URODYNAMIC STUDY OF SCHISTOSOMAL BLADDER

THESIS

SUBMITTED IN PARTIAL FULFILMENT

For the Doctorship Degree in Urology

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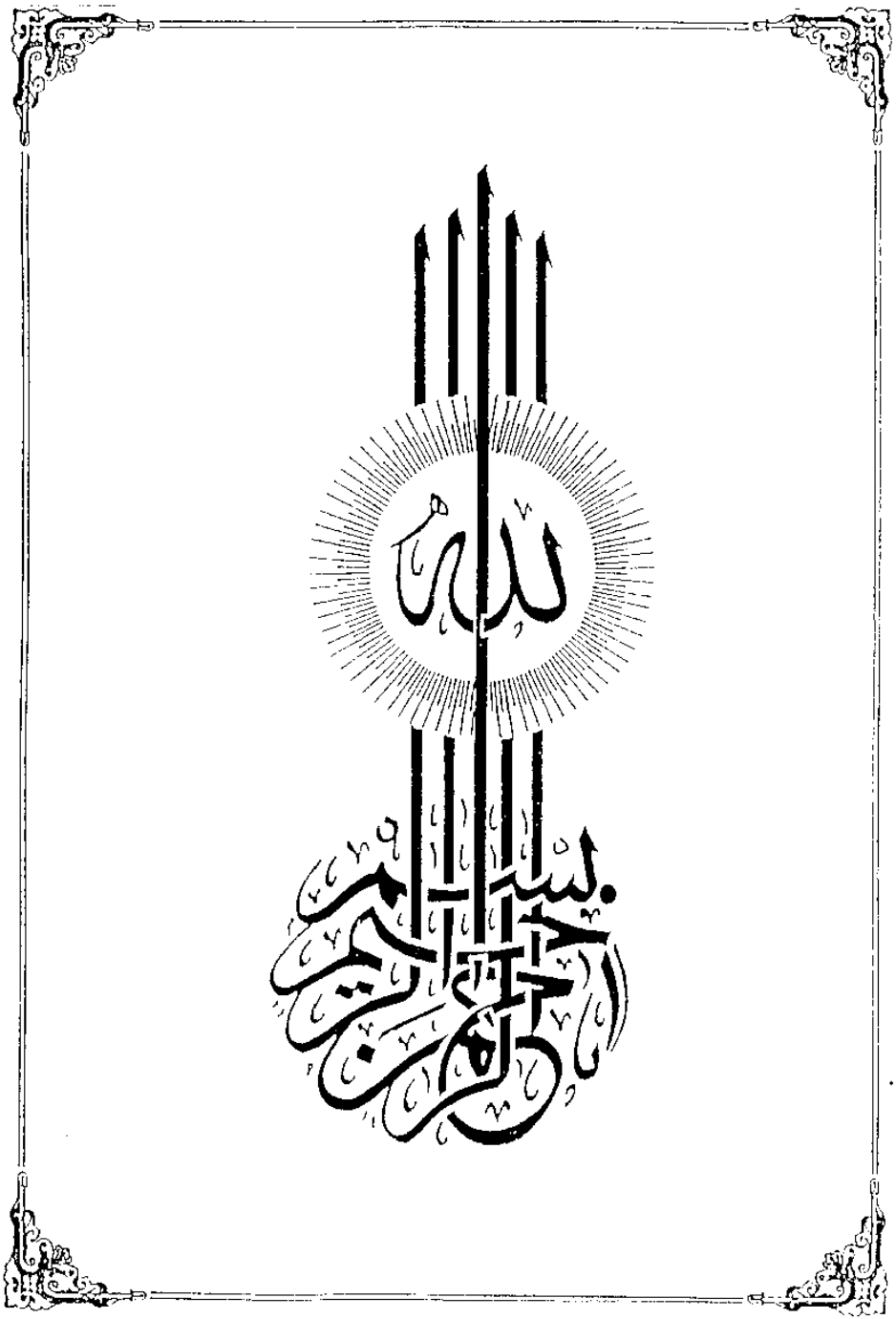

C O N T E N T S

REVIEW OF LITERATURE

A N A T O M Y

Functionally, the lower urinary tract consists of the bladder and its outlet.

