

# Vaginal birth after caesarean for women with three or more prior caesareans: assessing safety and success

AG Cahill, M Tuuli, AO Odibo, DM Stamilio, GA Macones

Department of Obstetrics and Gynecology, Washington University in St Louis, MI, USA  
Correspondence: Dr AG Cahill, Assistant Professor, Division of Maternal-Fetal Medicine, Washington University School of Medicine, 660 South Euclid, Campus Box 8064, St Louis, MO 63110, USA. Email cahilla@wustl.edu

Accepted 25 November 2009. Published Online 3 February 2010.

**Objective** To estimate the rate of success and risk of maternal morbidities in women with three or more prior caesareans who attempt vaginal birth after caesarean (VBAC).

**Design** Retrospective cohort design.

**Setting** Multicentre, from 1996 to 2000, including 17 tertiary and community delivery centres in north-eastern USA.

**Population** A total of 25 005 women who had had at least one prior caesarean delivery.

**Methods** Women who attempted VBAC with three or more prior caesareans were compared with those who attempted after one and two prior caesareans. Univariable and stratified analyses were used to select factors for multivariable analyses for maternal morbidity. Maternal characteristics were compared using a Student's *t* test, Mann-Whitney *U* test, chi-square test or Fisher's exact test, as appropriate.

**Main outcome measures** The primary outcome was composite maternal morbidity, defined as at least one of the following:

uterine rupture, bladder or bowel injury, or uterine artery laceration. Secondary outcomes were VBAC success, blood transfusion and fever.

**Results** Of 25 005 women, 860 had three or more prior caesarean deliveries: 89 attempted VBAC and 771 elected for repeat caesarean. Of the 89 who attempted VBAC, there were no cases of composite maternal morbidity. They were also as likely to have a successful VBAC as women with one prior caesarean (79.8% versus 75.5%, adjusted OR 1.4, 95% CI 0.81–2.41, *P* = 0.22).

**Conclusion** Women with three or more prior caesareans who attempt VBAC have similar rates of success and risk for maternal morbidity as those with one prior caesarean, and as those delivered by elective repeat caesarean.

**Keywords** Maternal morbidity, multiple caesareans, success, vaginal birth after caesarean (VBAC).

Please cite this paper as: Cahill A, Tuuli M, Odibo A, Stamilio D, Macones G. Vaginal birth after caesarean for women with three or more prior caesareans: assessing safety and success. BJOG 2010; DOI: 10.1111/j.1471-0528.2010.02498.x.

## Introduction

The commonly encountered counselling and clinical decision making for women with multiple prior caesarean deliveries is complex. Although relatively low complication rates, including uterine rupture, have been demonstrated among women with two prior low-transverse caesareans who attempt vaginal birth (VBAC),<sup>1,2</sup> there is very limited data on outcomes among women with more than two prior caesareans.<sup>3–5</sup> Prior studies have often combined all women with more than one prior caesarean into a single group, despite the fact that current recommendations for women with two prior, and those with more than two

prior, caesareans are clinically distinct.<sup>6</sup> Additionally, sample size limitations have impacted the interpretation of prior studies. This does not preclude the importance of continuing to add to the published body of literature with well-designed studies on risks associated with mode of delivery in women with more than two prior caesareans, despite the challenges inherent in studying this common clinical question.

Given the significant morbidities associated with multiple caesareans,<sup>7</sup> including surgical morbidity and abnormal placentation in future pregnancies, it is important to consider the possibility that for women with more than two prior caesareans VBAC may be associated with less

morbidity, particularly in women with a high likelihood of success.<sup>8</sup> Finally, acknowledging that not everything in obstetrics can be planned, clinicians have little evidence to quantify the maternal risks of uterine rupture or other maternal morbidities when a woman with three or more prior caesareans presents in spontaneous labour. To improve upon our ability to counsel and clinically manage women with three or more prior caesarean deliveries, we sought to estimate the risk of maternal morbidities associated with VBAC attempt in women with such a history, compared with repeat caesarean, as well as with VBAC attempts in women with fewer prior caesareans.

