Full length article

Risk of obstetric anal sphincter injury in women having a vaginal birth after a previous caesarean section: A population-based cohort study

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ABSTRACT

Objective: Caesarean section is increasing in prevalence and with it the proportion of women going into their next pregnancy with a scar on their uterus. For women considering vaginal birth after caesarean (VBAC), accurate information about the associated risks is required.

Study design: The cohort comprised 192,057 women who had a vaginal delivery of a singleton, term, cephalic infant between the 1st April 2013 and the 31st March 2014 in England: 182,064 women who were having their first baby, and 9993 women who were having a second baby after a previous caesarean delivery. Their risk of an obstetric anal sphincter injury (OASI) was compared using a mixed-effects logistic regression model, adjusting for maternal age, use of instrument, episiotomy, prolonged labour, shoulder dystocia, and demographic factors.

Results: The OASI rate was 5.0% in primiparous women, 5.8% in secondiparous women undergoing VBAC after previous elective caesarean, and 7.6% in secondiparous women undergoing VBAC after previous emergency caesarean. Women having a VBAC for their second baby following an emergency caesarean section in their first delivery had a higher rate of OASI than primiparous women (adjusted OR 1.31; 95% CI: 1.20, 1.43), For women with a previous elective delivery, the rates are similar to those for primiparous women.

Conclusion: Women having a VBAC after emergency caesarean have a higher rate of OASI than primiparous women. This is important in the counselling of women considering VBAC.

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Introduction

Caesarean section rates are rising worldwide; reasons include increase in need due to maternal and fetal comorbidity and increase in use as other methods of managing difficult birth, such as use of instruments, declines [1]. In the United Kingdom the rate of caesarean section has risen from 12% in 1990 to 26% in 2015 [2,3]. Having delivered by caesarean, a woman enters her next pregnancy with a scar on her uterus from the previous surgery. This has an impact on pregnancy and birth, including increased risk of placental disorders, stillbirth, postpartum haemorrhage, and uterine rupture [4].

In a pregnancy after a previous caesarean, current guidance [4,5], recommends that a choice is offered between a planned repeat elective caesarean (ERCS) and a planned vaginal birth after caesarean (VBAC). The rate of successful VBAC once attempted is estimated at 63%–75% [6–8].

Obstetric anal sphincter injury (OASI), or a third or fourth degree perineal tear, is a major complication of vaginal birth, occurring in 3.5% of all vaginal births in the UK [9,10]. It is more common in primiparous women, women of Asian ethnic origin, and women having an instrumental birth [11]. The rate of reported OASI has increased in recent years, tripling from 1.8% in primiparous women giving birth at term to a baby in the cephalic position in 2000 to 5.9% in the same population in 2012 [11]. Even with timely repair, the risk of complications is high: 20–40% of women will have symptoms of incontinence or urgency at 12 months after delivery [10].

Recently, a number of studies have suggested that there is an increased risk of OASI associated with VBAC [12–15] as compared with vaginal birth in primiparous women.

There is a need for information about the risk of OASI in VBAC in order to appropriately counsel women considering a trial of labour after previous caesarean section. This study aims to evaluate whether there is an association between VBAC and risk of OASI.

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Materials and methods

This is a retrospective cohort study of women aged 15–45 who delivered a singleton infant in the cephalic position at term gestation (between 37 weeks and zero days gestation and 42 weeks and six days gestation) vaginally as either their first or second birth, in English NHS trusts between the 1st April 2013 and 31st March 2014.The impact of previous caesarean delivery on OASI was examined by comparing two groups of women having their first vaginal delivery: primiparous women, and secondiparous women with previous caesarean delivery.

Data source

Women were included if the birth was recorded in Hospital Episode Statistics (HES) and occurred in an NHS trust with an obstetric unit. HES is an administrative dataset which includes information on all day case and inpatient admissions in the NHS in England. Data are uploaded from a range of different systems within NHS trusts, cleaned and validated centrally. The principal purpose of this dataset is for the coding and payment of NHS providers. Following the removal of identifying information, the dataset is made available for health services evaluation and research [16].

