Mullerian duct cyst. Ardill et al, (1990), reported a case of a large Mullerian duct cyst containing a calculus in a young man with epididymitis.

Surgical management by transurethral resection of prostatic utricle and Mullerian duct cysts is the treatment of choice in most of these cases, however, transrectal sonographically guided cyst aspiration may be helpful in selected cases particularly when the cysts are small. If the cyst is associated with azoospermia or ejaculatory difficulties, the cyst may be deroofed by transurethral resection. (Ritchey et al, 1988).

Pryor and Hendry (1992) described 10 patients out of a group of 26 subfertile males that underwent surgery for azoospermia with



(Figure 30) T.R.U.S. axial and sagital views showing mid line prostatic cyst.

low ejaculatory volume and showed remarkable post-operative improvement both in volume of the ejaculate and sperm concentration.

Eight female partners became pregnant (overall pregnancy rate 31%), although it was noted that in another 10 patients azoospermia (<1 /m1) persistent although the ejaculate volume were more or less corrected.

The basic clinical features of prostatic utricle cyst and Mullerian duct cyst are summarized in (Table 3).

Clinical Features	Prostatic utricle	Mullerian Duct
Age of presentation	First to second decade	Third to fourth decade
Configuration	Tubular	Round
Communication with urethra	Common	Rare
Associated anomalies	Common (usually hypospadias)	Rare

(Table 3) Ardal et al 1990

▪ Wolffian Duct cyst And Congenital Primary Cystic Ejaculatory Duct Dilatation:

They occur in midline along the course of the ejaculatory ducts. The seminal vesicles and vas may drain into Wolffian duct cysts and thus are differentiated from Mullerian or utricular cysts by being found to contain sperms. (Yamashita et al. 1985).

Cystic dilatation of the ejaculatory ducts may occur either primarily i.e. (ejaculatory duct cysts) that generally contain sperm and have not been reported to have calculi, or as a result of obstruction, in this case it is termed acquired cystic dilatation of the ejaculatory ducts, mostly secondary to obstruction by a stone or stricture
(Littrup et al, 1988).

(Table 4) demonstrates midline cystic structures of the prostate gland.

	Midline	Associated Abnormalities	Contains? Sperms
Normal prostatic utricle	+	-	-
Utricular cysts	+	+	-
Mullerian duct cyst	+	? Rare	-
Wolffian duct cyst	+	-	+
Ejaculatory duct cyst	+	-	+
* Degenerative prostatic cyst	-	-	-
* Retention cysts	-	-	-

(*) Acquired cysts

(Table 4) Carter et al (1989)

LATERAL PROSTATIC CYSTS:

The course of lateral prostatic cysts is unclear, and the embryologic origin is not established.

Acquired cysts include, degenerative post inflammatory cysts, parasitic i.e. (hydatid), cysts associated with carcinoma, benign prostatic hyperplasia and retention cysts. Other causes may include post surgical and prostatic abscesses that also causes

fluid – filled masses eccentricaly located in the prostate. These occur in symptomatic patients in association with Prostatitis.
(Bree Robert L, 1991)..

The clinical presentation of patients with prostatic cysts have been reported to include irritative or obstructive symptoms, acute retention, epididymitis, perineal and scrotal pains, infertility, hematospermia and incontinence (Littrup et al, 1988, Felderman et al 1987, Van proppel et al, 1983).

In summary, transrectal US offers new clinical insights into the causes of distressing genitourinary symptoms often ascribed to chronic non-bacterial Prostatitis or considered to be idiopathic.

B - THE SEMINAL VESICLES

As previously described, the seminal vesicles are important in the elaboration of the seminal plasma, constituting 80 – 90% of the ejaculatory volume. They also secrete fructose and prostaglandin and maintain an alkaline PH. Congenital anomalies in the seminal vesicles, as well as acquired and obstructive lesions, result in diminished semen volume, low PH (acidic), and low fructose (Carter et al 1989).

The congenital defects that produce infertility seem to be caused by developmental abnormalities that occur at approximately 35 days of gestation when the fetus has a crown-rump length of 8 mm. (King et al, 1989).

Men who have congenital abnormalities of the lower genitourinary tract are often asymptomatic. They may present in the reproductive years with vague symptoms of perineal discomfort, or may have palpable masses on rectal examination. Infertility is rarely the presenting problem.

Delayed recognition of congenital lower genitourinary abnormalities may occur because of the relatively nonspecific symptoms and the difficulty and nonspecificity of the clinical examination of the seminal vesicles and vas deferens.

Normal seminal vesicles are usually easily seen on endorectal sonography. They can be evaluated for their presence, symmetry, and evidence of obstruction. (Abbitt et al, 1991).

- **Seminal Vesicle Pathology :**

Abnormalities of the seminal vesicle may affect any age group. Pathologic conditions affecting the seminal vesicles usually do not become apparent until after the onset of sexual maturity. Classifications of seminal vesicle abnormalities are listed:

I- Congenital Anomalies :

A) Agenesis of seminal vesicles (unilateral or Bilat)

- May be associated with cryptorchidism.
- Associated with vasal agenesis.

B) Hypoplasia of seminal vesicles (Unil. Or Bilat.)

- May be associated with cryptorchidism.

C) Congenital seminal vesicle cysts

- Associated with renal agenesis or dysgenesis.
- Associated with ectopic insertion ureter into the seminal vesicle, vas deferens, ejaculatory duct, or prostatic urethra.
- Associated with vas deferens agenesis.

II- Acquired Cystic Dilatation :

Obstruction of seminal vesicles.

- Due to chronic infection and scarring of seminal vesicles and / or ejaculatory ducts.
- After prostatic surgery.
- Sequela to benign prostatic hypertrophy.
- Others; as normal aging process, frequency of sexual intercourse.

III- Miscellaneous:

A- Seminal vesiculitis.

- Associated with congenital anomalies.
- Associated with chronic Prostatitis.

B- Seminal vesicles hemorrhage

- Associated with infection, congenital cysts. The condition is associated with hematospermia.

C- Calcification

- Associated with chronic seminal vesiculitis, and Prostatitis.
- Associated with diabetes mellitus (most common).
- Associated with T. B.
- Associated with schistosomiasis.

IV- Tumors :

A– Benign tumors (mesenchymoma) i.e. very rare.

B- Primary seminal vesicle carcinoma (very rare).

C- Secondary carcinomas of seminal vesicles

- Prostatic carcinoma (most common).
- Bladder carcinoma.
- Rectal carcinoma.
- Others.

(King , et al, 1989)

1- Congenital Seminal Vesicle Cysts :

Seminal vesicle cysts can be either congenital or acquired secondary to obstructive lesions. Congenital seminal vesicle cysts are rare, and are usually associated with either a blind-ending ectopic ureter draining into seminal vesicle cyst with unilateral renal agenesis or with other upper or lower genitourinary anomalies.
(Foran et al 1992).

Seminal vesicle cysts are usually asymptomatic although they may be cause of pain (Sometimes associated with ejaculation), burning, or frequency. Knee- Land , 1985 and associates described a single case in their report a 17 years-old boy with an absent right kidney with compensatory hypertrophy of the left, ectopic insertion of the right vas deferens across the midline into the dilated tortuous left seminal vesicle. The right seminal vesicle represents a type of ectopia with abnormal insertion of the vas deferens into the contralateral (left). Seminal vesicle system confirmed by vasography. In addition, agenesis of all or part of the vas deferens often exists.
(Foran , et al 1992)

Several recent reports suggest that mal development of the mesonephric duct gives rise to congenital seminal vesicle cysts and the associated genitourinary anomalies. An association is made between ipsilateral renal agenesis and cysts of the seminal vesicle because of the common origin of the ureteral and seminal vesicle from the mesonephric (Wolffian duct). With isolated failure of development of the ureteric bud, renal agenesis ensues, but the genital tract is unaffected. However, maldevelopment of the mesonephric duct in the 12^{th} gestational week affects the ipsilateral seminal vesicle and vas deferens, as well as the ureter and kidney leading to their agenesis or maldevelopment. (Roehrborn et al, 1986).

