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Changes In Doppler Blood Flow Velocity After Dexamethasone Administration In Women At Risk For Preterm Birth

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Abstract:

Background : Maternal administration of Dexamethasone is beneficial and improve blood flow by changes in color Doppler indices (RI and PI) of umbilical artery, uterine artery, fetal MCA and fetal descending aorta in women at risk of preterm birth.

Objective : The study aims to evaluate the effect of Dexamethasone on fetal and uteroplacental circulation in pregnant women at risk of preterm birth after 24 hrs of its administration.

Design : Prospective observational study.

Setting : Tertiary care center.

Study Population : All pregnant women between 28-37 weeks of gestation admitted in labour room with preterm labour.

Sample size : With 80% power of the test and a level of significance 0.05 (p value), the sample size was estimated to be 210.

Methods : Total 210 pregnant women fullfilling inclusion criteria were included in the study and Color Doppler study was done on maternal uterine arteries, umbilical artery, fetal MCA, fetal descending aorta before and after 24 hrs of Dexamethasone administration.

Results : There was statistically significant difference between all Doppler indices before and after 24 hrs of dexamethasone administration and was as follows- Umbilical artery (PI -1.053 ± 0.03 and 1.048 ± 0.03, RI - 0.649 ± 0.051 and 0.644 ± 0.051, p=0.015), fetal MCA (PI - 2.12 ± 0.054 and 2.113 ± 0.053, RI - 0.92 ± 0.063 and 0.912 ± 0.063, p=0.003), maternal uterine artery (RI - 0.545 ± 0.078 and 0.538 ± 0.078, PI - 0.929 ± 0.076 and 0.921 ± 0.073, p=0.013), fetal descending aorta (PI - 1.835 ± 0.124 and 1.829 ± 0.122, RI - 0.92 ± 0.06 and 0.914 ± 0.085, p=0.005), thus showed improvement in all color Doppler indices after 24 hrs of Dexamethasone administration.

Conclusion : Antenatal administration of Dexamethasone in pregnant women at risk of preterm birth improves the fetal and uteroplacental blood flow 24 hrs after its administration.

Keywords: preterm birth, Dexamethasone.

Introduction

The preterm labour is defined as onset of uterine contractions of adequate strength and frequency to cause progressive dilatation and effacement of cervix before 37 completed weeks of gestation. According to world health organization about 15 millions babies

are born preterm each year which is more than 1 in 10 babies. About 1 million babies die each year due to complications of preterm birth making prematurity leading cause of death in children under age of 5 globally[1].

Infants who are born preterm are at increased risk of neonatal morbidity compared to infants born at term. Most organs are immature in preterm babies leading to a diversity of neonatal illnesses including respiratory distress syndrome (RDS), bronchopulmonary dysplasia (BPD), brain injuries such as intraventricular hemorrhage (IVH) and periventricular leukomalacia (PVL), necrotizing enterocolitis (NEC), retinopathy of prematurity (ROP), nutritional difficulties, renal failure, invasive infection, persisting fetal circulation and patent ductus arteriosus (PDA). These risks further increase with lower gestational age.

One of the most important interventions for improving survival and decreasing morbidity after preterm birth is to treat pregnant women with threatening preterm delivery with antenatal corticosteroids (ACS). Evaluation of fetal well being with color doppler examination of the blood flow velocity waveforms after maternal corticosteroid administration can be done to investigate fetal hemodynamic effects of exogenous corticosteroids.

Previous studies showed conflicting results regarding this important subject and most of them were focusing on the effect of steroids on pregnancies complicated with intrauterine growth restriction (IUGR)[2-5]. Also, most of previous studies investigated the effect of betamethasone on fetal and uteroplacental blood flow[6-9], few studies only investigated the effect of dexamethasone[10].

Therefore, the study aims to investigate the effects of dexamethasone on fetal and uteroplacental circulation in pregnant women at risk for preterm birth after 24 hours of its administration.

Methods:

Study Settings and Design: The study was a prospective descriptive type of observational study carried out at a tertiary center over a period of one year.

Inclusion and exclusion criteria: Eligible participants were pregnant women with singleton pregnancy of gestational age from 28 to 37 weeks with threatened preterm labour admitted in labour room. Gestational age was calculated according to the date of last menstrual period and confirmed by first trimester ultrasound. Patients presented with premature rupture of membrane, IUGR, fetal structural anomalies and women with medical disorder as diabetes mellitus, hypertension and women who had any contraindication of Dexamethasone administration had excluded from study.

