

Role of Medical Imaging in Cases of Stress Urinary Incontinence

Abdel Karim M. ElHemaly¹, Ibrahim Mahrous Kandil¹, Mohammed Salah Elden Hassanen¹,
Amr Mahmoud Zaied Mahmoud², Attia Mohammad Attia Ibrahim^{1*}

1 Obstetrics and Gynecology Department, Faculty of Medicine for Boys, Al-Azhar University

2 Radiology Department, Faculty of Medicine for Boys, Al-Azhar University

* Corresponding Author: Attia Mohammad Attia Ibrahim, E-mail: atiabayoumy122@gmail.com

ABSTRACT

Background: traditional methods for evaluation of women with urinary incontinence include urodynamic studies with measuring the pressure in the abdomen, the bladder, and the urethra and urine flow analysis. In addition, cysto-urethroscopy, cysto-urethrography are used for visualization of the bladder and the urethra.

Aim of the Study: urinary continence depends on a closed and empty urethra with high urethral pressure. High urethral pressure (Pura) depends on two factors; one is structural which is defined as damage and lacerations in the collagen chassis of the internal urethral sphincter (IUS), the second factor is acquired functional factor is having and maintaining high sympathetic tone at the IUS from toilet training.

Patients and Methods: 40 women who from SUI are examined clinically and investigated with sonar scanning 3DUS. 20 cases control by 3DUS. Patients with primary infertility those who had no vaginal deliveries, did not suffer cognitive behavioral therapy. This study is done at Bab El-Sharia Maternity University Hospital during the period from January 2017 to June 2018.

Result: the IUS, as it is a cylinder, the level and extent of the rupture along the cylinder will determine the type and the degree of urinary incontinence as well as the configurational shape seen on imaging (case with primary infertility two years ago).

Conclusion: we conclude that damage of the IUS leads low pura and stress urinary incontinence (SUI). Childbirth trauma causes damage to the collagen layer (the frame) of the vagina that leads to redundancy of the vagina and vaginal prolapse.

Keywords: Stress Urinary Incontinence, cysto-urethroscopy, Three Dimensional Ultrasound

INTRODUCTION

The female pelvis contains three major tracts that lie on and traverse the pelvic floor. These are the urinary bladder (UB) and the urethra anteriorly, the female genital tract in the middle, and the rectum and anal canal posterior. The pelvic floor consists of the pelvic floor muscles, mainly the levator ani muscles, and connective tissues and ligaments. The relative contributions to the structural support of the pelvic floor and its functions have been the subject of controversy⁽¹⁾.

With increasing age, women can develop voiding troubles as urgency, overactive bladder, frequency, nocturia and stress urinary incontinence (SUI). Other concomitant troubles, which occur, are genital prolapse, fecal incontinence (FI) and pelvic pain. All of these symptoms can be associated, to a greater or lesser extent, with pelvic floor defects⁽¹⁾.

Urinary continence depends on a closed and empty urethra with high urethral pressure (Pura) which depends upon two factors: One inherent and one acquired.

The inherent factor is the tough strong collagen layer constituent of the internal urethral sphincter (IUS), that creates the high wall tension necessary for keeping high urethral pressure (Pura). The IUS is a collagen-muscle tissue cylinder that extends from the bladder neck to the perineal membrane in both sexes⁽²⁾.

The acquired factor, which is high alpha-sympathetic tone at the IUS gained from learning and training in early childhood, keeps it contracted and the urethra closes all the time until there is a need or a desire to void as social circumstances allow. Injury to one or both factors leads to urinary incontinence.

Imaging with 3DUS and MRI can demonstrate the rupture in the IUS clearly. The level of the rupture along the cylinder of the

IUS and its extent will determine the type of SUI (DO, genuine SUI or mixed type of incontinence) and the morphological shape of the urethra seen on imaging. If the rupture affects mainly the upper part of the IUS, detrusor overactivity (DO) ensues, and funneling of the bladder neck with loss of urethrovesical angle appears on imaging.