For each admission, length of stay, date of admission and discharge, demographic characteristics and appropriate disease and procedure codes are recorded, using the International Classification of Diseases (WHO ICD-10 [17]) and NHS OPCS Classification of Interventions and Procedures (OPCS-4 [18]). For admissions resulting in the birth of a baby, information about the birth is recorded in HES as a separate 'maternity tail' and 'baby tail'. Episodes were identified as birth episodes in HES if there were details of delivery method in either the maternity tail or the procedure codes [19]. Birth datasets were available from 1st April 2000; data for each birth year were sequentially merged with HES ID as the unique identifier. A count variable was generated for previous births within the dataset, and a further indicator variable if this was by caesarean section. These variables were then used to supplement the available information about parity and to establish whether the woman had a previous caesarean section [20].

The overall period of history was thirteen years. The median interval between first and second birth in the UK is 36 months [21].

Definition of cohort

The exposure of interest was whether the woman had previously had a caesarean delivery.

Women were defined as primiparous if they had a delivery of a live, singleton baby at term between the 1st April 2013 and 31st March 2014, and had no deliveries recorded in HES between the financial years of 2000–2013.

Women were defined as VBAC for the purposes of this study if they had two and only two deliveries recorded in HES between 1st April 2000 and 31st March 2014; both deliveries were of live, singleton babies at term; their first delivery was a caesarean delivery; and their second delivery occurred between the 1st April 2013 and 31st March 2014 [6].

Women were regarded as having had an OASI if they had both an ICD-10 code for diagnosis of the tear and an OPCS code for its repair (Table 1) [11].

Table 1
Available Information and Source.

Variable	Detail	Source	Codes
Maternal factors			
Presence of diabetes	Whether or not the mother had diabetes	ICD-10 codes	O24: diabetes in pregnancy
Presence of pre-eclampsia	Whether the mother had pre-eclampsia	ICD-10 codes	O11: pre-eclampsia superimposed on chronic hypertension O14: pre-eclampsia O15: eclampsia
Presence of hypertension	Whether the mother had hypertension	ICD-10 codes for mother	O10: pre-existing hypertension complicating pregnancy, childbirth and puerperium
Presence of obesity	Whether or not the woman was obese	ICD-10 code for mother	E66: obesity
Information about delivery			
Indication for previous or current caesarean		ICD-10 codes for mother	Fetal distress codes: O68, O69.0, O69.1, O69.2 Obstructed labour codes: O62, O63, O64.0, O64.2, O64.4, O65, O66.2, O66.3, O66.4, O66.5, O66.8, O66.9 Failed induction of labour: O61 Placenta disorder:O43 Fetal malpresentation including breech: other O64 codes
Mode of delivery		OPCS codes, and HES maternity tail where not available	R17: elective caesarean; this was recoded if evidence of labour to emergency caesarean [6] R18: emergency caesarean R19: breech extraction R20: other breech delivery R21: forceps delivery R22 vacuum delivery R23 spontaneous cephalic delivery R24 normal delivery
Episiotomy	Whether an episiotomy was given	OPCS code R27.1	R27.1 episiotomy
Prolonged labour		ICD-10 code	O63 long labour
Shoulder dystocia		ICD-10 code	O66.0 obstructed labour as result of shoulder dystocia
Presence of OASI		ICD-10 code for injury with OPCS code for repair	Tear: O70.2 (third) O70.3 (fourth) Repair: R32.2 (third) R32.5 (fourth)

Choice of confounders was guided by previous work in this area [6,11]. The maternity record contained information about maternal age, ethnicity, and the socio-economic status of the mother's area of residence at the time of birth using the index of multiple deprivation, which combines economic and social information [22]. It also contained information about birth-weight and mode of birth, including whether a caesarean was emergency or elective. Both gestational age and the ICD-10 code O60 (preterm labour and delivery) were used to exclude preterm births. Information about delivery method was derived from OPCS codes where available (Table 1) and from the maternity tail where this was not available [6]. All variables used as confounders have been validated for quality and used in previously published work [2].