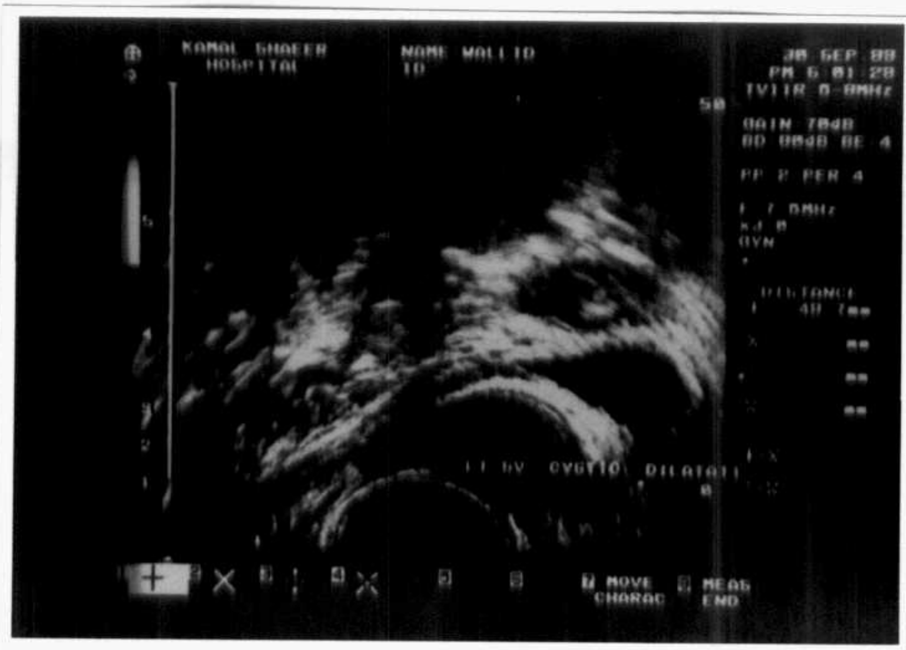
Cysts of the seminal vesicles are uncommon. Most but not all (69% - 80%) are associated with ipsilateral renal agenesis, dysplasia or hypoplasia (Gevenois et al 1990). King BF and associates, 1991, reported 13 cases out of 21 cases in his report with preoperative diagnoses of seminal vesicle cysts, had associated ipsilateral renal anomalies. About 20% of men with unilateral renal agenesis will have ipsilateral genital anomalies. (king et al 1989).

Pain was the most common symptom, other symptoms included pain and frequent urination those similar to Prostatitis or epididymitis.

The majority of seminal vesicle cysts are small (<5 cms). most are either asymptomatic or present clinically during the years of maximal sexual activity. However, the larger cysts (>12 cms), Those associated with ipsilateral renal agenesis and often atresia of the ureter, are congenital and oftenly they resulted in symptomatic obstruction of bladder outlet and rectum. Seminal vesicle cysts usually are unilateral and unilocular, although both bilateral and multilocular cysts occur.(Fig.31)

Heanay , 1987, original report he described a case having a giant (15 cms) seminal vesicle cyst that displaced the bladder and represented clinically by a suprapubic palpable mass. The patient had agenesis of the ipsilateral kidney and compensatory hypertrophy of the other.

Seminal vesicle cysts require differentiation not only from other deep pelvic cysts arising from the genital tract (e.g. Prostatic, utricular Mullerian) but also from hydronephrotic pelvic kidneys, abscesses, and benign or malignant tumors arising from the bladder, rectum, sacrum, spinal cord meninges, and lymph nodes. (Urethrography, seminal vesiculography, sonography and C.T. are useful in this differentiation. (knee-Land et al 1985, Heaney JA et al, 1987).



*(**Figure 31**)* T.R.U.S.axial view shows cyst of about 28.7mm of left seminal vesicles.(by author and others)

Unilateral renal agenesis may be suspected by urography scintigraphy, C. T ., and M. R. I. C. T. and M. R. I. Are useful in excluding a rudimentary or ectopic kidney, as well as ureterocele within the bladder. They are also helpful in evaluating the integrity and constituent of the cystic fluid content. (Heaney et al 1987, kneeland et al 1985, king et al 1991).

Cryptorchidism may also be seen with congenital seminal vesicle cyst. (king et al, 1989, Foran et al, 1992).

Congenital seminal vesicle cysts associated with autosomal-dominant adult polycystic kidney disease i.e. (APKD) was described by Alpern MB reported four patients with APKD with computed tomographic (CT) examinations of the abdomen and pelvis. The cause of the cyst formation in-patients with APKD has not been defined. Many theories explaining the reason of seminal vesicle cyst occurrence in patients with APKD, has evolved, however non is conclusive. (Alpern et al 1991).

It is recommended that any patients who demonstrate seminal vesicle cysts on U. S. or C. T. of the pelvis undergo evaluation of kidneys and ureters as well, to assess for associated upper genitourinary abnormalities, a variety of genito-urinary anomalies oftenly associated with seminal vesicle cysts.

2- Agenesis of The Seminal Vesicle :

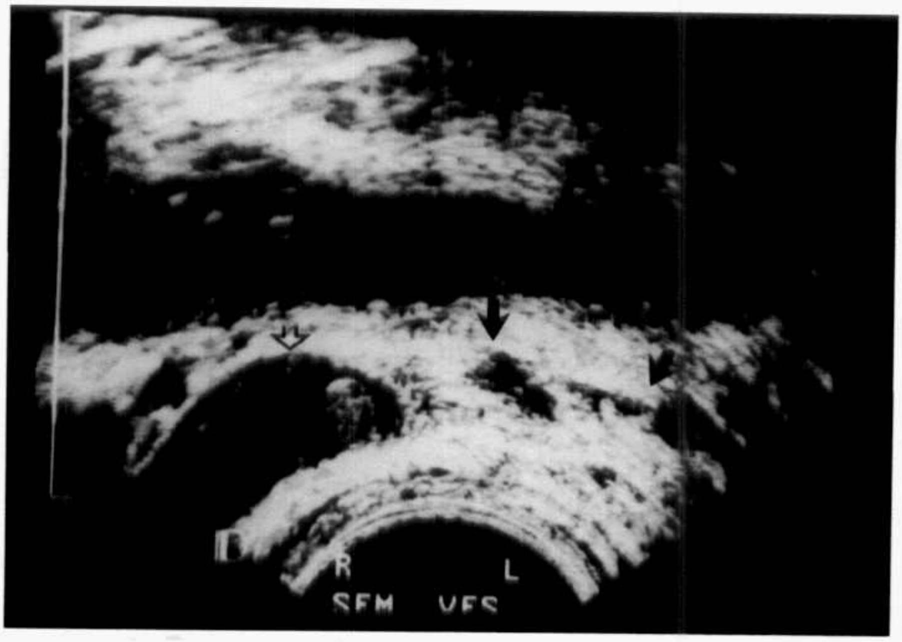
Agenesis of the seminal vesicles and seminal vesicle cysts constitute most congenital anomalies. Unilateral agenesis may be asymptomatic. Patients with bilateral agenesis of seminal vesicles have diminished ejaculatory volume and often are infertile. (Hricak , et al, 1991).

In agenesis of the seminal vesicle, the contralateral gland, if present, usually is hypoplastic. (Foran . et al 1992).

Congenital absence or hypoplasia of the seminal vesicles are often associated with vasal aplasia. Patients with klinefelters syndrome have small seminal vesicles associated with a low-volume ejaculate. Patients with mucoviscidosis who survive into adulthood have a high incidence of absent or hypoplastic seminal vesicles and fail to produce a normal-volume ejaculate (Carter et al, 1989).

Seminal vesicle abnormalities are reported to occur in 92% of patients with agenesis of the vas deferens (Godstein , et al 1988).

These congenital abnormalities seem to be caused by developmental abnormalities during early embryogenesis. (king , et al, 1989). Kuligowska et al, 1992, reported in her study of 70 men referred for the evaluation of infertility; seminal vesicle abnormalities were present in all of the patients (100%) with bilateral or unilateral agenesis of the vasa defrentia.(Fig.32)



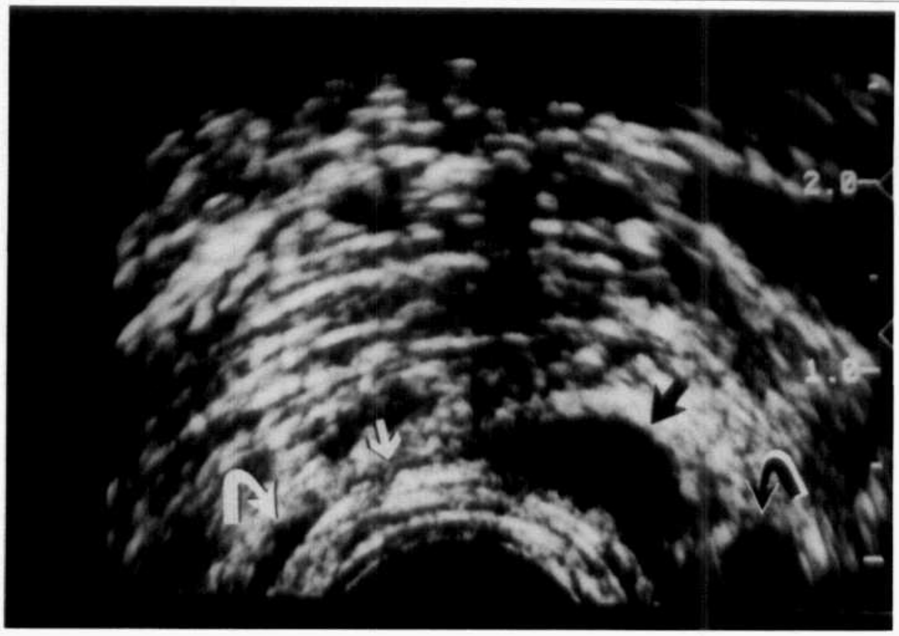
(FIGURE 32). Congenital absence of the vas deferens associated with absence of the seminal vesicle on the left side (black arrows demonstrate where the seminal vesicle would be expected) in transverse TRUS imaging. The right seminal vesicle and the ampulla of the vas are easily visualized (open arrow). These men require renal ultrasound examinations because of the risk of renal abnormalities.(Kim and Lipshultz 1996)

3- Hypoplastic Seminal Vesicle :

Seminal vesicles may appear echogenic, small in size, and lack normal convoluted Ductal structural pattern due to congenital or post-inflammatory changes. They may contain stones or be heavily calcified. (Kuligowska , et al, 1992).

