



Is the older perineum a safer perineum? Risk factors for obstetric anal sphincter injury

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Abstract

Introduction Obstetric anal sphincter injury (OASI) is the most common cause of anal incontinence. Identifying risk factors may facilitate change in labour and delivery practice, potentially reducing the risk. The objective of this study is to identify maternal, foetal and intrapartum risk factors for OASI in a regional hospital.

Method We conducted a retrospective analysis of vaginal deliveries over a 10-year period (2008–2017). Anal sphincter injury was diagnosed by an experienced clinician and classified according to RCOG recommendations. A multiple logistic regression model was created using the presence of OASI as the dependent variable. Coefficients were adjusted for relevant maternal, foetal and intrapartum risk factors.

Results During the study period, there were 23,887 vaginal deliveries. Of these births, 18,550 were spontaneous (77.66%), 3746 vacuum-assisted (15.68%), 1196 forceps (5.01%) and 395 sequential instrumental deliveries (1.65%). The overall rate of OASI was 1.76%, with an upward trend seen in nulliparous mothers. Significant factors that increased the risk of OASI were nulliparity, Asian ethnicity, delivery by forceps or sequential instruments, and shoulder dystocia. Vacuum delivery did not significantly increase risk.

Conclusion Maternal age ≥ 35 years confers a protective effect after adjusting for parity, birth weight and mode of delivery. Given the context of an ageing reproductive population, additional research is required to investigate the impact of maternal age on anal sphincter injury.

Keywords Maternal age · OASI · Obstetric anal sphincter injury · Perineal trauma · Reproductive ageing

Introduction

Obstetric anal sphincter injury (OASI) is a severe form of perineal trauma that occurs following vaginal delivery. It is a leading cause of faecal incontinence and can be associated with significant short-term and long-term morbidity [1, 2]. The risk of sphincter injury following childbirth is greatest at the first vaginal delivery, affecting up to 6% of nulliparous women compared with 1.7% of multiparae [3, 4]. There is a five-fold increased risk of recurrent sphincter disruption in subsequent pregnancies [5].

Modifiable birth practices such as perineal protection, ventouse rather than forceps as the choice of instrument, and mediolateral instead of midline episiotomy have been shown to reduce the risk of OASI [1, 6]. However, conflicting evidence exists on whether the use of episiotomy or epidural is protective against sphincter injury [7–9]. Clear identification of risk factors may allow informed discussions with women and enable modification of labour and delivery practices with a view to reducing the incidence of OASI.

The aim of the study was to examine maternal, foetal and intrapartum risk factors for obstetric anal sphincter injury in a district general hospital in the North-East of Ireland.

Materials and methods

This is a retrospective analysis of prospectively gathered data, including all women who had a vaginal delivery over a 10-year period from 1 January 2008 to 31 December 2017 in a

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university-affiliated district general hospital. Delivery records were extracted from the hospital's computerised maternity record service. These records are completed contemporaneously by the attending midwife and obstetrician (if involved). This data is part of a continuous audit of labour and delivery and, thus, ethical approval was not deemed necessary by our institutional research ethics committee.

In our institution, every woman who has a vaginal delivery has a rectal examination to determine the integrity of the anal sphincter immediately after delivery, which is carried out by the attending midwife or obstetrician. Episiotomy is not routinely performed but is at the discretion of the birth attendant, where indicated. All episiotomies carried out in our hospital are mediolateral. Suspected sphincter injuries are examined and diagnosed by an obstetrician who has received specialist training in the diagnosis and repair of anal sphincter injury. Sphincter injuries are graded according to severity (3rd–4th degree), though for the purposes of this study, they were recorded as either present or absent.

