MRI PELVIC FLOOR FINDINGS IN FEMALES WITH URGENCY URINARY INCONTINENCE

Thesis

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ABSTRACT

Objective: Finding a correlation between the uterosacral ligaments(USL) and the urgency urinary incontinence(UUI) in females ,as assumed by recent studies , using MRI pelvic floor with the aim of detecting gross anatomical differences in the uterosacral ligaments configuration between the control group and the urge incontinence cases group thus repairing a female's lax uterosacral ligaments could be a possible treatment for her UUI if what supposed was true.

Patients and methods: The study was designed as a prospective controlled study during the period from May 2014 to september 2015.It was conducted on 68 female subjects(30 cases complaining of urge urinary incontinence and 38 normal controls) . Evaluation included detailed history , physical examination, urinalysis , abdominopelvic ultrasound , urodynamic evaluation and MRI examination (static and dynamic) to compare the mean length , craniocaudal leveling , origin and insertion of the uterosacral ligaments between the study groups**.** All control group were continent and asymptomatic, with their POPQ assessment having all points at least 1 cm above the hymen .

Results: There is statistically significant difference between the mean USL lengths in the case and control groups with longer lengths in the urge incontinence group. There was no correlation between the length (laxity) of the ligament and the symptoms of the cases whether its severity or duration. We divided the UUI cases group into 2 subgroups (with pelvic organ prolapse(POP) and without POP) and by comparison we found that both subgroups have longer USLs than the control group(significant P value) and the POP subgroup have longer USLs that the "no POP" subgroup(not statistically significant). We also found that both USLs in most of the cases originated from the female genital tract at a more caudal level than in the control group. A descriptive analysis of the origin and insertion points of the uterosacral ligament in all subjects was done .

Conclusion: Our study found a correlation between the increased length of the USLs and urge urinary incontinence but we found no relation between the increased length of the USLs in the cases and the duration or severity of their urinary symptoms.The cases group were found to have a more caudal level of the ligament attachment to the female genital tract than the control group , a result which may indicate downward displacement of the vaginal apex in the urge incontinence patients. This may correlate with what was proposed in the "integral theory" in the pathogenesis of the UUI in females ; a lax vagina . Our results suggest that the urgency incontinence itself is associated with laxity of the USLs and that the USLs are further more lax if pelvic organ prolapse is present , however , our study may be limited by the small number of cases especially cases without POP and thus we recommend further confirmatory studies. This will open more research fields about the relation between the idiopathic urge urinary incontinence in females and an anatomical defect that can be managed surgically .

Keywords:

Urgency urinary incontinence , uterosacral ligaments , pelvic organ prolapse , MRI pelvic floor , females.

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LIST OF ABBREVIATIONS

ATFP .....Arcus Tendinus Fascia Pelvis

ATLA .....Arcus Tendinus Levator Ani.

CL .....Cardinal ligament.

EAS ..... External anal Sphincter .

EUS .....External Urethral Sphincter.

LUT .....Lower urinary tract.

MRI .....Magnetic Resonance Imaging.

OAB .....Overactive bladder.

POP .....Pelvic organ prolapse.

PULs ..... Pubourethral ligaments.

RVF.....Rectovaginal fascia.

SUI.....Stress urinary Incontinence.

USL .....Uterosacral ligament.

UUI .....Urge urinary incontinence.

TFS.....Tissue Fixation System

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INTRODUCTION

Urinary incontinence is a common problem among adult women. Of the women consulting a general practitioner, 45-50% has complaints of stress urinary incontinence and a further 36-44% of mixed urinary incontinence[1,2] .

Urinary incontinence is not a life-threatening disease, but the symptoms may seriously influence the physical, psychological and social well being of the affected women [3]. Moderate to severe restriction of activity of daily living caused by urinary incontinence occurs in 13%; above the age of 60 years this can increase up to 46-65% [1,6].

Urinary incontinence is commonly divided into three types based on symptoms; stress, urgency and mixed urinary incontinence.

- **Stress urinary incontinence (SUI)** is defined as the complaint of involuntary loss of urine on effort, physical exertion, on coughing or sneezing[4]. This is usually due to anatomical defects in the structures that support the bladder and urethra, and/or dysfunction of the neuromuscular components that help to control urethral pressure.
- **Urgency urinary incontinence(UUI)** is defined as the involuntary leakage of urine accompanied by or immediately preceded by urgency [4]. This usually results from involuntary increase in the bladder pressure due to detrusor activity.