In a review of fifty patients with a variety of complaints, the volume of ejaculate was compared with the seminal vesicle volume as determined by ultra-sonography. Patients with small seminal vesicles had low- volume ejaculater. The cause of small seminal vesicles was congenitally hypoplasia in the majority of cases and only in few cases, the cause of hypoplasia was due to chronic infection. Occasionally, the seminal vesicles seem to be smaller than normal or contain unusual echo- dense material in patients with epididymitis.
(carter et al, 1989).

When no normal seminal vesicle tissue was identified and only tiny remnants were noticed, absence of the seminal vesicles is diagnosed. If the seminal vesicles were smaller than 30 % of normal volume, hypoplasia is diagnosed, (Kuligowska et al., 1992).(Fig.33)



(Figure 33): Unilateral absence of the vas deferens as shown at transrectal us. Axial view shows absence of the right vas deferens (straight white arrow) and a rudimentary right seminal vesicle (curved white arrow). On the left, a normal vas deferens (straight black arrow) and seminal vesicle (curved black and white arrow) are seen.(Kuligowska and Fenlon 1998)

4- Seminal Vesicle Acquired Cystic Dilatation :

Cystic disease of the seminal vesicles may result not only from a spectrum of mesonephric duct anomalies, but it may also result from processes that obstruct the seminal vesicle or ejaculatory duct . (king, et al, 1989).

Seminal vesicle dilatation was arbitrarily defined as asymmetric or bilateral enlargement greater than or equal to 1.5 cms in anteroposterior dimensions

Cystic dilatation of the seminal vesicles and vasa defrentia was attributed to scarring and subsequent obstruction of the ejaculatory duct either by post-inflammatory stricture stone calcifications or post-traumatic strictures . also may be due to large midline cysts e.g. . utricular cysts compressing the ejaculatory ducts (king et al 1989) , (Fig.34).

Dilated ejaculatory ducts in direct continuity with dilated seminal duct were not considered cysts since such changes can by found in inflammatory conditions of the seminal vesicles due to iatrogenic scarring (littrup et al 1988)

Other causes may include inflammatory strictures or obstructions of the seminal duct by stones. (kuligowska .et al 1992 king ,etal,1991)

Obstruction of the ejaculatory duct is an infrequent cause of male infertility. Most patients have an associated dilatation of the seminal vesicles. Success has been reported with treatment by incision or resection of the ejaculatory duct orifice (Dunet , et al, 1986).(Fig.35).

Interruption of the normal innervation of the distal urogenital tract not only may prevent closure of the bladder neck during ejaculation but also may paralyze the seminal vesicle and lead to dilatation of the gland by retained secretions. This may occur in neurologic disease, particularly in diabetic neuropathy and the administration of neuropharmacological agents (Colpi , et al 1987).

Sonographically, the seminal vesicles appears enlarged with exaggerated internal convolutional tubular pattern, with dilated acini.

A

B

(Figure 34) Distal ductal cysts as shown at transrectal us. (a) sagittal view demonstrates a cyst of the right seminal vesicle (cursors). (By convention, images acquired during the initial years of the study were displayed more recently are displayed with the transducer seen inferiorly). (b) Axial view through the prostate shows an 11-mm midline cyst (cursors). (Kuligowska and Fenlon 1998)

C -

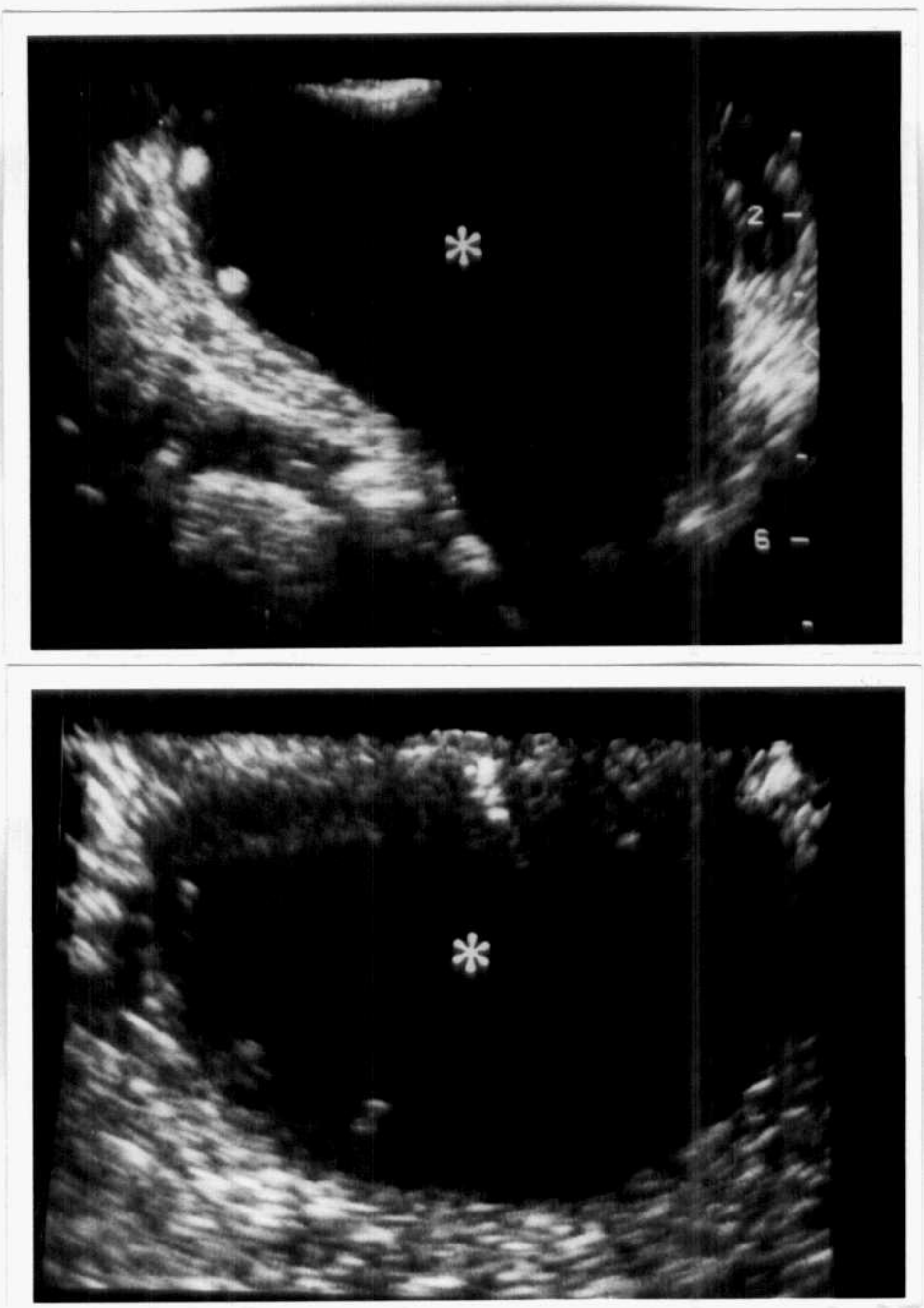
D -

(c) Sagittal view demonstrates the elongated appearance of a left ejaculatory duct cyst (arrow).
(d) Axial view obtained cranial to c demonstrates gross proximal dilatation of both the vas deferens (straight arrows) and seminal vesicles (curved arrows).(Kuligowska and Fenlon 1998)

e)-

(e) Axial view demonstrates a large midline cyst (ejaculatory duct cyst, straight white arrow) extending above the prostate (black arrow) and protruding into the urinary bladder (curved white arrow). Note multiple internal echoes indicating the presence of spermatozoa.(Kuligowska and Fenlon 1998) a-

b-



(***Figure 35).*** Transrectal us-guided cyst aspiration. (a) Sagittal view shows a large seminal vesicle cyst (*) with multiple internal echoes corresponding to spermatozoa and mural calcification. (b) Axial view demonstrates partial decompression of the cyst (*) during transrectal us guided needle aspiration. Aspiration yielded spermatozoa for in vitro fertilization. (Again. According to previous convention. The transducer is displayed at the top of a and b.)(Kuligowska and Fenlon 1998)

5- Inflammatory Changes Of The Seminal Vesicles:

Inflammatory disease of the seminal vesicles often presents with non-specific findings, including pelvic or perineal pain and fever or Hemospermia-unrecognized infection of the seminal vesicles may occur in association with Prostatitis in 25% of patients (Meares , 1978).

