Predictors for caesarean delivery and neonatal admission after trial of labour in women with one previous lower segment caesarean scar

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ABSTRACT

Introduction: Caesarean delivery rates are still increasing, and reliable predictors of adverse outcomes at a subsequent trial of scar are important as they guide decision-making on the best mode of delivery. We aimed to evaluate whether there are any predictors for caesarean delivery and neonatal admission, following trial of labour after one lower transverse caesarean section.

Methods: 768 women at term with singleton gestation and who had undergone a trial of labour between June 2002 and December 2005, were retrospectively identified using the labour ward register. 51 infants were admitted to a neonatal unit. Case notes for these cases were retrieved. Emergency repeat caesarean delivery and neonatal admission were the main outcome measures.

Results: Following multivariate logistic regression analysis, no previous vaginal birth (adjusted odds-ratio [AOR] 3.4), diabetes mellitus or hypertension in pregnancy (AOR 1.7), induction of labour (AOR 2.0), oxytocin use in labour (AOR 2.4), and meconium-stained liquor (AOR 4.9) were independent predictors of emergency caesarean delivery. Diabetes mellitus or hypertension in pregnancy (AOR 3.1), prelabour rupture of membranes (AOR 4.7) and caesarean delivery (AOR 6.0) were independent predictors of neonatal admission.

Conclusion: Predictors for emergency caesarean delivery and neonatal admission following a trial of labour can be identified. This information should be incorporated into the counselling of women contemplating a trial of labour. The strongest predictor for neonatal admission was emergency caesarean delivery, further emphasising the need for careful case selection in a trial of labour to minimise the risk of failure.

Keywords: emergency caesarean section, meconium-stained liquor, neonatal admission, prelabour rupture of membranes, trial of labour

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INTRODUCTION

Vaginal birth after caesarean delivery has declined in parts of the developed world[1] due to a fall in the trial of labour rate.[2] Recent large scale but non-randomised studies have shown increased adverse maternal and neonatal outcomes with a trial of labour, although absolute risks are low.[3-5] Adverse outcomes are most common following a failed trial of labour.[3,6] A trial of labour, in low risk women with one previous lower segment scar, if conducted within a centre with appropriate facilities for a timely emergency caesarean delivery, is an accepted practice.[7,8] PubMed searches (www.ncbi.nlm.nih.gov/entrez/query.fcgi) were carried out in all languages using the search terms, "trial of labor and predictors of cesarean", and subsequently the terms, "trial of labor and predictors of neonatal admission", on January 19, 2007. Several pertinent studies were available on predictors of caesarean but no relevant study was found on predictors of neonatal admission following a trial of labour, indicating a paucity of information on the latter issue. This retrospective study was designed to look at predictors of emergency caesarean and neonatal admission in a trial of labour in women at term with a singleton foetus and after one previous lower segment caesarean, with the aim of obtaining information to aid counselling.

METHODS

This study is a further analysis of a case series of 1,000 women at term with a singleton gestation and who had one previous lower transverse caesarean, but otherwise considered suitable for a trial of labour. In an earlier study, we compared obstetric outcome between the 232 women that had elective repeat caesarean with the 768 women that had a trial of labour.[9] In the current study, we analysed the 768 women that had a trial of labour to identify independent predictors for emergency caesarean delivery and neonatal admission. There were about 5,000 deliveries per year, delivered at our centre. The labour ward birth register was searched retrospectively

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Table I. Characteristics of the study women.

