Maternal outcomes of cesarean sections

Do generalists' patients have different outcomes than specialists' patients?

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ABSTRACT

OBJECTIVE To compare maternal outcomes of cesarean sections performed by GPs with the outcomes of those performed by specialists.

DESIGN Retrospective, comorbidity-adjusted study.

SETTING Mostly small isolated rural hospitals in Ontario, British Columbia, Alberta, and Saskatchewan compared with all levels of specialist obstetric programs offered in Canada.

PARTICIPANTS Fifteen GPs with less than 1 year of surgical training who performed cesarean sections.

METHOD Using data from the Canadian Institute for Health Information's Discharge Abstracts Database for the years 1990 to 2001, we matched each of 1448 cesarean section cases managed by these GPs to 3 cases managed by specialists and looked for comorbidity. In total, we analyzed the outcomes of 5792 cesarean sections.

MAIN OUTCOME MEASURES Composites of major morbidity possibly attributable to surgery: death, sepsis, cardiac arrest, shock, hypotension, ileus or bowel obstruction, major puerperal infection, septic or fat embolism, postpartum hemorrhage requiring hysterectomy, need for cardiopulmonary resuscitation, or another operation; and all major morbidity: major surgical morbidity, acute coronary syndrome, endocarditis, pulmonary edema, cerebrovascular disorder, pneumothorax, respiratory failure, amniotic fluid embolism, complications of anesthesia, deep vein thrombosis, pulmonary embolism, acute renal failure, and need for mechanical ventilation.

RESULTS The rate of all major morbidity was higher among GPs' patients than among specialists' patients (3.1% vs 1.9%, odds ratio [OR] 1.6, 95% confidence interval [CI] 1.1 to 2.3, $P=.009$) as was the rate of major surgical morbidity (2.5% vs 1.6%, OR 1.6, 95% CI 1.1 to 2.4, $P=.024$). Differences in major morbidity variables were not significant if major postpartum infection was excluded (all major morbidity 1.5% vs 1.1%, major surgical morbidity 1.0% vs 0.8%). Secondary outcomes included rate of transfer to acute care institutions (6.0% vs 1.5%, OR 4.6, 95% CI 3.6 to 6.5, $P<.001$), mean length of hospital stay (5.2 vs 4.9 days, $P=.006$), need for blood transfusion (5.9% vs 7.0%, OR 0.76, 95% CI 0.5 to 1.1, $P=.11$) and frequency of surgical error (0.8% vs 0.7%, OR 1.1, 95% CI 0.6 to 2.3, $P=.72$).

CONCLUSION Although major morbidity was higher among GPs' patients, differences were entirely attributable to the rate of postpartum infection. Infection rates in both groups were far below expected rates. The observation that blood transfusion and surgical error rates were similar suggests that surgical technique was not the cause of differences between groups. We conclude that these GPs with a mean of 4 months' training subsequently performed cesarean sections with an acceptable degree of safety compared with specialists.

EDITOR'S KEY POINTS

- While studies of rural obstetric care suggest that neonatal outcomes of cesarean sections managed by general practitioners are equivalent to those managed by specialists, there is little documentation of maternal outcomes.
- The most striking finding is the low rate of all major morbidity and major surgical morbidity observed in both groups. When major puerperal infection was removed from the 2 composite major morbidity variables, differences in outcomes were non-significant.
- General practitioners with a mean of 4 months' training can perform cesarean sections with an acceptable degree of safety.

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Issues maternelles des césariennes

Les patientes des omnipraticiens et celles des spécialistes ont-elles des issues différentes?

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RÉSUMÉ

OBJECTIF Comparer les issues maternelles des césariennes pratiquées par des omnipraticiens à celles pratiquées par des spécialistes.

TYPE D'ÉTUDE Étude rétrospective ajustée pour la comorbidité.

CONTEXTE Hôpitaux, pour la plupart petits et isolés, des provinces de l'Ontario, de la Colombie-Britannique, de l'Alberta et de la Saskatchewan comparés à des programmes d'obstétrique spécialisés de tous niveaux offerts au Canada.

