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Influence of mode of delivery on pelvic organ support six months postpartum

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Short title: Pelvic organ support postpartum

Abstract

Aims: The aims of this study were to describe pelvic organ support six months postpartum among women delivered by cesarean section, spontaneous and instrumental vaginal delivery and to evaluate the differences between the groups.

Methods: This was a cross-sectional study of 382 primigravid women who gave birth at Donostia Hospital during 2007. Pelvic organ support was explored six months postpartum using the pelvic organ prolapse quantification (POPQ) system. Joint hypermobility, height and weight were also assessed.

Results: POPQ stage ≥ II was present in 7.7%, 18.1% and 29.0% of women delivered by caesarean section, spontaneous and instrumental vaginal delivery respectively. Spontaneous vaginal delivery increased the risk by more than three times (OR:3.19; 95% CI:1.07–9.49) while instrumental vaginal delivery increased it more than five-fold (OR:5.52; 95% CI:1.79–17.30) in comparison with caesarean section. Instrument-assisted delivery did not increase the risk of prolapse in women who delivered vaginally, although this result was limited by the sample size.

Conclusions: Cesarean section has a protective effect on pelvic floor support. Instrument-assisted delivery is not associated with postpartum prolapse among women delivered vaginally.

Key words: Pelvic organ prolapse quantification; Postpartum; Mode of delivery; Risk factors.

Introduction

Parity is one of the well established risk factors involved in the development of pelvic organ prolapse (POP) [1-6]. It seems that pelvic floor injuries that take place during pregnancy, labor and delivery may predispose to POP later in life. However the mechanisms by which pregnancy and parturition lead to failure of pelvic organ support are not completely understood. During pregnancy, specific hormonal changes that prepare pelvic floor for delivery and the mechanical effect of the gravid uterus may be involved in pelvic floor damage. Besides, the passage of the baby through the birth canal damages not only the connective tissue and muscles which are supporting structures, but also the nerves, modifying the proper function of pelvic floor muscles. Neurophysiological tests have demonstrated denervation of the pubovisceral muscles and anal sphincter following 40 to 80 percent of vaginal births [7,8].

There does seem to be an increase in pelvic floor damage as regards both anatomy and function in relation to instrumental vaginal delivery. In particular, an association between forceps-assisted delivery and both levator ani muscle injury [9] and anal sphincter disruption [10] have been found. Urinary [11] and anal incontinence [12,13] in the postpartum period have also been associated with the use of forceps. However, the role of instrumental vaginal delivery in the development of POP is not so well documented. The long interval of time between childbirth-associated damage and the appearance of symptomatic prolapse makes it difficult to evaluate obstetric variables, since other well recognized risk factors for POP, such as increasing BMI and effects of aging, can act as confounders.

The introduction of the pelvic organ prolapse quantification (POPQ) system has allowed researchers to detect minimal descents in the different compartments of the pelvic floor during pregnancy and in the postpartum period. Previous studies in this field have indicated that there is an increase in the grade of prolapse in the third trimester and postpartum compared with the first trimester of pregnancy [14]. There is also some evidence indicating an association between vaginal delivery and the development of POP postpartum [14-19].

The aim of this study was to describe pelvic organ support six months postpartum among women delivered by cesarean section, spontaneous and instrumental (forceps or spatulas) vaginal delivery and to evaluate the differences between the groups.

Methods

An observational study was undertaken to evaluate the influence of mode of delivery on pelvic organ support after childbirth. The study group was selected from the primigravid women at term that came to give birth at Donostia Hospital from April to October, 2007. We excluded cases of: multiple pregnancy, gestation of less than 37 weeks, previous vaginal urogynecological surgery or urogynecological malformations, diagnosis of connective tissue disease and neurological disorders. Women were invited to participate when they came to give birth at our Hospital and after being fully informed about the study.

Pelvic organ support was evaluated six months postpartum using the pelvic organ prolapse quantification (POPQ) system which has been described previously [20]. The examination was performed with the women in the lithotomy position and under maximum straining. Each distance was measured using a wooden spatula marked at 0.5 cm intervals. A single experienced gynecologist (I.D.-I.) supervised all the examinations, and was blinded to delivery data to reduce bias. We obtained the individual POPQ point measurements corresponding to the anterior (Aa, Ba), central (C, D) and posterior compartments (Ap, Bp) during maximal Valsalva effort. Total vaginal length (tvl), genital hiatus (gh) and perineal body (pb) were also measured. Pelvic organ prolapse quantification system stage was established on the basis of the most prolapsed compartment. In addition, we calculated the proportion of women with POPQ stage ≥ II.

