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Evaluation of the effect of vaginal delivery on stress urinary incontinence and bladder neck mobility with trans perineal ultrasonography

Vajinal doğumun stres üriner inkontinans ve mesane boyun hareketliliğine etkisinin transperineal ultrasonografi ile değerlendirilmesi

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ABSTRACT

Aim: In our study, we aimed to evaluate the effect of vaginal birth, which is known to increase the likelihood of stress urinary incontinence, on bladder neck motility.

Materials and Methods: In our study, 116 patients who gave birth in our hospital between January 2020 and May 2022 were evaluated retrospectively. The presence of stress urinary incontinence and transperineal ultrasonography data of all patients were examined from the patient files. To evaluate changes in bladder neck motility, ultrasound measurements made both prenatally and postnatally were evaluated retrospectively.

Results: The presence of stress urinary incontinence was found to be statistically higher in the multiparous and primiparous patient groups compared to the patients in the cesarean section group. ΔDx, ΔDy and M values of the cesarean birth group were found to be significantly lower than both the primiparous and multiparous vaginal birth groups.

Conclusion: Vaginal birth was found to be a risk factor for stress urinary incontinence by increasing bladder neck mobility compared to cesarean delivery.

Keywords: Bladder neck mobility, perineal ultrasound, stress urinary incontinence, vaginal delivery

ÖZ

Amaç: Çalışmamızda, stres üriner inkontinans olasılığını arttırdığı bilinen vajinal doğumun mesane boynu hareketliliği üzerindeki etkisini değerlendirmeyi amaçladık.

Gereç ve Yöntemler: Çalışmamızda Ocak 2020 - Mayıs 2022 tarihleri arasında hastanemizde doğum yapan 116 hasta retrospektif olarak değerlendirilmiştir. Tüm hastaların stres üriner inkontinans varlığı ve transperineal ultrasonografi verileri hasta dosyalarından incelenmiştir. Mesane boynu hareketliliğindeki değişiklikleri değerlendirmek için hem doğum öncesi hem de doğum sonrası dönemlerde yapılmış olan ultrason ölçümleri retrospektif değerlendirildi. Bulgular: Multipar ve primipar hasta grubunda, sezaryen grubundaki hastalar ile karşılaştırıldığında stres üriner inkontinans varlığı istatistiksel olarak daha yüksek saptandı. Sezaryen doğum grubunun ΔDx, ΔDy ve M değerleri hem primipar hem de multipar vajinal doğum gruplarına göre anlamlı olarak daha düşük saptandı.

Sonuç: Vajinal doğumun sezaryen doğum ile karşılaştırıldığında mesane boynu hareketliliğini artırarak stres üriner inkontinans için bir risk faktörü olduğu saptandı.

Anahtar Kelimeler: Mesane boynu hareketliliği, perineal ultrason, stres üriner inkontinans, vajinal doğum