Primary Outcome: The primary outcome of the study was detection of changes in Doppler indices before and after Dexamethasone administration.

Sample Size: With 80% power of the test and a level of significance 0.05 (p-value), the sample size was estimated to be 210.

Methodology: Eligible participants were evaluated through full history taking and clinical examination. Each woman received four doses of Dexamethasone 6 mg IM 12 hrs apart. Doppler studies were performed just before and 24 hrs after Dexamethasone administration by using a Philips Affiniti 704 Ultrasound scanner which had a facility for color flow mapping and a pulsed wave duplex Doppler using a 32 Hz transducer for the study. A 100 Hz thump filter was used to eliminate Doppler shift frequencies caused by vessel wall movement.

Blood flow velocity waveforms were obtained from the umbilical artery, uterine artery, fetal MCA, fetal descending aorta, spectral pulsed wave analysis was done after that. RI and PI of each vessel were calculated.

Blood flow velocity waveforms were recorded from umbilical artery in free floating midportion of umbilical cord, from proxmial third portion of fetal MCA and from uterine artery in the region of lower uterine segment, waveforms from fetal descending aorta were recorded at lower thoracic level just above the diaphragm, keeping the angle of insertion of the Doppler beam below 45^{o}.

Statistical Analysis: Continuous variables were summarized as Mean and Standard Deviation, whereas nominal / categorical variables as proportion (%). Unpaired 't' test and parametric test were used for analysis of continuous variables while chi-square test / Fischer exact test and other non- parametric test

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were used for nominal / categorical variables. p-value< 0.05 was taken as significant. MEDCALC 16.4 version software was used for all statistical analysis.

Ethical Clearance: Institutional review board and ethical committee clearance was taken.

Results:

Total 210 women participated in the study.

The mean age of participant women was 26.41 ± 4.45 yrs and maximum number of women belongs to 24-27 years age group. Mean gestational age was 32.85 ± 2.15 weeks and maximum number of cases were between 30-32 weeks of gestation (Table-1).

In the study, there were statistically significant changes in color Doppler indices (RI and PI) before and 24 hours after of maternal Dexamethasone administration (Table-2).

Umbilical artery RI and PI before and after 24 hours of maternal Dexamethasone administration were as RI = 0.649 ± 0.051 and 0.644 ± 0.051 (p=0.015), PI = 1.053 ± 0.03 and 1.048 ± 0.03 (p=0.016) showed statistically significant decrease in RI and PI after Dexamethasone administration. Uterine artery RI and PI were RI = 0.545 ± 0.078 and 0.538 ± 0.078 (p=0.013), PI = 0.929 ± 0.076 and 0.92 ± 0.073 (p=0.003) also showed statistically significant changes. Fetal MCA RI and Pi were RI = 0.92 ± 0.063 and 0.91 ± 0.063 (p=0.002), PI = 2.12 ± 0.054 and 2.113 ± 0.053 (p=0.00) while fetal descending aorta RI and PI before and 24 hours after maternal Dexamethasone administration were as RI = 0.92 ± 0.06 and 0.914 ± 0.085 (p=0.005), PI = 1.835 ± 0.124 and 1.829 ± 0.122 (p=0.001) showed statistically significant reduction in color Doppler indices.

Table-1

Maternal Characteristics of the Study Participants

Maternal Characteristics	Mean ± SD
Age (years)	26.41 ± 4.45 years
Parity Median (Range)	0 – 3
Gestational Age (weeks)	32.85 ± 2.15 weeks

Table – 2

Fetal and Uteroplacental Doppler Indices Before and After Comparison by Using Paired t-Test

Characteristics		Before	After	Paired t – test	p–value	Significance
Umbilical Artery	**RI**	0.649 ± 0.051	0.644 ± 0.051	2.449	0.01515	**All are significant**
	PI	1.053 ± 0.03	1.048 ± 0.03	2.416	0.01657	
Rt Uterine Artery	**RI**	0.545 ± 0.078	0.538 ± 0.078	2.503	0.01308	
	PI	0.929 ± 0.076	0.921 ± 0.073	2.915	0.00395	
Lt Uterine Artery	**RI**	0.572 ± 0.07	0.568 ± 0.073	3.064	0.00247	
	PI	1.03 ± 0.086	1.012 ± 0.124	2.971	0.00332	
MCA	**RI**	0.92 ± 0.063	0.912 ± 0.063	3.050	0.00258	

