MALFORMATIVE OBSTRUCTIVE LESIONS OF BLADDER OUTLET IN INFANCY & CHILDHOOD

Thesis

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By

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بسم الله الرحمن الرحيم

<u>CONTENTS</u>

INTRODUCTION AND AIM OF THE WORK

Bladder outlet obstruction in infancy and childhood is a very important entity of pediatric urology that merits throwing light on it. Urologists generally think from their clinical experience that those patients form an important sector in urological practice. This problem affects the quality of life and may also steals the life of the child. Hence, every effort should be done for its early spotting and proper management.

A scientific study is attempted here including the development of the bladder and its outlet, anatomy of the bladder outlet, physiology of voiding and pathological aspects of the bladder outlet obstruction.

Management of the fetus with lower urinary tract obstruction will be concerned in this work. Prenatal sonographic assessment of urinary tract anatomy and function can improve perinatal management. The fetus with hydronephrosis secondary to lower urinary tract obstruction may benifit from early decompression inutero or after delivery.

Management of an infant or a child with bladder outlet obstruction will be discussed stressing the different diagnostic modalities,differential diagnosis and different lines of treatment with special reference to the most accepted surgical precedures.

DEVELOPMENT OF THE BLADDER AND ITS OUTLET

The urogenital system develops from a number of different embryonic tissues that are at first widely separated. During the process of development their relative positions change considerably and the junctional regions between the various components undergo much modification. It is, therefore, not surprising that developmental abnormalities of both urinary and genital systems are common and often of great clinical importance (Moffat,1982).

THE VESICOURETHRAL UNIT

The cloaca (in Latin means a sewer)is appropriately named as it is a cavity common to both urogenital and alimentary systems into which open, in the early stages of development, the allantois and the hindgut. Its lumen is separated from the amniotic cavity by a thin cloacal membrane, which is present much earlier in development as a small area into which mesoderm from the primitive streak does not penetrate so that the endoderm and ectoderm come into contact (Moffat, 1982).

The allantois is a blind-ended diverticulum of endoderm that projects into the mesoderm of the connecting stalk. In many animals the endodermal diverticulum is large and important, acting as a reservior for waste products but in man it is vestigial although it is still associated with the development of the excretory system. The allantois is at first an extraembryonic structure but is soon taken into the body of the embryo so that the angle between it and the hindgut becomes more and more acute and the separation of the cloaca into two separate cavities becomes more pronounced. The dorsal part of the cloaca forms the lower end of the hindgut and the ventral part merges imperceptibly into the allantois,becomes the primitive urogenital sinus.As the "spur" between the cavities deepens and grows caudally it approaches the cloacal membrane and will eventually completely separate the hindgut from the primitive urogenital sinus(Moffat,1982).

The vrogenital sinus receives the mesonephric ducts. The cavdal end of the mesonephric duct distal the vreteral bud is progressively absorbed into the urogenital sinus. By the seventh week, both mesonephric duct and vreteral bud have independent opening sites. This will introduce an island of mesodermal tissue amid the surrouding endoderm of the urogenital sinus. As the development progresses, the opening of the mesonephric duct(which will become the ejaculatory duct)migrates down wards and medially.The opening of the vreteral bud which will become the vreteric orifice)migrates upwards and laterally. The absorbed mesoderm of the mesonephric duct expands with this migration to occupy the area limited by the final position of these tubes.This will later be differentiated as the trigonal structure,which is the only mesodermal inclusion in the endodernal vesicourethral unit. Urogenital sinus can be devided into two main segments,the deviding line is the junction of the combined Mullerian ducts with the urogenital sinus,which is the more fixed reference point in the whole structure.The segments are:

1- The ventral and pelvic portion will form the bladder,part of the urethra in the male, and the whole urathra in the female.This portion receives the vreter.

2- The urethral or the phallic portion receives the mesonephric and the fused Mullerian ducts.This will be part of the urethra in the male,and forms the lower fifth of vagino and the vaginal vestibule in the female(Tanagho, 1981).

