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## Trial of labor versus elective cesarean delivery for patients with two prior cesarean-sections: A retrospective propensity score analysis

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1 **Trial of labor versus elective cesarean delivery for patients with two prior cesarean-**  
2 **sections: a retrospective propensity score analysis.**

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4 Léa Roux<sup>1</sup>, M.D., Rennes, France

5 Marie-Charlotte Chiemlewski<sup>1,3</sup>, MD Rennes, France

6 Linda Lassel<sup>1</sup>, M.D, Rennes, France

7 Hélène Isly <sup>1</sup>, M.D, Rennes, France

8 Isabelle Enderle<sup>1,3</sup>, M.D, Rennes, France

9 Alain Beuchée <sup>1,4</sup>, M.D, PhD, Rennes, France

10 Maela Le Lous<sup>1,4</sup>. M.D, PhD, Rennes, France\*

11

12 1. Department of Obstetrics and Gynecology, University Hospital of Rennes, France.

13 2. Department of Public Health, University Hospital of Rennes, France.

14 3. Univ Rennes, CHU Rennes, Inserm, EHESP, Irset (Institut de Recherche en Santé, Environnement et Travail) -  
15 UMR\_S 1085, F-35000, Rennes, France.

16 4. University of Rennes 1, INSERM, LTSI - UMR 1099, F35000, Rennes, France.

17

18 **\*Corresponding author:**

19 Maela LE LOUS, MD, PhD

20 Phone : +33(0)6 95 02 38 05

21 E-mail : [maela.le.lous@chu-rennes.fr](mailto:maela.le.lous@chu-rennes.fr)

22 Address : Hôpital Sud, 16 boulevard de Bulgarie, 35200 Rennes

23 Fax number : +33 (0) 2 99 02 34 20

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Journal Pre-proofs

32 **Abstract**

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34 **Introduction** Despite awareness of obstetricians to the constant increase in the number of  
35 cesarean sections in recent years, the fear of a uterine scar rupture is still present and influences  
36 the choice of the mode of delivery in patients with two previous cesarean sections. However,  
37 several clinical studies have suggested that, under certain conditions, vaginal birth after two  
38 cesarean sections is usually successful and safe.

39 **Objective** The objective of this study was to compare maternal and neonatal issues according  
40 to the planned mode of delivery in patients with two previous cesarean sections.

41 **Methods** It was a retrospective observational comparative study at Rennes University Hospital  
42 between January 1, 2013, and December 31, 2020. We performed a propensity score for the  
43 comparison of neonatal outcomes: cord pH, cord lactates, Apgar scores, transfer to neonatal  
44 unit and deaths, according to the planned delivery mode. Secondary outcomes were maternal  
45 issues: uterine rupture, post-partum hemorrhage, deaths.

46 **Results** A total of 410 patients with two previous cesarean section were eligible for our study.  
47 Prophylactic cesarean was performed in 358 cases (87.3%). Trial of labor was attempted in the  
48 52 remaining patients (12.7%), 67.3 % of whom were successful. Neonatal weight, APGAR  
49 score at 1-5-10 minutes, and pH on cord blood were comparable in both groups. One case of  
50 uterine rupture occurred in the trial of labor group.

51 **Conclusion** Trial of labor seems to be a reasonable option for women with two previous  
52 cesarean sections in a selected population.

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54 **Keywords** uterine scar; previous cesarean section; mode of delivery; trial of labor; elective  
55 cesarean section: neonatal outcomes; maternal outcomes.

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**63 Introduction :**

64 Despite obstetricians' awareness of the need to limit cesarean sections, the legitimate  
65 fear of uterine rupture influences the choice of delivery route in the case of a patient with a  
66 history of two previous cesarean section, and trial of labor in this case is not often offered to  
67 women.

68 However, there are inherent risks to the mother and fetus after a cesarean delivery, both  
69 short and long term, especially if repeated[1]. Cesarean delivery is associated with higher rates  
70 of maternal mortality, intensive care management, hysterectomy, blood transfusions in the  
71 immediate post-partum[1–4]. The consequences of a third cesarean delivery also have a major  
72 impact on subsequent pregnancies. Indeed, multiple cesarean sections increase the risk of  
73 uterine rupture, placenta accreta spectrum, post-partum hemorrhage, infertility, pelvic  
74 adhesions, hysterectomy and premature deliveries [1–4][5].

75 From a neonatal point of view, cesarean section would increase neonatal short term  
76 morbidity leading to neonatal respiratory distress and would bear a greater risk of severe  
77 neonatal asphyxia in future pregnancies[6]. Considering long-term consequences, cesarean  
78 sections may be responsible for alterations in the immune system and intestinal microbiota, as  
79 well as an increased risk of future obesity and asthma in the child[1,4,7].

80 A meta-analysis by Tasheen et al. showed that vaginal delivery after two cesareans was  
81 not associated with an excess of maternal and neonatal morbidity and mortality compared with  
82 a trial of labor after one cesarean section[8]. Trial of labor in patients with two previous cesarean  
83 sections was therefore offered to women in some centers, but this offer is still heterogenous[11].  
84 In our center we started to offer the possibility of a trial of labor in selected patients.

85 Our main objective was therefore to compare neonatal morbidity and mortality after a  
86 trial of labor in patients with two previous cesarean section versus an elective cesarean section.  
87 Maternal outcomes were analyzed secondarily.

