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Original Research Article

Effect of antenatal corticosteroids on neonatal respiratory outcomes in term singleton pregnancies undergoing elective cesarean section: a prospective cohort study

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ABSTRACT

Background: Elective cesarean section (ECS) at term prior to labor onset is associated with a heightened risk of neonatal respiratory complications compared to vaginal delivery. The routine use of prophylactic antenatal corticosteroids (ACS) in early-term scheduled deliveries remains controversial.
Methods: An institutional-based, open-label prospective cohort study was conducted at Umaid Hospital, Dr. SN Medical College, Jodhpur (February 2025 to July 2025). Pregnant women aged >37 to <39 weeks scheduled for elective CS were consecutively enrolled (n=104). The intervention group (group A, n=52) received intramuscular Dexamethasone (6 mg every 12 hours for 4 doses) at least 48 hours prior to surgery. The control group (group B, n=52) received standard care without steroids.
Results: Baseline demographic and maternal characteristics (age, religion, socioeconomic status, residency, BMI, gravida, and gestational age) were statistically comparable between both cohorts (p>0.05). The mean maternal age was 26.90±6.09 years in the steroid cohort versus 27.02±6.11 years in the non-steroid cohort (p=0.922). Cephalopelvic disproportion (CPD) was the leading surgical indication (26.9%).
Conclusions: Prophylactic administration of antenatal dexamethasone to mothers undergoing elective cesarean sections between 37 and 39 weeks of gestation significantly optimizes early neonatal APGAR scores.

Keywords: Antenatal corticosteroid, APGAR, RDS, Prematurity

INTRODUCTION

Worldwide cesarean section (CS) rates have risen drastically over the past decade, frequently exceeding the World Health Organization's recommended target threshold of 10–15%. While medically indicated CS mitigates maternal risk in high-risk scenarios, elective cesarean section (ECS) performed prior to the onset of labor significantly spikes the vulnerability of term neonates to acute respiratory morbidities.[1,2] Term infants (≥ 38^{+0} weeks) born via planned elective CS are highly susceptible to transient tachypnea of the Newborn (TTN), respiratory distress syndrome (RDS) and acute respiratory failure compared to those delivered vaginally.[3,4]

Physiological labor triggers neurohormonal surges that clear alveolar fluid via the activation of specialized epithelial sodium channels (Na^+). ECS bypasses this vital transitional pathway, leading to persistent fluid retention. Antenatal corticosteroids mimic this natural phenomenon by upregulating channel gene expression, enhancing catecholamine responses and driving surfactant production. While the efficacy of ACS before 34 gestational weeks is universally accepted, its role in reducing respiratory morbidity during early-term elective

deliveries remains heavily debated due to sparse trial consensus and competing concerns over potential long-term neurodevelopmental effects. This study evaluates the impact of antenatal dexamethasone on early neonatal clinical profiles within an early-term Indian cohort.[5-7]

METHODS

Study setting and design

This prospective cohort study was conducted in the Department of Obstetrics and Gynaecology at Umaid Hospital, Dr. SN Medical College, Jodhpur, India. The clinical trial spanned a six-month window from February 2025 to July 2025. Institutional Ethics Committee clearance and written informed consent were obtained from all participants prior to enrollment.

Study population and selection criteria

The sample population comprised term pregnant women scheduled for elective cesarean section. Using a consecutive, non-probability sampling methodology to avoid selection bias, a final sample size of 104 subjects was achieved (n=52 per arm).

Inclusion criteria: Maternal age >37 weeks to <39 weeks; planned elective CS without signs of labor.

Exclusion criteria: Prior corticosteroid exposure before 34 weeks; emergency CS; multiple gestations; oligohydramnios/polyhydramnios; intrauterine growth restriction (IUGR); pre-operative infections; and severe maternal medical/surgical conditions (e.g., gestational diabetes, pre-eclampsia, hypothyroidism, heart or renal disease).

Intervention protocol

Enrolled participants were allocated into two parallel groups based on their clinical deployment:

Group A (steroid group): Received an intramuscular course of dexamethasone (6 mg IM every 12 hours for 4 doses) initiated at least 48 hours prior to the scheduled surgery. Surgery was executed exactly 24 hours after the final dose.

Group B (non-steroid/control group): Managed with standard operative care without any corticosteroid administration.