This study is a complete case analysis. Birth records without a valid birthweight, maternal age or delivery method were removed from the analysis.

Statistical analysis

Baseline data were assessed by grouping: primiparous women; and secondiparous women with a previous caesarean delivery. The distribution of categorical variables was assessed using chi-squared tests. Initial cross tabulations were performed for each predictor variable and the binary outcome (presence of an OASI), with chi-squared tests performed for categorical variables and simple logistic regression analyses for comparing sequential associations.

The multivariable models included maternal age (categorised in five year intervals from 15 to 45 years), birthweight ($<2500\,g$, $2500\,g$–$4000\,g$ and over $4000\,g$ [11]), mode of delivery, episiotomy and maternal ethnicity as demographic variables. There were no concerns about number of outcomes per parameter.

A mixed effects model was constructed by adding a variable for which trust the woman had given birth in. The level of both obstetric anal sphincter injury and VBAC is known to vary
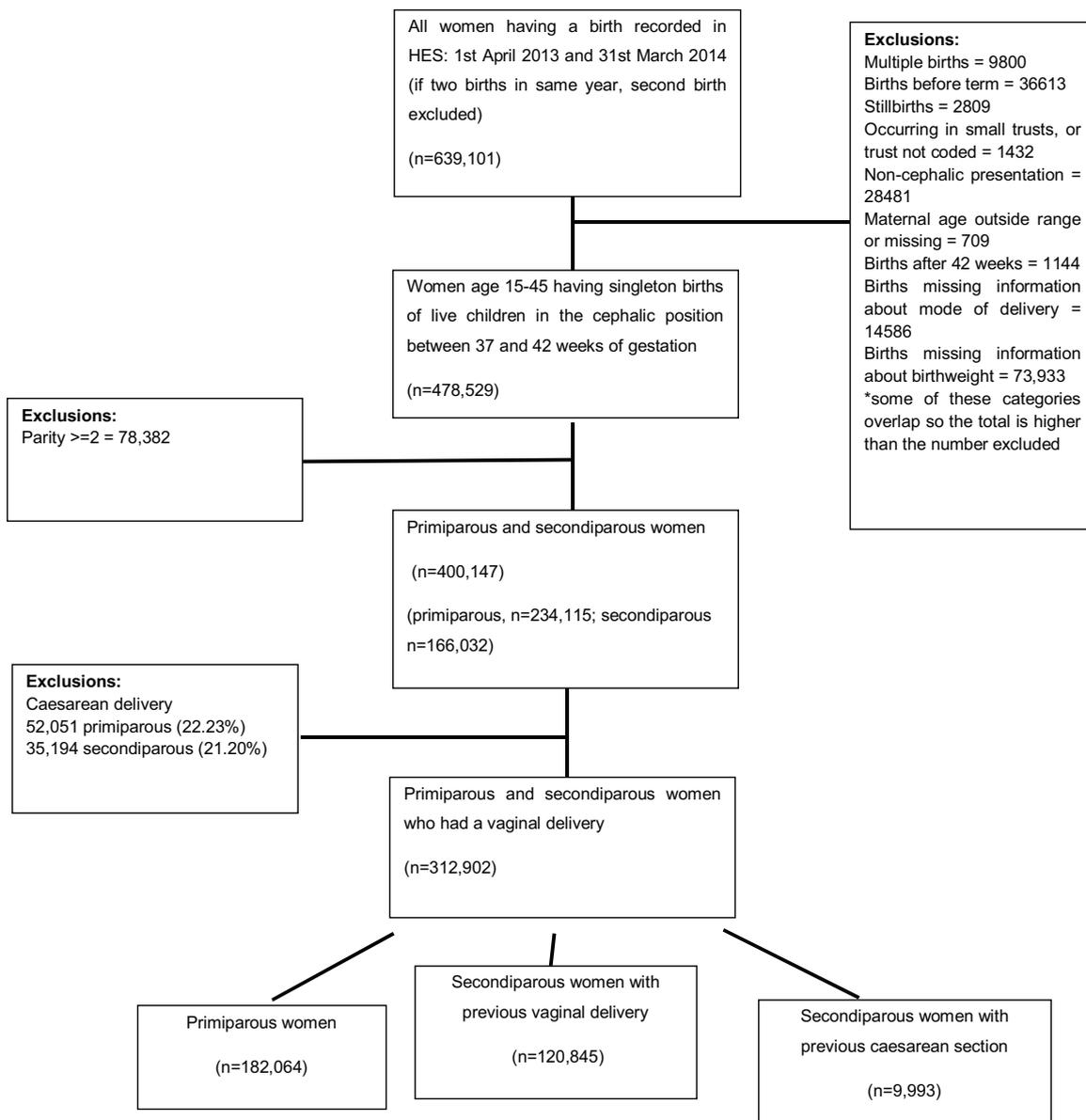
Fig. 1. Selection of Cohort.