Bacterial infections of the seminal vesicles undoubtedly occur but generally cannot be proved clinically. Whether bacterial seminal vesiculitis occurs with out concomitant prostatic infections is unknown.(Meares , 1992).

Pure vesicular fluid is virtually unobtainable for culture and analysis, the challenge of proving a case of seminal vesiculitis clinically is formidable. Semen analysis that show a low volume and subnormal levels of fructose suggests secretory dysfunction of the seminal vesicles but do not confirm an infectious cause of dysfunction.

When a bacterial infection of the seminal vesicles is suspected, recommended therapy is the same as that as for bacterial Prostatitis. (Dunnick et al, 1982).

When an infection involves the seminal vesicles primarily, fibrotic changes may produce cystic dilatations, obliteration or stricture of the lumen. The seminal vesicles in the acute and subacute stages, are enlarged with thick septal walls, hypoechoic showing cystic dilatation of its convoluted ductal architecture. Hemospermia often is the striking clinical features.

In chronic inflammation, the seminal vesicles are usually small, echogenic, nonhomogenous and lacking their normal convoluted ductal architecture. Chronic inflammation may decrease seminal vesicle function and cause infertility. (Secaf , et al 1991).

An abscess may be demonstrated as a mass with cavitation, septations and contains an usual echo-dense complex material. Adjacent soft tissue infiltration that result in indistinct seminal vesicle margins also is observed. (Foran et al, 1992). Other complications may include a hemorrhagic seminal vesicle cystic mass with chronic inflammatory changes (King 1989). Seminal vesicle abscess may also occur-complicating vasectomy. (Zagoria et al, 1987).

C- VASAL ABNORMALITIES

- **VASAL APLASIA :**

Congenital abnormalities of the vas deferens are found among men investigated for subfertility.

The incidence within the normal male population of unilateral vasal aplasia is 1-7 per 1000 individuals. Congenital bilateral aplasia of the vas is reported in 1 to 2.5% of infertile men and accounts for between 4.4 and 17 percent of cases of azoospermia.
(Carter, et al, 1989, papanicolaou et al, 1992).

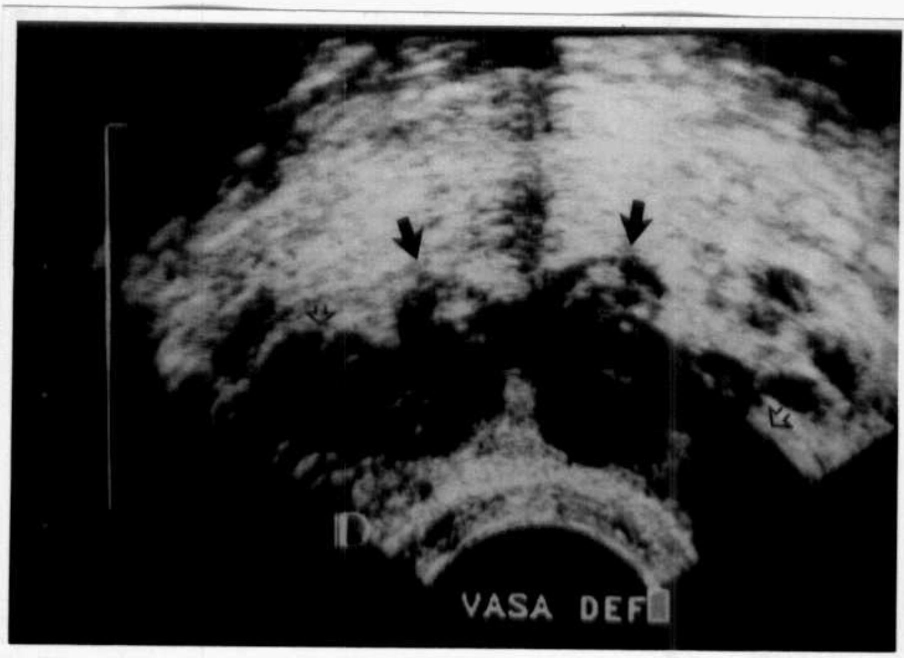
Between 16 and 43% of patients of vasal aplasia have renal anomalies such as agenesis, crossed renal ectopia, or an ectopic pelvic kidney, usually on the left side. (Goldstein et al 1988).

Vasal aplasia associated with seminal vesicle abnormalities are reported to occur in 92% of patients. (Goldstein et al 1988), and in 100% reported by kuligovska . et al 1992).

Congenital unilateral absence of the scrotal vas deferens is a rare anomaly with an estimated prevalence of 0.06 to 1.0% in healthy

A

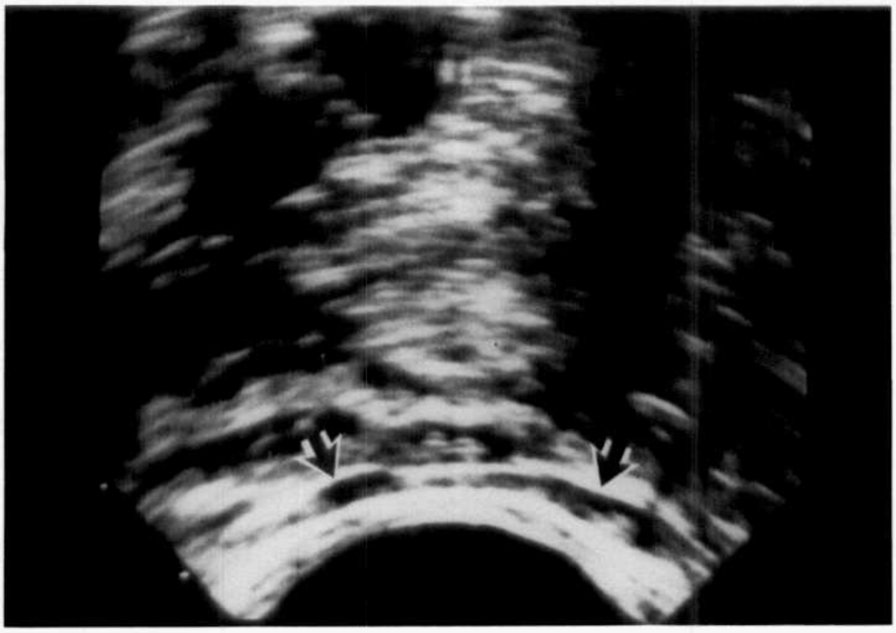
B



(FIGURE 36) (A) Normal transrectal ultrasound of the vas deferens (v) and seminal vesicles (SV) in transverse section. The vas are convoluted, tubular structures lying medial to the seminal vesicles and cephalad to the prostate. The rectal mucosa is indicated by solid white arrow (B) Ampulla of the vas (solid black arrows) with internal calcifications. Seminal vesicles are demonstrated with the open black arrows.(Kim and Lipshultz 1996) men. By itself, it has little clinical significance other than an associated 79% incidence of ipsilateral renal agenesis. On the other hand Hall and Oates reported in their study with 10 patients who presented for infertility, had unilateral absence of the vas and a contralateral mesonephric duct anomaly, only 3 patients out of 10 had ipsilateral renal agenesis or ectopia (30%) (Hall . et al, 1993). Another 3 patients with unilateral agenesis of the vas deferens in a select group of 70 men reported by kuligowska and associates, had renal agenesis on the same side and non of her patients with bilateral vasal agenesis (n = 26), had renal agenesis. (kuligwoska , et al, 1992).

In unilateral vasal agenesis associated contralateral mesonephric duct abnormalities are common. (Hall . et al, 1993). Abnormalities may include the seminal vesicle cysts, ejaculatory duct or epididymal – vasal obstruction, ipsilateral /contralateral agenesis or hypoplasia of the seminal vesicles, Jequier . et al, 1985.

Agenesis of all or part of the vas deferens may also be seen with seminal vesicle cysts. Scrotal vas may be palpable however it may end in the anterior pelvis. Absence or presence of the ampullary portion of the vas is adequately diagnosed only by T. R. U. S. (Hall , et al, 1993, kuligowska et al, 1992).



