

Caesarean Section on Maternal Request: Risks and Benefits in Healthy Nulliparous Women and Their Infants

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Abstract

Objective: To determine the risks and benefits of an elective Caesarean section (CS) at term in healthy nulliparous women.

Methods: We conducted a population-based cohort study of deliveries between 1994 and 2002. Using bivariate and multivariable techniques, we compared maternal and neonatal outcomes in healthy nulliparous women who had undergone elective pre-labour CS (using breech presentation as a surrogate) with those in women who had undergone spontaneous labour with anticipated vaginal delivery (SL) at full term.

Results: There were 1046 deliveries in the pre-labour CS group and 38 021 in the SL group. Life-threatening maternal morbidity was similar in each group. Life-threatening neonatal morbidity was decreased in the CS group (RR 0.34; 99% CI 0.12 to 0.97). Subgroup analysis of the SL group by mode of delivery demonstrated the increased neonatal risk was associated with operative vaginal delivery and intrapartum CS but not spontaneous vaginal delivery.

Conclusion: An elective pre-labour Caesarean section in a nulliparous woman at full term decreased the risk of life-threatening neonatal morbidity compared with spontaneous labour with anticipated vaginal delivery. However, the 63% of women with spontaneous labour who achieved a spontaneous vaginal delivery would not have benefited from delivery by Caesarean section. Further research is needed to better identify women with an increased likelihood of an operative vaginal or intrapartum Caesarean section, as this may assist maternity caregivers in decision-making about childbirth. Further research is also needed to determine if these findings can be confirmed in a prospective study.

Résumé

Objectif : Déterminer les risques et les avantages d'une césarienne (CS) de convenance à terme chez les nullipares en santé.

Key Words: Caesarean, labour, nulliparous, maternal request

Competing Interests: None declared.

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Méthodes : Nous avons mené une étude de cohorte en population générale portant sur les accouchements survenus entre 1994 et 2002. Au moyen de techniques bivariées et multivariées, nous avons comparé les issues maternelles et néonatales qu'ont connues des nullipares en santé ayant subi une CS de convenance prétravail (en utilisant la présentation du siège à titre de substitut) à celles qu'ont connues des femmes ayant vécu un travail spontané s'accompagnant d'un accouchement vaginal anticipé (TS) à terme complet.

Résultats : Le groupe « CS prétravail » comptait 1 046 accouchements et le groupe « TS » en comptait 38 021. La morbidité maternelle constituant un danger de mort était semblable dans les deux groupes. La morbidité néonatale constituant un danger de mort connaissait une baisse au sein du groupe « CS » (RR, 0,34; IC à 99 %, 0,12 à 0,97). Une analyse de sous-groupe par mode d'accouchement du groupe « TS » a indiqué que la hausse du risque néonatal était associé à l'accouchement vaginal opératoire et à la CS intrapartum, mais non pas à l'accouchement vaginal spontané.

Conclusion : Une césarienne de convenance prétravail menée chez une nullipare à terme complet entraînait la baisse du risque de morbidité néonatale constituant un danger de mort, par comparaison avec le travail spontané s'accompagnant d'un accouchement vaginal anticipé. Toutefois, les 63 % des femmes ayant vécu un travail spontané qui ont connu un accouchement vaginal spontané n'auraient tiré aucun avantage d'un accouchement par césarienne. D'autres recherches s'avèrent requises pour mieux identifier les femmes qui connaissent une probabilité accrue de subir un accouchement vaginal opératoire ou une césarienne intrapartum, puisque cela pourrait guider le processus décisionnel des fournisseurs de soins de maternité en ce qui concerne l'accouchement. D'autres recherches s'avèrent également requises pour déterminer si ces résultats peuvent être confirmés dans le cadre d'une étude prospective.