THE BLADDER BODY

Although the smooth muscle fibers of the bladder body were at one time thought to be composed of three layers (the external and internal longitudinal layers and the middle layer, thickest and composed of circularly running fibers), as early as 1891 Griffiths denied the existence of separate strata in the urinary bladder. He observed that muscular bundles run from plane to plane and became circular and oblique in the region of the bladder neck. More recently Hunter in 1954 analyzed the musculature of the bladder and found that the apparently longitudinal surface bundles separated from the another to run deeper into the wall and decussate. He described a maximum of five decussations for some fascicles. Woodburne in 1968 described the muscular coat of the bladder as a meshwork, consisting of fascicles, some broad, some narrow, running in many directions, changing planes and orientation, crisscrossing and decussating through the wall. Wesson in 1920 believed that he could follow anterior fascicles from the bladder wall that circled behind the urethral orifice and fascicles from the posterior wall of the bladder that circled infront of it. Thus in the body of the urinary bladder, muscle fibers from all layers are intermingled, and the muscular wall of the bladder may be considered as a continuum of smooth musculature, the vesical detrusor.

THE BLADDER BASE AND BLADDER NECK

The bladder base is considered to include the trigonal structures as well as the other smooth muscle fibres in the distal one inch of the bladder just above the bladder neck.

As the detrusor muscle bundles converge on the internal orifice of the bladder, they tend to become oriented into three layers:

Inner longitudinal layer:

Throughout the bladder the fibers of this layer are widely separated and run in almost every direction. As these muscle bundles approach the bladder neck they become arranged in a radial fashion. They converge on the internal meatus where their continuity is interrupted as they meet the longitudinal fibers of the superficial trigone along its superior and lateral borders and fuse with it. All of these fibers then sweep over the edges of the internal meatus to continue into the urethra as its inner longitidunal muscle coat (Tanagho and Smith, 1966; Hutch, 1971; Bissada and Finkbeiner, 1978).

Middle circular layer:

It is present in all parts of the bladder wall, but as this layer approaches the bladder neck it undergoes changes that have sphincteric significance. First, it terminates at the bladder neck, it does not pass into the

urethra. Second, as the middle circular layer approaches the bladder neck it begins to thicken and its fibers become more prominent. This thickening begins about 2.0 to 2.5 cm proximal to the bladder neck and at its widest point is often three to four times thicker than is the middle circular layer elsewhere in the bladder. Thickening is caused by a marked increase in the number of circularly oriented smooth muscle rings arranged concentrically around the bladder neck and incorporated into the base of the bladder, the most caudal of these fibres from the true bladder neck. This ring is complete enteriorly and laterally, but not posteriorly as it fuses with the deep trigone in the same manner as the inner longitudinal layer fuses with the superficial trigone.

Hutch (1971) stated that this structure was first described by Heiss in 1915 (Heiss's Ring), and then by ulenhuth and associates in 1953 as the fundus ring. In 1965 Hutch demonstrated that, anatomically and functionally, the fundus ring or Helss's ring fuses with the deep trigone to form a structure that he called the Base plate. Thus the Base plante is divided into two parts.. The anterior part made up of the anterior bladder well from the bladder neck to a point 2.0 to 2.5 cm above it. The posterior part is the deep trigone.

Outer longitudinal layer:

Hutch in 1971 stated that thin layer contains many muscle bundles that are prominent along the anterior and posterior wall of the bladder. The layer is quite thin on its lateral aspects. As the fibers representing this group converge on the narrow bladder neck they coalesce into distinct muscle groups.

