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ORIGINAL ARTICLE

Attempted vaginal birth after cesarean: assessment of morbidity and predictors of success

Parto tras cesárea anterior: análisis de la morbimortalidad materno-fetal

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Abstract

Objective: *Determining the appropriate approach for delivery after previous cesarean is a very controversial issue. Our objective was to establish whether pregnant women with a previous cesarean have an increased maternal and fetal morbidity and mortality after attempting vaginal delivery as well as to determine which factors may influence the achievement of a vaginal birth after cesarean.* **Materials and methods:** *A retrospective observational cohort study including 390 patients (196 cesarean group and 194 nulliparous group) was carried out. We compared neonatal and maternal outcomes between groups. Afterward, a multivariate logistic regression was applied for our second objective.* **Results:** *There were higher rates of uterine rupture (2% vs. 0%, p: 0.045) and puerperal hemorrhage (9.7% vs. 3.1%, p: 0.008) in the cesarean group and lower vaginal delivery rate (58.2% vs. 77.8%, p < 0.0005). We found that the induced onset of labor (OR = 2.9) and new born weight (OR = 1.0001) were associated with an increased risk of cesarean section.* **Conclusions:** *Our findings stress the need for further investigations in this field, which might provide a basis for a better management of patients with a previous cesarean.*

Keywords: *Vaginal births after cesarean. Repeat cesarean section. Maternal mortality. Neonatal mortality. Obstetric delivery.*

Resumen

Objetivo: *Determinar el abordaje adecuado del tipo de parto tras una cesárea previa es un tema muy controvertido. Nuestro objetivo fue establecer si las gestantes con cesárea previa presentan mayor morbimortalidad materna y fetal tras intentar parto vaginal, así como determinar qué factores pueden influir en conseguir un parto vaginal posterior a la cesárea.* **Material y métodos:** *Estudio observacional de cohortes retrospectivo incluyendo 390 pacientes (196 con cesárea previa, 194 nulíparas). Comparamos los datos sobre los resultados neonatales y maternos. Posteriormente se aplicó un modelo de regresión logística multivariante.* **Resultados:** *Hubo mayores tasas de ruptura uterina (2% vs. 0%; p = 0.045) y hemorragia puerperal (9.7% vs. 3.1%, p: 0.008) en el grupo de cesárea anterior, así como una tasa de parto vaginal mas baja (58.2% vs. 77.8%, p < 0.0005). La inducción del parto (OR = 2,9) y el peso del recién nacido (OR = 1.0001) se asociaron a un mayor riesgo de cesárea.* **Conclusión.** *La probabilidad de parto vaginal en estas pacientes disminuye cuanto mayor sea el peso del recién nacido y con partos inducidos.*

Palabras claves: *Parto vaginal tras cesárea. Cesárea anterior. Mortalidad materna. Mortalidad neonatal. Parto obstétrico.*

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Introduction

Cesarean delivery is becoming increasingly frequent in our environment, tripling its rate during the past three decades. Many reasons have been posed to explain this rise during the past years, being an iterative cesarean delivery one of the most frequent causes[1]. Vaginal birth after cesarean (VBAC) is a safe and acceptable option, backed by most scientific societies[2-4]; however, determining the appropriate approach for the type of delivery after previous cesarean is a very controversial issue nowadays. This is due to the fact that a non-negligible number of recent literature reports highlight an increased risk of maternal and fetal morbidity and mortality if vaginal delivery is attempted, whereas other studies conclude the opposite[4]. In addition, the success rate for VBAC is around 70%, therefore, many patients are reluctant to attempt at it[5].

Perhaps, the reason behind these disparities is the lack of a standardized classification system of cesarean which would facilitate comparison research studies[6]. In 2001, Robson et al. proposed the application of a classification system based in obstetrics characteristics (parity, onset of labor, gestational age, number of fetuses, and fetal presentation), which encompasses 10 classification groups. Thus, patients may be placed in only one of the 10 established groups[7]. At present, this is the classification system recommended by the World Health Organization to audit, monitor, and compare cesarean rates[8-10].

The main objective of our study is to establish whether pregnant women with a previous cesarean section have an increased maternal and/or fetal morbidity and mortality after attempting VBAC than nulliparous women. The secondary objective is to determine which factors may influence the success to achieve VBAC.