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INTRODUCTION

Caesarean section on maternal request is currently one of the most controversial topics in obstetrics. An increasing number of women are choosing to have a CS at term despite the absence of an accepted obstetric indication.¹ Reasons cited include concern about potential damage to

the perineum, the risk of postpartum sexual dysfunction, fear of possible negative effects on the child, and the desire for exact scheduling of the birth.¹ This issue involves a small proportion of pregnant women. In Italy, where women's choice of mode of delivery must by law be respected, 4% of lay women choose an elective CS.² In a report by Health Grades,³ 2.6% of women who gave birth in the United States in 2003 chose delivery by CS. There is limited available evidence for caregivers to provide adequate counselling for women requesting a CS without obstetrical indication. This was the main conclusion of the NIH Consensus Conference on Caesarean section on maternal request⁴ and was reiterated by Visco et al.⁵

This study was designed to determine the potential risks and benefits for a healthy nulliparous woman requesting a CS. We performed a population-based cohort study in British Columbia to determine the maternal and neonatal morbidity in women undergoing a low-risk pre-labour CS compared with the morbidity in women undergoing spontaneous labour with an anticipated vaginal birth. No previously published studies have specifically compared outcomes for both healthy nulliparous mothers and neonates by mode of delivery.

The proportion of deliveries by CS has risen substantially in Canada and around the world, from 5% to 7% in the early 1970s to 25% to 30% in 2003.⁶ Physicians are becoming less inclined to decrease rates of CS and more inclined to support maternal choice for method of delivery.⁷ Many physicians are choosing an elective CS for themselves or their partners; in a survey of female obstetricians in practice in the United Kingdom, 31% stated they would choose an elective CS for themselves in an uncomplicated singleton pregnancy.⁸ Hence, the advantages and disadvantages of pre-labour CS compared with vaginal delivery are issues of much discussion.^{9,10} While the complications of an indicated CS have been well studied, the risks and benefits of an elective CS in the absence of maternal or fetal indications are not known. Data from populations such as those attempting a vaginal birth after CS cannot be extrapolated to this subset of women.

In November 2003, the American College of Obstetricians and Gynecologists released Committee Opinion 289,

entitled "Surgery and Patient Choice." The authors stated that "in the absence of data on the long-term risks and benefits of elective Caesarean versus vaginal delivery in healthy women, no single, correct response exists for a physician confronting such a patient request."¹¹ The Society of Obstetricians and Gynaecologists of Canada released an SOGC Advisory in March 2004¹² in which the authors state that the SOGC "does not promote Caesarean sections on demand. The Society has always promoted natural child-birth and believes that the decision to perform a Caesarean section during labour and delivery should be based on medical indications." They further state that "at a time where Canadian men and women are waiting weeks if not months for proper treatment of serious conditions such as cancer, it would be irresponsible to promote an elective procedure that would require the increased use of limited resources." However, they conclude that "the final decision rests between the woman and her health care provider as to the safest route for the delivery of the baby." Given the opinions of these large organizations in North America, we felt it was important to study this group of women. Our objective was to compare birth outcomes of women undergoing low-risk pre-labour Caesarean section (for breech presentation) with those of women intending to have a vaginal delivery at term.

METHODS

We conducted a population-based cohort study comparing maternal and infant morbidity and mortality in nulliparous women delivering by planned CS because of breech presentation with the morbidity and mortality in nulliparous women who anticipated a vaginal delivery after spontaneous labour at 37 weeks of gestation or later. The study population consisted of healthy nulliparous women and their term (37–41 completed weeks' gestation) live-born singleton neonates delivered in British Columbia between April 1, 1994, and March 31, 2002, representing fiscal years 1994–1995 to 2001–2002.

All data for this study were obtained from the British Columbia Perinatal Database Registry, which is under the direction of the British Columbia Perinatal Health Program. The database includes standardized antenatal, intrapartum, immediate postpartum, and newborn data on all births in British Columbia occurring after 20 weeks' gestation. These data are abstracted from hospital charts after discharge by trained health records staff according to standardized protocols, including reabstraction studies and data quality checks.

Unfortunately, there is no variable for Caesarean section on maternal request in the BC perinatal database. We therefore identified Caesarean section for breech presentation as an

ABBREVIATIONS

BCPHP	British Columbia Perinatal Health Program
CS	Caesarean section
ECS	emergency Caesarean section
OVD	operative vaginal delivery
SL	spontaneous labour
SVD	spontaneous vaginal delivery

Table 1. Definitions of maternal and neonatal morbidity (including ICD9 and 10 codes)