Contingency tables were analysed using chi-square test or Fisher's exact test, as appropriate. Means were compared using Student's *t* test. Trends in anal sphincter injuries over the 10-year period were analysed using Chi-squared test for trends in proportions. A multiple logistic regression analysis model was produced, with anal sphincter injury as the dependent categorical variable and coefficients adjusted for mode of delivery (SVD/vacuum/forceps/sequential instrumentation), episiotomy, epidural analgesia, birth weight, gestation, maternal age, ethnicity and length of the second stage of labour. Results are presented as adjusted odds ratios (exp B), with associated 95% confidence intervals and *P* values. R 3.4.5 (R Foundation for Statistical Computing, Vienna, Austria) was used for all statistical analyses and a two-tailed probability value of $P < 0.05$ was considered significant.

Results

During the period from 1 January 2008 to 31 December 2017, there were 24,159 vaginal deliveries, of which 8573 (35.5%) were in nulliparous women, and 15,586 (64.5%) were in multiparous women. There were 429 obstetric anal sphincter injuries giving an overall rate of OASI of 1.8% (429/24,159) in our institution over the study period. The overall rate of OASI has increased from 1.1% (33/2906) in 2008 to 2.0% (39/1869) in 2017, though this did not reach statistical significance ($P = 0.075$). A significant increase was seen in nulliparous ($P = 0.009$) but not in multiparous ($P = 0.748$) women (see Fig. 1). Nulliparous women had a significantly higher rate of anal sphincter injury compared with multiparous women (3.5% [297/8573] versus 0.8% [132/15,586], $P < 0.001$, odds ratio [OR] 4.20, 95% confidence interval [CI] 3.42–5.18). Nulliparity was a significant risk factor in our regression

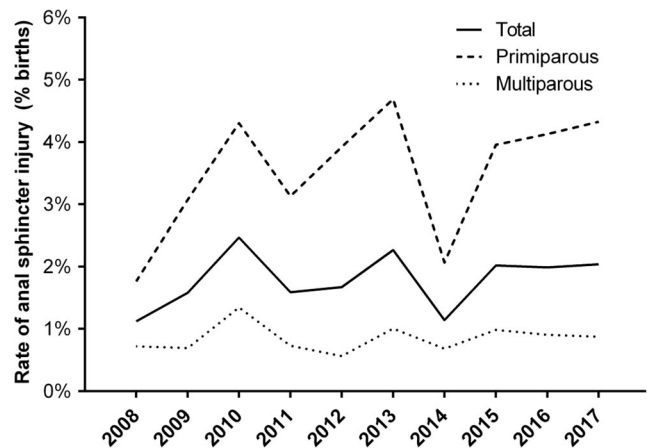


Fig. 1 Trends in obstetric anal sphincter injury in the period 2008–2017

model. A multivariate regression model comparing mothers with anal sphincter injury with those with an intact sphincter can be seen in Tables 1 and 2, and comparison of characteristics between women with an intact sphincter and those with a sphincter injury can be seen in Table 3.

Instrumental delivery

Women with anal sphincter injury were more likely to have had a forceps delivery compared with those with an intact sphincter (44.8% [192/429] versus 22.1% [5240/23,730], $P < 0.001$). There was no significant difference in the number of vacuum-assisted deliveries (16.3% [70/429] versus 15.8% [3744/23,730], $P = 0.813$). Forceps delivery and delivery by sequential instruments were found to be strong predictors of anal sphincter injury in our multiple regression model, while vacuum delivery was found to be non-significant. The rate of vacuum delivery in our institution rose over the study period ($P < 0.001$), while the rate of sequential instrumental delivery fell ($P = 0.038$). The rate of forceps delivery remained stable over the 10-year period ($P = 0.689$) (Fig. 2).

Episiotomy

There was a higher rate of episiotomy in women with sphincter damage when compared with those with an intact sphincter (41.5% [178/429] versus 21.0% [4984/23,730], $P < 0.001$). After adjusting for other confounding risk factors, episiotomy was not found to reduce the risk of sphincter injury in our multiple regression model.