During the third month, the ventral part of the urogenital sinus starts to expand and forms an epithelial sac whose apex tapers into an elongated,narrowed urachus.The pelvic portion remains narrow and tubular,and this will form the whole urethra in the female and the supramontanal portion of the prostatic in the male. The splanchnic mesoderm surrounding the ventral and the pelvic portion of the urogenital sinus begins to differentiate into interlacing bands of smooth muscle fibers and an outer fibrous connective tissue coat. By the twelfth week, the layers characteristic of the adult urethra and bladder are recognizable. The part of the urogenital sinus caudal to the opening of the mullerian duct will form the vaginal vestibule and contribute to the lower fifth of the vagina in the female. In the male, it forms the inframontanal part of the prostatic urethra and the membranous urethra. The penile urethra is formed by the fusion of the urethral folds on the ventral surface of the genital tubercle. In the female, the urethral folds remain separate and form the labia minora. The glandular urethra in the male is formed by the canalization of the urethral plate (Tanagho,1981).

In his studies on the musculature of the urinary bladder and the urethra in the human male and female foetuses between 6 and 20 cm.Crown Rump Length (C.R.L). Droes (1974) distinguished four smooth systems and one striated system,which are:

1- THE DETRUSOR MUSCLE:

Droes (1974) found that the detrusor myscle surrounds the entire bladder and is present in the foetuses of either sex at 6 cm C.R.L. in the form of network of coarse smooth muscle bundles embeded in a loose connective tissue. Systematic arrangement of bundles is found at certain places especially on the ventral and dorsal walls of the bladder, where there is an outer longitudinal layer which becomes more distinct near the bladder base, and an inner circular layer. The dorsal longtudinal layer extends downwards behind the trigonal area where it is distinguished into one dorsomedial fascicle and two dorsolateral fascicles. The dorsomedial fascicle is inserted into the prostatic capsule in the male and into the urethrovaginal septum in the female. The dorsolateral bundles continue downwards and forwards after curving around the vesical orifice,they meet infront of it and in the adjacent part of the ventral wall of urethra. Thus establishing an oblique caudal loop which forms the lower edge of the detrusor ventrally and laterally. The superficial longitudinal bundles of the ventral bladder wall cover the anterior part of this loop and continue into the pubovesical ligament, thus fixing the detrusor to the pubic bone, so, the detrusor muscle is sharply delimited caudally by the caudal loop. Woodburne (1961) and Hutch (1971) were in agreement with the statement of Droes (1974) that the detrusor is delimited caudally by an oblique muscle sling (caudal loop).

2- THE TRIGONAL SYSTEM:

It is composed of very delieate smooth muscle bundles embedded in a dense connective tissue and arranged into an inner longitudinal layer and an outer circular layer both layers are continuous cranially with the ureteral musculature. At the upper edge of the vesical trigone, the circular layer is quite thin, its bundles passing laterally between the bundles of the caudal loop of the detrusor.

On reaching the level of the vesical orifice,the circular layer becomes much thicker,the innermost bundles encircle the proximal ring which lies in an oblique plane, just like the caudal loop of the detrusor, by which it is partially covered.Because many bundles fan out into the caudal loop of the detrusor,the dorsal part of the ring always seems to be thicker than the ventral part. In the female, the trigonal system extends into the dorsal urethral wall, forming a major part of it in the 11 and 20 cm. CRL foetus. Because of the plate-like appearance of the extension,it is called the "trigonal plate". Droes (1974) also stated that the longitudinal bundles which cover the inner side of the circular trigonal tissue pass between the bundles of the detrusor muscle,or merge into the circular trigonal layer cranially. Caudally, they pass between the longitudinal elements of the smooth urethral musculature and into the prostatic stroma. The above mentioned observations agree with those of Hutch (1966) and Tanagho and Smith (1966) as regards the fanning out of the circular muscle layer of the vesical trigone between its bundles,forming the "base plate".