Mother	Neonate
*Thromboembolism (671.3,671.4,673.2)	Ventilation via mask
*Haemorrhage requiring blood transfusion	*Ventilation via Endotracheal tube
Surgical complications (E870.0)	*Ventilation > 60 minutes
Wound infection (674.3,998.5)	Transient tachypnea of newborn (770.6)
Puerperal infection (670)	*Seizures (779.0)
3 rd /4 th degree vaginal tear (664.2,664.3)	*CNS Depression (779.2)
*Anaesthetic complications (668.0,668.1,668.2,668.8,668.9)	*Meconium aspiration syndrome (770.1;P24.0,P94.1,P24.2,P24.3,P24.8,P24.9)
*Intracranial haemorrhage (767.0; P111&112)	*Umbilical cord pH < 7.00
Genital tract trauma(665.5,665.3,665.4, 665.6,665.8,665.9,674.2)	5 minutes apgar < 6
*Pneumonia (770.0,486.0)	*Intracerebral hemorrhage
*Hysterectomy (80.2,80.31;RM89DA,1RM89LA)	*Death
*Denotes life-threatening morbidity	

appropriate surrogate group. Our choice of surrogate group was based on the Term Breech Trial.¹³ Since the results of this trial were published, 87% to 97% of women throughout the world have chosen CS for delivery of a breech-presenting infant.^{14,15} In Canada, the percentage of physicians offering vaginal breech delivery decreased from 84% before the trial¹³ to 14% after the trial.¹⁶ Another factor influencing our decision was that all other accepted indications for CS, such as placenta previa, tend to have other associated morbidities. Women undergoing a CS for breech presentation only are generally healthy. This means that the only difference between our surrogate group and a maternal request for CS group is the presentation of the fetus, which is unlikely to have a substantial effect on the results. Therefore, they represent the “pre-labour Caesarean” group (CS group). The comparison group consisted of women at term with a cephalic-presenting singleton, in spontaneous labour with an anticipated vaginal delivery. This was called the “spontaneous labour” group (SL group).

Groups were chosen to represent everyday clinical practice. A nulliparous woman who intends to have a vaginal delivery does not know whether or not she will be successful in delivering vaginally. In our cohort, we therefore performed a subgroup analysis by mode of delivery in the SL group. In doing so, we were able to account for all women who met the inclusion criteria, regardless of how they delivered. SL subgroups included emergency intrapartum Caesarean sections, operative vaginal deliveries and spontaneous vaginal deliveries. This is an important part of the analysis, as ECSs and OVDs are associated with higher maternal and neonatal morbidity than SVDs.^{17–20} In continuing with this

approach, women who presented in latent phase labour and had CS performed before their scheduled time were included in the pre-labour CS group.

Women who had labour induced for any reason were excluded from the study because this process carries an increased risk of intrapartum CS.²¹ If there were major maternal and fetal complications such as diabetes, hypertension, intrauterine growth restriction, congenital anomalies, oligohydramnios, or stillbirth, women were also excluded. We specifically chose nulliparous women because we wanted to avoid any bias associated with a woman’s previous birth experience. The intent was to examine two groups of healthy women and compare neonatal and maternal morbidity and mortality arising from a planned vaginal delivery and a low-risk pre-labour CS.

All outcome variables, including ICD-9 and 10 codes when applicable, are listed in Table 1. Life-threatening maternal morbidity included any of the following conditions: thromboembolism, hemorrhage requiring blood transfusion, anaesthetic complications, intracranial hemorrhage, hysterectomy, and death. Life-threatening neonatal morbidity included any of the following conditions: ventilation via endotracheal tube, ventilation for more than 60 minutes, seizures, CNS depression, meconium aspiration, umbilical cord blood pH < 7, pneumonia, intracranial hemorrhage, or death. International Classification of Disease, 9th Revision (ICD-9) or 10th revision (ICD-10), and Current Procedural Terminology codes were used. ICD-10 codes were used for the 2001–2002 fiscal year. Low 5-minute Apgar scores were abstracted directly from the delivery records and obtained