Physical examination six months postpartum also included the evaluation of joint hypermobility according to the modified Beighton criteria [21] and the measurements of height and weight. Body mass index (BMI) was calculated as weight in kilograms/ (height in meters)^2 and categorized into <25 kg/m^2 or ≥ 25 kg/m^2 based on prevalence data. Information about labor, delivery and the newborn was obtained from the clinical charts.

The influence of mode of delivery on pelvic organ support was analyzed comparing the differences of individual POPQ point measurements between the groups. It was also evaluated by comparing the proportion of women included in POPQ stage ≥ II. These analyses were adjusted for age, BMI and joint hypermobility.

A possible increase in the risk of POPQ stage ≥ II following instrumental vaginal delivery in comparison with spontaneous vaginal delivery was also investigated.

We included the following variables as potential confounders: age, BMI, joint hypermobility, use of epidural anesthesia, oxytocin use, length of the second stage of labor, episiotomy, newborn weight and head circumference. Second stage of labor was defined as time from full cervical dilatation to delivery and active second stage of labor was defined as the phase of active pushing. The second stage of labor was considered "prolonged" when it lasted two or more hours, while prolonged pushing time was defined as one hour or more. Newborn weight and head circumference were also categorized as <4000 g or ≥ 4000 g, and < 36 cm or ≥ 36 cm respectively.

All the patients included in the present study were fully informed about the study before enrollment and gave their consent. The study protocol was approved by the Donostia Hospital Medical Ethics and Research Committee.

Statistical analysis of the data

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS version 15.0 for Windows). Association of clinical and demographic characteristics with the presence of prolapse six months after delivery was examined by comparison of means (Student's t test, analysis of variance) and percentages (Chi-square and Fisher's test). Statistical significance was set as p=0.05. A linear regression model and a logistic regression model were used for multivariable analysis. The linear regression model was built including age, body mass index and joint hypermobility as potential confounders because they are recognized risk factors for prolapse. The logistic regression models were built including these potential confounders and also the variables that were near to statistical significance (p<0.2) in the univariant analysis.

Results

Three hundred eighty two primiparous women who delivered at term in our hospital participated in this study. Another 47 women were also invited to participate but declined. Mean age of the study group was 31.2 years (range 18-46) and mean BMI was 23.3 (range 15.9- 44.2). Of the total, 52 (13.6%) were delivered by caesarean section (18 scheduled and 34 intrapartum), 237 (62%) had a spontaneous vaginal delivery, and the remaining 93 (24.3%) were delivered instrumentally (62 by forceps and 31 using spatulas).

The individual POPQ point measurements for all 382 postpartum exams according to mode of delivery and the comparison between the groups adjusted for age, BMI and joint hypermobility are shown in table 1. Both points of the anterior compartment (Aa, Ba) were significantly higher after spontaneous and instrumental vaginal delivery when we compared them with caesarean section. The comparison between spontaneous and instrumental vaginal delivery showed significantly higher values in the anterior compartment among the women delivered instrumentally.

The pelvic organ prolapse quantification system stages for the population were distributed as follows: stage 0, 18.6%; stage I, 62.0%; and stage II, 19.4%. None of the examined women had a POPQ stage higher than II. The distribution of prolapse stage according to mode of delivery is shown in table 2. In all but one of the patients who presented a POPQ stage ≥ II the prolapsed compartment was the anterior. We also evaluated the risk of POPQ stage ≥ II after spontaneous and instrumental vaginal delivery in comparison with caesarean section, among other constitutional and obstetric factors. This analysis indicated that both spontaneous and instrumental vaginal delivery were associated with prolapse (table 3). The result of the multivariable model built with age, BMI and joint hypermobility as potential confounders and mode of delivery is shown in table 5. Specifically, spontaneous vaginal delivery was found to more than treble the risk (OR: 3.19; 95% CI:1.07–9.49) while with instrumental vaginal delivery it increased more than five-fold (OR: 5.52; 95% CI:1.79–17.30).

