The effect of betamethasone on fetal movement, biophysical profile and fetal circulation in preterm fetuses

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Abstract: Objective: Evaluating the effect of antenatal betamethasone on the biophysical profile and Doppler indices of umbilical and middle cerebral arteries. Materials and Methods: Twenty-five preterm labor singleton pregnancies (gestational age, 26-34 weeks) were studied prospectively. These patients received two consecutive doses of betamethasone 24 hours apart to accelerate pulmonary maturation. Fetal biophysical profile (BPP) and Doppler assessment were performed twice, on admission and 48 hours after administration of the first dose. The mother recorded fetal movement before, during and after the study periods. Comparison was made between biophysical profile score, fetal movement and Doppler indices of the umbilical and middle cerebral artery before and after betamethasone administration. Continuous data were compared by paired t test and dichotomous data were compared by McNemar test between pre and post treatment evaluations. The statistical significance was set at 0.05 levels. Results: Twenty-five women–median age, 26 (19-42) years; median of gestational age, 32 (26-34) weeks–which were referred to Imam Sajjad hospital, Yasuj from August 2010 to December 2011 were enrolled into the study. There was significant different in fetal movement before and after betamethasone administration (p=0.004). The frequency of BPP scores ≤8 increased from 13 to 21 subjects (p=0.039) at post treatment evaluation which was significant statistically. There was statistically significant difference in the reduction of umbilical artery PI (0.10) (95%CI: 0.01-0.19) and RI (0.07) (95%CI: 0.08-0.06)), but these changes were not important clinically. The mean changes of MCA PI and RI were 0.01 (95% CI:-0.16-0.19) and -0.01 (95% CI:-O.08-0.06), respectively. Conclusion: After betamethasone administration, fetal movement, BPP scores and umbilical artery indices were decreased, while MCA Doppler indices were not affected.

[Soghra kazardoost, Parichehr pooransari,Masoome mirzamoradi, Hashemi Mohammad Abad Nazir. **The effect of betamethasone on fetal movement, biophysical profile and fetal circulation in preterm fetuses.** *Life Sci J* 2012;9(4):354-356] (ISSN:1097-8135). http://www.lifesciencesite.com. 54

Keywords: Betamethasone, Biophysical profile, Doppler indices, fetal movement

Introduction

Preterm birth is associated with significant prenatal morbidity and mortality rates. The overall preterm delivery (PTD) rate is 8.1% (1). The use of prophylactic maternal corticosteroids to enhance fetal lung maturity in women at risk of PTD has currently been carried out (2). Biophysical assay is a useful tool for the assessment of the fetal well being. Previous studies have shown that antenatal steroid administration may suppress fetal activity and change the biophysical score (3). Sometimes this transient changes may result to un warranted iatrogenic delivery. Doppler velocimetry of the brain circulation and umbilical for evaluation of the well being of the fetus in the uterus has been used (4, 5). We have also been want that used this technique in healthy preterm fetus, because that can differentiate between fetal distress and suppression of biophysical profile due to steroid effect. Therefore we studied onset and duration of betamethasone administration on biophysical profile and Doppler indices of healthy fetus. These information can decrease management errors due to misinterpretations of biophysical profile data.

Materials and Methods

Thirty one single fetus pregnancies at high risk for preterm delivery who were admitted to the obstetrics unit of Imam Sajjad hospital, Yasuj from August 2010 to December 2011 with 26-34 weeks gestation were enrolled into the study. Six of these patients were excluded from the analysis due to spontaneous delivery prior to completion of all the examinations or incomplete data. The median age was 19-42 years. The main indication for hospital admission and steroid use was third trimester vaginal bleeding, previous preterm delivery, uterine anomaly and false labor due to urinary infection. Usually, any patient who was admitted to the hospital with a gestational age of less than 34 weeks received steroids. Informed written consent was obtained from all patients. Before baseline examination, an ultrasonography examination was performed for the

biometry and estimated fetal weight. All of the examinations were done after breakfast at 8-12 midday to control the fetal circadian rhythm. The gestational age was calculated based on the last menstrual period (LMP) which agreed with the second trimester ultrasonography examination.

Karyotypic suspicion of medication of magnesium sulfate and narcotic analgesics that might interfere with the biophysical profile and Doppler studies were excluded from the study. All of the examination was carried out by one person. Both arteries were sampled at the lowest feasible incident angle.

After completion of the base line examination (0) the patients who were eligible for the study received two doses of 12 mg betamethasone, 24 hours apart. BPP scores and Doppler flow velocimetry wave forma of umbilical and middle cerebral artery were performed at 0 and 48 hours after the first dose of betamethasone administration. Fetuses were included if their initial biophysical profile scores were equal to or higher than 8.

