ECTOPIC URETER AND URETEROCELE

A REVIEW SUBMITTED FOR PARTIAL FULFILLMENT
FOR THE MASTER DEGREE IN UROLOGY

By

HANNA EMIL BARSOUM
M.B., B.ch.

Supervision By

PROFESSOR DR. FAROUK M. FAHMY

PROFESSOR OF UROLOGY - FACULTY OF MEDICINE

AIN-SHAMS UNIVERSITY

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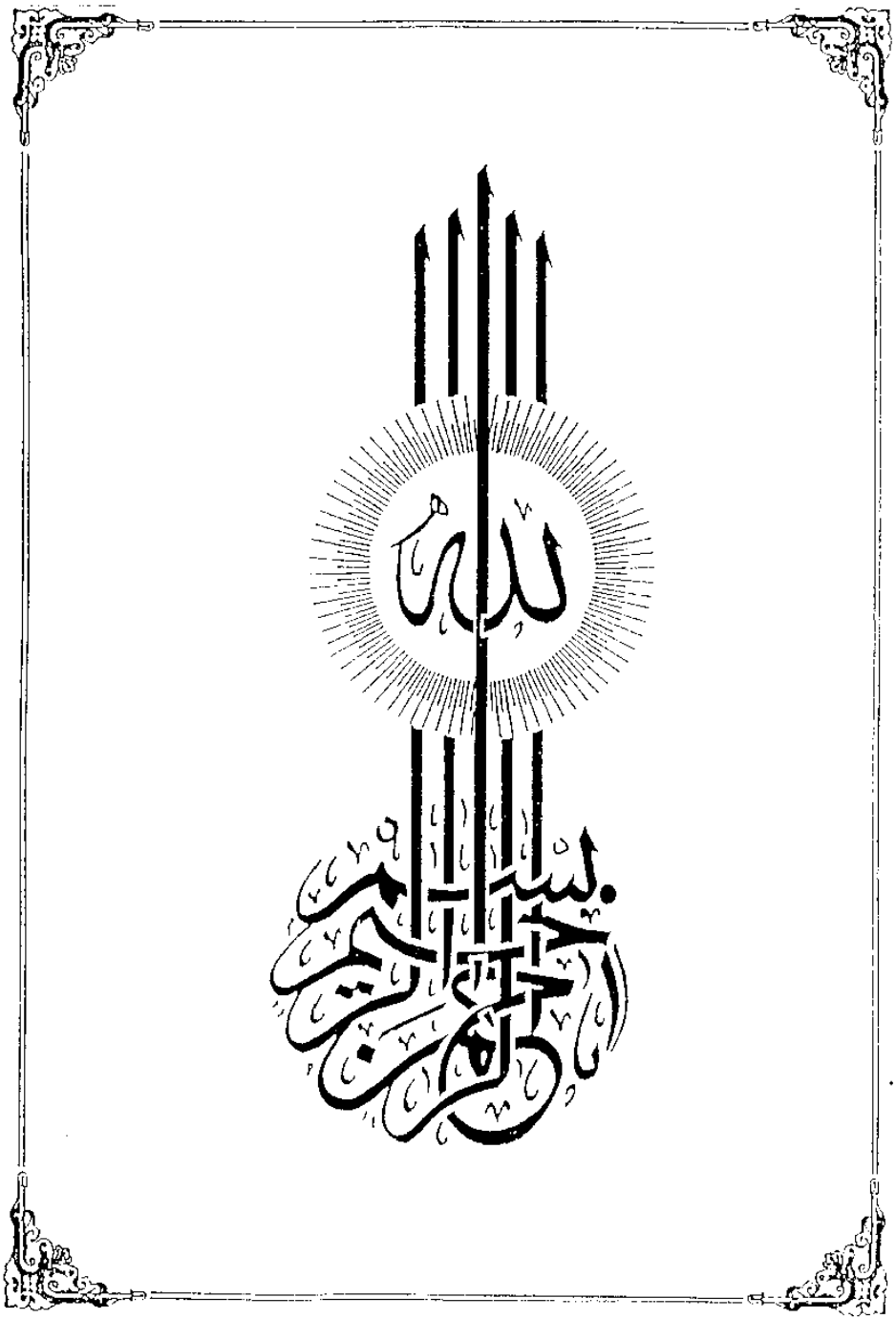