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INTRODUCTION

Urinary incontinence is a distressing and prevalent situation in females, impacting emotional and psychological well-being by interrupting sexual, physical, and social forms of life. Stress urinary incontinence (SUI) is defined by the involuntary release of urine during actions like sneezing, coughing, or physical activity, without bladder contraction (1). SUI arises when the natural interplay of anatomical and functional factors is disturbed. Two mechanisms elucidate SUI: intrinsic sphincter and urethral hypermobility deficiency. Perineal trauma, especially during childbirth, is one of the most common contributing factors (2-5). Differentiating between urethral malposition or hypermobility and intrinsic sphincter deficit (ISD) is a common method used to classify SUI, yet this may be oversimplifying the situation (6). According to the McGuire categorization system, urethral hypermobility causes stress incontinence in types 1 and 2, whereas intrinsic sphincter deficit causes type 3 of stress incontinence (7). It is known that SUI negatively affects the life quality in 54.3% of all pregnant females in four areas: emotional health, social relations, travel, and physical activity. Sangsawang et al. reported that lower urinary tract symptoms most frequently occur in the 36th week of pregnancy and continue one year after pregnancy (8). One of the primary causes of neuromuscular injury in the pelvic floor is trauma sustained during birth (9). In terms of delivery method, according to ultrasound examination, vaginal birth results in more damage to the pelvic floor than cesarean section since it is correlated with a higher incidence of levator ani muscle injuries, puborectalis deformities, increased neck mobility of the bladder, and expansion of the hiatal region (10). Pelvic floor ultrasound is gaining popularity in urogynecology. Studies have demonstrated good reproducibility of ultrasonographic measurements of pelvic structures (11). Dietz et al. found that perineal ultrasound evaluation of bladder neck motility using a transabdominal probe remained consistent, even when repeated after several weeks (12). Ultrasound assessments of urethral mobility offer a direct visualization of bladder neck mobility, which correlates with the severity of stress urinary incontinence. Pelvic floor ultrasound offers several advantages over other diagnostic methods for stress urinary incontinence, including affordability, noninvasiveness, real-time imaging capabilities, and the ability to repeat measurements multiple times. The objective of this research is to evaluate the impact of vaginal delivery, a known risk factor for postpartum stress incontinence, on bladder neck mobility. This will be accomplished using transperineal ultrasonography, a diagnostic method that is noninvasive and well-tolerated.

MATERIALS AND METHODS

This was a retrospective cohort study conducted at a tertiary center. Informed consent forms were obtained from participants for the current study. The research was conducted in accordance with the principles outlined in the Declaration of Helsinki. This study was started after receiving ethics committee approval from our hospital dated 25/10/23 and numbered 2023/177. In our study, 116 pregnant women who were followed up in our gynecology outpatient clinic from January 2020 to May 2022 and whose deliveries were made in a tertiary care hospital were included. This study included 50 primiparous patients and 66 patients who had experienced one or more deliveries (multiparous). Initial transperineal ultrasonography assessments were conducted between the 32nd and 36th weeks of gestation, and subsequently, during the 6th week postpartum. Retrospective data collection was done using patient files and the hospital database. To ensure participant homogeneity, individuals with complicated deliveries involving forceps and vacuum extraction, those experiencing pregnancy complications (multiple pregnancies, macrosomia, intrauterine growth restriction), those with a urinary tract infection during pregnancy, with a history of normal birth after cesarean section, and those with a history of gynecological or incontinence surgery were not included in the research.

The study group consisted of females who delivered vaginally with fetuses in the vertex presentation, while the control group was formed from individuals who delivered through selective cesarean section. The participants were categorized into three groups: (1) group of primiparous vaginal delivery, (2) group of multiparous vaginal delivery, and (3) group of elective cesarean section. Postnatal assessment encompasses the method of delivery, the need for episiotomy in vaginal delivery, the duration of the 2nd stage of labor, and the baby's birth weight. The time limits for diagnosing failure to progress at the 2nd stage of labor were determined as two hours for nulliparous females and one hour for multiparous females, based on the criteria established by ACOG in 1989. Incontinence was assessed by questioning patients twice, during the 32-36th gestational weeks and at the 6th postnatal week. The Ingelmann Sundberg classification was used to grade incontinence.

1st Degree: Urinary incontinence during coughing, sneezing, and laughing.

2nd Degree: Urinary incontinence while walking, running, climbing, and jumping.

