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Urodynamic indices and pelvic organ prolapse quantification 3 months after vaginal delivery in primiparous women

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Abstract

Introduction and hypothesis—This study aims to describe multichannel urodynamic indices and pelvic organ prolapse quantification (POP-Q) in primiparous women 3 months after vaginal delivery.

Methods—This was a secondary analysis of a group of women who had been randomized to either coached or non-coached pushing during the second stage of labor. Primiparous women were evaluated with POP-Q examination and multichannel urodynamic testing 3 months after vaginal delivery.

Results—Of 128 women evaluated, the cumulative stage of prolapse was distributed as 4.7% stage 0, 39% stage I, 56% stage II, and none with stage III prolapse or greater. For the anterior compartment, most had stage II prolapse. Stage I prolapse predominated for both the central and posterior compartments. Of the women, 14.1% had urodynamic stress incontinence, 12.5% had detrusor overactivity, and 6% had both.

Conclusions—In a predominantly Hispanic primiparous population, ICS POP-Q stage II prolapse of the vagina, urodynamic stress incontinence, and detrusor overactivity are common findings at a 3-month postpartum assessment.

Keywords

POP-Q; Pregnancy; Postpartum; Primiparous; Urodynamic stress incontinence; Detrusor overactivity; Multichannel urodynamics

Introduction

The exact pathophysiology of pelvic floor dysfunction is still poorly understood. Studies have suggested that pudendal neuropathy, pelvic floor trauma, or ischemia may be etiologic factors [1-4]. Some have documented an association between vaginal childbirth and pelvic floor dysfunction, specifically pelvic organ prolapse or urinary incontinence [1, 3, 5]. However, a direct causal relationship between the two has not been as evident.

What is considered normal pelvic organ support in the puerperium and what represents the natural course of pelvic organ support in the intermediate and late postpartum period are unknown. However, to study the development of pelvic organ prolapse, it is important to

classify what is “normal.” Establishing prevalence data may be a first step in helping to distinguish the threshold between normal and abnormal. In an effort to understand the effect of pregnancy on the natural history of prolapse, other investigators have used the pelvic organ prolapse quantification (POP-Q) exam to study changes in pelvic organ support during pregnancy [6] and in the postpartum period [7]. However, only few have included data regarding specific POP-Q points in primiparous women [6-8]. Furthermore, there are few data that describe quantification and incidence of prolapse, in addition to urodynamic evaluation, in primiparous women beyond 6 weeks from delivery.

The objective of this study was to describe indices of multichannel urodynamic evaluation and POP-Q values in a cohort of primiparous women 3 months after vaginal delivery.

Materials and methods

This was a secondary analysis of data from a group of 325 women who had been randomized to either coached or non-coached pushing during the second stage of labor [9]. After institutional review board approval was obtained, primiparous women delivering vaginally at Parkland Memorial Hospital, Dallas, TX, USA, between November 1, 2000 and August 31, 2002, were invited to participate. After informed consent, all women were evaluated in a standardized fashion 3 months after vaginal delivery with POP-Q examination and multichannel urodynamic testing by one of two urogynecology nurse practitioners. Women with a previous history of urinary incontinence and pelvic organ prolapse were excluded.

Pelvic organ prolapse quantification

Women were examined in the dorsal lithotomy position with the head of the bed inclined at a 45° angle. Individual POP-Q measurements were determined as described by Bump and coinvestigators [10]. POP-Q stage was determined for the anterior, posterior, and central compartments of the vagina. Then a cumulative or overall stage, representing the highest ordinal stage of any compartment, was assigned.

Multichannel urodynamic testing

All testing were performed with the patient seated upright in a urodynamics evaluation chair (Sonesta, Model Number 6202, Dallas, TX, USA). All standards conformed to the International Continence Society guidelines [11].

Uroflowmetry—For uroflowmetry, women were asked to empty their bladder into a commode connected to a flowmeter (Laborie Medical Technologies Corp., Williston, VT, USA). After recording the maximal flow rate, they were catheterized to ensure an empty bladder prior to cystometrography and to measure a postvoid residual.