between trusts in England for reasons which are independent of case mix [2,6]. This was therefore modelled using a random effect.

Ethics

This project uses routine data collected for the purposes of health services evaluation in the UK and no local approval is required. This project was considered by the LSHTM MSc Ethics Committee and approved (application reference 13,715).

Results

Selection of cohort

There were 552,462 women who gave birth to a singleton baby in the cephalic position at term (37–42 weeks gestation) in England between the 1st April 2013 and the 21st March 2014. 88,625 records were excluded as they did not have complete information about mode of birth, maternal age, or birthweight (Fig. 1).

Characteristics of cohort

The cohort for study was composed of 192,057 women who had a vaginal delivery of a singleton, term cephalic infant between the 1st April 2013 and the 31st March 2014 in England: 182,064 women were having their first baby, and 9993 women were having a second baby after a previous caesarean delivery. The baseline characteristics of the two groups are given in Table 2. Women who were in the secondiparous group were more likely to be older and of non-white ethnic origin, and more likely to experience a shoulder dystocia. The groups had similar rates of episiotomy during instrumental delivery, but women having a VBAC were more likely to have an episiotomy during a spontaneous vaginal delivery. The indications for the initial caesarean section are available in Table 3.

Rates of obstetric anal sphincter injury

The number of women who had an obstetric anal sphincter injury was 9103 (5.0%) of primiparous women, 98 (5.8%) of secondiparous women undergoing VBAC after previous elective caesarean, and 618 (7.6%) in secondiparous women undergoing VBAC after previous emergency caesarean.

The observed increased chance of OASI was restricted to women with previous emergency caesarean delivery (adjOR 1.31; 95% CI 1.20 to 1.43; p < 0.001) (Table 4). There was no difference in rates between those who had a previous elective caesarean delivery and primiparous women adjOR 1.06; 95% CI 0.89 to 1.29; p > 0.5). The adjusted rate of OASI in women with an emergency caesarean is 6.40% (calculated from OR and baseline rate) compared to 5.0% in primiparous women. Further stratification by indication of emergency caesarean showed no restriction of effect (Table 5).

Incidence of OASI was higher in women of Asian ethnic origin (adjOR 2.18, 95% CI 2.03–2.34) in shoulder dystocia

Table 2
Summary characteristics of cohort who delivered vaginally.