3- <u>THE SMOOTH URETHRAL MUSCULATURE</u>:

Droes (1974) stated that it is present in the 6 cm.C.R.L. foetuses of both sexes where it consists of a network of coarse smooth muscle bundles which are separated from the detrusor by the relatively undifferentiated mesenchyme of the trigonal ring and,in the male, by prostatic mesenchyme. Droes (1974) also found that the smooth urethral musculature can easily be distinguished from the trigonal and detrusor smooth muscle tissue,so,he concluded that the major part of the smooth muscle tissue in the urethral wall develops as an independent muscular system. Its bundles are loosely arranged into an outer layer of oblique or circular bundles and an inner more or less longitudinal bundle layer. In the male, the network covers the lower part of the prostatic urethra ventrally and continues around the membranous urethra in the shape of a horse-shoe. On its lateral sides,the prostatic part is fixed in the connective tissue covering the prostatic gland. The bundles in the wall of the membranous urethra insert dorsally into a fibrous plate which in subsequent stages will become the dorsal raphe of the membranous urethra. In the female,the smooth urethral musculature surrounds the middle part of the urethra in the shape of a hore-shoe and the bundles insert into the trigonal plate dorsally. The above observations disagree with the findings of other workers where Lapides (1958) stated that the detrusor muscle and urethra form one continuous sheet of muscle. Also,Woodburne (1961) stated that the embryonic development of the bladder and urethra gives no justification for regarding them as having separate origins. He added that the constituents of their walls are the same and the musculature of the bladder extends without interruption as the muscular wall of the urethra. Also, Tanagho and Smith (1968) stated that the detrusor muscle and the urethral musculature are of the same origin and are one continuous structure.

4- THE PROSTATIC MUSCULATURE:

It develops in the male foetus between 11 and 20 cm. C.R.L.in the outer mesenchymal layer of the incipient prostatic gland and consists of many selender and twisted muscle bundles which can be distinguished easily from the trigonal and urethral muscle tissue.

5- STRIATED URETHRAL MUSCULATURE:

Droes (1974) showed that it is present in foetuses of either sex at 6 cm. C.R.L. but actual striation is still abcent in this stage. The earliest muscle striation is found in 10 cm. CRL foetuses while in 20 cm. CRL foetuses, the entire layer consists of striated muscular tissue. The striated musculature covers the smooth urethral musculature and extends cranially to the lower edge of the detrusor muscle, thus covering a part of the trigonal ring as well. In the male, the caudal bundles surround the membranous urethra like a horse-shoe inserting into its dorsal raphe. In the female, the cranial bundles surround the proximal urethra like a hore-shoe inserting into the trigonal tissues of the dorsal wall,while the caudal insert into the urethrovaginal septum, lateral vaginal wall and perineal body (the centrum tendinium).

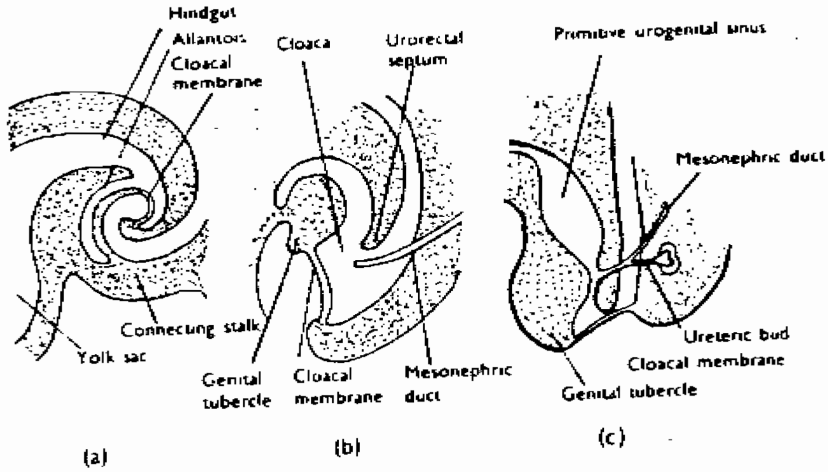

Fig. 1 Early development of the cloacal region. In (a) the allantois is largely in the connecting (body) stalk. In (b) it has been taken into the embryo and, together with the hindgut, forms the cloaca. The mesonephric duct opens into the cloaca. In (c) the urorectal septum has reached the cloacal membrane thus separating the primitive urogenital sinus from the hindgut (Moffet, 1962).