Laceration of the collagen chassis of the IUS leads to its weakness and subsequent stress urinary incontinence (SUI). Redundant lax vaginal walls, due to lacerations in the collagen chassis of the vagina leads to vaginal prolapse. Similarly, lacerations of the collagen chassis of the IAS lead to its weakness and FI⁽³⁾.

AIM OF THE STUDY

Urinary continence depends on a closed and empty urethra with high urethral pressure (Pura). High pura depends on two factors; one is structural which is defined as damage and lacerations in the collagen chassis of the IUS, the second factor is acquired functional factor is having and maintaining high sympathetic tone at the IUS from toilet training. The structural factor can be assessed by medical imaging with three-dimension ultrasound and magnetic resonance imaging. Scanning with 3DUS has the advantages of being easy to do, fast to do, not invasive and not expensive. So, 3DUS is done for our patients with SUI and vaginal prolapse to see if there is any lacerations in the collagen chassis of the IUS and any lacerations will be demonstrated. The level and the extent of the lacerations in the IUS and its correlations with the symptoms will be assessed. So, we will scan any patients with SUI and vaginal prolapse with 3DUS to see if there is any lacerations in the collagen chassis of the IUS, the level and extent of the laceration in the IUS and its correlations with the symptoms.

PATIENTS AND METHODS

40 women who suffer from SUI are examined clinically and investigated with sonar scanning 3DUS. 20 cases control by 3DUS. Patients with primary infertility those who had no vaginal deliveries, did not suffer CBT. This study was done at Bab El-Sharia Maternity University Hospital during the period from January 2017 to June 2018.

Inclusion criteria:

- Patients delivered vaginally.
- Age 30 years or more.

There may be combined by vaginal prolapse.

Exclusion criteria:

- Diabetes mellitus uncontrolled patients to be controlled and included in the study.
- UTI. (treated and included)
- Patients who had elective CS.

Methods:

History:

- Personal history.
- Complaint (continuous dribbling of urine or failure of voluntary control of micturition).
- Present history (duration and onset).
- Menstrual history (regular or irregular menstruation, period and amount of menstrual blood and history of pain related to menstruation).
- Obstetric history: (**Pregnancy, abortion, delivery (labour), puerperium, contraception**).
- Past history (previous operations, history of heart, hepatic, pulmonary or renal troubles and management, history of allergy to drugs and history of hormone therapy).
- Family history (diabetes mellitus, hypertension, malignancy or any chronic diseases of family).

Scanning using a vaginal probe multifrequent 5 to 7.5 MHz Kretz-Medison 3D US machine and General Electric, integrated 3D-4D Unit (GE Volosone) machine, are used to scan 150 patients with SUI and vaginal prolapse. 40 normal women, who do not suffer from SUI or vaginal prolapse, were also scanned.

Also MRI imaging was used to assess normal women and women with SUI and vaginal prolapse. 3D US imaging is faster, simpler and cheaper than MRI. We performed MRI scanning to confirm our concept and they were comparable to 3D US scanning.

Ethical Considerations: The study was approved by the Ethics Board of Al-Azhar University.

Statistical analysis

Data was analyzed using SPSS 16. Mean + standard deviation was computed for age, weight and height. Chi square test was applied to compare cardiovascular side effects. Repeated measures analysis of variance (ANOVA) was used to compare effects like heart rate, systolic and diastolic blood pressures of the two groups. P-value of 0.05 or less was considered statistically significant.

RESULTS



Figure (1): Ultrasound imaging by 3DUS, coronal section of a normal intact IUS in a normal continent women; kindly notice two echoes, muscle overlying collagen, and the muscles connected above with the detrusor muscle.



Figure (2): Patient who suffers from severe SUI scanned with 3DUS. The IUS is torn, seen clearly in the cross section, and the urethra is open and flask-shape, and coronal section showed a horseshoe appearance.



