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Birth after Caesarean Section: A Retrospective Audit of 10 Years of State-Wide Data

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Introduction

Rates of Caesarean Section (CS) have been increasing worldwide with varying rates of [5] percent in Sub-Saharan Africa to 43 percent in Latin America and the Caribbean [1]. In Australia too rates have increased from 32 percent in 2011 to 38 percent in 20212. Attempts have been made to seek ways at slowing the rise in rates of CS but with little success [3]. Women who have had a previous CS may elect to have a Elective Repeat CS (ERCS) or have an attempt at a Vaginal Birth (VBAC) in their subsequent pregnancy. A planned VBAC, considering the woman's individual history and needs, is viewed as a safe option for many women with a single previous lower segment caesarean section [4]. Studies have shown that a Trial of Labour (TOL) ending in a VBAC is most favourable for the mother, newborn, and the health service [5,6]. Likelihood of success rates are reported to be between 60 and 80 percent [7]. A recent meta-analysis [8] noted successful vaginal birth rates of 74.3 percent if labour was spontaneous and 60.7 percent if induced. Achieving successful VBAC has also been reported to be less expensive and more effective than undergoing an ERCS [9,10]. There has recently been an international multi-centre trial that aims to increase the proportion of women having VBAC by increasing woman-centred care and facilitating women's empowerment in their choice of birth in three countries – Germany, Ireland and Italy [1]. An attempt at vaginal birth is also supported by various colleges across countries [4,7,12].

One of the reasons for the preference of ERCS may be a concern of a failed trial at vaginal birth resulting in an emergency CS. In one study of 29 352 women who attempted a vaginal birth after CS compared to 169 377 women without previous CS, Odds Ratio (OR) for emergency CS was 3.65 (CI: 3.26-4.08) higher when compared to women without previous CS [13]. The aim of this retrospective study however was to use a large dataset with a specific objective to report on the success and failure rate and to identify any specific predictors of a successful or an unsuccessful vaginal birth in women who are pregnant after one previous CS.

Methods

The study population included all pregnant women with a previous CS and with a singleton birth of ≥37 weeks' gestation with cephalic presentation in a public maternity facility between 01 January 2011 and 31 December 2021. Women who had an ERCS were excluded.

Study data was retrieved from the Queensland Perinatal Data Collection (QPDC) database. The QPDC collects information on all live births and stillbirths, that occur throughout Queensland. Midwives and other medical staff complete notification forms for each birth using information obtained directly from women's hospital charts coded by medical records staff. Completed forms and electronic extracts are validated and queries relating to missing, contradictory, or ambiguous data are directed back to the hospital or independent practitioner. Validated and confirmed data are then entered in Queensland Perinatal Data records. Diagnoses were coded using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) and procedures using the Australian Classification of Health Interventions (ACHI).

Study variables: The outcome variable of Vaginal Birth After Caesarean (VBAC) was ascertained using a combination of the variables labour onset (no labour, induced, spontaneous) and mode of delivery (vaginal instrumental, vaginal non-instrumental, caesarean section). Births with no labour onset and caesar-

ean section were classified as repeat elective caesarean deliveries and were excluded from the study population. Women with spontaneous or induced labour were considered to have had a trial of labour after caesarean section. Women who had spontaneous or induced labour and had a vaginal birth were considered as having a successful VBAC while those who laboured and had a caesarean section were considered as having an unsuccessful VBAC.

Maternal outcomes included uterine rupture before or during labour (ICD10AM code 0710, O711), postpartum haemorrhage, blood transfusion (ACHI code 1370601, 1370602), length of postnatal hospital stay. Neonatal outcomes included baby's birthweight, low 5 minute Apgar score (defined as less than 7), resuscitation, hospital transfer, transient tachypnoea of newborn (P221), perinatal respiratory disorder (P20-P28 excluding P221), umbilical cord blood pH, neonatal sepsis (P36), meconium aspiration (P240), use of continuous positive airway pressure during resuscitation or treatment during the birth admission, length of stay in Special Care Nursery (SCN) or Intensive Care Nursery (ICN), and status of the baby on discharge (alive or deceased).