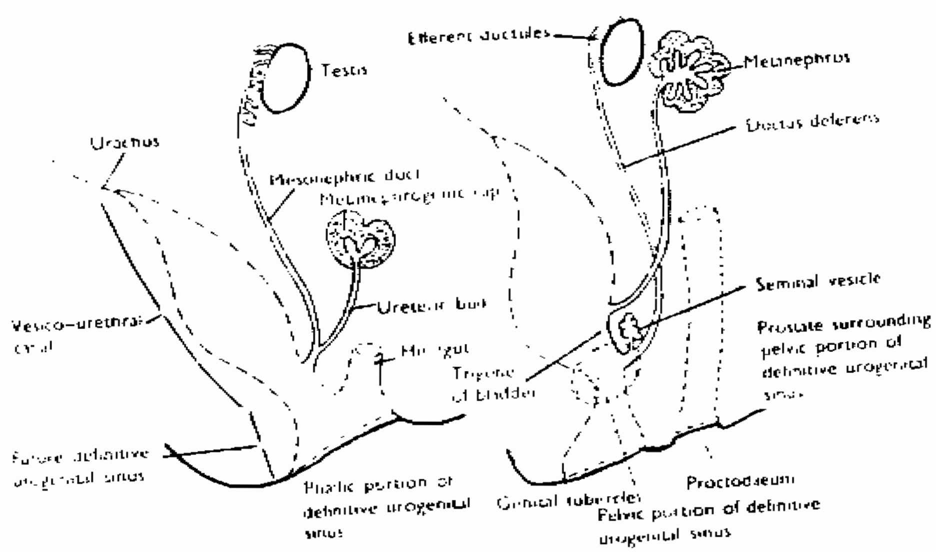

Fig. 2 The subdivision of the primitive urogenital sinus into a vesico-urethral canal and a definitive urogenital sinus, the latter being itself subdivided into pelvic and phallic parts. Endodermal derivatives are drawn in dotted lines and mesodermal in solid lines (Moffet, 1982).

ANATOMY OF THE BLADDER OUTLET

The bladder outlet is a region limited proximally by the interureteric bar (extending between the ureteric orifices) and distally by the veromontanum. The corresponding parts of the anterior and lateral walls of the bladder and the urethra complete the boundaries of the region (Badr, 1966).

The musculature of the bladder outlet will be discussed under the following headings:

1. Trigonal musculature.
2. The detrusor muscle.
3. The urethral musculature.
4. The voluntary external sphincter.

1. THE TRIGONAL MUSCULATURE

The trigone lies in the floor of the bladder in the triangular area bounded by two ureteral orifices and the urethral orifice.

The trigone is essentially mesodermal in origin. It is a direct continuation of the ureter at the same time intimately connected to the detrusor and vesical neck musculature. So arranged, the trigone has an important role in the physiological control of both the ureterovesical junction and the bladder neck.

Any pathological change in the trigone will be reflected on the function of either or both of these segments.

The trigone is composed of two layers, the superficial trigone and the deep trigone, both being direct continuation of the lower ureter with its Waldeyer's sheath (Tanagho et al., 1968).