C O N T E N T S

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INTRODUCTION

The ectopic ureter that opens anywhere other than the posterolateral extremity of the trigone often presents when this ureter opens outside the urinary sphincter. The term ureterocele is derived from two Greek words meaning ureter and hernia. It may be defined as a cystic dilatation of the lower end of the ureter and balloons into the bladder. It was first described by Lechler in 1835.

In the following chapters, the description of the various theories of the origin and embryogenesis of the two anomalies are mentioned. The pathophysiology, clinical presentation and different modalities of diagnosis are provided.

Each case should be treated individually as no single method of surgical repair would suffice for all. The various plans and techniques of surgical correction are described.

As both anomalies are categorized as anomalies due to abnormal termination of the ureter, the ureterovesical junction is studied from the embryological, anatomical and physiological point of view so as to get a comprehensive idea about the entity.

EMBRYOLOGY
ANATOMY
PHYSIOLOGY
Of THE
Ureterovesical Junction

EMBRYOLOGY OF THE URETERO-VESICAL JUNCTION

The cloaca is the cavity common to both the urogenital and alimentary systems into which open in early stages of development, the allantois through the allantoic duct superiorly and the hindgut. Its lumen is separated from the amniotic cavity by a thin cloacal membrane. Later on it is separated into two separate cavities: a dorsal part which will form the lower end of the hindgut and a ventral part which becomes the primitive urogenital sinus. As the spur between the two cavities deepens and grows caudally to approach the cloacal membrane it separates completely the hindgut from the primitive urogenital sinus. It is known as the uro-rectal septum. (Moffat, 1981).[34] The Separation starts in stage 13 embryos (4-6 mm. embroys) and is completed when the uro-rectal septum meets the cloacal membrane in stage 18 embryos (6-7 weeks post-ovulation).(Muecke,1979).[36] (Fig. 1).

The urorectal septum grows down between the primitive urogenital sinus and the hindgut until it reaches the cloacal membrane where it is divided into an anal membrane and urogenital membrane. The primitive urogenital sinus changes its shape and becomes subdivided into a cylinderical vesico-urethral canal above the level of the openings of the mesonephric ducts and a definitive urogenital sinus below these openings. The definitive urogenital sinus is subdivided into a short cylinderical portion, the pelvic part (pars pelvina) and a more extensive phallic part (pars phallica).

The mesonephros forms a ridge projecting into the coelomic cavity. The two mesonephroi lie on either side of the root of the mesentery. (Moffat, 1981).[34] Although 20-40 pairs of mesonephric units are formed, not more than 30-32 are ever present as the rostrally located units have disappeared by the time the most caudal ones appear. (Muecke,1977).[36] Each mesonephric unit consists of a medially placed large glomerulus and a convoluted tubule that opens laterally into the mesonephric duct. The convoluted tubule becomes S-shaped in stage 13. In stage 12 embryos the mesonephric duct (Wolffian duct)which has been a solid rod shows signs of canalization into a hollow duct. (Moffat, 1981).[34] (Fig. 2).

Near the lower end of the mesonephric duct where it bends sharply forwards and medially to enter the urogenital sinus, a small outgrowth from the duct grows dorsally and then cranially to meet the lowermost part of the nephrogenic ridge. It starts to develop at the end of the 4th week (Stage 13 embryo, 5 mm. stage). This is called the ureteric bud and as it ascends, its dilated end picks a mass of mesenchyme called the metanephric cap.(Moffat,1981).[34] (Fig. 3).

