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ORIGINAL ARTICLE

Role of Magnetic Resonance Imaging in Diagnosis of Stress Incontinence and Pelvic Floor Dysfunction in Female Patient

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Abstract

Background: ***Stress urinary incontinence (SUI) is characterized by a quick, uncontrollable loss of urine as a consequence of a rise in intra-abdominal pressure that exceeds the maximum urethral closure pressure and a rise in intra-vesical pressure.***

Aim: ***To assess the diagnostic efficacy of MRI in women patients with stress incontinence and pelvic floor dysfunction.***

Patients and Methods: ***This retrospective, case-control study was performed on twenty-five female cases suffering from stress urinary incontinence that had been clinically diagnosed. Five normal females were included as control cases; they were not complaining of any urinary symptoms. MRI examinations were conducted at Sayed Galal Hospital from March 2023 to March 2024.***

Results: ***There was no statistically significant variance among the continent volunteers incontinent cases regarding body mass index (BMI). At the same time, there was a significant variance among patient and control groups regarding Urethral Length, Length of supra pubic urethra and Levator hiatus width. 44.4% of the studied cases had Urethral motility, and 55.6% had Intrinsic sphincter Defects. 38.88% had continence, and 61.11% had no continence, as regard to cystocele there were 38.88% had no cystocele, 33.33% had grade I, 16.66% had grade II while 11.11% had grade III.***

Conclusion: ***When combined with dynamic and static sequences, MRI can identify the entire pelvic floor, making it a dependable alternative for noninvasive pelvic evaluation.***

Keywords: Magnetic Resonance Imaging; Stress urinary incontinence (SUI); Pelvic Floor Dysfunction.

1. Introduction

Stress urinary incontinence (SUI) is characterized by a rapid and involuntary loss of urine due to an increase in intra-abdominal pressure that exceeds the maximum urethral closure pressure and an increase in intra-vesical pressure. Furthermore, this deprivation is frequently correlated with difficult physical activities, including exercising, coughing, or sneezing, all of which induce discomfort or directly impact one's quality of life. SUI has a multifactorial etiology and is frequently linked to dysfunctions of the pelvic floor muscles (PFM) in the bladder and ligamentous structures, among other contributing factors. [1]

Pelvic floor muscles (PFM) comprise fascias, ligament components, and muscles that provide support for the bladder, rectum, and reproductive organs. Therefore, structures that include the urethra during urination, vagina during childbirth, &b rectum throughout defecation can open & close in response to the proper functioning of these components. Myofascial disorders cause PFM failure; consequently, this results in muscle weakness and urinary incontinence. [2]

By utilizing its multiplanar acquisition and excelling soft tissue contrast, MRI enables the visualization of periurethral and female urethral tissues associated with SUI. The results of an MRI concerning SUI in women caused by UH & ISD have been detailed. Prior research utilizing Magnetic resonance imaging to evaluate urethral support mechanism lesions, levator ani muscle defects, paravaginal fascia, and the kinematics of pelvic floor muscle function in female cases patients with SUI were limited to these areas. [3]

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It has been demonstrated that dynamic sequence MRI is precise and dependable for detecting the weakening of the pelvic floor, particularly when multiple compartments are involved, due to the simultaneous visualization of all three compartments. [4]

Furthermore, magnetic resonance imaging can detect unanticipated underlying masked functional anomalies. These abnormalities may differ from the predominant symptom. They can potentially impact the surgical approach selection in about forty-two per cent of cases associated with various spectra of pelvic floor disorders. [5]

The objective of this study was to assess the utility of MRI in the diagnosis of pelvic floor dysfunction and stress incontinence in female patients.

2. Patients and methods

This retrospective, case-control research was performed on twenty-five female cases suffering from stress urinary incontinence that have been diagnosed clinically. The Patient's age ranges between 20 and 60 years. Five normal females have been included as control cases; they are not complaining of any urinary symptoms; their age range is 19-38 years; they performed an MRI to serve as a control group to standardize the normal values. MRI examination was conducted at Sayed Galal Hospital from Mars 2023 to Mars 2024.

The cases were separated into two groups: Group I (Patient) involved 18 patients, and Group II (control) involved 12 subjects.

Inclusion Criteria: Women with signs and symptoms of stress incontinence and pelvic floor dysfunction.

Exclusion Criteria: Absolute and/ or relative contraindications to MRI, which include Pacemakers, Aneurysm clips, Intra-ocular foreign bodies, Cochlear implants, and the Possibility of early pregnancy. The Patient should remove all jewellery, credit cards, coins, watches, etc., and be very obese (depending on the system). The Patient should not be claustrophobic, agitated, or have a history of claustrophobia.

Each Patient involved in the research was exposed to history and clinical examination, including personal history and symptoms.