Perineal ultrasonography examinations were conducted using a Samsung SonoaceR7 and a 3.5 MHz convex probe, within a bladder volume ranging from 100 to 300 ml. This allowed visualization of the bladder base and neck, urethra, and symphysis pubis through transsagittal imaging. Examination of the bladder neck involved assessing its position relative to an anatomical landmark, the lower border of the pubic symphysis. Initially, the lower edge of the symphysis pubis, bladder, urethrovesical junction, and urethra at rest were imaged and the image was frozen on one side of the screen. Subsequently, patients were imaged during the Valsalva maneuver, with the resulting image frozen and located on the other half of the screen. Analysis of bladder neck position was conducted using the XY coordinate system, a reproducible technique where the X-axis was a vertical line tangent to the lower border of the symphysis pubis, and the Y-axis was perpendicular to the X-axis. Standardization of scenario and image acquisition ensured consistency across patients, with the transducer positioned on top and the patient's ventral aspect represented on the left side of the screen. At rest, the distance between the bladder neck and the Y-axis is defined as Dyr, and at the time of the Valsalva maneuver, Dyv. The same applies to the X-axis as Dxr and Dxv. Subtraction scores of Dyv and Dyr indicated bladder neck cephalocaudal mobility (ΔDy). Subtraction scores of Dxr and Dxy indicated bladder neck ventrodorsal mobility (ΔDx). Bladder neck mobility was determined as vector distance with the following formula: Mobility (M) = $\sqrt{}$ (xv-xr) ² + (yr-yv)². Vector distance was compared after and before delivery for every participant. Prenatal values (ΔDx1, ΔDy1, M1) were defined as postnatal values (ΔDx2, ΔDy2, M2). Subtraction values of postnatal measurements and prenatal measurements differed. Participants were urged to refrain from exercising their pelvic floor muscles until the 6th week after delivery.

Statistical analysis was performed by SPSS version 26.0 (IBM Inc., Chicago, IL, USA). The distribution normality was evaluated with Kolmogorov-Smirnov test. Normally distributed parameters were analyzed by using ANOVA. Not normally distributed parameters were analyzed by using the Kruskal Wallis and Mann-Whitney U tests. Chi-square test and Fisher precision test were utilized in the analysis of categorical data. Quantitative data with normal distribution are shown as mean ± SD, while quantitative data with non-normal distribution are shown as median (min-max). Descriptive statistics of categorical data are presented as number (n) and percentage (%). A p-value smaller than 0.05 was taken statistically significant.

RESULTS

With regard to the demographic values of the patients, a statistically significant difference was seen in terms of the presence of urinary incontinence when multiparous and primiparous patients were compared with patients in the cesarean section group (p:0.01). There were 36 (72%) patients with a history of cesarean section once, and 14 (28%) patients with a history of cesarean section twice. There was no statistically significant difference between the groups regarding birth weight, body mass index (BMI), age, and ultrasound week (Table 1).

In the antepartum period, ΔDx, ΔDy values of the cesarean section group showed significant differences compared to both primiparous and multiparous vaginal birth groups (p:0.04, p:0.04, respectively). There was a significant difference in the M value of the cesarean birth group compared to both the primiparous and multiparous vaginal birth groups (p:0.02). In the postpartum period, ΔDx, ΔDy values of the cesarean section group showed significant differences compared to both primiparous and multiparous vaginal birth groups (p:0.03, p:0.04, respectively). There was a significant difference in the M value of the cesarean birth group compared to both the primiparous and multiparous vaginal birth groups (p:0.02) (Table 2).

Table 1. Comparative Analysis of Demographic Characteristics Across Varied Delivery Modes

	Normal Spontaneous Vaginal Delivery			
	Primiparous	**Multiparous**	**C/S**	**p**
	Mean±SD			
Age (year)	27.18 ±4.39	27.67 ± 4.63	27.11 ± 4.89	0.08
BMI (kg/m²)	24.19 ± 4.59	24.61 ± 5.11	24.26 ± 4.77	0.09
Parity	1.00 ± 0.00	2.21 ± 0.84	1.00 ± 0.00	**0.01**
Birth Weight (g)	3345.9 ± 592.7	3380.4 ± 484.6	3311.1 ± 550.6	0.07
Ultrasound Week	35.74 ± 1.37	35.55 ± 1.19	35.85 ± 1.29	0.09

*BMI: Body mass index, C/S: Cesarean Section

Table 2. Assessment of antepartum and postpartum Ultrasonographic Parameters Based on Delivery Modes

