



Predictive Factors for Cesarean Delivery – A Retrospective Study

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Abstract

Background: Cesarean section rates have risen markedly worldwide. Considering the potential harm caused by this mode of delivery, and the general concern in reducing its incidence, it would be useful to individualize the risk of non-planned cesareans, and if there is any possibility, reduce that risk, and anesthesiologists should take part of this risk evaluation. In recent studies, many factors have been related with a higher risk of cesarean, and controversy still surrounds labor analgesia impact on cesarean risk. The aim of this study was to search for predictive factors for non-planned cesarean delivery.

Methods: Retrospective analysis of all labors occurred in our Obstetric Department during 2014. Maternal related factors, previous obstetric history, birth weight and factors related to labor analgesia and labor progression were studied. Our primary outcome was cesarean delivery.

Results: We identified two independent predictive factors for cesarean delivery: birth weight ($p=0,007$ OR= 1,001 CI 95% [1,0003; 1,002]) and labor length since beginning of analgesia ($p<0,0001$ OR= 1,00005 CI 95%[1,00003; 1,00007]). Searching correlation between registered variables, maternal body mass index was positively associated with newborn birth weight ($p<0.0001$, $R=0.157$).

Conclusion: Our study showed that birth weight and labor length since beginning of epidural analgesia are independent predictor factors of non-planned cesarean delivery. Furthermore, birth weight was associated with maternal body mass index, providing health professionals a modifiable factor in which we can intervene to improve outcome. As labor progression to cesarean is of major obstetric and anesthetic concern, multidisciplinary initiatives are warranted to clearly identify important variables concurring to operative delivery.

Keywords: Labor analgesia; Cesarean; Cesarean predictors; Mode of delivery

Introduction

During the last decades, cesarean section (CS) rates have risen markedly worldwide. The number of cesarean delivery in Portugal increased from 29,7% to 36,4% from 2001 to 2009 [1]. In 2007, Portugal had the second highest CS rate in Europe [2]. According to the latest projections, this number will probably reach 45,7% in 2016 [1].

CS is only effective in improving maternal and infant outcomes when required for medical reasons [3]. The risks and morbidity of the procedure depend on the level of urgency [4]. Even elective CS carries operative risks, increased maternal morbidity, including blood loss and wound infection, as well as increased risk of complications for future pregnancies, like placenta accreta and uterine rupture [5,6]. Main indications to proceed with a non-planned cesarean delivery during labor are fetal distress or dystocia (difficult labor) [7]. This urgent situation requires a rapid progression from decision to delivery.

In recent studies, many factors have been related with a higher risk of CS, although predictive power of many of them is still in debate [8], namely factors related to the mother (as maternal age, body mass index, and previous gynecological and obstetric history), to the fetus (birth weight), and controversy still surrounds labor analgesia impact on CS risk.

Neuraxial analgesia and mode of delivery

In 2002, the American College of Obstetricians and Gynecologists reported that “there is considerable evidence suggesting that there is in fact an association between the use of epidural analgesia for pain relief during labor and the risk of cesarean delivery” [9,10]. In 2006, and reaffirmed in 2013, they revised their opinion, and jointly with American Society of Anesthesiologists, advocated that unless

contraindicated, “maternal request is a sufficient medical indication for pain relief during labor”, as epidural analgesia has shown to have no influence on cesarean delivery rates [11].

Neuraxial techniques became the gold standard for labor analgesia. These techniques have gained preference while multiple randomized controlled trials have demonstrated lower maternal pain scores and higher maternal satisfaction with neuraxial analgesia comparing with systemic analgesia [12-15]. Moreover, the physiological benefits of neuraxial analgesia in what concerns maternal cardiovascular and pulmonary physiology, and the acid – base status of the fetus, are well-documented [16-19].

Along the past two decades several impact studies and one large meta-analysis have evaluated the influence of neuraxial labor analgesia in obstetric outcomes and have shown no association of caesarian delivery and epidural administration [20-25]. More recently, a 2005 Cochrane review involving 20 studies reported no increase in CS rates between women who received epidural versus systemic analgesia for labor [12]. After initiating neuraxial labor analgesia, many techniques can be used to maintain analgesia for the duration of labor.

