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The Relation between Transperineal Ultrasound Assessment of the Levator Ani Muscle and Postpartum Urinary Incontinence

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Abstract:

Background: Urinary incontinence affects around one in two females at least once in their lifetime. **Aim**: The main goal was to assess the correlation among urinary incontinence risk and the function and integrity of the levator ani muscle. Additionally, the second goal was to evaluate the association among the kristeller maneuver and the probability of postpartum urinary incontinence. Patients and methods: This was an observational analytical cohort investigation performed on 92 patients at Obstetrics and gynecology department at Al-Zahraa University hospital, from December 2021 till the end of the investigation. **Results**: There was statistically significant increase in the LAM avulsion and any LAM damage (ballooning or avulsion) with Kristeller maneuver in comparison to those without Kristeller maneuver $p<0.05$. There statistically insignificant variance was observed in the Stress incontinence, Urge incontinence and any incontinence with Kristeller maneuver in comparison to those without Kristeller maneuver (P value =0.613). Also, there was insignificant relation among Urge incontinence and Any lAM damage $P>0.05$, but there was significant correlation among Kristeller maneuver and Neonatal head circumference $P>0.05$ as well as, there was significant correlation among Stress incontinence and LAM avulsion p= 0.025. **Conclusion**: There is a correlation between levator ani avulsion and a smaller decrease in the levator hiatal area (LHA) from rest to maximum contraction, and a greater probability to have urine stress incontinence after delivery. There is insignificant correlation among the Kristeller technique and the occurrence of any urinary incontinence.

Keywords: **3D/4D transperineal ultrasound, levator ani muscle avulsion, urinary incontinence.**

1. Introduction

Approximately 50% of women will suffer from urine incontinence at some point in their lives **(1)**. The urine incontinence significantly influences the overall well-being of women, since it has wide-ranging effects on their social, physical, psychological, and economic consequences of life. Typically, three primary categories of urine incontinence are identified: stress urinary incontinence (SUI), urgency urinary incontinence (UUI), and mixed urine incontinence. Pregnancy and parturition are significant contributors to the occurrence of urinary incontinence **(2)**. One potential explanation for the influence of parity on the progress of parturition urine incontinence Can be observed in pelvic floor injuries that arise as a result of delivery.

The utilization of transperineal ultrasonography (TPU), whether in two-dimensional or three-dimensional/ four-dimensional form, has enhanced our understanding of the pathophysiology of pelvic floor dysfunction and the characteristics of pelvic floor damage resulting from childbirth **(3)**. The extensive utilization of imaging is recommended as it has the capability to alter the treatment of pelvic floor morbidity. **(4)** The use of 3D/4D TPU technology has allowed for accurate and consistent diagnosis of levator ani muscle (LAM) damage.**(5)**

Several investigations have identified associations among levator ani muscle injuries and pelvic floor dysfunction **(6)**. Evidence has shown that applying fundal pressure during the 2nd stage of labor, frequently referred to as the Kristeller maneuver, is related to a greater probability of levator ani muscle avulsion.3 The correlation among levator ani muscle lesions and functions and levator ani muscle is unclear with contrasting data**(7) .**

The objective of this investigation was to evaluate the correlation among the integrity and function of the levator ani muscle and the probability of having urine incontinence. The secondary aim is to evaluate the correlation among the kristeller maneuver and the probability of postpartum urine incontinence.

Patients and methods

This was an observational analytical cohort investigation carried out at Obstetrics and gynecology department at Al-Zahraa University hospital, from December 2021 till the end of the investigation.

Sample size and method of selection

The study included a total of ninety-two cases, with forty-six females in the case group who delivered using uterine fundal pressure (also known as the Kristeller maneuver) throughout the 2nd stage of labor. The remaining forty-six females in the control group delivered vaginally without any fundal pressure applied.

Inclusion criteria: Females who are undergoing their 1st vaginal delivery.

Exclusion criteria: Females who delivered instrumental delivery, women with mutiple pregnancies, abnormal presentation, Shoulder dystocia and Prior pelvic floor dysfunctions.

