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ORIGINAL ARTICLE

Obstetric anal sphincter injury following previous vaginal delivery

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Abstract

Introduction and hypothesis Obstetric anal sphincter injury (OASI) is a debilitating complication of vaginal delivery. The aim of this study was to identify risk factors for OASI in women with a previous vaginal delivery. We further attempted to detect specific risk factors for severe OASI in this subgroup.

Methods We conducted a retrospective cohort study between 2003 and 2019. The study group included women who had a singleton, live, vertex, vaginal delivery at term and who also had at least one previous vaginal delivery. The control group included women with at least one previous vaginal delivery without OASI. General medical history, obstetric history, and ante-, intra- and post-partum data were collected and compared between groups.

Results Following implementation of the inclusion criteria, 79,176 women were included. Allocation to study groups was according to OASI occurrence: 135 patients (0.2%) had a third- or fourth-degree perineal tear, while 79,041 patients (99.8%) had no such injury. Multivariate analysis revealed that one previous vaginal delivery, birthweight ≥ 3900 g (90th percentile), vacuum-assisted vaginal delivery and episiotomy were associated with increased risk of OASI. Comparison of more severe OASI (3C and 4th-degree) cases to the control group showed similar results with the addition of prolonged second stage and younger age to risk factors associated with severe OASI while episiotomy was no longer significant.

Conclusion In women with a previous vaginal delivery, one vs. two or more previous vaginal deliveries, increased birthweight, vacuum-assisted vaginal delivery and episiotomy are risk factors for OASI.

Keywords Obstetric anal sphincter injury · Parous women · Perineal laceration · Primiparity · Previous vaginal delivery

Introduction

Obstetric anal sphincter injury (OASI) is a common cause of fecal incontinence (FI) in women, a debilitating complication of vaginal delivery. Reports have shown up to 50% of women suffering from such injury may develop FI [1, 2]. Other complications include pelvic floor and sexual dysfunction, perineal pain and rectovaginal fistula [3].

Nulliparity has been established as one of the leading risk factors for OASI in numerous studies [4–8]. Other variables, such as prolonged second stage, shoulder dystocia, operative vaginal delivery, increased birthweight and large head circumference, have also been suggested as risk factors for OASI [9–13].

Women who have had a previous vaginal delivery are a unique group with previous studies estimating the OASI rate to be substantially lower than in nulliparous women [14–19]. Furthermore, most studies dealing with OASI in parous women have focused on risk of OASI during vaginal birth after cesarean delivery (VBAC) [20–24]. These studies included

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both women for whom it was their first vaginal delivery and women who had given birth vaginally in the past. While it is plausible that certain risk factors may be shared by nulliparous and parous women, some studies have speculated that parous women may have specific risk factors for OASI [25]. To date, data regarding risk factors for OASI in women with a previous vaginal delivery are scarce.

The aim of this study was to identify risk factors for OASI in women with a previous vaginal delivery. We further attempted to detect specific risk factors for severe OASI in this subgroup.

Materials and methods

We performed a retrospective cohort study from 2003 to 2019. Included were women who had a singleton, live, vertex, vaginal delivery at term and who also had at least one previous vaginal delivery. Excluded were women with multifetal pregnancies, breech presentation, preterm delivery, intrauterine fetal death, cesarean delivery and women who did not deliver vaginally in the past. We compared parous women who were diagnosed with OASI following vaginal delivery to those who were not. The control group included women with at least one previous vaginal delivery who gave birth from 2003 to 2017 and who did not suffer from OASI. Institutional review board approval was received for this study (IRB 0348-20-HMO).

General medical history, obstetric history, and ante-, intra- and post- data were obtained from the delivery room management software used in our medical center. Among parameters collected were age, parity, previous cesarean delivery, comorbidities, gestational week at delivery, method of labor initiation, epidural analgesia, prolonged second stage, persistent occipito-posterior position, mode of delivery, birthweight, head circumference and episiotomy. With respect to type of episiotomy, during the study period common practice in our department was to perform a mediolateral episiotomy.

