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MECHANISM OF MICTURITION

Essay

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By

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INTRODUCTION

In this thesis, I am going to deal with the mechanism of micturition, which can be regarded as an entrance to the understanding of many urological problems.

Before discussing the mechanism of micturition I found it reasonable to discuss, in some detail, the structure and innervation of the detrusor, bladder neck and its sphincteric mechanisms and the urethra.

The urodynamic evaluation of the lower urinary tract function sheds more light on the understanding of the forces sharing in the act of micturition and its aberrations in different pathological or abnormal conditions.

The effect of drugs on vesicourethral system can not be ignored as drugs can modulate its function.

ANATOMY OF BLADDER ; BLADDER
NECK AND URETHRA

ANATOMY OF BLADDER,
BLADDER NECK AND URETHRA

This chapter is devoted to give an account on the anatomy of the bladder and its outlet.

The bladder constitutes the midportion of the urinary tract and is the major reservoir of the urinary tract. It varies in shape, size and position according to the age and the amount of urine it contains.

In infancy, the bladder is an abdominal structure, whereas, in the adult, it occupies a pelvic position.

This is actually a relative change which occurs due to change in the shape of the bladder, as well as in the contour of the bony pelvis, due to pubic expansion and evolution of sacral curve with tilting, broadening and deepening of the pelvis. The bladder occupies a more abdominal position in the male, being supported by the prostate. The full bladder is distended and ovoid in shape. The resting contracted bladder is a thick-walled organ having superior and inferior surfaces, fundus and an apex (Ken Koshiba, 1979).

Anatomic Relations of The Bladder :
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The neck of the bladder is fixed to the surrounding structures by : Prostate, reflections of the visceral pelvic

fascia, strong areolar connections to the urethra and rectum, true ligaments (pubovesical and umbilical ligaments), false ligaments (ureters - obliterated hypogastric vessels - blood vessels and the peritoneal reflection).

Peritoneum covers the small portion of the base between the levators and the upper surface of the bladder, and is reflected anteriorly on the posterior aspect of anterior abdominal wall, so, when the bladder is filled, this reflection anteriorly is raised well above the pubis.

In the male, the posteroinferior aspect of the bladder is related to the rectum, being separated from it by seminal vesicles, ampullae of vasa efferentia and the rectovesical fascia of Denonvilliers. In the female, the posteroinferior aspect of the bladder rests against the upper part of the vagina and uterine cervix, the uterus extends and arches behind the posterosuperior aspect of the bladder but is separated by a pouch of covering peritoneum forming the vesico-uterine excavation.

The prevesical area or space of Retzius is a division of the extraperitoneal space that extends from the pelvic floor to level of the umbilicus bounded anteriorly by the posterior sheath of rectus muscle to the level of the arcuate line, then by posterior surface of rectus muscle and the posterior surface of pubic rami (Ken Koshiba, 1979), and

is filled with loose fatty tissue.

Structure of The Bladder :

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The bladder body : The detrusor muscle :

Although the smooth muscle fibres of the bladder body were thought to be composed of three layers (external, internal longitudinal layers and a middle circular layer) but, as early as (1891) Griffiths denied the existence of separate strata in the bladder. He observed that muscular bundles ran from plane to plane and became circular and oblique in the region of the bladder neck. Hunter in (1954), analysed the musculature of the bladder and found that the apparently longitudinal surface bundles separate from one another to run deeper into the wall and decussate.

Woodburne(1968) described the muscular coat of the bladder as a meshwork, consisting of fascicles, some broad and some narrow, running in many directions, changing planes and orientation, decussating through the wall, and separated by bundles of connective tissue and elastic fibres which are continuous with those of tunica propria. This arrangement of the muscular wall of the bladder is ideally suited to cause reduction in all directions of the bladder on contraction of the muscle

coat (Gosling, 1977).

So, in the body of the urinary bladder, muscle fibres from all layers are intermingled and the muscular wall may be considered as a continuity of smooth musculature, the detrusor, within which a tendency to an organization in an outer longitudinal, a middle circular and an inner longitudinal layer can be recognised.

This layering is more evident in the caudal part of the bladder than in the cranial part, ventrally and dorsally it is more distinct than laterally.

Inner longitudinal layer :

As the muscle bundles of this layer approach the bladder neck, they become arranged in a radial fashion and converge on the internal meatus where their continuity is interrupted as they meet the longitudinal fibres of the superficial trigone along its superior and lateral borders and fuse with it.

Then, all of these fibers sweep over the edges of the internal meatus to continue into the urethra as its inner longitudinal muscle coat (Tanagho and Smith, 1966; Hutoh, 1971).

The middle circular layer :

Hutch (1971), stated that this layer 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 fibres become more prominent.

This thickening begins about 2-2½ Cm. proximal to the bladder neck and at its widest point is often three to four times thicker than 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 form the true bladder neck.