MRI examination

Imaging technique: Utilizing a pelvic phased-array coil, an MRI was conducted with the cases supine in a 1.5-T MRI device (Achieva Philips). Initially, three-plane static images of the pelvis were obtained utilizing T2-weighted turbo spin-echo sequences (5000/132 repetition time in milliseconds and echo time in milliseconds; field of view). Furthermore, balanced fast field echo images that were T2-weighted (9.0/4.0; field of view: two hundred twenty millimetres; thickness of section: two millimetres; the number of acquired signals: eight; flip angle: forty-five degrees; matrix size: 512 x 512; acquisition time: 2.12 minutes) were acquired. During exertion, dynamic magnetic resonance imaging was conducted in the axial, sagittal, and coronal planes utilizing an echo sequence with a balanced fast-field (5.0/1.6; 300 mm field of view; six to seven millimetres section thickness; a 0.7- millimetre gap in each plane).

Statistical analysis: The computation was performed utilizing IBM SPSS software program version 20.0 on the inputted data. (IBM Corp., Armonk, New York). Qualitative data were described in terms of percentages and numbers. The Kolmogorov-Smirnov test was employed to assess the distribution's normality. The range (minimum and maximum values), mean, standard deviation, median, and interquartile range (IQR) were employed to characterize the quantitative data. At the 5% significance level, the derived results were deemed significant. The statistical tests employed included the Wilcoxon signed ranks test, the Student t-test, the Paired t-test, Fisher's Exact or Monte Carlo correction, and the Mann-Whitney test.

3. Results

Table 1. Demographic data of studied groups

	GROUP I (PATIENT) (N = 18)		GROUP II (CONTROL) (N = 12)		P
	No.	%	No.	%	
AGE (YEARS)					
MIN. – MAX.	20.0 – 60.0		20.0 – 50.0		0.011*
MEAN ± SD.	48.35 ± 3.99		38.10 ± 4.91		
BMI (KG/M2)					
MIN. – MAX.	21.0 – 35.0		20.0 – 31.0		0.319
MEAN ± SD.	26.0 ± 2.56		24.0 ± 228		

FE: Fisher Exact.

The data in this table indicated that incontinent female displayed a higher average age (SD) of 48.35 ± 3.99 y vs 38.10 ± 4.91 y for controls (P < 0.001, t- test). The mean BMI of the incontinent group 26.0 ± 2.56 while it was 24.0 ± 2.28 for the control group. No statistically significant distinction was observed in body habitus (as measured by the BMI among the continent volunteers & the incontinent cases.

Table 2. Urethral findings of studied groups

	GROUP I (PATIENT) (N = 18)	GROUP II (CONTROL) (N = 12)	P
LENGTH OF SUPRA PUPIC URETHRA (CM)			
MIN. – MAX.	1.5 – 2.9	2.25 – 4.0	0.005*
MEAN ± SD.	1.92 ± 0.05	3.12 ± 0.24	
URETHRAL LENGTH			
MIN. – MAX.	2.3 – 3.9	3.24 – 4.57	0.004*
MEAN ± SD.	2.72 ± 0.92	3.50 ± 0.71	

URETHRAL HYPER MOTILITY (UH)			
YES	10(55.6%)	9.0 – 28.0	0.242
NO	8(44.4%)	16.45 ± 5.15	

IQR: Inter quartile range; SD: Standard deviation

U: Mann Whitney test; t: Student t-test

p: p value for comparing between the studied groups

This table showed that there was a significant variance in among patient & control groups regarding to Urethral length and Length of supra pupic urethra with P= 0.004; 0.005 respectively

Table 3. Distribution of the studied cases according to Urethral hyper motility and Intrinsic sphincter Defect (ISD)

	NO.	%
URETHRAL HYPER MOTILITY (UH)		
NO	10	(55.6%)
YES	8	(44.4%)
INTRINSIC SPHINCTER DEFECT (ISD) YES	10	(55.6%)
NO	8	(44.4%)

This table showed that there was 44.4% of the studied cases had Urethral hyper motility and 55.6% had Intrinsic sphincter Defect.

Table 4. Distribution of the studied cases according to cystocele and continence

	NO.	%
CYSTOCELE		
ABSENT	7	38.88%
GRADE I	6	33.33%
GREADE II	3	16.66%
GRADE III	2	11.11%
CONTINENCE YES	7	38.88%
NO	11	61.11%

This table showed that 38.88% had continence and 61.11% had no continence, as regard to cystocele there were 38.88% had no cystocele, 33.33% had grade I, 16.66% had grade II while 11.11% had grade III.

Table 5. Funneling of U.B neck in the studied groups

	GROUP I (PATIENT) (N = 18)	
	No.	%
ABSENT	4	22.22
PRESENT	14	77.77

$\chi 2$: Chi square test

p: p value for comparing between the studied groups

This table showed that there were 22.22% of the studied cases had no Funneling of U.B neck and 77.77% had Funneling of U.B neck.