## Methods

A retrospective cohort study of women with at least one prior caesarean delivery was conducted between 1996 and 2000 in 17 centres in the north-eastern USA to estimate the maternal risks associated with VBAC, and specifically the risk of uterine rupture. Within this cohort, we performed a secondary analysis of women with a history of three or more prior caesareans, comparing their within-group morbidity by mode of delivery, as well as comparing women who attempted VBAC after three or more caesareans with women after one prior caesarean, and with women after two prior caesareans. The methods of the parent cohort study have been described previously in detail,<sup>9</sup> but a brief description is as follows. After Institutional Review Board approval was obtained at all 17 participating institutions, women were identified for inclusion using International Classification of Disease, Ninth Revision (ICD-9) codes for 'previous caesarean delivery, delivered'. Women without a prior low-transverse uterine incision were excluded. Charts were extracted by trained research nurses using closed-ended extraction tools, and 3% were re-extracted for quality assurance. Detailed information on maternal sociodemographics, medical and surgical history, and antepartum course were collected. Data on intrapartum course, medications, delivery, maternal outcomes, and surgical and medical complications were also extracted.

The primary outcome of the parent cohort, symptomatic uterine rupture, was defined *a priori* as full-thickness disruption of the uterine scar, identified at laparotomy, accompanied by one of the following: acute maternal haemorrhage, maternal hypotension (systolic blood pressure <70 mmHg or diastolic blood pressure <40 mmHg), maternal heart rate >120 beats/minute, blood in the peritoneal cavity at the time of laparotomy or non-reassuring fetal heart rate tracing immediately preceding surgery. This definition allowed for the distinction between clinically significant uterine rupture (primary outcome of the parent cohort study) and incidental findings of 'uterine windows' and 'scar separations' that are of unknown

clinical significance. For this secondary analysis, the primary outcome was a composite of maternal morbidity, defined as at least one of the following: uterine rupture, bladder or bowel injury, or uterine artery laceration. Secondary outcomes included VBAC success, the individual components of the composite outcome, as well as transfusion and fever, defined as the need for transfusion, determined by the caring physician, and as a temperature of >100.5 F (38.0 C) respectively.

Descriptive statistics were used to estimate the incidence of maternal morbidity and secondary outcomes in women with a history of three or more prior caesareans, and were compared between those who attempted VBAC and those who elected for a repeat caesarean. The characteristics and birth outcomes of patients who attempted VBAC with three or more prior caesarean deliveries were then compared with women who attempted VBAC with one and two prior caesareans, respectively. Continuous variables were compared using a Student's *t* test if normally distributed and a Mann-Whitney *U* test if non-normally distributed, whereas dichotomous variables were compared using chi-square or Fisher's exact tests in cases with the expected value of any single cell containing fewer than five observations. Stratified analyses were conducted to identify potential confounding variables. The results of the univariable and stratified analyses were used to select factors for our multivariable analyses for VBAC success and maternal morbidity. Factors including prior vaginal birth, gestation age, oxytocin exposure, labour type, birthweight, and diabetes were considered. Because of the rare (fewer than ten cases) or non-occurrence of uterine rupture, maternal composite morbidity, and transfusion, adjusted analyses were not performed for these outcomes. For more prevalent outcomes backward selection was used to reduce the number of variables in the model, by assessing the magnitude of change in the effect size estimate of the primary exposure (three or more prior caesareans) and each of the outcomes. Differences in the hierarchical explanatory models were tested using the likelihood ratio test or Wald test. All variables that were statistically significant, as well as those with known biological importance, or that were historically associated with VBAC morbidity, were included in the final models. The possibility of non-independence between patients as a result of common hospital site was evaluated by cluster analysis. All statistical analyses were completed using STATA v10, special edition ([www.stata.com](http://www.stata.com)).

## Results

Of the 25 005 women with a history of a prior caesarean delivery, 860 (3.4%) had three or more prior caesareans: 748 (87%) had three prior, 97 (11%) had four prior, 13 (2%) had five prior, and two (0.2%) had six prior caesareans.