(Figure 37) Bilateral absence of the vas deferens and hypoplastic seminal vesicles as shown at transrectal Us. Axial view shows complete absence of the vas deferens associated with bilateral rudimentary seminal vesicles (arrows).(Kuligowska and Fenlon 1998)

D- Abnormalities Of The Ejaculatory Ducts :

- **Disorders Of Ejaculation** :

In practice, urologists encounter a variety of patients complaints related to dysfunction of ejaculation, including retrograde ejaculation, ejaculatory failure, premature ejaculation, and ejaculatory duct obstruction.

The etiology of these abnormalities can be congenital, pharmacological, surgical, traumatic metabolic, functional or idiopathic (Murphy et al, 1987).

- **Ejaculatory Duct Obstructions :**

As previously described, normal ejaculatory ducts have a 2-mm lumen and can be recognized on axial and sagittal images.

With meticulous examination, the course of the ejaculatory ducts could be entirely visualized on only the sagittal image .

When congenital absence of the vasa defrentia and seminal vesicles identified-ejaculatory ducts may not be formed and, therefore, may not be seen at transrectal U. S. (kuligowska , et al, 1992). The precise level and nature of obstructing ejaculatory duct lesions can usually be identified in the sagittal view. This information may be essential for the planning and execution of potentially corrective surgery.

A- **PARTIAL EJACULATORY OBSTRUCTION :**

In the past, ejaculatory duct obstruction has been underdiagnosed and under treated despite several reports. With the advent of transrectal ultrasonic screening, this condition is now more frequently recognized (Weintraub et al, 1993).

The usual presenting complaints include infertility, ejaculatory and testicular pain, perineal discomfort and hematospermia, although low back pain, urinary obstruction, dysurea, difficulty with defecation and pain in thighs have been reported (Weintraub , et al 1993, Littrup , 1988). Signs may include hemospermia, severe oligospermia and azoospermia. (Schnall . et al, 1992).

Partial ejaculatory duct obstruction due to either a congenital or an acquired cyst or ejaculatory duct stenosis secondary to calcification, chronic inflammation, can produce a wide spectrum of seminal fluid abnormalities. Sperm density may range from azoospermia to normospermia while ejaculatory volume can be low to normal. Sperm motility is consistently diminished (less than 30%) (Hellerstein et al ,1992). Hellerstein described in his report two cases with partial ejaculatory duct obstruction diagnosed, by T. R. U. S. and underwent successful corrective transurethral resection. One with calcification along the path of the ejaculatory duct and another with a mullerian duct cyst compressing both ducts. The two patients improved symptomatically, objectively with marked improvement of semen quality with subsequent pregnancy.

Ejaculatory duct stenosis with partial obstruction may be caused by infections, inflammatory agents, urethral trauma, and indwelling catheters. (Carson , 1984).

Cysts of both the ejaculatory duct /urogenital sinus and mullerian duct ie. (utricle cysts) are midline in location. The wolffian (mesonephric) and mullerian (Paramesonephric) systems are separate and descrete. Normally, there is no communication between the two systems. Wolffian structures in the male include the epididymis, vas, seminal vesicles, ejaculatory ducts and prostate. As previously mentioned, a true mullerian duct cyst, therefore, would not contain any sperms. (Sharlip ,1984).

Partial ejaculatory duct obstruction is suggested when there is a low semen volume (less than 1.0 cc), or low motility (less than 30%), or oligospermia)less than 20 million sperm /m1), and normal findings on physical examination with normal gonadotropin value. (Hellersteir , et al 1992).

B- COMPLETE EJACULATORY DUCT OBSTRUCTION:

Ejaculatory duct obstruction should be considered in patients with azoospermia or markedly decreased sperm count-decreased motility (in nonazoospermic patients), and an ejaculatory volume less than 1.5 ml. Serum F. S. H. and testosterone are generally within the normal range.

Diagnosis of ejaculatory duct obstruction has been relatively uncommon in the past, due in large part to the technical difficulties involved in its identification. All patients reported in previous series were diagnosed by means of operative vasography.

The advent of high-resolution transrectal ultrasonography has greatly facilitated the diagnosis of ejaculatory duct obstruction. Because transrectal U. S. is much less invasive and more easily obtained than vasography, the indications for evaluating patients suspected of having ejaculatory duct obstruction may be broadened. (Meacham , et al, 1993). Vasography remains the standard for the diagnosis of ejaculatory duct obstruction but should be deferred until definitive surgical repair is scheduled. C. T. imaging has been used for investigating vasal abnormalities, but its resolution is not as good. (Goldsteir , et al 1988).(Fig.38).

The diagnosis of ejaculatory duct obstruction is suggested by presence of dilated seminal vesicles or a posterior midline cyst in the region of prostatic urethra.(Fig.39,40)

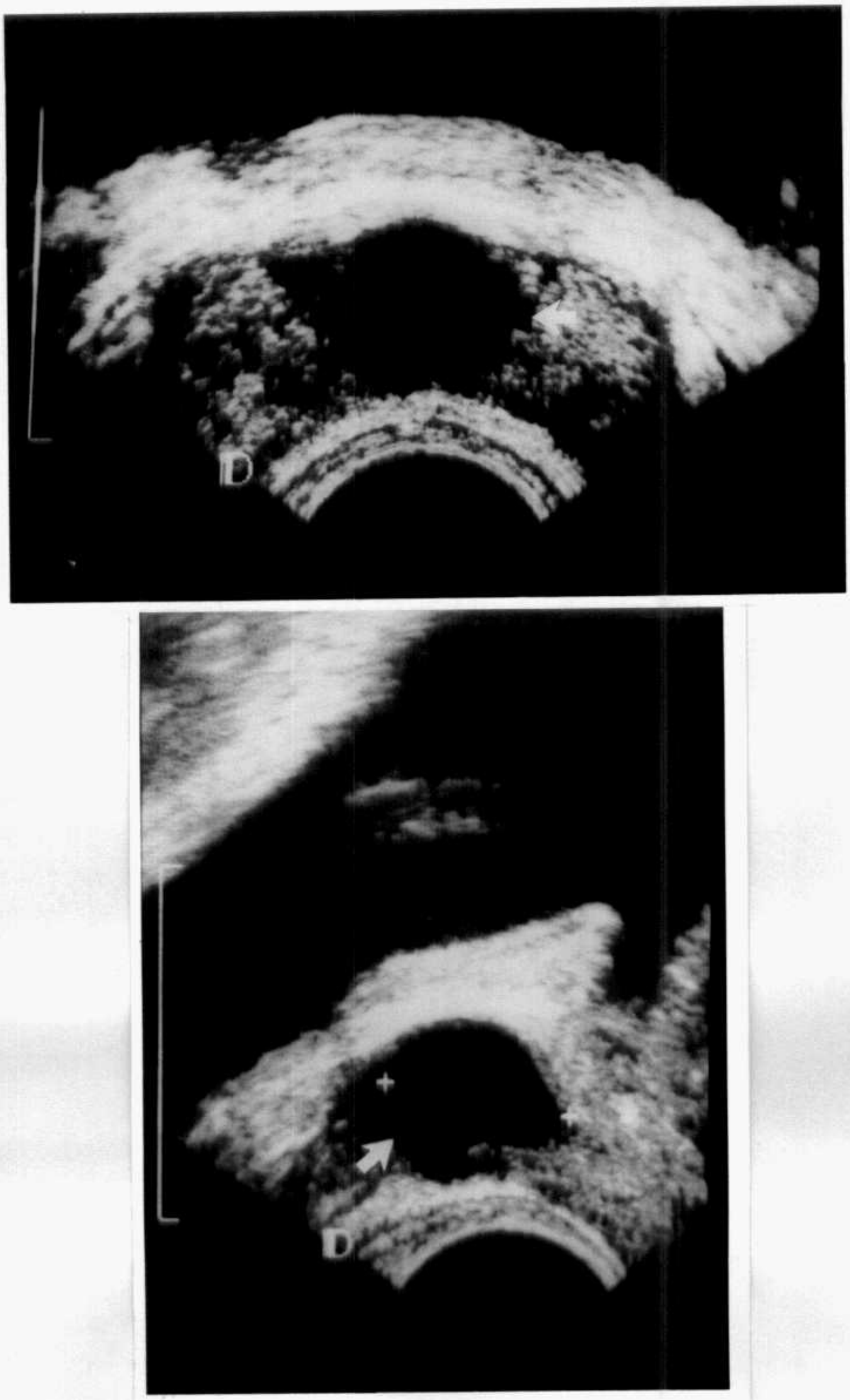
Complete obstruction of the ejaculatory duct is a well defined Phenomenon and its treatment is similar to that of partial obstruction. (Jarrow , et al 1989).