Ethical consideration

The investigation protocol received approval from the Research Ethics Committee of the Faculty of Medicine at AL-Azhar University. Prior to the investigation, each participant was provided with a detailed explanation of the purpose and process, and their agreement was gained based on their

comprehension of the information provided. The investigation respected confidentiality and personal privacy at all levels.

Method

Group 1: will consist of forty-six females who deliver with uterine fundal pressure throughout the 2nd stage of labor (also known as the Kristeller maneuver). **Group 2** will consist of forty-six females who deliver vaginally without any fundal pressure applied.

All cases have been submitted to careful history taking and investigation including:

Personal history as maternal age, history of the present pregnancy and any present illness, Past history, obstetric history, general examination ,family history, and obstetric examination: Recording labor durations includes the active phase of the second stage, oxytocin administration, epidural analgesia administration, episiotomy, uterine fundal pressure throughout labor (kristeller maneauver), induction of labor, birth weight, and neonatal head circumference, as well as uterine fundal pressure during labor. **Three to six months following delivery:** females who reported having urine incontinence, regardless of how often it occurred. The patients received a full clinical and 4D TPU assessment, which included a thorough physical examination of the pelvic support compartments to exclude causes such as fistulas, diverticula, and vaginal discharge. The assessment of pelvic organ prolapse was conducted to avoid the concealing of symptoms related to urine incontinence.

TPU examination

Every woman who was recruited was invited to undergo a trans perineal ultrasound scan within three to six months following giving birth. Each case underwent the acquisition of two dynamic 4D volumes: one while performing maximum pelvic floor muscular contraction (PFMC) & the other during maximal Valsalva maneuver. The females have been educated on correct pelvic floor muscle contractions & Valsalva maneuvers. A Voluson E8 and sonoscape ultrasound machine was used, and 4D TPU has been carried out at rest, maximum pelvic floor muscular contraction, and maximum Valsalva. The levator hiatal area (LHA) has been evaluated using the Omni View technique and contrast enhancement technique. levator ani muscle integrity has been evaluated utilizing tomographic ultrasound imaging during maximal contraction.

The following were checked

The following terms are used in the setting of pelvic floor anatomy: levator ani muscle ballooning, LAM avulsion, LHA at rest, subpubic arch angle, levator hiatal area at pelvic floor muscular contraction (measured in cm2), & levator hiatal area at Valsalva (measured in cm2). The change in the levator hiatal area from its resting state to the maximum pelvic floor muscle contraction and from its resting state to the maximum Valsalva maneuver was determined utilizing the following formulas: The proportional change under the maximum pelvic floor muscle contraction can be calculated utilizing the formula [(LHARest − LHAPFMC)/LHARest] × 100. The proportional change under maximum Valsalva can be calculated using the formula: [(LHAValsalva − LHARest)/LHAValsalva] × 100.

The 3 Incontinence Questionnaire (3IQ) includes

The questionnaire asked whether the individual had leaked urine in the past three months, including during physical activity, when experiencing an urge to empty the bladder, without physical activity or a sense of urgency, and how often they lacked urine. The responses were yes or no, and the most common leakage was when the individual was unable to get to the toilet quickly enough. The frequency of the response was approximately the same for both physical activity and a sense of urgency.

RESULTS

Table (1): general characteristics of the studied cases

		No. = 92
Maternal age	Mean ± standard deviation Range	23.03 ± 3.39 17 – 31
Weight (kg)	Mean ± standard deviation Range	66.09 ± 5.53 52 – 75
Height (m)	Mean ± standard deviation Range	160.98 ± 3.51 150 – 169
BMI (kg/m^2)	Mean ± standard deviation Range	25.48 ± 1.93 19.8 – 28.9

SD: Standard deviation

The mean women age was 23.03 ± 3.39 years (range 17-31years), the mean Weight (kg) of the studied group was 66.09 ± 5.53 (range 52 – 75), the mean Height (m) was 160.98 ± 3.51 (rang e 150 – 169). The mean BMI (kg/m2) was 25.48 ± 1.93 (range19.8 – 28.9). (Table 1)