Other variables: Other maternal and pregnancy characteristics assessed included maternal age, Indigenous status, parity defined as the total number of previous pregnancies, any smoking during pregnancy, pre-pregnancy body mass index (<18.5, 18.5-24.9, 25-29.9, 30-39.9, ≥40 kg/m^2), Edinburgh Postnatal Depression Scale assessment (not done, <10, 10 or more, unknown/not stated), hospital ward accommodation status (public, private), whether antenatal care was received, antenatal care provider, any current medical conditions, diabetes (ICD10AM codes: E10-E11, E13-E14, O24.0-O24.4, O24.9), hypertension (O10-O11, O13-O16), labour assistance, whether pharmacological analgesia was used, baby's year of birth, duration from rupture of membranes to birth, duration of first and second stages of labour.

Ethics: Ethics approval was granted by West Moreton Hospital and Health Service Human Research Ethics Committee (HREC/2022/DEF/87483).

Statistical analysis: Maternal and pregnancy characteristics were compared between successful and unsuccessful VBAC groups using Chi square, T test and Mann Whitney U tests for categorical, normally, and non-normally distributed continuous data, respectively. Associations between characteristics and successful VBAC were assessed using modified Poisson regression with robust error variances. Potential predictors of successful VBAC were selected for inclusion in multivariable analysis based on statistically significant univariate association at α=0.05. Maternal and neonatal outcomes for successful and unsuccessful VBAC groups were compared using descriptive statistics.

All analyses were undertaken using SAS for Windows 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

During the ten-year period from January 2011 to December 2021, there were a total of 57,946 singleton ≥37 weeks' gestation births with cephalic presentation in public maternity facilities in Queensland to women who have had a previous caesarean birth. Of the 57,946 women, 38,080 women had an ERCS and were excluded. The study population included 19,866 women. Of these, 11,327(57%) women had a successful VBAC (Figure 1).

Table 1 demonstrates the general characteristics of the women included in the analyses based on mode of birth.

Associations between characteristics and successful VBAC were assessed using modified Poisson regression with robust error variances. Factors that increased chance of successful VBAC were increasing number of previous pregnancies, having antenatal care provided by a midwife, and labour induction or augmentation. Provision of care by a midwife was seen to increase rates of successful VBAC - both public and private midwifery models with adjusted Relative Risk (aRR) of successful VBAC 1.35 (95% CI: 1.24-1.48) and 1.15 (95% CI: 1.09-1.21) for private midwifery and public hospital midwifery care, respectively. Increasing parity increased the rate of successful VBAC with aRR 1.24 (95% CI: 1.19-1.30), 1.35 (95% CI: 1.29-1.43), and 1.42 (95% CI: 1.36-1.49) for three, four, or five previous births respectively. The use of any labour assistance including Artificial Rupture of Membranes (ARM) and/or use of oxytocin was associated with increased rate of successful VBAC with aRR 1.42 (95% CI: 1.37-1.46). Conversely, maternal age ≥35 years, maternal overweight and obesity, diabetes, hypertension, and having antenatal care provided by a medical practitioner in public hospital/clinic – were all associated with decreased risk of having a successful VBAC (Table 2).