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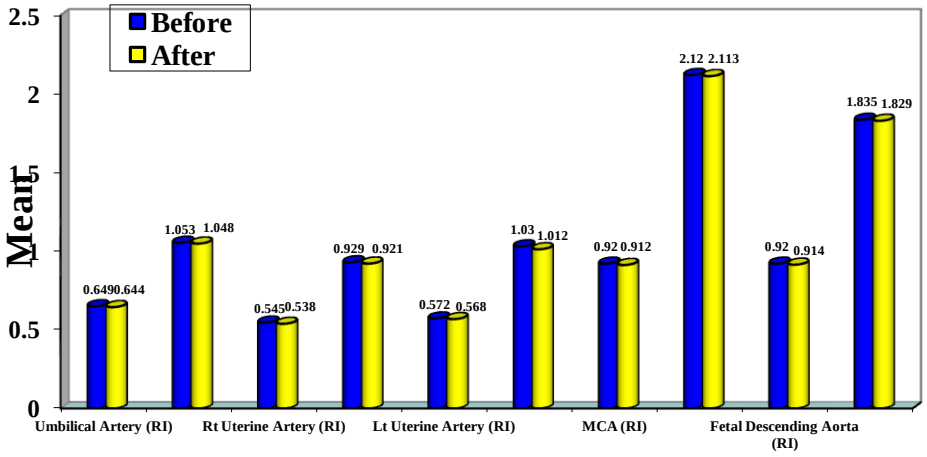
	PI	2.12 ± 0.054	2.113 ± 0.053	3.151	0.00187	
Fetal Descending Aorta	**RI**	0.92 ± 0.06	0.914 ± 0.085	2.800	0.00559	
	PI	1.835 ± 0.124	1.829 ± 0.122	3.178	0.00171	

Fetal and Uteroplacental Doppler Indices Before and After Comparison by Using Paired t-Test



Discussion:

Prematurity is known to cause neonatal morbidity and mortality. Dexamethasone administration was found to have a beneficial effect on fetuses at risk for preterm birth as evident by the decrease in the color Doppler indices of umbilical artery, uterine artery, MCA and fetal descending aorta.

The study aims to evaluate the effect of antenatal dexamethasone administration on color Doppler indices of umbilical artery, uterine artery, MCA and fetal descending aorta in the women who are at risk of preterm birth. 210 pregnant women were included in study.

Mean age was 26.4 ± 4.45 years. Study conducted by Elsnosy E et al (2017)[11] included women with mean age 27.7 ± 4.5 years. While study conducted by Alsayed MA et al (2021)[12] included women with mean age 27.1 ± 5.3 years. Yassin AA et al (2019)[13] conducted study and included women with mean age 29.1 ± 4.6 years. In study mean gestational age in weeks was 32.85 ± 2.15. Study conducted by Elsnosy E et al (2017)[11] included women with mean gestational age 30.7 ± 2.5. While study conducted by Alsayed MA et al (2021)[12] included women with mean gestational age 31 ± 2 weeks. Yassin AA et al (2019)[13] conducted study and included women with mean gestational age 27.2 ± 2.9 weeks. Maximum number of women were gravida 2 (38.10%) and parity 1 (37.14%). While study conducted by Elsnosy E et al (2017)[11] mean parity range was 4 (0-8). In Alsayed MA et al (2021)[12] study mean parity was 1.9 ± 0.3 and mean gravidity was 4.3 ± 2.2 and in Yassin

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AA et al (2019)[13] study women were with mean parity 2.14 ± 1.4. Maximum women belongs to lower socio-economic status (34.67%) and maximum women were literate (85.71%).

Changes in color Doppler indices (RI & PI) before and after 24 hours of Dexamethasone administration were as follows: -

Umbilical Artery:

In the study umbilical artery Doppler indices (RI and PI) showed statistically significant reduction 24 hrs after Dexamethasone administration. Mean ± SD RI and PI of umbilical artery before and after Dexamethanose administration was 0.649 ± 0.051 and 0.644 ± 0.051 (p=0.01515), 1.053 ± 0.03 and 1.048 ± 0.03 (p=0.01657) respectively. My results agreed with Elsnosy E et al (2017)[11] who reported that RI and PI of umbilical artery before and after Dexamethasone administration were 0.66 ± 0.14 and 0.63 ± 0.14 (p=0.001) and PI was 1.09 ± 0.4 and 1.05 ± 0.39 (p=0.001) which was statistically significant. My results also agreed with Yassin AA et al (2019)[13] who reported RI and PI of umbilical artery before and after 24 hrs of Dexamethasone administration as RI - 0.73 and 0.63 (p<0.001) and PI - 1.15 and 1.10 (p<0.001) which was statistically significant. My results also showed agreement with study conducted by Alsayed MA et al (2021)[12] who reported that RI and PI of umbilical artery were RI - 0.65 ± 0.02 and 0.61 ± 0.01 (p=0.031) and PI - 0.98 ± 0.04 and 0.90 ± 0.02 (p=0.014) which were statistically significant.