Birth weight

Over the study period, 22.4% (96/429) of infants born to mothers with an obstetric anal sphincter injury were macrosomic (birth weight greater than 4 kg), compared with 16.4% (3886/23,730) of babies born to mothers with

Table 1 Multiple logistic regression model comparing mothers with anal sphincter injury with those with an intact sphincter

Intact sphincter (n = 23,730)	OASI (n = 429)	OR	95% CI	P value
Maternal factors				
Caucasian	93.0 (22,072/23,730)	91.1 (391/429)	-	-
Asian	2.7 (632/23,730)	5.1 (22/429)	2.26	1.40–3.46
Black	3.7 (880/23,730)	3.5 (15/429)	1.26	0.71–2.06
Other	0.6 (141/23,730)	0.2 (1/429)	0.41	0.02–1.88
Age < 20	3.2 (770/23,730)	3.7 (16/429)	0.87	0.49–1.45
Age 20–24	12.6 (2981/23,730)	15.2 (65/429)	0.98	0.72–1.33
Age 25–29	25.4 (6020/23,730)	29.6 (127/429)	-	-
Age 30–34	35.0 (8306/23,730)	34.7 (149/429)	0.92	0.72–1.18
Age ≥ 35	23.8 (5653/23,730)	16.8 (72/429)	0.68	0.50–0.92
Nulliparity	34.9 (8276/23,730)	69.2 (297/429)	2.10	1.67–2.62
Foetal factors				
< 2500 g	2.6 (621/23,730)	0.5 (2/429)	0.20	0.03–0.64
2500–2999 g	11.0 (2608/23,730)	7.9 (34/429)	0.91	0.62–1.13
3000–3499 g	33.5 (7950/23,730)	25.6 (110/429)	-	-
3500–3999 g	36.5 (8665/23,730)	43.6 (187/429)	1.62	1.27–2.06
≥ 4000 g	16.4 (3886/23,730)	22.4 (96/429)	1.77	1.31–2.37
Labour and delivery				
Vacuum	15.8 (3744/23730)	16.3 (70/429)	1.26	0.90–1.76
Forceps	6.3 (1128/23730)	20.5 (122/429)	4.80	3.27–7.02
Sequential instruments ^a	1.6 (368/23730)	7.9 (34/429)	5.87	3.61–9.37
Episiotomy	21.0 (4984/23,730)	41.5 (178/429)	0.94	0.68–1.30
Epidural	27.2 (6463/23,730)	33.1 (142/429)	0.59	0.45–0.76
Prolonged second stage	7.5 (1778/23,730)	15.6 (67/429)	1.01	0.75–1.36
Shoulder dystocia	2.0 (473/23,730)	5.1 (22/429)	1.91	1.16–2.88
Gestational age	39.5 ± 1.7	39.9 ± 1.2	1.04	0.95–1.15

^a Vacuum and forceps

Table 2 Odds ratios comparing mothers with anal sphincter injury with those with an intact sphincter

Predictor	Odds ratio	95% Confidence interval	P
Maternal factors			
Caucasian ethnicity (reference)	-	-	-
Asian ethnicity	2.26	1.40–3.46	< 0.001
Black ethnicity	1.26	0.71–2.06	0.393
Maternal age < 20	0.87	0.49–1.45	0.614
Maternal age 20–24	0.98	0.72–1.33	0.914
Maternal age 25–29 (reference)	-	-	-
Maternal age 30–34	0.92	0.72–1.18	0.521
Maternal age ≥ 35	0.68	0.50–0.92	0.013
Nulliparity	2.10	1.67–2.62	< 0.001
Multiparity (reference)	-	-	-
Foetal factors			
BW < 2500 g	0.20	0.03–0.64	0.026
BW 2501–3000 g	0.91	0.62–1.33	0.648
BW 3001–3500 g (reference)	-	-	-
BW 3501–4000 g	1.62	1.27–2.06	< 0.001
BW > 4000 g	1.77	1.31–2.37	< 0.001
Labour and delivery			
Vacuum	1.26	0.90–1.76	0.173
Forceps	4.80	3.27–7.02	< 0.001
Failed vacuum and forceps	5.87	3.61–9.37	< 0.001
Episiotomy	0.94	0.68–1.30	0.715
Shoulder dystocia	1.91	1.16–2.99	< 0.001
Induction of labour	0.86	0.69–1.07	0.178

