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Influence of prior delivery mode on perineal trauma risk

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Declarations of Interest: The authors declare that they have no conflicts of interest.

Financial disclaimer/conflict of interest: none

Funding: none

Abstracts based on this study previously presented at RCOG World Congress London, 2019 and ICS Tokyo 2016

Contribution to authorship:

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Word Count: 2707

Abstract

Influence of prior delivery mode on perineal trauma risk

Objective

To evaluate the impact of a previous pregnancy and delivery on perineal trauma rates in the subsequent vaginal birth.

Methods

Retrospective cohort study. The perineal outcomes of secundiparous women with history of previous (first) delivery in one of three categories: failed operative vaginal delivery (FOVD) and second stage emergency caesarean section (EmCS); elective caesarean section (ELCS), and vaginal delivery (VD) with intact perineum, were compared with a control primiparous group.

Results

The percentage OASIs at first vaginal delivery after prior FOVD+EmCS was 17.3%(n=9), 12.9%(n=18) after previous ELCS, and 0.6%(n=9) after prior VD maintaining an intact perineum, compared with 6%(n=1193) in the control primiparous group of women. Multivariate regression analysis demonstrated prior FOVD+EmCS and ELCS were associated with a statistically significant increased risk of OASIs of 180% and 110% when compared to control (odds ratio (OR): 2.80; 95% confidence interval (CI): 1.35-5.78 and OR: 2.10; 95%CI: 1.27-3.48) respectively. Prior VD with intact perineum was associated with a statistically significantly reduced risk of OASIs (OR: 0.09; 95%CI: 0.04-0.17).

Conclusions

Previous FOVD+EmCS and ELCS were associated with increased risk of OASIs in subsequent vaginal delivery compared to control, whilst previous VD with intact perineum was associated with decreased risk.

Word Count: 197

Keywords: Caesarean section, OASIs, perineal tear, previous mode of delivery, risk factors, VBAC

Synopsis: A previous emergency Caesarean following failed instrumental or an elective Caesarean delivery is associated with increased risk of OASIs in subsequent vaginal delivery.

Manuscript

Introduction

Third- and fourth-degree perineal trauma, alternatively called obstetric anal sphincter injuries (OASIs), is a complication of vaginal delivery. Over the past two decades there has been an increase in the incidence of OASIs, with some series demonstrating a three-fold increase from 1.8% to 5.9% between 2000 and 2012 [1].

Third- and fourth-degree perineal trauma are known to be associated with potentially major physical and psychological morbidity and long-term effects [2-4]. Identifying and modifying risk factors is a important prevention strategy. Among recognised risk factors for OASIs are instrumental delivery, ethnicity, use of regional analgesia, gestational age, birth weight and sex of baby [5-7]. However, the effects of prior pregnancy, labour stages and delivery methods on the risk of OASIs in subsequent pregnancies are not well known. A previous pregnancy (without the involvement of labour and vaginal delivery), a previous pregnancy and labour (but no vaginal delivery), and a previous vaginal delivery with intact perineum are common obstetric histories in multiparous women. We hypothesised that such histories may be associated with altered incidence of OASIs. This is because a previous pregnancy with the associated hormonal changes may have an effect on the biomechanical properties of the pelvic floor tissues possibly influencing risks of perineal trauma in a subsequent pregnancy. There is a paucity of evidence regarding the impact of the previous mode of delivery on severe perineal trauma (OASIs) in subsequent pregnancy. Recent studies have evaluated the risk of OASIs in women with previous perineal trauma, in particular those delivering by vaginal birth after caesarean (VBAC) [8-12]. However, the risk of OASIs is unclear, as their results are contradictory. D'Souza et al reported a 1.4-fold increase of OASIs after VBAC compared with primiparous women, and a protective role of mediolateral episiotomy as well as higher incidence if the previous CS was urgent [9]. Rusavy et al found no difference in the

risk of sustaining obstetric anal sphincter injuries between primiparous women and those with a previous CS [12].