Of the 860 women with three or more prior caesareans, 89 attempted VBAC and 771 elected for a repeat caesarean. We compared baseline characteristics of all women with three or more prior caesareans by mode of delivery (Table 1). Women who attempted VBAC were similar to those who delivered by elective repeat caesarean with respect to gravidity, and rates of diabetes, hypertensive disorders of pregnancy, and twin gestation. Women who attempted VBAC were slightly younger, delivered about a week earlier, were more likely to be of black race, and were less likely to deliver at a university hospital.

Though there were no uterine ruptures in any of the 860 women with three or more prior caesareans, those women who elected for repeat caesareans appeared to have a higher rate of maternal morbidity (2.2% versus 0.0%,  $P = 0.12$ ) when compared with those who attempted VBAC, but the difference was not statistically significant. There was no difference in rates of transfusion requirement (2.2% versus 2.2%,  $P = 0.98$ ) or postpartum fever (15.7% versus 15.7%,  $P = 0.99$ ) between women who attempted VBAC and those who elected for repeat caesarean with three or more prior caesarean deliveries (Table 2).

Of the 89 women with three or more prior caesareans who attempted VBAC, 58% ( $n = 52$ ) laboured spontaneously, 32% were induced ( $n = 29$ ), and 10% were augmented ( $n = 9$ ). Furthermore, 36% ( $n = 32$ ) of women who attempted VBAC with at least three prior caesareans had had a prior vaginal delivery, and 91% ( $n = 29$ ) of

those successfully delivered vaginally, compared with a 74% ( $n = 42$ ) success rate among the 57 women who attempted VBAC with three or more prior caesareans and no prior vaginal delivery.

Comparing the baseline characteristics of women who attempted VBAC having had three or more prior caesareans with those having had one prior caesarean (Table 3), they were of similar age, with similar rates of prior vaginal

**Table 1.** Baseline characteristics of women with three or more prior caesarean deliveries, by mode of delivery

	VBAC attempt ( $n = 89$ )	Elective repeat caesarean ( $n = 771$ )	<i>P</i> value
Gravidity (mean $\pm$ SD)	4.9 $\pm$ 1.9	5.0 $\pm$ 1.4	0.69
Maternal age (year, mean $\pm$ SD)	30.9 $\pm$ 5.2	32.7 $\pm$ 5.3	<0.01
Gestational age at delivery (week, mean $\pm$ SD)	37.2 $\pm$ 4.1	37.9 $\pm$ 2.3	0.78
Preterm delivery (<34 weeks)	7.8%	4.2%	0.11
Postterm delivery (>41 weeks)	16.8%	10.0%	0.06
Birthweight (g, mean $\pm$ SD)	3046 $\pm$ 748	3285 $\pm$ 640	<0.01
Black race	47.2%	31.6%	<0.01
Tobacco use	41.6%	27.0%	<0.01
Twins	1.1%	1.7%	0.69
Prior vaginal delivery	35.9%	5.6%	<0.01
Diabetes	11.2%	9.2%	0.51
Hypertensive disorder of pregnancy	7.9%	10.1%	0.50
University hospital	40.4%	56.9%	<0.01
OB/GYN residency	18.0%	25.4%	0.12

**Table 2.** Major and minor morbidity in women with three or more prior caesarean deliveries who attempt VBAC, compared with those who undergo repeat caesarean delivery

Outcome	VBAC $n = 89$	Repeat caesarean $n = 771$	Unadjusted RR (95% CI)	<i>P</i> value
Uterine rupture (%)	0.0	0.0	–	–
Bladder injury (%)	0.0	1.6	–	0.24
Surgical injury (%)	0.0	0.9	–	0.44
Composite morbidity (%)	0.0	2.2	–	0.12
Transfusion (%)	2.2	2.2	1.02 (0.24–4.34)	0.98
Fever (%)	15.7	15.7	1.00 (0.60–1.67)	0.99

**Table 3.** Comparison of patient characteristics in women who attempt VBAC with a history of one or two prior caesarean deliveries versus three or more prior caesarean deliveries