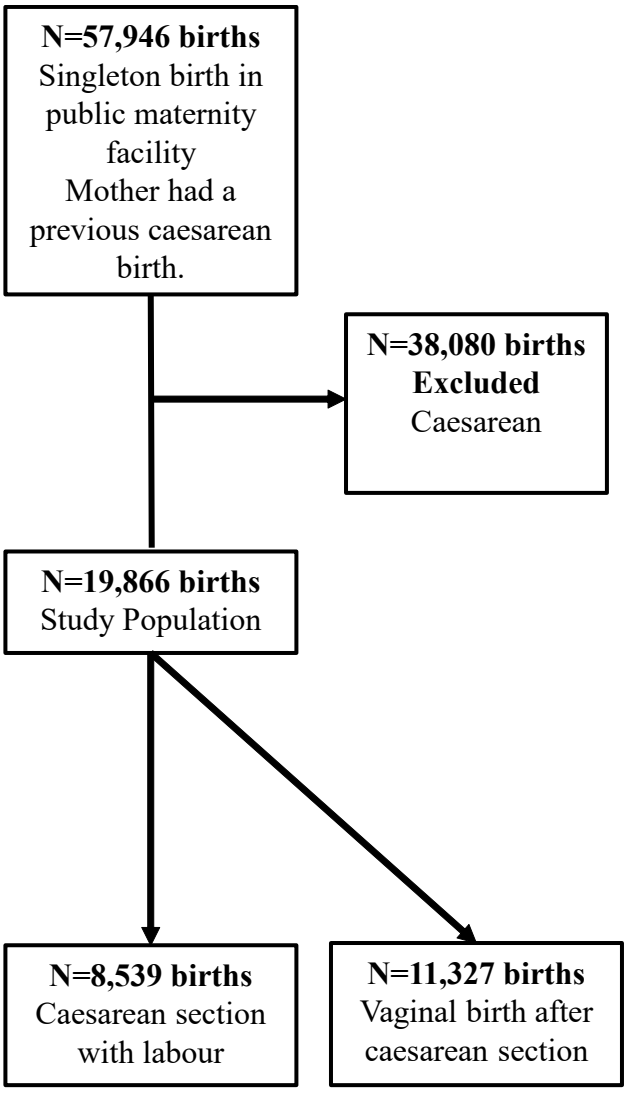

Figure 1: Flowchart of the study population.

Table 1: Characteristics of the study population by mode of birth.

Characteristic	Vaginal birth N=11,327	Caesarean section N=8,539	p value
Maternal age, mean (SD)	30.3(5.2)	30.3(5.3)	0.495
<20 years	98(0.9)	103(1.2)	0.035
20-34 years	7651(76.4)	6462(75.6)	
35-39 years	2149(19.0)	1617(18.9)	
40+ years	418(3.7)	346(4.1)	
missing	11(0.1)	11(0.1)	
Parity, median (IQR)	2(1-4)	2(1-3)	
1	3348(29.6)	3439(40.3)	<0.001
2	2923(25.8)	2292(26.8)	
3 and above	5056(44.7)	2808(32.9)	
Indigenous ethnicity, N(%)	1254(11.1)	935(11.0)	0.787
Any smoking, N(%)	2096(18.5)	1578(18.5)	0.612
Body mass index (kg/m^2)			
<18.5	485(4.3)	346(4.1)	<0.001
18.5-24.9	4967(43.9)	3394(39.8)	
25.0-29.9	2900(25.6)	2235(26.2)	
30.0-39.9	2338(20.6)	2035(23.8)	
40+	448(4.0)	386(4.5)	
Unknown	189(1.7)	189(1.7)	
Any antenatal care	11251(99.3)	8489(99.4)	0.453
Private specialist medical practitioner*	203(1.8)	166(1.9)	0.433
Private midwifery*	336(3.0)	153(1.8)	<0.001
Public hospital midwifery*	9288(82.0)	6804(79.7)	<0.001
Public hospital medical*	8824(77.9)	7016(82.2)	<0.001
Private general practitioner*	5468(48.3)	4330(50.7)	<0.001
Any medical conditions	3786(33.4)	3144(36.8)	<0.001
Any diabetes	1324(11.7)	1247(14.6)	<0.001
Gestational diabetes	1280(11.3)	1173(13.7)	<0.001
Type 1 diabetes	12(0.1)	19(0.2)	0.039
Type 2 diabetes	28(0.3)	49(0.6)	<0.001
Any hypertension	335(3.0)	323(3.8)	0.001
Pre-existing	70(0.6)	60(0.7)	0.464
Pregnancy induced	181(1.6)	155(1.8)	0.240
Pre-eclampsia/eclampsia	99(0.9)	114(1.3)	0.002
Any labour assistance	5422(47.9)	2505(29.3)	<0.001
ARM	4524(39.9)	1960(23.0)	<0.001
Oxytocin	2472(21.8)	1240(14.5)	<0.001
Prostaglandin	122(1.1)	74(0.9)	0.137
Mechanical	465(4.1)	335(3.9)	0.518
Other	574(5.1)	372(4.4)	0.020

