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Original Research Article

Neonatal outcomes of elective caesarean section at term without prophylactic use of antenatal corticosteroids

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ABSTRACT

Background: We aimed to describe the outcomes of neonates born at or near term to women undergoing elective C-section without prophylactic corticosteroids.
Methods: Single-centre retrospective observational study of neonates born between 36+0 and 42+0 weeks. Associations between neonatal complications and maternal and neonatal factors were evaluated by univariate analyses and multivariate logistic regression.
Results: A total of 2151 (26%) neonates were born by elective C-section during the study period, of whom 429 were included in the study. Fifty-six (13.05%) neonates developed some complication with 39 (9.1%) requiring NICU admission. Respiratory distress syndrome (RDS) and hypoglycemia occurred in 21 (4.9%) and 7 (1.6%) neonates, respectively. Maternal age >35 was associated with higher odds of neonatal complications (OR: 5.52, 95% CI: 1.02-29.74, p=0.047).
Conclusions: The rate of RDS was comparable to other reported studies. The study revealed a high rate of term elective C-sections, providing grounds for conducting further research on administering antenatal corticosteroid to this population to reduce new-born morbidities.

Keywords: Antenatal care, Corticosteroids, Caesarean Section, Infant, New-born, Respiratory Distress Syndrome, Transient Tachypnoea of the New-born

INTRODUCTION

Over the last few decades, the rate of cesarean section has steadily increased all over the world.[1] In Pakistan, the proportion of neonates delivered by C-section rose substantially from 14% in 2012-2013 to 22% in 2017-2018, and rates as high as 49% were reported in women with higher education and those belonging to the highest socioeconomic stratum.[2] While C-section is a life-saving procedure in certain cases, it may pose a greater risk of maternal and neonatal morbidity and mortality in the absence of obstetric indications.[3] In mothers, it can increase the risk of hemorrhage, uterine rupture, and major infection.[4] In neonates, elective C-section is independently associated with a greater incidence of transient tachypnea of the newborn (TTN) and respiratory distress syndrome (RDS).[5,6] This, in turn, may extend the duration of hospital stay, increase the number of interventions, impact mother-infant bonding, and raise healthcare costs.[7] Antenatal corticosteroids (ACS) play an important role in accelerating fetal lung maturation.[8] A large body of evidence shows that treatment with ACS before anticipated preterm birth decreases the risk of perinatal and neonatal death, RDS, and other measures of adverse neonatal outcomes.[9] They are therefore considered a standard of care in women at risk of delivering between 24+0 and 33+6 weeks of gestation.[10,11] However, the effectiveness of this intervention remains controversial in several understudied subgroups, including neonates born at term gestation by C-section.[12]

The international guidelines on the role of ACS in elective C-section are varying and limited. The American College of Obstetricians and Gynecologists (ACOG) and the World Health Organization (WHO) do not provide any recommendations for planned C-section beyond 36+6 weeks' gestation.[10,13] The Royal College of Obstetricians and Gynaecologists (RCOG) specify that ACS in these cases should only be used with informed consent of women after potential risks and benefits associated with ACS are explained.[14] New Zealand and Australian guidelines state that there is insufficient evidence to administer ACS in term C-section deliveries but provide practice points for their use if fetal lung immaturity has been diagnosed prior to C-section.[15] It is crucial to understand the impact of C-section on neonates before any recommendations on administering ACS can be developed. The purpose of this study was to document the demographics and outcomes of neonates born at term by C-section without antenatal ACS therapy.

METHODS

Study design

We conducted a retrospective chart review of elective C-section cases at the Aga Khan University Hospital from January 2012 till December 2013. We included all deliveries that occurred during this period by elective caesarean section between 36+0 and 42+0 weeks of gestation. All women included in the study were low risk. Neonates with major congenital malformations were excluded. Women with medical disorders like diabetes and hypertension, having multiple births, and undergoing emergency C-section or planned caesarean section for intrauterine growth restriction were also excluded. A prior approval from the university's Ethical Review Committee was obtained (ref no: 2260-Obs-ERC-12).