	Primiparous women	Secondiparous women, previous caesarean	p-value[a]
Women in group	182,064	9993	
Mode of delivery			<0.001
Spontaneous vaginal	128,930 (70.8%)	6177 (61.8%)	
Instrumental	53,134 (29.2%)	3816 (38.2%)	
ventouse	22,875 (12.6%)	1726 (17.3%)	
forceps	30,259 (16.6%)	2090 (20.9%)	
Episiotomy			
With spontaneous vaginal	18,319 (14.2%)	1148 (18.6%)	<0.001
With instrumental			
ventouse	17,695 (77.4%)	1302 (75.4%)	0.07
forceps	27,098 (89.6%)	1874 (89.7%)	0.87
Factors in labour			
Prolonged labour	27, 234 (15.0%)	1516 (15.2%)	0.56
Shoulder dystocia	2233 (1.2%)	161 (1.6%)	0.001
Birthweight			<0.001
<2500 g	5,285 (2.9%)	275 (2.8%)	
2500–3999 g	161,101 (88.5%)	8723 (87.3%)	
≥4000 g	15,678 (8.6%)	995 (10.0%)	
Age			<0.001
15–20	15,650 (8.6%)	110 (1.1%)	
20–25	42,176 (23.2%)	1280 (12.8%)	
25–30	53,925 (29.6%)	2633 (26.4%)	
30–35	47,734 (26.2%)	3598 (36.0%)	
35–40	18,509 (10.2%)	2014 (20.2%)	
40–45	4,070 (2.2%)	358 (3.6%)	
Ethnic origin			<0.001
White	22,600 (74.7%)	1497 (71.6%)	
Afro-Caribbean	661 (2.2%)	96 (4.6%)	
Asian	2,986 (9.9%)	334 (16.0%)	
Other	1,808 (6.0%)	91 (4.4%)	
Unknown	2,204 (7.3%)	72 (3.4%)	

[a] χ^2 test of association between groups.

Table 3
Indications for previous caesarean.

First delivery	Number of women	Second delivery: elective caesarean	Second delivery: emergency caesarean	Second delivery: vaginal delivery	p-value[a]
Women in group	36,512	18,163	8,356	9993	
Elective caesarean	6,800	3,898 (57.3%)	1218 (17.9%)	1684 (24.8%)	<0.001
Placental disorder	340	173 (50.9%)	65 (19.1%)	102 (30.0%)	
Failed induction of labour	943	606 (64.3%)	226 (24.0%)	111 (11.8%)	
Fetal presentation	3,120	1,315 (42.2%)	584 (18.7%)	1221 (39.1%)	
Other reasons	2,397	1,804 (75.3%)	343 (12.3%)	250 (10.4%)	
Emergency caesarean	28,503	13,523 (47.4%)	6879 (24.1%)	8102 (28.4%)	<0.001
Fetal distress	11,166	5,185 (46.4%)	2913 (26.1%)	3068 (27.5%)	
Prolonged/obstructed labour	6,836	3,318 (48.5%)	1489 (21.8%)	2029 (29.7%)	
Fetal distress and prolonged/obstructed labour	5,545	2,686 (48.4%)	1313 (23.7%)	1546 (27.9%)	
Other reasons	4,956	2334 (47.1%)	1164 (23.5%)	1459 (29.4%)	

[a] χ^2 test of association between groups.

Table 4
Adjusted rates of obstetric anal sphincter injury, in cohort who delivered vaginally and had no previous vaginal delivery; stratified analyses by type of previous caesarean (elective or emergency).