Our medical center is a tertiary university teaching hospital catering to a large population within the public healthcare system. During delivery it is common practice in our institution to perform hands-on delivery with vertex advancement controlled using perineal protection. Operative vaginal delivery is performed almost exclusively using vacuum-assisted vaginal delivery, with forceps delivery seldom used. With regard to episiotomy, standard protocol includes performing an episiotomy when clinically indicated (because of fetal distress or high risk of perineal trauma). Definition of prolonged second stage for parous women is 2 h and 1 h with and without epidural analgesia, respectively.

Perineal tears were classified according to the American College of Obstetricians and Gynecologists (ACOG) practice bulletin [26]. According to this system a 3a tear includes injury to < 50% of the external anal sphincter while a 3b tear > 50% of the external anal sphincter. Once the internal anal sphincter is injured the tear is classified as 3c, and a fourth-degree tear involves the anal sphincter as well as anal epithelium [26]. Our department's protocol regarding diagnosis of OASI has been previously described by us [27]. In short, upon suspicion of OASI, assessment of the laceration is performed by the most senior physician on the labor and delivery floor. When there is a question regarding degree of laceration, a general surgeon is called upon to evaluate the tear. Once diagnosis of OASI is confirmed, the patient is transferred to the operating room where the injured sphincter and vaginal laceration are repaired.

Statistical analysis

Statistical analysis in this study was performed using Office Excel 2010 (Microsoft, Seattle, WA) and IBM SPSS 27 for Windows (IBM corp. Armonk, NY). The chi-square and Fischer exact tests were used for categorical variables and the *t*-test and Mann-Whitney tests for continuous variables. Following univariate analysis, multivariate analysis using logistic regression was implemented. We report adjusted odds ratios (aOR), 95% confidence interval (CI) for parameters included in the final multivariate analysis. A two-sided p value with a value < 0.05 were considered significant.

Results

During the study period, 146,836 deliveries were evaluated, with 35,146 cesarean deliveries excluded following implementation of the exclusion criteria. Out of 111,690 deliveries remaining, 79,176 parturients had a previous vaginal delivery and therefore were included in the final analysis. Allocation to study groups was according to OASI occurrence: 135 patients (0.2%) had a third- or fourth-degree perineal tear (OASI group), while 79,041 patients (99.8%) had either a first-degree, second-degree or no perineal tear (no OASI group) (Fig. 1).

Descriptive statistics of parturients with OASI vs. without OASI are presented in Table 1. Mean age of the entire study population was 30.1 ± 5.5 years, and the average number of previous vaginal deliveries was 2.6 ± 1.9. Patients with OASI were more likely to be younger, with fewer previous vaginal deliveries and more advanced gestational week at delivery. Within the OASI group 84 women (62.2%) had one previous vaginal delivery, 29 (21.5%) had two deliveries, and 22 (16.3%) had three or more vaginal deliveries prior to OASI occurrence. Rates of VBAC did not differ between the groups (8.1% vs. 7.5% for OASI vs. no OASI, respectively, $p = 0.743$).

During the course of labor, OASI patients were more likely to experience prolonged second stage (8.3% vs. 2.7%, $p < 0.001$) and to undergo a vacuum-assisted vaginal delivery (12.6% vs. 3.0%, $p < 0.001$). They were also more likely to