Table 2. Sociodemographic characteristics

Descriptive characteristics	CS (n = 1046)	SL (n = 38 021)	P
Gestational age, weeks, n (%)			< 0.001
37	112 (10.71)	2618 (6.89)	
38	401 (38.34)	6458 (16.99)	
39	402 (38.43)	11339 (29.82)	
40	99 (9.46)	12513 (32.91)	
41	32 (3.06)	5093 (13.40)	
Gestational age, weeks, mean (SD)	38.56 (0.91)	39.29 (1.11)	< 0.001
Birthweight, mean (SD)	3383.8 (415.96)	3531.4 (441.85)	< 0.001
Maternal age, years, mean (SD)	29.01 (5.35)	27.14 (5.61)	< 0.001
< 20	35 (3.35)	3796 (9.98)	
20–34	843 (80.59)	30510 (80.25)	
≥ 35	168 (16.06)	3715 (9.77)	
BMI (missing = 9194), n (%)			< 0.001
< 20	160 (22.16)	7379 (25.31)	
20–24.9	383 (53.05)	16011 (54.92)	
15–29.9	120 (16.62)	4262 (14.62)	
≥ 30	59 (8.17)	1499 (5.14)	
Single parent, n (%)	62 (6.25)	3489 (9.56)	< 0.001
Smoker, n (%)	142 (13.58)	5599 (14.73)	NS
Hospital deliveries per year, n (%)			NS
< 50	1 (0.10)	362 (0.95)	
50–249	72 (6.88)	2664 (7.01)	
250–499	63 (6.02)	2425 (6.38)	
500–999	135 (12.91)	4531 (11.92)	
1000–1499	176 (16.83)	5651 (14.86)	
1500–2499	146 (13.96)	5214 (13.71)	
2500–4999	250 (23.90)	9505 (25.00)	
≥ 5000	203 (19.41)	7668 (20.17)	

from BCPHP. The variables chosen were based on examination of previously published studies, discussion and consensus among the co-authors, and the availability of variables in the database.

Although caregivers will presumably be concerned about the variables listed in Table 1, the women they care for will want to know “What is the chance that something bad may happen to me?” and “What is the chance that something bad may happen to my baby?” To assist caregivers in answering these questions, we combined maternal outcomes considered life-threatening into a composite category of maternal morbidity, and neonatal outcomes considered life-threatening or resulting in death into a composite category of neonatal morbidity. These composite categories

count the number of individuals experiencing at least one life-threatening event rather than counting the number of total events. For example, a neonate experiencing seizures, ventilation via an endotracheal tube, and an intracranial hemorrhage is counted only once despite having three serious outcomes.

The cohorts were compared in a univariate analysis using the SAS statistical package (SAS Institute Inc., Cary SC) to assess baseline comparability. The chi-square statistical test was used to compare categorical variables, *t* test was used for continuous variables, and $P < 0.05$ denoted statistical significance. Cumulative incidences of selected maternal and neonatal outcomes were calculated in both groups (CS vs. SL), as well as the subgroups of spontaneous labour (CS

Table 3. Maternal morbidity: Caesarean section versus spontaneous labour

Maternal outcomes	CS, n = 1046 n (%)	SL, n = 38 021 n (%)	RR (99% CI)
Maternal death	0 (0)	0 (0)	na
Wound infection	10 (0.96)	189 (0.50)	1.92 (0.84–4.42)
Wound complication	9 (0.86)	185 (0.49)	1.77 (0.74–4.24)
Postpartum infection	1 (0.10)	104 (0.27)	0.35 (0.03–4.64)
Bladder/ureteric injury	0 (0)	53 (0.14)	na
Laceration of cervix	0 (0)	108 (0.28)	na
Laceration of vagina	0 (0)	213 (0.56)	na
Pelvic joints injury	1 (0.10)	47 (0.12)	0.77 (0.06–10.43)
Vaginal hematoma	1 (0.10)	129 (0.34)	0.28 (0.02–3.74)
Postpartum transfusion	3 (0.29)	123 (0.32)	0.89 (0.2–3.99)
Deep vein thrombosis	0 (0)	3 (0.01)	na
Pulmonary embolism	0 (0)	1 (0)	na
Iatrogenic surgical injury	0 (0)	27 (0.07)	na
Anaesthesia complications	4 (0.38)	117 (0.31)	1.24 (0.34–4.59)
Hysterectomy	1 (0.10)	4 (0.01)	9.09 (0.51–161.68)
Any life-threatening morbidity	8 (0.76)	270 (0.71)	1.08 (0.43–2.7)

vs. SVD, CS vs. OVD, CS vs. ECS). Relative risks for all outcomes were calculated with 99% confidence intervals to minimize the probability of a type I error. This conservative approach was chosen because a difference between the groups could have implications for, and influence, obstetric practice. This approach is also more suitable when multiple outcomes are evaluated.