PARTICIPANTS Quinze omnipraticiens effectuant des césariennes et ayant moins d'un an de formation chirurgicale.

MÉTHODE À l'aide de la Base de données sur les congés des patients de l'Institut canadien d'information sur la santé pour les années 1990 à 2001, nous avons apparié chacune des 1448 césariennes effectuées par les omnipraticiens à trois cas effectuées par des spécialistes en recherchant la comorbidité. Au total, nous avons analysé les issues de 5792 césariennes.

PRINCIPALES ISSUES ÉTUDIÉES Éléments de morbidité importante possiblement attribuables à la chirurgie: décès, infection, arrêt cardiaque, choc, hypotension, ileus ou obstruction intestinale, infection puerpérale majeure, embolie septique ou graisseuse, hémorragie post-partum nécessitant une hystérectomie, besoin de réanimation cardio-respiratoire, ou intervention chirurgicale additionnelle; et toute morbidité importante: morbidité chirurgicale importante, syndrome coronarien aigu, endocardite, œdème pulmonaire, problème cardiovasculaire, pneumothorax, insuffisance respiratoire, embolie de liquide amniotique, complications de l'anesthésie, thrombose veineuse profonde, embolie pulmonaire, insuffisance rénale aiguë, et besoin de ventilation mécanique.

RÉSULTATS Le taux pour toute morbidité majeure était plus élevé chez les patientes des omnipraticiens que chez celles des spécialistes (3,1% vs 1,9%, rapport de cotes [RC] 1,6, intervalle de confiance [IC] à 95% 1,1 à 2,3, *P*=,009); il en est de même pour le taux de morbidité chirurgicale importante (2,5% vs 1,6%, RC 1,6, IC à 95% 1,1 à 2,4, *P*=,024). Dans le cas des variables de la morbidité importante, les différences n'étaient pas significatives si on excluait les infections post-partum importantes (toute morbidité majeure 1,5% vs 1,1%; morbidité chirurgicale majeure 1,0% vs 0,8%). Les issues secondaires incluaient, le taux de transfert à un établissement de soins actifs (6,0% vs 1,5%, RC 4,6, IC à 95% 3,6 à 6,5, *P*<,001), la durée moyenne du séjour hospitalier (5,2 vs 4,9 jours, *P*=,006), le besoin de transfusion (5,9% vs 7,0%, RC 0,76, IC à 95% 0,5 à 1,1, *P*=,11) et la fréquence des erreurs chirurgicales (0,8% vs 0,7%, RC 1,1, IC à 95% 0,6 à 2,3, *P*=,72).

CONCLUSION Même si le taux de morbidité importante était plus élevé chez les patientes des omnipraticiens, les différences étaient entièrement attribuables au taux d'infection post-partum. Dans les deux groupes, le taux d'infection était de beaucoup inférieur au taux attendu. L'observation que les taux de transfusions sanguines et d'erreurs chirurgicales étaient semblables donne à penser que la technique chirurgicale n'était pas responsable des différences entre les groupes. Nous concluons que ces omnipraticiens qui avaient eu un entraînement préalable moyen de 4 mois pratiquaient des césariennes avec un degré de sécurité acceptable par rapport aux spécialistes.

POINTS DE REPÈRE DU RÉDACTEUR

- Alors que certaines études sur l'obstétrique rurale donnent à croire que les issues néonatales sont équivalentes pour les césariennes pratiquées par des omnipraticiens et par des spécialistes, il y a peu de données sur les issues maternelles.
- L'observation la plus frappante est le faible taux de morbidité majeure et de morbidité chirurgicale majeure trouvé dans les deux groupes. Si on enlève l'infection puerpérale majeure des deux variables composites de morbidité majeure, il n'y a plus de différence significative entre les issues.
- Avec une formation de 4 mois en moyenne, les omnipraticiens sont en mesure de pratiquer des césariennes avec un degré de sécurité acceptable.