To evaluate the role of instrumental vaginal delivery in prolapse among women who delivered vaginally we also considered other obstetrical variables as potential risk factors. The univariant analysis (table 4) indicated that women delivered instrumentally had nearly double the risk of prolapse. There was also an association between POPQ stage ≥ II and both increased BMI and use of oxytocin but in both cases this did not reached statistical significance. We built a multivariable model with these variables and also age and joint hypermobility as potential confounders. We were not able to demonstrate that instrumental vaginal delivery was independently associated with prolapse six months postpartum (table 5), although this result was limited by the sample size.

Discussion

This observational study describes the differences in pelvic organ support six months postpartum among women delivered by cesarean section, spontaneous and instrumental (forceps or spatulas) vaginal delivery. We report the individual POPQ point measurements and the pelvic organ prolapse quantification system stage of each group, as well as the comparisons between the groups. Forceps and Thierry's spatulas were included in the same group assuming that spatulas can be considered unarticulated forceps. Moreover, it has previously been reported that pelvic floor damage is nearly the same when delivery is assisted with spatulas or forceps [22].

Points Aa and Ba, corresponding to the anterior compartment, had significantly higher mean values after spontaneous and instrumental vaginal delivery in comparison with cesarean section. However, the other measurements appear to be similar across the groups. The effect of vaginal delivery on the anterior compartment has been previously reported. Dannecker et al. [17] using POPQ measurements indicated more evidence of anterior vaginal wall descent after vaginal delivery in comparison with a nulliparous control group. Sze et al. [16] reported that 97% of the 78 women with pelvic organ prolapse 6 weeks postpartum had the more severe defect in the anterior vaginal wall. Handa et al. [18] also found a trend toward poorer support of the anterior vaginal wall in the vaginal delivery cohort as compared to cesarean without labor. Meyer et al. [15] using the Baden-Walker system published an incidence of cystocele in 53 % of 82 women delivered by spontaneous vaginal delivery, whereas the incidences of uterine prolapse and rectocele were only 8% and 2% respectively.

In terms of pelvic organ prolapse quantification system stage, it was found that 19.4% women assessed as POPQ stage ≥ II. There has been some data published in this field, but the prolapse prevalence varies considerably. Sze et al. [16] found postpartum prolapse in 50 out of 94 primiparous women (52%) 6 weeks after delivery. Similarly, O`Boyle et al. [14] found POPQ stage II in two thirds of 62 primiparous women examined 5-22 weeks postpartum. Handa et al. [18] found stage II support in only one third of women examined one year after delivery. The differences may be due to timing of the postpartum evaluation. When the examination was performed shortly after delivery [14,16] it is likely that the recovery of pelvic floor structures had not yet been completed. We choose six months for evaluation because recovery of connective tissue and complete pelvic floor muscles contractility is known to take up to six months [23].

Further, some differences may be secondary to the specific characteristics of the populations studied. Indeed, Handa et al. [18] evaluated prolapse in a select population including a large number of primiparous women with a recognized anal sphincter laceration.

Similar to other authors [14,16,18], we observed a low prevalence of prolapse after cesarean section. We found prolapse stage ≥ II in only 4 (7.7%) women who had undergone cesarean sections. Our results suggest that cesarean section, regardless of whether is performed prior to the onset of labor or intrapartum, has a protective effect against pelvic floor damage. Spontaneous vaginal delivery more than trebles the risk for prolapse and instrumental vaginal delivery increases the risk by more than five-fold. Our results agree with published data suggesting that prolapse is particularly associated with pelvic floor injuries sustained during vaginal delivery and that caesarean section may decrease the risk of pelvic organ prolapse [4,24,25].

Once we had shown that vaginal delivery increased the risk of prolapse, we also wanted to evaluate the specific effect of different labor and delivery variables that have been associated with a greater pelvic floor injury. These include the use of oxytocin, prolonged second stage of labor, higher infant birth weight and instrument-assisted deliveries. The univariant analysis indicated that instrument-assisted delivery was associated with an increase in the risk for prolapse, but when we included this variable in a multivariable model with other obstetric factors it did not reach statistical significance. Our findings suggest that forceps-assisted delivery does not increase the level of damage in pelvic support six months after first vaginal delivery, although this result should be interpreted with care because the statistical power of the sample size was limited. In any case, these results are in agreement with other authors. Meller et al. [15] published similar cystocele, uterine prolapse and rectocele rates 10 months postpartum among 82 women who delivered spontaneously and 25 who were assisted using forceps. There is also some evidence that forceps-assisted vaginal delivery does not increase the risk of symptomatic pelvic organ prolapse [4] or prolapse requiring surgery later in life [24,26].

