

Timing of Elective Repeat Cesarean Delivery at 38 Weeks versus 39 Weeks: Rate of Spontaneous Onset of Labor before Planned Cesarean Section and Impact on Maternal Outcome: A Retrospective Cohort Study

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Abstract

Background: The timing of elective repeat cesarean delivery at 38 weeks versus 39 weeks is still a debatable subject, both regarding maternal and neonatal outcomes. In the Saudi context, there is lack of local data to aid decision-making regarding the timing of elective repeat cesarean delivery. **Objectives:** To estimate the rate of spontaneous onset of labor before the planned gestational age for repeat cesarean section in women who were booked at gestational age of (39 0/7 - 39 6/7) weeks (W39) versus (38 0/7 - 38 6/7) weeks (W38) and to compare the rate of maternal composite outcome between these groups. **Design:** Retrospective cohort. **Setting:** This study was conducted at King Abdulaziz Medical City, Jeddah, KSA. **Method:** Delivery registry books were reviewed to identify all deliveries from 1 January 2014 to 31 December 2016 (3 years). All low-risk pregnant women who had 2 or more cesarean deliveries and who met the inclusion criteria were included. **Results:** A total of 440 women were included of whom 318 (72.3%) were planned for elective cesarean section at W38 gestational age and 122 women at W39 gestational age. Mothers planned at W39 had higher rate of emergency cesarean deliveries versus those planned at W38 (18.0% versus 10.4%, $p = 0.030$; $RR = 13.06$), most frequently due to early onset of contractions (16.4% versus 8.2%, $p = 0.012$; $RR = 12.17$) or cervical dilatation (11.6% versus 5.4%, $p = 0.024$, $RR = 16.15$). No difference in the incidence of individual or composite maternal complications was noted between the two groups. Mother's age ($OR = 0.93$, $p = 0.018$) and schedule date at W39 ($OR = 1.94$, $p = 0.028$) were independently associated with spontaneous onset of labor before the scheduled gestational age, while no association was found with parity, previous number

of spontaneous vaginal deliveries, number of previous cesarean deliveries or interval from last cesarean delivery. **Conclusion:** Elective cesarean section scheduled at 39 weeks of gestation or beyond carries a higher risk of emergency cesarean section, with no significant increase in maternal complications. The identification of factors associated with spontaneous onset of labor before the planned gestational age should be carefully identified to determine the optimal timing.

Keywords

Elective Cesarean, Emergency Cesarean, Repeat Cesarean, Previous Cesarean, Spontaneous Onset of Labor, Maternal Outcome, Neonatal Outcome, Timing of Delivery, Risk Factors

1. Introduction

Cesarean section is the most commonly performed surgical procedure in the obstetrical field [1]. Thanks to progress in surgical techniques, the rate of elective repeat cesarean deliveries has significantly increased in the last decade. In the United States, repeat cesarean deliveries account for around 20% of the total cesarean deliveries [2].

The timing of elective repeat cesarean delivery at 38 weeks versus 39 weeks is still a debatable subject. The American College of Obstetricians & Gynecologists (ACOG) and National Institute for Health and Care Excellence (NICE) guidelines have recommended timing of elective cesarean delivery at 39 weeks to optimize perinatal outcomes, notably by reducing the rates of adverse respiratory complications, neonatal intensive care unit (NICU) admission, and cardiopulmonary resuscitation (CPR) [3] [4] [5]. However, little evidence exists regarding maternal outcome when women are booked for elective repeat cesarean delivery at 39 weeks in comparison to 38 weeks. Reportedly, the rate of spontaneous onset of labor before the scheduled cesarean section (C-section) at 39 weeks ranges from 8.5% - 23%, and the associated risk of adverse maternal outcomes may increase [6] [7] [8] [9]. Due to this reason, some obstetricians opt to book women for elective repeat C-section at 38 weeks rather than 39 weeks. Others consider earlier delivery not justifiable, as no significant benefit on maternal outcome was evident for elective cesarean delivery at 37 - 38 weeks of gestation [10].

On the other hand, some studies addressed maternal outcome only if cesarean delivery was done as planned elective delivery at 38 weeks versus 39 weeks. One of these studies concluded that the optimum time for elective repeat cesarean delivery is 39 weeks for both mother and neonate [11]. In contrast, another study concluded no significant difference in maternal outcome if cesarean delivery was performed at 38 weeks with reference to 39 weeks of gestation [6].

In the Saudi context, there is lack of local data to aid decision-making regarding the timing of elective repeat cesarean delivery, 38 weeks versus 39 weeks.

