Evaluation of Oxidative Stress Marker Malondialdehyde Level in the Cord Blood of Newborn Infants

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INTRODUCTION

It is said pregnancy gives new birth to mothers as it deals with strong pains and aggressive episodes of systemic changes in metabolism and physiology of the body. It shows unforgettable and severe pain events occur during this period for sustaining mother and fostering the growth and maintenance of fetus.¹ Due to high energy demand for growth of the fetus, mother during pregnancy takes large amount of oxygen for metabolic functions. This oxygen very necessary but can be toxic if in excess and cause oxidative stress. Many pathophysiological conditions may have oxidative stress. In normal conditions, it is balanced by the antioxidant system but during labor this balance is disturbed due to increased oxidative stress. Malondialdehyde (MDA) is the best indicator of lipid peroxidation and so of oxidative stress. The oxidative stress shows important role in the pathogenesis of many diseases.² The antioxidants are the substances that reduce oxidation of substrates and constitute the body’s main protection against free radicals injury. Reducing the oxidative stress by supplementation of antioxidant could be an effective option to prevent oxidative stress.³ The oxidative stress caused by more and more free radical formation and due to decreased antioxidant level in the target cells and tissues has been noted to play a valuable role in carcinogenesis.⁴⁻⁶ The levels of free radicals molecules are ruled by various cellular defense mechanisms consisting of enzymes such as catalase, superoxide dismutase, glutathione peroxidase, and glutathione components.⁷ The perinatal period is a significant period which affects the rest of the newborn’s life. Although the relation between mother-related factors (the presence of systemic diseases

Abstract

Introduction: Due to high energy demand for growth of the fetus, a mother takes large amount of oxygen for metabolic functions. This oxygen in excess can lead to many pathological conditions and have oxidative stress. Malondialdehyde level in the umbilical cord blood of newborn is indicative of oxidative stress during the perinatal period. The extent of free radical-induced oxidative stress can be enhanced by the decreased efficiency of an antioxidant mechanisms. The present study was conducted to investigate the extent of oxidative stress in cesarean section (C/S) and normal vaginal delivery (NVD).

Materials and Methods: Plasma thiobarbituric acid reactive substances (TBARS) were analyzed in the circulations of 30 umbilical cord blood of neonates born via C/S and NVD.

Results: Significantly increased concentrations of plasma TBARS, were observed in cord blood of C/S than NVD and was significantly high (P ≤ 0.0001). Increase levels of lipid peroxidation may be due to excessive oxidative stress.

Conclusion: Our study shows that both the mother and their newborn in C/S are exposed to higher oxidative stress as compared with NVD.

Keywords: Cord blood, Malondialdehyde, Peroxidative stress
such as preeclampsia and hypertension), birth-related factors (low gestational age, low Apgar score, presence of hypoxic-ischemic encephalopathy, etc.), and exposure of newborns to oxidative stress has been discussed in previous studies, there is an insufficient number of studies that have been conducted on this issue. The study done by Gülbayzar et al. showed that in the emergency cesarean section (C/S) group, the MDA level was statistically and significantly high in newborns with a low ponderal index; hence, they showed that it serve as an indicator of intrauterine growth retardation. They also showed that in the emergency C/S group, the MDA level was statistically and significantly higher in babies with low hemoglobin and hematocrit values in the cord blood. They showed that anemia accompanies many pathological processes of the neonate and shows negative effects on prognosis; this fact revealed through increasing MDA levels as an indicator of oxidative stress. D Weber et al. concluded that oxidative stress (elevated PrCarb) was associated with lower BW/head circumference and small to gestational age (SGA). They explained that incomplete hemodilution showed inverse relation of maternal retinol with baby weight and head circumference, and showed that the association between highest maternal retinol had risk for SGA. Studies have shown that the serum concentration of 8-isoprostanone, which one of the oxidative stress indices connected with vessel constriction has been increased in women diagnosed as having intrauterine growth restriction (IUGR). It has been reported by some workers that during pregnancy complicated by IUGR, MDA concentration in amniotic fluid was almost three times more than in normal pregnancy. Studies have also showed that gravidas with poor pregnancy had increased oxidative damage to their DNA. The oxidative DNA damage was increased in mothers with pregnancy complicated by IUGR. The result of the study conducted by Kamath et al. (2006) indicates that oxidative stress was induced in IUGR babies and their mothers indicating an increased lipid peroxidation and protein oxidant damage. The study done by Dolapo et al. showed significant negative correlations between placenta weight and MDA ($r = -0.25; P < 0.05$), between birth weight and MDA ($r = -0.56; P < 0.05$). The present study is aimed to determine oxidative stress at the time of delivery.