We used multivariate analysis to examine the independent association between two composite outcomes: any life threatening maternal morbidity and any life-threatening neonatal morbidity, exposure (mode of delivery defined as CS or SL). Two logistic regression models were used to estimate the adjusted odds ratios and 99% CI for the composite variables, controlling for factors not evenly distributed between the comparison groups, i.e., single parent status, BMI (≤ 30 vs. > 30), and maternal age (< 35 vs. ≥ 35 years). We also adjusted for gestational age because increasing gestational age is associated with higher rates of perinatal morbidity and mortality.²²

Our study was reviewed and approved by the British Columbia Perinatal Database Registry Research Committee. All data obtained from the British Columbia Perinatal Database Registry were stripped of identifiers to comply with confidentiality requirements.

RESULTS

We included 39 067 singleton births in our study; there were 1046 deliveries in the pre-labour CS group, and 38 021 in the SL group. In the CS group, 49 women (4.7%) had CS performed prior to the booked date because they presented in the latent phase of labour. Of the 38 021 deliveries in the SL group, 24 089 women (63.3%) had a spontaneous vaginal delivery, 8352 (22%) had an operative vaginal delivery, and 5580 (14.7%) had an intrapartum CS. Of the 5580 intrapartum Caesarean sections, 132 women (2.3%) had an unsuccessful attempt at operative vaginal delivery.

The two groups differed with respect to some sociodemographic characteristics (Table 2). Women in the CS group were older, less likely to be single parents, had a higher BMI, delivered at an earlier gestational age, and had infants with a lower average birthweight than women in the SL group. There were no differences between the groups in percentage of women who smoked during pregnancy or number of deliveries performed each year in the hospital at which they delivered. In the subgroup analysis, women in the SL group who had SVD were younger than women who had OVD or ECS. Infants in the ECS group had higher birthweights than the OVD or SVD groups (data not shown).

Maternal morbidity outcomes associated with each group are shown in Table 3. No maternal deaths were recorded. There were no cases of bladder or urethral injury, accidental

Table 4. Maternal morbidity: Caesarean section versus spontaneous labour by mode of delivery

Maternal outcomes	CS	SL		OVD (n = 8352)		ECS (n = 5580)	
	(n = 1046)	SVD (n = 24 089)		n (%)	RR (99% CI)	n (%)	RR (99% CI)
	n (%)	n (%)	RR (99% CI)	n (%)	RR (99% CI)	n (%)	RR (99% CI)
Maternal death	0 (0)	0 (0)	na	0 (0)	na	0 (0)	na
Wound infection	10 (0.96)	44 (0.18)	5.23 (2.13–12.86)	33 (0.4)	2.42 (0.96–6.11)	112 (2.01)	0.48 (0.2–1.11)
Wound complication	9 (0.86)	43 (0.18)	4.82 (1.88–12.35)	33 (0.4)	2.18 (0.83–5.72)	109 (1.95)	0.44 (0.18–1.07)
Postpartum infection	1 (0.10)	29 (0.12)	0.79 (0.06–10.89)	16 (0.19)	0.5 (0.04–7.09)	59 (1.06)	0.09 (0.01–1.21)
Bladder/ureteric injury	0 (0)	37 (0.15)	na	8 (0.1)	na	8 (0.14)	na
Laceration of cervix	0 (0)	59 (0.24)	na	37 (0.44)	na	12 (0.22)	na
Laceration of vagina	0 (0)	121 (0.5)	na	87 (1.04)	na	5 (0.09)	na
Pelvic joints injury	1 (0.10)	17 (0.07)	1.35 (0.1–19.16)	10 (0.12)	0.8 (0.05–11.88)	20 (0.36)	0.27 (0.02–3.73)
Vaginal hematoma	1 (0.10)	13 (0.05)	1.77 (0.12–25.63)	10 (0.12)	0.8 (0.05–11.88)	106 (1.90)	0.05 (0–0.67)
Postpartum transfusion	3 (0.29)	62 (0.26)	1.11 (0.24–5.1)	36 (0.43)	0.67 (0.14–3.12)	25 (0.45)	0.64 (0.13–3.08)
Deep vein thrombosis	0 (0)	0 (0)	na	0 (0)	na	3 (0.05)	na
Pulmonary embolism	0 (0)	0 (0)	na	0 (0)	na	1 (0.02)	na
Iatrogenic surgical injury	0 (0)	0 (0)	na	2 (0.02)	na	25 (0.45)	na
Anaesthesia complications	4 (0.38)	33 (0.14)	2.79 (0.72–10.89)	50 (0.6)	0.64 (0.17–2.43)	34 (0.61)	0.63 (0.16–2.44)
Hysterectomy	1 (0.10)	1 (0)	23.03 (0.6–878.88)	0 (0)	na	3 (0.05)	1.78 (0.09–34.77)
Any life-threatening morbidity	8 (0.76)	94 (0.39)	1.96 (0.76–5.04)	88 (1.05)	0.73 (0.28–1.87)	88 (1.58)	0.49 (0.19–1.25)