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Maintenance of analgesia with continuous epidural infusion (CEI) results in the frequent need for rescue bolus. Higher infusion rates, which decrease the need for rescue bolus, result in motor block in a relatively high percentage of patients. Despite analgesia efficacy seems to be similar, Patient-controlled epidural analgesia (PCEA) has been associated with a lower consumption of local anesthetic and incidence on unscheduled clinician interventions, reducing the incidence of lower extremity motor block [26]. However, meta-analysis of the literature determined that there are no clinically significant differences on obstetric and neonatal outcomes between techniques, namely mode of delivery and Apgar scores, but different concentrations of local anesthetics for each technique were used among studies [22].

Epidural techniques aside, controversy also follows the moment when these techniques should be performed and its impact on mode of delivery and newborn outcome. Data from observational studies have suggested an association between cesarean delivery and the initiation of neuraxial analgesia during early labor (usually defined as cervical dilation less than 4–5 cm) [23,24]. However, meta-analysis of the literature determined that the timing of neuraxial analgesia does not affect the frequency of cesarean delivery [25,27].

These recent evidence has led to a change in recommendations from various associations, including the American Society of Anesthesiology which stated in 2007 that “Patients in early labor (i.e., <5 cm dilation) should be given the option of neuraxial analgesia when this service is available. Neuraxial analgesia should not be withheld on the basis of achieving an arbitrary cervical dilation, and should be offered on an individualized basis. Patients may be reassured that the use of neuraxial analgesia does not increase the incidence of cesarean delivery” [22].

In what concerns the duration on labor it has been shown that effective epidural analgesia has variable effects on first stage of labor duration but it can prolong the second stage of labor [28,29].

Considering the potential harm caused by CS, and the general concern in reducing its incidence [30], it would be useful to individualize the risk of non-planned cesareans, and if there is any possibility, to reduce it, and anesthesiologists should take part of this risk evaluation.

Cesarean prediction risk should be a tool for decision-making during labor process, so that mothers could be given anticipated information about their condition and obstetric and anesthesiologist teams could predict and anticipate their actions. Although many prediction models have been yet published, their routinely applicability is still limited [30].

In this study, we retrospectively analyzed the labors in our department during 2014, searching for predictive factors for non-planned cesarean delivery.

Materials and methods

Study design and sample

We performed a retrospective analysis of all labors occurred in our Obstetric Department between 1st January and 31st December 2014. Elective CS was excluded. Women receiving intravenous analgesia for labor were excluded. Data were collected in charts designed to evaluate labor analgesia in our Department, fulfilled by an anesthesiologist attending or resident.

Variables

The following variables were registered: maternal age (years), maternal body mass index (BMI) (kg/m²), the American Society of

Anesthesiologists (ASA) physical status (1,2,3), monitored versus non-monitored pregnancy, gestation number (n), previous labor (n), gestational age (weeks), previous cesarean (yes or no), single or multiple gestation, birth weight (g), beginning of labor (spontaneous or induced), cervix dilatation at beginning of analgesia (inferior to 3 cm and superior or equal to 3cm), mode of epidural analgesia (PCEA: patient-controlled epidural analgesia with ropivacaine 0.1% and sufentanil 0.25 ug/mL (10ml/h), with 5 mL bolus (lockout time: 30 min); CEI-HLA: continuous epidural infusion with high local anesthetic concentration, ropivacaine 0.2% (6-8 ml/h), with sufentanil 10ug or ropivacaine 0.2% boluses, administered with 4hours minimum interval, as needed; CEI-LLA: continuous epidural infusion with low local anesthetic concentration and opioid, ropivacaine 0.1% with sufentanil 0.25 ug/mL (10ml/h), and bolus given by anesthesiologist as needed; others/mixed), ambulation after epidural (yes or no), delivery hour (hh:mm:ss) and labor length since beginning of analgesia (hh:mm:ss).

Outcome

Our primary outcome was mode of delivery, expressed as CS or vaginal delivery. This information was obtained from medical charts.

Statistical analysis

Statistical analysis was performed using IBM SPSS statistics version 22. Categorical variables are presented as frequency and percentage and continuous variables are presented as mean \pm standard deviation (SD). For comparison between groups, the t-student’s test was used for continuous variables; chi-squared test was used for categorical variables. Levene’s test was used to check the homogeneity of variances. Logistic Regression with forward stepwise Wald method was used to identify independent risk factors for cesarean labor. The Pearson correlation coefficient (R) was used to analyze the correlations between continuous variables, while Spearman correlation coefficient was applied for categorical variables. Non parametric Kruskal-Wallis test was used to compare the delivery time of day. A p-value < 0.05 was considered to be statistically significant.