This ring is complete anteriorly 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 (1915), as (Heiss's ring), and then by Ulenhuth and associates (1953), as the (fundus ring). In (1965) Hutch demonstrated that, anatomically and functionally, the fundus ring with the deep

trigone form a structure that he called the (base plate). Thus, the base plate is divided into two parts. The anterior part made up of the anterior bladder wall from the bladder neck to a point 2 - 2½ Cm. above it. The posterior part is the deep trigone.

The outer longitudinal layer :

Hutch (1971), stated that this 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 fibres representing this group converge on the narrow bladder neck and coalesce into distinct muscle groups :

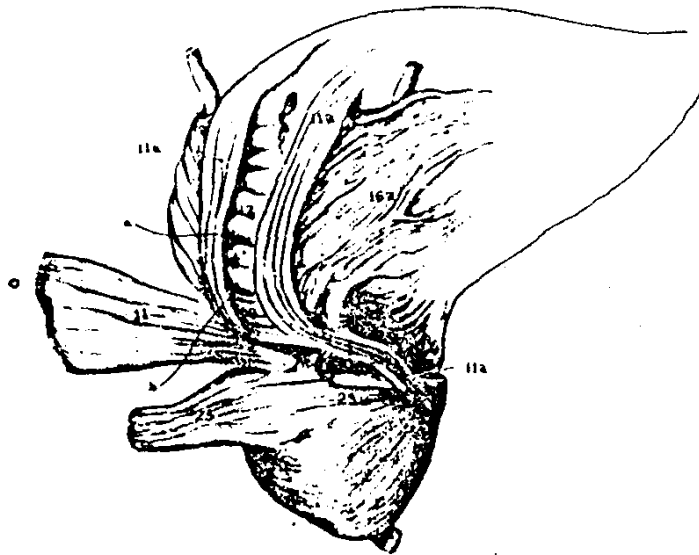
- 1) The anterior portion : This group is arranged in a wide band extending from the bladder neck to the vertex of the bladder along its anterior wall.

Superiorly, many of these fibres can be seen to loop around the urachus. Inferiorly, this group narrows and thickens as it approaches the bladder neck and makes a major insertion just ventral to the vesical neck.

- 2) The posterior portion : This concentration of longitudinal fibres is even larger and stronger than the anterior portion. The fibres also run from the vertex of the

bladder neck and some of them also loop around the urachus. At the bladder neck, they form a medial group and a (right and left) lateral groups. The medial group of fibres forms a flat wide muscle which inserts into the posterior surface of the apex of the trigone at the bladder neck. It lies against the posterior surface of the deep trigone, but is not attached to it except at the apex. It is usually about 1 Cm. wide and is sometimes enclosed in a fascial envelope. Tanagho et al, (1966), observed that some fibres of the medial group penetrate the base of the prostatic gland and mix with its musculature. The lateral group of fibres (to right and left of the medial group), is the remaining part of outer posterior longitudinal fibres which passes downward and forward, actually leaving the bladder to pass into the groove formed by the junction of the bladder and urethra in females, or the bladder and the prostate in males. (Fig.1).

These muscle bundles then leave the vesicourethral groove to form the superior part of the anterior wall of the urethra just distal to the anterior part of the base-plate. They loop back to the opposite vesicourethral groove and to the posterior outer longitudinal layer on the side of the bladder opposite their origin. This is the (Detrusor loop) first described by Heiss. This



Bladder dissection demonstrates both medial (II) and right and left lateral (II, a) groups of posterior outer longitudinal layer. Medial group (II) inserts into posterior surface of trigonal apex. Right and left lateral groups (II, a) pass downward and forward into vesical prostatic groove to form detrusor loop on the anterior urethral wall. (From Uhlenhuth and Hunter. Courtesy of J. P. Lippincott Co., 1953.³)

Fig. (1)



Fig. (2)

Bladder dissection illustrates region of anterior bladder neck. 1, transverse pre-cervical arc, which is fibromuscular insertion of anterior outer longitudinal muscle. My dissections have shown that transverse pre-cervical arc is also insertion for detrusor loop. (From Gil Vernet. Courtesy of Canova, 1968.⁴)

fascinating horse-shoe shaped structure forms most of the anterior and lateral portions of the bladder neck. It is directed dorsally and continues into the posterior bladder wall in the same manner as the left and right lateral posterior fibres of the outer longitudinal muscles described. Its concave surface in which the apex of the trigone fits, is directed dorsally. Ventrally, its convex surface is fused with the transverse precervical arc, which is a tough fibrous point of insertion for the anterior part of the outer longitudinal layer and detrusor loop.(Fig.2)

It lies at the anterior bladder neck, just anterior to the detrusor loop, and just below the anterior part of the base plate. It surrounds the anterior one third of the bladder neck (Hutch, 1971; Bissad and Finkbeiner, 1978).

The Trigone : =====

The trigone can be defined as that region of the posterior bladder wall which extends between the ureteric orifices and the internal urethral meatus.

It is considered as direct continuation of the ureter and is at the same time intimately connected to the detrusor and the vesical neck musculature. The trigone has an important role in the physiological control of both ureterovesical