Therefore, we conducted this study to probe into the issue and provide local data regarding the maternal outcome as a function of the gestational age at planned elective delivery.

2. Aims and Objectives

The primary outcome is to estimate the rate of spontaneous onset of labor before the planned repeat C-section in women planned at 38 weeks (38 0/7 - 38 6/7) versus 39 weeks (39 0/7 - 39 6/7 or 40 w) of gestation. The second primary outcome is to compare the rate of composite maternal complications, including perioperative and postpartum events, between the two groups. The secondary outcome is to identify maternal risk factors that could be associated with spontaneous onset of labor before the scheduled date.

3. Methods

This retrospective cohort study was conducted at King Abdulaziz Medical City in Jeddah (KAMC-J), Kingdom of Saudi Arabia. KAMC-J is a tertiary hospital with approximately 30% C-section rate of deliveries.

Delivery registry books were reviewed to identify all deliveries between January 1, 2014 and December 31, 2016, among women with two or more previous C-sections. Medical records for these women were reviewed for eligibility, and the data was extracted using a data collection form.

3.1. Inclusion and Exclusion Criteria

Women who met the following criteria were included in the study: singleton pregnancy, booked for elective C-section at (38 0/7 - 38 6/7) or (39 0/7 - 40) weeks of gestation, women who had two or more prior low transverse uterine incisions. Women who had any of the following criteria were excluded: previous scar other than low transverse uterine incision; previous uterine rupture or dehiscence; maternal indications for earlier delivery including chronic hypertension, preeclampsia, HELLP (hemolysis, elevated liver enzyme levels, and low platelet levels), cholestasis disease of pregnancy, uncontrolled gestational diabetes mellitus, diabetes mellitus; major fetal anomalies or stillbirth; fetal indications for earlier delivery (e.g. IUGR (intrauterine growth restriction), macrosomia, etc.), polyhydramnios, and abnormal placentation (*i.e.* placenta previa, placenta accreta/increta/percreta). Additionally, cases with significant missing data for the main study variables were excluded.

Women who met the inclusion criteria were further subdivided into two groups: Group 1—those who were booked for elective C-section at W38 of gestation; Group 2—women who were booked for elective C-section at W39 of gestation. The gestational age on the scheduled day of elective C-section was confirmed by early scan or sure date of last menstrual period with a second or third trimester scan. Women who did not have any scan during pregnancy and those with an unsure last menstrual period with only late scan were excluded.

Overall, 440 women met the inclusion criteria. Their medical records were reviewed to extract the following data:

1) Baseline characteristics: age; gravida: number of pregnancies; parity including number of deliveries after 20 weeks of gestation, number of previous term deliveries, number of previous preterm deliveries, number of previous vaginal deliveries, and number of previous cesarean deliveries with interval from last C-section (in years); medical history; surgical history; smoking status (smoker and passive-smoker were counted as smoker); professional status (employee or not employee); and body mass index (at time of delivery).

2) Current pregnancy parameters: last menstrual period; earliest ultrasound scan; current pregnancy complications (e.g. gestational diabetes controlled on diet); planned gestational age of delivery; gestational age at time of emergency C-section; cause of emergency C-section (contraction, rupture of membrane, scar tenderness); interval between the planned gestational age of delivery and emergency C-section gestational age (in days).

3) Surgical and postpartum events: difficulty in fetal extraction; uterine extensions; scar dehiscence; uterine rupture; bowel or bladder injury; hysterectomy; degree of adhesions (no adhesions or mild adhesions were categorized as non-significant adhesions, while moderate and severe adhesions were categorized as significant adhesions); postpartum hemorrhage; blood transfusion (intra-operative or post-operative); re-operation; infection (wound infection, endometritis); venous thromboembolism, intensive care unit (ICU) admission; and death.

4) Neonatal outcomes: birth weight; nursery admission; NICU admission; neonatal death.

3.2. Ethical Approval

This research project was approved by the Institutional Review Board (IRB) at King Abdullah International Medical Research Center (KAIMRC), in Jeddah, Saudi Arabia.