The primary objectives of this study were to evaluate the impact of a previous pregnancy and different modes of delivery with and without labour on the rates of perineal trauma in the subsequent vaginal birth. In particular:

1. Does a previous pregnancy but no labour or vaginal birth have any impact on the rates of OASIs in the subsequent pregnancy and vaginal birth?
2. Does a previous pregnancy and labour but no vaginal birth have any impact on the rates of OASIs in the subsequent pregnancy and vaginal birth?
3. Does a previous pregnancy, labour and a vaginal birth but no perineal trauma have any impact on the rates of OASIs in the subsequent pregnancy and vaginal birth?

In order to address the primary objectives, we considered the following groups:

1. A previous pregnancy with labour including active second stage (pushing) but no vaginal delivery on OASIs rates in subsequent vaginal delivery.

2. A previous pregnancy but no labour (elective caesarean section) on OASIs rates in subsequent vaginal delivery.

3. A previous vaginal birth with intact perineum and no diagnosed perineal injury on OASIs rates in subsequent vaginal delivery.

For the purpose of this study, we evaluated the incidence of OASIs, as denoted by third and fourth degree perineal tears.

Materials and Methods

The study was conducted in a London tertiary maternity unit. Ethical approval was not required (https://www.hra.nhs.uk/covid-19-research/guidance-using-patient-data/#research) as this retrospective cohort study was based on analysis of data collected during standard

clinical practice during the study period . All births between the years 1999 and 2015 were reviewed. Anonymised data were acquired from the electronic maternity database and included demographic information, obstetric history, data on first and subsequent pregnancies, parity, gestation, labour and delivery information, mode of delivery, occurrence and type of perineal trauma, use of spinal/epidural analgesia, sex of baby and birth weight. Women were included if they had been primiparous for their first birth and also had their second child at the tertiary maternity centre, whilst fulfilling the inclusion and exclusion criteria outlined below.

Inclusion Criteria:

- Para ≤2 – to fit the study design
- Maternal age between 18-40 years
- Maternal BMI between 17.5 - 40.0
- Birth weight <5,000 g
- Gestational age at birth 37-42 weeks

Exclusion criteria:

- Previous perineal injury
- Intrauterine fetal demise (IUFD)
- Multiple pregnancies
- Emergency Caesarean Sections (EmCS) when unable to confirm they were performed due to failed operative vaginal deliveries (FOVD).

These inclusion and exclusion criteria were chosen in order to minimise the potential effect of confounders, and to permit an accurate evaluation of how prior delivery mode can impact perineal trauma in subsequent delivery. In particular, women under the age of 18 will not have reached full maturation whilst maternal age over 40 is associated with increased perineal trauma [13]. Pre-pregnancy BMI is associated with birth weight of the fetus [14, 15],

and it has been reported that increased maternal BMI is associated with gestational diabetes and a macrosomic fetus [16]. Women who delivered a fetus that has undergone intrauterine fetal demise were excluded as this is known to be associated with a decreased risk of OASIs [17], and may therefore confound the findings.

To investigate the effect of a first pregnancy, labour, and caesarean section or vaginal delivery on the perineum (which had not previously sustained any trauma) the modes of delivery resulting in an intact perineum were identified. These included:

- Group 1: Failed operative vaginal deliveries completed by emergency caesarean section at second stage of labour (FOVD+EmCS),
- Group 2: Elective caesarean sections (ELCS),
- Group 3: Spontaneous vaginal delivery (SVD) with an intact perineum.

A control group was included to facilitate the comparison with women who had not previously had physiological pregnancy changes.

- Group 4 (control group): Primiparous women who have a vaginal delivery.

These groups allowed for the analysis of the risk of OASIs in women who had had a vaginal delivery but with differing histories of the extent to which their bodies had previously experienced the physiological changes of pregnancy and labour. This includes a previous birth without perineal trauma or by abdominal delivery with or without labour.