Materials and methods

We conducted a retrospective observational cohort study between January and December 2018. The study included 390 patients who gave birth at our center's obstetrics department, which is a tertiary birth unit with a rate of approximately 2500 deliveries/year. Patients were consecutively recruited and those who met our inclusion criteria were invited to participate in the study. Written informed consent was obtained from those who accepted to participate. Ethical approval was given by the local Board of Biomedicine Ethics Committee, and it was carried out following the ethical principles of the Declaration of Helsinki.

Subjects

According to maternity unit's protocol, all patients with a previous cesarean section are offered a trial of VBAC, for either spontaneous or induced onset of labor. VBAC was excluded in those patients whose previous cesarean was performed < 18 months prior and in those who had an absolute contraindication for vaginal delivery (maternal medical history, placenta previa, vasa previa, short birth interval after cesarean, history of prior uterine rupture, previous myomectomy where the endometrial cavity was entered, and prior inverted T uterine or classical cesarean). In these cases, an elective cesarean was performed. If none of these criteria were presented, all patients with a previous cesarean section were offered a VBAC, without distinction between spontaneous or induced onset of labor.

The inclusion criteria were as follows: patients who were over 18 years old, whom had a singleton at-term pregnancy, and no history of previous vaginal delivery. The exclusion criteria were as follows: patients under 18 years old, multiple pregnancy, preterm delivery, breech presentation, and prior vaginal delivery.

Patients who met the inclusion criteria were offered to participate in the study. Those who accepted to participate in our study were sorted into two groups: patients with only one previous cesarean (CG) and nulliparous patients (NG).

Data collection

Data gathering was performed using the subjects' digitalized medical records. A core outcome set (COS) was not used in this study as there was not consensus on an existing COS system for cesarean deliveries before the realization of the study. Outcomes measured were based on the previous studies and clinical experience.

Maternal and labor variables were collected

Age, race, pre-gestational body mass index (BMI), weight gain, indication for previous cesarean gestational age, onset of labor, type of induction, indication for induction, Bishop test before induction, type of delivery, indication for instrumentation, indication for cesarean, length of second stage of labor, and newborn weight.

Variables related to neonatal morbidity and mortality

Apgar test in the 1st min, Apgar test at 5 min, umbilical cord pH, orotracheal intubation, admission to neonatal intensive care unit (NICU), and neonatal death.

Table 1. Maternal characteristics

Maternal characteristics	Cesarean group	Nulliparous group	p value
Maternal characteristics			
Age (years)	28 ± 5	32.5 ± 12	0.184
Race			
Caucasian	193 (98.5%)	189 (97.4%)	0.323
Gypsy	1 (0.5%)	2 (1%)	
African-American	2 (1%)	1 (0.5%)	
Asian	0 (0%)	0 (0%)	
Arabic	0 (0%)	2 (1%)	
Pre-gestational BMI = kg/m2	26.8 ± 4.65	30.25 ± 4.82	0.158
Weight gain (kg)	9 ± 4.1	12.25 ± 2.92	0.586
Previous cesarean indication			
Risk of fetal distress	55 (28.4%)		
Induction failure	31 (16%)		
Progression failure	64 (33%)		
Breech/transverse presentation	30 (15.5%)		
Placenta previa	2 (1%)		
Maternal medical history	9 (4.6%)		
Other	3 (1.5%)		

Data are displayed as mean ± standard deviation or frequencies and percentages.
BMI: body mass index.

Finally, maternal morbidity and mortality variables

Uterine rupture, puerperal hemorrhage, blood transfusion, sepsis, endometritis, surgical wound infection, reoperation, surgical injuries, and maternal death.

Statistical analysis

Statistical analysis was carried out using IBM SPSS Statistics software version 20 (IBM, Armonk, NY). Quantitative variables were described as means and standard deviations, or with medians and interquartile range in the case of asymmetrical distributions, while qualitative variables were written as percentages. The normality of the data was contrasted using Kolmogorov–Smirnov test. Comparisons of quantitative variables between study groups were performed using Student's t-test for independent samples if the data were normally distributed, and the non-parametric Mann–Whitney U-test was used for non-normally distributed data. For qualitative variables, comparisons between study groups were made with Chi-square test. For the second objective of the study, we stratified CG patients in two groups, according to the type of delivery: vaginal delivery (VD) or cesarean delivery (CD). We performed a bivariate analysis using the variables that according to the existing literature have shown an increased risk for a cesarean delivery. A logistic regression was performed afterward. Significance level was set at 95% ($p < 0.05$).