Results

Two thousand and six labors were performed in our Department (excluding elective cesareans). For this study, 96 labors were excluded due to missing data on delivery mode, 25 patients were further excluded because were submitted to intravenous labor analgesia.

One thousand eight hundred and eighty five labors were analyzed. Among those, 1608 patients (85,3%) delivered vaginally (eutocic or instrumented labor) and 277 (14,7%) were submitted to CS. Demographic data of study population is presented in Table 1. No relationship was found between ASA status, gestation number, previous CS, single or multiple gestations, monitored pregnancy, cervix dilatation at beginning of analgesia, mode of analgesia, time of delivery and the incidence of cesarean section. The following variables presented significantly different in vaginal and cesarean delivery groups, however were statistically insignificant after adjustment:

Maternal age was lower in vaginal group, as well as BMI and gestational age, previous labor was more common in vaginal group. Induced labor was associated with a higher incidence of cesarean labor. Patients who ambulate after epidural also presented a higher incidence of cesarean section.

Analyzing all variables in a logistic regression, only two independent predictive factors for cesarean delivery were identified:

| Characteristics | Vaginal (n=1608) | Cesarean (n=277) | p |
|--|---------------------|---------------------|-----------|
| Maternal age (years) | 29,9 ± 6,3 | 31,0 ± 6,0 | 0.015* |
| BMI (kg/m ²) | 28,9 ± 4,3 | 30,2 ± 4,7 | <0.001* |
| ASA status | | | |
| 1 | 1082 (70,6%) | 171 (67,1%) | 0.351 |
| 2 | 448 (29,2%) | 83 (32,5%) | |
| 3 | 2 (0,1%) | 1 (0,4%) | |
| Gestation number (n) | 1,9 ± 1,5 | 1,9 ± 1,7 | 0.532 |
| Previous labor (n) | 0,7 ± 1,3 | 0,4 ± 1,3 | 0.033*** |
| Previous cesarean section: | | | |
| Yes | 118 (8,0%) | 28 (11,5%) | 0.069 |
| No | 1356 (92,0%) | 215 (88,5%) | |
| Gestational age (weeks) | 38,3 ± 2,5 | 38,7 ± 2,3 | 0.015* |
| Single or multiple pregnancy: | | | |
| Single | 1550 (96,4%) | 270 (97,5%) | 0.363 |
| Multiple | 58 (3,6%) | 7 (2,5%) | |
| Birth weight (g) | 3125,6 ± 494,1 | 3297,7 ± 533,4 | <0.001* |
| Monitored pregnancy: | | | |
| Yes | 1484 (98,1%) | 242 (98,4%) | 0.755 |
| No | 29 (1,9%) | 4 (1,6%) | |
| Beginning of labor: | | | |
| Spontaneous | 1089 (81,8%) | 154 (69,4%) | <0.001* |
| Induced | 243 (18,2%) | 68 (30,6%) | |
| Cervix dilatation at beginning of analgesia: | | | |
| < 3 cm | 37 (2,5%) | 4 (1,6%) | 0.386 |
| ≥ 3 cm | 1459 (97,5%) | 249 (98,4%) | |
| Mode of analgesia: | | | |
| PCEA | 704 (53,0%) | 120 (50,8%) | 0.081 |
| CEI-High-Ropi | 499 (37,5%) | 93 (39,4%) | |
| CEI-Low-Ropi | 93 (7,0%) | 11 (4,7%) | |
| Others/Mixed | 33 (2,5%) | 12 (5,1%) | |
| Ambulation after epidural: | | | |
| Yes | 51 (5,6%) | 12 (10,8%) | 0.032* |
| No | 857 (94,4%) | 99 (89,2%) | |
| Time of delivery | 13:50:00 | 14:00:00 | 0.860 |
| Labor length since beginning of analgesia (hh:mm:ss) | 05:02:48 ± 03:58:52 | 08:05:11 ± 05:29:22 | <0.001*** |

Data presented as mean±SD, n (%) and for time of delivery as median.

* p<0.05 for statistic significance

** Levene Test was used for samples with different variance

*** Kruskal-Wallis test was used to test difference in time of delivery

Table 1: Demographic data of vaginal and cesarean deliveries.

