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Fetal Heart Rate Variability Before and After Antenatal Corticosteroids in Patients at High Risk of Preterm Labor

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ABSTRACT

Background: Premature birth (PTB) occurs in one in ten pregnancies. There are about 13 million PTBs annually worldwide. Antenatal corticosteroids are administered to enhance fetal lung maturation in cases of threatened preterm delivery between 24- and 34-weeks' gestational age (GA).

Objective: This study aimed to study the cardiotocograp (CTG) before and after antenatal corticosteroids administration in patients at high risk of preterm labor to reduce preterm risks.

Patients and Methods: A prospective cohort study included 52 women who were at risk of premature birth. Each woman received the recommended course of corticosteroids consists of 4 doses of dexamethasone 6 mg for 48 hours (Dexamethasone 8 ml intramuscularly, 12 h apart). CTG examination: Fetal heart rate was monitored with fetal monitor cardiotocogram machine. Cardiotocography strips were interpreted visually.

Results: In our study we recorded decrease in baseline fetal heart rate and increase in fetal heart rate variability (LTV, STV) after dexamethasone course by 24 hours, which were statistically significant. The number of accelerations showed a slight increase, which was significant. Decelerations were not present at all before or after the course. The STV showed a significant change before the course, all participants had moderate STV, but after the course, 8 (15.4%) showed marked variability, which was significant. We found that most of participants (90.4%) had decreased fetal kicks after injection relying on maternal perception.

Conclusion: There was a decrease in baseline fetal heart rate and increase in fetal heart rate variability (LTV, STV) after dexamethasone course by 24 hours, which were statistically significant. The number of accelerations showed a slight increase, which was significant.

Keywords: Antenatal Corticosteroids, Cardiotocograph, Fetal heart rate, Preterm labor.

INTRODUCTION

Premature birth (PTB) occurs in one in ten pregnancies. There are about 13 million PTBs annually worldwide. In 2011, 9% of all children born in Germany were born before the end of GA 37 **(1).** Antenatal corticosteroids are administered to enhance fetal lung maturation in cases of threatened preterm delivery between 24- and 34- weeks' gestational age (GA) **(2).**

Since Liggins and Howie first described improved survival and reduced morbidity among preterm infants treated with antenatal corticosteroids in 1972, their use has become internationally recommended practice **(3).**

Respiratory distress syndrome (RDS), formerly known as hyaline membrane disease, is a result of surfactant deficiency, which causes increased surface tension in the air-liquid interface of the terminal respiratory units leading to atelectasis, increased ventilation-perfusion mismatch, and potential lung injury due to a marked pulmonary inflammatory response. RDS is the most common cause of respiratory distress in preterm infants because lung immaturity is associated with inadequate production of pulmonary surfactant. The incidence of RDS increases with decreasing gestational age and infants born below 30 weeks gestation are at the greatest risk for RDS [(4)].

Early detection of fetal risk is one of the main issues in today obstetrics. CTG is used both antenatally (before birth) and during labor to monitor the baby for any signs of distress. By looking at various aspects of the baby's heart rate, doctors and midwives can see how the baby is coping **(5).**

Cardiotocography records changes in the fetal heart rate and their temporal relationship to uterine contractions. The aim is to identify babies who may be short of oxygen (hypoxic), so additional assessments of fetal well-being may be used, or the baby delivered by caesarean section or instrumental vaginal birth **(6).**

It is therefore important to understand short-term effects of corticosteroids on the fetus in utero, and whether there are correlations between these effects and neonatal outcomes and/or later outcomes. Also, of importance is whether different steroid preparations display different effects on fetal hemodynamics.

This study aimed to study the CTG before and after antenatal corticosteroids administration in patients at high risk of preterm labor to reduce preterm risks.

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PATIENTS AND METHODS

The current study was a prospective cohort study. The study was conducted at the Obstetrics and Gynecology Department, Zagazig University Hospital, Al Sharqia, Egypt, during the period from November 2020 to June 2021. The study included 52 women who were at risk of premature birth with uncomplicated singleton pregnancies between 29 and 36 weeks of pregnancy.

Gestational age was calculated according to the date of the last menstrual period and confirmed by first trimester ultrasound. Each participant underwent obstetric history taking, physical examination and laboratory investigations.

Inclusion criteria[7]:

Pregnant women with gestational age from 29 and 36 weeks and at risk for preterm labor. Patients at risk of preterm labor included.