Table (2): Comparison among the two studied groups according to the LAM data

		Kristeller maneuver				**Test value***	**P-value**	**Sig.**
		Positive		**Negative**				
		No.	**%**	**No.**	**%**			
LAM avulsion	Negative	32	69.6%	40	87.0%	4.089	0.043	S
	Positive	14	30.4%	6	13.0%			
LAM ballooning	Negative	37	80.4%	40	87.0%	0.717	0.397	NS
	Positive	9	19.6%	6	13.0%			
Any LAM damage (ballooning or avulsion)	Negative	26	56.5%	36	78.3%	4.946	0.026	S
	Positive	20	43.5%	10	21.7%			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value < 0.01: highly significant (HS) *Chi-square test

There was statistically significant increase in the LAM avulsion and any LAM damage (ballooning or avulsion) with Kristeller maneuver in comparison to those without Kristeller maneuver p-value less than 0.05, but there was statistically insignificant variance in the levator ani muscle ballooning

with Kristeller maneuver in comparison to those without Kristeller maneuver (P value =0.397). (Table 2)

Table (2): Comparison among the two examined groups according to Stress incontinence; urge incontinence and any incontinence

		Kristeller maneuver				Test value*	P-value	Sig.
		Positive		Negative				
		No.	%	No.	%			
Stress incontinence	Negative	35	76.1%	37	80.4%	0.256	0.613	NS
	Positive	11	23.9%	9	19.6%			
Urge incontinence	Negative	42	91.3%	43	93.5%	0.155	0.694	NS
	Positive	4	8.7%	3	6.5%			
Any incontinence	Negative	32	69.6%	34	73.9%	0.214	0.643	NS
	Positive	14	30.4%	12	26.1%			

There was statistically insignificant variation in the Stress incontinence, Urge incontinence and any incontinence with Kristeller maneuver in comparison to those without Kristeller maneuver (P value =0.613). (Table 3)

Table (3): Relation of kristeller maneuver with LHA data and neonatal head circumfere

		Kristeller maneuver		Test value•	P-value	Sig.
		Positive	Negative			
		No. = 46	No. = 46			
LHA at rest (cm^2)	Mean ± SD	15.16 ± 1.39	14.65 ± 1.28	-1.840	0.069	NS
	Range	13 – 17	13 – 18			
LHA at pelvic floor muscle contraction (cm2)	Mean ± SD	11.80 ± 1.54	11.31 ± 1.40	-1.601	0.113	NS
	Range	9 – 15	9 – 15			
LHA at valsalva (cm2)	Mean ± SD	20.75 ± 1.83	20.08 ± 1.56	-1.881	0.063	NS
	Range	18 – 25	17.4 – 24			
Proportional change of levator hiatal area at pelvic floor muscle contraction (%)	Mean ± SD	22.40 ± 4.72	22.76 ± 4.65	0.367	0.714	NS
	Range	11.7 – 30.6	13.3 – 30.7			
Proportional change of LHA under valsalva (%)	Mean ± SD	26.84 ± 3.19	27.08 ± 2.80	0.389	0.698	NS
	Range	22.7 – 33.3	22.2 – 32.5			
Neonatal head circumference	Mean ± SD	34.63 ± 1.12	34.15 ± 1.01	-2.148	0.034	S
	Range	33 – 36	33 – 36			

There was significant relation among Kristeller maneuver and Neonatal head circumference P-value more than 0.05. (Table 4)

Table (4): Relation of Stress incontinence with LAM data

		Stress incontinence				Test value*	P-value	Sig.
		Negative		Positive				
		No.	%	No.	%			
LAM avulsion	Negative	60	83.3%	12	60.0%	5.009	0.025	S
	Positive	12	16.7%	8	40.0%			
LAM ballooning	Negative	61	84.7%	16	80.0%	0.256	0.613	NS
	Positive	11	15.3%	4	20.0%			
Any (AM damage (ballooning or avulsion)	Negative	52	72.2%	10	50.0%	3.517	0.061	NS
	Positive	20	27.8%	10	50.0%			

