

The Timing of Elective Caesarean Deliveries and Early Neonatal Respiratory Morbidity in Term Neonates

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Abstract

Background: Respiratory distress is one of interesting presentation of elective caesarean deliveries, the presence of labor before elective caesarean delivery decrease the risk of respiratory distress adverse respiratory problem in neonate delivered before 39 weeks of gestation are increased.

Aim: To evaluate the association between gestational age at delivery and neonatal respiratory outcomes after elective caesarean delivery between 37 and 41 completed weeks.

Patients and methods: Descriptive study with prospectively collected data from Baghdad teaching hospital/ medical city at neonatal care unit. All infants of gestational age from 37 to 41 completed weeks, with uncomplicated pregnancy, of which 1407 were born by elective caesarean delivery compared to 1304, delivered by spontaneous vaginal delivery between 1st of September 2015 and 31st of January 2016. The neonates delivered by elective caesarean delivery were stratified into five groups according to the gestational age. Data including maternal age, indication of elective caesarean delivery birth weight, gender, respiratory outcomes (transient tachypnea of the newborn (transient tachypnea of the newborn), Respiratory distress syndrome pneumothorax) and also included others measures oxygen therapy, assisted ventilation, length of hospital stay and neonatal death.

Results: There were 1407 neonates delivered by elective caesarean delivery compared with 1304 by spontaneous vaginal delivery of overall 118 neonate were admitted to the Neonatal care unit with Respiratory distress and receiving oxygen therapy or assisted ventilation. Early neonatal Respiratory distress risk was significantly higher in neonate delivered by elective caesarean delivery 108/1407 (7.7%) compared with spontaneous vaginal delivery 10/1304 (0.7%) (Eleven folds higher, odd ratio was 11.12 (5.61 to 22.04), $p < 0.0001$). Respiratory distress risk decreased with each increment week of gestation from 37 weeks to 40 weeks, odd ratio 3.57 (1.69-7.53) for 37 weeks about four folds higher than 39 weeks, odd ratio 1.2 (0.52-2.76) for 38 weeks more than one fold higher than 39 weeks. Male newborns delivered by elective caesarean delivery more at risk of developing Respiratory distress than female. Requirement of assisted ventilation increased significantly with earlier week of gestation ($p = 0.004$). The rate of Respiratory distress such as (transient tachypnea of the newborn, Respiratory distress syndrome and pneumothorax) increased with earlier gestational age for both group (elective caesarean delivery, and spontaneous vaginal delivery). The hospitalization days, also decreased with increased gestational age.

Conclusions: Term neonates delivered by elective caesarean section are at increased risk for developing Respiratory distress compared vaginal delivery. The neonatal Respiratory distress decreased if elective caesarean delivery performed after 39 gestational weeks.

Keywords: Respiratory distress (RD); Elective caesarean delivery (ECS); Transient tachypnea of the newborn (TTN); Gestational age (GA); Oxygen therapy (O₂); Spontaneous vaginal delivery (SVD); Neonatal care unit (NCU)

Introduction

Respiratory distress is one of common presentation in the newborn which occurs in up to 7% [1]. A lot of studies done on RDS and bronchopulmonary disease in preterm infants, [2,3] but daily a significant number of term neonates are managed in NCU for their RD [4-6].

RD in the neonates most commonly presents as one or all of the following physical signs: tachypnea, grunting, nasal flaring, retraction and cyanosis [7].

Causes of RD in newborns

Common conditions: TTN, pneumonia, RDS, meconium aspiration syndrome (MAS), pneumothorax, pulmonary hypertension, congenital heart disease and hypoxic ischemic encephalopathy.

Rare conditions: Pulmonary hemorrhage, Pleural effusion, Neuromuscular disorders, Inborn errors of metabolism, Diaphragmatic hernia, Trachea oesophageal fistula, Choanal atresia,

Cystic congenital adenomatoid malformation, Lobar emphysema, Pulmonary hypoplasia [8-10].

Aims of the Study

To evaluate the effect of ECS timing on respiratory outcomes in term infants and to compare the risk of developing RD in association between ESC and SVD.