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The discipline of family medicine struggles to meet the needs of women in labour in Canada. Many programs have instituted extra training of varied length for specialized obstetric skills. In many small community hospitals, family physicians and GPs with additional training already offer advanced maternity care, such as cesarean sections.[1] While studies of rural obstetric care suggest that neonatal outcomes of GP-managed cesarean sections are si milar to those of specialist-managed cesarean sections,[2] there is little evidence in the literature on maternal outcomes. There is evidence that suggests that GP-managed patients have outcomes comparable to accepted standards; however, the studies from which this evidence comes are limited by methodologic problems.[3,4]

We sought to determine the safety of GP-managed cesarean sections by doing a retrospective study using specialists' patients as the reference group. To adjust for differences in patient populations, we matched GPs' cases to those of specialists' for comorbid diagnoses that might have influenced surgical outcomes. Neonatal outcomes were not available in the data set we accessed.

METHOD

Data on all cesarean sections performed during the fiscal years 1990 to 2000 were accessed in the Canadian Institute for Health Information's Discharge Abstracts Database (DAD) for provinces where most GPs performing cesarean sections in Canada practise: Alberta, British Columbia, Ontario, and Saskatchewan.

A questionnaire asking about surgical training was distributed to GPs performing cesarean sections. Physicians were enrolled in the study if they had 1 year or less of surgical training beyond their family or general practice training in order to exclude highly trained GPs who had had surgical training approaching that of specialists. Informed consent was obtained from each of these GP surgeons and their hospitals. Consent from specialists was not necessary because all identifying information in the DAD was encrypted, and the database included all cesarean sections done by specialists during the 10-year period. Approval for the study was received from the Lakehead University Research Ethics Board.

Case matching

Each case managed by a consenting GP was extracted and matched for noniatrogenic comorbid diagnoses to 3 cases managed by specialists. Matching was 1 to 3 in order to increase statistical power. Cases were grouped into 5-year categories by patient age and 3-year categories by date of cesarean section, then matched within these categories. Diagnoses were included if they were likely the indication for proceeding to cesarean section or if they were thought to adversely affect maternal outcomes[5] (**Table 1**[6,7]).* Maternal obstetric history (with the exception of whether or not mothers had had previous cesarean sections), body mass index, and socioeconomic status were not available in the DAD.

Outcome measures

There were 2 primary outcome measures: the composite of death and major morbidity possibly attributable to surgery (major surgical morbidity), and the composite of all major morbidity (**Table 2**[6,7]).* Ileus and bowel obstruction diagnoses typically had a length of hospital stay similar to the mean, suggesting minimal morbidity. They were included, however, when they contributed to a prolonged length of stay (mean length of stay plus 2 standard deviations).

Secondary outcomes included length of hospital stay, postpartum transfer to another acute care institution, surgical error (**Table 3**[6]), and the need for blood transfusion. For patients of GPs transferred postpartum directly from the treating facility to another acute care hospital, we accessed the database record at the receiving institution, where possible, and adjusted data as appropriate. When length of stay at the receiving institution was unavailable, data on these transferred patients were excluded from the final analysis.

Statistics

Given the relatively small number of GPs and the possibility of clustering of outcomes by GP, a GP surgeon variable was incorporated into the regression model. As this adjustment did not affect any results, we present only unadjusted data in the Results section. For conditional logistic regression data, we give the Wald *P* value. Differences were considered significant if $P<.05$. Data are presented as means with standard deviations or odds ratios with 95% confidence intervals where appropriate. Conditional logistic regression analyses were done using Stata version 8.2. Length of hospital stay for

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*Tables 1 and 2 are available at **www.cfp.ca**. Go to the full text of this article on-line, then click on **CFPlus** in the menu at the top right-hand side of the page.

the 3 specialist cases within each match were averaged, and these data were then compared using paired *t* tests in SPSS version 11.5.0.