Bold type indicates statistical significance.

surgical injury or thromboembolism in the CS group. The incidence of serious perineal tears (third or fourth degree) was 6.0% in the SL group (4.5% with SVD and 14.6% with OVD). With the exception of severe perineal tears, the rates of the studied morbidities were low (less than 1.0%) in each group. In a multivariate analysis, mode of delivery (CS vs. SL) was not significantly associated with any life threatening maternal morbidity (aOR 1.05; 99% CI 0.41 to 2.65). Women over 35 years of age were at increased risk for any life-threatening morbidity compared to women less than 35 years of age (OR 1.65; 99% CI 1.01 to 2.70). Other risk factors such as smoking, single parent status, hospital size (number of deliveries per year), or gestational age were not significantly associated with maternal morbidity outcome.

In our subgroup analysis, maternal morbidity outcomes associated with CS vs. SL by delivery mode (SVD, OVD, ECS) are shown in Table 4. There was an increased risk of wound infection (RR 5.23; 99% CI 2.13 to 12.86) and surgical wound complication (RR 4.82; 99% CI 1.88 to 12.35) in the CS group compared with the SVD group. The risk of a serious hemorrhage requiring blood transfusion was not significantly different between the subgroups when compared to CS. There was a reduced risk of vaginal hematoma (RR 0.05; 99% CI 0.00 to 0.67) in the CS group relative to the ECS group. No differences were noted in rates of hemorrhage requiring hysterectomy, anaesthetic complications, or thromboembolism.

Table 5. Neonatal morbidity: Caesarean section versus spontaneous labour

Neonatal outcomes	CS, n = 1046 n (%)	SL, n = 38021 n (%)	RR (99% CI)
Intermittent positive pressure via mask	91 (8.70)	2900 (7.63)	1.14(0.88–1.48)
Transient tachypnea	33 (3.15)	1102 (2.90)	1.09 (0.7–1.70)
Apgar < 7	0 (0)	182 (0.48)	na
CNS depression	0 (0)	1 (0)	na
Intracranial hemorrhage	0 (0)	10 (0.03)	na
Endotracheal tube	1 (0.10)	352 (0.93)	0.1 (0.01–1.36)
Meconium aspiration	1 (0.10)	178 (0.47)	0.2 (0.02–2.70)
Pneumonia	1 (0.10)	29 (0.08)	1.25 (0.09–17.19)
Ventilation > 60 min	2 (0.19)	379 (1.00)	0.19 (0.03–1.19)
Seizures	1 (0.10)	37 (0.10)	0.98 (0.07–13.35)
pH < 7	1 (0.10)	51 (0.13)	0.71 (0.05–9.60)
Neonatal death	0 (0)	38 (0.10)	na
Any life-threatening complication	6 (0.57)	645 (1.7)	0.34 (0.12–0.97)

Bold type indicates statistical significance.

Neonatal morbidity outcomes associated with each cohort, CS versus SL, are shown in Table 5.

There were no neonatal deaths in the CS group. Thirty-eight infants (0.10%) died in the early neonatal period in the SL group. The rates of low 5-minute Apgar scores, CNS depression, intracranial hemorrhage, ventilation via an endotracheal tube, ventilation > 60 minutes, meconium aspiration syndrome, seizures, and death were low (< 1.0%) in both groups. There were no cases of low 5-minute Apgar scores, CNS depression, or intracranial hemorrhage in the CS group. Neonates in the CS group had less risk of experiencing any life-threatening morbidity than those in the SL group (RR 0.34; 99% CI 0.12 to 0.97).

In our subgroup analysis, neonatal morbidity outcomes associated with CS vs. SL by mode of delivery (SVD, OVD, ECS) are shown in Table 6. There was a higher risk of administration of intermittent positive pressure ventilation via a mask (IPPV mask) in the CS group than the SVD group. When compared to OVD and ECS respectively, but not SVD, CS was associated with less risk of endotracheal intubation, ventilation > 60 minutes, and any life-threatening or asphyxial event.