Study sample and data collection

Information about mothers and neonates was retrieved from medical record files and hospital information management database system (HIMS). Medical record files and hospital electronic records were reviewed manually and data were documented on a standard questionnaire. Entered data were rechecked by the study investigators for quality control. Gestational age was recorded by LMP and verified by dating ultrasonography where available. The questionnaire included information about the current pregnancy, maternal obstetric history, and pregnancy outcomes, which included baby's birth weight, Apgar score, delivery room treatment, length of hospital stays, respiratory support, and any neonatal complications.

Study outcomes

Neonatal complications included NICU admission, RDS, and hypoglycemia. All diagnoses were made at the time of the baby's discharge by the attending physicians. Diagnosis of each neonatal complication was based on clinical definitions and the institutional guidelines, which are as follows:

Respiratory distress syndrome: An acute lung disease of the newborn characterized by rapid breathing, flaring of the nostrils, inelastic lungs, edema of the extremities, and in some cases the formation of a hyaline membrane on the lungs. A chest x-ray, reviewed by a radiologist, was the basis of diagnosis16.

Neonatal hypoglycemia

Target Blood glucose concentration (taken through Glucometer) <50mg/dl before 48 hours, and <60 after 48 hours of age 17.

Statistical analysis

A sample size of 400 was required when taking the anticipated frequency of respiratory morbidity as 3.7±1.85%18 and confidence level at 97%. Statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) version 19 (IBM, Armonk, NY). Continuous variables were reported as means (SD) and categorical variables were reported as frequencies (percentages). Univariate analyses and multivariate logistic regression were performed to evaluate the association of individual and composite neonatal complications with maternal and neonatal factors. P<0.05 was considered significant. The results were reported as odds ratios and 95% CI.

RESULTS

During the study period, a total of 8048 deliveries took place, of which 2151 (26%) were by elective C-sections, and 429 were included in the study. The demographic characteristics of mothers and neonates are summarized in table 1. The mean age of the mothers was 29.51±4.7 years and the mean gestational age was 37.99±0.95 weeks. The mean birth weight of the newborns was 3.02±0.42 kg and the length of NICU stay was 2±0.68 days. Our results showed that 55 (13.3%) neonates developed some complication with 38 (8.8%) requiring NICU admission. The frequency of respiratory distress was 4.6% (n=20) and that of hypoglycemia was 1.6% (n=7).

Table 1: Demographic characteristics of the maternal and new-born dyad (n=412).

Demographic characteristics	Values
Age (years), mean ± SD	29.50±4.71
<25	67 (16.3%)
25-35	299 (72.6%)
>35	46 (11.2%)
Height (cm), mean ± SD	156.39±5.75
Weight (kg), mean ± SD	74.04±12.95
Body Mass Index (kg/m^2), mean ± SD	30.31 ± 5.31
Underweight (<18.9 kg/m^2)	1 (0.2%)
Normal (18.91-25.0 kg/m^2)	56 (13.6%)
Overweight (25.1-29.99 kg/m^2)	148 (35.9%)
Obese (≥ 30 kg/m^2)	207 (50.2%)
Indication for CS	
Maternal wish	19 (4.6%)
Previous scar	310 (75.2%)
Abnormal presentation	41 (10.0%)
CPD	11 (2.7%)
Placental abnormality	12 (2.9%)
Maternal comorbid	13 (3.2%)
Others	6 (1.5%)
Gestational age (weeks), mean ± SD	38.07 ± 0.87
37	104 (25.2%)
38	208 (50.5%)
39	72 (17.5%
40	22 (5.3%)
41	6 (1.5%)
Parity, mean ± SD	0.57 ± 0.02
Primiparous (Parity =1)	68 (16.5%)
Multiparity (Parity (2 - 4))	330 (88.1%)
Grand mulit (Parity ≥ 5)	14 (3.4%)
Child's weight (kg)	3.03 ± 0.42
Low birth weight (<2500 gm)	31 (7.5%)
Normal birth weight (≥ 2500 gm)	381 (92.5%)
NICU admission (days), mean ± SD	2.02 ± 0.67
1	5 (13.2)
2	30 (78.9)
4	3 (7.9)
Hospital length of stay (days), mean ± SD	2.95 ± 0.79