Patients and Methods

A Prospectively cohort study - all singleton term infants (who completed 37 to 41 gestational weeks) who were born by ECS and SVD at Baghdad Teaching Hospital/medical city from 1st September 2015 to 31st January 2016 were evaluated for RD. The exclusion criteria included those women with the multiple gestations, had labour or attempted induction and had medical or obstetrical conditions such as (preeclampsia, eclampsia, diabetes mellitus, renal disease, cardiac disease, placenta praevia, placental abruption, still birth) that may increase the risk of neonatal illness. Infants with congenital malformations or infection including pneumonia or MAS also excluded due to the cause of RD in these cases unrelated to delayed transition from fetus to term neonate, the definition of ECS as a delivery occurred before the labour onset [11]. Indications for ECS included mother decision, fetus mal presentation, repeated cesarean [12]. The information of the infants and mother included: maternal age, indication of ECS, gestational age, birth weight, gender, neonatal respiratory outcomes which included (TTN, RDS, pneumothorax) and also included other therapeutic measures which included: type of respiratory support required (O₂, assisted ventilation), length of hospital stay and neonatal death. History, examination and

investigations as a complete blood count, c reactive protein, blood culture and chest x ray were carried out in the NCU to find out various etiologies of RD. All neonates were followed until discharged from NCU.

Statistical methods

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 20. The Chi square was used to assess the association between the data. The continuous data were represented by mean and standard deviation. Student's T test and Analysis of variances (ANOVA) tests were used to compare mean values between study groups; P- value of less than 0.05 was used as significance.

Results

Overall 4115 live born singletons were delivered at Baghdad teaching hospital-medical city, between 1st of September 2015 till 31st of January 2016, 2711 women with pregnancy of GA from 37 to 41 completed weeks, with uncomplicated pregnancy were identified who underwent ECS and SVD. Women who underwent ECS were 1407 (51.9%) and for SVD were 1304 (48.1%).

The GA at delivery was the important factor to determine the risk of RD, which was significantly higher with younger GA (p=0.05). The commonest indication for ECS was previous CS for both group, the rate was 99% for those with RD (p=0.002), and one was malpresentation (1%). The mean birth weight of infants born by ECS was significantly lower for those with RD which was 2.757 (p=0.04). Males delivered by ECS were more at risk to develop RD (58.4%) than female (41.6%) (Table 1).

Variables	No Respiratory Distress (N=1299)	With Respiratory Distress (N=108)	P value
Maternal age	32 ± 4.8	33 ± 4.9	0.8
Gestational age (weeks)	38 ± 0.6	37 ± 0.4	0.05
Birth weight (g).	2.815 ± 0.343	2.757 ± 0.355	0.04
Indication for ESC			
Previous CS	1160 (89%)	107 (99%)	0.002
Malpresentation	130 (10%)	1 (0.9%)	
Maternal request	9 (0.7%)	0 (0)	
Gender	Male	717 (55.2%)	0.3
	Female	582 (44.8)	
		45 (41.6%)	

Table 1: Demographic maternal and neonatal information and the characteristics of ESC singleton deliveries at term with or without RD.

The risk of RD in infants delivered by ECS significantly higher than those delivered by SVD (11 folds higher, Odd ratio (OR) 11.12 (5.61 to 22.04) and p-value <0.0001. Adjustment for potential confounding variables (AOR) which was adjusted for neonates' birth weight, gender and requirement assisted ventilation not change the estimated risk. Bivariate analyses were repeated for pregnancies with low risk, also

resulted in high risk estimates of RD. AOR at 37 weeks was 4.61 (2.04 to 10.73), AOR at 38 weeks was 16.89 (1.93 to 117.31), AOR at 39 weeks was 6.27 (1.01 to 28.97). The risk also increased at 39 and 40 weeks (Table 2).

Gestational Age		No. of deliveries	Infants with RD No. (%)	OR (95% CI)	AOR (95%CI)	p-values
(37 ⁰ -37 ⁺⁶)	ECS	603	75 (12.4)	4.99 (2.27 to 10.99)	4.61 (2.04 to 10.73)	0.0001*
	SVD	253	7 (2.8)	Reference	Reference	
(38 ⁰ -38 ⁺⁶)	ECS	460	21 (4.3)	17.73 (2.37 to 132.71)	16.89 (1.93 to 117.31)	0.005*
	SVD	391	1 (0.3)	Reference	Reference	
(39 ⁰ -39 ⁺⁶)	ECS	209	8 (3.8)	6.33 (1.33 to 30.1)	6.27 (1.01 to 28.97)	0.02*
	SVD	320	2 (0.6)	Reference	Reference	
(40 ⁰ -40 ⁺⁶)	ECS	106	4 (1.9)	-	-	-
	SVD	235	0 (0)	-	-	
(41 ⁰ -41 ⁺⁶)	ECS	29	0 (0)	-	-	-
	SVD	105	0 (0)	-	-	
Over all	ECS	1407	108 (7.7)	11.12 (5.61 to 22.04)	8.55 (4.96 to 14.52)	<0.0001*
	SVD	1304	10 (0.7)	Reference	Reference	

OR=Odds ratio, CI=Confidence interval, AOR=Adjusted odds ratio
*Significant at 0.05 level.