After adjustment for other risk factors in a multivariate analysis, life-threatening neonatal morbidity was not significantly associated with mode of delivery (CS vs. SL). The adjusted OR for the CS group compared to SL was 0.42 (99% CI 0.14 to 1.20). Adjustment was made for gestational age (categorical variable 37 vs. 38, 39, 40, 41 weeks), single parent status, smoking, BMI (≤ 30 vs. > 30), any maternal life-threatening condition, and hospital size (> 2500 births

per year vs. 1000–2499 births, 250–999, and < 250 births per year). Neonates born after 38 completed weeks of gestation were more likely to have a life-threatening or asphyxial event than neonates born at 37 weeks' gestation, those at 39 weeks had an aOR of 1.44 (99% CI 1.04 to 2.00), those at 40 weeks had an aOR of 1.95 (99% CI 1.43 to 2.65), and those at 41 weeks had an aOR of 2.29 (99% CI 1.61 to 3.26). A significant association was found between mother's life-threatening morbidity during or after delivery and neonatal life-threatening morbidity (aOR 2.9; 99% CI 1.38 to 6.09).

DISCUSSION

We investigated maternal and neonatal morbidity and mortality in a healthy low-risk obstetric population at term by comparing outcomes in nulliparous women who were delivered by a pre-labour Caesarean section (for breech presentation) with outcomes in nulliparous women who were delivered after spontaneous labour (cephalic presentation) with an anticipated vaginal delivery. Our objective was to better clarify the comparative risk of an elective CS on maternal request with a planned vaginal delivery following spontaneous labour.

Our study did not find a difference in maternal morbidity between the groups. This is in contrast to Liu et al.,²³ who did find the risk of severe maternal morbidity is higher with a planned CS than with a planned vaginal delivery. However, the absolute differences in morbidity risk were small. The Confidential Enquiries into Maternal Deaths in the United Kingdom, 1997–1999 did not find an increase in maternal mortality associated with an elective CS (RR 2.3;

Table 6. Neonatal morbidity: Caesarean section versus spontaneous labour by mode of delivery

Neonatal outcomes	CS (n = 1046)	SL SVD (n = 24 089)	RR (99% CI)	OVD (n = 8352)	RR (99% CI)	ECS (n = 5580)	RR (99% CI)
	n (%)	n (%)		n (%)		n (%)	
Intermittent positive pressure via mask	91 (8.70)	1500 (6.23)	1.4 (1.07–1.82)	831 (9.95)	0.87 (0.67–1.15)	569 (10.20)	0.85 (0.65–1.13)
Transient tachypnea	33 (3.15)	613 (2.56)	0.99 (0.98–1.01)	303 (3.63)	1 (0.99–1.02)	186 (3.33)	1 (0.99–1.02)
Apgar < 7	0 (0)	91 (0.38)	na	53 (0.63)	na	38 (0.68)	na
CNS depression	0 (0)	0 (0)	na	0 (0)	na	1 (0.02)	na
Intracranial hemorrhage	0 (0)	4 (0.02)	na	3 (0.04)	na	3 (0.05)	na
Endotracheal tube	1 (0.10)	139 (0.58)	0.17 (0.01–2.19)	113 (1.35)	0.07 (0.01–0.94)	100 (1.79)	0.05 (0–0.71)
Meconium aspiration	1 (0.10)	103 (0.43)	0.22 (0.02–2.97)	37 (0.44)	0.22 (0.02–2.93)	38 (0.68)	0.14 (0.01–1.91)
Pneumonia	1 (0.10)	18 (0.07)	1.28 (0.09–18.02)	3 (0.04)	2.66 (0.14–52.04)	8 (0.14)	0.67 (0.04–10.23)
Ventilation > 60 min	2 (0.19)	157 (0.65)	0.29 (0.05–1.83)	119 (1.42)	0.13 (0.02–0.84)	103 (1.85)	0.1 (0.02–0.65)
Seizures	1 (0.10)	17 (0.07)	1.35 (0.1–19.16)	12 (0.14)	0.67 (0.05–9.7)	8 (0.14)	0.67 (0.04–10.23)
pH < 7	1 (0.10)	16 (0.07)	1.43 (0.10–20.45)	20 (0.24)	0.40 (0.03–5.58)	15 (0.27)	0.36 (0.02–5.08)
Neonatal death	0 (0)	18 (0.07)	na	9 (0.11)	na	11 (0.20)	na
Any life-threatening complication	6 (0.57)	302 (1.25)	0.45 (0.16–1.32)	185 (2.22)	0.68 (0.55–0.85)	158 (2.83)	0.2 (0.07–0.59)

Bold type indicates statistical significance.