*Antenatal care categories are not mutually exclusive, some women had more than one type of antenatal care provider. Percentages may sum up to more than 100% due to rounding.

Table 2: Predictors of successful VBAC.

Characteristic	Relative Risk RR (95% CI)	Adjusted Relative Risk aRR (95% CI)
Maternal age		
<20 years	0.84(0.73-0.97)	0.92 (0.75-1.14)
20-24 years	0.95(0.92-0.99)	0.96 (0.91-1.02)
25-29 years	Ref	Ref
30-34 years	0.99(0.96-1.02)	0.97 (0.94-1.01)
35-39 years	0.98(0.95-1.02)	0.94 (0.90-0.98)
40+ years	0.94(0.88-1.01)	0.85 (0.78-0.93)
Parity		
1	Ref	Ref
2	1.14(1.10-1.18)	1.13 (1.08-1.18)
3	1.20(1.16-1.25)	1.24 (1.19-1.30)
4	1.32(1.27-1.38)	1.35 (1.29-1.43)
5 or more	1.41(1.36-1.46)	1.42 (1.36-1.49)
Body mass index (kg/m^2)		
<18.5	0.98(0.92-1.04)	0.97 (0.90-1.04)
18.5-24.9	Ref	Ref
25.0-29.9	0.95(0.92-0.98)	**0.94 (0.90-0.97)**
30.0-39.9	0.90(0.87-0.93)	**0.88 (0.85-0.92)**
40+	0.90(0.85-0.97)	**0.90 (0.83-0.97)**
Edinburgh Postnatal Depression Scale		
Not done	1.01(0.95-1.07)	0.97 (0.91-1.03)
Less than 10	Ref	Ref
10 or more	0.92(0.88-0.97)	0.92 (0.88-0.96)
Unknown/not stated	0.88(0.66-1.16)	0.92 (0.70-1.21)
Type of antenatal care provider		
Private midwifery*	1.21(1.14-1.29)	1.35 (1.24-1.48)
Public hospital midwifery*	1.07(1.03-1.10))	1.15 (1.09-1.21)
Public hospital medical practitioner*	0.90(0.87-0.92)	0.89 (0.85-0.92)
Private general practitioner*	0.96(0.94-0.98)	0.99 (0.96-1.02)
Any diabetes	0.89(0.86-0.93)	0.90 (0.86-0.94)
Any hypertension	0.89(0.82-0.96)	0.87 (0.80-0.95)
Any labour assistance	1.38(1.35-1.42)	1.42 (1.37-1.46)
Any pharmacological analgesia	1.09(1.06-1.12)	0.98 (0.95-1.02)

Multivariable model adjusted for maternal age, parity, body mass index, Edinburgh perinatal depression score, type of antenatal care provider, diabetes, hypertension, labour assistance, pharmacological analgesia, duration from ruptured membranes to birth, baby's year of birth.

Discussion

The overall rate of successful VBAC was 57 percent. This rate is lower than findings from a recent meta-analysis18 that noted a success rate of 74.7% though the rates have varied from 23 to 86 percent [10,14,19-23].