Data presented as mean ± SD and n (%)

Table 2: Factors associated with any complication.

	Any complications		Univariate analysis		Multivariate analysis	
	No	**Yes**	**OR (95% CI)**	**P value**	**OR (95% CI)**	**P value**
N	357	55				
Age (years)	29.15 ± 4.50	31.80 ± 5.38				
<25	63 (17.6%)	4 (7.3%)	Ref.		Ref.	
25-35	262 (73.4%)	37 (67.3%)	2.22 (0.77, 6.47)	0.142	2.21 (0.65, 7.54)	0.206
>35	32 (9.0%)	14 (25.5%)	6.89 (2.1, 22.65)	0.001	8.07 (1.91, 34)	0.004
Body Mass Index (kg/m^2)	30.45 ± 5.19	29.41 ± 6.0				
Underweight (<18.9	1 (0.3%)	0 (0.0%)	---		---	

Continued.

	Any complications		Univariate analysis		Multivariate analysis	
kg/m²)						
Normal (18.91-25.0 kg/m²)	43 (12.0%)	13 (23.6%)	Ref.		Ref.	
Overweight (25.1-29.99 kg/m²)	131 (36.7%)	17 (30.9%)	0.43 (0.19, 0.96)	0.038	0.46 (0.16, 1.35)	0.158
Obese (≥ 30 kg/m²)	182 (51.0%)	25 (45.5%)	0.45 (0.22, 0.96)	0.039	0.82 (0.3, 2.27)	0.703
Gestational age (weeks)	37.92 ± 0.67	39.05 ± 1.31	4.14 (2.84, 6.03)	<0.001	4.45 (2.92, 6.78)	<0.001
Parity						
Primiparous (Parity =1)	66 (18.5%)	2 (3.6%)	Ref.		Ref.	
Multiparity [Parity (2 - 4)]	279 (78.1%)	51 (92.7%)	6.03 (1.43, 25.41)	0.014	5.36 (1.22, 23.48)	0.026
Grand mulit (Parity ≥ 5)	12 (3.4%)	2 (3.6%)	5.5 (0.70, 42.9)	0.104	7.61 (0.77, 75.27)	0.083
Child's Weight (kg)	3.01 ± 0.41	3.16 ± 0.47				
Low birth weight (<2500 gm)	28 (7.8%)	3 (5.5%)	0.68 (0.2, 2.31)	0.534	1.38 (0.29, 6.61)	0.684
Normal birth weight (≥ 2500 gm)	329 (92.2%)	52 (94.5%)	Ref.		Ref.	

Data presented as mean ± SD and n (%) Ref. = Reference category, OR= Odds ratio, CI =Confidence Interval

Table 3a: Factors associated with respiratory distress syndrome.