The symptoms of SUI are often coexisting with overactive bladder symptoms. The overactive bladder syndrome is defined as urinary urgency, often accompanied by frequency and nocturia, with or without urgency urinary incontinence, in the absence of urinary tract infection or other obvious pathology [4].

- When the complaint of involuntary loss of urine is associated with effort, physical exertion, sneezing or coughing and also with urgency symptoms, it is called **mixed urinary incontinence** [4].

Determination of the type of incontinence is important since it determines the treatment and predicts its expected success and complications. Important treatment options for SUI are pelvic floor physiotherapy and surgery, the most common surgical therapy is the midurethral sling procedure with an average success rate of 90% [5].

Urge urinary incontinence is extremely a bothersome disorder and affects probably 30% of postmenopausal women. UUI involves a triad of factors (urgency, frequency and incontinence) that has detrimental effects on the patient's quality of life [7] . UUI is considered to be related to abnormal detrusor muscle function or innervation. Pharmacological treatments are disappointing, since they are only slightly more effective than placebo [8] .

In 1991, **de Lancey** [9] emphasized the importance of the support of the genital tract for continence function. He considered in that respect that the attachments of the ligaments at the cervix were so important that he proposed to perform supracervical hysterectomy instead of total hysterectomy whenever possible. This suggested critical role of the supportive structures for incontinence and especially for urge urinary incontinence, is indicated by observations in patients with uterine descent. Up to 50% of these patients suffer from urge urinary incontinence [10, 11] . Uterine descent is not a disease of the uterus but a disease of the supportive structures, so it is not surprising that neither vaginal nor abdominal hysterectomy can cure urge urinary incontinence in these patients [12] .

In his 'Integral Theory', **Petros** [13] presented an anatomical classification which delineates three zones of vaginal damage (explaining all types of female urinary dysfunction), and a series of ambulatory surgical operations which repair these defects. He pointed out the importance of the posterior compartment for establishing continence function. He classified the urgency ,nocturia and urge incontinence as symptoms of weak posterior compartment(Uterosacral ligaments(USL) and perineal body) . He assumed that the lax USLs are particularly essential for causing urge urinary incontinence . He states that urgency (and DO) at least in the female, may be caused by the inability of the vaginal membrane to support the bladder stretch receptors . It follows from this that unstable bladder symptoms are potentially curable surgically by restoring the tension of the anterior vaginal wall, by repair of the suspensory ligaments of the vagina [14,15].Therefore the association between uterine descent and urge urinary incontinence could be caused by a defective functioning of the USL[13].

In 2004, **Jager and colleagues** also hypothesized that the association between descensus uteri and urge urinary incontinence could be caused by a defective functioning of the USL (based on the integral theory) and they decided to repair the USL in uterine descent patients instead of removing the uterus [16] . Since the USL in postmenopausal patients do not have a ligamentous structure but are more or less a peritoneal fold with only microscopically detectable musculature, a classical repair was not possible. They therefore replaced it with alloplastic tapes. Since all of the patients were past child-bearing age, they performed a supracervical hysterectomy and sutured the tapes on the cervical stump where they could cover them with peritoneum. They found out that their operation, which they called ***'cervical-rectal-sacral fixation' (CERESA),*** could cure the urge urinary incontinence in descensus uteri patients . However, patients with vaginal vault prolapse and urge urinary incontinence also asked for that operation. On these patients they placed the tapes at the vaginal vault instead of the cervix. This ***vaginal-rectal-***

sacral fixation (VARESA) also led to cure in 7 of the first 10 hysterectomized women with urge urinary incontinence[16] . After intensive discussions they finally made an interventional study in 2012[17] in which they offered VARESA or CERESA (by laparotomy) to 133 patients with urge and mixed incontinence who had failed conservative treatment. Based on the symptoms, 64 patients (48%) suffered from mixed urinary incontinence and 69 patients (52%) had urge urinary incontinence. No patient had a uterine or vaginal prolapse grade 4. Two patients had a descensus grade 3 and two patients had grade 2 .The overall cure rate in urge and mixed incontinence patients was 77% (102 of 133 patients). 24 patients (18%) reported a subjective improvement after surgery. In 7 patients (5%) no cure or improvement was achieved. *Thus they assume that the urge urinary incontinence in females, a disease previously considered to be incurable, can be cured surgically[17].*

Magnetic resonance imaging (MRI), is a noninvasive technique that allows excellent soft tissue resolution in the living, can depict the endopelvic fascia, the uterosacral ligaments, and related structures with little distortion [18,19]. Recent researches have been published confirming that static and dynamic MRI plays an invaluable role in the diagnosis of pelvic floor dysfunction[20,21]. Indeed, previous studies used MRI evaluations of women with pelvic floor dysfunction to provide significant information that altered clinical management in 41.6% of patients with urinary incontinence in one study [22], and MRI and cystocolpoproctography findings led to changes in the initial operative plan in 41% of patients with pelvic floor dysfunction in another study [23].