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92 **Methods**93 *Study design*

94 This was a single-center retrospective observational study taking place at the University  
95 Hospital of Rennes, Obstetric department, between January 1<sup>er</sup> 2013 and December 31 2020.  
96 We compared neonatal outcomes in case of trial of labor versus elective cesarean section in  
97 case of two previous cesarean sections, using a propensity score for the comparison of neonatal  
98 outcomes according to the planned delivery mode.

99

100 *Study population and data collection*

101 A total of 466 patients with two previous cesarean sections were found via a  
102 computerized file search using the International Classification of Diseases ICD 10O34.2 and  
103 ICD 10O75.7; and by searching in local patient records software (DxCare®). All patients who  
104 delivered at a term  $\geq 37$  SA of a singleton fetus in cephalic presentation and who had previously  
105 delivered twice by cesarean section were included in the study.

106 Patients with twin pregnancies, a preterm delivery before 37 weeks of gestation (WG),  
107 a fetus with a condition requiring elective cesarean delivery, placenta accreta, uterine  
108 malformation, a history of uterine rupture or previous corporal incision were excluded.

109 Data collection was carried out in agreement with the local Ethics Committee. Each  
110 patient was informed individually by mail of the use of her data and non-opposition was  
111 confirmed.

112 The variables collected were maternal age, body mass index and maternal history of  
113 hypertension or diabetes, parity, previous vaginal deliveries, indications and course of the two  
114 previous cesarean sections, pelvic tomodensitometry, estimated fetal weight at third trimester  
115 of pregnancy. Postpartum maternal complications included postpartum hemorrhage, defined as  
116 a bleeding greater than 500cc no matter the delivery route was, uterine rupture, defined as  
117 rupture of all layers of the uterine wall (including muscle and serosa), and maternal death.  
118 Neonatal data collected were cord pH, lactate and APGAR score at 1 minute, 5 minutes and 10  
119 minutes of life, and transfer to intensive care neonatal unit, gestational age, birth weight and  
120 neonatal death.

121

122 *Protocol for trial of labor acceptance in case of two previous cesarean section*

123 The department's protocol for acceptance of a trial of labor was as follows: fetus in  
124 cephalic presentation, estimated fetal weight under 90<sup>e</sup> percentile at the third trimester scan  
125 (performed between 30 and 35 weeks), previous transverse and segmental cesarean sections. A  
126 pelvic tomodensitometry was to be performed with the following limits: promontoretropubic  $\geq$   
127 10.5cm, bispinal  $> 10$ cm, transverse  $\geq 12.5$ cm. Finally, patient had to be keen to a vaginal  
128 delivery. Each case had to be validated during staff meeting. Induction of labor was not  
129 authorized, although a moderate use of oxytocin to increase labor was possible. If no labor  
130 occurred by 41+6 WG, a cesarean section was performed.

131

132 *Statistical analysis*

133           Categorical variables were represented by counts and percentages and compared by  $\chi^2$   
134 test or a Fisher exact test. Continuous variables were tested for normality (Q-Q plots and  
135 Shapiro's test), represented by their median [minimum, maximum] and compared by Student's  
136 t-test or a Mann-Whitney U test as appropriate.

137           To analyze the effect of the decision "trial of labor" or " elective cesarean delivery" on  
138 short-term maternal and neonatal morbidity and mortality, the confounding factors that could  
139 affect the decision to agree to vaginal delivery were taken into account by estimating a  
140 propensity score. The variables introduced into the model for estimating the propensity score  
141 were : maternal age, maternal history of diabetes, history of myomectomy, maternal BMI,  
142 indications for the two previous cesarean sections, history of vaginal delivery before and after  
143 cesarean section, the presence of maternal pathology related to the pregnancy and in particular  
144 gestational diabetes, estimated third trimester fetal weight, pelvic tomodensitometry.

145           Missing values prior to the decision on the route of delivery were considered as an  
146 additional mode of the variable concerned, as its absence could influence decision  
147 making. First, we compared different matching and weighting methods for their performance  
148 in reducing the imbalance between the two groups with or without a decision of trial of labor.  
149 Each pre-decision covariate averaged across decision groups were Patients with or without a  
150 decision of trial of labor were compared by estimating the standardized mean differences (SMD)  
151 after weighting on Inverse Probability of Treatment Weighting (IPTW), on IPTW truncated at  
152 the 95th percentiles and on Matching Weights (MW) which is a variant of the IPTW, and  
153 pairwise 1:1 matching 1:1 without replacement on their propensity score within 0.2 standard  
154 deviation of the logit of the propensity score[13,14]. The quality of the weighting and matching  
155 was verified by estimating the standardized mean differences (SMD) showing the absence of  
156 residual imbalance (Figure 3). The matching weights (MW) method, which is a variant of the  
157 Inverse Probability of Treatment Weighting (IPTW), performed best with all pre-decision  
158 covariate variables having a SMD <0.1 (supplemental data) as shown in Figure 4 [13,14].  
159 Consequently, to reduce the imbalance between the two groups, the MW weighing method was  
160 used in subsequent analysis of the outcome after the decision to agree or not to vaginal delivery.  
161 The significance level was defined as  $p < 0.05$ . All data were analyzed with R (R Core Team  
162 (2021) URL <https://www.R-project.org/>).

163           The design and reporting of the study was carried out in accordance with the Strategy  
164 for Strengthening Observational Studies in Epidemiology (STROBE) .