Uterine Artery:

Color Doppler indices RI and PI before and after 24 hrs of Dexamethasone showed a statistically significant reduction. RI of right uterine artery was 0.545 ± 0.018 and 0.538 ± 0.078 (p=0.003). PI was 0.929 ± 0.076 and 0.921 ± 0.073 (p=0.003) and of left uterine artery RI was 0.0572 ± 0.07 and 0.568 ± 0.073 (p=0.003), PI was 1.03 ± 0.086 and 1.012 ± 0.129 (p=0.003). My results correlated with Elsnosy E et al (2017)[11] who reported RI and PI of uterine artery before and after 24 hrs Dexamethasone administration as RI = 0.56 ± 0.11 and 0.53 ± 0.11 (p=0.001), PI = 0.9 ± 0.27 and 0.87 ± 0.26 (p=0.001) which were statistically significant. Results of study conducted by Yassin AA et al (2019)[13] also agreed with study results RI and PI of uterine artery before and after 24 hrs of Dexamethasone were RI - 0.59 and 0.56 and PI - 0.97 and 0.85 (p<0.001) which were statistically significant.

Fetal Middle Cerebral Artery:

In the study RI and PI of fetal MCA before and after 24 hrs of Dexamethasone administration showed statistically significant reduction. RI and PI of fetal MCA were as RI - 0.92 ± 0.063 and 0.912 ± 0.063 (p=0.003) and PI - 2.12 ± 0.054 and 2.113 ± 0.053 (p=0.001). My results agreed with Elsnosy E et al (2017)[11] who reported statistically significant reduction in color Doppler indices. RI and PI of fetal MCA before and after 24 hrs of Dexamethasone administration were RI - 0.86 ± 0.12 and 0.83 ± 0.13 (p=0.001) and PI - 2.19 ± 0.72 and 2.5 ± 0.72 (p=0.001). My findings are also in agreement with results of Yassin AA et al (2019)[13] RI - 0.88 and 0.79 (p<0.001) and PI - 2.21 and 1.98 (p<0.001) showed statistically significant reduction in color Doppler

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indices of fetal MCA. Ekin A et al (2016)[14] reported that administration of maternal Betamethasone was followed by a significant decrease in PI of MCA at 24 hr ($p<0.05$). Alsayed MA et al (2021)[12] conducted a study on clinical implications of Dexamethasone administration on color Doppler indices of fetal MCA and results showed decrease in RI and PI of fetal MCA after Dexamethasone administration RI - 0.79 ± 0.04 and 0.71 ± 0.02 (p=0.022), PI - 1.83 ± 0.12 and 1.80 ± 0.21 (p=0.028).

Fetal Descending Aorta:

In the study, RI and PI of fetal descending aorta before and after 24 hrs of Dexamethasone administration was RI - 0.92 ± 0.06 and 0.914 ± 0.085 (p=0.005), PI - 1.835 ± 0.124 and 1.829 ± 0.122 (p=0.001) and was statistically significant. Study results agreed with Elsnosy E et al (2017)[11] who reported RI - 0.9 ± 0.55 and 0.87 ± 0.55 (p=0.001) and PI - 1.91 ± 0.44 and 1.89 ± 0.44 (p=0.040) which are statistically significant.

Thus, there was statistically significant reduction in Color Doppler indices (RI and PI) of umbilical artery, uterine artery, fetal MCA and fetal descending aorta after 24 hrs of Dexamethasone administration in women who are at risk of preterm birth resulting in increased blood flow to fetus.

Conclusion:

This study found beneficial effect of maternal administration of Dexamethasone to the pregnant women at risk of preterm labour resulting in increased blood flow of the umbilical artery, uterine artery, fetal MCA and fetal descending aorta after 24 hours of Dexamethasone administration.

Conflict Of Interest:

There is no conflict of interest.

Contribution To Authors

Dr. Amrita Yadav: data collection, statistical analysis and writing the manuscript.

Dr. Rakhi Arya: idea conception and writing manuscript.

Dr. K.P. Banerjee: idea conception and writing manuscript.

Dr. Anuradha Pilaniya: idea conception and manuscript writing.

Dr. Sumeet Sidhu: idea conception and manuscript writing.

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