Corrective surgical options in this population included vasoepididymostomy, transurethral resection of the ejaculatory ducts using a resectoscope loop resection for careful unroofing of the involved ejaculatory duct orifice, Collings knife incision or loop resection of the veru itself and microscopic epididymal /vasal sperm aspiration. (Hall , et al 1993, Weintraub et al, 1993, and Meacham , et al, 1993).(Fig.41)

(Figure 38). Seminal vesiculography using TRUS guidance. This KUB demonstrates needle guidance and in stillation (needle indicated with open arrow) of 5 ml of non-ionic contrast into the left seminal vesicle. The pelvic portion of the vas deferens is also visualized (arrowhead), as is filling of the bladder (curved arrow). From Reidenklau E, Buch Jp, jarow Jp: Diagnosis of vasal obstruction with seminal vesiculography: an alternative to vasography in select patients. Fertil Steril 64 (6) 1224-1229, 1995 Reproduced with permission of the publisher, the American Society for Reproductive Medicine Medicine (The American fertility society).(Kim and Lipshultz 1996)

A

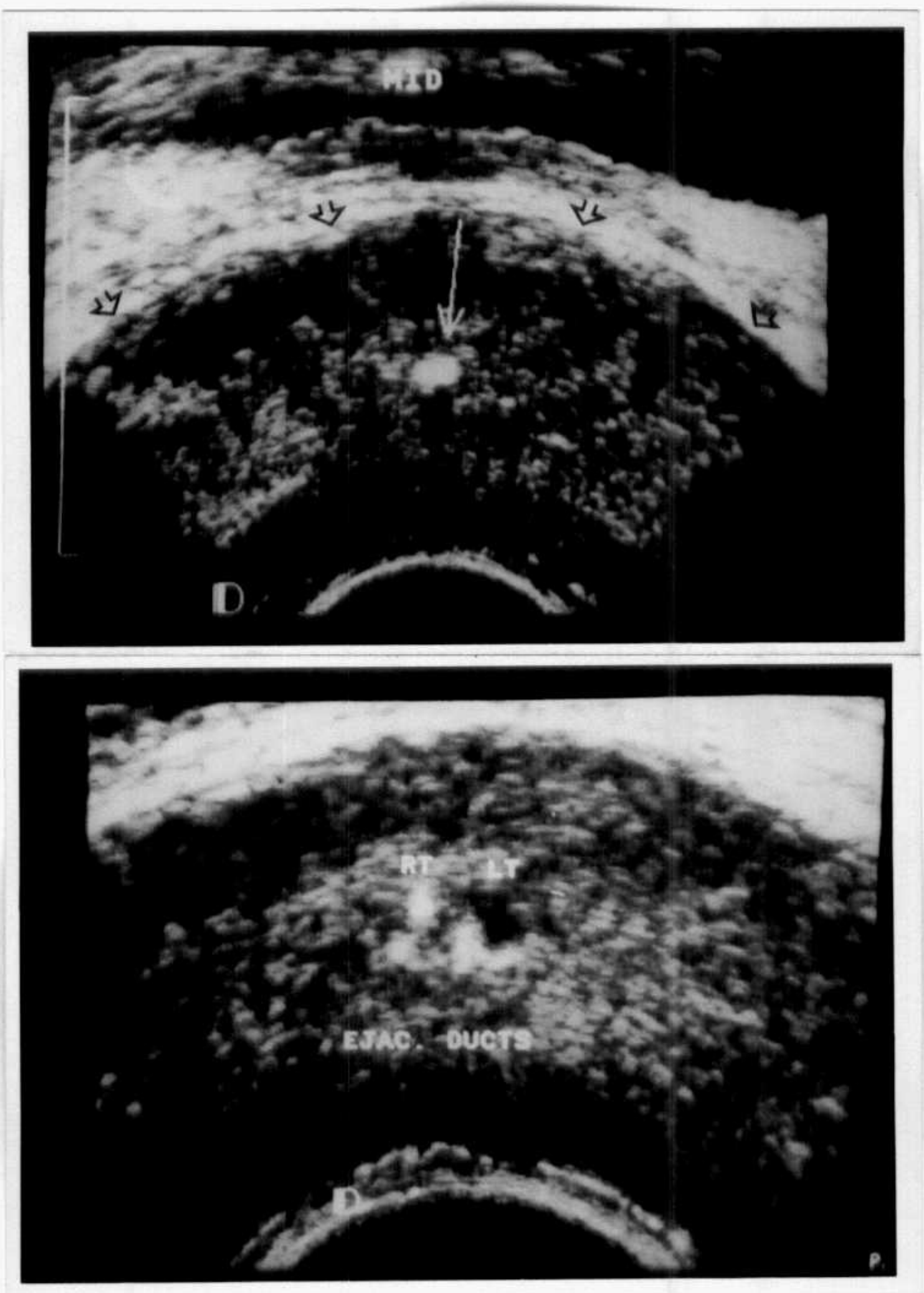
B



(FIGURE 39) Large ejaculatory duct cyst (White arrow) within the prostate. (A) Transverse diameter measuring 14 mm. (B) Sagittal diameter measuring 16.2 mm.(Kim and Lipshultz 1996))

A

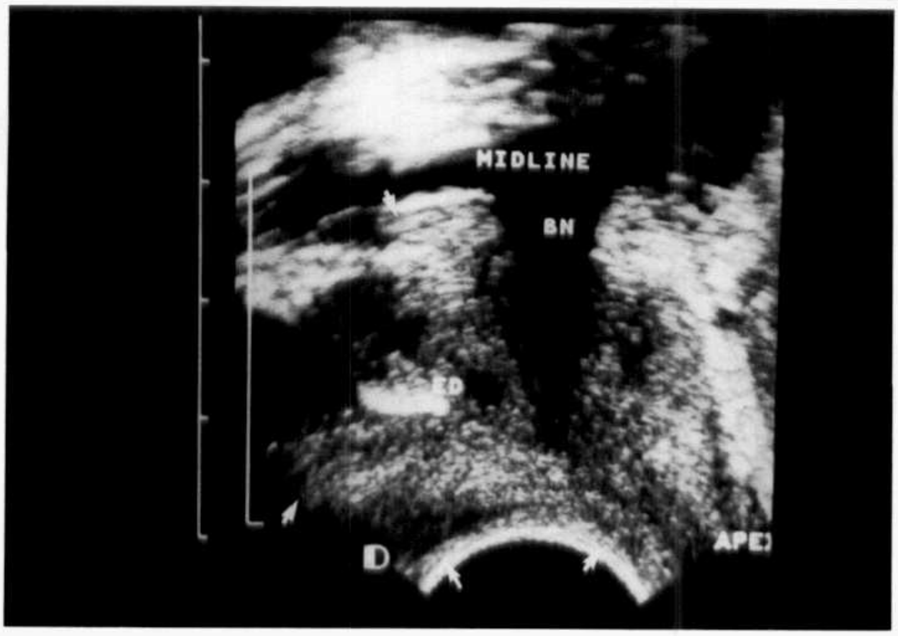
B



(FIGURE 40) Ejaculatory duct calcification resulting in obstructive, low volume azoospermia. (A) Transverse TRUS image of the prostate demonstrating a 2.9 mm *1.7 mm calcification (long white arrow) at the confluence of the ejaculatory ducts. The anterior boundary of prosate gland is indicated by black open arrows. (B) An image just cephalad to (A) shows the calcification extending into each ejaculatory duct.(Kim and Lipshultz 1996)