If the ureteral bud fails to appear, there can be no kidney. The appearance of the ureteral bud seems to depend upon proper chemical interaction of the terminal portion of the Wolffian duct with the endodermal cloacal wall.(Muecke, 1979).[36]

The bladder and the upper part of male urethra (the whole urethra in females) develop from the endodermal vesico-urethral canal and the lower end of the mesonephric

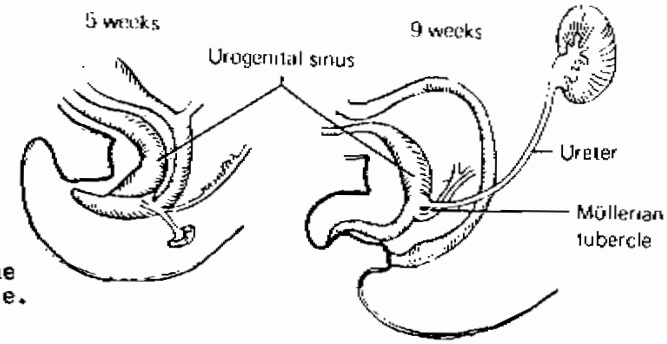


Fig.1 Differentiation of the urogenital sinus in the male.

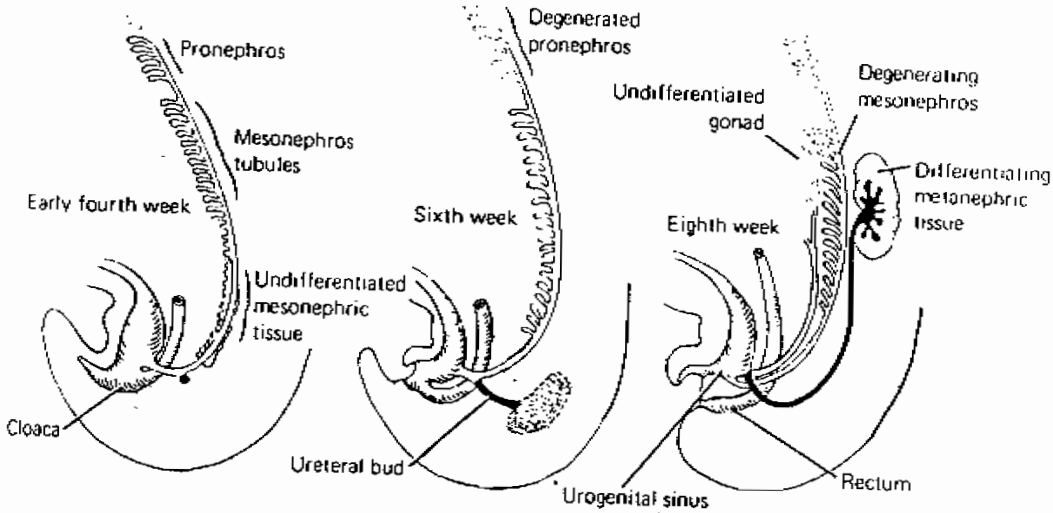


Fig.2 The cloaca and the ureteric bud.