Characteristics	Trial of labour, n = 768
Age (years)	31.4 ± 4.3
≥ 35	169 (22)
Gestation (weeks)	38.9 ± 1.2
≥ 40	260 (33.9)
Parity	1 (IQR 1)
No previous vaginal birth	426 (55.5)
Indication for previous caesarean	
Failure to progress	261 (34)
Others	507 (66)
Diabetes mellitus or hypertension in pregnancy	120* (15.6)
Hypertension	31*
Diabetes mellitus	91*
Prelabour rupture of membranes	60 (7.8)
Induction of labour	96 (12.5)
Mode of delivery	
Spontaneous vaginal	484 (63)
Instrumental vaginal	63 (8.2)
Caesarean	221 (28.8)
Birth weight (kg)	3.18 ± 0.43
Neonatal admission	51 (6.6)
Indication for admission†	
Respiratory distress syndrome	32
Sepsis	22
Neonatal jaundice	21
Hypoglycaemia	7
Low birth weight	3
Congenital diaphragmatic hernia	1

Data is expressed as number (%), mean ± standard deviation, or median (IQR or interquartile range), where applicable.

* Two women had both diabetes mellitus and hypertension in pregnancy

† Some neonates have more than one indication for admission; a few had up to four indications

from December 31, 2005 to identify consecutive cases of women with a singleton foetus at term (36–42 weeks gestation) that had previous caesarean delivery. A history of caesarean delivery was a routinely-collected statistic in our birth register. Women with more than one previous caesarean section, a classical caesarean section, an unknown uterine incision, multiple gestations, lethal foetal anomalies, severe pre-eclampsia and repeat caesarean section indicated by breech presentation, transverse lie or placentae previae were excluded. The 1,000th woman that fulfilled study criteria of one previous lower transverse scar but otherwise suitable for trial of labour, was identified as having delivered in June 2002.

Case notes of study women were retrieved and data which included previous delivery history, current pregnancy and labour details and neonatal information were extracted, transferred onto a data sheet, and listed in Tables I–III. Neonates who were admitted to a neonatal unit within the first week of life before hospital discharge were also identified from the birth register and maternal case notes. To ensure complete ascertainment of neonatal admissions, all newborns' details were checked against the registry of our neonatal unit for the relevant time period. The case notes of babies that were admitted were also retrieved and studied. During data collection, we categorised indication for previous caesarean section into two groups: those indicated by failure to progress in labour, and those whose indications of failure to progress may have been due to a recurrent condition, like relative cephalopelvic disproportion.[10] Data was also collected on whether or not the pregnancy was complicated by diabetes mellitus or hypertension, as these medical disorders in pregnancy are known to increase the risk of emergency caesarean section during trial of labour.[11-13] We also chose to categorise length of labour with an eight hour cut-off, as this demarcation point represented one standard deviation above the mean for study women who had successful VBACs.

Our study was conducted on women who delivered in a university hospital with a blood bank, laboratory facilities, radiology services, operating theatres and neonatal intensive care support available at any time. Obstetric registrars and a trained obstetrician were on duty on-site around the clock. An anaesthetic registrar dedicated to labour ward service was also available 24 hours a day. A neonatal registrar was also on duty on site at all times. Our labour ward set-up was compliant with recent major guidelines for the conduct of a trial of labour after caesarean.[7,8] Labour induction after a previous lower segment caesarean delivery was permitted in our centre; vaginal prostaglandin for induction can be used if such management was agreed on by the patient after being advised by our specialist staff. Continuous electronic foetal monitoring in labour was universally applied for trial of labour after caesarean section. Augmentation of labour with oxytocin was also permitted in accordance with our labour ward guidelines and at the discretion of the specialist staff. Oxytocin augmentation can be applied if labour progress was below the two-hour action line on the partogram.

Women in labour were assessed at least every four hourly initially. No specific time limit was set for a trial of labour and any decision on emergency caesarean delivery was made at the discretion of the specialist staff on duty. We obtained institutional approval from the University of Malaya for this retrospective study, and the conduct of the study followed the institutional guidelines for a study of this type. Data was entered into the Statistical Package for Social Sciences version 14.0 (SPSS Inc, Chicago, IL, USA). The *t*-test was used to compare means, Mann-Whitney U-test for non-parametric nominal data, and multivariate logistic regression analysis was used to control for dependent variables. GraphPad Instat and

Table II. Risk factors for caesarean delivery in study women who had undergone trial of labour after one previous caesarean delivery.