3.3. Statistical Analysis

Statistical analysis was performed with the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc., Chicago, IL, USA). The two study groups were compared for baseline characteristics, the rate of emergency C-sections (primary outcome), maternal intraoperative and post-operative complications, and fetal outcomes. Additionally, the two groups were compared regarding the percentage of composite maternal outcome, defined by the occurrence of any of the following intra-operative or post-operative complications: uterine extensions, uterine rupture, scar dehiscence, bowel or bladder injury, difficulty in fetal extraction, hysterectomy, post-partum blood transfusion, post-partum infection, venous thromboembolism, ICU admission, reoperation, and death. Chi-square or Fisher's exact test, as appropriate, was used to compare percentages; while independent t-test was used to compare means of numerical data assumed to be

normally distributed and Mann-Whitney U (nonparametric) test for numerical variables non-normally distributed. Relative risk (RR) was calculated for outcomes that verified statistically significant association with the planned gestational age of delivery. Factors of spontaneous onset of labor before scheduled date were analyzed by comparing patients who had emergency C-section with those who had elective cesarean delivery. Univariate and multivariate binary logistic regression was carried out to analyze predictors of emergency cesarean deliveries using significant factors as independent variables and emergency C-section as dependent variable. Results are presented as odds-ratio (OR) with 95% confidence interval (CI). A p value of <0.05 was considered to reject the null hypothesis.

4. Results

Missing data management

Missing data was managed using mean imputation for BMI (1 observation) and birth weight (2 observations). No further data was missing in the database.

4.1. Baseline Demographic, Lifestyle, and Clinical Characteristics

Of the 440 included women, 318 (72.3%) were planned to have elective cesarean delivery at (38 0/7 - 38 6/7) weeks of gestation while 122 of them at (39 0/7 - 40) weeks of gestation. Mean (SD) age was 32.90 (4.81) years with no difference between the two groups ($p = 0.976$). Women who were planned at (38 0/7 - 38 6/7) weeks of gestation had higher parity ($p = 0.016$), more previous term labors ($p = 0.014$), greater number of previous C-sections ($p = 0.003$) and greater body mass index ($p = 0.032$) compared to those planned at (39 + 0 - 40) weeks of gestation. No significant difference was observed between the two groups regarding previous spontaneous vaginal delivery (SVD) ($p = 0.062$), time interval from last cesarean delivery ($p = 0.438$), presence of gestational diabetes ($p = 0.588$), job status ($p = 0.116$) or smoking status ($p = 1.000$). Baseline characteristics of the total population and comparison between the two groups are presented in **Table 1**.

4.2. Intra-Partum and Post-Partum Complications

Elective C-section planned at (39 0/7 - 40) weeks of gestation was associated with higher rate of emergency cesarean deliveries (18.0% versus 10.4%, $p = 0.030$; RR = 13.06), most frequently due to contractions (16.4% versus 8.2%, $p = 0.012$; RR = 12.17) or cervical dilatation (11.6% versus 5.4%, $p = 0.024$, RR = 16.15), with reference to those planned at (38 0/7 - 38 6/7) weeks of gestation. No significant difference was observed regarding the incidence of intraoperative complications, and no difference was noted in the composite adverse maternal outcome between Group 1 (70.8%) and Group 2 (67.2%), $p = 0.469$. Regarding neonatal outcomes, birth weight (mean [SD] = 3226.9 [399.1] versus 3084.9 [400.3] g, $p = 0.001$) was higher in Group 2 compared to Group 1 (**Table 2**); however, the difference is not considered clinically significant. Other outcomes

Table 1. Baseline participants' characteristics.

Parameter	Category	Total population (N = 440)		Group 1 (GA 38 weeks, N = 318)		Group 2 (GA 39 weeks, N = 122)		p-value
		Freq.	%	Freq.	%	Freq.	%	
Age	Mean, SD	32.90	4.81	32.91	5.01	32.89	4.27	0.976 ^t
	2	209	47.5	138	43.4	71	58.2	
Parity	3	167	38.0	128	40.3	39	32.0	0.016*
	4+	64	14.5	52	16.4	12	9.8	
Previous term labor	Median, P95	2	6	3	7	2	6	0.014 ^{*M}
	0 - 1	19	4.3	12	3.8	7	5.7	
Previous term labor (categorical)	2	204	46.4	138	43.4	66	54.1	0.054
	>2	217	49.3	168	52.8	49	40.2	
Previous preterm labor	None	402	91.4	289	90.9	113	92.6	0.560
	1 or 2	38	8.6	29	9.1	9	7.4	
SVD	None	321	73.0	224	70.4	97	79.5	0.062
	1	54	12.3	46	14.5	8	6.6	
	2+	65	14.8	48	15.1	17	13.9	0.003*
	2	279	63.4	187	58.8	92	75.4	
No. of c/s	3	127	28.9	101	31.8	26	21.3	0.003*
	4+	34	7.7	30	9.4	4	3.3	
Time interval from last c/s	Mean, SD	3.66	1.91	3.61	1.85	3.79	2.05	0.386 ^t (0.438 ^M)
	<2 years	50	11.4	36	11.3	14	11.5	
Time interval from last c/s (categorical)	2+ years	390	88.6	282	88.7	108	88.5	0.964
	No	336	76.4	245	77.0	91	74.6	
Gestational diabetes	Yes	104	23.6	73	23.0	31	25.4	0.588
	Smoker	9	2.0	7	2.2	2	1.6	
Smoking status	Non-smoker	431	98.0	311	97.8	120	98.4	1.000 ^F
	Employed	86	19.5	68	21.4	18	14.8	
Job status	Unemployed	354	80.5	250	78.6	104	85.2	0.116
	Mean, SD (range = 18.50, 52.00)	32.92	5.99	33.30	6.22	31.93	5.25	