165

166

167 **Results**

168

169 *Population*

170

171 We identified 466 patients with two previous cesarean sections, 410 of whom were  
172 eligible for our study and met the inclusion criteria. Of these, 95 had a vaginal delivery  
173 agreement, and for the other 315 patients a cesarean section was planned. Of those who had a  
174 vaginal delivery agreement, 13 patients ultimately refused the trial of labor, 26 did not go into  
175 labor spontaneously, 2 patients developed pre-eclampsia, 2 had non cephalic fetal presentations.  
176 A total of 52 patients had trial of labor, of whom 35 actually delivered vaginally (67.3%), all  
177 under epidural anesthesia (**Figure 1**).

178 The characteristics of our total and weighted population are shown in **Table 1**. The  
179 indications for the two previous cesarean sections were similar in both groups. Estimated fetal  
180 weight at the third trimester averaged 65<sup>e</sup> percentile in the elective cesarean section group  
181 versus 46<sup>e</sup> percentile for trial of labor group (OR 1.02 [1.01 ;1.02] and a  $p < 0.001$ ). The cut-  
182 off point for a planned cesarean delivery decision appeared to be around the 75<sup>e</sup> percentile  
183 (Figure 2). Since the introduction of that protocol in October 2012, practices appeared to be  
184 homogeneous over time, with notably a stable rate of trial of labor from 2014 onwards (**Figure**  
185 **2**).

186

187 *Neonatal and maternal outcomes:*

188 Neonatal outcomes in univariate analysis before and after the propensity score are  
189 presented in **Table 2**. Neonatal weight, APGAR score at 1-5-10 minutes, and cord blood pH  
190 were comparable in the two groups. Lactatemia was higher in the trial of labor group,  
191 significantly at 3.10mmol/L versus 2.20mmol/L ( $p < 0.001$ ). Transfers to neonatology were  
192 similar in both groups 3.2% versus 2.5% ( $p = 1.00$ ) before the propensity score. There were  
193 slightly more respiratory distress in the newborns born by cesarean section, 3 versus 1 in the  
194 group of patients with a vaginal delivery agreement. There were no neonatal deaths.

195 From a maternal point of view, there was one uterine rupture. The uterine rupture  
196 occurred in a G3P2 woman, with a eutrophic fetus (50<sup>th</sup> percentile). The first stage of labor  
197 lasted 9 hours, with oxytocin at a maximum of 6mUI/min. CTG abnormalities developed and  
198 an emergency cesarean section was performed. Birth weight was 3305g, APGAR score was 7-  
199 9-10 at 1, 5 and 10 minutes, cord blood was: pH = 6.9 lactates 8.1 = mmol/L. The rate of post-  
200 partum hemorrhage was 29.9% in the group that did not agree to a vaginal delivery compared  
201 with 21.1% in the group that did agree to a vaginal delivery ( $p = 0.13$ ). There were 3 transfusions  
202 in each group. There were no maternal deaths. There 2 bladder injuries, 6 additional surgeries  
203 (4 intrauterine aspiration and 2 scar revisions), and 2 ileus, all in the planned cesarean section  
204 group. There was no bowel injury. The rate of postpartum infections was 2% for patients with  
205 a vaginal delivery agreement versus 1.5% for elective cesareans ( $p = 0.73$ ). There was no  
206 difference in the length of stay before or after ponderation (**Table 2**).

207 The gestational age at birth was 39 WG for the elective cesarean section group (SD  
208 [37.00; 40.71]) versus 40 WG (SD [37.00; 41.86]) for the vaginal delivery agreement group ( $p$



209 < 0.001).

210 After weighting by the propensity score, we compared maternal and neonatal outcomes  
211 between patients who had a trial of labor and those who did not. We had 92 comparable patients,  
212 weighted with the MW method. **Table 1** shows that our two weighted populations are  
213 completely comparable at the time of the decision for vaginal delivery.

214 Similarly, maternal and neonatal outcomes were comparable, with no significant  
215 difference found except for birth term ( $p < 0.001$ ) (**Table 2**). Neonatal birth weights were  
216 significantly different, 3379g [2495 ;4520] for patients with a trial of labor versus 3220g [1800  
217 ; 4625] for patients with an elective cesarean section ( $p = 0.04$ ).

218 The rate of postpartum hemorrhage was 21.3% for patients with a vaginal delivery  
219 agreement versus 31.7% for elective cesareans ( $p = 0.18$ ). Lactatemia was similar in both  
220 groups, at 2.60 mmol/L versus 2.20 mmol/L for patients without a vaginal delivery agreement  
221 ( $p = 0.06$ ); and APGAR scores at 1 and 10 minutes were similar ( $p = 0.16$  and 0.68 respectively).  
222 The median APGAR score at 5 minutes showed a significant difference with  $p = 0.045$ , (10 [8-  
223 10] for the vaginal delivery agreement group versus 10 [4-10] for the no vaginal delivery  
224 agreement group). There were no more transfers to neonatology, i.e. 2.2% for newborns of  
225 patients with a vaginal agreement versus 4.3% for newborns of patients without a vaginal  
226 agreement ( $p = 0.53$ ). We then analyzed the cord blood pH at birth in multivariate analysis, the  
227 mode of delivery did not significantly modify the cord pH value of the newborns (for elective  
228 cesarean section group [-0.01 - 0.02] with  $p = 0.64$ ) (**Table 3**).

229

230 *Predictive factors for successful vaginal delivery*

231 After the multivariate analysis, a vaginal delivery after the two cesarean sections was a positive  
232 predictive factor for a successful vaginal delivery (OR = 42.82 [5.48 ; 334.58]  $p=0,0003$ ) and a  
233 BMI  $\geq 30$  was a negative predictive factor for a successful vaginal delivery (OR =0.76 [0.62 ;  
234 0.92]  $p=0.0065$ ) (**Table 4**).