Transverse precervical Arc: is a tough fibrous point of inserior longitudinal layer and detrusor loop. It lies at the anterior bladder neck, just anterior outer longitudinal layer and detrusor loop. It lies at the anterior bladder neck, just anterior to the detrusor loop and just below the enterior part of the base plate. It surrounds the anterior one third of the bladder neck (Hutch, 1971, Bissada Finkbeiner, 1978).

THE TRIGONE

The trigone is a direct continuation of the ureter and is at the same time intimately connected to the detrusor and the vesical neck musculature. So arranged, the trigone has an important role in the physiological control of both 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. Tanagho and associates 1963, 1968 stated that the trigone is composed of two layers, both being direct continuation of the lower ureter with its Waldeyer's sheath.

a. The superfiscial trigone:

The longitudinal fibres of the intravesical ureter diverge at the ureteric orifice & continue uninterrupted into the base of the bladder as the superfiscial trigone. The rest fan out & converge at the iternal meatus to proceed downward into the urethra in the midline poster iorly. In the male, these filers terminate at the level of the verumontanwn & possibly join the musculature of the ejaculatory ducts, & they form the crista urethralis. In the female, the same fibers terminate at the level of the external meatus.

b. The Deep trigone.

All the fibres forming Walldayer's sheeth continue downward uninterrupted into the base of the bladder, forming the deep trigone. Again, the only change is that the tubular sheeth has become flat & its muscle bundles has become more compact & more firmly bound together. This flattening & fanning begins shortly before the ureter loses its lumen at the ureteralorifice. The upper fibersproceed medially to meet those from other side, forming the base of the trigonal structure, the iter ureteral ridge or Mercier's bar. The lower fibres proceed medialy & downward at various degrees of obliquity to meet & fuse with the fibers from the other side. The deep trigone end at the internal meatus as a dense muscular fibrocollagenous structure. There is muscular communication between the

superficial & deep trigones, & they can be dissected easily from one another. The deep trigone is also easily dissected from the detrusor muscle behind it in its upper half. However, in its lower half, it is more adherent to underlying detrosor & middle circular layer of the bladder. The superficial trigone is adherent to overlying mucosal layer. However, the two layers of trigone are in direct continuation with the lower ureter with no interruption or loss of the musculature merely changing from a tubular to sheet like form (combined trigonal). (Campbell, Urology, 1986).

THE URETHRA

The anterior urethra in the male acts merely as a conduit, it normally has no role in voiding or continence and it will not be discussed further. So in our literature the term urethra will apply to the entire urethra in the female subject and the prostatic and membranous urethra in the male subject. Significant differences between the two will be discussed when pertinent. The urethral musculature is discussed under two components:

a. The Smooth Muscle Component:

This segment is a muscular tube about 4 cm long in the adult, consisting of two muscle layers throughout its entire length.

1. An Inner Longitudinal Coat, embeded in dense collagen, its muscular fibres a direct continuation of the

detrusor inner longitudinal layer (Tanagho, 1978). Hutch and Rambo (1967) stated that it encloses the lumen of the urethra which is lined by transitional urothelium that becomes stratified just proximal to the urethral meatus in the female subject. This epithelial tube is separated from the layer of longitudinal smooth muscle fibers by a vascular lamina propria. Multiple small glands are present in the subepithelial layer in the female subject. On the posterior wall of the male urethra there is a prominent fold, the crista urethralis which passes from the bladder neck to the verumontanum. This fold is a direct continuation of Bell's muscle which has passed down over the bladder neck. The female urethra contains a corresponding longitudinal fold that often runs the entire length of the urethra along its posterior wall.