Values are frequencies/percentages, except if otherwise specified. Percentages are calculated on column variables (groups). P-values correspond to comparison between Group 1 and Group 2. SD: Standard deviation; P95: 95th percentile; SVD: spontaneous vaginal delivery; c/s: Cesarean section; BMI: body mass index; *Statistically significant result (p < 0.05); test used: ^F: Fisher's exact test, ^t: independent t-test, ^M: Mann-Whitney U test, otherwise test used is Chi-square.

included one case of hysterectomy in Group 2 (39 0/7 - 40 W), while no cases of post-partum infection, reoperation, venous thromboembolism, maternal ICU admission, maternal or child death were noted.

Table 2. Management and outcomes in women planned for elective cesarean at 38 weeks versus 39 weeks of gestation.

Parameter	Category	Total population (N = 440)		Group 1 (GA 38 weeks, N = 318)		Group 2 (GA 39 weeks, N = 122)		p-value	RR
		Freq.	%	Freq.	%	Freq.	%		
<i>Primary outcome</i>									
Emergency c/s	Yes	55	12.5	33	10.4	22	18.0	0.030*	13.06
<i>Indication of emergency Cesarean</i>									
Contracting	Yes	46	10.5	26	8.2	20	16.4	0.012*	12.17
PROM	Yes	11	2.5	8	2.5	3	2.5	1.000 ^F	0.98
Scar tenderness	Yes	2	0.5	1	0.3	1	0.8	0.478 ^F	2.61
Cervical dilatation	Yes	31	7.1	17	5.4	14	11.6	0.024*	16.15
Interval El.c/s-Em.c/s	Median, P95	5	20.25	5	22.20	5.5	25.35	0.804 ^M	-
<i>Intraoperative and postoperative complications</i>									
Adhesions	Significant	297	70.2	218	71.2	79	67.5	0.454	0.95
Extension	Yes	8	1.8	8	2.5	0	0.0	0.113 ^F	0.15
Rupture	Yes	2	0.5	0	0.0	2	1.6	0.076 ^F	12.97
Dehiscence	Yes	9	2.0	8	2.5	1	0.8	0.455 ^F	0.33
BBI	Yes	4	0.9	1	0.3	3	2.5	0.067 ^F	7.82
EBL (mL)	Mean, SD	770.23	209.10	774.84	205.86	758.20	217.74	0.455	-
Intra-operative blood transfusion	Yes	4	0.9	3	0.9	1	0.8	1.000 ^F	0.87
Difficulty in fetal extraction	Yes	16	3.6	11	3.5	5	4.1	0.778 ^F	1.18
Post-operative blood transfusion	Yes	10	2.5	7	2.2	3	2.5	1.000 ^F	1.12
Composite adverse maternal outcome	Yes	307	69.8	225	70.8	82	67.2	0.469	0.95
<i>New natal outcomes</i>									
Birth weight (g)	Mean, SD	3124.2	404.6	3084.9	400.3	3226.9	399.1	0.001*	-
Nursery	Yes	432	98.4	312	98.1	120	99.2	0.678 ^F	1.01
NICU admission	Yes	7	1.6	6	1.9	1	0.87	0.679 ^F	0.44

Values are frequencies/percentages, except if otherwise specified. Percentages are calculated on column variables (groups). P-values correspond to comparison between Group 1 and Group 2. GA: Gestational age; RR: Relative risk; only significant where p-value is significant; El.: elective; Em.: emergency; c/s: cesarean section; PROM: premature rupture of membranes; BBI: bowel/bladder injury; EBL: estimated blood loss; *: Statistically significant result ($p < 0.05$); test used: ^F: Fisher's exact test, ^t: independent t-test, ^M: Mann-Whitney U test, otherwise test used is Chi-square. Other outcomes (not depicted): Hysterectomy (1 case, Group 2); post-partum infection 0 cases, reoperation (0 cases); venous thromboembolism (0 case); maternal intensive care unit admission (0 case); maternal death (0 case); child death (0 case).