Statistical analysis

Logistic regression analysis was undertaken to obtain the unadjusted odds ratios for risk of OASIs in second pregnancy for groups 1-3 based on mode of delivery in first pregnancy. Adjusted odds ratios were subsequently obtained for the risk of OASIs in the second pregnancy for groups based on mode of delivery in the first pregnancy, having adjusted for the maternal characteristics (age, ethnicity and BMI), intrapartum risk factors (gestation age at delivery, epidural use and mode of delivery), plus neonatal measurements (birth weight and

sex). Maternal age, maternal BMI, plus birth weight were modelled as categorical variables, with maternal age based on categories of 5 years, BMI on categories of 5 units ($kg.m^{-2}$), and birth weight 500 grams. Gestation was modelled as a continuous variable based on number of weeks. The critical level of significance was set at 0.05. No adjustment was made for multiple hypothesis testing. All analyses were performed using SPSS, version 21 [18]. For each variable, the number of non-missing values are used.

Results

Between 1999 and 2015 there were a total of 74,184 births. Of these, 33,033 births were considered for inclusion in the study. These included cases with a prior FOVD+EmCS in first pregnancy, EICS in the first pregnancy, previous vaginal birth in first pregnancy maintaining an intact perineum, plus primiparous women who delivered their first child vaginally.

After application of the inclusion and exclusion criteria 21,535 women were included in the study as follows:

Group 1 (FOVD+EmCS) Women with a prior FOVD+EmCS in first pregnancy: 52 (84%) out of 62 met the inclusion criteria.

Group 2 (EICS) Women with EICS in the first pregnancy: 139 (86%) out of 162 met the inclusion criteria.

Group 3 (SVD) Women with a previous vaginal birth in first pregnancy maintaining an intact perineum: 1554 (29%) out of 5425 met the inclusion criteria.

Group 4 (Control) Primiparous women who delivered their first child vaginally: 19,790 (73%) out of 27,384 births met the inclusion criteria.

Maternal Demographics

The maternal demographics for the four groups are shown in Table 1. The distribution of BMI was similar between the groups, with mean BMI ranging from 23.9 (control group) to 24.6 (SVD). The four groups had a diverse ethnic composition. However, the majority of pregnancies were to mothers of white ethnicity in each group with the percentage ranging from 56.7% (n=881) (SVD) to 71.2% (n=37) (FOVD+EmCS) There was variation between the groups in maternal age; the mean maternal age for both the SVD group plus the control group was 29.4 years, compared to 33.0 years for the EICS group.

Neonatal Characteristics

The neonatal characteristics for each of the four groups are shown in Table 2. The primiparous control group the lowest mean birth weight (3334.7g) compared to the FOVD+EmCS group that had the largest mean birth weight (3539.8g). The percentage of male neonates was higher than that of females for all birth groups, ranging from 50.4% (n=70) (Prior ELCS) to 55.8% (n=29) (prior FOVD+EmCS group).

Pregnancy and Birthing Outcomes

The pregnancy and birthing outcomes for each of the four groups are shown in Table 3. The group of women that had a prior VD with no OASIs were more likely to deliver via spontaneous VD, with only 3.9% (n=56) requiring operative intervention.

Effect of Previous Pregnancy and Mode of Delivery on Risk of OASIs

The percentage OASIs was 17.3% (n=9) at first vaginal delivery after previous FOVD+EmCS, 12.9% (n=18) after prior ELCS and 0.6% (n=9) after prior VD with intact perineum, compared with 6% (n=1193) in the control primiparous group of women (Table 4).

The unadjusted and adjusted odds ratios for the risk of OASIs in the subsequent pregnancy for each group based on their mode of delivery in first pregnancy are presented. The control primiparous group was the reference group. The odds ratios were adjusted for the effects of maternal age, maternal BMI, maternal ethnicity, gestation, birth weight, mode of delivery, epidural use and sex of child. Multivariate regression analysis demonstrated prior FOVD+EmCS and ELCS were associated with a statistically significant increased risk of OASIs of 180% and 110% when compared to control (odds ratio (OR): 2.80; 95% confidence interval (CI): 1.35-5.78 and OR: 2.10; 95% CI: 1.27-3.48) respectively. Prior VD with intact perineum was associated with a statistically significantly reduced risk of OASIs of 91% (OR: 0.09; 95% CI: 0.04-0.17). There was little difference in magnitude between the unadjusted and adjusted odds ratios, whilst statistical significance remained following adjustment for confounding. This is suggestive of limited confounding due to maternal characteristics, intrapartum risk factors, plus neonatal measurements.