Risk factor	Three or more prior caesareans ( $n = 89$ )	One or two prior caesareans ( $n = 13\ 617$ )	<i>P</i> value
Age (year, mean $\pm$ SD)	30.9 ( $\pm$ 5.3)	30.2 ( $\pm$ 5.5)	0.21
Gestational age (week, mean $\pm$ SD)	37.2 ( $\pm$ 4.1)	38.7 ( $\pm$ 2.4)	<0.01
Preterm delivery (<34 weeks)	7.8%	3.2%	0.05
Postterm delivery (>41 weeks)	16.8%	16.6%	0.95
Tobacco use (%)	41.5	18.6	<0.01
Alcohol use (%)	18.2	7.1	<0.01
Diabetes (any) (%)	11.2	5.3	0.01
Gestational hypertensive disease (%)	7.9	7.8	0.20
Black race (%)	47.2	29.6	<0.01
University hospital (%)	40.4	54.6	0.01
OB/GYN residency (%)	18.0	25.5	0.10
Prior vaginal delivery (%)	36.0	36.7	0.87
Prior SAB (%)	38.2	27.3	0.02
Prior EAB (%)	24.7	21.2	0.43
Induction (%)*	32.6	29.1	0.47
Oxytocin exposure (%)	30.1	38.2	0.16

SAB, spontaneous abortion; EAB, elective abortion.

\*As opposed to spontaneous/augmentation of labour.

births, and had similar rates of induction. On average, women with three or more prior caesareans tended to deliver more than a week earlier, were more likely to report tobacco or alcohol use, have diabetes, and be of black race compared with women with one prior caesarean. Women with three or more prior caesareans who attempted VBAC were less likely to do so at a university hospital, or at a hospital with a residency program in obstetrics and gynaecology. Women with three or more prior caesareans were also significantly less likely to be exposed to oxytocin than women with one prior caesarean. The women with three or more prior caesareans were statistically similar with regard to all of these variables when compared with those with two prior caesareans.

Of the 89 patients with three or more prior caesareans who attempted VBAC, there were no cases of uterine rupture, uterine artery laceration, bladder injury, or bowel injury, and thus the composite maternal morbidity was 0% (95% CI 0–4.1%). Women with three or more prior caesareans were as likely to have a successful VBAC attempt as women with one prior caesarean (79.8% versus 75.5%), and this similarity remained after adjusting for previous vaginal delivery, induction, oxytocin exposure, and diabetes [adjusted OR (aOR) 1.4, 95% CI 0.81–2.41,  $P = 0.22$ ]. Women with three or more prior caesareans appeared to have a higher rate of transfusion (2.2 versus 0.7%,  $P = 0.10$ ) and postpartum fever (15.7% versus 9.5%,  $P = 0.47$ ) than women who attempted VBAC with one prior caesarean, although these did not reach statistical significance (Table 4).

When women attempting VBAC having had three or more prior caesareans were compared with women having had prior caesareans, they were similarly successful (79.8%

versus 74.6%, respectively), even after adjusting for prior vaginal delivery, labour induction, oxytocin exposure, and diabetes (aOR 1.49, 95% CI 0.85–2.60,  $P = 0.16$ ) (Table 4). Gestational age at delivery and birthweight were not found to be significant covariates, and were thus not included in the final model. The trends in differences in need for transfusion and postpartum fever were similar to the findings when compared with women attempting VBAC having had one prior caesarean.

## Discussion

We found that women with three or more prior caesarean deliveries did not experience a difference in morbidity based on whether they attempted VBAC or elected for a repeat caesarean. In our cohort, there were no cases of uterine rupture or major maternal morbidity in the 89 women who underwent VBAC attempt with a history of three or more prior caesareans. Women who attempted VBAC after three or more prior caesarean deliveries did not have a significantly increased risk of maternal morbidity or failed VBAC attempt when compared with women who attempted VBAC after one prior caesarean, or when compared with women having had two prior caesareans. Our results have two important clinical implications. First, although there is measurable maternal morbidity associated with delivery for a woman with a history of three or more prior caesareans, it does not differ significantly by mode of delivery. Our data and those of others<sup>5</sup> suggest that precluding VBAC for all women with three or more prior caesareans may not be evidence based. Our study also raises a second, broader clinical issue. Our findings for the specific group of women with three or more prior caesareans add

**Table 4.** Risk of VBAC failure and minor maternal morbidity for women undergoing VBAC attempt with a history of three or more prior caesarean deliveries, compared with those having had one or two prior caesarean deliveries