235 **Discussion**

236

237 This study provided a preliminary investigation of the immediate neonatal outcomes of  
238 patients with two previous cesarean deliveries by comparing the two possible strategies in this  
239 context for the obstetrician: elective cesarean section and trial of labor, after weighing the  
240 confounding factors in both groups. The success rate of trial of labor was 67.3% and appeared  
241 reasonable in terms of maternal and neonatal safety.

242

243 *Neonatal outcomes*

244 The immediate neonatal outcomes were similar in our two groups after weighting. The  
245 results of lactatemia and cord blood pH at birth were not significantly different ( $p = 0.06$  and  $p$   
246  $= 0.77$  respectively). The number of APGAR were also similar. There were no more transfers  
247 to neonatology for neonates from the vaginal delivery group. Pre-propensity score lactatemia  
248 was significantly higher in the vaginal agreement group, but not clinically significant, averaging  
249 3.10 mmol/L [1.40; 10.20] versus 2.20mmol/L [1.20; 9.30] in the no vaginal agreement group  
250 ( $p < 0.001$ ). We did not find any cerebral palsy or neonatal death in our series. The differences  
251 in time of birth and term of birth between the two groups are explained by the fact that elective  
252 Cesarean sections are more likely to be performed in the morning around 10 a.m., at  
253 approximately 39 weeks of gestation.

254 The meta-analysis by Tahseen et al. compared outcomes between women who had trial  
255 of labor after 2 cesareans versus after one cesarean section, and also compared trial of labor  
256 after two cesareans versus a third elective cesarean section [8]. Although the numbers were too  
257 small to draw firm conclusions at the neonatal level, they showed similar reassuring results  
258 about trial of labor after two previous cesarean sections. Neonatal admission rates were similar  
259 at 8.85% for patients with trial of labor after two cesareans versus 8.49% after one cesarean ( $p$   
260  $= 0.57$ ). The combined rate of neonatal asphyxia and neonatal mortality was 0.09% versus 0.05%  
261 ( $p = 0.35$ )[8].

262 Another study by Rotem et al. compared neonatal outcomes of patients with trial of  
263 labor after one and after two cesarean sections. They also concluded that the overall neonatal  
264 outcomes were favorable and comparable when a vaginal delivery was attempted after one  
265 versus two cesareans, without neonatal asphyxia or death. [16].

266

267 *Maternal Outcomes*

268 There appeared to be no excess risk of morbidity and mortality in patients who had a  
269 trial of labor, including for those who have had an actual natural delivery, those who had an  
270 emergency cesarean section during labor, and those who had an elective cesarean section for  
271 no onset of labor.

272 In particular, the rate of postpartum hemorrhage was not different in our two groups,  
273 and was even insignificantly higher in the elective cesarean group (21.3% versus 31.7%  $p =$   
274 0.18), and there were no hysterectomies or maternal deaths in our cohort. Also, in our cohort,  
275 additional complications occurred in the cesarean section group including 4 additional

276 intrauterine aspirations, 2 bladder injuries, and 2 ileus. The infection rate appeared to be the  
277 same for both strategies.

278 The 2015 prospective study by Miller et al. including 152 trials of labor and nearly 6000  
279 elective cesarean sections in patients with two previous cesarean sections also found no  
280 significant difference in maternal outcomes between trial of labor and iterative cesarean section,  
281 in terms of maternal morbidity including transfusions (2% versus 1.8%), hysterectomies (0  
282 versus 0.4%), and uterine ruptures (0.7 versus 0.1%) [17]. The study by Rotem et al. showed a  
283 similar rate of postpartum hemorrhage in patients who had trial of labor after one versus two  
284 cesarean sections (2.6% versus 3.5%  $p=0.24$ ), and a similar rate of uterine rupture (0.3% versus  
285 0.6%  $p=0.24$ )[16]. The meta-analysis by Tahseen et al. also showed similar rates of  
286 hysterectomy and transfusion when comparing outcomes of trial of labor after 1 versus 2  
287 previous cesareans [8]. A French series by Bretelle et al. included 180 patients with two  
288 previous cesarean sections who had trial of labor, with one hysterectomy for uterine atony in  
289 the trial of labor group[18].

290

### 291 *Predictive factors for successful vaginal delivery*

292 Our success rate for vaginal delivery of 67.3% is in line with the literature which found  
293 success rates between 62.8% and 74.6%. [8,18–21]. The success of the trial of labor is an  
294 important point because cesarean sections during labor might be more morbid than elective  
295 cesarean sections [22]. However, vaginal deliveries are also less morbid than elective cesarean  
296 sections. It is therefore important to define the patients for whom labor has a good chance of  
297 succeeding. To this end, for patients with a unique previous cesarean section, Grobman et al.  
298 developed a prediction score for successful vaginal delivery. In their prospective study of over  
299 11,000 patients in different centers, successful vaginal delivery after cesarean section was  
300 significantly more likely if the patient was large and/or had a history of vaginal delivery.  
301 Conversely, they were less likely to succeed if the reason for the cesarean section was labor  
302 arrest or failure to engage, and if they had a history of treatment for chronic hypertension, and  
303 in patients of higher weight or age [23]. In our study, diabetes was not an exclusion criterion  
304 for trial of labor. However, patient with uncontrolled diabetes with macrosomia were not  
305 eligible for trial of labor.