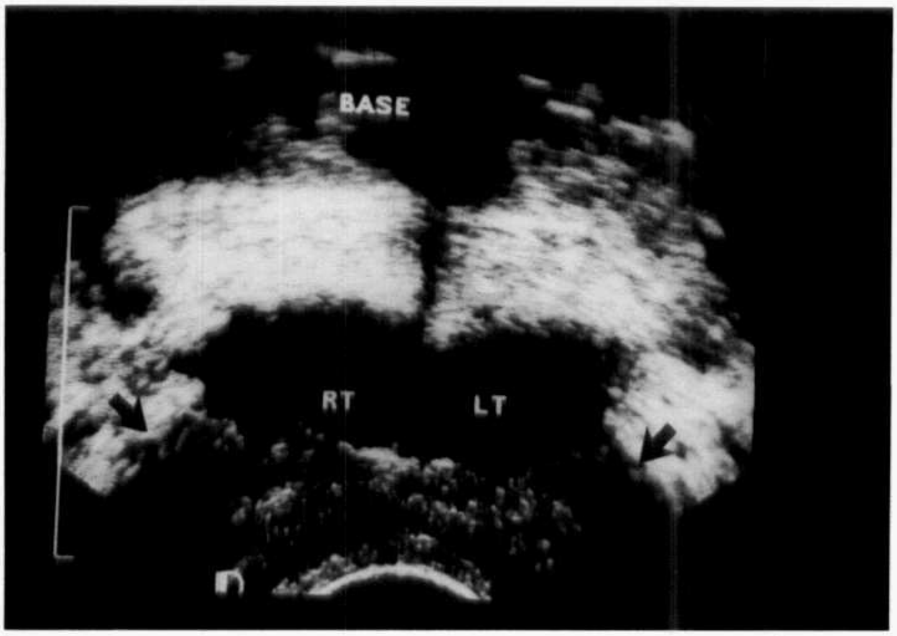
C

D

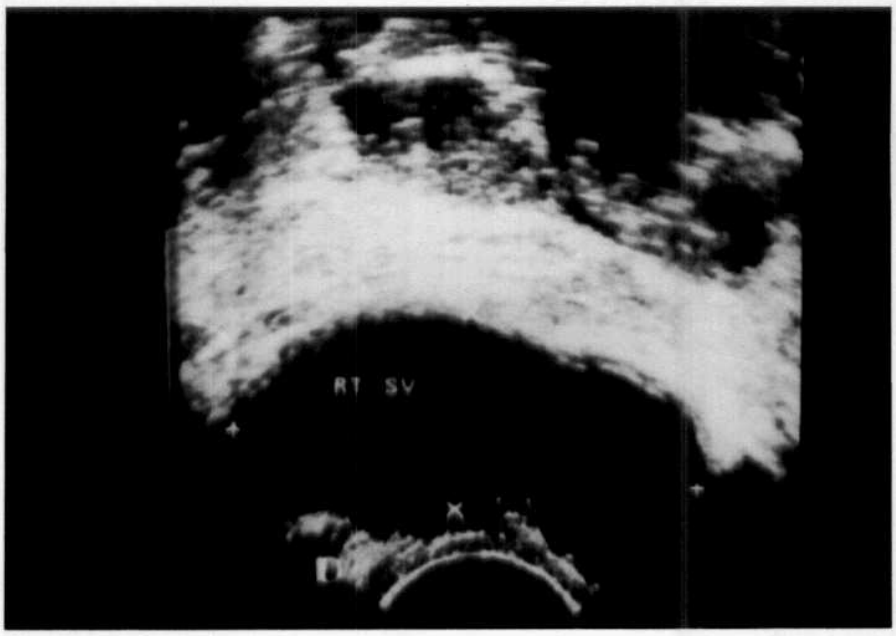


(FIGURE 40). (Continued) Ejaculatory duct calcification. © A further cephalad image shows dilated ejaculatory ducts (White arrowheads) in transverse section. (D) Sagittal image demonstrating the ejaculatory duct (ED) calcification in relation to the bladder neck (BN) and apex of the prostate (white arrows).(Kim and Lipshultz 1996)

E



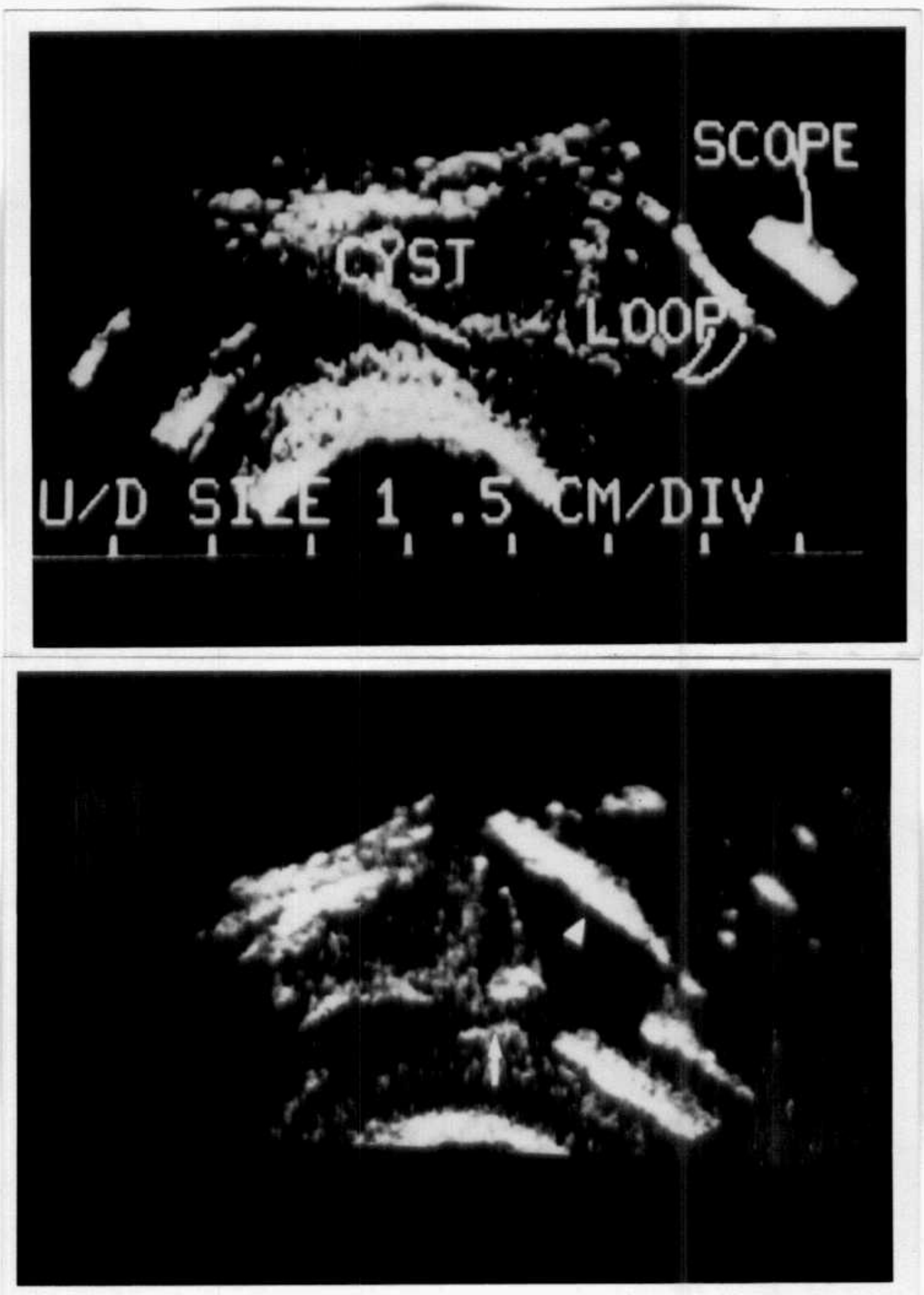
F



(FIGURE 40). (continued) Ejaculatory duct calcification. (E) Dilated seminal vesicles (RT, LT) are first imaged at the base of the prostate (black arrows). (F) The right seminal vesicle (RT SV) is clearly dilated having a width of 18.6 mm (white "X" marks).(Kim and Lipshultz 1996)

A

B



(***FIGURE 41***) Intraoperative use of TRUS for transurethral resection of the ejaculatory duct. (A) Sagittal image demonstrating relationship of ejaculatory duct cyst to the rectum and resectoscopy loop. (B) After resection of the ejaculatory duct cyst (resectoscope indicated by arrowhead). Note the communication between the cyst and the urethra (arrow). (From Honig SC: Use of ultrasonography in the infertile male. World J Urol 11:102, 1993, reproduced with permission).(Kim and Lipshultz 1996)

Table (5) summarizes the results of previously reported experience in the treatment of ejaculatory duct obstruction. In infertile males. From 1978 to 1993, obstruction was documented by intraoperative vasography.

(Table 5)

Date	Author	No. of patients	No. of patients with post-operative Improvement of Semen quality	No. of Pregnancies
1978	Hassler, et al, 1978	1	1	1
1978	Porch	1	1	1
1980	Weintraub	4	2	2
1980	Silber	4	1	0
1982	Amelar et al	6	2	1
1983	Vicente et al	9	3	1
1984	Sharlip	2	1	1
1984	Carcon	4	3	1
1985	Goldwasser , et al	1	1	1
1986	Dunetz et al	1	1	1
1993	Hellerstein et al	2	2	2
1993	Weintraub , et al	8	6	2
1993	Meacham , et al	24	17	7
	Total	67	41	21

▪ Summary and conclusion

The clinical evaluation of male infertility was limitated until recently by the inability to visualise directly and non invasively the distal parts of vas deferens ,seminal vesicles ,ejaculatory ducts and prostate gland.Methods for imaging the distal male reprodutive tract include vasography,magnetic resonance imaging ,and transrectal ultrasound that has now replaced in many cases the more invasive technique of vasography ,which has the potential risk of causing iatrogenic injurey to the vas deferens.M.R.I. with endorectal coil can elegantly demonstrate the distal ductal system and the results are less operator dependant than those of T.R.U.S.In my openion however ,M.R.I.rarly provides information that can not be obtained by TRUS.except in some cases of complex anatomic male formation,and its use is limited by cost and availability.