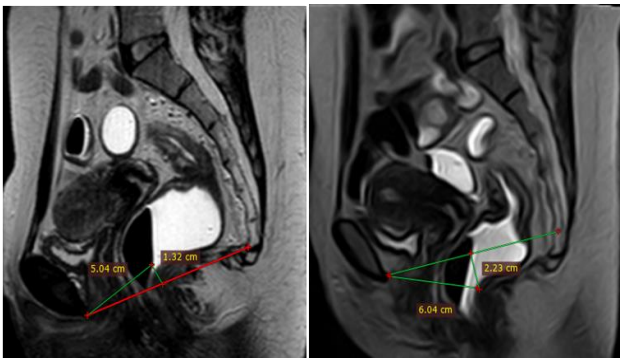
Table 6. Levator hiatus width (cm) of studied groups

LEVATOR HIATUS WIDTH (CM)	GROUP I (PATIENT) (N = 18)	GROUP II (CONTROL) (N = 12)	P
MIN. – MAX.	4.6 – 7.5	4.4 – 5.1	0.033
MEAN ± SD.	6.02±2.3	4.81 ± 1.31	

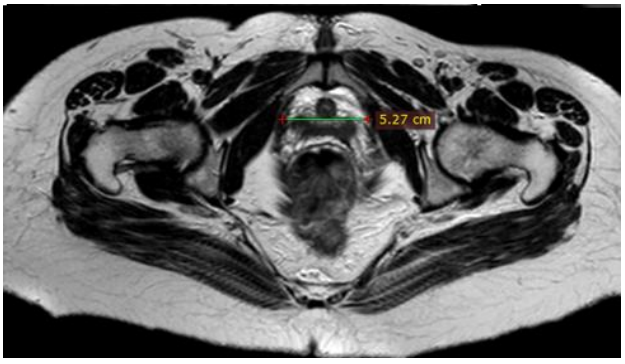
This table demonstrate that there was a statistically significant variance in among the 2 groups regarding to Levator hiatus width with P= 0.033.

Case Presentation

Case: 51 years old woman with stress incontinence grade III She had a history of seven pregnancies and pelvic floor laxity on physical examination.



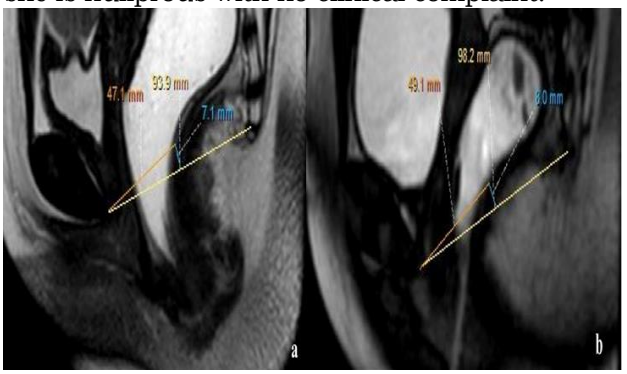
A



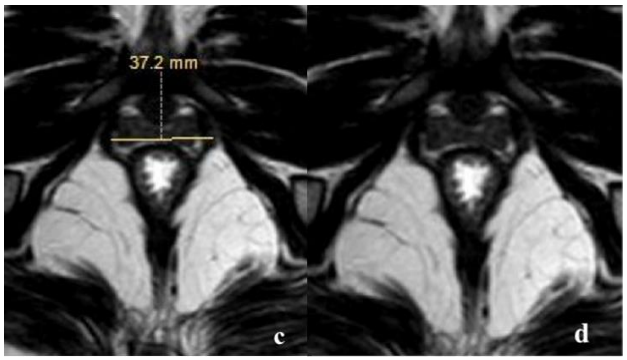
B

Figure (1): showed A): MRI Sagittal T2-weighted images of the patient at rest (a) & during pelvic strain (b). On the strain image, the H & M lines are elongated (H line=6.04 cm versus 5.04 cm at rest; M line=2.23 cm versus 1.32 cm at rest). The H line measurements indicate pelvic floor laxity at straining. B): (c) axial T2-weighted image, the vagina demonstrations distorted shape. The levator hiatus width is increased (5.27 cm).

Control case: 19 years old volunteer woman, she is nuliprous with no clinical complaint.



A



B

Figure (2): showed A): MRI Sagittal T2-weighted images of a control case at rest (a) & throughout pelvic strain (b) show no bladder neck descent below the pubococcygeal line. On the strain image, the H & M lines are within normal range (H line=4.91 cm versus 4.71 cm at rest; M line=0.8 cm versus 0.71 cm at rest). The levator plate shows normal transverse orientation indicating good posterior muscular support. B): (c, d) On axial T2-weighted images, the vagina shows normal butterfly configuration. The puborectalis sling is intact, showing uniform thickness and homogenous low signal. The levator hiatus width is preserved (3.72 cm).

