Repeat cesarean delivery in the 39-week rule era: outcomes at a community based hospital

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Summary

Objective: To compare adverse perinatal outcomes between scheduled and unscheduled repeat cesarean deliveries performed prior to 39 weeks' gestation. *Materials and Methods:* The authors performed a single-center, retrospective cohort study comparing scheduled, and unscheduled repeat cesarean deliveries. Outcomes compared included (1) adverse operative injuries, (2) excessive blood loss, defined as drop in Hg greater than then 97% (3.6 g), or need for blood transfusion, and (3) adverse neonatal outcome (low 5-minute Apgar, or NICU admission). The presence of any adverse event, and the number of adverse events per 100 deliveries were compared between scheduled and unscheduled cases. *Results:* A total of 724 repeat cesarean deliveries were reviewed, of which 48.9% (n = 354) were unscheduled. There were significantly more adverse outcomes in the unscheduled cesarean cohort (32 per 100 deliveries), compared to the scheduled cesarean cohort (13 per 100 deliveries) ($p < 0.001$). When compared with those undergoing scheduled cesarean deliveries, women with unscheduled repeat cesarean deliveries were noted to have increased adverse outcomes (OR 3.11, 95% CI 2.04-4.74). *Conclusion:* Almost half (48.9%) of patients with previous cesarean deliveries deliver for either maternal or fetal indication prior to 39 weeks of gestation, and carry greater risk for adverse perinatal outcome.

Key words: Labor and delivery; Repeat cesarean delivery; Repeat cesarean section; Adverse perinatal outcome; Unscheduled cesarean delivery.

Introduction

Many national organizations [American College of Obstetricians and Gynecologists (ACOG), Society for Maternal-Fetal Medicine (SMFM)] have recommended that elective repeat cesarean delivery be performed after 39 $^0/_7$ weeks [1, 2]. The recommendation to wait until at least 39 $^0/_7$ weeks is in large part driven by improved neonatal outcomes measured at the time of elective repeat cesarean delivery [3-7]. In a large study by the Maternal-Fetal Medicine Units Network comparing outcomes in elective repeat cesarean deliveries at 37-40 weeks, Chiossi *et al.* found neonatal improvement at 39 weeks with an OR of 0.79 (95% CI 0.68-0.92). [5] However, maternal and neonatal outcomes of women delivering electively can only be compared to outcomes of women who have been managed expectantly and delivered at a later gestational age [3-5]. In addition, the benefits of reaching the 39th week landmark are often based on outcomes of elective scheduled cesarean deliveries in women without comorbidities - far removed from the day-to-day practice of the present community-based teaching hospital [8]. As the present authors follow the recommendations to perform elective repeat cesarean at 39 weeks gestation, they now see an increase in the number of patients with previous cesarean scars presenting to their labor and delivery units with indications for delivery, such as labor or ruptured membranes, or obstetric complications such as preeclampsia.

Here, the authors assess the incidence and indication for unscheduled repeat cesarean deliveries, and compare adverse perinatal outcomes between scheduled and unscheduled repeat cesarean deliveries.

Materials and Methods

The authors performed a single-center, retrospective cohort study of 854 cesarean deliveries performed during 2012 and 2013 at Arrowhead Regional Medical Center (ARMC). ARMC is a medium size, community-based teaching hospital owned and operated by the County of San Bernardino, in Colton, California. ARMC performs approximately 2,500 deliveries per year. The percentage of patients delivered by cesarean is 23% (unpublished data). ARMC has a policy to schedule elective repeat cesarean delivery at 39 $^0/_7$ weeks or greater based on ACOG dating criteria. This policy has been in effect since before 2011.