	Unadjusted ate of tear per 100 births (%)	Crude odds ratio	Adjusted odds ratio	95% CI	p-value[a]
Primiparous women	5.0%	–	–	–	–
Previous elective caesarean	5.8%	1.18	1.06	(0.89, 1.29)	0.67
Previous emergency caesarean	7.6%	1.56	1.31	(1.20, 1.43)	<0.001
Mode of delivery					
Spontaneous vaginal	4.2%	Ref	Ref	–	–
Instrumental					
ventouse	4.0%	0.96	1.78	(1.63, 1.95)	<0.001
forceps	9.6%	2.44	5.20	(4.81,5.62)	<0.001
Factors in labour					
Episiotomy	4.8%	0.92	0.30	(0.28, 0.32)	<0.001
Prolonged labour	7.1%	1.55	1.04	(0.97, 1.11)	0.246
Shoulder dystocia	11.0%	2.34	1.77	(1.52, 2.06)	<0.001
Birthweight					
<2500 g	2.2%	0.44	0.41	(0.34, 0.50)	<0.001
2500–3999 g	4.8%	Ref	Ref	–	–
≥4000 g	8.8%	1.92	1.80	(1.69, 1.92)	<0.001
Age					
15–20	2.6%	0.68	0.74	(0.66, 0.82)	<0.001
20–25	3.8%	Ref	Ref	–	–
25–30	5.9%	1.60	1.46	(1.37, 1.56)	<0.001
30–35	6.0%	1.63	1.51	(1.41, 1.62)	<0.001
35–40	5.2%	1.38	1.26	(1.14, 1.38)	<0.001
40–45	3.9%	1.02	1.10	(0.91, 1.34)	0.31
Ethnic origin					
White	4.7%	Ref	Ref	–	–
Afro-Caribbean	4.2%	0.90	1.17	(1.02,1.33)	0.02
Asian	8.7%	1.94	2.18	(2.03,2.34)	<0.001
Other	4.8%	1.04	1.12	(1.02, 1.23)	0.02
Unknown	5.2%	1.12	1.15	(1.05, 1.27)	0.004
Deprivation – by quintile					
Least deprived	5.9%	–	Ref	–	–
2nd	5.4%	0.92	0.94	(0.87, 1.02)	0.14
3rd	5.1%	0.86	0.91	(0.84, 0.98)	0.01
4th	4.8%	0.81	0.99	(0.82, 0.95)	0.002
Most deprived	5.1%	0.76	0.86	(0.79, 0.93)	<0.001

(adjOR 1.77, 95% CI 1.52–2.06) and with birthweights of 4 kg or above (adjOR 1.80, 95% CI 1.69–1.92). Episiotomy (adjOR 0.30, 95% CI 0.28–0.32) and birthweight of less than 2.5 kg (adjOR 0.41, 9%% 91 0.34–0.50) appeared to be protective. This is consistent with previously published work [11].

The finding that OASI rate is higher in secondiparous women undergoing VBAC than primiparous women was robust to sensitivity analyses: (1) examining methods of defining parity using the value of parity recorded in HES [20] (adjOR 1.27, 95% CI 1.28–1.38); and (2) examining alternative methods of identifying tears, if they had either a record of a tear using the ICD-10 code or the repair using the OPCS code (adjOR 1.37, 95% CI 1.24–1.52); and (3) restriction to cases complete for all covariates (adjOR 1.34, 95% CI 1.23–1.45).

Table 5
Indications for previous caesarean delivery, among women who went on to have a vaginal delivery in their second birth, stratified by whether they experienced an OASI.

First delivery	Second delivery: vaginal delivery (no OASI)	Second delivery: vaginal delivery with OASI	p-value[a]
Women in group	9,275 (92.8%)	718 (7.2%)	
Elective caesarean	1,586 (94.2%)	98 (5.8%)	0.74
Placental disorder	148 (94.3%)	9 (5.7%)	
Fetal presentation	2,092 (92.2%)	178 (7.8%)	
Failed induction of labour	104 (93.7%)	7 (6.3%)	
Other reasons	5,348 (92.4%)	438 (7.6%)	
Emergency caesarean	7,484 (92.4%)	618 (7.6%)	0.18
Fetal distress	2,833 (92.3%)	235 (7.7%)	
Prolonged/obstructed labour	1,855 (91.4%)	174 (8.6%)	
Fetal distress and prolonged/obstructed labour	1,434 (92.8%)	112 (7.2%)	
Other reasons	1,362 (93.5%)	97 (6.7%)	
Caesarean section, undefined	205	#[b]	

[a] χ^2 test of association between groups.
[b] # suppression of numbers under 5.

Comment

We found that women having a VBAC for their second baby are 1.3 times more likely to experience OASI compared to women having their first baby vaginally, adjusted for delivery method, birthweight, ethnicity and other potential confounding factors. Indication for the previous emergency caesarean did not seem to have impact on this effect.