Table 3 Comparison of characteristics of women with sphincter injuries after delivery with women with an intact sphincter, in the period 2008–2017

	Intact (<i>n</i> = 23,730)	OASI (<i>n</i> = 429)	<i>P</i> value
Vacuum	15.8 (3744/23730)	16.3 (70/429)	0.738
Forceps	6.3 (1128/23730)	20.5 (122/429)	<0.001
Sequential instrument ^a	1.6 (368/23730)	7.9 (34/429)	<0.001
Nulliparity	34.9 (8276/23,730)	69.2 (297/429)	<0.001
Maternal age	30.4 ± 5.5	29.4 ± 5.3	<0.001
Ethnicity			
White	93.0 (22,072/23,730)	91.1 (391/429)	0.127
Asian	2.7 (632/23,730)	5.1 (22/429)	0.002
Black	3.7 (880/23,730)	3.5 (15/429)	0.980
Other	0.6 (141/23,730)	0.2 (1/429)	0.498
Birth weight	3513 ± 502	3655 ± 459	<0.001
Length of second stage of labour	42 ± 57	66 ± 53	<0.001
Prolonged second stage (> 120 min)	7.5 (1778/23,730)	15.6 (67/429)	<0.001
Episiotomy	21.0 (4984/23,730)	41.5 (178/429)	<0.001
Shoulder dystocia	2.0 (473/23,730)	5.0 (22/429)	<0.001
Epidural	27.2 (6463/23,730)	33.1 (142/429)	0.010

Categorical data presented as % (*n*/total). Continuous data presented as mean ± SD

^a Vacuum and forceps

an intact sphincter ($P = 0.001$). Similarly, there was a higher mean birth weight in the sphincter injury group compared with those with an intact sphincter ($P < 0.001$). Birth weight greater than 3.5 kg was a significant risk factor in our multiple regression model, while a birth weight of less than 2.5 kg was found to be protective.

Length of the second stage of labour

When the length of labour was examined, those with an anal sphincter injury had a significantly longer second stage when compared with those with an intact sphincter (66 ± 53 min versus 42 ± 57 min, $P < 0.001$). In addition, the proportion

of women with a prolonged second stage of labour—when defined as > 120 min—was higher in the sphincter injury group (15.6% [67/429] versus 7.5% [1778/23730], $P < 0.001$). After adjusting for other factors, the length of the second stage was not a significant predictor in our multiple regression model.

Shoulder dystocia

Shoulder dystocia occurred more often in women with an anal sphincter injury (5.1% [22/429] versus 2.0% [473/23,730], $P < 0.001$) and was a significant risk factor in our regression model (OR 1.91, $P = 0.007$).

Epidural analgesia

One-third (142/429) of women who had a sphincter injury opted for epidural analgesia, significantly higher than the 27.2% (6463/23730) in those with an intact sphincter ($P = 0.008$). However, when other confounding risk factors were adjusted for, epidural analgesia conferred a protective effect on anal sphincter injury in our multiple regression model (OR 0.65, $P < 0.001$).

Gestation and maternal age

Delivery occurred at later gestations in the sphincter injury group than in the intact group (39.8 ± 1.2 weeks versus 39.5 ± 1.5 weeks, $P < 0.001$). Women who had a sphincter injury were significantly younger than women with an intact