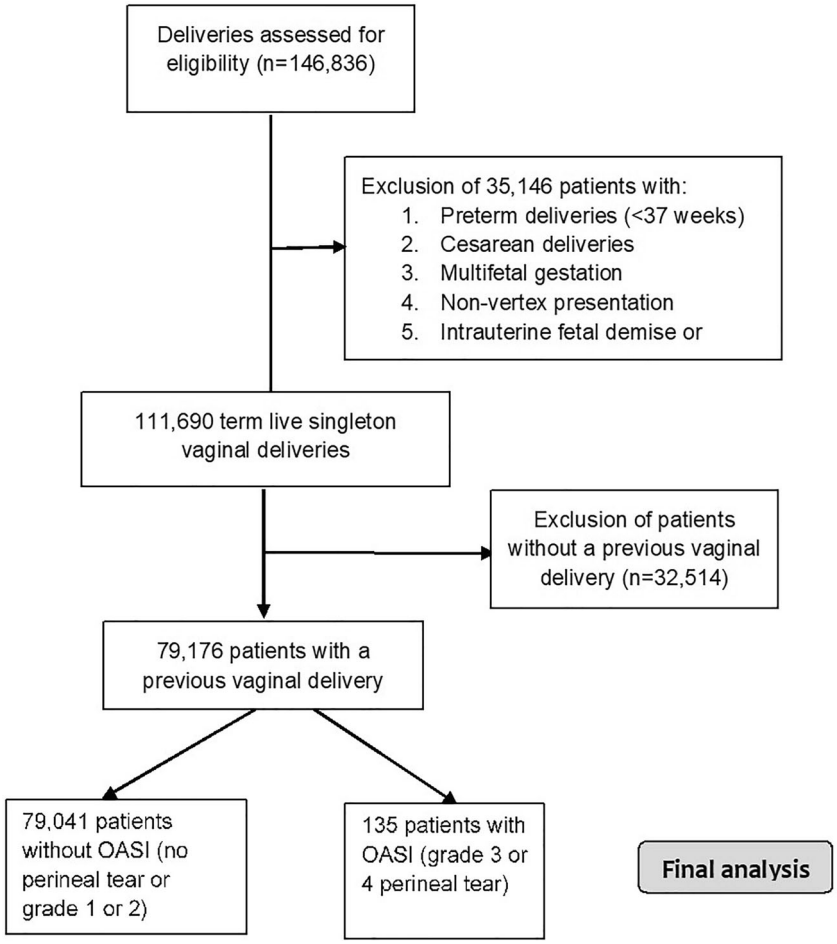

Fig. 1 Study population flow chart

Table 1 Demographic and obstetric characteristics of the study population patients with and without obstetric anal sphincter injury ($N = 79,176$)

Parameter	OASI	No OASI	*P* value*
No. of patients	135 (0.2%)	79,041 (99.8%)	
Age	29.8±4.6	30.8±5.2	0.021
Parity	1.8±1.2	2.7±1.9	< 0.001
1	78 (57.8%)	25,326 (32.0%)	< 0.001
2–3	44 (32.6%)	34,903 (44.2%)	
4 or more	13 (9.6%)	18,812 (23.8%)	
One previous vaginal delivery	78 (57.8%)	25,326 (32.0%)	< 0.001
VBAC delivery	11 (8.1%)	5932 (7.5%)	0.743
Gestational diabetes	5 (3.7%)	1393 (1.8%)	0.092
PIH/preeclampsia	1 (0.7%)	370 (0.5%)	0.518
Gestational week	39.9±1.2	39.5±1.2	< 0.001

Data presented as mean ± SD or *n*(%) or *n*/*N* (%)

OASI, obstetric anal sphincter injury; PIH, pregnancy-induced hypertension; VBAC, vaginal birth after cesarean

**P*-values indicate comparison of parturients with and without OASI tears grade 3–4 and were calculated for $\chi 2$ test for dichotomous features and Mann-Whitney U test for continuous features

give birth to neonates with increased birthweight (3678 ± 438 vs. 3357 ± 418 g, $P < 0.001$) and larger head circumference (34.9 ± 1.1 vs. 34.4 ± 1.2, $p = 0.005$). Birthweight > 3900 g and head circumference > 36 cm were cutoff points for the 90th percentile. Neonates born to mothers with OASI had higher rates of birthweight ≥ 3900 g (31.9% vs. 10.1% $p < 0.001$) and head circumference ≥ 36 cm (24.1% vs. 10.6%, $p = 0.028$) (Table 2). Finally, rates of episiotomy were significantly higher among those with OASI compared to those without (10.4% vs. 2.5%, respectively; $p < 0.001$).