There was significant relation among Stress incontinence and LAM avulsion p= 0.025. (Table 5)

Table (6): Relation of Urge incontinence with LAM data

		Urge incontinence				Test value*	P-value	Sig.
		Negative		Positive				
		No.	%	No.	%			
LAM avulsion	Negative	67	78.8%	5	71.4%	0.208	0.648	NS
	Positive	18	21.2%	2	28.6%			
LAM balloning	Negative	72	84.7%	5	71.4%	0.835	0.361	NS
	Positive	13	15.3%	2	28.6%			
Any lAM damage (ballooning or avulsion)	Negative	58	68.2%	4	57.1%	0.362	0.547	NS
	Positive	27	31.8%	3	42.9%			

There was insignificant relation among Urge incontinence and Any lAM damage P>0.05. (Table 6)

Discussion

The main results of this investigation were as follows:

Overall, among 92 women included in this study. As regard demographic data of the studied patients, we found that The mean women age was 23.03 ± 3.39 years (range 17-31years), the mean Weight (kg) of the studied group was 66.09 ± 5.53 (range 52 – 75), the mean Height (m) was 160.98 ± 3.51 (rang e 150 – 169). The mean BMI (kg/m2) was 25.48 ± 1.93 (range19.8 – 28.9).

Females in the Kristeller group had a greater occurrence of levator ani muscle avulsion compared with the control group (14/46 vs. 6/46, p = 0.043), increased SPA (p=0.030), associated with increased neonatal head circumference (p=0.034) whereas insignificant variation among both groups have been discovered according to the occurrence of urgency urinary incontinence, stress urinary incontinence, or any urinary incontinence.

Regarding Stress UI: Females who reported stress urinary incontinence had a greater occurrence of levator ani muscle avulsion (8 out of 20, or forty percent, compared to twelve out of seventy-two or 16.7 percent, p = 0.025). They also had a larger levator hiatus area when contracting their pelvic floor muscles (12.52 ± 1.31 cm2 compared to 11.29 ± 1.42 cm2, p = 0.001), a smaller decline in levator hiatal area from rest to maximum contraction (18.05 ± 3.85% compared to 23.84 ± 4.06%, p = 0.000), and gave birth to babies with higher birth weights (3030 ± 180 g compared to 2842 ± 207 g, p = 0.000) compared to women without SUI. No statistically significant variance was seen in relation to all the other evaluated clinical and ultrasonography parameters.

Regarding Urgency UI: Females who stated urgency urinary incontinence have significantly lower weight (61.14 ± 4.63 vs. 66.49 ± 5.42kg, p = 0.013), lower BMI (23.66 ± 1.41 vs. 25.63 ± 1.9kg/m2, p = 0.009), shortened second stage duration (min) (52.86 ± 4.88 vs. 59.09 ± 7.11, p=0.026). UUI increased with induction of labor p=0.000, increased with episiotomy p=0.022.

In the end, we did not discover any significant association among the Kristeller technique & any postpartum urinary incontinence. Our research indicates that pelvic floor injury is a significant factor in the progress of postpartum urinary incontinence. Pregnancy and parturition are significant predisposing factors to the progress of pelvic floor dysfunction, including conditions like urine and rectal incontinence, as well as pelvic organ prolapse .

The findings of our investigation were consistent with those of **Youssef et al. (3)**, who conducted a study to evaluate the association among the integrity & function of the levator ani muscle and the risk to have urine incontinence. Additionally, they examined the correlation among fundal pressure during the 2nd stage of labor (Kristeller maneuver) and the possibility of postpartum urinary incontinence. In this prospective cohort investigation, females were subjected to a transperineal and clinical ultrasound investigation at rest, during pelvic floor muscle contraction, & during the Valsalva maneuver, three to six months following their initial vaginal delivery. The levator ani muscle avulsion and levator hiatal area have been assessed. Also, women have been interviewed regarding the presence of urinary incontinence, whether it be stress or urgency.