Outcome measures and statistical analysis

The primary outcome was the incidence of neonatal respiratory morbidity (RDS, TTN graded via Downes/Silverman-Anderson metrics). Secondary metrics evaluated neonatal intensive care unit (NICU) admission rates, maternal sepsis and neonatal APGAR scores at 1 and 5 minutes.

Statistical profiling was executed using SPSS Version 20.0. Continuous variables were verified for normality and analyzed using unpaired Student's t-tests or Mann-Whitney U tests. Categorical matrices were handled via Chi-Square or Fisher's Exact tests . Significance levels were designated as $p<0.05$ (*) and $p<0.01$ (**).

RESULTS

Baseline maternal and demographical data

The baseline demographic profile demonstrated a highly uniform distribution across both groups, confirming confounding control ($p>0.05$).

Table 1 shows that mean age of study subjects in both the groups were comparable (26.90±6.09 years in steroidal group versus 27.02±6.11 years in non-steroidal group. The majority of subjects fell within the 21–25 age bracket (25.0%) (Table 2).

Lower-middle class socioeconomic distribution predominated (41.3%), and the majority resided in rural areas (58.7%). Mean BMI values were strictly identical (21.12±1.56 kg/m² vs. 21.25±1.37 kg/m²; p=0.519). Most participants were multigravida (66.3%) with a minimal history of abortion (17.3%). The mean gestational age at delivery was 37.38±0.49 weeks for the steroid arm and 37.52±0.50 weeks for controls (p=0.170).

Surgical indications and neonatal demographics

Surgical distributions presented distinct clinical profiles (p=0.043). Cephalopelvic disproportion (CPD) represented the most frequent overall presentation (26.9%), followed closely by breech presentation (26.0%) and previous scarring from a prior LSCS (31.7%). General neonatal sex profiling showed a slight female preponderance overall (53.8% female vs 46.2% male; p=0.694).

Clinical neonatal outcomes (APGAR scores)

Neonates whose mothers received dexamethasone displayed statistically superior physiological stability directly following birth compared to their unexposed counterparts (Table 4).

At 1 minute of life, 67.3% of the steroid group achieved optimal APGAR metrics (9–10) compared to only 57.7% in the control arm (p=0.040). This clear benefit persisted at 5 minutes, where 80.8% of dexamethasone-exposed neonates scored a perfect 10, whereas the non-steroid group lagged behind at 71.2% (p=0.043) (Table 5).

Table 6 shows that the incidence of TTN was higher in non-steroidal group as compared to steroidal group (9.6% (n=5) in non-steroidal group and 3.8% (n=2) in steroidal group but the difference was not statistically significant.

Table 7 shows that the incidence of RDS was higher in non-steroidal group as compared to steroidal group (5.8% (n=3) in non-steroidal group and 1.9% (n=1) in steroidal group but the difference was not statistically significant.

Table 1: Comparison of mean age of study group.

Parameters	Category			P value
	Steroid group	Non-steroid group	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
Age (years)	26.90±6.09	27.02±6.11	26.96±6.07	0.922

Table 2: Comparison of age distribution of study group.

		Category						P value
		Steroid group		Non-steroid group		Total		
		No.	%	No.	%	No.	%	
Age category (years)	≤20	11	50.0	11	50.0	22	21.2	0.999
	21-25	13	50.0	13	50.0	26	25.0	
	26-30	13	52.0	12	48.0	25	24.0	
	31-35	10	47.6	11	52.4	21	20.2	
	>35	5	50.0	5	50.0	10	9.6	
	Total	52	50.0	52	50.0	104	100.0	

Table 3: Comparison of study group according to socio-economic distribution.

		Category						P value
		Steroid group		Non-steroid group		Total		
		No.	%	No.	%	No.	%	
Socio-economic status	Lower	13	50.0	13	50.0	26	25.0	0.990
	Lower middle	22	51.2	21	48.8	43	41.3	
	Upper class	5	55.6	4	44.4	9	8.7	
	Upper lower	5	45.5	6	54.5	11	10.6	
	Upper middle	7	46.7	8	53.3	15	14.4	
	Total	52	50.0	52	50.0	104	100.0	

Table 4: APGAR score at 1 minute stratification between cohorts.