- Those with preterm uterine contractions.
- Placenta previa.
- Polyhydramnios.
- Multiple pregnancy.
- Pregnancy associated hypertension.
- Pre-eclampsia.
- Patients present with premature rupture of membrane.

Exclusion criteria [7]:

- Patients who were in active labor.
- Intrauterine growth restriction (IUGR).
- Patients who had received corticosteroids in their pregnancies.
- Fetuses with suspected structural abnormalities.
- Women who had any contraindication of corticosteroids administration.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation.

This work was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

All patients were subjected to the following:

1. **Complete history taking:** Including personal history of mother: Name, age, residence, occupation, social, marital status and special habits of medical importance particularly smoking, alcohol intake or drug abuse, past history of medical problems, mode of delivery, gestational age by date and first trimetric ultrasonography and any medical problems or drug taking during this pregnancy.

   Past obstetric history including previous preterm labor, previous D and C, previous sections, previous uterine operations, complications in previous pregnancies, and during cesarean section.
2. **General examination:** To exclude any systemic diseases.
3. **Local examination for pregnancy with ultrasound:** Detailed anatomical scan before inclusion to confirm their gestational age and exclude any structural anomalies.

Study intervention:

Dexamethasone treatment:

Each woman received the recommended course of corticosteroids consists of 4 doses of dexamethasone 6 mg for 48 hours (Dexamethasone 8 ml, Sigma, Italy) intramuscularly 12 hour apart.

Outcome of the study was evaluation of medical side effects of dexamethasone on pregnancy.

Cardiotocograph (CTG) examination:

Fetal heart rate was monitored with Bistos Bt 350 fetal monitor Cardiotocogram machine. Cardiotocography strips were interpreted visually.

- Two recordings were taken from everyone during the study period. One recording was made immediately before the administration of the first dose of dexamethasone (reference recording).
- Subsequent recording was made after 24 hours of dexamethasone administration [7].
- Basal fetal heart rate (FHR) (bpm), short-term (STV), long-term variation (LTV), the numbers of accelerations and decelerations were calculated for each recording.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Wilk test. Qualitative data were represented as frequencies and relative percentages. Quantitative data were expressed as mean ± SD (Standard deviation).

Paired t test was used for comparison of two means before and after dexamethasone. McNemar test was used for comparison of two frequencies (percentage) before and after dexamethasone. P value of < 0.05 indicates significant results.

RESULTS

Table 1 shows the descriptive data of the studied group.

Table (1): Descriptive data of the studied group

Variables		The studied group No=52
Age (years)	Mean ± SD	30.5 ± 12.4
	Range	(21 – 36)
	Median	30.5
Age group	**20 – 25**	3 (5.8 %)
	25 – 30	23 (44.2 %)
	30 – 35	21 (40.4 %)
	35 – 40	5 (9.6 %)
Gravidity	Mean ± SD	3.2 ± 0.96
Mode of delivery	Previous vaginal delivery	28 (53.8 %)
	Previous Cs	24 (46.2 %)
	Parity	
*** Previous full term**	No	12 (23.1 %)
	Yes	40 (76.9 %)
*** Previous preterm**	No	30 (57.7 %)
	Yes	22 (42.3 %)
*** Previous abortion**	No	35 (67.3 %)
	Yes	17 (32.7 %)
*** living children**	No	8 (15.4 %)
	Yes	44 (84.6 %)

This table shows that most of studied group (90.4%) had decreased fetal kicks after injection (Table 2).

Table (2): Perception of fetal kicks after dexamethasone injection

Fetal kicks after injection	The studied group No=52
No effect	5 (9.6 %)
Decreased	47 (90.4 %)

There was statistically significant change on baseline fetal heart rate, long term variability and acceleration before and after dexamethasone (Table 3).

Table (3): CTG parameters before and after dexamethasone injection

Variables		Before dexa-methasone	After dexa-methasone	P. value
Baseline fetal heart rate	Mean ± SD	134.4 ± 9	125.2 ± 9.9	**0.001** **
(Long term variability)	Mean ± SD	3.17 ± 0.83	3.86 ± 0.9	**0.001** **
Acceleration	Mean ± SD	3.61 ± 0.69	3.94 ± 0.85	**0.01***

* Statistically significant difference
** Statistically high significant difference

Table (4) shows that all fetal short-term variability (100.0 %) was moderate before dexamethasone while after dexamethasone (84.6% and 15.4%) had moderate and marked short term variability, respectively.