Cystometrography—For the cystometrogram, a 8-Fr microtransducer catheter (Mikro-tip, Millar Instruments Inc., Houston, TX, USA) was inserted transurethrally into the bladder and a second catheter was inserted into the vagina. The bladder was filled with room temperature 0.9% normal saline at a rate of 100 mL/min and the women were asked to cough at each 50-mL interval. The first desire to void, maximal cystometric capacity, and presence of detrusor overactivity and/or urodynamic stress incontinence were determined. Abdominal leak point pressures were measured during Valsalva maneuver at a bladder volume of 200 mL, using the true zero of intravesical pressure as the baseline.

Pressure flowmetry—Pressure flowmetry was conducted after cystometric evaluation. Patients were asked to void and the maximum flow rate, detrusor pressure at maximum flow, and postvoid residual were recorded.

Urethral pressure profilometry—The urethral pressure profile was performed at rest, in the supine position, with a 200-mL volume instilled into the bladder and the catheter transducer directed to the nine o'clock position. The microtip dual-sensor catheter was pulled through the urethra with the aid of an automated puller arm (UPP Puller, Laborie Medical Technologies Corp., Williston, VT, USA) at a speed of 1 mm/s. Maximum urethral closure pressure was determined by averaging three profiles. The functional urethral length and the area of continence zone were obtained.

Statistics

Descriptive statistics were used with values expressed as means $\pm$ standard deviations (SD) for measurable data. Frequency data are presented as counts (frequencies) and percentages. Ninety-five percent confidence intervals (95% CI) are provided for some percentage estimates to allow understanding of the numerical precision. Pearson chi-square analysis and Wilcoxon rank-sum analysis were used to analyze POP-Q points and urodynamic parameters according to the following obstetrical antecedents: prolonged second stage of labor (duration ≥ 2 h without epidural anesthesia), episiotomy, third or fourth degree laceration, macrosomia (birthweight $\geq 4,000$ g), epidural anesthesia, and oxytocin augmentation of labor. Bonferroni adjustment was applied for testing of multiple samples.

Results

Of the 325 women that were randomized to the original study of coached versus non-coached pushing [9], 128 women consented to POP-Q and multichannel urodynamic evaluation at 3 months postpartum. All women delivered cephalic-presenting infants vaginally without operative assistance. Mean age was 21 ± 3 years (range, 16–34 years). Ninety-four percent were Hispanic, 4% African American, and 2% Caucasian. The mean body mass index of the cohort was 28.5 ± 3.9 kg/m². The mean gestational age at the time of delivery was 39.8 ± 0.9 weeks, and the mean infant birthweight was $3,307 \pm 361$ g. Only seven patients sustained either a third or fourth degree laceration.

Pelvic organ support

Individual POP-Q point measurements and their ranges were determined in accordance with the International Continence Society guidelines [10] (Fig. 1). With respect to the cumulative stage of prolapse, 6 (4.7%) of the 128 women had POP-Q stage 0 support, 50 (39%) had stage I, 72 (56%) had stage II, and none had stage III prolapse or greater (Fig. 2a). For the anterior compartment (POP-Q point Ba), the majority of women, 62 out of 128 (48%), had stage II pelvic support (Fig. 2b). Stage I prolapse predominated for POP-Q point C, 95 out of 128 (74%); POP-Q point Bp, 60 out of 128 (47%) (Fig. 2c, d); and POP-Q point D, 121 out of 128 (95%). Inspection of the relative distributions of the women who had stage II prolapse of the anterior or posterior compartment revealed that the majority were at or proximal to the plane of the hymen (94% for the anterior wall and 94% for the posterior wall). Specifically for point Ba, 36 (58%) were proximal to, 22 (35%) were at, and 4 (6%) were distal to the plane of the hymen. For point Bp, 15 (47%) were proximal to, 15 (47%) were at, and 2 (6%) were distal to the hymen. The mean $\pm$ SD Q-tip straining angle was $39 \pm 27^\circ$ (range, -35° to 90°).