Females who had significant avulsion had a lower level of sexual activity throughout both the prenatal and postnatal periods (P-value less than 0.030). These females had a higher prevalence of postnatal urine incontinence and reported symptoms like decreased vaginal feeling and a sensation of vaginal loosening. There were no observed variations in fecal incontinence, prolapse symptoms, or quality of life after childbirth. The avulsion severity was only slightly to moderately correlated with the variations in variables.

Our findings were consistent with **Dietz et al. (6)**, who discovered that levator ani muscle avulsion and ballooning were two distinct risk factors for the manifestation of symptoms and signs associated with pelvic organ prolapse. A total of 605 females participated in the study, out of which 258 (forty-three percent) stated having symptoms of prolapse. A significant prolapse was seen utilizing the International Continence Society Prolapse Quantification System. Specifically, thirty-seven percent of females had a cystocele, twenty-seven percent had a rectocele, and eight percent had an apical prolapse. Additionally, eighteen percent of females had an avulsion .

A significant correlation was seen among hiatal ballooning, avulsion, and symptoms/signs of prolapse (p-value less than 0.001). In multivariable backwards stepwise logistic regression, the presence of puborectalis avulsion has been found to be related to a greater risk to have symptoms and signs of prolapse. This association remained significant following considering the extent of levator ballooning. The presence of avulsion didn't alter the correlation among hiatal area & symptoms of prolapse.

In this study, we assessed the cases effects of levator ani muscle avulsion and ballooning. Interestingly, there has been a recent correlation between levator ani muscle avulsion and prolonged postpartum voiding problems **(8)**. Another investigation conducted by **Dietz et al. (9)** has also confirmed this finding, showing that females with levator ani muscle avulsion have a greater risk of experiencing voiding prolapse and dysfunction .

In contrast, other investigations were unable to establish an association among LAMavulsion and voiding dysfunction & incontinence. **Mathew et al., (10)**. An observational investigation was conducted on a group of 608 females who gave birth for the first time between 1990 and 1997. The investigation evaluated these women in the years 2013 to 2014. The symptoms were quantified using the Urinary Distress Inventory (UDI-6) and Colorectal Anal Distress Inventory (CRADI-8), with a range of 0-100.

This was consistent for females with intact versus injured levator ani muscle; urinary incontinence fifty-three percent versus forty-nine percent P = .67; FI eleven percent versus twelve percent, P = .44; stress urinary incontinence forty-two percent versus forty-two percent, P = .93; urge urinary incontinence twenty-nine percent versus thirty-five percent, P = .34. It was also consistent for females with and without BND. In females with urethral funneling, stress urinary incontinence was more prevalent (fifty percent versus forty percent), odds ratio 1.56 (ninety five percent confidence interval: 1.03-2.37), P = .04.

Our findings were consistent with those of **Van Delft et al. (11)** who discovered that levator ani muscle avulsion has been related to a greater risk of postnatal urinary incontinence, a lower pelvic floor muscle strength, & greater occurrence of anterior compartment prolapse. Furthermore, the investigation found that women who had urinary incontinence throughout their pregnancy had a significant improvement in urinary symptoms following delivery if they didn't develop levator ani muscle avulsion at delivery. Conversely, females who had levator ani muscle avulsion had significantly more severe postpartum urinary incontinence symptoms .

In the current investigation, we discovered that the pelvic floor muscle strength was diminished in only females with stress urinary incontinence, as evidenced by a lesser decrease in levator hiatal area throughout contraction. This implies that pelvic floor training may be more advantageous for this subgroup. The role of pelvic floor muscle training in both the management and prevention of

antenatal & postpartum urinary incontinence is still a matter of debate. Although some investigations have identified a beneficial impact, others have been unable to exhibit it **(12)**.

Conclusion

There is a correlation between levator ani avulsion and a smaller reduction in the levator hiatal area from rest to maximum contraction, and an increased incidence of postpartum urinary stress incontinence. There is insignificant correlation among the Kristeller technique and the occurrence of any urinary incontinence.

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