- Birth weight, p=0,007 OR= 1,001 CI 95% [1,0003; 1,002], Spearman correlation coefficient: R=0,132 p<0.001
- Labor length since beginning of analgesia, p<0,0001 OR= 1,00005 CI 95%[1,00003; 1,00007], Spearman correlation coefficient: R=0,206 p<0.001.

Searching correlation between registered variables, maternal BMI is positively associated with newborn birth weight (p<0.0001, R=0.157).

Discussion

Cesarean rates

Our global CS rate (including all CS during 2014) was 29,8%. Despite this number is still far from World Health Organization 10-15% mark [31], it is below our national reality, reported as 36,4% in 2009 [1]. Facing those numbers, efforts must be conducted to reduce this rate, namely identifying modifiable risk factors for CS.

Predictive factors

According to our findings, only birth weight and labor length since beginning of analgesia have been identified as independent factors of CS. Considering birth weight, this finding is consistent with literature, as it has already been posted that fetal macrosomia increases the risk for adverse labor outcomes [32].

Despite in our study maternal BMI has lost its significance in the logistic regression, according to literature maternal BMI can be associated with a significantly longer first labor stage [33] and higher CS rates [34]. On the other hand, maternal BMI was significantly related to newborn birth weight, allowing for a possible intervention in order to improve outcome. Pre-conceptional counseling on ideal body weight and maintenance of ideal BMI during pregnancy could be important measures to reduce CS rates [8].

The finding that time from beginning of epidural analgesia until delivery is related to CS rate, is an obvious conclusion and skewed

as prolonged labor is per se an indication for CS. However, there are many obstetric and anesthetic variables that can concur to increase labor duration, epidural analgesia included, as it has been shown to prolong second stage of labor. Moreover, this finding should alert for the importance of assuring ideal obstetric and anesthetic conditions for CS, as labor further prolongs.

Mode of labor epidural analgesia, as well as the moment in labor stage when it has begun (assessed as cervix dilatation) does not seem to influence type of delivery in our sample, data consistent with the most recent discussions on the subject [27].

Previous gynecological and obstetric history was not significantly important to determine CS in our sample. Nevertheless multiparas presented a lower risk for cesarean delivery in univariate analysis, which is according to literature [34]. On the other hand, gestation number and previous cesarean section showed no difference between groups. In fact, on this matter, the American College of Obstetricians and Gynecologists states that women with previous history of uncomplicated CS should be counseled to try to deliver vaginally [32]. Despite that, we believe that some of our pregnant women with previous CS may have been scheduled to elective cesarean delivery, inducing biased results.

Ambulation during labor has been advocated to have many benefits and improve mother satisfaction. Previous studies have showed that ambulation may reduce operative deliveries and shorten first stage of labor [35]. In our sample, women who ambulated had a higher CS rate, although it has lost its significance in multivariate analysis. This contradictory result could be due to the small number of patients included in this group, as it is not a regular practice in our institution.

Controversy surrounds whether induction of labor in term pregnancy is associated with adverse obstetric outcomes, namely CS, with studies showing opposite results [36]. In our study, CS rate was significantly superior in induced labors but this association did not persisted after logistic regression. Since 2014, strict policy has been implemented regarding induction of labor, which is allowed only after 41 weeks gestation or in particular obstetric conditions.

Study Limitations

As a retrospective study there are inherent limitations in data collection that can not be controlled. In Portugal, National Health Service considers elective cesarean delivery only by medical indication and economically disincentives all public hospitals with high CS rates. However, a recent national study advocated women socio-economic position to be a factor affecting CS rates [7]. This factor was not controlled in our sample.

Women BMI were calculated according to self reported data of weight and height, not objectively measured at admission. Newborn weight was assessed after birth and there can be a difference of more than 10% from estimated fetal weight [30]. As it appears as a predictor factor for CS, assessment of fetal weight by ultrasound would provide a more accurate measure. Nonetheless there are anesthetic and obstetric protocols to guide and unify clinical practice in labor management, professionals are organized in fixed weekly teams, which can induce a certain pattern of actuation and possible bias.

In conclusion, our study showed that birth weight and labor length since beginning of epidural analgesia are independent predictor factors of cesarean delivery. Furthermore, birth weight was associated with maternal BMI, providing health professionals a modifiable factor in which we can intervene to improve outcome. As labor progression to

cesarean is of major obstetric and anesthetic concern, multidisciplinary initiatives are warranted to clearly identify important variables concurring to operative delivery.

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