Associations between characteristics and successful VBAC were assessed using modified Poisson regression with robust error variances. Factors identified increased chance of successful VBAC were increasing number of previous pregnancies, having antenatal care provided by a midwife, and labour induction or augmentation. Unfortunately, our data did not include data of previous vaginal deliveries or previous successful VBAC. Throughout the literature, the strongest predictor of successful VBAC is having a previous vaginal birth and/or previous successful VBAC [10,12,23,24]. Conducting further analysis to include this will assist in determining the outcome for our current population. It could be inferred based on our population of women undergoing labour with one previous caesarean section with parity >1, and increased success with increasing number of pregnancies. However, it is not clearly defined.

Antenatal care can be provided in several different models of care. It was demonstrated that provision of care by a midwife was seen to increase rates of successful VBAC - both public and private midwifery models. This is consistent with the "Queensland Clinical Guideline: Vaginal birth after caesarean" 25 which describes that midwifery led 'next birth after caesar-

ean clinic' is effective to meet women's information needs and address decisional conflict around VBAC [25,26]. A small prospective study carried out by Zhang and Liu [27] determined that continuing midwifery care provided during the antenatal, labour and birth, and postnatal period resulted in significantly higher rate of VBAC, reduced length of labour, and reduced Post-Partum Haemorrhage (PPH) rate. An important consideration is a woman's experience with antenatal care, labour, and birth. An Australian survey conducted by Keedle and colleagues [28] found that women planning a VBAC benefitted from midwifery continuity of care models. Utility of models of care for women undergoing VBAC requires further attention.

Interestingly, induction or augmentation of labour was associated with successful VBAC. This is an unexpected finding as many previous studies contradict this, reporting that induction of labour was associated with unsuccessful VBAC. This included any labour assistance offered, and specifically by Artificial Rupture of Membranes (ARM), and use of oxytocin. Contrary to our findings, spontaneous labour is seen as a factor associated with successful VBAC [14,19,20,24]. Compared with spontaneous labour, induction of labour is a factor associated with unsuccessful VBAC [14,20,24]. A meta-analysis conducted by Zhang and colleagues 14 reported rates of successful VBAC as 60.7% and 74.3% with induction of labour and spontaneous labour respectively, with spontaneous labour significantly increasing rates of VBAC. Parveen and colleagues [20] determined that favourable Bishop Score (BS) was independently associated with successful VBAC. It could be postulated that induction of labour being positively associated with successful VBAC in our population may be due to local guidelines for induction of labour that recommend ARM only when the BS is greater than [6].

Maternal age ≥35 years, maternal overweight and obesity, Edinburgh Perinatal Depression Scale (EDPS) score of 10 or more, diabetes, hypertension, and having antenatal care provided by a medical practitioner in public hospital/clinic – were all associated with decreased risk of having a successful VBAC. This is consistent with reported findings in literature. Increasing maternal age was seen by Parveen and colleagues [20] as an independent factor associated with unsuccessful VBAC also shown in another stud [21]. This is consistent with a large meta-analysis conducted by Wu and colleagues [24] who found that advanced maternal age, maternal obesity, maternal diabetes, and hypertensive disorders were all factors associated with unsuccessful VBAC.

Strengths and limitations: This retrospective audit is a large study using state-wide data register - the Queensland Perinatal Data Collection - encompassing a decade of data from 2011 to 2021. Data from the register is routinely and contemporaneously collected in structured format using state-wide instructions, which ensures adequate reporting and reduced possible reporting and selection biases. The strengths of the analysis include the use of a large, heterogenous, and representative cohort. The contributing patient factors and outcomes used were well-defined.

The limitations include the lack of data relating to previous pregnancies and the index caesarean section, and birthweight as a predictor of successful VBAC. It would be useful to identify these factors as they inform counselling, with an overwhelming existing base of evidence taking these factors into account.

Conclusion

The study contributes to assisting health care providers and pregnant women wishing to have a vaginal birth with the decision-making process in understanding their chances of a successful vaginal birth. Further studies are required to explore further associations and outcomes that enable comprehensive antenatal counselling. This information could further be adapted to create a clinically useful decision-aid.

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