To detect a difference of at least 10% with a 95% confidence level and 90% power in maternal outcome rate, we needed a sample of 173 women per study group.

Results

A total of 390 patients were recruited, 196 patients belonging to the CG group and 194 to the NG group.

Maternal and labor characteristics in both groups are shown in tables 1 and 2. We found statistically significant differences between groups, with a higher C-section rate in the CG group (41.8% vs. 22.2%; $p < 0.05$), as well as an increased second stage length (113 ± 79.03 vs. 109.17 ± 73.33; $p < 0.05$). There were not statistically significant differences between study groups for the rest of the variables.

Regarding maternal and neonatal morbidity and mortality, results are shown in table 3. There were statistically significant differences between study groups, with higher rates of uterine rupture and puerperal hemorrhage in the CG group (2% vs. 0%, p: 0.045; 9.7% vs. 3.1%, p: 0.008).

When assessing the vaginal delivery rates, as shown in table 4, we found a lower rate in the CG (58.2% vs. 77.8%, $p < 0.0005$). Regarding operative vaginal delivery, there

Table 2. Labor characteristics

Labor characteristics	Cesarean group	Nulliparous group	p value
Labor characteristics			
Gestational age (weeks)	38 ± 3	39.5 ± 2	0.46
Onset of labor			
Spontaneous	116 (70.7%)	136 (71.6%)	0.954
Induced	48 (29.3%)	54 (28.4%)	
Type of induction			
Dinoprostone	42 (87.5%)	40 (74.1%)	0.063
Misoprostol	0 (0%)	0 (%)	
Cook balloon	1 (2.1%)	0 (%)	
Oxytocin	5 (10.4%)	14 (25.9%)	
Indication for induction			
Prolonged pregnancy	16 (33.3%)	17 (31.5%)	0.069
SGA/IUGR	8 (16.7%)	6 (11.1%)	
HDP/pre-eclampsia	1 (2.1%)	7 (13%)	
Gestational diabetes	0 (%)	4 (7.4%)	
Other	23 (47.9%)	20 (37%)	
Previous bishop test	2.6 ± 1.8	2.67 ± 1.3	0.456
Type of delivery			
Normal	67 (34.2%)	79 (40.7%)	< 0.05
Vacuum	37 (18.9%)	59 (30.4%)	
Forceps	10 (5.1%)	13 (6.7%)	
Cesarean section	82 (41.8%)	43 (22.2%)	
Instrumentation indication			
Risk of fetal distress	17 (36.2%)	19 (26.4%)	0.352
Prolonged second stage of labor	30 (63.8%)	53 (73.6%)	
Maternal pathology	0 (0%)	0 (0%)	
Cesarean indication			
Risk of fetal distress	29 (36.25%)	14 (32.6%)	0.091
Induction failure	15 (18.75%)	3 (7%)	
Progression failure	14 (17.5%)	14 (32.6%)	
Breech/transverse presentation	13 (16.25%)	11 (25.6%)	
Maternal medical history	4 (5.0%)	0 (0%)	
Uterine rupture suspicion	1 (1.25%)	0 (0%)	
Other	4 (5.0%)	1 (2.3%)	
Second stage period length (min)	113 ± 79.03	109.17 ± 73.33	< 0.05
Newborn weight (grams)	3170 ± 433.24	3435 ± 466.41	0.892

Data are displayed as mean ± standard deviation or frequencies and percentages.
SGA: small for gestational age; IUGR: intrauterine growth restriction; HDP: hypertensive disorders of pregnancy.

were not statistically significant differences between the study groups. When stratifying the groups into induced or spontaneous labor, we found no differences between the study groups regarding vaginal delivery rates.

Regarding the second objective of our study, a logistic regression was carried out to find predictive parameters of failure for VBAC. The bivariate analysis showed only statistically significant differences between groups for variables: weight gain, the onset of labor, and newborn weight (Table 5). The logistic regression included the mentioned variables, finding that only the induced onset of labor, and newborn weight were associated with an increased risk of cesarean section, with an OR of 2.9 and 1.0001, respectively, as shown in table 6.