306 In our study, the pelvic TDM has contributed to a drastic exclusion of 112 patients that  
307 were candidates for trial of labor. We cannot tell how would have been the outcomes for these  
308 patients if they have had a trial of labor. However, pelvic TDM is no more recommended for  
309 women with one previous cesarean and a similar approach may be applied to those with two  
310 previous cesareans.

311

### 312 *Strengths and Weaknesses*

313 The main strength of our study is that it included only patients with two previous  
314 cesarean and compared the two strategies in an intention to treat strategy. Most of the available  
315 studies for the management of patients with two previous cesarean sections compare the  
316 outcomes of women with one versus two previous cesarean sections deliveries[16,17,19,20,24–  
317 26]. Few studies, even national ones, address this issue, as the strategy of allowing vaginal  
318 delivery after two cesarean sections is in the minority. [18]. However, the size of our study is

319 too small to conclude on differences for events as rare as uterine rupture or hysterectomy. Our  
320 analysis therefore focused on a simple criterion of judgement which is the neonatal cord pH.

321 Also, the patients were individually informed about the advantages and risks of both delivery  
322 routes, which could have led to information bias.

323 A randomized study is always ethically difficult to implement with regard to the delivery  
324 route. We therefore used a propensity score to mimic a "quasi-randomisation" situation after  
325 weighting the patients in the two groups, in order to control for selection and indication bias.  
326 This statistical analysis technique, which allowed us to have perfectly comparable groups, was  
327 also a methodological strength of our study. However, as with all non-randomized studies, the  
328 major limitation of our statistical analyses was the inability to identify all confounding  
329 variables. A multicenter prospective study on a national scale and with varied protocols would  
330 provide a better answer to this question.

331

332 **Conclusion**

333           The proposal of a vaginal delivery seems to be a reasonable option in a selected  
334 population of patients with two previous cesarean sections, after the patient has been informed  
335 of the short and long term benefit/risk balance, in particular the risk of uterine rupture.

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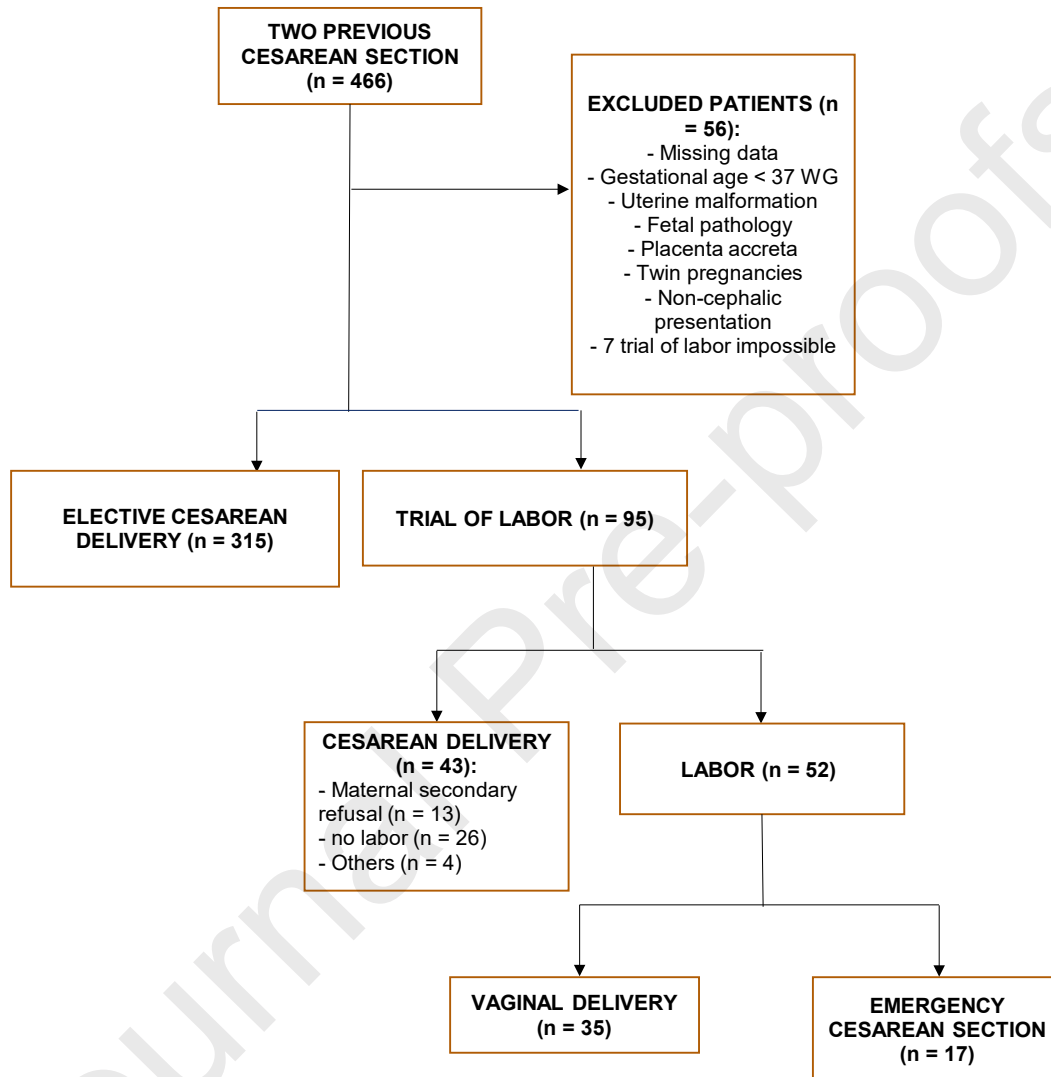
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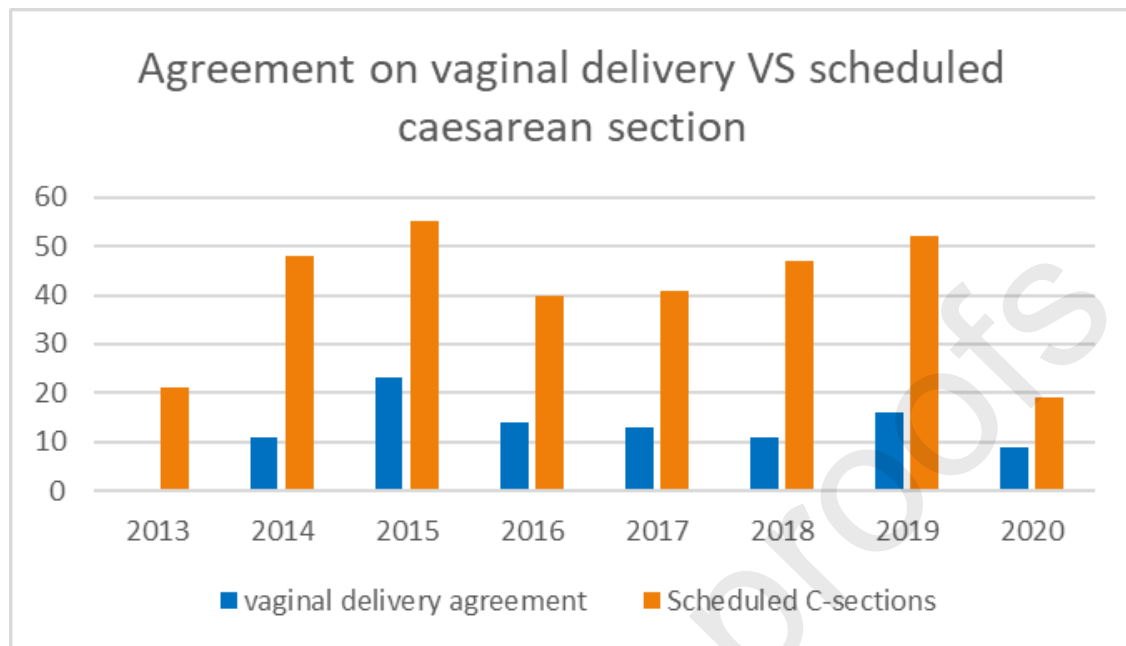
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**Figure 1.** Flow chart