APGAR 1-Minute [n (%)]	Steroid group (n=52)	Non-steroid (n=52)	P value
≤ 8	17 (32.7%)	22 (42.3%	0.040*
9–10	35 (67.3%)	30 (57.7%)	0.040*

*Statistically significant (p<0.05).

Table 5: APGAR score at 5 minute stratification between cohorts.

APGAR 5-Minute [n (%)]	Steroid group (n=52)	Non-steroid (n=52)	P value
≤ 9	10 (19.2%)	15 (28.8%)	0.043*
10	42 (80.8%)	37 (71.2%)	0.043*

*Statistically significant (p<0.05).

Table 6: Comparison of study group according to TTN.

Number of cases		Category						P value
		Steroid group		Non-steroid group		Total		
		No.	%	No.	%	No.	%	
TTN	No	50	51.5	47	48.5	97	93.3	0.240
	Yes	2	28.6	5	71.4	7	6.7	
	Total	52	50.0	52	50.0	104	100.0	

Table 7: Comparison of study group according to RDS.

		Category						P value
		Steroid group		Non-steroid group		Total		
		No.	%	No.	%	No.	%	
RDS	No	51	51.0	49	49.0	100	96.2	0.308
	Yes	1	25.0	3	75.0	4	3.8	
	Total	52	50.0	52	50.0	104	100.0	

DISCUSSION

The current study reinforces the baseline premise that planned elective cesarean deliveries carried out before 39 completed weeks disrupt normal neonatal transition mechanics, which can manifest as lowered APGAR profiles.[8,9] Prophylactic deployment of antenatal corticosteroids clearly accelerates surfactant synthesis and triggers swift alveolar fluid absorption.[10]

The significantly higher 1 minute and 5 minute APGAR scores seen in our dexamethasone cohort align with the comprehensive meta-analysis by Saccone et al which noted enhanced physiological transition scores at birth after steroid coverage.[11] By actively preparing the fetal lungs for extrauterine respiration via sodium channel maturation, dexamethasone minimizes early hypoxia and subsequent physical depression at delivery.

While the immediate data strongly advocate for the use of ACS to optimize short-term outcomes, long-term vigilance is necessary. Conflicting data from historical trials like ASTECS suggest that early term steroid administration might negatively impact later school performance and increase behavioral risks.[12,13] Therefore, balancing short-term respiratory advantages against potential neurodevelopmental risks remains a core clinical consideration.

Comparison of incidence of TTN at 1 minute and 5 minutes between the two groups

In present study the incidence of TTN was higher in non-steroidal group as compared to steroidal group (9.6% (n=5) in non-steroidal group and 3.8% (n=2) in steroidal group.

Similar to our study, an earlier study performed in 2005 by the Antenatal Steroids for Term Elective Caesarean Section (ASTECS) (n = 819) , trial result showed that the incidence of TTN was higher in non-steroidal group as compared to steroidal group which is consistent with results of present study.

Similarly in the study conducted by Ahtar N et al and Panwar M et al in their study found that the incidence of TTN was higher in non-steroidal group as compared to steroidal group which is consistent with results of present study.

Comparison of incidence of RDS between the two groups

In present study the incidence of RDS was higher in non-steroidal group as compared to steroidal group [5.8% (n=3) in non-steroidal group and 1.9% (n=1) in steroidal group. Thus, in our study, respiratory morbidity was found to be more in non-steroidal group than non-steroidal group. Same findings were found by Roberts et al who stated that treatment with antenatal corticosteroids is associated with an overall reduction in incidence of RDS which is in agreement with results of present study.[14]

Shahzad et al stated that 230 patients were divided on the basis of dexamethasone exposure in two groups, 76(33.0%) cases (term neonates) had respiratory distress syndrome, of which 26(22.4%) were in exposed group and 50(43.9%) of non-exposed group which is in agreement with results of present study.[15]

Limitations

A large multicentric study is warranted to validate our study findings. Further studies are required on the optimal dose to delivery interval, optimal corticosteroid to use, effects in multiple pregnancies, long term effects into adulthood, as well as in groups not well studied, including women with pregestational diabetes and those who previously had received a course of corticosteroids.

CONCLUSION

A short, targeted course of antenatal dexamethasone given 48 hours prior to an early-term elective cesarean section (37^{+0} to 38^{+6} weeks) significantly enhances early neonatal APGAR scores. This simple step supports a smoother transition to extrauterine life.

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