Discussion

Cesarean delivery has increased exponentially in recent years, with iterative cesarean being one of the most frequent causes and reaching 22.5% of cesarean deliveries[11].

Table 3. Morbidity and mortality variables

Morbidity and mortality variables	Cesarean group	Nulliparous group	p value
Neonatal			
Apgar test at 1 min	10 ± 3	9 ± 1	0.142
Apgar test at minute≤5	5 (2.6%)	4 (2.1%)	0.748
Apgar test at 5 min	10 ± 1	10 ± 1	0.608
Apgar test at 5 min≤7	5 (2.6%)	2 (1%)	0,258
Umbilical cord pH	7.38 ± 0.22	7.27 ± 0.09	0.173
Umbilical cord pH≤7.2	11 (13.8%)	26 (16.6%)	0.573
Orotracheal intubation	10 (5.1%)	4 (2.1%)	0.104
Admission to NICU	15 (7.7%)	14 (7.3%)	0.870
Neonatal death	2 (1%)	1 (0.5%)	0.568
Maternal			
Uterine rupture	4 (2%)	0 (%)	0.045
Puerperal hemorrhage	19 (9.7%)	6 (3.1%)	0.008
Blood transfusion	6 (3.1%)	4 (2.1%)	0.532
Sepsis	0 (0%)	0 (0%)	-
Endometritis	0 (0%)	0 (0%)	-
Surgical wound infection	0 (0%)	2 (1%)	0.154
Reoperation	3 (1.5%)	0 (0%)	0.084
Surgical injuries	8 (4.1%)	2 (1%)	0.057
Maternal death	0 (0%)	0 (0%)	-

Data are displayed as mean ± standard deviation or frequencies and percentages.
NICU: neonatal intensive care unit.

Table 4. Vaginal delivery and instrumentation rate

Vaginal delivery and instrumentation rate	Cesarean group	Nulliparous group	p value
All patients			
Delivery route			< 0.05
Vaginal	114 (58.2%)	151 (77.8%)	
Cesarean	82 (41.8%)	43 (22.2%)	
Type of vaginal delivery			0.296
Normal	67 (58.8%)	79 (52.3%)	
Instrumented	47 (41.2%)	72 (47.7%)	
Patients with an induced labor			0.058
Vaginal delivery	25 (52.1%)	38 (70.4%)	
Cesarean delivery	23 (47.9%)	16 (29.6%)	
Patients with a spontaneous labor			0.207
Vaginal delivery	89 (76.7%)	113 (83.1%)	
Cesarean delivery	27 (23.3%)	23 (16.9%)	

Data are displayed as frequencies and percentages.

The choice of type of delivery after a previous cesarean section is a widely studied topic, with opposing results in different publications. The benefits and risks of elective repeated cesarean section versus induction of labor have not been evaluated by clinical trials[12], so caution should be exercised when interpreting results of existing studies. While some conclude that complications are higher in patients undergoing trial of VBAC compared to those who opt for elective cesarean section (up to 1.5 times)[13], other studies show the complete opposite[14]. Furthermore, elective cesarean section is not a harmless procedure and presents a number of complications that are not always predictable or avoidable, with an incidence of maternal morbidity ranging from 0.05 to 10.9%[15,16]. The main controversy surrounding VBAC has been dominated by the possibility of uterine rupture, increasing the rate of related complications such as postpartum hemorrhage, the need for blood transfusion, and the need for hysterectomy or genitourinary injuries, in addition to fetal acidosis or maternal-fetal death.

Table 5. Bivariate analysis for success of VBAC

Bivariate analysis	Vaginal delivery	Cesarean delivery	p value
Age	34 ± 7	34.5 ± 7.25	0.331
Race Caucasian African-American	 113 (98.3%) 1 (1.7%)	 81 (98.8%) 1 (1.2%)	0.814
Gestational age	39 ± 4	40 ± 3	0.798
Pre-gestational BMI (cm/kg)	26.09 ± 6.72	26 ± 6	0.428
Weight gain (kg)	10 ± 7	11 ± 6	0.038
Previous cesarean motive Elective Intrapartum	 25 (22.3%) 87 (77.7%)	 16 (20.3%) 63 (79.7%)	0.942
Onset of labor Spontaneous Induced	 90 (78.3%) 25 (21.70%)	 27 (54%) 23 (46%)	0.003
Previous bishop test	2.28 ± 1.6	2.5 ± 1.9	0.591
Newborn weight	3109.2 ± 511	3451.9 ± 599.3	0.011

Data are displayed as mean ± standard deviation or frequencies and percentages.
VBAC: vaginal birth after cesarean, BMI: body mass index.