Table 3. *International Classification of Diseases*, 9th Revision,[6] (ICD 9) and *Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedure*[7] (CCP) codes for outcomes of surgical error

OUTCOME	ICD 9 CODE	CCP CODE
Other injury to pelvic organs	665.5	
Accidental puncture or laceration during a procedure	998.2	
Suture of bladder		697.1
Other repair of bladder		697.9
Suture of fallopian tube		786.1
Other repair of fallopian tube		786.9
Other repair of uterus		815.9
Repair of obstetric laceration of uterus		877.1
Repair of obstetric laceration of cervix		877.2
Repair of obstetric laceration of corpus uteri		877.3
Repair of obstetric laceration of bladder or urethra		878.1

Table 4. Characteristics of general practitioner surgeons

CHARACTERISTIC	MEAN (STANDARD DEVIATION)	RANGE
Postgraduate general practice training (y)	1.4 (0.8)	0–3
Additional obstetric training (mo)	4.2 (3.1)	0–12
Additional surgical training (mo)*	4.7 (2.3)	1–6
Total surgical or obstetric training (mo)†	6.1 (4.3)	0–12
No. of cesarean sections done during training‡	48 (38)	26–120
No. of cesarean sections done in career	264 (198)	50–800
No. of cesarean sections done by each physician in data set	100 (93)	4–310
No. of cesarean sections done per year by each physician in data set‡	13 (8)	2–28

*Seven general practitioner surgeons had received non-obstetric surgical training.
†Estimated by general practitioner surgeons.
‡Total no. of cesarean sections done by each surgeon divided by the number of years in which surgeons in the data set had done at least 1 cesarean section.

RESULTS

Fifty-two surveys were mailed to GPs; response rate was 58%. Fifteen GPs were excluded: 7 had received more than 1 year of surgical training; 5 had not done any cesarean sections during the study period; 1 was not a GP surgeon; 1 replied too late; and 1 did not get hospital approval. Characteristics of the 15 GPs included are shown in **Table 4**.

Data were retrieved for a total of 498 979 cesarean sections, 1509 of which were performed by the GPs in this study. Among the 1509 GP cases, 61 could not be matched to 3 specialist cases and were excluded. Primary outcomes for these excluded cases were not significantly different from outcomes of the remaining GP cases (data not shown). Each of the remaining 1448 GP cases was matched to 3 specialist cases, so 5792 cases were included in the subsequent analysis.

Of all the cesarean sections performed by specialists, 183 (4.2%) were done by general surgeons, and the remainder were done by obstetricians. Mean age of patients was 26.7 years in the GP group and 26.8 years in the specialist group. Other relevant group characteristics were included in the matching algorithm, so the rates were identical (**Table 1**[6,7]).

Data on rates of composite major morbidity variables, blood transfusions, surgical errors, and patient transfers are shown in **Table 5**. When the *International Classification of Diseases,* 9th Revision,[6] code for major puerperal infection (endometritis, peritonitis, pyemia, salpingitis, and septicemia) was removed from the 2 composite major morbidity variables, differences in outcomes were non-significant (1.5% vs 1.1% for all major morbidity and 1.0% vs 0.8% for major surgical morbidity). Length of hospital stay was shorter in the specialist group than in the GP group (4.9 vs 5.2 days, mean difference 0.23 days, 95% confidence interval for difference 0.06 to 0.39, $P=.006$). Results of other secondary outcome analyses are shown in **Tables 5**, **6**, and **7**.

DISCUSSION

Comparing outcomes of GP-managed and specialist-managed patients

Previous studies have compared the outcomes of generalist-managed cesarean sections with referenced rates of complications in the literature[3] or with the outcomes of unmatched specialist-managed cases.[4] This is the first study to do a simultaneous comparison with a set of equivalent patients. Perhaps the most striking finding here is the low rates of all major morbidity and major surgical morbidity observed in both groups, despite the comprehensive definitions of these outcomes.

General practitioners are likely to transfer high-risk patients to specialist centres. Using our matching algorithm, we therefore selected low-risk specialist-managed patients. The complication rates we have calculated should be generalizable to low-risk patient populations.