0 or 2 points were assigned for each component of the biophysical profile, the non stress test, fetal movement, fetal tone, breathing movements and amniotic fluid volume. Fetal heart rate tracing was recorded daily for 30 min before the biophysical profile was obtained and evaluated and interpreted as reassuring or non-reassuring as proposed by ACOG.

Doppler studies were performed immediately after the biophysical profile scores. Peak systolic velocity, pulsatility index (PI), resistance index (RI), S/D ratios of both the middle cerebral and umbilical arteries were obtained.

MCA: Median Cerebral Artery; UA: Umbilical Artery; PI: Pulsatility Index; RI: Resistance Index

Discussion

In this study, it was observed that administrating betamethasone for the mother may lead to a significant but temporary decrease of biophysical profile scores in healthy preterm fetuses. In a study performed by Rotmensch et al., a profound suppression was observed on the biophysical profile scores at 48 hr of steroid use (5) which was consistent with our findings. The mechanism causing the suppression of biophysical activities by steroids are not clear. The ability of synthetic glucocorticosteroids in suppressing neural activity has been documented (6); furthermore, glucocorticoid receptors are widely expressed in cerebral cortical tissues, mid brain and subcortical nuclei which may partly explain the suppression. Jackson et al. also obtained the same results. They showed that the administration of betamethasone decreases fetal movement and breathing and as a result the biophysical profile scores may be decreased. In their study, amniotic fluid was also decreased, but this result was not obtained in our study (7).

Biophysical monitoring using the biophysical profile scores has been shown to decrease both mortality and morbidity in the at risk fetus. This is the most commonly used tool in at risk fetuses and also in the high-risk pregnancy monitoring (8). By suppression of the multiple fetal biophysical parameters, antenatal steroids may result in a significant clinical confusion (9).

Another modality for evaluation of the fetal status is Doppler velocimetry of the umbilical and fetal cerebral circulation (10). In a previous study carried out by Cohlen et al., corticosteroids had no effect on Doppler indices obtained from fetal, placental or uterine arteries (11). This finding has been subsequently confirmed by others (12, 13). In our study, the middle cerebral and the umbilical artery Doppler indices decreased, although not clinically

The data were analyzed using SPSS version 11.5, continuous data were compared by paired t test and dichotomous data were compared by MCNemar test between pre and post treatment evaluation. The statistical significance was set at 0.05 level.

Results

Twenty five women with the median (range) age of 26 (19-42) years were enrolled into the study. The median (range) of gestational weeks at delivery was 32 (26-34) weeks.

The mean reduction of umbilical artery PI was 0.10 (95% CI: 0.01-0.19) and of the umbilical artery RI was 0.07 (95% CI: 0.01-0.12). The mean changes of MCA PI and RI were 0.01 (95% CI: -0.16-0.19) and 0.01 (95% CI: -0.08-0.06), respectively (Table 1).

In nine (36%) subjects, fetal movement decreased 48 hours after steroid treatment (P = 0.004).

The frequency of a higher or equal to 6 BPP score increased from 2 to 3 subjects (P=1.0) and the frequency of a higher or equal to 8 BPP score increased from 13 to 21 subjects (P = 0.039) at post treatment evaluation.

	Pre treatment	Post treatment	PV*
	N = 25		
UA PI	1.09 (± 0.32)	0.99 (± 0.34)	0.025
UA RI	0.62 (± 0.11)	0.55 (± 0.16)	0.019
MCA PI	1.99 (± 0.61)	1.98 (± 0.72)	0.875
MCA RI	0.84 (± 0.13)	0.85 (± 0.19)	0.823

* paired t test

significant. These findings suggest the reliability of this modality for the assessment of fetuses previously exposed to antenatal steroids. Doppler studies have the potential to differentiate the steroid-induced changes in the fetal biophysical profile from those due to fetal compromise (14). The fact that antenatal steroid usage is rising, subsequently leading to an increase in the rate of abnormal biophysical profile highlights this matter as a notable clinical consideration (15). Until new monitoring tools or algorithms are added, the decision regarding the delivery of preterm fetuses exposed to antenatal steroids should be cautiously made.

Conclusion

We demonstrated that betamethasone administration can cause a remarkable, but impermanent reduction in fetal body movement. This result is particularly outstanding for the biophysical profile score obtained after 72 hr of steroid administration. Misinterpretation of the post steroid biophysical depression as an evidence of fetal compromise could lead to the unwarranted delivery of a preterm fetus but MCA and umbilical artery Doppler indices can detect the difference between the two compromised and non compromised fetus groups.

Acknowledgement
None declared.

Conflict of Interest

None declared.

Running Title: Betamethasone and Biophysical Profile in Preterm Fetuses

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9/16/2012