Discussion

Main findings

Women with a history in their first delivery of EmCS after FOVD, or ELCS had a significant increase in the risk of OASIs in their subsequent pregnancy when compared to control (180% and 110% respectively). Those who had a previous vaginal birth maintaining an intact perineum had a reduced risk (0.6%) of OASIs of 91% when compared to control in subsequent vaginal birth; this is suggestive that a previous vaginal delivery with intact perineum is a protective factor from OASIs. These findings may have an impact on antenatal counselling and help inform women's choices around the preferred mode of delivery when there is relevant obstetric history with factors increasing or decreasing the background risk of OASIs.

Strengths

The classification of the study population into the four groups, allowing specific evaluation of risk of OASIs according to previous mode of delivery, adds new information to our understanding of understudied risk factors associated with perineal trauma. A further strength is the large number of women studied through hospital records with complete data, along with the control for confounding factors. The effect of a series of well documented and known risk factors for OASIs were controlled for in the multivariate analyses [19]. The diagnosis of OASIs is based on clinical criteria as per standard practice, and underdiagnosis or overdiagnosis is possible. However, when compared to ultrasonographic diagnosis according to other researchers [20], the cases of OASIs in this study were always repaired by surgeons with specific training in these types of repairs or supervised by trained surgeons, thus adding confirmation of clinical diagnosis and surgical expertise in the diagnosis and management of these cases. Additionally, all cases of OASIs are regularly reviewed by the Departmental Risk Management Group. Therefore, data and medical records in relation to these cases were cross checked and scrutinised.

Limitations

The main drawback was the inherent limitation of the retrospective observational study design. Data were recorded by a variety of staff members with inherent possible variation of the accuracy of the measurements recorded. However, data entries of OASIs cases are cross-checked when inputted into the database, reducing the likelihood of errors. Nevertheless, due to the wide timeframe of data collection, and the inevitable variation in staff collecting data, the study is open to inaccuracies during data input. A further limitation was

unknown numbers of women lost to follow up (numbers of women who subsequently delivered at another hospital). Data were collected over a 16-year period, and it is likely these numbers were small. However, the groups of previous FOVD+EmCS and ELCS were small in number, so any reduction in numbers may have a big impact on precision of estimates with wider confidence intervals. It worth noting that some data were partially missing, particularly maternal BMI. Lack of data on indication for a previous CS was a further limitation. Misdiagnoses, especially of an intact perineum (when there is an occult injury), or misclassifications of perineal trauma on clinical grounds is an inherent limitation in all studies in this field, particularly those based on retrospective data collection [21-23].

Interpretation of findings

There is limited evidence, to our knowledge, on the risk of OASIs in index pregnancy associated with the mode of delivery in previous pregnancy. A small number of studies [24, 25] have reported a previous CS as a significant risk factor for OASIs at subsequent vaginal delivery, in agreement with our findings. In line with our findings are also findings by Rusavy et al who reported that first vaginal births after Caesarean section have an increased association with both perineal and cervical lacerations [12]. Furthermore, by D'Souza et al demonstrated increased risk of OASIs at time of VBAC depending on the urgency of the initial CS [9]. However, aside from this, there is sparse evaluation of OASIs risks in women with previous EmCS after FOVD and ELCS separately. This study demonstrated increased rates of OASIs in subsequent vaginal delivery in women having previous EmCS post FOVD compared to those having previous ELCS. This may result from undiagnosed or underreported cephalopelvic disproportion which may be recurrent and contribute to an increased risk of OASIs in subsequent vaginal births [24]. A group of primiparous women were selected in order to provide a control group with the baseline rates of OASIs.