Repeat cesarean deliveries were classified as either scheduled, or unscheduled by the operating surgeon at the time of delivery, and this information was recorded in the medical record. This classification was cross-correlated with the labor and delivery schedule for verification. Patients who arrived on their pre-determined date for a planned repeat cesarean delivery were considered scheduled. Patients who arrived at the present unit without an appointment for cesarean delivery, or who ended up undergoing cesarean delivery within that admission were considered un-

scheduled. Unscheduled cesarean deliveries included emergency repeat cesarean. Indication for repeat cesarean delivery, demographic information, and maternal and neonatal complications were abstracted from the medical record. The present authors defined labor as the presence of regular and strong contractions not abated with hydration, with either some degree of cervix change during serial digital examination, or advanced cervix dilation > 4 cm. Preeclampsia was defined according to the ACOG Task Force on Hypertension in Pregnancy [9]. Gestational age was determined by the best obstetric estimate (last menstrual period compared to ultrasound). Blood loss was measured by collecting pre-operative hemoglobin and post-operative day one hemoglobin (> 12 hours after surgery). The authors included women with medical and obstetric complications. However, women with schedule cesarean deliveries prior to 39 weeks for maternal or fetal indication (i.e. diabetes, hypertension) were excluded. Additionally, women with a suspected placenta accreta with planned delivery far prior to 39 weeks, those who attempted vaginal birth after cesarean (VBAC), and deliveries under $34\ ^0/_7$ weeks of gestation were excluded as their known elevated risk for adverse operative outcome would bias results. The present institution employs a laborist type model with in house on-call obstetricians and anesthesiologists, as well as resident physicians. Cesarean deliveries were performed by the on-call attending physician and resident.

Cases were reviewed to determine any adverse maternal or neonatal outcome, including (1) adverse operative injury: maternal bowel laceration, bladder laceration, extension of hysterotomy into uterine artery, or extension of hysterotomy into cervix, (2) excessive blood loss: large hemoglobin drop, operative or postpartum transfusion, uterine atony, and (3) adverse neonatal outcome: low Apgar at 5 minutes (<7), or NICU admission. These adverse outcomes were chosen as they are the most common operative complications, or reflect neonatal status at delivery. The authors assessed blood loss in three ways: (1) an estimated blood loss at the time of surgery by the operating surgeon, (2) the decrease in hemoglobin (Hg) from pre-operative to post-operative day number one, and (3) a large drop in hemoglobin from pre-operative to post-operative day number one defined as being outside the 97.5% (over 3.6 g drop). The presence of any adverse event (i.e. a single adverse outcome from the list above or more, as a binary variable) was compared by type of cesarean – scheduled, or unscheduled. The total number of adverse events, defined as a summation of each of the adverse events listed above scoring a single point where a single case could have more than one adverse event, per 100 deliveries was also compared.

Comparison was made between the scheduled and unscheduled cases using *t*-test, chi-squared, and fishers exact statistics where appropriate. In order to evaluate confounding due to number of prior cesarean deliveries, ANOVA was employed to compare the number of adverse events per delivery based on type of cesarean (scheduled or unscheduled) and number of prior cesarean deliveries (one, two, or more than three prior cesarean deliveries).

This study was conducted with the approval of the ARMC Institutional Review Board. Informed consent was not needed due to the retrospective nature of this study. Statistical analysis was conducted with SPSS version 22.0.0.0. A two-sided $p < 0.05$ was considered statistically significant.

Results

Nine-hundred and eight repeat cesarean deliveries were performed in the study period. One-hundred and eighty-four cases (20%) were excluded for attempted VBAC, scheduled delivery prior to $39\ ^0/_7$ weeks for maternal or
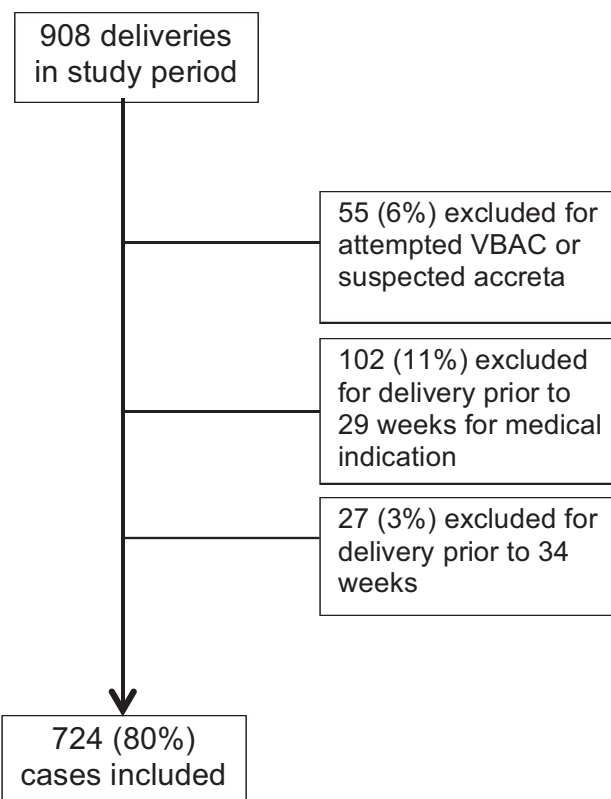

Figure 1. — Description of excluded and included cases.