Urodynamic evaluation

Multichannel urodynamic evaluation of the 128 women revealed that 18 (14.1%) [95% CI, 8.6, 21.3] had urodynamic stress incontinence and 16 (12.5%) [95% CI, 7.3, 19.5] had detrusor overactivity. Of these 34 women, 8 (6.3%) had both urodynamic stress incontinence and detrusor overactivity. The mean values and the ranges of the urodynamic indices are presented in Table 1. Of the women, 7.8% (95% CI, 3.8, 13.9) had a positive Valsalva leak point pressure of 120 ± 36 cm H₂O.

Obstetrical antecedents

Multiple logistic regression analysis adjusting for prolonged second stage of labor (duration ≥ 2 h without epidural anesthesia), episiotomy, third or fourth degree laceration, macrosomia (birthweight $\geq 4,000$ g), epidural anesthesia, and oxytocin augmentation of labor initially showed associations for certain POP-Q points and urodynamic parameters (Table 2). However, these did not persist after Bonferroni adjustment for multiple testing.

Discussion

Of the few studies that have quantified the amount of prolapse in the immediate postpartum period, most have concentrated on stage of prolapse only and not on individual POP-Q points [6, 7]. There are little data that describe the quantification of prolapse in primiparous women beyond 6 weeks from delivery. The objective of this study was to describe urodynamic indices and quantification of pelvic floor support in a large group of primiparous woman 3 months after vaginal delivery. In this group of young, primiparous, predominantly Hispanic women, 3-month postpartum anatomic and functional assessment revealed significant vaginal wall descent (56% with stage II cumulative prolapse, 48% with stage II anterior wall prolapse, and 47% with stage II posterior wall prolapse) as well as urodynamic evidence of stress incontinence (14%) and detrusor overactivity (13%).

This study demonstrates that stage II prolapse is common in a cohort of predominantly Hispanic primiparous women 3 months after vaginal delivery. None in the cohort had stage III prolapse or greater, effectively placing all POP-Q points at or above a point 1 cm distal to the plane of the hymen. It also appears that the anterior compartment was the main contributor to the highest cumulative stage of prolapse.

In the past, it was difficult to compare degrees of prolapse without standardized, quantitative, and reliable methods of assessment. Since the development of the POP-Q system, a standardized technique with good interexaminer and intraexaminer reliability for examining pelvic organ prolapse [12], investigators have been able to better assess and compare the physical findings and severity of prolapse in women. Using POP-Q, O'Boyle and coinvestigators prospectively documented the natural history of pelvic organ support during pregnancy [6]. They found a significant difference in POP-Q stage only between the first and third trimesters for the anterior vaginal wall (points Aa and Ba), posterior vaginal wall (points Ap and Bp), perineal body, genital hiatus, and total vaginal length. No one had greater than POP-Q stage II support, and the majority of those classified as stage II were found in the third trimester. Specifically, O'Boyle and coinvestigators found that stage II prolapse was common during the third trimester of pregnancy, with 35% of patients having this degree of prolapse [6]. Similarly, the majority of the patients in our study had stage II prolapse, but instead, at 3 months after vaginal delivery. Our prevalence of 56% of stage II prolapse is similar to the 52% reported by Sze [7] at 6 weeks postpartum and slightly higher than the 31% reported by Handa [8] at 6 months postpartum and likely reflects a plausible and consistent estimation of the true prevalence in primiparous women at 12 weeks after delivery.

Additionally, there is evidence to suggest that even nulliparous women may have significant pelvic floor support defects [13, 14]. Consistent with these findings are results from a study by Swift and coinvestigators who performed POP-Q in order to establish normative data in women presenting for routine gynecologic care [15]. They found that the majority of these women had stage I or II prolapse, few were stage 0, and none had stage III prolapse. The threshold at which pathology occurs, what is defined as symptomatic prolapse, and the optimal time of intervention still remain unclear. Although the definition of anatomic prolapse has been defined by the National Institutes of Health as descent of stage I or greater [16], this may not represent the point at which patients become truly symptomatic. In fact, other investigators have found that bothersome symptoms of pelvic organ prolapse occur largely when the leading edge of the prolapse protrudes beyond the hymenal remnants [17, 18]. In our study, further inspection of those with stage II prolapse revealed that the majority were at or proximal to the plane of the hymen (97% for the anterior wall and 94% for the posterior wall). Thus, only 6% of patients had clinically significant prolapse. Nevertheless, the findings of our study, in conjunction with others, suggest that stage II prolapse is a common finding in antepartum and postpartum women, as well as in those presenting for general gynecologic care, and that perhaps the definition of “normal” should be reconsidered.