Conclusion

This study provides additional information on risk factors for perineal trauma. Women having their first vaginal birth after elective caesarean section or an emergency caesarean section for failed operative vaginal delivery have a high risk of sustaining an obstetric anal sphincter injury during the subsequent vaginal delivery.

Further research is required to establish the aetiology and physiological or anatomical mechanisms implicated in these clinical and epidemiological observations. Also, further research may shed light on the OASIs risks by evaluating larger group sizes and subcategories.

These findings could potentially support antenatal counselling. Due to the physical and psychological implications of severe perineal trauma, it is recommended that all women considering a vaginal birth after emergency Caesarean section following failed instrumental delivery be counselled on the risk of obstetric anal sphincter injury. Additionally, the associations of forceps delivery, either as a primary mode of delivery or following a failed attempt for ventouse, with risks of OASIs, should be ideally communicated with the woman. However, in most cases where forceps are selected to assist a vaginal delivery, decisions are often made in clinical situations of emergency when time does not permit detailed patient counselling. Therefore, considerations of the best interests of the mother and baby may indicate choices by the obstetrician that would potentially allow for higher risks of perineal injury.

Conflicts of interest: None. There are no conflicts of interest for any of the authors.

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Table legends

Table 1: Maternal Demographics

Table 2: Neonate Characteristics

Table 3: Pregnancy & Birth Outcomes

Table 4: For each of the maternal demographics (age, ethnicity and BMI), intrapartum risk factors (gestation age at delivery, epidural use and mode of delivery), neonatal measurements (birth weight and sex) plus mode of delivery in first pregnancy, the odds ratio for OASIs during vaginal delivery in second pregnancy. The odds ratio are unadjusted. All women who met the inclusion criteria were included (n=21,535). For the continuous variables of age, BMI and gestation and birth weight the odds ratio represents the increase in odds for each increment stated.

Table 5: Unadjusted and adjusted odds ratios for the risk of OASIs in second pregnancy for each of the four groups based on their mode of delivery in first pregnancy. The control primiparous group was the reference group. Odds ratios were adjusted for the effects of maternal age, maternal BMI, maternal ethnicity, gestation, birth weight, mode of delivery, epidural use and sex of child.

Table 1: Maternal Demographics

Group number	Group 1	Group 2	Group 3	Group 4
	Prior FOVD+EmCS*	Prior ELCS**	Prior VD (maintaining an intact perineum)	Primiparous (control group)
	n= 52	n = 139	n = 1554	n = 19790
Age (years)				
Mean (SD)	31.9 (5.1)	33.0 (4.5)	29.4 (5.5)	29.4 (5.1)
Median	32.7	33.8	29.4	30.2
BMI^	n = 46	n = 126	n = 1405	n = 18023
Mean (SD)	24.5 (3.7)	24.0 (3.6)	24.6 (4.3)	23.9 (5.4)
Median	23.9	23.4	23.8	23.1
Ethnicity				
White	37 (71.21%)	93 (66.9%)	881 (56.7%)	11723 (59.2%)
Black	3 (5.8%)	7 (5.0%)	266 (17.1%)	2030 (10.3%)
Asian	9 (17.3%)	30 (21.6%)	225 (14.5%)	3581 (18.1%)
Other	3 (5.8%)	9 (6.4%)	182 (11.7%)	2456 (12.4%)

* Failed operative vaginal delivery and emergency caesarean section
** Elective caesarean section
^ BMI: Incomplete data available for body mass index (BMI).
Where indicated, percentages represent the percentage of pregnancies within group.