We found a slight but significantly higher rate of adverse maternal outcomes in the GP group ($P = .009$). Although it might be inferred that the GPs themselves are responsible for this, other factors help explain the difference. The surgical error variable includes the typical surgical mistakes often observed during cesarean sections. The observation that rates of both surgical error and the need for blood transfusion were similar in the 2 groups suggests that surgical technique does not explain the differences observed in major morbidity outcomes. Other factors, such as socioeconomic status, maternal medical and obstetric history, duration of ruptured membranes, and anesthetic technique were not available in the data set and might help explain these differences.

Table 5. Primary and secondary outcomes

OUTCOMES	GPS %	SPECIALISTS %	ODDS RATIOS* (95% CONFIDENCE INTERVAL)
Primary outcomes			
• All major morbidity	3.1	1.9	1.6 (1.1-2.3)
• Major surgical morbidity	2.5	1.6	1.6 (1.1-2.4)
Secondary outcomes			
• Surgical errors	0.8	0.7	1.1 (0.6-2.3)
• Blood transfusion	5.9	7.0	0.8 (0.5-1.1)
• Transfer to another acute care facility	6.0	1.5	4.6 (3.6-6.5)

*Odds ratios generated by conditional logistic regression.

Table 6. Rates of diagnoses of major surgical morbidity outcomes by study group

OUTCOMES	GENERAL PRACTITIONERS N = 1448 %*	SPECIALISTS N = 4344 %*
Major puerperal infection	1.6†	0.8
Cardiac arrest	0.3	0.4
Repeat operation	0.2	0.1
Ileus or bowel obstruction	0.2	0.05
Shock or hypotension	0.1	0.2
Repeat operation for hemorrhage	0.1	0.1
Postpartum hemorrhage requiring hysterectomy	0.1	0.1
Death	0.07	0.02
Sepsis	0	0.02
Cardiopulmonary resuscitation	0	0
Septic or fat embolism	0	0
TOTAL	2.5†	1.6

*Percentages do not add to 100 because some patients had more than 1 major morbidity.
†$P < .05$ relative to specialists.

All the GPs in our study practised in rural or semirural areas, whereas the specialists practised in larger, urban centres. This could have affected our data in several ways: first, socioeconomic status tends to be lower[8] and maternal parity higher in rural areas, 2 factors that have been shown to affect neonatal and likely maternal outcomes adversely.[9,10] Second, limited access to obstetric care in rural areas has been shown to affect obstetric outcomes negatively.[11-13] Third, staff in small rural hospitals might be less familiar with delivery and operating room best practices than staff in large centres where specialists tend to practise.

Reasons for different rates of adverse outcomes

The observation that the removal of major puerperal infection from the composite morbidity variables made the differences in outcomes non-significant suggests several explanations for the differences between groups.

Table 7. Rates of diagnoses of all major morbidity outcomes by study group

OUTCOMES	GENERAL PRACTITIONERS N = 1448 %*	SPECIALISTS N = 4344 %*
Major surgical morbidity	2.5†	1.6
Venous thrombosis	0.3	0.1
Cerebrovascular disorders	0.2	0
Pneumothorax	0.1	0.1
Amniotic fluid embolus	0.1	0.05
Complications of anesthesia	0	0.1
Pulmonary edema	0	0.05
Respiratory failure or acute respiratory distress syndrome	0	0.02
Acute renal failure	0	0
Endocarditis	0	0
Need for mechanical ventilation	0	0
Myocardial infarction	0	0
TOTAL	3.1†	1.9

*Percentages do not add to 100 because some patients had more than 1 major morbidity.
†$P < .05$ relative to specialists.
‡$P < .01$ relative to specialists.