4.3. Factors and Predictors of Spontaneous Onset of Labor before Planned Gestational Age of Delivery

Analysis of risk factors of spontaneous onset of labor before scheduled date for

elective surgery leading to emergency cesarean is presented in **Table 3**. This showed that emergency C-sections were associated with younger age (mean [SD] = 31.49 [4.90] versus 33.11 [4.77] years, $p = 0.020$), along with delayed (39 0/7 - 40 weeks of gestational age) scheduled date (40% versus 26.0%, $p = 0.030$), compared to C-sections carried out on the scheduled date, respectively. No association with parity ($p = 0.614$), previous spontaneous vaginal delivery ($p = 0.731$), number of previous cesareans ($p = 0.460$) or interval from last cesarean ($p = 0.840$) was noted. Both age (OR 0.93, $p = 0.018$) and W39 schedule (OR = 1.94, $p = 0.028$) were independent risk factors for spontaneous onset of labor before scheduled date, as shown in the multivariate binary regression model (**Table 4**).

Based on the equation of the previous multivariate model, the risk of spontaneous onset of labor before scheduled date was estimated as a function of women's age ranging 20 - 45 years and by comparison of two groups. Results depicted in **Figure 1** shows gradual decrease of the risk; women with (39 0/7 - 40 W) schedule being associated with a greater risk than (38 0/7 - 38 6/7 W). For example, in a 20-year old woman with history of 2 previous C-sections, the spontaneous onset of labor is estimated to occur with approximately 26.5% risk before 38 weeks of gestational age and 51% before 39 weeks; while this same risk decreases to 13% and 25%, respectively, in a 30-year old woman.

5. Discussion

5.1. Principal Findings

This study showed higher rate of emergency C-sections in women who planned for later timing (39 0/7 - 40 weeks) compared to those who planned earlier (at 38 0/7 - 38 6/7 weeks). Emergency C-section was most frequently indicated by early onset of contractions and cervical dilatation. No difference was observed between the two groups regarding the other intraoperative and post-partum maternal outcomes; and especially, no increase in NICU admission or neonatal mortality rates was observed in (38 0/7 - 38 6/7 weeks) group. On the other hand, the risk of spontaneous onset of labor before scheduled date was independently predicted by young age of women and was approximately twice greater among those planned at later timing (39 0/7 - 40 weeks of gestational age).

5.2. Results

5.2.1. Risk of Spontaneous Delivery Onset by Timing of Elective Repeat Cesarean

The increased rate of emergency cesarean delivery among women planned for later timing is consistent with commonly reported findings from previous studies [12] [13]. This outcome is predictable, as approximately 25% of pregnant women experience uterine contractions between 38 and 39 weeks of gestation, regardless of their obstetrical history [14]. Thus, for example at 37 weeks, women are subject to even lesser risk of labor onset and consequently have lower rate of emergency cesarean deliveries [15]. However, in the context of repeat

Table 3. Demographic and baseline risk factors of spontaneous onset of labor before scheduled date among women planned for elective Cesarean section.

Parameter	Category	Type of Cesarean section				p-value
		Elective (N = 385)		Emergency (N = 55)		
		Freq.	%	Freq.	%	
Age	Mean, SD	33.11	4.77	31.49	4.90	0.020 ^{††}
	2	180	46.8	29	52.7	
Parity	3	147	38.2	20	36.4	0.614
	4+	58	15.1	6	10.9	
	Median, P95	2	6.7	2	6	
Previous term labor (categorical)	0 - 1	15	3.9	4	7.3	0.467 ^M
	2	178	46.2	26	47.3	
	>2	192	49.9	25	45.5	
Previous preterm labor	None	354	91.9	48	87.3	0.248
	1 or 2	31	8.1	7	12.7	
	None	282	73.2	39	70.9	
SVD	1	48	12.5	6	10.9	0.731
	2+	55	14.3	10	18.2	
	2	241	62.6	38	69.1	
No. of c/s	3	115	29.9	12	21.8	0.460
	4+	29	7.5	5	9.1	
	Mean, SD	3.65	1.93	3.71	1.78	
Time interval from last c/s (categorical)	<2 years	46	11.9	4	7.3	0.840 [†]
	2+ years	339	88.1	51	92.7	
	No	295	76.6	41	74.5	
Gestational diabetes	Yes	90	23.4	14	25.5	0.734
	Smoker	9	2.3	0	0.0	
Smoking status	Nonsmoker	376	97.7	55	100.0	0.610
	Employed	78	20.3	8	14.5	
Job status	Unemployed	307	79.7	47	85.5	0.317
	Mean, SD	33.00	5.95	32.41	6.28	
BMI (kg/m ²)	38 weeks	285	74.0	33	60.0	0.495 [†]
	39 weeks	100	26.0	22	40.0	
Planned timing (gestational age)	38 weeks	285	74.0	33	60.0	0.030 [*]
	39 weeks	100	26.0	22	40.0	