	Antepartum			p	Postpartum			p
	Primiparous	Multiparous	C/S		Primiparous	Multiparous	C/S	
ΔDx (mm)	7.26±0.59	8.12±2.62	5.66±2.01	**0.04**	8.38±0.63	9.98±2.52	5.86±1.27	**0.03**
ΔDy (mm)	15.43±1.18	17.01±2.66	11.66±2.56	**0.04**	16.84±1.26	18.24±2.95	11.72±2.88	**0.04**
M (mm)	17.03±0.89	18.22±2.88	12.99±2.58	**0.02**	18.53±0.84	20.12±3.29	12.92±2.87	**0.02**

* C/S: Cesarean section

Table 3. Evaluation of Ultrasound Parameters According to the Type of Birth

	Primiparous n:20	Multiparous n:46	C/S n:50	p
ΔDx difference	1.12±1.03	1.86±2.22	0.20 ±1.22	0.016
ΔDy difference	1.39±1.58	1.23±0.86	0.06±0.88	0.018
M difference	1.50±1.49	1.90±0.92	-0.07±0.86	0.022

* C/S: Cesarean section

Table 4. Postpartum Incontinence Evaluation According to the Presence of Episiotomy

		Episiotomy		p
		(+) n:30	(-) n:36	
Primiparous n:20	SUI (+)	5 (33.3%)	5 (100%)	**0.02**
	SUI (-)	10 (66.7%)	0 (0%)	
Multiparous n:46	SUI (+)	9 (60%)	19 (61.2%)	0.9
	SUI (-)	6 (40%)	12 (38.8%)	

*SUI: Stress urinary incontinence

The ΔDx difference and ΔDy difference between antepartum and postpartum were found to be statistically significantly lower in the cesarean section group compared to the primiparous vaginal birth group and multiparous vaginal birth group (p:0.016 and p:0.018, respectively)

The M difference between antepartum and postpartum were found to be statistically significantly lower in the cesarean section group compared to the primiparous vaginal birth group and multiparous vaginal birth group (p:0.022) (Table 3).

When evaluating primiparous and multiparous patients individually for symptoms of SUI at 6 weeks postpartum, it was observed that in the primiparous group, patients delivered without episiotomy were significantly more likely to experience SUI than those without (p:0.02). In the multiparous group, no significant difference was noted based on the presence or absence of episiotomy (p:0.9) (Table 4).

In the group of patients with SUI symptoms postpartum, a significant difference was found between prenatal and postnatal measurements of bladder neck mobility. Vectorial, ventrodorsal, and cephalocaudal movements were found to be significantly greater than group of patients does not present SUI symptoms ($p < 0.05$) (Table 5).

DISCUSSION

In our study, stress urinary incontinence values at pregnancy were seen to be similar to the primiparous patient group and lower than the multiparous patient group. This suggests that

Table 5. Assessment of Antepartum and Postpartum Ultrasonographic Parameters Based on the Presence of Incontinence Symptoms

		Postpartum SUI Symptoms (+) n: 49	Postpartum SUI Symptoms (-) n:67	p
Antepartum	ΔDx(mm)	7.92 ± 2.32	5.79 ± 1.76	**0.03**
	ΔDy(mm)	15.84 ± 2.76	11.90 ± 2.11	**0.04**
	M(mm)	17.68 ± 2.88	13.16 ± 2.12	**0.03**
Postpartum	ΔDx(mm)	9.68 ± 2.29	5.99 ± 1.18	**0.01**
	ΔDy(mm)	17.77 ± 2.65	11.95 ± 2.52	**0.02**
	M(mm)	19.66 ± 3.03	13.32 ± 2.67	**0.02**

*SUI: Stress urinary incontinence

pregnancy alone may be one contributing factor to pelvic muscle dysfunction. Two different studies identified a history of cesarean section as a pregnancy-related risk factor for urine incontinence (13, 14). Groutz et al. showed that the occurrence of postpartum stress urinary incontinence was comparable between spontaneous vaginal delivery and cesarean section after non-progressed labor. In such instances, it's plausible that pelvic floor damage may already be too extensive to be prevented by surgical intervention. However, elective cesarean section in the absence of prior labor history was linked with a notably lower prevalence of stress urinary incontinence (15). In another research by Nygaard et al., it was stated that females who had their second vaginal delivery experienced urinary incontinence problems twice as often as those who gave birth by cesarean section (16).

