Neonatal respiratory morbidity after elective cesarean section

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Abstract

Objective. The objective of this study was to examine the rate of respiratory morbidity in neonates delivered by elective cesarean delivery (ECD) at term, with a definite confirmation of gestational age (GA) by 1st-trimester ultrasound.

Methods. Consecutive women carrying a singleton pregnancy and undergoing ECD at term (> 38 1/7 weeks), confirmed by 1st-trimester ultrasound, were included in the study group. Multiple gestations, cesarean section (CS) in labor, CS performed after rupture of membranes and induced deliveries were excluded. The control group included women with a singleton pregnancy at term (> 38 1/7 weeks) who delivered spontaneously. This group of women was randomly selected during the study period.

Results. The study group included 277 women delivered by ECD. The control group consisted of 311 women. Five newborns in the study group and none in the control group were admitted to the neonatal intensive care unit (NICU) due to respiratory disorders (p < 0.02). Excluding diabetic women did not change the results. On multivariate analysis, no other factors were found to independently influence the risk of respiratory complications.

Conclusion. In our study, the rate of respiratory morbidity was found to be significantly higher in neonates delivered by ECD compared to those delivered vaginally. The fact that GA was confirmed by 1st-trimester ultrasound makes iatrogenic prematurity an unlikely sole cause for this excess morbidity.

Keywords: Elective cesarean section, RDS, TTN, maternal complications

Introduction

The rate of cesarean sections has increased substantially in the last few decades, from 5% in 1970 to 25% in 1990 in the United States [1,2]. A large portion is attributed to elective cesarean deliveries (ECD) [2,3]. The most common indications for ECD are: fetal malpresentation, elective repeat cesarean delivery and macrosomia.

Several reports addressing neonatal morbidity after ECD have had various conclusions. Most of these studies reported an increase in neonatal respiratory morbidity, especially due to respiratory distress syndrome (RDS), persistent pulmonary hypertension of the newborn, and transient tachypnea of the newborn (TTN) [4–7].

The cause for this increased morbidity has not been clearly defined. In early studies it was assumed that many cases of respiratory morbidity were attributable to iatrogenic prematurity and incorrect gestational age dating [4,8–11]. Another possible reason, which was supported by in vitro studies, is that the delivery process itself causes physiological changes in the neonate's respiratory system (e.g., clearing of pulmonary fluid [12] or exposure to a catecholamine surge during labor [13,14]). It was postulated that neonates who were not vaginally delivered do not benefit from these physiologic mechanisms leading to increased respiratory morbidity.

In the last two decades, different tools to accurately evaluate gestational age have become widely available. Thus 'iatrogenic prematurity' due to inaccurate dating has become less important.

The objective of this study was to compare respiratory morbidity in neonates born by ECD vs. spontaneous vaginal delivery in accurately determined gestational age pregnancies (by performing 1st-trimester ultrasound).

Methods

The study group consisted of women delivered sequentially by ECD. Only women who had their elective operation at the scheduled time were
included, those delivered before or after the booked date were excluded (such as cesarean section during active labor or after rupture of membranes, and deliveries after induction of labor).

Inclusion criteria were ECD in a singleton pregnancy at ≥38 1/7 weeks of gestation confirmed by 1st-trimester ultrasound. Exclusion criteria were multiple pregnancies or no documentation of 1st-trimester ultrasound.

The control group included the consecutive women who had normal term vaginal delivery at ≥38 1/7 weeks after each ECD. The number of women in the control group was larger due to exclusion of some of the women in the ECD group.

In both groups, gestational age was calculated from last menstrual period (LMP) and confirmed by 1st-trimester ultrasound. If a discrepancy was noted between LMP and 1st-trimester ultrasound, gestational age was determined by 1st-trimester ultrasound.

Analyses were performed on maternal demographic data, clinical parameters related to the delivery, immediate neonatal outcome variables, neonatal intensive care unit (NICU) admissions, neonatal respiratory complications and also maternal postpartum complications.

Respiratory outcomes included TTN and neonatal RDS, both diagnosed in agreement with standard pediatric criteria including clinical and radiological findings.

Maternal morbidity included postpartum fever defined as maternal temperature >38°C beginning >24 h after delivery, and postpartum hemorrhage defined as blood loss >500 ml in spontaneous vaginal deliveries or >1000 ml in cesarean sections.

The association between the different parameters was assessed by group statistics, Student t-test, χ² test and Fisher’s exact test as appropriate. In order to eliminate confounding factors and to identify multiple associations between study variables, multivariate conditional logistic regression analysis was also performed.

Results

The study group consisted of 277 women who delivered by ECD. A cohort of 311 women who delivered vaginally was included as the control group. These women were randomly selected during the study period.

The main indications for ECD were breech presentation (112 women, 40%) and previous cesarean section (103 women, 37%). Demographic parameters are presented in Table I. Maternal age was slightly higher in the study group. Gestational age was significantly lower on average in women delivered by ECD: 39.1 weeks in the study group and 39.8 weeks in the control group. The distribution of gestational age at delivery for both groups is presented in Figure 1. The neonatal gender distribution was similar between the two groups.

Regional anesthesia (epidural/spinal) was used in 97.5% of the ECD group. All neonates in the ECD group had Apgar scores of ≥8 at 5 minutes.

Neonatal respiratory morbidity was significantly more prevalent after ECD (5 neonates vs. 0 in the control group, p < 0.02). Two out of 62 neonates who were delivered at 38+ weeks, two out of 128 of the neonates delivered at 39+ weeks and one out of 70 neonates delivered at 40 weeks of gestation had respiratory morbidity.