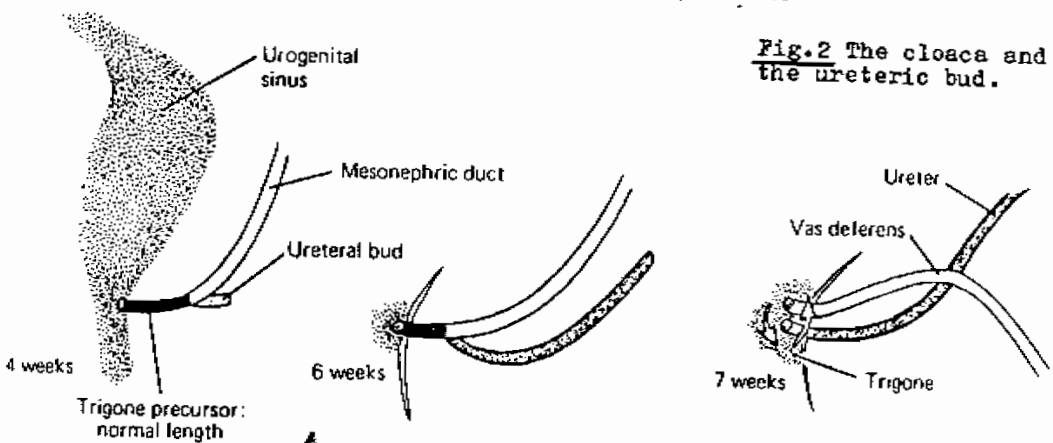
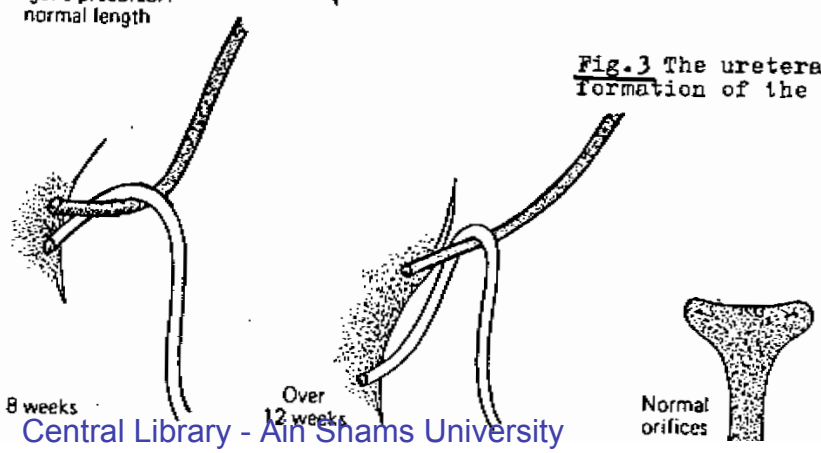


Fig.3 The ureteral bud and the formation of the trigone.



duct including the origin of the ureteric bud which is mesodermal. The two mesonephric ducts open into the lower end of the vesico-urethral canal while the two ureters open into the wider upper part. The vesico-urethral canal is now subdivided into a dilated segment which will form the bladder and a much narrower urethral portion. The mesonephric duct and the ureter are taken into the bladder. The lower end of the mesonephric duct forms a caudally directed loop, the ascending limb of which becomes absorbed into the vesico-urethral canal leaving the opening of the duct at a much lower level. (Fig. 4).

Other authors described a dilatation at the lower end of the mesonephric duct which involves the orifice of the ureteric bud and is absorbed into the bladder to form the trigone. The opening of the ureteric bud into the mesonephric duct moves into the lower end of the vesico-urethral canal and then migrates upwards and laterally until it reaches a definitive position at the upper and outer angle of the trigone. The ureters achieve their independent ostia as the Wolffian duct openings are translocated downwards into the urogenital sinus. The separation of ureters from the Wolffian ducts is aided by the overall growth of the bladder in the cephalocaudal axis which is faster than the overall growth of the embryo's body. The ureter rotates through a 135-degree angle, thus assuming a lateral position compared to the Wolffian ducts..(Muecke, 1979)[36] (Fig. 5).

The mesonephric duct itself remains as an opening at the lower end of the vesico-urethral canal. The ureteric

orifice remains closed by a double-layered membrane which remains for about 16 days in stage 18 embryos. The lower layer is composed of epithelium similar to that of the bladder, while the upper layer is continuous with the ureteric epithelium.