Values are frequencies/percentages, except if otherwise specified. Percentages are calculated on column variables (groups). P-values correspond to comparison between patients who had elective and those who had emergency cesarean delivery. SVD: Spontaneous vaginal delivery; c/s: Cesarean section; BMI: body mass index; *: Statistically significant result; test used ($p < 0.05$): ^F: Fisher's exact test, [†]: independent t-test, ^M: Mann-Whitney U test, otherwise test used is Chi-square.

Table 4. Predictors of spontaneous onset of labor before scheduled date among women planned for elective cesarean section.

Predictor	Category	Univariate model				Multivariate model			
		OR	95% CI		p-value	OR	95% CI		p-value
Age	(Years)	0.93	0.88	0.99	0.021*	0.93	0.87	0.99	0.018*
Schedule	38 weeks	(ref)	-	-	-	(ref)	-	-	-
	39 weeks	1.90	1.06	3.41	0.032*	1.94	1.07	3.50	0.028*

Binary logistic regression; dependent variable: emergency cesarean; OR: odds-ratio; CI: confidence interval; *: statistically significant result ($p < 0.05$).

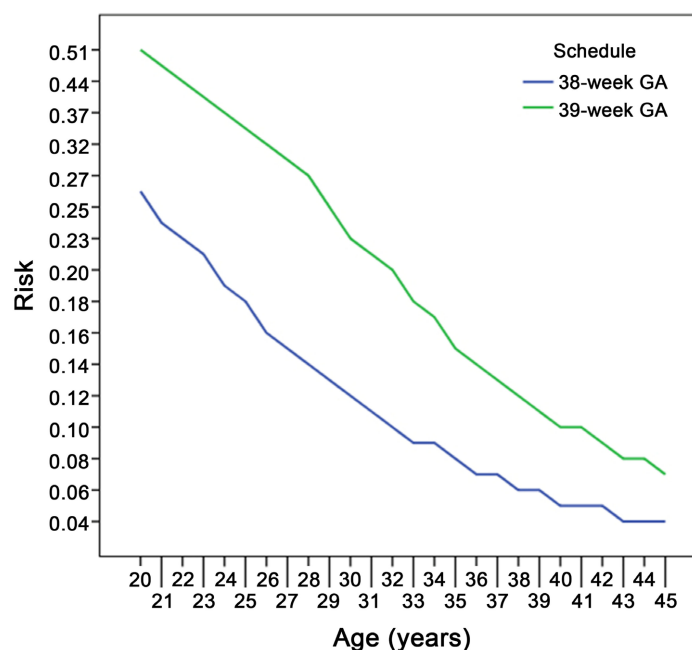


Figure 1. Prediction of the risk of emergency cesarean among women planned for elective cesarean as a function of their age and gestational age at schedule date (38-versus 39-week). *Caption:* Curves represent the estimation of the risk of emergency cesarean as a function of age, among women planned for elective cesarean at 38-week versus 39-week gestational age. Curves were estimated based on the multivariate logistic regression model including age (in years) and schedule date. Regression equation: risk of emergency cesarean = $0.27 + 0.66(\text{schedule}) - 0.08 * \text{age}$; where schedule: 38 weeks = 0; 39 weeks = 1.

cesarean delivery, spontaneous labor onset has more significance, as vaginal delivery among these patients entails greater incidence of obstetrical complications such as chorioamnionitis and endometritis due to premature and or prolonged rupture of membranes [16]. Additionally, it is well known that maternal morbidity increases with increasing cesarean deliveries, which is principally attributed to placenta accreta as well as the increasing need for hysterectomy. On the other hand, when carried out before labor onset, repeat cesarean delivery is safer for women and increased number of planned cesarean deliveries does not comprise additional risk of endometritis, wound infection or dehiscence, which is associated with lower maternal mortality [6].