Table 1. — *Indications for unscheduled repeat cesarean delivery.*

	Scheduled		Unscheduled	
	n=370	(%)	n=354	(%)
Elective > 39 weeks	348	(94.1%)	0	(0.0%)
Maternal medical problem	4	(1.1%)	18	(5.1%)
Labor	4	(1.1%)	155	(43.8%)
ROM	0	(0.0%)	55	(15.5%)
Preeclampsia	4	(1.1%)	50	(14.1%)
Non reassuring fetal status	2	(0.5%)	31	(8.7%)
IUGR	1	(0.3%)	6	(1.7%)
Oligohydramnios	1	(0.3%)	20	(5.6%)
Macrosomia	4	(1.1%)	6	(1.7%)
Previa	1	(0.3%)	3	(0.8%)
Other	1	(0.3%)	10	(2.8%)

fetal indication, or for unscheduled delivery prior to $34\ ^0/_7$ weeks of gestation (Figure 1). A total of 724 repeat cesarean deliveries were reviewed, of which 48.9% (n = 354) were unscheduled. The most common indication for unscheduled repeat cesarean was labor (n = 155, 43.8%), followed by rupture of membranes (n = 55, 15.5%), and preeclampsia (n = 50, 14.1%). Over half (59.3%) of patients who underwent unscheduled repeat cesarean delivery were for

Table 2. — *Comparison of demographic and outcome variables between scheduled and unscheduled cesarean deliveries. Values are n or mean (% or standard deviation) where appropriate.*

	Scheduled cesarean	Unscheduled cesarean	
	370 (51)	354 (49)	*p*-value
Age	28.6 (5.4)	2.91 (5.6)	0.333
Ethnicity			0.442
Hispanic	268 (72.4)	260 (73.4)	
White	45 (12.2)	33 (9.3)	
Black	42 (11.4)	41 (9.3)	
Asian	3 (0.8)	2 (0.6)	
Other	5 (1.4)	12 (3.4)	
Not recorded	7 (1.9)	6 (1.7)	
Number of prior CD	1.51 (0.67)	1.73 (0.94)	<0.001
1	210 (56.8)	184 (52.0)	<0.001
2	137 (37.0)	108 (30.5)	
3	17 (4.6)	43 (12.1)	
4	5 (1.4)	12 (3.4)	
5	1 (0.3)	7 (2.0)	
GA delivery	39.3 (0.4)	38.2 (1.4)	<0.001
Blood loss and anesthesia			
Estimated blood loss	666.6 (148.5)	671.5 (176.5)	0.299
Hg Drop	1.45 (0.94)	1.51 (1.24)	0.003
Large Hg drop[a]	6 (1.6)	11 (3.1)	0.225
Type of anesthesia[b]			
General	9 (2.4)	28 (7.9)	0.001
Spinal	356 (96.2)	314 (89)	
Epidural	5 (1.4)	11 (3.1)	
Maternal complications[c]			
Any	9 (2.5)	13 (3.7)	0.389
None	357 (97.5)	337 (96.3)	
Bowel injury	0	1 (0.3)	0.860
Extension into uterine artery	4 (1.1)	4 (1.1)	
Bladder injury	2 (0.5)	2 (0.6)	
Extension into cervix	0	0	
Uterine Atony	2 (0.5)	3 (0.9)	
Transfusion	5 (1.4)	10 (2.8)	0.197
Neonatal complications			
Apgar < 5 at 1 minute	6 (1.6)	12 (3.4)	0.154
Apgar < 7 at 5 minutes	3 (0.8)	3.(0.8)	1.000
NICU admission[c]	18 (4.9)	69 (19.7%)	<0.001
NICU for observation	12 (3.3)	50 (14.3)	
NICU for problem	6 (1.6)	19 (5.4)	
Any adverse event	36 (10.1)	89 (25.8)	<0.001
Number of adverse events per 100 deliveries[d]	13	32	<0.001