**Figure 2.** Histogram showing the percentage of vaginal delivery in patients with two previous cesarean sections over time from 2013 to 2020



**Table 1.** Population characteristics before and after propensity score

	Total population (n = 410)			Weighted Population (n = 92)		
	Trial of labor	Elective cesarean section	SMD	Trial of labor	Elective cesarean section	SMD
	n = 95	n = 315		n = 46	n = 46	
<b>Age</b>						
<32	31 (32.6)	115 (36.5)	0.207	15.7 (34.1)	15.2 (33.1)	0.070
32 -35	36 (37.9)	99 (31.4)		18.0 (39.1)	17.0 (36.9)	
>36	26 (27.4)	99 (31.4)		12.3 (26.8)	13.7 (29.8)	

	Missing data	2 (2.1)	2 (0.6)		0 (0.1)	0 (0.1)	
<b>BMI</b>	Obesity	31 (32.3)	95 (30.1)	0.270	14.3 (30.9)	14.4 (31.4)	0.010
	No obesity	65 (67.7)	210 (66.5)		31.8 (69.1)	31.6 (68.6)	
	Missing data	0 (0)	11 (3.5)		0 (0)	0 (0)	
<b>Maternal history of diabetes</b>	0	91 (95.8)	302 (95.9)	0.175	45.5 (98.8)	45.4 (98.7)	0.007
	1	4 (4.2)	9 (2.8)		0.5 (1.2)	0.6 (1.3)	
	Missing data	0 (0)	4 (1.3)		0 (0)	0 (0)	
<b>Previous myomectomy</b>	0	92 (96.8)	306 (97.1)	0.159	44.1 (95.7)	44.5 (96.6)	0.048
	1	3 (3.1)	6 (1.9)		2.0 (4.3)	1.5 (3.4)	
	Missing data	0 (0)	3 (0.9)		0 (0)	0 (0)	
<b>SVD before caesarean section</b>	0	69 (72.6)	278 (88.3)	0.466	36.5 (79.2)	35.4 (77)	0.053
	1	12 (12.6)	26 (8.25)		3.6 (7.8)	3.8 (8.3)	
	2 or more	13 (13.7)	10 (3.17)		5.9 (12.7)	6.6 (14.3)	
	Missing data	1 (1.05)	1 (0.3)		0.1 (0.3)	0.1 (0.3)	
<b>SVD after two caesarean sections</b>	0	60 (63.2)	312 (99.0)	1.023	43.3 (94)	43.9 (95.3)	0.060
	1	29 (30.5)	3 (0.95)		2.8 (6)	2.2 (4.7)	
	2	6 (6.32)	0 (0)		0 (0)	0 (0)	
<b>γ CI indication</b>	CTG anomaly	26 (27.4)	78 (24.8)	0.265	12.8 (27.7)	13.1 (28.6)	0.069