	Caesarean delivery n = 221	Vaginal delivery n = 547	OR (95% CI)	p-value	AOR (95% CI)	p-value
Age (years)	31.7 ± 4.8	31.2 ± 4.1		0.20‡		
≥ 35	56 (25.3)	113 (20.7)	1.3 (0.9–1.9)	0.18		
Gestational age (weeks)	38.8 ± 1.3	39.0 ± 1.1		0.19‡		
≥ 40	73 (33.0)	187 (34.2)	0.9 (0.7–1.3)	0.80		
Parity	1 (IQR 1)	2 (IQR 1)		< 0.001§		
No previous vaginal birth	170 (76.9)	256 (46.8)	3.8 (2.7–5.4)	< 0.001	3.4 (2.3–5.0)	< 0.001
Indication for previous caesarean						
Failure to progress in labour	88 (39.8)	173 (31.6)	1.4 (1.0–2.0)	0.035	1.3 (0.9–1.9)	0.15
Others	133 (60.2)	374 (68.4)				
Diabetes mellitus or hypertension in pregnancy	46 (20.8)	74 (13.5)	1.7 (1.1–2.5)	0.015	1.7 (1.1–2.7)	0.022
Prelabour rupture of membranes	24 (10.9)	36 (6.6)	1.7 (1.0–3.0)	0.053		
Induction of labour	46 (20.8)	50 (9.1)	2.6 (1.7–4.0)	< 0.001	2.0 (1.2–3.3)	0.006
Oxytocin use in labour	116 (52.5)	148 (27.1)	3.0 (2.2–4.1)	< 0.001	2.4 (1.7–3.5)	< 0.001
Epidural analgesia in labour	65 (29.4)	137 (25.0)	1.2 (0.9–1.8)	0.24		
Duration of labour (hours)	6.1 ± 2.8	5.4 ± 2.7		0.002‡		
> 8	58 (26.2)	88 (16.1)	1.9 (1.3–2.7)	0.002	1.2 (0.8–1.8)	0.49
Meconium-stained liquor in labour	41 (18.6)	23 (4.2)	5.2 (3.0–8.9)	< 0.001	4.9 (2.7–8.6)	< 0.001
Male infant	113 (51.1)	298 (54.5)	0.9 (0.6–1.2)	0.43		

Data is expressed in number (%), means ± standard deviation, or median (IQR), where applicable.
OR: odds ratio (derived using Fisher's exact test); AOR: adjusted odds ratio (shown where parameter was incorporated in the multivariate logistic regression analysis); CI: confidence interval
‡ Analysis of means by *t*-test
§ Analysis of non-parametric ordinal data by Mann-Whitney U-test

Quickcalc software (GraphPad Inc, San Diego, CA, USA) were also used to obtain odds-ratio using Fisher's exact test and the 95% confidence interval of a proportion, respectively. We included all variables with $p < 0.05$ into our models for multivariate logistic regression analyses. All tests were two-tailed and $p < 0.05$ was taken as a level of significance.

RESULTS

The characteristics of the study women are listed in Table I. 232 (23.2%) women, who had an elective repeat caesarean, were excluded, while the remaining 768 women that had undergone a trial of labour were included for analysis. The vaginal delivery rate was 71.2% and the emergency caesarean section rate was 28.8% in women that had a trial of labour. There were 51/768 (6.6%) neonatal admissions in the trial of labour group, compared to 14/232 (6.0%) in the elective repeat caesarean group. There were three (0.4%) perinatal deaths due to unexplained intrauterine death, intracranial haemorrhage following a difficult emergency caesarean delivery and meconium-aspiration syndrome, the details of which have been previously reported.[9] There were two (0.3%) uterine rupture that required emergency caesarean; both infants had Apgar scores of 9 at five minutes. Only one baby was admitted to the neonatal unit for a three-day stay, but mechanical ventilation was not needed. Neither babies had any evidence of hypoxic-ischaemic encephalopathy. The small number of perinatal deaths and uterine ruptures precluded any meaningful statistical analysis on these outcomes.[9]