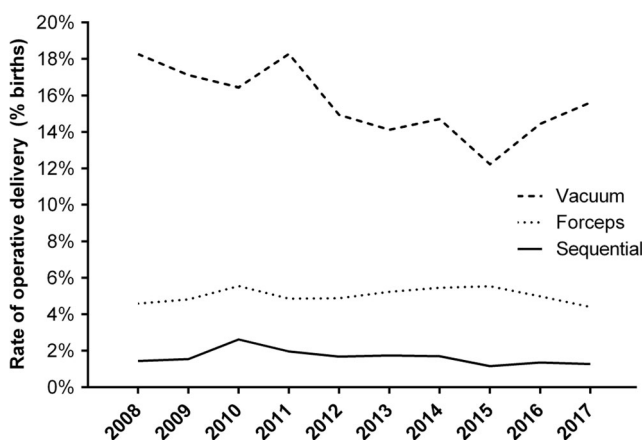


Fig. 2 Trends in spontaneous and operative vaginal deliveries in the period 2008–2017

sphincter over the same time period (29.4 ± 5.3 years versus 30.4 ± 5.5 years, $P < 0.001$). When age was analysed categorically in our regression model, those aged 35 and above were at lower risk (OR 0.68, $P = 0.013$). The rate of OASI in women less than 35 years of age was 1.9% (357/18434), while the rate in women 35 years or older was 1.3% (72/5725). Gestational age was not found to be a significant risk factor in our regression model.

Ethnicity

Asian ethnicity was found to be a significant risk factor in our regression model (OR 2.26, $P < 0.001$), while *Black* or *Other* were non-significant.

Discussion

This study has demonstrated an upward trend in sphincter injury in nulliparous mothers over the 10-year period, similar to reports from England [3] and Scandinavia [4, 10]. This may be attributed to increased awareness and detection, rather than an increase in actual injuries [7]. Introduction of a standardised classification system and guidelines for the repair of anal sphincter injuries has resulted in improved management and increased recognition of such cases [11, 12]. First time mothers were four times more likely to have a sphincter injury compared with multiparous women. Nulliparity remained a significant risk factor for sphincter injury after adjusting for confounders.

We found that ventouse remains the instrument of choice amongst clinicians, with the rate of vacuum-assisted delivery rising over the study period, in keeping with other European studies [13, 14]. Ventouse delivery was not a significant risk factor in our cohort, similar to a large population study in the UK [7], but contrary to other published research [4, 15–17]. This lack of benefit seen with episiotomy in ventouse delivery may be specific to our institution, and as with all single-centre studies, warrants careful analysis before generalising to other centres. The rate of forceps delivery has not changed over the study period, in contrast to a sharp decline in the USA [18]—perhaps reflecting the difference in cultural practice between the two countries. While the use of forceps has been attributed to the risk of OASI, operator experience is also a contributing factor. A lower rate of OASI has been demonstrated amongst obstetricians who use forceps exclusively, compared with those with an either/or preference [14]. While the use of forceps remained stable, the rate of sequential instrumental delivery fell. A possible explanation for the decline in sequential instrumental deliveries is a move away from ‘heroic obstetrics’, with a corresponding increase in fully dilated caesarean section. Recent Irish research reported a 50% increase in the rate of fully dilated caesarean section over a 10-year period

[19], though they did not comment on the use of sequential instrumentation.

The overall rate of OASI was 1.8% in our institution over the 10-year period with an incidence of 3.5% in nulliparae versus 0.8% in multiparae. This figure is low compared with rates in the USA [20] but is consistent with other European data [4, 7]. The difference may be explained by the use of mediolateral episiotomy in our institution rather than midline episiotomy in the USA [6]. A midline episiotomy is associated with significantly higher rates of OASI, while an increased angle of episiotomy reduces this risk [6, 21]. Though mediolateral episiotomy has been established as safer than midline, conflicting data exists on the protective benefits of episiotomy itself. Some studies report a reduction in OASI with episiotomy [3, 8, 10, 20] while a large British study reported that liberal use of episiotomy did not improve perineal outcomes [9]. Episiotomy did not confer protection in our regression model; however, as the majority of our deliveries were spontaneous—and included multiparous women—the effect of episiotomy on instrumental delivery [17] may have been masked.