Table 2: Odds ratios of neonatal RD delivered by ESC, according to GA at delivery.

According to GA at delivery the risk of RD was calculated to every week of pregnancy at the time of ECS. It was found that increasing the risk of RD in infants born by ECS with decreased GA from 37 weeks to 40 weeks, there was about four folds increased the risk for 37 weeks

than 39 weeks (p<0.001) and more than one fold (1.2) for 38 weeks than 39 weeks, and the risk of RD was nearly the same at 40 weeks of GA (3.8%) (Table 3).

Gestational age	Total (N=1407)	Adverse respiratory events (N=108)	OR (95% CI)	p-value
37 ⁰ -37 ⁺⁶	603	75 (12.4)	3.57 (1.697.53)	<0.001*
38 ⁰ -38 ⁺⁶	460	21 (4.6)	1.2 (0.522.76)	0.501
39 ⁰ -39 ⁺⁶	209	8 (3.8)	1 (Reference)	-
40 ⁰ -40 ⁺⁶	106	4 (3.8)	1 (0.293.35)	0.392
41 ⁰ -41 ⁺⁶	29	0 (0)	-	-

OR=Odds ratio, CI=Confidence interval
*Significant at 0.05 level.

Table 3: The risk of neonatal RD, according to GA at delivery for ECS.

The rate of both TTN and RDS decreased as GA advanced in infants delivered by ECS but the relation was statistically not significant. Only one Pneumothorax developed at 37 weeks (0.1%). The rate of

requirement of respiratory support (oxygen supplement, CPAP, MV) was significantly decreased with increased GA in infants delivered by ECS, as shown in Table 4.

A-Diagnoses	Gestational age at delivery/weeks No (%)					p-value
	37 ⁰ -37 ⁺⁶ N=603	38 ⁰ -38 ⁺⁶ N=460	39 ⁰ -39 ⁺⁶ N=209	40 ⁰ -40 ⁺⁶ N=106	41 ⁰ -41 ⁺⁶ N=29	
TTN	59(9.7%)	18(3.9%)	7(3.3%)	4(3.7%)	0(0%)	0.9
RDS	0(0%)	0(0%)	1(0.4%)	3(0.6%)	15(2.4%)	

Pneumothorax	0(0%)	0(0%)	0(0%)	0(0%)	1(0.1%)	p-value
B-Respiratory Support	Gestational age at delivery/weeks No (%)					
	37 ⁰ -37 ⁺⁶ N=603	38 ⁰ -38 ⁺⁶ N=460	39 ⁰ -39 ⁺⁶ N=209	40 ⁰ -40 ⁺⁶ N=106	41 ⁰ -41 ⁺⁶ N=29	
Oxygen supplement	0(0%)	3(2.8%)	6(2.8%)	14(3%)	19(3.1%)	0.004
CPAP	0(0%)	1(0.9%)	2(0.9%)	6(1.3%)	46(7.6%)	
MV	0(0%)	0(0%)	0(0%)	1(0.2%)	10(1.6%)	

Table 4: The relation between (type of respiratory support, diagnosis) & GA in infants of ECS.

Discussion

The frequency of delivery by ECS increased over the past 30 years, due to different causes of which changes of breech management, previous CS, medical illness of the mother, fetal cause, and maternal request [13], while results from studies on the importance of timing of ECS consistently showed increased risk of RD with decreasing GA such as Zanardo et al. [14], Van de berg et al. [15] Morrison et al. [16].

Most ECS were decided according to the clinician's opinion, a request from the parents and the availability of a theater, but there are major implications in the timing of ECS at term, since the incidence of RD could be halved for each additional week of pregnancy [17].

Male delivered by ECS more to be at risk of RD, this is consistent with Dani C [18] study, which show that male gender was a one of risk factor for RD; which explained by the hypothesis of later maturation of male fetuses who has poor ability to react to stress, inflammation response, and their blood pressure regulation [18,19].

Previous CS was the commonest indication for ECS in this study. The rate was 99% for those with RD, and one was malpresentation (1%), these percentages were not similar to Kayoka et al. study [20], who reported that previous CS as indication for ECS, represented 70% among infants with RD (Table 1). The mean birth weight of infants of ECS was significantly lower in infants with RD as in others studies, Kayoka et al. [20], Tita et al. [21], Alawkati et al. [22].