Table II shows the risk factors for caesarean delivery after a trial of labour. On univariate analysis, previous vaginal birth, previous caesarean indicated by failure to progress, diabetes mellitus or hypertension in pregnancy, induction of labour, oxytocin use in labour, labour duration of more than eight hours, and meconium-stained liquor were associated with caesarean delivery. After multivariate logistic regression analysis controlling for variables with crude $p < 0.05$, no previous vaginal birth, diabetes mellitus or hypertension in pregnancy, labour induction, oxytocin augmentation and meconium-stained liquor remained independently associated with caesarean delivery. Table III depicts the analyses of potential predictive factors for neonatal admission after trial of labour. On univariate

Table III. Risk factors for the admission to a neonatal unit of babies of study women who had undergone trial of labour after one previous caesarean delivery.

	Neonatal admission n = 51	No neonatal admission n = 717	OR (95% CI)	p-value	AOR (95% CI)	p-value
Age (years)	32.0 ± 5.0	31.3 ± 4.3		0.27‡		
≥ 35	14 (27.5)	155 (21.6)	1.4 (0.7–2.6)	0.38		
Gestational age (weeks)	38.7 ± 1.4	38.9 ± 1.1		0.18‡		
≥ 40	16 (31.3)	244 (34.0)	0.9 (0.5–1.6)	0.76		
Parity	1 (IQR 1)	1 (IQR 1)		0.25§		
No previous vaginal birth	33 (64.7)	393 (54.8)	1.5 (0.8–2.7)	0.19		
Indication for previous caesarean						
Failure to progress in labour	15 (29.4)	246 (34.3)	0.8 (0.4–1.5)	0.54		
Others	36 (70.6)	471 (65.7)				
Diabetes mellitus or hypertension in pregnancy	18 (35.3)	102 (14.2)	3.3 (1.8–6.1)	< 0.001	3.1 (1.6–6.0)	0.001
Prelabour rupture of membranes	13 (25.5)	47 (6.6)	4.9 (2.4–9.8)	< 0.001	4.7 (2.2–10)	< 0.001
Induction of labour	10 (19.6)	86 (12.0)	1.8 (0.9–3.7)	0.12		
Oxytocin use in labour	26 (51.0)	238 (33.2)	2.1 (1.1–3.7)	0.014	1.1 (0.6–2.1)	0.71
Epidural analgesia in labour	17 (33.3)	185 (25.8)	1.4 (0.8–2.6)	0.25		
Duration of labour (hours)	5.8 ± 2.6	5.6 ± 2.7		0.66‡		
> 8	10 (19.6)	136 (19.0)	1.0 (0.5–2.1)	0.86		
Meconium-stained liquor in labour	9 (17.6)	55 (7.7)	2.6 (1.2–5.6)	0.03	1.4 (0.6–3.2)	0.46
Male infant	33 (64.7)	378 (52.7)	1.6 (0.9–3.0)	0.11		
Caesarean delivery	36 (70.6)	185 (25.8)	6.9 (3.7–12.9)	< 0.001	6.0 (3.1–12)	< 0.001

Data is expressed as number (%), means ± standard deviation, or median (IQR), where applicable.
OR: Odds ratio (derived using Fisher's exact test); AOR: Adjusted odds ratio (shown where parameter was incorporated in the multivariate logistic regression analysis); CI: confidence interval
‡Analysis of means by *t*-test
§Analysis of non-parametric ordinal data by Mann-Whitney U-test

analysis, diabetes mellitus or hypertension in pregnancy, prelabour rupture of membranes, oxytocin use in labour, meconium-stained liquor and caesarean delivery were associated with neonatal admission. After adjustment, only diabetes mellitus or hypertension in pregnancy, prelabour rupture of membranes and caesarean delivery remained independently associated with neonatal admission.