Factors	Respiratory distress syndrome		
	No (N=408)	**Yes (N=21)**	**P value**
Maternal factors			
Age (years)	29.40 ± 4.61	31.57 ± 5.90	0.04
<25	68 (16.7%)	2 (9.5%)	0.03
25-35	298 (73.0%)	13 (61.9%)	
>35	42 (10.3%)	6 (28.6%)	
Body mass index (kg/m²)	30.18 ± 5.26	32.21 ± 5.54	0.09
Underweight (<18.9)	1 (0.25%)	0 (0%)	0.12
Normal (18.91-25.0)	58 (14.2%)	1 (4.8%)	
Overweight (25.1-29.99)	149 (36.5%)	5 (23.8%)	
Obese (≥ 30)	200 (49%)	15 (71.4%)	
Parity	0.56 ± 1.00	0.57 ± 1.29	0.96
Nulliparous (Parity =0)	69 (16.91%)	2 (9.53%)	0.14
Multiparous (Parity 1 - 2)	283 (69.4%)	13 (61.9%)	
Multiparous (Parity ≥ 3)	56 (13.7%)	6 (28.6%)	
Neonatal factors			
Gestational age (weeks)	38.00 ± 0.96	37.86 ± 0.79	0.51
Child's weight (kg)	3.01 (0.42)	3.06 (0.50)	0.59
Underweight [5th percentile (< 2.5)]	33 (8.1%)	1 (4.8%)	0.67
Normal [6-94th percentile (2.5-3.7)]	352 (86.3%)	18 (85.7%)	
Overweight [95th percentile (≥ 3.8)]	23 (5.6%)	2 (9.5%)	

Data presented as mean ± SD and n (%)

Table 3b: Factors associated with hypoglycemia.

Factors	Hypoglycemia		
	No (N=422)	**Yes (N=7)**	**P value**
Age (years)	29.39 ± 4.63	36.86 ± 2.67	<0.001
<25	70 (16.6%)	0 (0.0%)	0.02
25-35	307 (72.7%)	4 (57.1%)	
>35	45 (10.7%)	3 (42.9%)	

Continued.

Factors	Hypoglycemia		
Body mass index (kg/m^2)	30.28 ± 5.30	30.30 ± 4.88	0.99
Underweight (<18.9)	1 (0.24%)	0 (0%)	0.92
Normal (18.91-25.0)	58 (13.7%)	1 (14.3%)	
Overweight (25.1-29.99)	152 (36.0%)	2 (28.6%)	
Obese (≥ 30)	211 (50%)	4 (57.1%)	
Gestational age (weeks)	38.00 ± 0.96	37.71 ± 0.49	0.44
Parity	0.55 ± 0.99	1.29 ± 1.89	0.06
Nulliparous (Parity =0)	71 (16.82%)	---	0.34
Multiparous Parity 1 – 2	291 (68.9%)	5 (71.4%)	
Multiparous (Parity ≥3)	60 (14.22%)	2 (28.6%)	
Neonate's weight (kg)	3.02 ± 0.43	2.84 ± 0.26	0.27
Underweight [5th percentile (< 2.5)]	33 (7.8%)	1 (14.3%)	0.68
Normal [6-94th percentile (2.5-3.7)]	364 (86.3%)	6 (85.7%)	
Overweight [95th percentile (≥ 3.8)]	25 (5.9%)	0 (0.0%)	

Results of univariate analysis and multivariate logistic regression of risk factors for any neonatal complication are shown in Table 2. Univariate analysis demonstrated that maternal age >35 years at elective C-section, higher gestational age, and multiparity were associated with an increased risk of neonatal complications whereas maternal BMI between 25.1 and 29.99 kg/m^2 and greater than 30 kg/m^2 were associated with a decreased risk of neonatal complications. On multivariate logistic regression, maternal age >35 years (OR: 8.07, 95% CI: 1.91-30, p=0.004), gestational age (OR: 4.45, 95% CI: 2.92-6.78, p<0.001), and multiparity (OR: 5.36, 95% CI: 1.22-23.48, p=0.026) were significantly associated with an increased risk of neonatal complications. Factors associated with RDS and hypoglycemia are presented in tables 3a and 3b respectively.

DISCUSSION

This study reported the prevalence of neonatal complications following term and near-term elective cesarean delivery. We found that 26% of all deliveries during the study period occurred by planned C-section. RDS and hypoglycemia were seen in 4.9% and 1.6% of neonates in our study population. Approximately 9% of the neonates required a NICU admission and the average length of hospital stay was 3 days. The odds of having individual and composite complications were higher in neonates born to multiparous mothers and mothers older than 35 years, and in neonates with a greater gestational age.