The mean (median) age of nulliparous women in our population was 27.7 (28) years, compared with 31.8 (32) in multiparous women ($P < .001$). Nulliparous women are likely to be younger than their multiparous counterparts, although nulliparity was found to be an independent risk factor for OASI in our regression model after adjusting for mode of delivery, birth weight and other antenatal and intrapartum confounders. Previously published research has established nulliparity as a risk factor for OASI regardless of the mode of delivery [2, 4, 22]. Asian women remained at a higher risk of severe perineal trauma in our cohort. Previous work has identified ethnic origin as an independent risk factor for OASI, perhaps due to the racial difference in perineal body length [23].

A prolonged second stage of labour (> 120 min) has been associated with an increased rate of severe perineal trauma [24], though some studies report no effect [25]. In our cohort, those with sphincter injury had more prolonged labours than those with an intact sphincter. After adjusting for confounders, a prolonged second stage of labour was not found to be a risk factor for OASI in our regression model. This likely represents collinearity between the length of the second stage of labour and other risk factors for OASI, such as instrumental delivery and macrosomia.

Foetal macrosomia (when defined as ≥ 4000 g) has been linked to OASI. This was mirrored in our cohort where birth weight above 3.5 kg or 4 kg was found to be significant risk factors for OASI, consistent with other studies [3, 4, 6]. Conversely, a low birth weight (< 2500 g) was protective for sphincter injury.

Conflicting evidence exists in the literature as to whether epidural influences the risk of anal sphincter injury. A 2011

Cochrane review [26] concluded that epidural increases the risk for instrumental delivery, and thus may indirectly introduce risk for OASI. However, we found epidural to be protective, in line with other studies [15, 22]. Epidural anaesthesia may reduce involuntary pushing at the end of labour, possibly explaining this protective effect, though this has not been conclusively proven.

Maternal age over 35 years conferred a protective effect against sphincter injury when we adjusted for parity, birth weight and mode of delivery. Advancing maternal age has been studied as a predictor for adverse pregnancy outcomes [27], but there has been less focus on its influence on the perineum. Collagen and elastic tissue content of connective tissue change with ageing [28], perhaps reducing the elasticity of the perineum. However, one study found no difference in OASI between nulliparous women aged over and under 35 years [15]. The rate of OASI was lower in women over 35 years of age in our cohort, and this protective effect persisted after adjustment for confounders in our multiple regression model. The RCOG recommends induction of labour in older parturients to reduce the risk of antepartum stillbirth [29] and recent evidence published in *The New England Journal of Medicine* [30] suggests that induction at 39 week gestation, amongst women of advanced maternal age, showed no significant difference in the rate of caesarean section or operative vaginal delivery when compared with expectant management. Available data on perineal injury in this older cohort of women should form part of patient counselling when planning the mode of delivery.

There are limitations worthy of discussion in our analysis. As this was a retrospective database analysis, the coding of diagnoses and procedures is potentially inaccurate or incomplete. However, the information is audited locally on a monthly basis and is submitted to the National Perinatal Epidemiological Centre. While this was a retrospective analysis, the data were collected contemporaneously by the birth attendant and so should eliminate recall bias. Information on the type of perineal support performed, either during delivery of the head or shoulders, is not available in our data set. Similarly, we do not have information on the angle or size of episiotomy, though culturally mediolateral episiotomy is most commonly employed in our institution. While single-centre studies may limit the generalisability of our results, we can be reassured by the homogeneity of the management of our women. Full data on all variables were available for all women.

Conclusion

This study found that the rate of anal sphincter injury in nulliparous women has risen, mirroring reports from other European countries. The greatest predictors of OASI were nulliparity, forceps delivery and the sequential use of

instruments. We found that maternal age over 35 years of age conferred a protective effect on the perineum. This is particularly relevant in the context of an ageing reproductive population and should form part of patient counselling when deciding mode of delivery.

Authors' contributions CN and BO'L extracted the data, analysed the data and wrote the manuscript. VC analysed the data and wrote the manuscript. This manuscript has been read and approved by all authors.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval These data were compiled as part of a continuous clinical audit of adverse delivery outcomes. Medical records for individual patients were not accessed during data collection and it was deemed by the institutional research ethics committee that specific ethical approval was not necessary.

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