Figure (3): A case with severe SUI, where you can see lacerations that affect the IUS

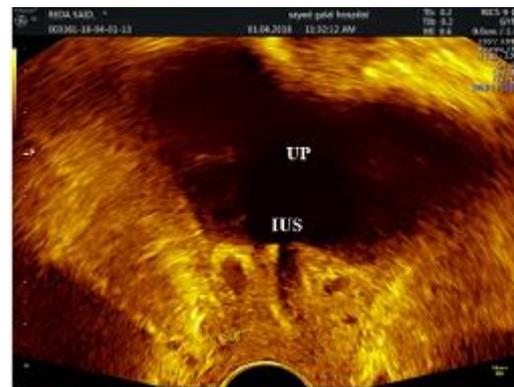


Figure (4): Lacerations of the IUS affecting the whole length with irregular walls and an open dilated urethra (severe SUI) and coronal section shows a horseshoe appearance.

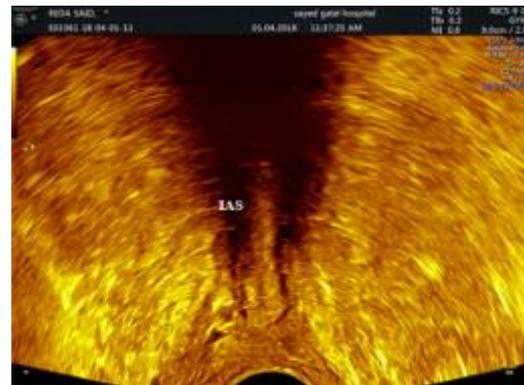
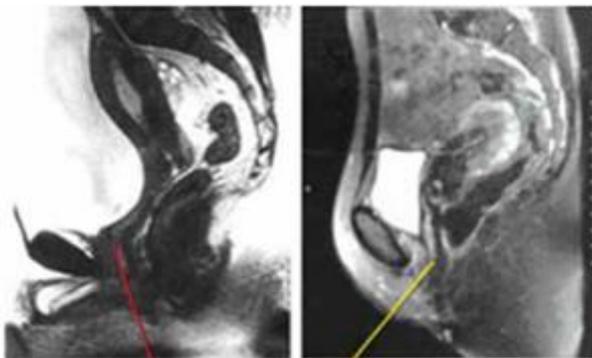


Figure (5): Lacerations of the internal anal sphincter (IAS) with severe fecal incontinence.



Figure (6): Images of torn IUS; the lacerations affect more the collagen layer leading to shortening of the urethra with irregular walls as seen.



A tough and strong vagina is an essential support for the intimately overlying internal urethral sphincter and the lower part of the post wall of the UB
A torn, weak anterior vaginal wall will fall down, prolapse with its overlying torn internal urethral sphincter as seen

Figure (7): Comparison between normal continent woman as seen on the left to a patient with SUI and vaginal prolapse on the right in MRI images, sagittal sections.

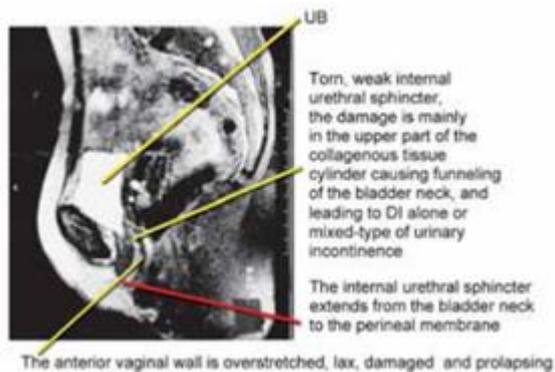


Figure (8): An image by MRI, sagittal section that clearly shows the IUS as a cylinder that extends from the bladder neck to the perineal membrane. The IUS is torn mainly in its upper part leading to funneling of the bladder neck. Note that the anterior vaginal wall is torn and prolapsing.

DISCUSSION

SUI is a common pelvic dysfunction disease, the morbidity of which increases as the age increases, and it has become the severe health problem that affects the health and life of patients. Due to the privacy of patients, the diagnostic rate has always been low. According to the conservative estimation, the morbidity of SUI in reproductive age women is around 17.3%-48.4%. And in elder women, the morbidity can reach to 80%, the condition can also be worse and significantly affect the life quality of patients if the disease is not diagnosed and treated timely. Thus, the early stage diagnosis is the key to guide the therapeutic regimen and improve the life quality of patients ⁽⁴⁾. As the most common diagnostic method for SUI, urodynamic examination can directly show the functional indexes of bladder and urethra, which can exclude any other potential lower urinary tract symptom and provide an effective reference for the diagnosis and treatment of SUI ⁽⁵⁾.