Urodynamic findings from this study are in general agreement with comparable studies in the literature where the age range and timing of the postpartum evaluation are similar. Notably, Meyer and coinvestigators studied the effects of delivery on bladder function in 149 primiparous women 9 weeks after delivery [19]. Considering only those who had undergone non-instrumented vaginal delivery ($n=91$), their study found that 21% had stress urinary incontinence postpartum, slightly higher than that reported in our study. Urethral pressure profile measurements were also similar (maximal urethral closure pressure, 80 ± 25 cm H₂O; functional urethral length, 3.1 ± 0.8 cm; area of continence zone, 591 ± 342 mm²). Another study involving 161 primiparous women found a 5% prevalence of stress urinary incontinence 12 weeks postpartum [20]. Inspection of the urodynamic values for the 89 patients who had a normal vaginal delivery in this cohort revealed similar values for first desire to void (150 ± 83 mL), maximal cystometric capacity (300 ± 114 mL), maximal detrusor pressure (33 ± 19 cm H₂O), and peak flow rate (24 ± 18 mL/s) when compared with the values found in our study.

Initially, associations for certain POP-Q points and urodynamic parameters were found with multiple logistic regression analysis adjusting for prolonged second stage of labor (duration ≥ 2 h without epidural anesthesia), episiotomy, third or fourth degree laceration, macrosomia (birthweight $\geq 4,000$ g), epidural anesthesia, and oxytocin augmentation of labor. However, after statistical adjustment for multiple testing, these associations did not persist. One explanation may be that the number of patients with those obstetrical antecedents was too few to achieve statistical significance.

The strength of the current study lies in the large number of women evaluated who delivered vaginally without operative assistance. It provides cross-sectional data on primiparous women at 3 months postpartum on multichannel urodynamic parameters and discrete POP-Q measurements for a relatively racially homogenous cohort. The relative racial homogeneity, with 94% of the cohort being Hispanic, eliminates the inherent variability associated with race. However, it is acknowledged that it also may limit our ability to generalize the findings of this study to other populations that are not predominantly Hispanic. Additionally, most studies in the literature have focused on only one aspect of urodynamic evaluation in the study population, such as either the urethral pressure profile or the filling cystometry instead of including all parameters.

One of the limitations of this study is the lack of antepartum prolapse and urodynamic assessment. Without longitudinal data on POP-Q points or urodynamic indices, it is not possible to comment on the effects of pregnancy, labor, or delivery on the integrity of the pelvic floor. Although some have specifically focused on this endeavor and have studied the effects of vaginal delivery on various urodynamic parameters and pelvic floor dysfunction [19], it is emphasized that no conclusion can be made on whether the findings from our study represent an insult that occurred during any of the stages of pregnancy or during delivery. It is important to keep in mind that the original intent of this study was to provide cross-sectional information on prolapse and urodynamic indices after the immediate postpartum period and we caution against trying to make an association between pregnancy, delivery, and postpartum findings. Additionally, we acknowledge that participation bias may have been introduced with the fact that a number of women in the original randomization were not able to provide sufficient data to be included in the analysis. Finally, since data on various postpartum practices, such as breastfeeding and contraceptive use, were not collected, we are not able to comment on how patient hormone status and the potential resultant hypoestrogenic state may have impacted on the parameters studied in this investigation.