The pudendal nerve may sustain injury during delivery as a result of tugging or compression in the Alcock canal. Snooks et al. described denervation after vaginal delivery that lasted for two months after delivery utilizing single fiber EMG of the pudendal nerve latency and external anal sphincter (17). Additionally, aberrant collagen patterning or hormonal changes during pregnancy may potentially have a significant role in the development of postpartum SUI (18). In the postpartum period, the incidence of SUI in patients with a history of cesarean section was significantly lower than in the primiparous and multiparous vaginal delivery patient groups. Additionally, elective cesarean section was associated with a lesser rise in bladder neck mobility in comparison with primiparous and multiparous patients with vaginal delivery. This can be interpreted as cesarean delivery serving as a protective measure against the development of SUI.

Transperineal ultrasonography enables repeatable quantitative measures by allowing for the morphological and dynamic evaluation of the bladder neck and urethra. It is possible to measure the location of the bladder neck both at rest and during the maximum Valsalva movement. The discrepancies between the two measurements may be used to calculate the bladder neck displacement. Measurements of the bladder neck position are taken both at rest and during the maximum Valsalva movement. Proximal urethra displacement in a posteroinferior orientation is possible in Valsalva. Despite the suggestion of cutoffs between 15 and 25 mm to characterize hypermobility, bladder neck displacement lacks a "specific definition of normal" (19, 20). In our study, to be able to get great precision, we used a bidirectional XY coordinate system. Cephalocaudal and ventrodorsal mobility were found to be significantly higher in both the primiparous and multiparous groups that delivered vaginally compared to the elective cesarean section group. A study has demonstrated that vaginal delivery causes pelvic floor damage and disrupts innervation (21). In our study, bladder neck mobility in the multiparous and primiparous groups was significantly higher than in the cesarean section group, supporting the findings of our study. It is reported in the literature that the incidence and severity of incontinence increase as pregnancy progresses, especially at its climax in the third trimester (22, 23). For this reason, we took measurements at 32-36th gestational weeks.

Both antepartum and postpartum vector bladder neck movement measurements were higher in patients presenting symptoms of SUI than in patients not presenting symptoms in the postpartum period. Contrary to our study, one study reported that both the continent and incontinent groups showed a comparable increase in bladder neck mobility following delivery beyond antepartum values, indicating that the incontinent group did not experience more tissue stress from birth. However, in that study, they stated that the development of SUI cannot be explained solely by the obstetric experience of female (24).

A study has shown that women with more than four vaginal deliveries have significantly higher rates of urinary incontinence. This study supports the idea that pelvic floor damage increases exponentially with the number of vaginal deliveries (25). Despite the belief that vaginal birth harms the shape and functionality of the pelvic organs, according to several writers' incontinence usually decreases significantly after 6 weeks and usually disappears within three months after delivery (23, 26). Also, transient incontinence during pregnancy is suggested to be a result of the interaction between predisposing hereditary factors, the pressure of the uterus on the bladder, and hormonal effects on the suspensory ligaments of the urethra (27). Unlike Wilson PD et al. (25), who used not only SUI but a broad definition for urinary incontinence to evaluate patients at postpartum 3 months, this could be a reason for our results conflicting with their study. The study had some limitations. One of these was that the study was retrospective. For this reason, patients whose data were not recorded or who did not come for a postpartum control were excluded from the study. This situation caused the small number of patients, which is another limitation. The results could have been more remarkable in a study conducted on a larger population. The strength of the study could be considered as the fact that the imaging method applied can be performed routinely, is easily accessible, and does not impose any additional costs on the patient.

CONCLUSION

Vaginal birth was found to be a risk factor for stress urinary incontinence by increasing bladder neck mobility compared to cesarean delivery. Transperineal ultrasound seems to be a suitable method for assessing bladder neck mobility. This technique can aid in identifying urinary incontinence during and after pregnancy.

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