However, this method is invasive, the operation is comparatively complicated, and the morphological change of bladder and urethra are not clear. Thus, looking for a non-invasive and simple objective index has always been the hotspot in clinical ⁽⁶⁾.

The IUS is described by the new concept, and as seen by imaging, is a cylinder that extends from the bladder neck to the perineal membrane and is not a muscular ring at the bladder neck. It is composed mainly of collagen sheet (the frame, chassis), a very strong tissue that gives the IUS the high wall tension necessary for creating high Urethral Pressure Profile (UPP). There are muscle fibers that intermingle with the collagen in the middle of the cylinder's thickness innervated by alpha-sympathetic nerves (T10-L2) which are responsible for opening and closing the urethral lumen. The muscle fibers are connected above with the detrusor muscle. The IUS is intimately lying on the anterior vaginal wall, so that lacerations affecting the vagina from over distention in childbirth will lacerate the posterior wall of the IUS, mainly its collagen sheet (frame). The level and the extent of the laceration along the cylinder of the IUS will determine the type and severity of SUI, and the configurationally shape seen on imaging the IUS with three-Dimension Ultrasound (3DUS) and

Magnetic Resonance Imaging (MRI). If the damage is mainly in the upper part of the IUS then Detrusor Overactivity (DO) (overactive bladder) will ensue and funneling of the bladder neck with loss of the posterior urethrovesical angle appears on imaging. When the damage affects mainly the lower part of the IUS, this will lead to genuine type of SUI, and a "flask-shape" appearance of the urethra on imaging. However, if the damage affects the whole length of the IUS, this will lead to mixed type of SUI (the commonest type of SUI), and a collapsed apparently short urethra with irregular torn walls (7).

CONCLUSION

We conclude that damage of the internal urethral sphincter (IUS) leads low pura and stress urinary incontinence (SUI). Childbirth trauma causes damage to the collagen layer (the frame) of the vagina that leads to redundancy of the vagina and vaginal prolapse.

REFERENCES

1. **Liedl B, Markovsky O, Wagenlehner F, Gunnemann A (2012):** The Role of Altered Connective Tissue in the Causation of Pelvic Floor Symptoms, Urinary Incontinence, Mr. Ammar Alhasso (Ed.). Available from: <http://www.intechopen.com/books/urinary-incontinence/connective-tissue-looseness-and-development-of-pelvic-floor-dysfunction-and-symptoms>.
2. **Liedl B, Goeschen K, Durner L (2017):** Current treatment of pelvic organ prolapse correlated with chronic pelvic pain, bladder and bowel dysfunction. *Curr Opin Urol.*, 27(3):274-81.
3. **El Hemaly AM, Mousa LA, Kurjak A et al. (2013):** Pelvic Floor Dysfunction: the Role of Imaging and Reconstructive Surgery. *Donald School J Ultrasound Obstet Gynecol.*, 7(1): 86-97.
4. **Chen Y, Wen JG, Shen H et al. (2014):** Valsalva leak point pressure-associated Q-tip angle and simple female stress urinary incontinence symptoms. *Int Urol Nephrol.*, 46: 2103-2108.
5. **Valdevenito JP, Águila F, Naser M et al. (2015):** Urodynamic study in women with pure stress urinary incontinence. *Actas Urol Esp.*, 39: 98-103.
6. **Tantanasis T, Daniilidis A, Pantelis A et al. (2013):** Minimally invasive techniques for female stress urinary incontinence, how, why, when. *Arch Gynecol Obstet.*, 288: 995-1001.
7. **El Hemaly AK, Mousa LA and Kandil IM (2012):** The concept and pathophysiology of urinary incontinence. In: Alhasso A and Fernando A (eds). *Urinary incontinence*. [www.Intechopen.com](http://www.intechopen.com).