5.2.2. Maternal Outcomes by Timing of Elective Repeat Cesarean Delivery

There was no significant difference between the two timings in individual or composite maternal outcome, including both intraoperative and post-partum complications. The only exception is one case of hysterectomy in the (39 0/7 - 40 weeks) group, where a woman had 4 previous C-sections with severe adhesions, for whom an emergency C-section was done due to labor pain with no cervical dilatation. During the intervention, hysterectomy was carried due to uncontrolled post-partum hemorrhage. These observations demonstrate the absence of benefit of early schedule regarding maternal outcome, regardless of the risks related to emergency cesarean due to spontaneous onset of labor. These findings are supported by a randomized controlled multicenter trial, by Glavind *et al.*, which showed no difference in maternal composite outcomes between women who were scheduled at week 38 + 3 versus week 39 + 3 of gestational age [9]. Comparable findings were reported in a retrospective cohort study by Mohammed *et al.*, who observed no increase in maternal complications between women planned at 38 versus 39 weeks of gestation [10]. Similarly, Tita *et al.*, confirmed the absence of benefit, in term of maternal outcome, in scheduling elective cesarean delivery at 38 weeks of gestation with reference to 39 weeks, as no decrease in maternal morbidity was observed [7]. However, these observations are not consistently reported in literature. A study by Roberts *et al.*, showed an increased risk of maternal morbidities when pregnant women were booked at or beyond 39 weeks of gestation, which was related to the increase in the rate of intra-partum cesarean deliveries [8]. Similar findings were noted by Melamed *et al.*, and Chiossi *et al.* [5] [11] [17] denoting that adverse maternal outcomes remain the dreaded disadvantage of term planning of elective repeat cesarean. However, by excluding the effect of spontaneous labor onset, a study by Chiossi *et al.*, showed no difference in individual and composite maternal outcomes between elective cesarean carried out at 38 weeks of gestational age compared with 39 weeks or later. Overall, these observations suggest that the adverse maternal outcomes observed in later planning are more frequently the consequence of spontaneous onset of labor before the scheduled date, and not of the direct effect of the gestational age.

5.2.3. Neonatal Outcomes by Timing of Elective Repeat Cesarean Delivery

Although not statistically significant, there were more cases of NICU admissions in the group planned at 38 0/7 - 38 6/7 weeks than their counterparts; however, no further clinical information could be obtained to analyze the causes of these admissions and whether they were related to the gestational age. Generally, data from literature show greater neonatal morbidity, notably respiratory distress syndrome, besides other complications such as sepsis, transient tachypnea, mechanical ventilation, and NICU admissions among deliveries to women planned at 38 weeks or earlier compared with those planned later, with 39 weeks constituting the optimal compromise between preterm and post-term neonatal com-

plications [11]. Contrary to maternal outcomes, these differences in neonatal outcomes were observed even in the absence of spontaneous labor onset, which supports their relation with gestational age [13].

On the whole, the choice of timing for elective repeat cesarean should consider the triangular trade-off between preterm- and post-term-related neonatal outcomes and maternal complications, keeping in mind that both maternal and eventually neonatal outcomes may occur as a consequence of spontaneous onset of labor.

5.2.4. Identifying Predictors of Spontaneous Labor Onset before the Scheduled Date

This study demonstrated that spontaneous onset of labor before the scheduled delivery time was predicted by both younger age and later planning of the cesarean, *i.e.* at 39 0/7 - 40 weeks of gestational age. The depiction of the likelihood of spontaneous onset of labor as a function of two parameters provides a visual representation of the estimated risk, which appears to be reduced by half in case of earlier planning or for every additional 10 years of mother's age, approximately. This indicates that earlier planning, *i.e.* before 39 weeks of gestational age, for elective cesarean delivery might be the most appropriate option for younger women with repeat cesarean deliveries. On the other hand, this study showed no significance of parity, number of previous spontaneous vaginal deliveries or C-sections, and interval from last C-section in the likelihood of spontaneous onset of labor. By comparison, Phaloprakarn *et al.*, reported approximately 4-fold increase in the likelihood of spontaneous onset of labor among women less than 20 years, with reference to women of 20 - 34 years, including both primary and repeat cesarean deliveries; whereas this association was not verified when analyzing repeat cesareans separately. On the other hand, authors reported 74% decrease in the likelihood of spontaneous onset of labor among women planned for elective repeat cesarean at W38 of gestational age, compared with those planned at W39, which is in line with our findings. Further, the study by Phaloprakarn *et al.*, demonstrated that a previous cesarean delivery represents itself a major risk for spontaneous onset of labor, with an adjusted odd-ratio as high as 14.3 [7]. Interestingly, Robert *et al.*, identified an inverse association of spontaneous delivery onset before 39 weeks of gestational age at prior delivery, notably when the prior delivery occurred with spontaneous onset of labor. That is, a lower gestational age at prior delivery should be considered as a risk factor for early spontaneous labor onset in the current pregnancy, and could indicate earlier planning of the elective cesarean delivery. Besides, Roberts *et al.*, observed other factors associated with spontaneous labor before 39 weeks of gestational age including smoking during pregnancy, increased number of C-sections, and prior history of planned preterm [12].