Multivariate analysis for the entire study population (Table 3) was performed, with the following parameters associated with OASI: a single vs. two or more previous vaginal deliveries (OR = 0.33, CI [0.22–0.49]), birthweight ≥ 3900 g (OR = 4.82, CI [3.32–6.98], $p < 0.001$), vacuum-assisted vaginal delivery (OR = 2.99, CI [1.65–5.41], $p < 0.001$) and episiotomy (OR = 2.14, CI [1.18–3.86], $p = 0.012$). Head circumference was not included in the multivariate analysis because of a large number of cases for which this parameter was missing.

Obstetric anal sphincter tear degree: 3A, 3B, 3C or 4 was available for 103 of 135 patients (76.3%). Distribution of perineal tear grade among OASI cases is presented in Fig. 2.

Table 2 Labor-related characteristics of the study population – patients with and without obstetric anal sphincter injury (OASI)

Parameter	OASI	No OASI	*P* value*
No. of patients	135 (0.2%)	79,041 (99.8%)	
Induction of labor	20 (14.8%)	10,818 (13.7%)	0.717
Epidural analgesia	62 (54.1%)	36,470 (46.1%)	0.999
Artificial rupture of membranes	69 (56.1%)	37,852 (58.1%)	0.361
Meconium-stained amniotic fluid	25 (18.7%)	12,576 (16.6%)	0.494
Prolonged 2nd stage	11 (8.3%)	2002 (2.7%)	< 0.001
Persistent occipito-posterior position	2983 (3.8%)	2983 (3.8%)	0.175
Mode of delivery			
Vaginal	118 (87.4%)	76,684 (97.0%)	Referent
Vacuum assisted	17 (12.6%)	2336 (3.0%)	< 0.001
Forceps assisted	0 (0.0%)	21 (0.0%)	1.000
Episiotomy	14 (10.4%)	1753 (2.5%)	< 0.001
Birthweight (g)	3678±438 (3700)	3357±418 (3348)	< 0.001
Birthweight>90th percentile (> 3900 g)	43 (31.9%)	7943 (10.1%)	< 0.001
Head circumference (cm)	34.9±1.1 (35)	34.4±1.2 (33.4)	0.005
Head circumference>90th percentile (> 36 cm)**	7 (24.1%)	3201 (10.6%)	0.028

Data presented as mean ± SD (median) or *n* (%) or *n*/*N* (%)

**P*-values indicate comparison of parturients with and without OASI tears grade 3–4 and were calculated for $\chi 2$ test for dichotomous features and Mann-Whitney U test for continuous features

**Electronic records available since 2010 for 29 in tear group and for 30,285 in the remaining cohort

Further analysis was performed for the OASI subgroup looking at severe OASI cases: 3C and fourth-degree tears ($n = 43$) compared to the no OASI group ($n = 79{,}041$). This analysis showed similar results, as the severe OASI group had higher rates of a single previous vaginal delivery (46.5% vs. 32.0%), more advanced gestational age (39.9 ± 1.2 vs. 39.5 ± 1.2, $p = 0.006$), lower rates of induction by artificial rupture of membranes (40.5% vs. 58.1%, $p = 0.027$) and higher rates of vacuum-assisted vaginal delivery (16.3% vs. 3.0%, $p < 0.001$). Furthermore, neonates in the severe OASI group had increased birthweight (3646 ± 484 vs. 3358 ± 418 g, $p < 0.001$) as well as increased rate of birthweight ≥ 3900 g (27.9% vs. 10.1%, $p < 0.001$) and larger head circumference (35.2 ± 0.63 vs. 34.4 ± 1.6 cm, $p < 0.001$). Multivariable logistic regression analysis for this subgroup showed that younger age (OR = 0.92, CI (0.89–0.95), $p < 0.001$), a single vs. two or more previous vaginal deliveries (OR = 0.5, CI [0.31–0.81], $p = 0.005$), prolonged second stage of labor (OR = 2.17, CI [1.39–3.36], $p < 0.001$), birthweight ≥ 3900 g (OR = 2.98, CI [1.99–4.46], $p < 0.001$) and vacuum-assisted vaginal delivery (OR = 3.89, CI [2.62-5.78], $p < 0.001$) were all associated with severe OASI.