	Stagnation	15 (15.8)	63 (20.0)		9.2 (19.9)	9.9 (21.6)	
	Trigger failure	9 (9.4)	33 (10.4)		5.4 (11.7)	4.9 (10.6)	
	Narrowed pelvis	2 (2.11)	19 (6.03)		1 (2.2)	0.7 (1.6)	
	Other	43 (45.3)	122 (38.7)		17.7 (38.5)	17.3 (37.7)	
<b><math>\gamma</math> C2 indication</b>	CTG anomaly	26 (27.4)	41 (13.0)	0.672	9.8 (21.3)	9.9 (21.5)	0.089
	Stagnation	14 (14.7)	42 (13.3)		7.9 (17.2)	9.1 (19.8)	
	Trigger failure	15 (15.8)	34 (10.8)		7.5 (16.4)	8 (17.4)	
	Narrowed pelvis	1 (1.05)	52 (16.5)		1 (2.2)	1 (2.2)	
	Other	39 (41.1)	146 (46.2)		19.8 (43)	18 (39.2)	
<b>Gestational diabetes</b>	Gestational diabetes	21 (22.1)	61 (19.4)	0.064	8.9 (19.2)	9.3 (20.3)	0.026
	No gestational diabetes	74 (77.9)	254 (80.6)		37.2 (80.8)	36.7 (79.7)	
<b>Pregnancy pathology</b>	0	58 (61.1)	199 (63.2)	0.194	31.1 (67.5)	30.1 (65.4)	0.045
	1	37 (38.9)	111 (35.2)		15 (32.5)	15.9 (34.6)	
	Missing data	0 (0)	5 (1.59)		0 (0)	0 (0)	
<b>T3 EFW ultrasound &gt; 90th percentile</b>	Not Macrosome	80 (84.2)	210 (66.7)	0.436	37.4 (81.1)	37.1 (80.6)	0.038
	Macrosome	10 (10.5)	56 (17.8)		4 (8.7)	4.5 (9.7)	
	Missing data	5 (5.2)	49 (15.6)		4.7 (10.2)	4.5 (9.7)	
<b>Pelvi TDM</b>	Narrowed pelvis	39 (41.1)	173 (54.9)	1.070	26.2 (56.9)	26.5 (57.6)	0.044

Normal	41 (43.2)	15 (4.7)	11 (23.8)	11.4 (24.7)
No pelvimetry	15 (15.8)	127 (40.3)	8.9 (19.3)	8.1 (17.6)

BMI: Body Mass Index, SVD: spontaneous vaginal delivery, CTG: ardiotocography, EFW Estimated Fetal Weight, SMD: Standardized Mean Difference; TDM Tomodensitometry

**Table 2.** Maternal and neonatal outcomes. Comparison of the two groups before and after weighting by the MW method based on the propensity score.

	Total population			Weighted population			
	Trial of labor	Elective cesarean section	p	Trial of labor	Elective cesarean section	p	
	N=95	N=315		N=46.1	N=46.0		
<b>Gestational Age</b>	40.14 [37.00, 41.86]	39 [37.00, 40.71]	< 0.001	39.88 [37.00, 41.86]	39 [37.00, 40.71]	< 0.001	
<b>Lactates</b>	3.10 [1.40, 10.20]	2.20 [1.20, 9.30]	< 0.001	2.60 [1.40, 10.20]	2.20 [1.20, 9.30]	0.06	
<b>Lactatemia 6</b>	Lactatemia < 6	82 (92.1)	297 (96.4)	0.15	41.4 (93.2)	44 (96.7)	0.38
	Lactatemia ≥ 6	7 (7.9)	11 (3.6)		3 (6.8)	1.5 (3.3)	
<b>pH</b>	7.28 [6.92, 7.40]	7.30 [6.92, 7.45]	0.23	7.30 [6.95, 7.40]	7.30 [7.01, 7.45]	0.77	
<b>pH 7</b>	pH > 7	86 (97.7)	303 (99.3)	0.50	42 (96.1)	45.1 (99.5)	0.30
	pH ≤ 7	2 (2.3)	2 (0.7)		1.7 (3.9)	0.2 (0.5)	
<b>APGAR 1 minute</b>	9 [0, 10]	9 [0, 10]	0.001	9 [0, 10]	9 [0, 10]	0.16	