4. Discussion

For optimal patient management, a comprehensive examination of the whole pelvic floor is crucial, particularly before attempting surgical correction. Radiologists must, however, possess knowledge of normal imaging findings and features associated with pathological states. Magnetic resonance imaging is frequently employed for assessing functional disorders and recurrent prolapse in addition to potential complications of the surgery and afterwards. [6]

In the current research, the mean age of the incontinent group was 48.35 ± 3.99, while it was 38.10 ± 4.91 for the control group. That was near the results in the research done by Refaat et al.[7] who discovered that the mean age in the inpatient group was thirty-nine (±SD = 14 years), and ten females served as controls with a mean age of thirty-six (±SD = three years).

In the current research, the mean BMI of the incontinent group was 26.0 ± 2.56, while it was 24.0 ± 228 for the control group with non-statistically significant variance in among. This agrees with Macura et al.[8] who discovered that the mean BMI of the incontinent group was 29.95 (6.6), while it was 29.98 (7.0) for the control group with non-statistically significant variance in among.

The Length of Lengthprapubic urethra was 3.12 ± 0.24 in the control group and 1.92 ± 0.05 in the incontinent group, with a significant difference between them.

Consistent with the outcomes reported by Morgan et al.[10] Tasali et al.[3], and Kim et al.[9] Pontbriand-Drolet et al.[11] our findings indicate a statistically significant distinction in urethral Length among the group of females who have diarrhoea, the control group. Age-related reductions in the relative volumes of urethral striated muscle and blood vessels have been demonstrated experimentally.[12]

Clinically, urethral mobility is evaluated using the Q test. In the absence of visual inspection for urethral attachment defects, the clinical Q test may lack reliability, given that hypermobility of the urethra may also be observed in continent females. [8]

Regarding urethral hypermotility, 44.4% of the studied cases had Urethral hypermotility.

As regards intrinsic sphincter defect (ISD), 55.6% had an intrinsic sphincter defect, which is in line with the results by Refaat et al.[7] who found that 43.63% of their studied cases had an intrinsic sphincter defect.

Regarding cystocele, 38.88% had no cystocele, and 61.12% had cystocele, divided into 33.33% having grade I, 16.66% having grade II, and 11.11% having grade III. That was the same as Refaat et al.[7] who found that 65.5% had cystocele.

In their study group, Keriakos et al.[13] discovered that Genital prolapse affected fifty per cent of cases, bladder base descent affected sixty-five per cent, and anterior rectocele affected seventy per cent of cases with pelvic floor disorders.

Azab et al.[14] examined females who presented with prolapse of pelvic organs, urinary incontinence, or faecal incontinence.

Cystocele was discovered in 82.5 per cent of the female, rectocele was discovered in 72.5 per cent of the female, &vaginal prolapse was discovered in four per cent of the female, which is ten per cent of the total participants.

Regarding continence, 38.88% had continence, and 61.11% had no continence, while in the study done by Refaat et al.[7], there was only 9.1% had 9.1 had continence, and that difference could be due to difference in sample size.

According to the urinary bladder neck, 22.22% of the studied cases had no Funneling of the U.B neck, and 77.77% had Funneling of the U.B neck. A mean descent of 5.15 centimetres was observed at the anorectal junction in the majority of females presenting symptoms of obstructed defecation; seventy per cent of the patients indicated the presence of an anterior rectocele.

Li et al.[15] It was reported that throughout Valsalva's manoeuvre, the bladder neck was below the pubococcygeal line in 16 patients with SUI, whereas it was above the line in all patients

at rest. The range of bladder neck mobility was thirty-two millimetres to three millimetres (mean ± standard deviation: 17.83 ± 8.3 millimetres).

In the present study, the mean levator hiatus width measured at maximum straining among incontinent patients was 6.02±2.3cm compared to 4.81 ± 1.31cm in the normal volunteers. These results disagree with El Sayed[16] where the mean width of the levator hiatus at maximum straining in 10 patients with SUI was 4.4 +/-0.8 cm, while the normal range was 4.5 +/- 0.7cm.

4. Conclusion

Magnetic resonance imaging can identify the whole pelvic floor when combined with dynamic and static sequences, making it an effective noninvasive pelvic assessment alternate. A prompt diagnosis enables optimum patient care to commence prior to surgical intervention. Dynamic magnetic resonance imaging evaluation indicates that physiotherapy may be advantageous for moderate to modest muscle weakness. Magnetic resonance imaging is typically investigated as part of the diagnostic evaluation for incontinence in women with severe and complex pelvic organ prolapse or those whose prior surgeries failed.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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