It is crucial to identify infertile patients with demonstrable distal abnormality for three reasons,first: to identify those patients with apotentially correctable causes of infertility,second:to determine appropriate treatment for patients with correctable deffects,and third: to preclude further unnecessary investigations and interventions in patients with clearly non correctable abnormalities, who are beast treated with epididymal sperm aspiration and in vitro fertilization.

In the absence of retrograde ejaculation ,neurogenic dysfunction ,and diabetes mellitus, patients with azoospermia and low ejaculate volume(<1.5mm) should be examined for congenital defects or obstructive disoreders of the distal genital tract,such abnormalities include absence or hypoplasia of the vas deferens, seminal vesicles,and ejacultory ducts and distal ductal obstruction by fibrosis,calcification,caculi ,or cysts.

For systematic logical,and thorough evaluation of infertile men, full history reviewing all previous laboratory test results including semen unalysis must be done and also complete physical examination is performed,attention is directed to the testes(size and consistency),vasa deferentia(palbable or not), epidydimides(length and consistensy)and the presence or absence of varicocele.Repeat semen unalysis ,further endocrine testing and post ejaculate urine unalysis to exclude retrograde ejaculation .

T.R.U.S. is employed to confirm congenital abnormalities and to identify potential obstructive conditions of the distal ductal system when the history ,physical examination ,or semen unalysis results suggestad this possibility

Three major groups were referred for T.R.U.S.Group(1) patients with suspected congenital bilateral absence of the vas deferens when no srotal vas was palbable,,semen unlysis generally showed a low volume, acidic azoospermic profile .Groupe (2) of patients presented with unilateral absence of scrotal vas and preserved contralateral ductal abnormality,either proximal or distal .Semen analysis generally showed either low or normal volume with azoospermia or sever oligospermira. Groupe 3: had palpable vasa deferentia bilaterally but demonstrated low semen volume coupled with various abnormalities of sperm count,motility,ormorphology.

We included that; inspite of the difficulties attributed to the complexity of the embryology,anatomy and pathological alterations of the urogenital tract, transrectal ultrasonography proved to be reliable and accurate modality in evaluating most of the gross anatomic abnormalities. (eg. Absence of the seminal vesicles and or vas deferans, and presence of cysts and calcification.)

In addition ,T.R.U.S. offers new clinical insights into the causes of distressing genitourinary symptoms often due to prostatitis and or seminal vesiculitis.The identification of organic cause may provide psychological relief for some patients,despite the lack of effective therapies at this time.

Finally,we feel that ultrasound shoud be employed as the initial diagnostic modality for urogenital tract . patholog, and that M.R.andC.T. shoud be reserved for more complex situations such as in the case of complex malformations of the pelvis in which their superior anatomic display (especially MR with its direct multiplanar imaging),might prove the value.

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ARABIC SUMMARY

الملخص العربي:-

حظيــت أســباب العقم عند الرجال بالكثير من الاهتمام في الأونة الأخيرة حيث ساعد الــتقدم المســتمر في الوسائل التشخيصية الحديثة مثل الفحص بالموجات فوق الصوتية والأشعة المقطعية بالكمبيوتر وكذلك التصوير بالرنين المغناطيسي في معرفة الكثير منها.

ويــتم فحص جميع المرضى المصابين بالعقم فحصا إكلينيكيا ومعمليا دقيقا وكذلك باستخدام التصــوير بالموجــات فــوق الصــوتية عبر البطن وعن طريق الشرج كما يتم تصوير بعض المرضــي باســتخدام الأشــعة المقطعية بالكمبيوتر والرنين المغناطيسي وكذلك عن طريق حقن الصــبغة بالقنوات المنوية. وقد استهدفنا من هذا البحث تقييم الموجات فوق الصوتية عن طريق الشــرج فــي تشــخيص الأمراض المسببة للعقم عند الرجال دون استخدام الوسائل التشخيصية الأخــرى مــثل حقــن الصــبغة بالقــنوات المنوية التي في حد ذاتها تعتبر فحص صولي وله مضاعفات نسبية.

ومــن خــلال الــبحث تم مراجعة وعرض التركيب التشريحي والإشعاعي للقناة البولية التناســلية عــند الرجال مع الاهتمام بتطوراتها الجنينة. كما تم عرض طريق الفحص بالموجات فــوق الصوتية عن طريق الشرج وقدرتها التشخيصية فيما يتعلق بموضوع البحث، كما أننا قمنا بمــراجعة الأســباب المرضــية المختلفة التي تصيب الجهاز لبولي التناسلي عند الرجال شاملة الأمراض الخلقية والتهابات البروستاتا والحويصلات المنوية.

أنــه بإمكانــنا أن نعتمد علي جهاز الموجات الصوتية عن طريق الشرج في ترائي وتصور الــتغيرات التشريحية الشاذة للجهاز البولي التناسلي مثل عدم تكون الحويصلات المنوية أو القناة الموصلة المنوية أو وجود أكياس وتكلسات.

الفحــص بالموجــات الصوتية عامة له مميزات كثيرة علي سبيل الحصر فهو قليل التكلفة ، غيــر صــولي يسير في استعماله كما أنه يعتمد عليه في تقييم أو قياس استقامة وكمال وتكوين الجهــاز التناســلي والبولي. وأنواع كثيرة من الأمراض الخلقية بالجهاز التناسلي يمكن أن تنظر

وتصـــور بالموجـــات الصـــوتية عن طريق البطن أو الخاصية وأكثر تفصيلية من خلال تطبيق الفحص عن طريق الشرج.

الفحـــص بالموجات الصوتية عن طريق الشرج له أيضا مميزات خاصة عن باقي الأجهزة التشخيصـــية مثال ذلك فإنها تعطي فكرة شمولية وخاصة في التقييم الوظيفي والباثولوجي للقذف المـــنوي الـــتي قـــد تؤثر علي الخصوبة وكذلك يمكنها أن تبرز أفاق وجوانب تشخيصية جديدة خاصة إذا كان جهاز الموجات فوق الصوتية مزود بإمكانية الازدواج بالدوبلر الملون.

إن تصـــوير الأوعية المنوية- شعاعيا في حد ذاته فحص صولي، يستخدم في أغلب الأحيان في تعريف درجة انسداد القناة الموصلة المنوية عند الرجال الذين يعانون من فقد الحبات المنوية أو نقصـــانها وأيضا كان يستخدم في استقصاء مرض التهابات البروستاتا والحويصلات المنوية المزمنة.

نحن نري استخدام فحص تصوير الأوعية المنوية شعاعيا أن استلزم الأمر، لابد أن يكون بعد فحص المريض بجهاز الموجات الصوتية عن طريق الشرج في بعض الحالات مثل إذا كان انسداد القنوات الموصلة المنوية في مجراها الأقرب للخصية.

إن الفحـــص بالموجـــات فـــوق الصوتية عن طريق الشرج فعال وسهل في تقييم وتشخيص انســـدادت القـــنوات الدافقـــة جزئيا كانت أو كاملة. إن أول هدف في علاج مرض فقد الحبيبات المـــنوية الانسدادية هو سرعة تحديد وبأقل التكاليف والأخطار الممكنة نوعية العلاج وإمكانيات الشـــفاء المـــتاحة. لـــذا نعتبر جهاز الموجات الصوتية عن طريق الشرج هو الجهاز الأمثل في تحقيق هذا الهدف لأنه يفي بالغرض دون أخطاء سلبية في إرشاد العلاج الجراحي المناسب لكل حالة علي حدة.

أخيـــرا نـــري أن التشـــخيص بالموجـــات الصوتية عامة لابد أن يكون الفحص الأول في تشـــخيص أمـــراض الجهاز البولي التناسلي علي أن ندخر الفحص بالأشعة المقطعية بالكمبيوتر والرنين المغناطيسي لأسباب مرضية أكثر تعقيدا بالحوض.

بسم الله الرحمن الرحيم

(قــــالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم)

البقرة (٣٢)

استخدام التصوير بالموجات فوق الصوتية عبر الشرج في تشخيص وتقييم حالات العقم عند الرجال

مقالة مقدمة من

الطبيب / إبراهيم وهبة مصطفى

بكالوريوس الطب والجراحة

توطئة للحصول على درجة الماجستير

في

الأشعة التشخيصية

تحت إشراف

الأستاذ الدكتور

مصطفى فاضل سنبل

أستاذ الأشعة التشخيصية

كلية الطب - جامعة الأزهر

الدكتور

عماد إبراهيم البسيوني

أستاذ مساعد الأشعة التشخيصية

كلية الطب - جامعة الأزهر

الدكتور

جودة محمد خليفة

أستاذ مساعد الأشعة التشخيصية

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كلية الطب

جامعة الأزهر

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