Outcome	≥3 prior caesareans (n = 89)	2 prior caesareans (n = 1082)	1 prior caesarean (n = 12 535)	≥3 versus 1 prior caesarean			≥3 versus 2 prior caesareans		
				Unadjusted RR (95% CI)	Adjusted OR (95% CI)	P value	Unadjusted RR (95% CI)	Adjusted OR (95% CI)	P value
Successful VBAC attempt (%)	79.8	74.6	75.5	1.06 (0.95–1.17)	1.40* (0.81–2.41)	0.22	1.07 (0.96–1.19)	1.49* (0.85–2.60)	0.16
Transfusion (%)	2.2	0.9	0.7	3.31 (0.83–13.3)	**	0.10	2.43 (0.54–10.9)	**	0.25
Fever (%)	15.7	8.9	9.5	1.66 (1.02–2.69)	1.50*** (0.50–4.56)	0.47	1.77 (1.06–2.97)	1.80*** (0.59–5.51)	0.30

Logistic regression models contain the following significant confounding variables.

\*Prior vaginal delivery, induced labour, oxytocin exposure, or diabetes (any type).

\*\*Too few observations to perform adjusted analyses for transfusion outcome.

\*\*\*Prior vaginal delivery or black versus non-black race.

to the available data on the greater topic of VBAC success and safety in women with more than one prior caesarean.

Because the American College of Obstetricians and Gynecologists (ACOG) does not currently recommend planned VBAC attempt in women with three or more prior caesarean deliveries, the number of women with such a history are less frequently encountered than those with fewer prior caesareans. Additionally, the incidence of significant maternal morbidity associated with VBAC, such as uterine rupture, is relatively rare, making the data available on risk estimates to inform decision making sparse. Prior to this study, Miller *et al.*<sup>4</sup> published a single-centre retrospective cohort study of women with at least one prior caesarean to estimate the incidence of VBAC and rates of success. In the subgroup analysis of 792 women with three or more prior caesareans, 241 attempted VBAC with a 79% success rate and three (1.2%) uterine ruptures. Unfortunately, interpretation of the estimates of VBAC success in this observational study was limited, as no adjustment for important confounding effects was made.

Landon *et al.*<sup>5</sup> published a multicentre, prospective cohort study of women with at least one prior caesarean, primarily comparing outcomes between those with one prior caesarean and those with more than one prior caesarean. In the subgroup of 103 women with three or more prior caesareans who attempted VBAC, 64 (61.5%) were successful. However, although the authors found no difference in the risk of uterine rupture between women with one prior caesarean and those with more than one (0.7% versus 0.9%,  $P = 0.37$ ), they did not distinctly analyse the risks in the women with three or more prior caesareans. Clinically, this latter group is distinct based on current recommendations, and their management may be better guided by specific risk estimates associated with VBAC attempt.

Despite the large, multicentre parent cohort, our greatest limitation remained sample size, as the occurrence of the primary exposure (three or more prior caesareans) and primary outcomes (uterine rupture and composite major maternal morbidity) are rare. Our group of 89 women with three or more prior caesareans who attempted VBAC experienced no uterine ruptures or major maternal morbidity (composite outcome), and rarely experienced a fever or required a blood transfusion, preventing us from performing adjusted analyses to refine our risk estimates for these outcomes. The clear, *a priori* definition of uterine rupture used to establish the primary outcome on the parent cohort is an important strength of our study, allowing this to be distinguished from defects in the uterine muscle that represent unknown clinical significance. Although the precision of risk estimates is limited by the restricted sample size relative to exposure and outcome prevalences, this large, established cohort provided a considerable sample to

investigate the primary question involving a rare but important clinical subgroup of women, and relatively rare outcomes. Furthermore, the accuracy of data collection was optimised by having dedicated trained research nurses extract the data with closed-ended tools, with re-extraction for quality assurance. Finally, the 17-centre design, which included both tertiary and community delivery settings, improves the generalisability of our results to many obstetrical populations.