<b>APGAR 1 minute</b>	APGAR at 1min $\geq$ 5	92 (96.8)	311 (99)	0.28	45.2 (98.2)	45.7 (99.5)	0.18
	APGAR at 1 min $<$ 5	3 (3.2)	3 (1)		0.8 (1.8)	0.2 (0.5)	
<b>APGAR 10 minutes</b>		10 [9, 10]	10 [5, 10]	0.74	10 [9, 10]	10 [5, 10]	0.68
<b>APGAR 5 minutes</b>		10 [8, 10]	10 [4, 10]	0.63	10 [8, 10]	10 [4, 10]	<b>0.045</b>
<b>APGAR 5 minutes</b>	APGAR 5min $\geq$ 5	95 (100)	313 (99.7)	1.000	46 (100)	45.9 (99.9)	0.32
	APGAR 5min $<$ 5	0 (0)	1 (0.3)		0 (0)	0.1 (0.1)	
<b>Neonatal resuscitation</b>	No neonatal resuscitation	95 (100)	312 (99.0)	0.78	46.1 (100)	45.9 (99.8)	0.20
	Resuscitation in the delivery room	0 (0)	3 (1.0)		0 (0)	0.1 (0.2)	
<b>Neonatal transfer</b>	No neonatal transfer	92 (96.8)	307 (97.5)	1.00	45 (97.8)	44 (95.7)	0.53
	Born transferred	3 (3.2)	8 (2.5)		1.0 (2.2)	2 (4.3)	
<b>Duration of hospitalization</b>		0 [0, 2]	0 [0, 20]	0.67	0 [0, 2]	0 [0, 20]	0.70
<b>Neonatal death</b>	0	91 (100)	307 (100)	NaN	45.9 (100)	45.8 (100)	NA
	1	0 (0)	0 (0)		0 (0)	0 (0)	
<b>Birth weight</b>		3370 [2495, 4520]	3410 [1800, 4625]	0.72	3379.8 [2495, 4520]	3220.3 [1800, 4625]	<b>0.04</b>
<b>zScore Birth weight</b>		-0.23 [-2.66, 2.07]	0.22 [-2.94, 2.55]	<b>&lt; 0.001</b>	-0.07 [-2.66, 2.07]	-0.03 [-2.94, 2.55]	0.93
<b>Postpartum hemorrhage</b>	0	71 (78.9)	218 (70.1)	0.13	35.2 (78.7)	30.9 (68.3)	0.18
	1	19 (21.1)	93 (29.9)		9.5 (21.3)	14.3 (31.7)	

<b>Uterine rupture</b>	0	94 (98.9)	315 (100)	0.52	45.1 (97.8)	46 (100)	0.31
	1	1 (1.1)	0 (0)		1 (2.2)	0 (0)	
<b>Length of stay</b>	(days)	4.68 [1.00, 16.96]	4.74 [0.00,15.71]	0.773	4.70 [1.00, 16.96]	4.00 [0.00, 15.71]	0.237

**Table 3.** Multivariate Models of Neonatal Cord Blood pH Analysis

<i>Predictors</i>	<b>Model 1 (weighted)</b>			<b>Model 2 (weighted, adjusted)</b>			<b>Model 3 (weighted, adjusted, outliers excluded)</b>		
	<i>Estimate<sub>s</sub></i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimate<sub>s</sub></i>	<i>CI</i>	<i>p</i>
Trial of labor agreement (No)	0.01	-0.01 - 0.02	0.459	0.00	-0.02 - 0.02	0.734	0.00	-0.01 - 0.02	0.642
Birth weight (g)				0.01	-0.01 - 0.03	0.386	-0.01	-0.03 - 0.01	0.241
Gestational age at birth (WG)				-0.00	-0.01 - 0.01	0.947	0.01	-0.00 - 0.02	0.155
Comments	393			388			376		
R <sup>2</sup> / R <sup>2</sup> adjusted	0.001 / -0.001			0.021 / 0.011			0.008 / -0.003		
Deviance	0.698			0.676			0.433		

AIC            -30.829                            -40.504                            -176.437

***Correlation between planned mode of delivery and cord pH as a continuous variable.***

*Among children with complete data. Model 1 was weighted by the MW method based on the propensity score and not adjusted. Model 2 was MW-weighted and adjusted for birth weight, gestational age at birth. Model 3 was adjusted and weighted, after excluding patients with aberrant cord blood pH values.*

**Table 4.** Maternal and neonatal characteristics in the labor group and univariate analysis and multivariate analysis of predictive factor for vaginal delivery success.

Univariate analysis Variable	Successful vaginal delivery N=35	Cesarean section during labor N=17	p	OR [IC95%]
<b>Age</b>				
<32	14(40.0)	4(23.5)		
32-35	7 (20 .0)	10(58.8)		
>35	14(40.0)	3(17.6)	p = 0.62	0.97 [0.87 ; 1.09]
<b>BMI</b>				
>30	6(17.1)	14(82.4)		
<30	29(82.9)	3(17.6)	p = 0.03	0.88 [0.78 ; 0.99]
<b>Parity</b>	2.8±1.3	2.8±1.3	p = 0.88	0.97 [0.63 ; 1.49]



<b>Number of Previous vaginal deliveries</b>	0.9±1.4	1.1±1.3	p = 0.72	0.93 [0.62 ; 1.39]
<b>VD after first cesarean</b>				
0	8	11	<b>p = 0.01</b>	1
1	25	4		6.82 [1.87 ; 24.87]
2	3	1		3.43 [0.34 ; 34.83]
<b>VD after second cesarean</b>				
0	6	12	<b>p = 0.0006</b>	1
1	27	2		29.25 [5.18 ; 165.25]
2	3	3		2.17 [0.33 ; 14.06]
<b>Estimated fetal weight (percentile)</b>	51.9±25.4	50.8±28.6	p = 0.59	1.06 [0.85 ; 1.34]
<b>Intergenic period (between last cesarean and present delivery, in years)</b>	4.2±2.2	3.9±1.8	p = 0.84	1.03 [0.76 ; 1.39]
<b>Birthweight C1 (100g)</b>	3166±846	2785±69	p = 0.06	1.07 [1.00 ; 1.15]

Birthweight C2 (100g)                      3304±581                       $\frac{2751 \pm 86}{0}$                       **p = 0.02**                      1.13 [1.02 ; 1.26]

<b>Multivariate analysis</b>		
<b>Variable</b>	<b>OR [IC95%]</b>	<b>P</b>
VD after 2 cesarean sections	42.82 [5.48 ; 334.58]	p = 0.0003
BMI > 30	0.76 [0.62 ; 0.92]	p = 0.0065

BMI : body mass Index ; VD : vaginal delivery.