The proportion of neonates in our study population who developed RDS is comparable to other studies that reported a prevalence between 2.2% and 5.4%.[19-21] A recent Cochrane review including data from 3596 women and 3893 infants enrolled in four trials reported that ACS reduced the risk of RDS and TTN by more than 50% and admission to special care units by nearly 60%.[21] However, the quality of this evidence was rated as low and the authors concluded that further high-quality trials with larger sample sizes are needed to determine the true effect of ACS in term cesarean delivery. Moreover, as the incidence of these complications is low, the absolute benefits derived from ACS therapy may be small and statistical significance may not translate into clinical significance.[21]

The long-term impact of ACS therapy is a further potential concern. Newer evidence suggests that ACS may impose deleterious effects on neonates, which include hypoglycemia and potential developmental delay. It is also uncertain if ACS reduces the risk of NICU admission in neonates born beyond 37 weeks of gestation.[22] While the benefits of ACS out-weigh potential harms in premature neonates and have been recommended in this population, further study is warranted to determine the safety and efficacy of this intervention in late preterm and term neonates23. At the same time, the provision of at least a minimum standard of care seems to be crucial in achieving benefits while preventing harms from ACS23, warranting further studies in low-resource settings where neonatal intensive care may be unavailable24.

Our study revealed a high rate of elective C-section, majority of which occurred before 39 weeks' gestation. The proportion of women undergoing elective C-sections in our study population was 26%, compared to the national average of 22%, which does not differentiate between elective and emergency surgeries. This may be related to the fact that cesarean deliveries are more frequent in the private sector compared to the public sector in LMICs and commonly occur due to previous C-section, as was the case in our study.[25-7] More than three quarters of the women delivered before 39 weeks and 4% of the deliveries occurred at 36 weeks despite international guidelines recommending delaying planned cesarean births till 39 weeks wherever possible to reduce the risk of respiratory morbidity and other complications.[10,15] Maternal age, multiparity, and gestational age were factor associated with RDS, hypoglycemia or the composite outcome of any complication in our study. Although advanced maternal age is a well-established risk factor for adverse pregnancy outcomes, studies inconsistently demonstrate an increased likelihood of a wide range of complications, including hypoglycemia, NICU admission, RDS prolonged ventilation and C-section.[28-34] The differing results may be due to the heterogeneity of study designs and variations in the definition of advanced maternal age, inclusion criteria, and outcomes measured.

Only 9% of the neonates in the present study required NICU admission. This proportion was lower than that reported by other publications, which showed neonatal intensive care admission rates between 10 and 22%.[35,36] This difference may be due to the varying admission criteria used by the hospitals that are, in turn, influenced by the local guidelines and protocols, the level of care provided, and the type of obstetric population catered.

Because this was a retrospective study, some confounders or unmeasured variables may have led to biases. For example, sex of the neonate was not considered, even though some evidence suggests that male sex is associated with a higher risk of adverse outcomes.[37,38] Although we attempted to exclude high-risk pregnancies, some women had placental abnormalities or maternal comorbidities which led to an elective C-section, which may be considered confounders. In addition, the study design prevents identification of a causal relationship between ACS and neonatal complications.

CONCLUSION

Our findings aid in determining the prevalence of neonatal complications in term and near-term planned caesarean deliveries without antenatal ACS therapy in a tertiary care unit of a LMIC. We demonstrate a low rate of RDS which was comparable to other studies. Considering the current data which also favors the uncertainty in any reduction in RDS, TTN and NICU admission overall and association with hypoglycemia in pregnancy and developmental delay in newborn warrant a cautious approach in administering antenatal steroids after 37 weeks of pregnancy. Robust population-based trials specific to low-resource settings are needed to determine the use of ACS in term planned C-sections.

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