The strengths of this study include the use of a validated instrument to assess pelvic organ support. Moreover, all the examinations were performed by or under the supervision of the same experienced gynecologist, and during the pelvic floor exam the gynecologists were blinded to delivery data to reduce bias.

Our study had several limitations that should be considered when interpreting the results. The study was cross-sectional and thus cannot determine causal associations. This design also implied the evaluation of the odds ratio instead of the risk ratio, and this value could overestimate the risk because the prevalence of prolapse was more than 5 %. Postpartum differences in pelvic support cannot be attributed only to mode of delivery, since pregnancy itself has been associated with prolapse. Pelvic floor evaluations during pregnancy have indicated that there is an increase in prolapse grade in the third trimester compared with the first trimester of pregnancy [14]. Furthermore, although childbirth is the major risk factor for pelvic organ prolapse, there is evidence that congenital factors may also play a role. The evaluation of the protective effect of a caesarean section also had limitations. Due to the small number of cases, scheduled caesareans were not separated from those performed during the active phase of labor. In women delivered by intrapartum caesarean section, there could be an influence of labor variables. In any case, none of the labor factors analyzed in our study were found to be independently associated with prolapse. Finally, as we have pointed out above, the evaluation of the effect of instrumental-assisted delivery among women delivered vaginally was limited by the sample size.

Despite these limitations, we were able to describe pelvic organ support differences among women delivered by cesarean section, spontaneous and instrumental vaginal delivery. Our results suggest that cesarean section has a protective effect against pelvic floor supporting structures damage. The study also indicates that forceps- or spatulas-assisted delivery is not independently associated with an increased risk of prolapse among women who delivered vaginally.

Further research is required to investigate the significance of support defects in the postpartum period for the prognosis of developing symptomatic prolapse later in a woman's life.

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Table 1. Individual POPQ point measurements for all 382 postpartum examinations according to mode of delivery and comparison between the groups

POPQ points	Mode of delivery			Mean differences (B) and *P* values*					
	Caesarean (n=52)	Spontaneous (n=237)	Instrumental (n=93)	Caesarean vs. spontaneous		Caesarean vs. instrumental		Spontaneous vs. instrumental	
				B	*P* value	B	*P* value	B	*P* value
Aa	-2.4±0.7	-1.9±0.7	-1.7±0.7	0.41	0.001	0.67	0.000	0.20	0.04
Ba	-2.4±0.7	-1.9±0.7	-1.7±0.8	0.43	0.001	0.69	0.000	0.19	0.05
Ap	-2.8±0.4	-2.9±0.2	-2.9±0.2	-0.05	0.28	-0.04	0.44	0.01	0.69
Bp	-2.8±0.4	-2.9±0.2	-2.0±0.2	-0.05	0.25	-0.04	0.44	0.01	0.62
C	-6.4±0.9	-6.3±1.0	-6.2±1.0	0.10	0.51	0.10	0.54	0.05	0.64
D	-8.3±0.9	-8.3±0.9	-8.4±0.8	-0.09	0.55	-0.17	0.24	-0.04	0.68
Tvl	8.5±0.9	8.6±0.8	8.6±0.7	0.074	0.56	0.16	0.23	0.04	0.63
Pb	3.2±0.7	3.1±0.6	3.1±0.7	0.00	0.95	0.00	0.94	-0.03	0.67
Gh	2.1±0.6	2.0±0.6	2.0±0.6	-0.08	0.37	-0.02	0.83	0.01	0.84

(*) *P* values adjusted for age, BMI and joint hypermobility

Table 2 Distribution of prolapse grade as a function of delivery

POPQ stage*	Mode of delivery		
	Caesarean (n=52)	Spontaneous (n=237)	Instrumental (n=93)
0	18 (34.6)	44 (18.6)	9 (9.7)
I	30 (57.7)	150 (63.3)	57 (61.3)
II	4 (7.7)	43 (18.1)	27 (29.0)

(*) None of the examined women had a POPQ stage higher than II

Table 3 Results of the univariant analysis performed to evaluate factors involved in POP six months postpartum among the 382 primiparous women included in the study