2. An Outer Circular or Semicircular Smooth Muscle Layer,

Hutch in 1967 described this layer as circular prominent only in the upper half of the urethra and is a direct continuation of the outer longitudinal smooth muscle layer of the bladder. As the muscle fibers of the outer longitudinal muscle layer of the bladder approach the bladder neck they tend to pass around it to the opposite wall of the urethra, i.e. the fibres approaching the bladder neck from the right posterior aspect of the bladder wind spirally around the right side of the bladder neck and continue to the left anterior wall of the urethra. Similarly, fibers from the left post wall of the bladder pass

to the right anterior wall of the urethra. This decussation occurs anterior and posterior to the bladder neck, and the fibers course in a circular direction around the inner longitudinal layer of the urethra before undergoing a gentle downward spiral. As the outer circular layer of the urethra proceeds downward it becomes absent or greatly attenuated in the inferior half of the urethra as it is met by striated muscle bundles reflected upward from the urogenital diaphram. However Tanagho and Smith (1966), and Tanagho (1978), found that this layer is rather semicircular where the fibers are "sling fibers" which do not form a complete ring around the urethra, but are at various degrees of obliquity looping around the urethra, then turning back towards the urinary bladder. He also noted that the thickness of this outer semicricular coat is slightly heavier in the proximal third than in the most distal third.

b. The Striated Muscle Component:

Hutch and Rambo (1967) stated that the true external sphincterconsists of circularly oriented striated muscle lying between the superior and interior layers of the urogential diaphragm. The paraurethral striated muscle originate from the striated muscle of the true sphincter and climb upward along the outer surface of the inner longitudinal layer of the urethra. This muscle inserts into the inferior border of the outer circular smooth muscle layer at a point about half way between the

urogeital diaphragm and the bladder neck. The paraurethral striated muscle is oriented in a circular or oblique direction and tends to maintain a peripheral position in relation to the smooth muscle as if it has been applied to the urithra from an outside source. The junction between striated and smooth muscle fibers is easily determined histologically. There is an interdigitation of bundles of both kinds of fibers and the junctions are characterized by bands of of collagen as through the striated muscle were inserting into the smooth muscle. Hutch and Rambo (1967) found that there is a difference between the destribution of the paraurethral striated muscle in the male and female subjects. In both sexes there is more striated muscle along the anterior wall than along the posterior wall of the urethra and in both sexes the striated muscle occupies the inferior one half or two thirds of the anterior urethral wall. Striated muscle of the anterior wall of the urethra does not reach the bladder neck in either male or female subjects. The junction between the smooth and striated fibers on the anterior wall is not a sharp horizontal line but rather an oblique line formed by tabering of outer smooth muscle layer downward and in male subject. It is abundant for 1 cm above the urogenital diaphragm, but the presence of the prostate seems to deny it access to the superior half of the posterior urethral wall. In female subject striated muscle is sparse along the inferior half of the posterior wall of the urethra probably because the vagina fuses so tightly to urethra in that area,

while it is abundant in the superior half of the posterior wall and may reach up to the bladder neck.

Gosling (1979) and Donker et al., (1982) showed that the intrinsic musculature is anatomically separate and morphologically distinct from the extrinsic or periurethral levator and muscle of the pelvic floor.

Gosling et al. (1979) have studied specimens from the human male and female external urethral sphincter and the periurethral levator and muscle using histochemical and electron microscopic techniques. They have shown that in both sexes, the external sphincter consists of a single population of type 1 (slow twitch) fibres with a mean diameter of 17.47±0.7 um in the absence of muscle spindles.

In contrast, the pariurethral levator ani possesses muscle spindles, and the constituent fibres form a heterogenous population of type 1 and type (fast twitch) fibres with mean diameters of 45.5 ± 0.8 um and 59.5 ± 3.4 um respectively.

These findings, indicate that the external urethral sphincter is functionally adapted to maintain tone over prolonged periods and may be of considerable importance producing active urethral closure during continence. The anatomical location and fibre characteristics of the levator ani muscle suggest that fibres actively assist in urethral closure, particularly during events which cause elevation of intraabdominal pressure.