Table 3 Multivariate analysis of parameters associated with obstetric anal sphincter injury in patients with a previous vaginal delivery

Parameter	OR (95% CI)	*P* value
Age	0.99 (0.96–1.03)	0.704
No. of previous vaginal deliveries		
One	Referent	
Two or more	0.33 (0.22– 0.49)	< 0.001
Prolonged second stage of labor	1.86 (0.92–3.76)	0.085
Birthweight≥3900 g	4.82 (3.32–6.98)	< 0.001
Delivery type		
Vaginal	Referent	
Vacuum extraction	2.99 (1.65–5.41)	< 0.001
Episiotomy	2.14 (1.18–3.86)	0.012

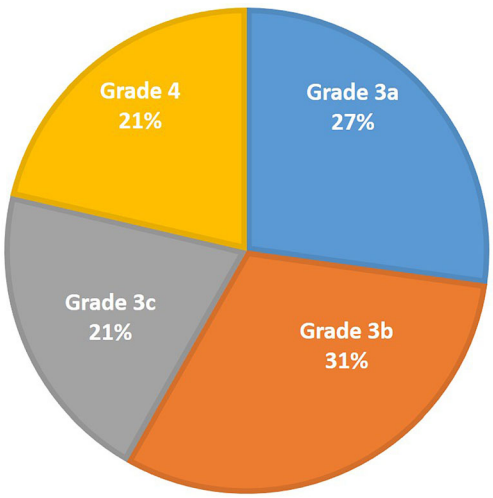

Fig. 2 Distribution of obstetric anal sphincter injury by degree of tear

Discussion

In this study, we attempted to describe risk factors for OASI in women who have given birth vaginally in the past. We found a single previous vaginal delivery, birthweight ≥ 3900 g, vacuum-assisted vaginal delivery and episiotomy to be independent risk factors for OASI. Large head circumference was also associated with OASI but was not included in multivariate analysis because of the large number of cases for which this parameter was missing. We further assessed risk factors for more severe OASI (3C and 4th-degree perineal tear) finding single previous vaginal delivery, younger age, prolonged second stage, birthweight ≥ 3900 g and vacuum-assisted vaginal delivery to be associated with these severe cases.

Few studies have focused on parous women with respect to OASI with the majority of these concentrating on risk of OASI during VBAC delivery. Most of these studies found increased risk of OASI during VBAC but these also included women without a previous vaginal delivery [20–24]. In this study we chose to exclude partuerients who did not have a previous vaginal delivery so as to give a more accurate representation of this subgroup.

In one recent study comparing women with OASI following at least one vaginal delivery to women without such injury, the authors found history of one previous vaginal delivery and increased neonatal birthweight to be independent risk factors for OASI [25]. Our results show similar findings with women who had one previous delivery demonstrating three times the risk of OASI compared to women with two previous deliveries. Though within the OASI group we did find a trend of decreased OASI as parity increases, we believe the small number of OASI cases in women with two and three or more vaginal deliveries limited our ability to reach conclusive results with respect to these subgroups.