Obstetric and constitutional variables		**n**	**POPQ stage ≥ II** (n=74)	OR	(95% CI)	*P* value
Maternal age (years)	< 30	104	16 (15.4)	1.00	(reference)	0.63
	30-34	208	42 (20.2)	1.39	(0.74-2.61)	
	35-39	65	15 (23.1)	1.65	(0.75-3.61)	
	≥ 40	5	1(20.0)	1.37	(0.14-13.11)	
Maternal BMI	< 25	286	50 (17.5)	1.00	(reference)	0.10
	≥ 25	96	24 (25.0)	1.57	(0.90-2.73)	
Joint hypermobility	No	343	64 (18.7)	1.00	(reference)	0.29
	Yes	39	10 (25.6)	1.50	(0.69-3.24)	
Mode of delivery	Cesarean	52	4 (7.7)	1.00	(reference)	0.006
	Spontaneous	237	43 (18.1)	2.66	(0.91-7.77)	
	Forceps or spatula	93	27 (29.0)	4.90	(1.61-14.95)	
Birth weight ≥ 4000 g	No	359	70 (19.5)	1.00	(reference)	0.80
	Yes	23	4 (17.4)	0.86	(0.28-2.63)	
Cephalic perimeter ≥ 36cm	No	301	56 (18.6)	1.00	(reference)	0.46
	Yes	81	18 (22.2)	1.25	(0.68-2.27)	

Table 4. Results of the univariate analysis performed to evaluate factors involved in POP six months postpartum among the 330 primiparous women delivered vaginally

Obstetric and constitutional variables		**n**	**POPQ stage ≥ II** (n=70)	OR	(95% CI)	*P* value
Maternal age (years)	< 30	95	16 (16.8)	1.00	(reference)	0.59
	30-34	181	40 (22.1)	1.40	(0.73-2.66)	
	35-39	50	13 (26.0)	1.73	(0.75-3.97)	
	≥ 40	4	1(25.0)	1.64	(0.16-16.85)	
Maternal BMI	< 25	251	48 (19.1)	1.00	(reference)	0.09
	≥ 25	79	22 (27.8)	1.63	(0.91-2.92)	
Joint hypermobility	No	295	62 (21.0)	1.00	(reference)	0.80
	Yes	35	8 (22.9)	1.11	(0.48-2.57)	
Mode of delivery	Spontaneous	237	43 (18.1)	1.00	(reference)	0.029
	Forceps or spatula	93	27 (29.0)	1.84	(1.05-3.22)	
Use of oxytocin	No	64	8 (12.5)	1.00	(reference)	0.058
	Yes	266	62 (23.3)	2.12	(0.96-4.70)	
2nd stage of labor ≥ 2 hours	No	232	49 (21.1)	1.00	(reference)	0.95
	Yes	98	21 (21.4)	1.01	(0.57-1.81)	
Active 2nd stage of labor ≥ 1 hour	No	310	64 (20.6)	1.00	(reference)	0.32
	Yes	20	6 (30.0)	1.64	(0.60-4.45)	
Epidural anesthesia	No	17	2 (11.8)	1.00	(reference)	0.32
	Yes	313	68 (21.7)	2.08	(0.46-9.32)	
Episiotomy	No	67	13 (19.4)	1.00	(reference)	0.68
	Yes	263	57 (21.7)	1.14	(0.58-2.25)	
3rd or 4th degree tears	No	323	68 (21.1)	1.00	(reference)	0.63
	Yes	7	2 (28.6)	1.50	(0.28-7.90)	
Birth weight ≥ 4000 g	No	311	66 (21.2)	1.00	(reference)	0.98
	Yes	19	4 (21.1)	0.99	(0.31-3.08)	
Cephalic perimeter ≥ 36cm	No	260	54 (20.8)	1.00	(reference)	0.70
	Yes	70	16 (22.9)	1.13	(0.60-2.12)	

Table 5 Results of the multivariable analysis performed to evaluate the influence of mode of delivery on POP six postpartum

Mode of delivery	n	POPQ stage ≥ II	Caesarean and vaginal delivery group n=382		Vaginal delivery group n=330	
			Adjusted OR*	(95%CI)	Adjusted OR**	(95%CI)
Caesarean section	52	4 (7.7)	1.00	(reference)	-	-
Spontaneous	237	43 (18.1)	3.19	(1.07-9.49)	1.00	(reference)
Instrumental	93	27 (29.0)	5.52	(1.79-17.30)	1.58	(0.89-2.81)

(*) OR adjusted for age, body mass index and joint hypermobility

(**) OR adjusted for age, body mass index, joint hypermobility and use of oxytocin