5.3. Clinical Implications

Clinically, the concern about emergency cesarean delivery lies in the fact that it

is often decided after labor onset, sometimes at advanced stage. This exposes to higher maternal morbidity and mortality and increased risk of adverse neonatal outcomes, as compared with cesarean delivery carried out at the scheduled date. Further, these adverse outcomes are observed even when emergency cesarean is carried out at early stage of labor [14]. The other aspect of this issue is the impact of unplanned cesareans on care organization at the institution level, as they are associated with greater risk of delivery during weekends, night shifts, and outside regular working days [14].

From the aforementioned observations, it appears more than ever crucial to identify the factors and predictors for spontaneous onset of labor before the scheduled time, which is likely to represent the linchpin of the choice of the elective cesarean timing. Identification of these factors for each individual patient would enable accurate determination of the safest zone where the elective cesarean delivery could be planned.

5.4. Research Implications

There is still insufficient evidence-based data regarding the optimal timing of scheduling repeat cesarean delivery among women with multiple previous cesareans deliveries, and the classification of risks related to different timing by patients' baseline parameters. Further multicenter randomized trials are warranted to provide accurate insights into maternal and neonatal risks associated with different timing options and how to mitigate these risks at the individual level. A risk stratification approach may be used to categorize patients according to their baseline obstetrical and fetal parameters, by estimating maternal versus neonatal risk levels for each subcategory. Additionally, the risk stratification should also consider the eventual factors related to the care setting, such as type of setting (secondary versus tertiary), available equipment, staff experience and availability, expected workload, etc. Thereby, a decision tree can be established to guide the medical decision regarding the optimal scheduling date for individual patient, with the respect to the care setting. Furthermore, studies should be conducted to measure the economic impact of spontaneous onset of delivery and the other complications associated with elective cesarean delivery timing.

5.5. Strengths and Limitations

This study is limited by its retrospective design, which was associated with some incomplete data notably other factors that could contribute in the occurrence of complications such as the surgeons' experience and type of anesthesia, in addition to the causes of NICU admissions. Also, some variables were described subjectively, such as degree of adhesions and estimated blood loss, which would be more objectively documented in a prospective design. Finally, this study included only low-risk pregnant women, who are supposedly at lower risk of complications and likely experience better outcomes, compared to high-risk pregnant women. This limits the generalization of the findings and restricts the re-

sulting recommendations to the low-risk category. Nevertheless, this study provided a 3-year experience from a representative tertiary care center in the region, thus filling the gap of such data in the local context.

6. Conclusions

Elective C-section scheduled at 39 weeks of gestation or beyond carried a higher risk of emergency cesarean section, which is most frequently indicated by early onset of contractions and cervical dilatation. However, there is no significant difference in maternal or neonatal complications between cesarean deliveries planned at 38 weeks versus 39 weeks or beyond. Besides planned delivery at 39 weeks, mothers of young age were associated with greater likelihood of spontaneous onset of labor, which appeared to be reduced by half for every additional 10 years of mother's age. Identification of these factors, in addition to the others reported in literature, should be considered to help physicians identify low-risk patients and determine the planned time of delivery accordingly.

Further research is warranted to provide accurate insights into the relationship between the different timing options and the maternal and neonatal risks, using risk stratification approach to enable establishing a consensual decision tree.

Contribution of Authors

1) AlSomairi, A.R: Substantial contributions to conception and design, acquisition of data, analysis and interpretation of data, drafting the article, revising it critically for important intellectual content, final approval of the version to be published, Agree to be accountable for all aspects of the work.

2) Faden, Y.A: Substantial contributions to conception and design, acquisition of data, analysis and interpretation of data, drafting the article, revising it critically for important intellectual content, final approval of the version to be published, Agree to be accountable for all aspects of the work.

3) Bedaiwi, W.A: Substantial contributions to conception and design, acquisition of data, drafting the article, final approval of the version to be published, agree to be accountable for all aspects of the work.

Conflicts of Interest

Authors declare no conflict of interest.

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