Most obvious, differences in infection rates suggest differences in sterility practices between family physicians and specialists or their hospitals. This hypothesis is supported by a previous study of cesarean sections performed by GPs and specialists that noted a difference in the rates of positive cultures and antibiotic treatment.[4] This information was not available in the DAD. Second, it is commonly believed that the obstetric patients of family physicians have a lower rate of cesarean sections. If true, this implies that family physicians' patients labour longer (family physicians wait longer before proceeding to cesarean section during which time some women deliver vaginally), a factor known to increase the rate of postpartum infection.[14] Other reasons GP patients labour longer could include delays associated with calling in operating room teams or surgeons, which likely takes longer in the smaller hospitals where GPs practise. While the difference between the 2 groups is statistically significant, the infection rates of 1.6% for GPs and 0.8% for specialists is likely of little clinical relevance, as typical infection rates after cesarean section approach 10%.[15]

We noted a significantly shorter length of hospital stay for specialist surgeons' patients ($P=.006$). The clinical significance of the 5.5-hour difference is unclear, but we are unable to exclude the possibility that it represents a difference in rate of recovery from surgery.

The rate of patient transfer to an acute care hospital following cesarean section was substantially higher among patients of GPs than among patients of specialists. Although this might imply a higher rate of complications requiring transfer for care by another physician, it could also be explained by the geographic differences between where the groups practise. Specialists practise in larger centres with greater access to other specialists where interdisciplinary referrals for maternity care would not require patients to transfer. In addition, mothers are typically transferred along with their neonates when the babies require specialist consultation, so more mothers are transferred from smaller hospitals than from specialist hospitals. We did not have access to DAD data on neonates, so we were unable to determine the rate of neonatal indications for transfer, and we did not analyze maternal indications for transfer.

Studies comparing outcomes of procedures by volume of treating physician or hospital show, albeit inconsistently, that higher volumes are associated with better outcomes, as one might expect.[16] The best evidence for this volume-to-outcome relationship comes from highly technical procedures, such as pancreatectomy, esophagectomy, and elective abdominal aortic aneurysm repair. Analysis of the volume-to-outcome relationship for obstetrics has focused almost exclusively on neonatal rather than maternal outcomes.[17] One study examining all maternal (vaginal and cesarean section) outcomes from administrative data suggested that there is a threshold effect, with hospital outcomes dependent on a minimum number of deliveries per year.[18] Analysis of chart-level data[19,20] does not support this conclusion. The effect of these findings on our results is uncertain given the range of experience of the GPs in this study. Previous studies have suggested that GPs record clinical findings more completely than specialists do.[3,4] This might have biased our results against GPs due to their more thorough reporting of adverse outcomes.

Limitations

Possible inaccuracies in the database[7,21-24] represent the most important limitation of studies of this type. As discussed above, we matched patients in this study to overcome referral bias whereby patients with comorbidity are identified antenatally and preferentially referred to specialists for management. Although we attempted to be as thorough as possible in the matching algorithm, including multiple comorbid diagnoses as well as previous cesarean sections, the number of previous cesarean sections received by each patient was not coded in the DAD. The number of patients with multiple previous cesarean sections is likely relatively small, however, and although this factor can affect neonatal outcomes, it likely has a minimal effect on maternal outcomes.[25]

Conclusion

Both generalists and specialists offer cesarean sections with a low rate of maternal complications. Patients of GPs with a mean of 4 months' surgical training have some differences in outcomes compared with patients of specialists. Factors other than the specialty of the care provider might be responsible for these differences. Further research could examine the adverse health and other effects associated with not having obstetric care close to home,[26] as well as the outcomes of women and neonates who require intrapartum transfer for cesarean section when this service is not offered at their local hospitals.

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Contributors

Dr Aubrey-Bassler, *the main author of this article, devised the concept, did the research, and wrote all drafts of the article.* **Dr Newbery** *assisted with concept and design of the study, the literature review, and writing the drafts.* **Dr Kelly** *assisted with the concept of the study, acquisition of funding, and editing drafts of the article.* **Dr Weaver** *assisted with data acquisition and analysis and read the drafts.* **Dr Wilson** *assisted with writing and editing the drafts and interpretation of data.*

Competing interests

None declared

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