Together with these strengths, it is important to consider some other limitations of our study when interpreting the results. Retrospective cohort studies, by design, have the potential for confounding and bias. However, the data from this large cohort were comprehensive and more than 95% complete on significant covariates, allowing us to adjust our estimates of risk of more prevalent outcomes for relevant potentially confounding effects. Specifically, the potential for confounding by indication for VBAC success exists, with the selection to VBAC for patients with three or more prior caesarean deliveries made at the level of each individual patient and physician. Although we adjusted for surrogate markers of practice patterns and likely factors incorporated into physician decision making, such as delivery site, university setting, and history of a prior vaginal birth, the potential for confounding by indication cannot be completely corrected statistically. In addition, because of the retrospective nature of the study, the indication for labour induction in the few patients who were induced could not be definitively determined. Finally, we did not have available information on neonatal outcomes, as it was not a primary outcome in the parent cohort study, but this is an important consideration when weighing the relevant adverse clinical risks associated with VBAC attempt.

Although our relatively limited sample size impacts on the precision of risk estimates, and therefore on the strength of the conclusions that we can draw from our study alone, there is significant importance to the publication of these data on women with three or more prior caesareans. It provides physicians with some reference when this scenario is encountered, and it will contribute to future analyses such as meta-analysis to formally summarise our best-risk estimates for morbidity risks associated with mode of delivery in women with three or more prior caesareans.

We found no difference in the rates of success or of VBAC-associated morbidities in women who attempted VBAC having had three or more prior caesareans compared with those having had one or two prior caesareans. In addition, maternal morbidity in women with three or more prior caesareans did not differ by mode of delivery. Since the 2004 ACOG publication of recommendations for VBAC,<sup>6</sup> studies have been published demonstrating that the risk of uterine rupture in women with more than one prior caesarean who attempt VBAC is not significantly



increased over the risk for women with one prior caesarean.<sup>1,5</sup> Furthermore, women with a history of more than one prior caesarean, and specifically three or more prior caesareans, have a small but measurable increase in maternal morbidity risk associated with delivery, regardless of mode.<sup>7</sup> Many have proposed a 'conservative' approach to VBAC attempts,<sup>10</sup> which we agree is prudent. But the evidence does not support that a conservative approach, which we interpret as one that reduces morbidity and specifically the risk of uterine rupture, is achieved by unequivocally allowing VBAC attempts only in women with one prior caesarean.<sup>5,7</sup> Instead, patient selection is paramount.<sup>8,11,12</sup> From the evidence, choosing women who are most likely to succeed has the greatest impact on reduction in maternal risk.<sup>13–15</sup> Our results, together long with those in recent publications, suggest that perhaps it is time to revisit the current recommendations for VBAC attempts for women with more than one prior caesarean.

### Disclosure of interests

All authors declare that they have no competing interests.

### Contribution to authorship

All authors have significantly contributed to this scientific work. AGC helped to develop the study design, analysed the data and wrote the manuscript. MT helped to analyse the data and co-wrote the manuscript. AOO helped with the study design, collected data, and assisted in analysis and manuscript drafting. DMS helped with the study design and manuscript drafting. GAM initiated the study, and was involved in all aspects, from concept development to manuscript writing.

### Details of ethics approval

Institutional Review Board approval was obtained at all 17 participating institutions.

### Funding

This work was supported by a grant from NICHD (RO1 HD 35631, to GAM). GAM was a recipient of a K24 grant from NICHD (K24 HD01289), which partially supported this work.