DISCUSSION

The rate of vaginal birth after trial of labour was 71.2% in our study group, comparable to reported rates of 70% in a 2003 literature review of 142,075 trials of labour.[14] More recent studies show success rates of 73.4% from a multicentre prospective study from USA,[3] 74.2% from a Scottish national database study,[15] 77.8 % from an Irish study[16] and 76.8% from a Qatari study.[17] Two women (0.3%) in a study of 768 trials of labour had scar rupture but neither of the babies had any evidence of hypoxic-ischaemic encephalopathy. Our scar rupture rate during trial of labour is similar to the 0.4%–0.62% quoted in recent large reviews of women who had undergone trial of labour.[14,18] We found that no previous vaginal delivery was a strong predictor for emergency caesarean section at a trial of labour (AOR 3.4; 95% CI 2.3–5.0), a finding consistent with other reports.[10,13,19,20] In our study, women with diabetes mellitus or hypertension during pregnancy had a higher emergency caesarean rate, findings which have also been reported by others.[11-13]

Labour induction, as expected, was shown to be an independent predictor of emergency caesarean in our study, a finding which has been reported before.[6,21] Oxytocin use in labour was also associated with emergency caesarean section, in agreement with a previous study.[6] Meconium-stained liquor was another strong predictor (AOR 4.9; 95% CI 2.7–8.6) of emergency caesarean sections in our study, in contrast to a previous study by Durnwald and Mercer (crude OR 1.2; 95% CI 0.8–1.9).[6] Durnwald and Mercer's study population included preterm trial of labour and differed substantially from ours, which did not. In addition, their study included only women with no previous vaginal birth that underwent trial of labour after a caesarean.

In this study, we found diabetes mellitus or hypertension during pregnancy to be an independent predictor for neonatal admission. There were 91 women (11.8%) with diabetes mellitus in pregnancy in our study group—this high rate may be a reflection of increased screening and detection of gestational diabetes mellitus in our study group of "high risk" women, as defined by a previous scar. Gestational diabetes mellitus has been shown to be associated with a high admission rate to a neonatal nursery with two-thirds of neonates admitted according to a recent multicentre trial.[22] Therefore, the independent association of maternal medical disorders to neonatal admission may be more a reflection of the underlying maternal disorder than due to a trial of labour after caesarean. We found prelabour rupture of membranes (AOR 4.9; 95% CI 2.4–9.8) to be a strong predictor of neonatal admission. A large randomised trial of women with prelabour rupture of membranes at term (TERMPROM) has shown an admission rate of 9.4% to the neonatal intensive care unit for more than 24 hours;[23] this is a higher admission rate than the overall rate of 6.6% in our study. Our neonatal admission rate for trial of labour after prelabour rupture of membranes was 21.7% (95% CI 13.0–33.8), which suggested a possible interaction between prelabour rupture of membranes and trial of scar, which increased the requirement for neonatal admission.

Emergency caesarean delivery had the strongest predictive value for neonatal admission in our study (AOR 6.0; 95% CI 3.1–12), but this was not supported by Durnwald and Mercer (crude OR 1.0; 95% CI 0.5–2.1),[6] possibly because their study (as discussed above) has a different population. However, neonatal admission notwithstanding, neonatal morbidity is generally worse following a failed trial of labour.[24,25] Risk of emergency caesarean delivery and neonatal admission at a trial of labour can be predicted, and this information should be incorporated into the counselling of women who are contemplating a trial of labour after one lower segment caesarean. Unplanned caesarean delivery was the strongest predictor of neonatal admission, adding to the importance of case selection in a trial of labour to reduce the risk of failure.

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