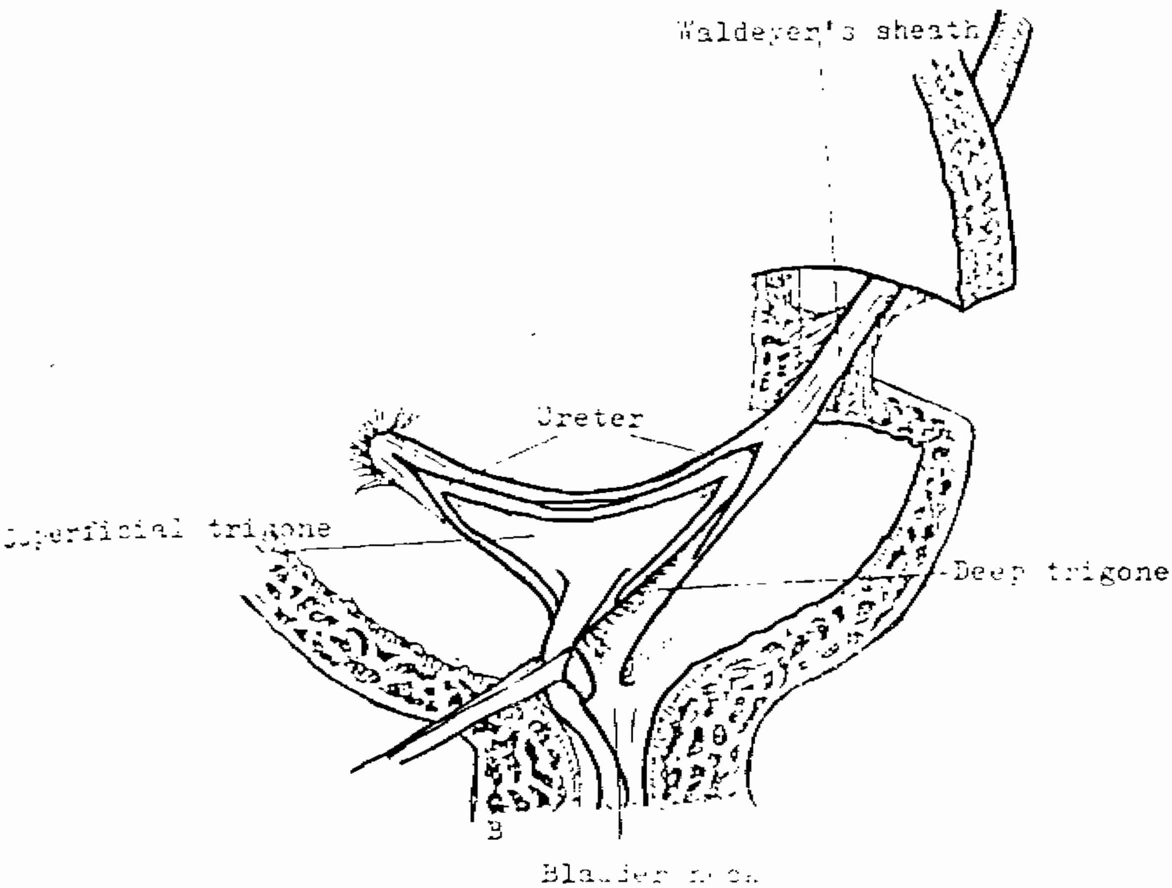

Fig.3 The anatomy of ureterovesical complex (Hutch,1971).

THE SUPERFICIAL TRIGONE:

The superficial trigone is this triangular sheet of muscle lying on the deep trigone and is directly under the bladder mucosa at a level corresponding to the inner longitudinal muscular layer of the detrusor muscle, to which it is fused along its superior border formed by Mercier's bar (interureteric ridge and its lateral) border formed by Bell's muscle (Hutch, 1971).

The superficial trigone is a direct continuation of the ureter proper.

The msuculature of the juxta vesical ureter is made up of longitudinal and circular fibers, As the ureter approaches the vesical wall, the spiral fibers become oriented longitudinally, running parallel to the lumen in the intravesical segment without loss in the size or number. Tanagho (1932) stated that the length of the intravesical ureter is about 1½ cm. It is divided into:

1. An intramural segment, totally surrounded by the detrusor msucle.

2. A submucosal segment, which is directly under the bladder mucosa, the average length of the latter is about 1 cm.

   The pure longitudinal rearrangement of muscle fibers in the intravesical ureter seems to be essential before it loses its lumen. As they approach the ureteric orifice, the roof fibers split and swing to sides, forming the lips of the ureteric orifice, they then join the floor fibers, where all of them accumulate forming an elevation which is