Possible reasons for this finding can be considered as power, passage and passenger.

Power may differ between groups: women having a VBAC may be required to progress more rapidly in labour than primiparous women, and subject to more interventions [23]. However, this effect is not seen in those with a previous elective caesarean, suggesting that this is less likely.

Women who undergo an emergency caesarean section may have some unmeasured underlying characteristic which affects the passage of the infant and is more likely to result in an emergency caesarean, or an OASI if delivering vaginally, such as underlying cephalo-pelvic disproportion. A prior study found an effect associated with maternal height.[12] However there is a paucity of evidence and this requires additional investigation.

Larger fetal size or fetal malpresentation is associated with both OASI and an emergency caesarean section. While this study adjusts for birthweight, data was not available for fetal head circumference or for fetal presentation at birth.

Our findings are consistent with previously published studies. An Irish study in a single centre, which looked at a cohort from 2001 to 2011, found an odds ratio for an OASI in a VBAC of 1.4 [13]. Similarly, a Finnish cohort study found an odds ratio of 1.42 for OASI in VBAC compared to primiparous women [12]. A study in the USA also showed an increased risk in VBAC (relative risk quoted as 1.4) [24]. No study, however, stratified based on whether the initial caesarean section was elective or emergency.

Strengths and limitations

To the best of our knowledge, this is the largest study to date to address the question of whether there is an increased risk of OASI in women undergoing VBAC.

The study uses data collected in the routine delivery of healthcare and used for payment of providers. The healthcare system in the UK is universally free at the point of need to individuals, and over 99% of babies in England are born in NHS care [25]. A very small number of women having a VBAC deliver at home or in trusts without obstetric units and thus would not be captured by this dataset [26]. Approximately 2% of births occur at home [9].

Home births are not well recorded in HES [27] but home births are not recommended for women attempting VBAC [28].

This study uses data which have been checked for quality and published on a named trust basis [2], from routine care at delivery in England. The coding for the key variables of mode of delivery, birthweight, tears and episiotomy is considered to be reliable [2,11,19]. This data has previously been used to inform guidelines and policy [29].

The most significant limitation of this analysis is in its unmeasured confounding. The groups of women are different in the baseline characteristics that can be measured and adjusted for in the dataset, such as age. Furthermore, HES does not contain information about BMI, and the code 'obesity' is used much less often than expected. Obesity is associated with a reduction in rates of obstetric anal sphincter injury [30]. Moreover, obesity is associated with a reduction in success rate of VBAC [31]. Therefore, it is possible that women with a high BMI are disproportionately represented in the primiparous group, and that this is a partial positive confounder. Labour anaesthesia is also unreliably coded in HES [2]; this, however, is likely to be a negative confounder, as epidural anaesthesia is both recommended early in VBACs [4] and is associated with a reduction in OASI [32,33].

This is a complete-case analysis; it assumes that missingness occurs at random. It is challenging to test this assumption completely; particularly as, while the cases included are complete for the variables where missingness is identifiable (such as birthweight), for some variables, such as episiotomy, it is assumed that if the diagnosis or procedure did not occur. However, even if the assumption is not completely met, provided the logistic model is correctly specified, a complete record analysis can generate asymptotically unbiased results under a wide range of missingness and selection patterns [34].

Conclusions

The odds ratio of an obstetric anal sphincter injury in women having a VBAC for their second baby is 1.3 compared to women having their first baby vaginally, adjusted for delivery method, birthweight, ethnicity and other potential confounding factors. This represents an absolute increase of risk from 5.0% in primiparous women to 6.4% (adjusted) in secondiparous women with previous emergency caesarean.

Our results are of use to clinicians counselling women considering VBAC in England and in countries with similar VBAC rates. Current guidance does not include any recommendation to counsel women receiving VBAC about their risk of OASI [4]. This advice should be re-evaluated in order to ensure women receive accurate information. However, choices about VBAC must continue

to be balanced against the risks of elective repeat caesarean section, which include increased scarring and prolonged recovery.

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