This study showed eleven folds risk increment of RD in neonates delivered by ECS compared to those were delivered vaginally. The RD risk after ECS in each week of gestation was compared with the risk after SVD, the risk was five folds at 37 weeks higher, seventeen folds at 38 weeks higher, six folds at 39 weeks higher, (Table 2), which was consistent by others studies, Zanardo [14], Van de berg [15], Morrison [16], Alawkati [22]. Morrison et al. [16] found that RD risk was increased 7 times by ECS, when stratified by gestational age, the risk decreased from 14 fold higher after 37 completed weeks of gestation to 3.5 fold after 39 completed weeks of gestation. Zanardo [14] also show a three folds increased risk with ECS delivery, this risk was peaked at 37, 38 completed weeks of gestation. Al Awqati [22] reported overall neonatal RD risk was significantly higher three to five folds in ECS delivery. In SVD there is a decrease secretion of liquid inside fetal lung with increased its absorption and the stimulation of surfactant release [23-25].

This study also showed that an important factor in determining respiratory morbidity of the newborn who were delivered by ECS was the gestational age at time of delivery; as there was a progressive increased rate of RD with each less week of gestation [26], while no significant difference at 39, 40 weeks (3.8%) at 37 week four folds 75/603 (12.4%) higher, at 38 week more than one fold 21/460 (4.6%) higher, (Table 3) this is consistent with others studies that stratified results by gestational age, as in Wilminck study [27], Tita [21], Doan [28]. Previous studies [21,27,28] had similar aim of this study but they have different definition of ECS, exclusion criteria, choice of adverse outcomes, analysis by individual weeks of gestation and comparison with vaginal birth, making it difficult to directly compare this study with others. However, despite differing methodologies, the results of this study, which are similar with their results, when comparing the primary outcomes (which means in their study the RD that comprising all neonates admitted to NCU and receiving oxygen therapy or assisted ventilation (MV and/or CPAP) by Tita [21], the rate of adverse respiratory outcomes at week 37 (AOR 2.5; 95% CI 1.9-3.3) and week 38 (AOR 1.7; 95% CI 1.4-2.1), two to three folds, compared to week 39.

Also Wilminck [27], reported a two to three folds increased risk of RD at week 37 (AOR 3.2; 95% CI 2.5-4.2) and week 38 (AOR 1.7; 95% CI 1.4-2.1), compared to week 39, including combined respiratory outcomes (RDS,TTN,MV,CPAP, and neonatal death) which is similar to this study. Doan [28], reported early term (defined gestational age from week 37-38), was compared to full term (defined gestational age from week 39-41), (AOR 1.23-4.03), the risk increased two to four folds, the RD comprising all 36 neonates admitted to NCU with a RD (which included RDS, TTN, pneumothorax) and receiving assisted ventilation with MV and/or CPAP and neonatal death, which similar to this study.

When the results were stratified by gestational age from 37 weeks to 40 weeks, the rate of both TTN and RDS diminished for each week of gestation increased, the rate of TTN was from 59/603 (9.7%) at 37 weeks to 7/209 (3.3%) at 39 weeks and 4/106 (3.7%) at 40 weeks, while RDS decreased from 15/603 (2.4%) at 37 weeks to 1/209 (0.4%) at 39 weeks and no RDS at 40 weeks (Table 4).

This study also showed significantly increased risk of required assisted ventilation (CPAP, MV) with earlier gestational age in infants of ECS. The rate of requiring CPAP was 46/603 (7.6%) at 37 weeks, 6/460 (1.3%) at 38 weeks, 2/209, 1/106 respectively (0.9%) at 39 weeks and 40 weeks, while ten infants required MV were at 37 weeks and one

at 38 weeks and no one required at 39 weeks and 40 weeks, (Table 4), these findings were consistent with studies, such as Van de berg [15], Wilmlink [27], Doan [28].

The length of the hospital stay was increased with decreased gestational age in infants of ECS, this is consistent with the study that was done by Tita [21] Six infants 6/108 (5.6%) died of those delivered by ECS, who admitted to neonatal department, all of them were delivered at 37 weeks, no death recorded among those who were delivered by SVD.

Conclusions

A term neonate delivered by elective caesarean section is at increased risk for developing RD compared vaginal delivery. A significant reduction of respiratory morbidities would be obtained if elective caesarean delivery were done after 39 completed weeks of gestation.

Authors Contribution

Asmaa Ghanim Tahir: Collecting of data through interview with families who's their newborns and mothers were involved in the samples, sharing and analysis of the result.

Manal Behnam Baythoon: Suggesting the problem and sharing with analysis and getting the ethical consents.

Yasir Ibrahim Al Saddi: Discussing the result and writing the manuscript.

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