The incidence of meconium-stained amniotic fluid was higher in spontaneous vaginal deliveries compared to those delivered by ECD (19 vs. 1, p < 0.001).

The five cases of respiratory morbidity included four males and one female neonate. Indications for ECD were: prior cesarean section (3), breech presentation (1), and large fetus (1). The average birth weight of this group was 3328 g (range

![Figure 1. Distribution of gestational age at delivery.](image-url)
Neonatal respiratory morbidity after ECD

2850–4500 g). In four out of five of the neonates, only oxygen supplementation was required and in one neonate assisted ventilation was indicated. In three out of five neonates, blood cultures were collected (all negative) and antibiotic agents were administered. The time spent in the NICU was 1–12 days.

When women with pre-gestational or gestational diabetes were excluded from the analysis, these results remained statistically significant.

Maternal morbidity outcomes included postpartum fever and postpartum hemorrhage. As expected, the rate of these complications was higher in the study group compared to the control group (Table II).

Multivariate conditional logistic regression analysis, using maternal age, neonatal sex, indication for cesarean section and gestational week at delivery as confounding variables, showed no other parameters to significantly influence respiratory morbidity. Mode of delivery remained an independent variable determining neonatal respiratory outcome.

Discussion

We found that in women with accurately determined gestational age, neonatal respiratory morbidity after ECD without labor was significantly higher than in vaginally delivered infants. This is in contrast to a widespread view in the non-professional community that cesarean delivery results in improved neonatal outcome, albeit increasing maternal risks and short-term morbidity.

Rising rates of cesarean delivery, and a growing proportion of ECD without absolute medical indication, has prompted an examination of the potential risks of this mode of delivery.

Most discussion has focused on maternal hazards: higher short-term morbidity, increased mortality and long-term implications for future deliveries. However, neonatal consequences have been receiving growing attention, and it is now widely accepted that ECD is associated with higher rates of neonatal respiratory morbidity [4–7].

It was long presumed that iatrogenic prematurity, i.e., incorrect gestational dating or mistiming of delivery, accounted for a large part of this association [4,8–11]. An important study on 1007 repeat ECDs [15] found significantly higher rates of neonatal respiratory problems in the presence of lower gestational age, among infants delivered by repeat ECD. A significant 9% of infants delivered by repeat ECD in this study were <38 weeks of gestation by postnatal examination.

Other studies have reported an independent influence of the mode of delivery per se on rates of respiratory morbidity, regardless of gestational age [5,6,11]. A popular hypothesis is that the mechanism of labor itself promotes neonatal respiratory function. Supporting this are reports on the increased risk of pulmonary morbidity in infants delivered by elective vs. emergency cesarean section, and the benefits of awaiting spontaneous onset of labor before performing a planned cesarean delivery [16–18]. Postulated mechanisms have included exposure to catecholamines during labor, proven in vitro [13,14] and differences in lung mechanics, demonstrated by lung volume studies [12,19].

Our study attempts to isolate the mode of delivery and assess its independent impact on neonatal respiratory morbidity. To this end we selected a population of women who delivered at term, with gestational age confirmed by first trimester ultrasound.

Gestational age was thus consistently determined. Although it was found to be significantly lower in women delivered by ECD compared to those who delivered spontaneously, three neonates with respiratory morbidity were delivered beyond 39 weeks of gestation. These neonates were delivered according to the American College of Obstetrics and Gynecology guidelines for ECD [20]. Both groups completed 39 or more weeks of gestation on average, complying with results of studies evaluating the risk of respiratory distress in electively delivered infants [21,22].

The high rate of regional anesthesia among the study group precludes the possibly deleterious effect of respiratory depressant anesthetic agents on neonatal respiratory outcome [6].

Maternal diabetes, maternal age and other demographic and obstetric parameters were also ruled out as confounding variables on multivariate analysis.

Our results indicate that the mode of delivery is an independent risk factor for neonatal respiratory morbidity, regardless of gestational age, and other maternal and intrapartum variables. Nevertheless, it is possible that this study is not large enough to detect additional independent variables that might contribute to the differences between the groups.

One might speculate that the spontaneous process of initiation of labor might discriminate immature from mature fetuses better than an arbitrary cut-off of certain gestational age.

<table>
<thead>
<tr>
<th>Table II. Maternal morbidity.</th>
<th>SD</th>
<th>ECD</th>
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<tbody>
<tr>
<td></td>
<td>$n = 311$ (%)</td>
<td>$n = 277$ (%)</td>
</tr>
<tr>
<td>Postpartum fever</td>
<td>2 (0.6)</td>
<td>8 (2.8)</td>
</tr>
<tr>
<td>Postpartum hemorrhage</td>
<td>10 (3.2)</td>
<td>2 (0.77)</td>
</tr>
<tr>
<td>Other complications</td>
<td>1 (0.3)</td>
<td>10 (3.6)</td>
</tr>
<tr>
<td>Total complications</td>
<td>13 (4.1)</td>
<td>20 (7.2)</td>
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</tbody>
</table>

SD, spontaneous delivery; ECD, elective cesarean delivery.
In summary, the data presented here demonstrate that ECD entails neonatal risks as well, despite meticulous gestational dating for timing of ECD. This aspect is important to present when discussing the alternative modes of delivery, in this era of informed consent.

References