Table 6. Logistic regression model for success of VBAC

Logistic regression model	p value	OR (CI 95%)
Age	0.134	-
Induced labor	0.002	2.9 (1.4-6)
Weight gain	0.112	-
Newborn weight	0.001	1.001 (1.001-1.002)

VBAC: vaginal birth after cesarean, OR: odds ratio, CI: confidence interval.

The incidence of uterine rupture published ranges from 1 to 12%[12,15], and puerperal hemorrhage is around 10%[17,18]. Unfortunately, there are not reliable means to predict these complications. Some authors have proposed measuring the thickness of the lower uterine segment in the third trimester as a marker for uterine rupture. The proposed cutoff point was between 0.6 and 2 mm, with a sensitivity of 0.76 and 0.92, respectively. However, there is a lack of prospective studies for the standardization and validation of this marker, and thus, its use is limited[19].

In our study, statistically significant differences were found in patients with a previous cesarean section in whom vaginal delivery was attempted and compared with nulliparous pregnant women regarding uterine rupture (2% vs. 0%) and puerperal hemorrhage (9.7% vs. 3.1%), similar to the published data, although the absolute number of cases was 4 and 19 in the CG. Even though uterine rupture is one of the most serious complications that can arise during labor after a previous cesarean, there is no increased risk for the mother or newborn provided that it is treated appropriately with rapid protocols, as observed in our study, where the higher rate of uterine rupture and puerperal hemorrhage did not result in an increased maternal or neonatal morbidity and mortality[14].

The benefits of attempting a VBAC are derived from avoiding the risks associated with repeated cesarean sections, in addition to a shorter hospital stay and fewer postpartum complications. As endorsed by most scientific societies, VBAC is a safe and acceptable option. For years, researchers have tried to find an accurate way to predict the success of trial of VBAC, to facilitate the choice between trial of VBAC and elective cesarean. One of the first prediction models published by Grobman et al.[20] was based in the data provided in the first obstetric appointment (maternal age, body mass index [BMI], ethnicity, prior vaginal delivery, the occurrence of VBAC, and a potentially recurrent indication for the CD). Since then, several studies have tried to adapt Grobman nomogram to population cohorts[21-24] and some even included modifications, not including ethnicity and race[25]. Nonetheless, there are not studies about the application of these models and its impact in their impact in the decrease of complications.

The current results indicate that 56-80% of attempted vaginal trial of labor after cesarean section result in a successful vaginal delivery[24,26,27], which corresponds to our study where the rate of vaginal delivery after a previous cesarean section remains at 58.2%. When analyzing the differences in the vaginal and instrumental delivery rates between the two groups, we found that cesarean delivery was significantly more frequent in the CG (41.8% vs. 22.2%), without finding any significant differences in the type of vaginal delivery, differentiating between normal and instrumental deliveries. A 51% of induced deliveries ended in vaginal delivery in the previous cesarean group, while in the nulliparous group, 70.4% ended in vaginal delivery, without these differences being statistically significant ($p = 0.058$). This closeness to significance makes us wonder if perhaps, the sample size might be insufficient to detect these differences.

Nowadays, the aim is to perform an individualized evaluation in pregnant women who are facing delivery with a previous cesarean section, with the objective of improving the success of trial of labor after previous cesarean, avoiding as far as feasible possible, an emergency intrapartum cesarean section due to failure of vaginal delivery, which has been shown to have a higher rate of complications than an elective cesarean. The main factors studied in literature that negatively impact the success of VBAC are age (≥ 40 years), non-Caucasian ethnicity, weight gain during gestation (≥ 15 kg) and pre-gestational BMI (≥ 30), indication for previous cesarean section (induction failure and cephalopelvic disproportion), onset of spontaneous or induced labor, and newborn weight (≥ 4000 g)[28-32].