It is called Chwalla's membrane. It ruptures between the 25 and 30 mm. stage. Rupture occurs due to increased pressure of accumulated urine and increased hydrostatic pressure. The trigone and the post. wall of the urethra down to the openings of the mesonephric ducts are mesodermal in origin while the rest of the bladder is endodermal. The trigonal musculature is derived from the ureteral musculature itself and from the deep peri-ureteral sheath surrounding the ureter.

The position of the ureteric bud on the mesonephric duct will decide the final position of the ureteric orifice. The lower it is situated on the duct, the more will be the ureteric orifice displaced upwards and laterally.

When a terminal Wolffian duct gives rise to two ureteral buds, the first bud terminates above the second ureteral orifice which has been carried further caudal and medial by the Wolffian duct to which it is still attached at its distal end. The constant finding of the ectopic ureteral orifice below and medial to the orthotopic orifice is known as the Weigert-Meyer Rule. (Moffat, 1981).[34] (Fig. 6).

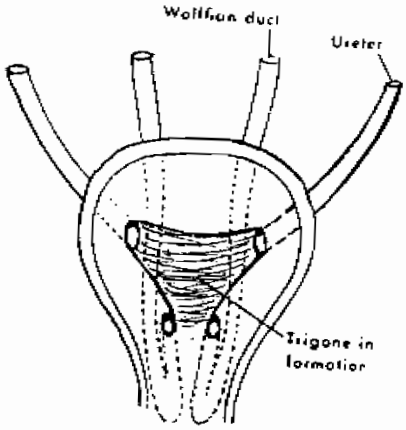


Fig. 4 Intermediary stage in the formation of the trigone

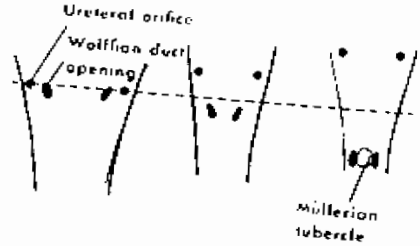


Fig. 5 Change in location of ureteric ostia and openings of Wolffian ducts as trigone forms.

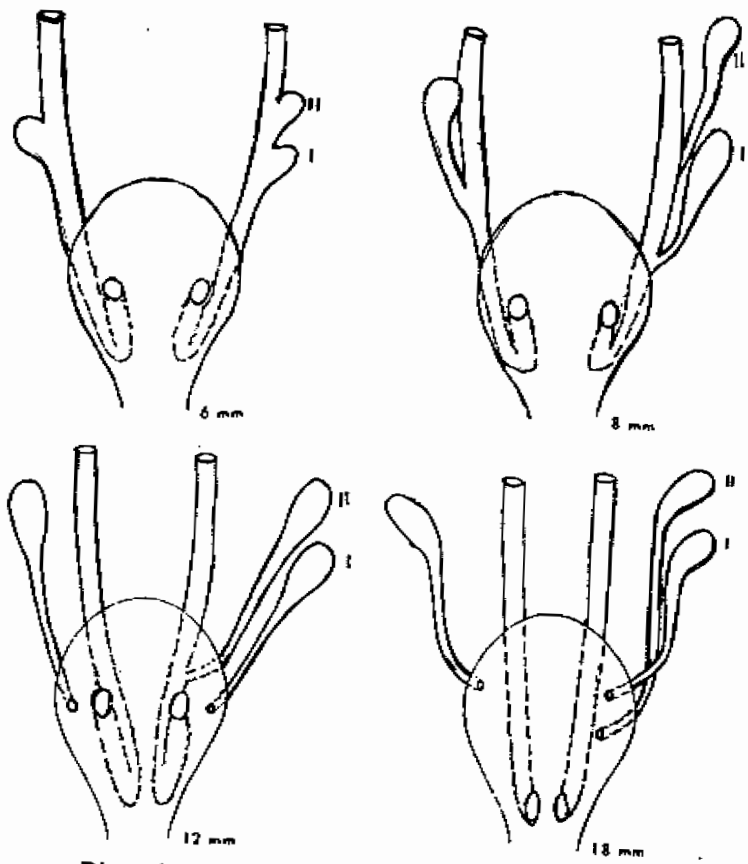


Fig. 6 The relationship of the orthotopic to the ectopic ureteral orifices to form the Weigert-Meyers Law.