The following n were used due to missing data: a: n=720 (367 scheduled, 353 unscheduled). b: n=723 (370 scheduled, 353 unscheduled). c: n=716 (366 scheduled, 350 unscheduled). d: For the number of adverse events per delivery, the case was excluded if a single variable was missing (n=703, 358 scheduled, 345 unscheduled).

either onset of labor or rupture of membranes. As expected, indications for delivery between scheduled and unscheduled cases were statistically different (*p* < 0.001). Indica-

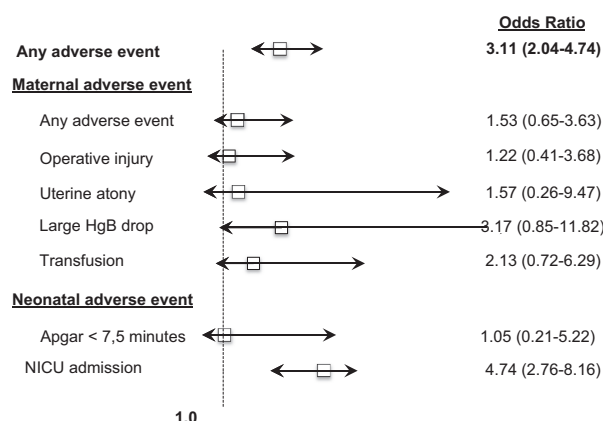|		Odds Ratio
Any adverse event		3.11 (2.04-4.74)
Maternal adverse event		
Any adverse event		1.53 (0.65-3.63)
Operative injury		1.22 (0.41-3.68)
Uterine atony		1.57 (0.26-9.47)
Large HgB drop		3.17 (0.85-11.82)
Transfusion		2.13 (0.72-6.29)
Neonatal adverse event		
Apgar < 7,5 minutes		1.05 (0.21-5.22)
NICU admission		4.74 (2.76-8.16)

Figure 2. — Forest plot demonstrating odds ratios for any adverse maternal event, and neonatal adverse outcomes for unscheduled cesarean delivery as compared to scheduled cesarean delivery. An odds ratio > 1 indicates greater chance of the adverse event in the unscheduled cohort.

tions for scheduled and unscheduled repeat cesarean delivery are shown in Table 1.

Maternal and neonatal characteristics and outcomes for scheduled and unscheduled deliveries are shown in Table 2. The scheduled and unscheduled cohorts had a similar age, ethnicity. The unscheduled cesarean delivery cohort had more prior cesarean deliveries. As expected, women with unscheduled cesarean deliveries were delivered at an earlier gestational age (mean 38 $\frac{1}{7}$ weeks, range 34 $\frac{0}{7}$ – 41 $\frac{1}{7}$ weeks), and were more likely to require general anesthesia. There was only a small difference of one week between the scheduled and unscheduled cohorts.

Thirty-six (10.1%) of repeat cesarean deliveries in the scheduled cesarean cohort had at least one adverse event, compared to 89 (25.8%) cases in the unscheduled cesarean cohort (*p* < 0.001). There were significantly more adverse outcomes in the unscheduled cesarean cohort (32 per 100 deliveries), compared to the scheduled cesarean cohort (13 per 100 deliveries) (*p* < 0.001). When compared with those undergoing scheduled cesarean deliveries, women with unscheduled repeat cesarean deliveries were noted to have increased adverse outcomes (OR 3.11, 95% CI 2.04-4.74). The largest contribution to the increased adverse outcomes in unscheduled cesarean deliveries was NICU admission (OR 4.74, 95% CI 2.76-8.16) (Figure 2). There were increased odds of maternal complications in the unscheduled cohort, but none reached statistical significance. This study was underpowered to detect small differences due to the rarity of each individual operative injury, large blood loss, and transfusion (51.8% statistical power to detect a 1.5% increase in adverse outcome, assuming a chance adverse outcome of 1% in the scheduled cohort).