In our study, when analyzing the CG patients regarding the type of delivery (vaginal vs. cesarean), we found an association between the route of delivery with weight gain, the onset of labor, and newborn weight. However, when using a logistic regression model, only the onset of induced labor and newborn weight were associated with a decrease in vaginal delivery probability, finding that induced labor increased the risk of a second cesarean section by almost a 3-fold (OR = 2.9) compared to a spontaneous onset delivery. As for the weight of the newborn, translating the results obtained into clinical terms, we found that in our sample, for every 700 g increase in the newborn weight, the risk of a second cesarean section doubles (OR = 2.01). In other words, our results are similar to those published by Lazarou et al. in which a higher newborn weight is associated with a lower chance of success of VABC[24]. We also found that a patients with a higher weight gain were less likely to success at trial of VABC, which goes in agreement with the published literature[20-22,33], although it was not included in the final model, similar to the results of Lazarou et al.[24]. Thus, we assume that these variables (induced delivery and newborn weight) are the ones that really define the probability of having a second cesarean section after a previous cesarean section.

Nonetheless, our study also has some limitations, with the main one being its retrospective design and its limited sample size. It would be valuable to perform a prospective cohort study with a larger sample size in future works.

Conclusions

The incidence of uterine rupture and puerperal hemorrhage was higher in patients with a previous cesarean section than in nulliparous patients in our study, without this increasing morbidity and mortality broadly. We also found that the probability of a vaginal delivery in these patients decreases the higher the newborn weight and if the labor was induced. Given the clinical significance of this issue, the findings of our study stress the need for further investigations in this field, which might provide a basis for a better management of patients with a previous cesarean.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjets. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The author declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained approval from the Ethics Committee for analysis and publication of routinely acquired clinical data and informed consent was not required for this retrospective observational study.