ANATOMY OF THE URETERO-VESICAL JUNCTION

The uretero-vesical junction is the meeting of the ureter and the urinary bladder. To describe the anatomy of the uretero-vesical junction, one has to consider 3 components;

(a) The lower ureter.

(b) The trigone.

(c) The adjacent bladder wall.

A. THE LOWER URETER:

The ureter has only one muscular coat where muscle fibres are oriented in every direction to form the irregular helical formation of the ureteric muscle bundles. As the ureter enters the bladder, the helical fibre arrngement elongates and becomes re-oriented into pure longitudinal muscular pattern without loss in size or number of the fibres, i.e. all the muscle fibres of the juxta-vesical ureter continue in the intra-vesical ureter where they change their orientation. (Fig. 7).

The length of the intra-vesical ureter is 1½ cm. divided into:

(a) Intramural segment surrounded by the detrusor about ½ cm.

(b) Submucosal ureter under the bladder mucosa about 1cm.

All the longitudinal fibres of the lower ureter proceed uninterrupted into the trigone. As these fibres app-

roach the ureteric orifice the roof fibres split and swing to the sides to form the lips of the ureteric orifice, then they join the floor fibres where all of them accumulate just distal to the orifice before they fan out into the trigone.

The juxta-vesical ureter (distal 3-4 cm.) and the intramural ureter are surrounded by Waldeyer's sheath which is fibromuscular. When traced upwards, it gradually fuses with the ureteric musculature. Distally, it surrounds the intramural ureter but at the level of the submucosal ureter, the fibres diverge and at the level of the ureteric orifice, the fibres sweep around the sides of the ureter to meet the fibres of the Waldeyer's sheath. Then the sheath continues deep to the superficial trigone forming the deep trigone which terminates at the level of the internal meatus. (Fig. 8).

The deep trigone shares in fixation of the ureter. At the level of the ureteric hiatus, the detrusor contributes to the formation of Waldeyer's sheath and the deep trigone.

Waldeyer's sheath is of ureteric origin, but histologically it resembles the detrusor muscle bundles due to collagen distribution. Detrusor appearance is dense bundles interspersed with loose collagen, while the ureteric appearance is fine bundles with more firmly binding collagen.

Musculature of lower ureter consists of 3 layers, the muscular coat of the ureter proper, Waldeyer sheath proper and a third separate layer of few detrusor muscle bundles deflected over the lower ureter. (Tanagho, 1981).[46]

B. THE TRIGONE:

Composed of two layers: (Fig. 9).

Superficial Trigone:

The longitudinal musculature of the intra-vesical ureter diverges at the ureteric orifice and continues into base of the bladder as the superficial trigone. Some fibres run across the base between one submucosal ureter to the other. The rest of fibres fan out and converge at the internal meatus down to the urethra in the midline posteriorly. In the male, it terminates at the level of the verumontanum. In the female, it terminates at the level of the external meatus.

Deep Trigone:

All the fibres forming Waldeyer's sheath continue downward into the base of the bladder to form the deep trigone, i.e. changing from a tubular sheath into a flat sheet at the level of the ureteric orifice. The upper fibres proceed medially to meet those from the other side to form the inter-ureteral ridge or Mercier's bar. The lower fibres proceed medially and downwards forming Bell's muscles and meet fibres from the other side to end at the internal meatus.

There is no muscular interconnection between superficial and deep trigones. They can be dissected easily from each other. The deep trigone can be dissected easily from the detrusor muscle in its upper half but in its lower half it is more adherent to the underlying detrusor. The superficial trigone adheres firmly to the overlying mucosal layer. (Tanagho, 1981).[46]