Table (4): Comparing short term variability before and after dexamethasone treatment

Variables		Short term variability after dexamethasone		P-value
		Moderate No (%)	Marked No (%)	
Short term variability before Dexa-methasone	**Moderate** (52)	44 (84.6)	8 (15.4)	**0.001****
	Marked (0.0)	0.0 (0.0)	(0.0)	
Total (52)		44	8	

** Statistically high significant difference (p<0.001)

There was no statistically significant correlation between heart rate, long term variability and acceleration rates before and after dexamethasone with gestational age (Table 5).

Table (5): Correlation between gestational age with cardiotocograp (CTG) parameters

Variables	Gestational age	
	Correlation Coefficient (R)	P value (P)
Heart rate before	0.03	0.8
Heart rate after	0.09	0.4
LTV before	0.1	0.5
LTV after	0.05	0.6
Acceleration before	0.2	0.07
Acceleration after	0.04	0.7

DISCUSSION

In our study we recorded decrease in baseline fetal heart rate and increase in fetal heart rate variability (LTV, STV) after dexamethasone course by 24 hours, which were statistically significant. The number of accelerations showed a slight increase, which was significant. Decelerations were not present at all before or after the course.

The STV showed a significant change before the course, all participants had moderate STV, but after the course, 8 (15.4%) showed marked variability, which was significant. This agrees with **Knaven *et al.*** [7] study which reported increased variability after dexamethasone administration. Also this agrees with **Wahby *et al.*** [8] who combined two steroids, dexamethasone and betamethasone, into one group to induce a significant increase of FHR STV. Interestingly, they attributed the increase in STV to the time of CTG recording. They mentioned **Knaven *et al.*** [7] **and Sarumi *et al.*** [9] studies for comparison. The patients described by **Knaven *et al.*** [7] received steroids first thing in the morning and had traces repeated at the same time on subsequent days; short term variation was found to be increased on day one.

However, some studies disagree with our results as **Tehrani *et al.*** [10] reported that amniotic fluid

index did not change significantly after the administration of both betamethasone and dexamethasone, but both drugs reduced FHR reactivity significantly. **Mulder *et al.* [11] and Sarumi *et al.* [9]** reported a substantial decrease in fetal heart rate variation following two doses of maternal betamethasone. But **Mulder *et al.* [11]** recorded an increase of FHR STV only in the dexamethasone group. Noteworthy, **Sarumi *et al.* [9]** used betamethasone only. On the contrary, **Rotmensch *et al.* [12]** found a decrease in FHR STV 48 hours after first dose. They attributed the increased FHR variability in **Knaven *et al.* [7]** study to the fact that 75% of the fetuses in their study were delivered by caesarean sections, thus increased FHR variability was a consequence to fetal distress.

Regarding accelerations, **Buschur *et al.* [13]** recorded that the number of accelerations increased significantly after treatment of betamethasone was stopped and long-term variation increased significantly after cessation of treatment and returned to pre-treatment values within a week. Our results disagree with **Subtil *et al.* [14] and Rotmensch *et al.* [12]** study that recorded a change in the acceleration number. Both studies recorded significant decrease in the number of accelerations on the second day.

We found that most of participants (90.4%) had decreased fetal kicks after injection relying on maternal perception. This agrees with **Jackson *et al.* [15]** study that showed the administration of dexamethasone decreases fetal movement and breathing and as a result the biophysical profile scores may be decreased. Also this agrees with **Sarumi *et al.* [9]** who demonstrated a considerable but transient reduction of fetal body movements and activity periods, breathing and heart rate variation, following two intramuscular injections of 12 mg of betamethasone-acetate. However, **Gabbe *et al.* [16]** demonstrated that fetal movements and fetal breathing reductions were more common after the administration of betamethasone compared with dexamethasone.

For the correlation coefficients, our research revealed that there was no statistically significant correlation between heart rate, long term variability and acceleration rates before and after dexamethasone with gestational age.

CONCLUSION

There was a decrease in baseline fetal heart rate and increase in fetal heart rate variability (LTV, STV) after dexamethasone course by 24 hours, which were statistically significant. The number of accelerations showed a slight increase, which was significant. Decelerations were not present at all before or after the course. The STV showed a significant change before the course, all participants had moderate STV, but after the course, 8 (15.4%) showed marked variability. Administration of dexamethasone had no harmful effect on fetus or mother except for transient decrease of fetal movements with no long term harm.

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