95% CI 0.88, 5.86) or a scheduled CS (RR 0.8; 95% CI 0.10 to 5.55) compared with a vaginal delivery.²⁴ The overall mortality rate for Caesarean sections in the enquiry was increased 4.9-fold (95% CI 2.96 to 7.97), with the categories predominantly responsible for the increase being emergency CS (RR 12.0; 95% CI 6.32 to 22.65) and urgent CS (RR 6.0; 95% CI 3.18 to 11.40). This is in agreement with Lydon-Rochelle et al.,²⁵ who reported their findings in pregnant women in the state of Washington. Our subgroup analysis results were similar to those reported by Allen et al.,²⁶ who found that the increased maternal morbidity with an elective CS was limited to puerperal febrile morbidity.

Our study did find that infants delivered by a pre-labour CS at term had less risk of any life-threatening morbidity than infants delivered at term following spontaneous labour. The subgroup analysis revealed that the OVD and ECS groups were responsible for the increased neonatal risk in the spontaneous labour group. Delivery by CS did not decrease the risk of a life-threatening neonatal event from SVD following spontaneous labour.

Additionally, we found an increased risk of life-threatening neonatal morbidity in infants born at 39 weeks of gestation

or later compared with those born at 37 weeks' gestation. There is a well-documented increase in perinatal morbidity and mortality with advancing gestational age after 37 weeks' gestation.²² Divon et al. showed increases in risk beginning at 40 weeks and 3 days of gestation.²⁷ This was confirmed in our study.

The cohort design and the population-based data are strengths of our study, as all births in both cohorts were accounted for, including home births. However, the retrospective design of our study, as well as the reliance on data collected in the perinatal database, raises possible concerns with respect to selection of our cohorts. Without a systematic study of all mothers and infants, morbidities may have been missed. However, the BC perinatal database is maintained for the purposes of perinatal surveillance; thus, the data quality is expected to be higher than in administrative databases used for billing purposes. Quality checks by BCPHP further increase the data reliability. Unfortunately, we could not document readmissions due to latent or recurrent maternal or neonatal morbidity and may therefore have underestimated the incidence of morbidity between delivery and 42 days postpartum for the different modes of delivery. A limitation in choosing CS for breech

presentation as a surrogate for CS by maternal request is that breech-presenting neonates have higher morbidity than cephalic-presenting neonates.^{28,29} Thus, we may have masked a further benefit of delivery by CS by using this as our surrogate group. It is also important to recognize that this study focused on nulliparous women with no prior uterine scar. If a nulliparous woman chose to have an elective CS, morbidity with subsequent pregnancies could be higher because of reported increases of abnormal placentation with the presence of a uterine scar.^{30,31}

Our population-based cohort study demonstrates that an elective CS without labour at term does lessen the risk of a neonate experiencing a life-threatening event compared with spontaneous labour with an anticipated vaginal delivery. However, subgroup analysis of the SL group by mode of delivery shows that this increased risk occurred only in the operative vaginal delivery and intrapartum CS subgroups. We do not suggest it is necessarily the mode of delivery itself causing the neonatal morbidity. The increased morbidity observed in these groups is likely associated with the indication for the operative vaginal delivery or intrapartum CS. This information is useful only if we can adequately predict those women who will end up with OVDs or ECSs.

CONCLUSION

An elective pre-labour Caesarean section in a nulliparous woman at term has a lower risk of life-threatening neonatal morbidity than spontaneous labour with an anticipated vaginal delivery. However, the increased risk of life-threatening neonatal morbidity in the spontaneous labour group was associated with an operative vaginal delivery or emergency intrapartum Caesarean section and not a spontaneous vaginal delivery. Further research is needed to better identify women with an increased likelihood of an operative vaginal delivery or intrapartum Caesarean section, as this may assist pregnancy caregivers in decision-making about childbirth. Further research is also needed to determine if these findings can be confirmed in a prospective study.

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