### Acknowledgement

None. ■

### References

- 1 Macones GA, Cahill A, Pare E, Stamilio DM, Ratcliffe S, Stevens E, *et al.* Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? *Am J Obstet Gynecol* 2005;192:1223–8. Discussion 1228–9.
- 2 Caughey AB, Shipp TD, Repke JT, Zelop CM, Cohen A, Lieberman E. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. *Am J Obstet Gynecol* 1999;181:872–6.
- 3 Spaans WA, van der Vliet LM, Roell-Schorer EA, Bleker OP, van Roosmalen J. Trial of labour after two or three previous caesarean sections. *Eur J Obstet Gynecol Reprod Biol* 2003;110:16–9.
- 4 Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. *Obstet Gynecol* 1994;84:255–8.
- 5 Landon MB, Spong CY, Thom E, *et al.* Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol* 2006;108:12–20.
- 6 American College of Obstetricians and Gynecologists (ACOG). Practice Bulletin #54: vaginal birth after previous cesarean. *Obstet Gynecol* 2004;104:203–12.
- 7 Silver RM, Landon MB, Rouse DJ, *et al.* Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* 2006;107:1226–32.
- 8 Grobman WA, Lai Y, Landon MB, *et al.* Development of a nomogram for prediction of vaginal birth after cesarean delivery. *Obstet Gynecol* 2007;109:806–12.
- 9 Macones GA, Peipert J, Nelson DB, *et al.* Maternal complications with vaginal birth after cesarean delivery: a multicentre study. *Am J Obstet Gynecol* 2005;193:1656–62.
- 10 Clark SL, Belfort MA, Dildy GA, Meyers JA. Reducing obstetric litigation through alterations in practice patterns. *Obstet Gynecol* 2008;112:1279–83.
- 11 Cahill AG, Macones GA. Vaginal birth after cesarean delivery: evidence-based practice. *Clin Obstet Gynecol* 2007;50:518–25.
- 12 Macones GA. Clinical outcomes in VBAC attempts: what to say to patients? *Am J Obstet Gynecol* 2008;199:1–2.
- 13 Landon MB, Leindecker S, Spong CY, *et al.* The MFMU Cesarean Registry: factors affecting the success of trial of labor after previous cesarean delivery. *Am J Obstet Gynecol* 2005;193:1016–23.
- 14 Cahill AG, Stamilio DM, Odibo AO, *et al.* Is vaginal birth after cesarean (VBAC) or elective repeat cesarean safer in women with a prior vaginal delivery? *Am J Obstet Gynecol* 2006;195:1143–7.
- 15 Macones GA, Cahill AG, Stamilio DM, Odibo A, Peipert J, Stevens EJ. Can uterine rupture in patients attempting vaginal birth after cesarean delivery be predicted? *Am J Obstet Gynecol* 2006;195:1148–52.

## Journal club

### Discussion points

1. Objective and background: Is the topic important in your area? What has been the prevailing practice, and the evidence to support it, for women with three or more caesareans in your area?
2. Methods: This study is a retrospective analysis of three different cohorts: women giving birth after one, two, or three or more caesareans. The objective was to compare the rate of success of vaginal birth and maternal morbidity among these cohorts. Which factors may influence these outcomes, and have the authors controlled for all of them in the analysis, to reduce the risk of confounding? Would a different design be desirable or feasible? Describe the

- eligibility criteria, and the sources and methods of selection of participants. Have the outcome measures, and the method(s) to determine them, been explained clearly? Does this study have any relevant strengths and weaknesses?
3. Results: Was there any statistically significant difference in maternal outcome between repeat caesarean and attempt at vaginal birth? Was there any clinically significant difference? How does maternal outcome for repeat (fourth) caesarean in this study compare with the outcome after repeat (third) caesarean birth in the (BJOG January 2010) paper 'Vaginal birth after two caesarean sections (VBAC-2)—a systematic review with meta-analysis of success rate and adverse outcomes of VBAC-2 versus VBAC-1 and repeat (third) caesarean sections'?
  4. Limitations: The study focused on maternal outcomes only: do the results provide sufficient information to inform fully the decision between elective caesarean and attempt at vaginal birth? How can these same results affect discussions of mode of birth for women with three or more previous caesareans, and induction of labour for intrauterine death? What is the difference?
  5. Generalisability: How do women in this study sample differ from women in your area/practice? Would you expect a similar proportion of women with three or more previous caesareans to attempt spontaneous or induced vaginal birth?
  6. Clinical implications: Will this paper change the way you counsel women who are pregnant after three or more caesareans, and how? Can single studies with small samples influence policy and practice? If not, what type of secondary analysis would be more likely to convince you?
  7. Implications for research: If the study were repeated, would you assess additional outcome measures? ■

**D Siassakos**

Southmead Hospital, Bristol, UK  
Email [jsiasakos@gmail.com](mailto:jsiasakos@gmail.com)