Table 2: Neonate Characteristics

Group number	**Group 1**	**Group 2**	**Group 3**	**Group 4**
	Prior FOVD +EmCS*	Prior ELCS**	Prior VD (maintaining an intact perineum)	Primiparous (control group)
	n= 52	n = 139	n = 1554	n = 19790
Sex				
Male	29 (55.8%)	70 (50.4%)	823 (53.0%)	9994 (50.5%)
Female	23 (44.2%)	69 (49.6%)	730 (47.0%)	9796 (49.5%)
Birth Weight (g)				
Mean (SD)	3539.8 (473.6)	3414.1 (481.1)	3383.7 (454.8)	3334.7 (437.3)
Median	3585	3400	3400	3320

* Failed operative vaginal delivery and emergency caesarean section
** Elective caesarean section
Where indicated, percentages represent the percentage within the group.

Table 3: Pregnancy & Birth Outcomes

Group number	Group 1	Group 2	Group 3	Group 4
	Prior FOVD +EmCS*	Prior ELCS**	Prior VD (maintaining an intact perineum)	Primiparous (control group)
	n= 52	n = 139	n = 1554	n = 19790
Gestation (weeks)				
Mean (SD)	40.3 (1.0)	40.1 (1.2)	39.9 (1.1)	40.1 (1.1)
Median (LQ:UQ)	40 (40:41)	40 (39:41)	40 (39:41)	40 (39:41)
Epidural Analgesia	17 (32.7%)	73 (52.5%)	190 (12.2%)	8496 (42.9%)
Birth Type				
Spontaneous VD	28 (53.8%)	89 (64.1%)	1498 (96.4%)	13322 (67.4%)
Ventouse	13 (25.0%)	31 (22.3%)	48 (3.1%)	4365 (22.1%)
Failed Ventouse to Forceps	3 (5.8%)	6 (4.3%)	2 (0.1%)	698 (3.5%)
Forceps	8 (15.5%)	13 (9.4%)	6 (0.7%)	1405 (7.1%)
Perineal Trauma				
Intact Perineum	2 (3.8%)	15 (10.8%)	1140 (73.4%)	3504 (17.7%)
First-Degree	5 (7.7%)	13 (9.4%)	167 (10.7%)	1733 (8.8%)
Second-Degree	27 (32.7%)	49 (35.3%)	197 (12.7%)	7094 (35.8%)
Third-Degree	9 (17.3%)	17 (12.2%)	9 (0.6%)	1167 (5.9%)
Fourth-Degree	0 (0%)	1 (0.7%)	0 (0%)	26 (0.1%)
Episiotomy	20 (38.5%)	44 (31.7%)	41 (2.6%)	6266 (31.7%)
Intact perineum	2 (3.8%)	15 (10.8%)	1140 (73.4%)	3504 (17.7%)

* Failed operative vaginal delivery and emergency caesarean section
** Elective caesarean section
Where indicated, percentages represent the percentage within the group.

Table 4: Unadjusted and adjusted odds ratios for the risk of OASIs in second pregnancy for each of the four groups based on their mode of delivery in first pregnancy. The control primiparous group was the reference group. Odds ratios were adjusted for the effects of maternal age, maternal BMI, maternal ethnicity, gestation, birth weight, mode of delivery, epidural use and sex of child.

Previous mode of delivery	Pregnancies with OASIS (n = 1229)		Univariate analysis			Multivariate analysis*		
	n	%	Odds Ratio (OR)	95% confidence interval (CI)	*P*-value	Odds Ratio (OR)	95% confidence interval (CI)	*P*-value
Group 1: Prior FOVD + EmCS* (n= 52)	9	17.3%	3.326	(1.59-6.71)	0.001	2.80	(1.35-5.78)	0.006
Group 2: Previous ELCS (n = 139)	18	12.9%	2.32	(1.41-3.82)	<0.001	2.10	(1.27-3.48)	0.004
Group 3: Intact perineum with previous vaginal delivery (n = 1554)	9	0.6%	0.09	(0.05-0.17)	<0.001	0.09	(0.05-0.17)	<0.001
Group 4: 1st pregnancy vaginal delivery (control group) (n = 19790)	1193	6.0%	reference group			reference group		

*Adjusted for maternal age, maternal BMI, maternal ethnicity, gestation, birth weight, mode of delivery, epidural use and sex of child