The role of episiotomy in preventing OASI is a point of much debate. Muraca et al. presented their population based retrospective study including > 2.5 million deliveries showing that episiotomy was associated with higher rates of OASI following spontaneous vaginal delivery. This association remained significant following stratification by parity and obstetric history. In contrast, a protective effect was shown in nulliparous women following forceps and vacuum-assisted vaginal deliveries, but this effect was lost in women who had previously delivered vaginally [19]. In our study episiotomy was a risk factor for formation of OASI. While in theory mediolateral episiotomy has the potential to redirect shear forces away from the anal sphincter, it may under certain circumstances become a leading point for a tear involving the anal sphincter complex. These results reinforce a more restrictive approach toward episiotomy especially in parous women.

Obstetric anal sphincter tears have traditionally been categorized according to the anatomical structures involved: 3a/3b: injury to the external anal sphincter; 3c: external and internal anal sphincter; 4: injury involving the anal sphincter complex and anal epithelium [26]. Previous studies have shown a clear correlation between severity of OASI and future risk of fecal and flatus incontinence [28, 29]. They have also shown a correlation among initial tear grading, residual defect on endo-anal ultrasound and specific symptoms of anal incontinence [30]. We found more severe cases of OASI (3C and 4th-degree tears) to be associated with younger age, a single vs. two or more previous vaginal deliveries, prolonged second stage of labor, birthweight ≥ 3900 g and vacuum-assisted vaginal delivery. Though all cases of OASI may have a detrimental effect on future incontinence, perhaps there is merit in focusing on more severe OASI, in which chances of fecal and flatus incontinence are substantially higher. Future research may allow for a better understanding of risk factors in this subgroup.

This study was conducted over almost 2 decades. While this fact enabled us to include a large number of cases, questions may be raised regarding the effect of change in practice over time on obstetric outcomes. One recent study which attempted to describe temporal trends in risk factors for OASI found the effect of primiparity, VBAC delivery and vacuum extraction to have increased during the study period. A better understanding of how risk factors change over time may be instrumental in lowering OASI rates [31].

Effective prevention of OASI is a goal which has yet to be achieved. The main difficulty is that most risk factors are non-modifiable, inherent maternal or neonatal parameters. Two risk factors found by us to increase risk of OASI which may be altered during labor are prolonged second stage and use of vacuum-assisted vaginal delivery. Though difficult to avoid in certain clinical scenarios, a more restrictive use of these interventions may be warranted in certain cases.

Strengths of this study include a relatively large cohort and comparative construct. Furthermore, this is one of the only studies to focus on women following a previous vaginal delivery with respect to their risk of OASI. Thanks to the availability of data regarding degree of OASI, we were able to present data regarding more severe cases of OASI in this subgroup.

The main limitation of this study is its retrospective design. Certain parameters such as previous OASI and head circumference were missing for part of the study period. The control group included cases up to 2017 but due to lack of change in common practice we believe this had little effect on our results. Data regarding type of episiotomy were not always available but since common practice in our medical center included mediolateral episiotomy, the effect of median episiotomy on our results seems negligible. Data were collected over a long period of time which in theory could cause our results to be affected by change in medical practice.

Conclusion

In summary, women with a previous vaginal delivery are a group which should be given special consideration with respect to their risk of OASI. One previous vaginal delivery, birthweight > 3900 g, large head circumference, vacuum-assisted vaginal delivery and episiotomy were shown to be associated with increased risk of OASI. While some of these risk factors are shared with nulliparous women, larger studies may enable identification of other risk factors and a better understanding of the mechanisms leading to OASI in this subgroup.

Author's contribution Chill: Project development, data collection, data analysis, manuscript writing and editing.

Karavani: Project development, data collection, data analysis, manuscript writing and editing.

Lipschuetz: Data collection, data analysis, manuscript editing.

Berenstein: Data collection, data analysis.

Eyal Atias: Data collection, data analysis.

Hagai Amsalem: Data analysis, mansuscriprt editing.

Shveiky: Project development, data analysis, manuscript writing and editing.

Declarations

Financial support None.

Conflicts of interest None.

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