Two way ANOVA tests of the composite adverse outcome for scheduled and unscheduled cesareans compared

by number of prior cesarean deliveries showed no interaction between number of prior cesareans and scheduled *vs*. unscheduled cesarean delivery ($p = 0.186$). Despite the unscheduled cesarean delivery cohort having more prior cesarean deliveries, this indicates that the number of prior cesareans was independent of whether the cesarean delivery was scheduled or unscheduled. Whether the cesarean was scheduled or unscheduled had a significant effect on number of adverse events per delivery ($p = 0.005$). The number of prior cesarean deliveries had no significant effect on adverse outcome ($p = 0.665$), which suggests the increase in adverse outcomes seen at unscheduled cesarean delivery is due to the fact that it is unscheduled, not because of the number of prior cesarean deliveries the patient has had.

Discussion

Nearly half (48.9%) of patients at the present institution with previous cesarean birth deliver for either maternal or fetal indication prior to 39 weeks of gestation. The present authors found that the odds of any complication during repeat cesarean delivery tripled if the cesarean was unscheduled, and the odds of NICU admission was four times higher for unscheduled cesarean deliveries compared to scheduled deliveries. Thus, 39 weeks may not be the optimal time for all patients, especially those with comorbidities.

The most common indication to the decision to proceed with unscheduled repeat cesarean section was labor. Over half of the current patients presented with labor or rupture of membranes prior to scheduled repeat cesarean section, which is substantially higher than the 16% of patients that presented with labor prior to cesarean in a large Maternal-Fetal Medicine Unit cesarean registry [5]. However, many patients in that study underwent elective repeat cesarean delivery prior to the 39 $^0/_7$ week landmark. Roberts *et al.* found only 8.5% of women planning repeat cesarean delivery had onset of labor prior to their scheduled date in a low risk cohort [10]. The higher rate of patients with spontaneous labor or rupture of membranes prior to their scheduled cesarean date seen in this study may be due to inclusion of high risk patients, or reflect different decision making among obstetric care providers based on their perception of the patient's risk [11].

The present findings are consistent with the premise that elective scheduled delivery is associated with fewer complications than when performed in labor or in emergency. [7, 12, 13] However, a limitation of this study is that it is underpowered to detect increased risk of maternal operative injury, due to the relative rarity of these events. The present results suggest a trend towards increase risk of maternal operative adverse outcome in unscheduled cesarean delivery.

Due to the more common nature of NICU admission, the present authors were able to detect a statistically significant risk of NICU admission in the unscheduled cesarean delivery cohort. The younger gestational age of the unscheduled cohort is likely the predominant factor attributing to this NICU admission rate. [14] Thus, they cannot conclude that women should be delivered prior to 39 $^0/_7$ weeks of gestation, as there are clear neonatal benefits to reaching 39 weeks. Here, they did not seek to determine the optimal gestational age for delivery at this institution, and cannot draw any conclusions from this analysis regarding optimal time of delivery. However, this study shows that we must be prepared to perform a substantial number of unscheduled repeat cesarean deliveries, both in the NICU and the operating room.

This study reflects experience in a medium-sized community based non-academic hospital, and does not exclude patients with underlying comorbidities or complications, thus reflecting experience of a general labor and delivery practice. By including all deliveries, we are able to grasp the possible consequences of extrapolating evidence based on selected patient populations to schedule most elective repeat cesarean deliveries after 39 $^0/_7$ weeks, to a general patient population. A natural consequence of spontaneous labor prior to 39 weeks is an increase in the number of cesarean deliveries performed during night hours, or on weekends, which may have significant implication in regards to staffing and provision of anesthesia services [15]. The implications to mothers and babies if we extrapolate the present results smaller or rural hospitals, without in-house coverage, or at centers without neonatal intensive care, may be even more profound [8, 16, 17] When it comes to planning repeat cesarean delivery, implications of performing unscheduled deliveries with marked increased frequency, and the associated risks of unplanned cesarean delivery in the community-based hospital should be considered so that mother and neonate have a healthy delivery at the most optimal time for all. The onset of labor may negate the benefits of patiently waiting for the 39th week to arrive, and methods to identify women likely to have labor prior to 39 weeks would benefit mothers, neonates and obstetricians alike.

Acknowledgments

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