ELECTROMYOGRAPHY AND DYNAMIC ULTRASONOGRAPHY OF VESICAL OUTLET

Essay Submitted for the Partial Fulfillment of the Master Degree in Urology

By

Khaled Mokhtar Kamal

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Supervised by

Prof. Dr. Ismail Osman Abdel-Hafeez

Professor of Urology-Ain Shams University

Dr. Mohamed Sherif Mourad

Lecturer of Urology-Ain Shams University

Faculty of Medicine

Ain Shams University

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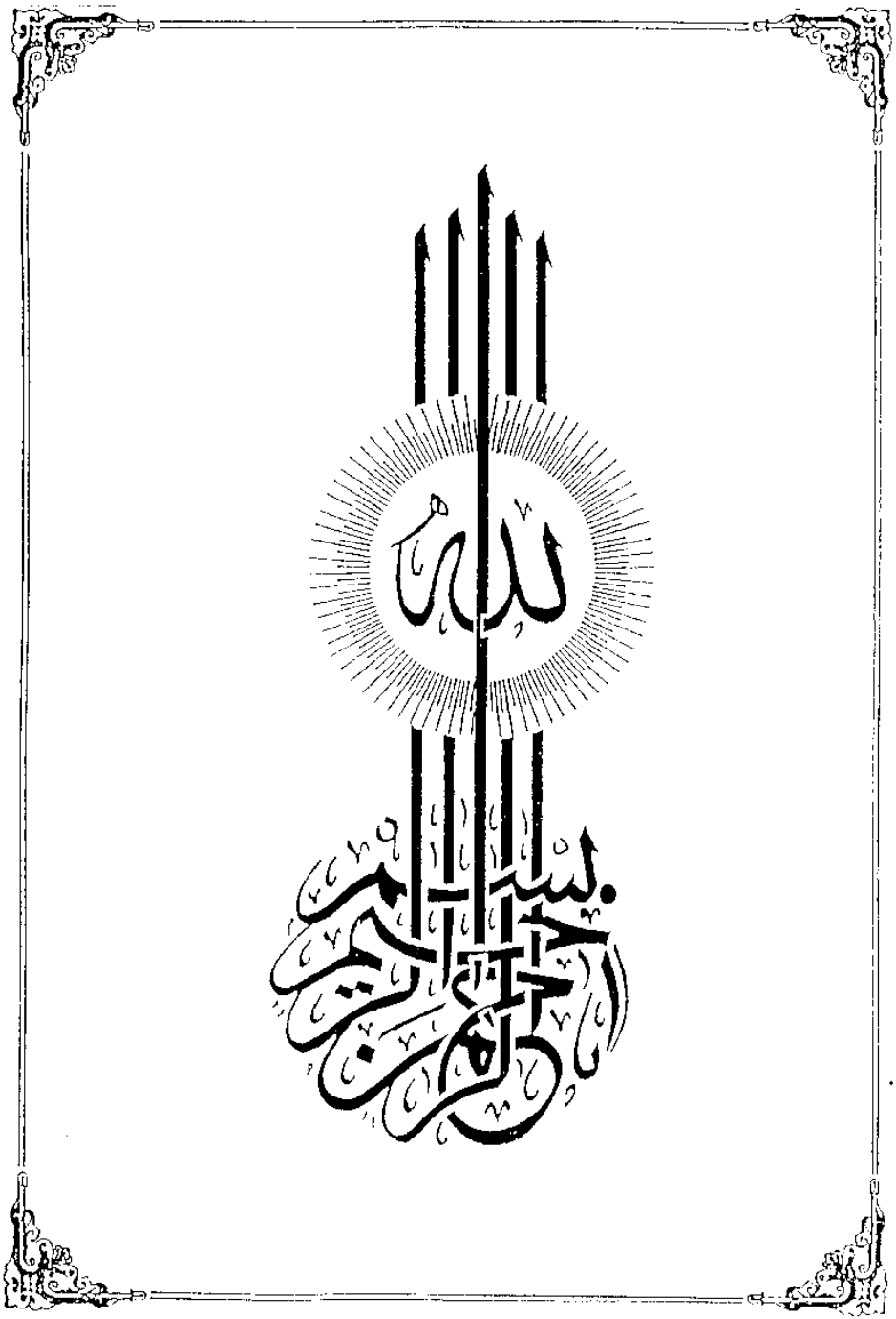

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Introduction

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The process of voiding and continence is a complex subject to discuss. For long, it has been a matter of controversy. The synchronous interaction between anatomy, physiology and neuropharmacology of the lower urinary tract is mandatory for competent voiding and continence pattern ***(Wein and Barett, 1988).***

The aim of interaction between these three subjects is to bring about low pressure bladder filling, urine storage as well as periodic expulsion of urine at low pressure.