In summary, this secondary analysis provides a single-time postpartum evaluation of and describes multichannel urodynamic indices and POP-Q point measurements at 3 months in a cohort of predominantly primiparous Hispanic women delivering vaginally. These figures may provide reasonable pilot estimates for statistical power planning of and contribute to future comparative studies involving such patients. Further study at time points more remote from delivery would be helpful in determining the natural course of pelvic organ prolapse and urodynamic parameters as a function of time after vaginal delivery in primiparous women.

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References

1. Allen RE, Hosker GL, Smith ARB, Warrell DE. Pelvic floor damage and childbirth: a neurophysiological study. *Br J Obstet Gynaecol.* 1990; 97:770–779. [PubMed: 2242361]
2. Tetzschner T, Sørensen M, Jønsson L, Lose G, Christiansen J. Delivery and pudendal nerve function. *Acta Obstet Gynecol Scand.* 1997; 76:324–331. [PubMed: 9174425]
3. Snooks SJ, Setchell M, Swash M, Henry MM. Injury to innervation of pelvic floor sphincter musculature in childbirth. *Lancet.* 1984; 2:546–550. [PubMed: 6147604]
4. Peschers U, Schaer G, Anthuber C, Delancey JO, Schuessler B. Changes in vesical neck mobility following vaginal delivery. *Obstet Gynecol.* 1996; 88:1001–1006. [PubMed: 8942842]
5. Sultan AH, Kamm MA, Hudson CN. Pudendal nerve damage during labour: prospective study before and after childbirth. *Br J Obstet Gynaecol.* 1994; 101:22–28. [PubMed: 8297863]
6. O'Boyle AL, O'Boyle JD, Ricks RE, Patience TH, Calhoun B, Davis G. The natural history of pelvic organ support in pregnancy. *Int Urogynecol J Pelvic Floor Dysfunct.* 2003; 14:46–49. [PubMed: 12601516]
7. Sze EH, Sherard GB 3rd, Dolezal JM. Pregnancy, labor, delivery, and pelvic organ prolapse. *Obstet Gynecol.* 2002; 100:981–986. [PubMed: 12423864]
8. Handa VL, Nygaard I, Kenton K, Cundiff GW, Ghetti C, Ye W. Pelvic floor disorders network. Pelvic organ support among primiparous women in the first year after childbirth. *Int Urogynecol J Pelvic Floor Dysfunct.* 2009; 20:1407–1411. [PubMed: 19777148]
9. Schaffer JJ, Bloom SL, Casey BM, McIntire DD, Nihira MA, Leveno KJ. A randomized trial of the effects of coached vs uncoached maternal pushing during the second stage of labor on postpartum

- pelvic floor structure and function. *Am J Obstet Gynecol.* 2005; 192:1692–1696. [PubMed: 15902179]
10. Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JOL, Klarshov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol.* 1996; 175:10–17. [PubMed: 8694033]
 11. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn.* 2002; 21:167–178. [PubMed: 11857671]
 12. Hall AF, Theofrastous JP, Cundiff GW, Harris RL, Hamilton LF, Swift SE, et al. Interobserver and intraobserver reliability of the proposed International Continence Society, Society of Gynecologic Surgeons, and American Urogynecologic Society pelvic organ prolapse classification system. *Am J Obstet Gynecol.* 1996; 175:1467–1470. [PubMed: 8987926]
 13. Larsen WI, Yavorek T. Pelvic prolapse and urinary incontinence in nulliparous college women in relation to paratrooper training. *Int Urogynecol J Pelvic Floor Dysfunct.* 2007; 18:769–771. [PubMed: 17036166]
 14. Larsen WI, Yavorek TA. Pelvic organ prolapse and urinary incontinence in nulliparous women at the United States Military Academy. *Int Urogynecol J Pelvic Floor Dysfunct.* 2006; 17:208–210. [PubMed: 16077995]
 15. Swift SE. The distribution of pelvic organ support in a population of female subjects seen for routine gynecologic health care. *Am J Obstet Gynecol.* 2000; 183:277–285. [PubMed: 10942459]
 16. Weber AM, Abrams P, Brubaker L, Cundiff G, Davis G, Dmochowski RR, et al. The standardization of terminology for researchers in female pelvic floor disorders. *Int Urogynecol J Pelvic Floor Dysfunct.* 2001; 12:178–186. [PubMed: 11451006]
 17. Swift SE, Tate SB, Nicholas J. Correlation of symptoms with degree of pelvic organ support in a general population of women: what is pelvic organ prolapse? *Am J Obstet Gynecol.* 2003; 189:372–379. [PubMed: 14520198]
 18. Gutman RE, Ford DE, Quiroz LH, Shippey SH, Handa VL. Is there a pelvic organ prolapse threshold that predicts pelvic floor symptoms? *Am J Obstet Gynecol.* 2008; 199:683.e1–683.e7. [PubMed: 18828990]
 19. Meyer S, Schreyer A, De Grandi P, Hohlfield P. The effects of birth on urinary continence mechanisms and other pelvic-floor characteristics. *Obstet Gynecol.* 1998; 92:613–618. [PubMed: 9764638]
 20. Chaliha C, Bland JM, Monga A, Stanton SL, Sultan AH. Pregnancy and delivery: a urodynamic viewpoint. *BJOG.* 2000; 107:1354–1359. [PubMed: 11117761]