References

1. La clasificación de Robson: Manual de Aplicación. Washington, D.C: Organización Panamericana de la Salud; 2018.
2. Souza JP, Gulmezoglu A, Lumbiganon P, Laopaiboon M, Carroli G, Fawole B, et al. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO global survey on maternal and perinatal health. BMC Med. 2010;8:71.
3. American College of Obstetricians and Gynecologists. ACOG practice bulletin no. 115: vaginal birth after previous cesarean delivery. Obstet Gynecol. 2010;116:450-63.
4. National Institutes of Health Consensus Development conference statement: vaginal birth after cesarean: new insights March 8-10, 2010. Obstet Gynecol. 2010;115:1279-95.
5. Grylka-Baeschlin S, Clarke M, Begley C, Daly D, Healy P, Nicoletti J, et al. Labour characteristics of women achieving successful vaginal birth after caesarean section in three European countries. Midwifery. 2019;74:36-43.
6. Robson M, Hartigan L, Murphy M. Methods of achieving and maintaining an appropriate caesarean section rate. Best Pract Res Clin Obstet Gynaecol. 2013;27:297-308.
7. Robson MS. Classification of caesarean sections. Fetal Matern Med Rev. 2001;12:23-39.
8. Torloni MR, Betrán AP, Souza JP, Widmer M, Allen T, Gulmezoglu M, et al. Classifications for cesarean section: a systematic review. PLoS One. 2011;6:e14566.
9. Betran AP, Vindevoghel N, Souza JP, Guelmezoglu AM, Torloni MR. A systematic review of the Robson classification for caesarean section: what works, doesn't work and how to improve it. PLoS One. 2014;9:e97769.
10. World Health Organization. WHO Statement on Cesarean Section Rates. Geneva, Switzerland: World Health Organization; 2015.
11. Cohen B, Atkins M. Brief history of vaginal birth after cesarean section. Clin Obstet Gynecol. 2001;44:604-8.
12. Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, et al. Williams obstetrics. 24th ed. United States of America: McGraw-Hill Education; 2014.
13. Crowther CA, Dodd JM, Hiller JE, Haslam RR, Robinson JS. Planned vaginal birth or elective repeat caesarean: patient preference restricted cohort with nested randomised trial. PLoS Med. 2012;9:e1001192.
14. Rodríguez-Vega E, Escudero A, Gaite M, Suárez M. Vía de parto tras cesárea anterior: factores asociados. Prog Obstet Ginecol. 2003;46:250-6.
15. Foradada C. Reflexiones sobre la cesárea. Matronas Prof. 2006;7:5-13.
16. Lorie M, Harper MD, George A, Macones MD. Predicting success and reducing the risks when attempting vaginal birth after cesarean. Obstet Gynecol Surv. 2008;63:538-45.
17. Zelop CM. Uterine rupture during a trial of labor after previous cesarean delivery. Clin Perinatol. 2011;38:277-84.
18. Lang CT, Landon MB. Uterine Dehiscence and Rupture After Previous Cesarean delivery. United States: Uptodate, Wolter Kluwer; 2013. p. 1-13.
19. Kok N, Wiersma IC, Opmeer BC, de Graaf IM, Mol BW, Pajkrt E. Sonographic measurement of lower uterine segment thickness to predict uterine rupture during a trial of labor in women with previous cesarean section: a meta-analysis. Ultrasound Obstet Gynecol. 2013;42:132-9.
20. Grobman WA, Lai Y, Landon MB, Spong CY, Leveno KJ, Rouse DJ, et al. Development of a nomogram for prediction of vaginal birth after cesarean delivery. Obstet Gynecol. 2007;109:806-12.
21. Fagerberg MC, Maršál K, Källén K. Predicting the chance of vaginal delivery after one cesarean section: validation and elaboration of a published prediction model. Eur J Obstet Gynecol Reprod Biol. 2015;188:88-94.
22. Haumonte JB, Raylet M, Christophe M, Mauviel F, Bertrand A, Desbriere R, et al. French validation and adaptation of the Grobman nomogram for prediction of vaginal birth after cesarean delivery. J Gynecol Obstet Hum Reprod. 2018;47:127-31.
23. Mizrachi Y, Barber E, Kovo M, Bar J, Lurie S. Prediction of vaginal birth after one caesarean delivery for non-progressive labor. Arch Gynecol Obstet. 2018;297:85-91.
24. Lazarou A, Oestergaard M, Netzl J, Siedentopf JP, Wolfgang H. Vaginal birth after cesarean (VBAC): fear it or dare it? An evaluation of potential risk factors. J Perinat Med. 2021;49:773-82.
25. Grobman WA, Sandoval G, Rice MM, Bailit JL, Chauhan SP, Costantine MM, et al. Prediction of vaginal birth after cesarean delivery in term gestations: a calculator without race and ethnicity. Am J Obstet Gynecol. 2021;225:664.e1-664. 7.
26. Aceituno L, Segura MH, Quesada J, Rodríguez-Zarauz R, Ruiz-Martínez E, Barqueros AI, et al. Resultados de la aplicación de un protocolo para disminuir la tasa de cesáreas. Prog Obstet Ginecol. 2003;46: 430-40.
27. Carr CA, Burkhardt P, Avery M. Vaginal birth after cesarean birth: a national survey of U.S. midwifery practice. J Midwifery Womens Health. 2002;47:347-52.
28. Hibbard JU, Gilbert S, Landon MB, Hauth JC, Leveno KJ, Spong CY, et al. Trial of labor or repeat cesarean delivery in women with morbid obesity and previous cesarean delivery. Obstet Gynecol. 2006 108: 125-33.
29. Elkousy MA, Sammel M, Stevens E, Peipert JF, Macones G. The effect of birth weight on vaginal birth after cesarean delivery success rates. Am J Obstet Gynecol 2003;188:824-830.
30. Coassolo KM, Stamilio DM, Paré E, Peipert JF, Stevens E, Nelson DB, et al. Safety and efficacy of vaginal birth after cesarean attempts at or beyond 40 weeks of gestation. Obstet Gynecol. 2005;106:700-6.
31. Chaillet N, Bujold E, Dubé E, Grobman WA. Validation of a prediction model for predicting the probability of morbidity related to a trial of labour in Quebec. J Obstet Gynaecol Can. 2012;34:820-5.
32. Eden KB, McDonagh M, Denman MA, Marshall N, Emis C, Fu R, et al. New insights on vaginal birth after cesarean: can it be predicted? Obstet Gynecol. 2010;116:967-81.
33. Landon MB, Leindecker S, Spong CY, Hauth JC, Bloom S, Varner MW, 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.