A simplification of voiding dynamics is that, the pelvic floor and urethral sphincter relax, the detrusor muscle contracts until the bladder is empty. The detrusor contraction subsides, the urethral sphincter and pelvic floor contract once more and resting position is achieved.

Disturbance of any of the contributing factors in the process of voiding results in either voiding and/or storage dysfunctions ***(Wein, 1988).***

With the introduction of urodynamic studies combined with either dynamic transrectal or perineal ultrasound with electromyography study of the external sphincter, marked improvement has resulted in management of cases with vesicourethral sphincter dysfunction.

Anatomy, Physiology and Neuropharmacology of Detrusor and Outlet

Anatomic consideration of the detrusor and its outlet

- In females: (Fig. 1)

The striated sphincter fibres surround the urethra over the middle third. This muscle has been termed the "Sphincter Urethrae", moving distally, and blending with the sphincter urethrae are striated fibres of the urethrovaginal component of the sphincter. These fibres do not surround the urethra but pass laterally along the urethra and then posteriorly around the vagina. Finally, there is a "Compressor Urethrae", which cross anterior to the urethra in conjunction with the previously mentioned urethrovaginal component, and inserts in the ischiopubic rami. This muscle serves to compress the urethra anteriorly and can pull the urethral meatus caudally and comprises as much as 80% of the luminal length of the urethra ***(Oelrich, 1983, DeLancy, 1990 and DeLancy, 1994).***

- In males: (Fig. 2)

The anatomy of the striated sphincter in the male subject is associated with the presence of the prostate and altered by the growth of the prostate ***(Beneverti and Marshall, 1956).*** During puberty, the growth of the prostate displaces the sphincter distally and incorporates part of it anteriorly. The sphincter shows varying amount of striated muscle fibres anteriorly and laterally near the junction of

the apex of the prostate and membranous urethra ***(Oelrich, 1980 and Beneverti & Marshall, 1956).***

Until the membranous urethra is reached, the sphincter tends to have a horse-shoe appearance. There is no clear cut plane or division between the prostate and urethral sphincter because striated muscle fibers are present within the substance of the prostate ***(Oelrich, 1980 and Beneverti & Marshall, 1956).***

As the urethra leaves the apex of the prostate, it travels caudally to end through the perineal membrane where it is surrounded by striated urethral sphincter fibres and medial fibres of the levator ani musculature. The levator is maintained in proximity to the prostate and membranous urethra by its medial fascia ***(Myers, 1991).***

Structurally, the levator would seem to offer support as well as some degree of compression during active contraction. ***Myers*** has indicated that the compressor function of the levator is not homogenous with the female compressor urethra ***(Myers, 1991).***

The striated muscle fibres of the external urethral sphincter is further classified into two

partitions, the fibers within the wall of the urethra (intramural) which are smaller and thinner than those located periurethrally (extramural) and are slow twitch in character. The periurethral muscle is a mix of slow and fast twitch fibres. Slow twitch muscle has a rich mitochondria and is resistant to fatigue. It is believed to be important in maintaining continence at rest. Fast twitch fibres are characterized by a high glycogen content and easy fatiguability. They are thought to help maintain continence during stress e.g. coughing or running ***(DeLancy, 1990).***

The voluntary sphincter maintains a constant tonus that is the primary continence mechanism, while the resting tone is involuntary, it can be voluntarily increased to prevent or abolish voiding ***(Nanninga, 1994).***

To summarize, the membranous urethra between the prostate and corpus spongiosum is surrounded by skeletal muscle fibres that constitute the main component of E.U.S. No other circumferentially skeletal muscle unit around the urethra was identified. The fibres of this unit gradually fade out proximally as they insert in the distal portion of the prostate. Distally the fibres are adjacent to the bulb of the corpus spongiosum.