<i>Aa</i>	<i>Ba</i>	<i>C</i>
-1.4 ± 1.0 (-3 to 1)	-1.4 ± 1.0 (-3 to 1)	-6.0 ± 1.3 (-9 to -1)
<i>Gh</i>	<i>Pb</i>	<i>Tvl</i>
3.6 ± 1.0 (2 to 8)	4.1 ± 0.9 (2 to 6)	9.4 ± 1.1 (7 to 12)
<i>Ap</i>	<i>Bp</i>	<i>D</i>
-1.9 ± 1.0 (-3 to 1)	-1.9 ± 1.0 (-3 to 1)	-8.0 ± 1.1 (-11 to -5)

Fig. 1.

POP-Q point measurements in women 3 months after vaginal delivery. Values are expressed as mean (centimeters) ± SD (range)

Fig. 2. Distribution of stage of prolapse. **a** Cumulative, **b** anterior compartment (point Ba), **c** central compartment (point C), and **d** posterior compartment (point Bp). Values are expressed as frequency (percent) $\pm$ standard error of the mean

Table 1

Urodynamic parameters in primiparous women 3 months after vaginal delivery

Urodynamic parameter	Measurement $\pm$ SD [range]
Maximum flow rate (mL/s), uroflowmetry	32 $\pm$ 32 [9–257]
First desire to void (mL)	180 $\pm$ 96 [31–555]
Maximum cystometric capacity (mL)	453 $\pm$ 120 [200–850]
Maximum detrusor pressure at peak flow (cm H ₂ O)	33 $\pm$ 70 [0–774]
Positive Valsalva leak point pressure (cm H ₂ O)	120 $\pm$ 36 [64–175]
Negative Valsalva leak point pressure (cm H ₂ O)	106 $\pm$ 27 [50–208]
Maximum flow rate (mL/s), pressure flowmetry	25 $\pm$ 26 [3–251]
Postvoid residual (mL)	45 $\pm$ 67 [0–300]
Maximal urethral closure pressure (cm H ₂ O)	86 $\pm$ 26 [24–168]
Functional urethral length (cm)	1.8 $\pm$ 0.8 [0.9–8.0]
Area of continence zone (cm ²)	430 $\pm$ 183 [122–1,049]

Statistically significant POP-Q points and urodynamic parameters after multiple logistic regression analysis. Statistical significance did not persist after Bonferroni adjustment for multiple testing

Table 2

POP-Q point or urodynamic parameter	Obstetrical antecedent	Measurement ± SD	P value
POP-Q point C	Oxytocin	-5.4±1.2	0.035
	No oxytocin	-6.1±1.2	
	3rd or 4th degree laceration	-6.9±1.2	0.040
	No laceration	-6.0±1.2	
POP-Q point D	Oxytocin	-7.4±0.8	0.006
	No oxytocin	-8.1±1.1	
Capacity	Macrosomia	564 ±115	0.046
	No macrosomia	449 ±118	