AIM OF WORK

The aim of the study is to try to find a correlation between the uterosacral ligaments and the urgency urinary incontinence in females ,as formerly assumed, using MRI pelvic floor with the aim of detecting gross anatomical differences in the uterosacral ligaments configuration between the control group and the urge incontinence cases group.

We aim at getting precise information that could alter the clinical management , helping clinicians switch from the current empiric approach of treatment for UUI , which is based on patients' symptom complex, to treatment of patients' specific defect that results in their symptoms , thus repairing a female's lax uterosacral ligaments could be a possible treatment for her UUI if what supposed was true.

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ANATOMY OF THE FEMALE LOWER URINARY TRACT AND CONTINENCE CONTROL SYSTEM

– **Introduction**

– Understanding the structure of the lower urinary tract and pelvic floor and how they function is fundamental to understand the physiology and pathophysiology of this region. The following discussion of the anatomy of the **bladder, urethra, and pelvic floor** is intended to cover those aspects of the anatomy that are important in understanding dysfunctions of the continence control system.

THE URINARY BLADDER

– The bladder is a hollow muscular pelvic organ. The empty bladder is tetrahedral and is described as having superior surface with an apex at the urachus, two inferolateral surfaces, and a posteroinferior surface or base with the bladder neck at the lowest point. For the purposes of study, it is usually divided into three anatomic layers;the inner mucosa, the middle detrusor smooth muscle layer and the outer adventitia consisting of fat and connective tissue. Bladder emptying requires synchronous activation of all its smooth muscles.

FEMALE URETHRA

– In the female, the urethra consists of a 4 cm tube of inner epithelium and outer muscular layer.

– The inner epithelium is of transitional cell type at the bladder neck and squamous at the meatus[1].This epithelial layer is generally thrown into folds that form a mucosal seal which is thought to contribute to continence mechanism[2]. The urethral smooth muscle cells are embedded in extracellular matrix, which may account for the major structural component in the female urethra[3].

– The outer muscular layer includes smooth muscles which lie in continuation with the trigonal musculature and striated muscle which is circularly oriented particularly in the middle third[4].The infolded epithelium is enclosed by a rich vascular sponge, surrounded by a coat of smooth muscle and fibroelastic tissue.

– The submucosa, consists of loosely woven connective tissue with smooth muscle bundles and an elaborate vascular plexux , provides a compressive effect

vital to the mechanism of continence[5].Healthy normal smooth muscle and the vascular spongy tissue of the urethra together provide a major contribution to the closure mechanism of the urethra and are therefore of great importance in normal passive urinary continenc[6].

URETHRAL SPHINCTERS

–The female urethra has two sphincters, the internal and the external sphincter. The internal sphincter lies at the bladder neck. The distal one lies below the bladder neck .There is too much controversy about the concept of the **internal sphincter**. Now there is general agreement that there is no classic anatomic sphincter at the bladder neck[7]. There are two distinct smooth muscle layers in the urethra. The circular muscle of the urethra is poorly developed. The longitudinal muscle that lies inside this is well developed and has considerable bulk. It extends to the level of the trigonal ring[4].The **external sphincter** is composed of striated muscle fibres extrinsic to the urethra at the level of the urogenital diaphragm.It provides reflex and voluntary sphincteric activity and contribute primarily to active continence[4].It may help to minimize incontinence in patients with imperfect support. When urine gets past the bladder neck, as it does in some continent women, this acts as a back up mechanism to ensure continence[8].

PELVIC FLOOR ANATOMY : (FIG.1)

– The maintenance of continence and prevention of pelvic organ prolapse rely on the support mechanisms of the pelvic floor. There are three supporting layers comprising the pelvic floor: the pelvic diaphragm, the urogenital diaphragm and the endopelvic fascia[9].

A. The Pelvic diaphragm:

–The pelvic diaphragm is a group of striated muscles together with their superior and inferior fascial layers that closes the pelvic outlet. This diaphragm is composed of the levator ani and coccygeus muscles, with their corresponding muscles from the opposite side[9]. The tendinous arch of levator ani, a linear condensation of fascia between the ischial spine and the lower portion of the symphysis pubis (arising predominantly from the obturator internus muscle), provides the origin for a large portion of the anterior pelvic diaphragm (Fig.1&2)[10&11].