**Inclusion Criteria for Mothers**
Healthy mother only on iron folic acid and calcium supplementation were included.

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History with alcoholism, smoking hypertension, thyroid disorders, diabetes mellitus, renal diseases, hypercholesterolemia, twins, liver diseases, tuberculosis and asthma, and pregnancy-induced hypertension were excluded.

**Inclusion Criteria for Neonates**
Gestational age between 35 and 42 weeks and absence of congenital anomalies were included.

**Exclusion Criteria for Neonates**
Congenital malformations, neonates born to the mother with maternal illness, neonates with perinatal problems such as hypoglycemia, pathological jaundice, and instrumental delivery including extraction, and also neonates with hypoxic ischemic encephalopathy and sepsis were excluded.

**Sample Collection**
After delivery and cord clamping umbilical venous blood was taken from the maternal umbilical end. Serum was separated and analyzed for MDA. The plasma MDA level was determined by a method of Yagi.

**Statistical Analysis**
The results are given as mean ± standard deviation (SD) values. The significance of the mean difference between groups was assayed by the unpaired $t$-test and was correlated by using Pearson correlation coefficient.

**RESULTS**
The age of all the pregnant women was between 22 and 31 years. They all delivered at the gestational age of between 36 and 40 weeks. In our study, out of 30 total newborn, 12 (40%) were male child and 18 (60%) were female child, all were full term newborn. Out of 30 cases, 10 were cesarean cases, and 20 were NVD cases. Mean age of mothers were 24.6 years. No significance statistically was found between maternal age, parity, environmental factors like rural-urban or tribal – non-tribal (Tables 1 and 2).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NVD (n=20) (%)</th>
<th>C/S (n=10)</th>
<th>Total (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6 (20)</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Female</td>
<td>14 (46.6)</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Birth time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preterm</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Term (36-40 weeks)</td>
<td>20</td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>

NVD: Normal vaginal delivery, C/S: Cesarean section

**MATERIALS AND METHODS**
The case-control study was conducted and following information was recorded: Mode of delivery, the age of mother, sex of baby, parity, and weight of the baby. A total of 30 healthy neonates (following normal normotensive pregnancy) were included in the study which were divided on the basis of mode of delivery as normal vaginal delivery (NVD) ($n = 20$) and C/S ($n = 10$).
Mean MDA level in cord blood in the NVD is 4.38 ± 0.28, whereas in C/S it was 6.47 ± 0.51 which was highly significant (P < 0.0001). The male child with NVD had mean ± SD values as 4.35 ± 0.25 and in female as 4.38 ± 0.28, whereas in C/S it was 6.19 ± 0.48 and 6.90 ± 0.10 in male and female child (Table 3).

Table 4 shows the correlation among the measured variables. There were positive correlations between gestational age and NVD (r = 0.047; P = 0.84), birth weight and NVD (r = 0.08; P = 0.73). Furthermore, there were negative correlations between NVD and C/S MDA (r = −0.25; P = −0.46), between gestational age and C/S MDA (r = −0.61; P = −0.05), between birth weight and C/S MDA (r = −0.470; P = −0.16).

**DISCUSSION**

All neonates were full term normotensive (36-42 weeks) born. This has lead to nullify the effect that gestational age has on oxidative stress. The studies showed increase oxidative stress as pregnancy advances. The age range of mothers included was not above 40 years. The effect of aging factor on our selected biochemical parameter was also exempted. All neonates were born through spontaneous vertex delivery bearing in mind the effect that different mode of deliveries could have on oxidative stress.20 It has been showed that babies born through elective C/S have less oxidative stress than those born through spontaneous vertex delivery. This has been due to the stress of labor the baby passes with and some pains may even be prolonged.21

The oxidative stress in babies develops the same way it develops in the adult. This is as a result of the generation of free radical in excess. Free radicals like reactive oxygen species when they attack cellular polyunsaturated membrane lipid, a chain reaction occurs. These reactions go on until when scavengers of free radicals act on. These scavengers are antioxidants available and in fact mechanism is widely studied. Our study considered the measurement of plasma MDA to see the extent of free radical injury (lipid peroxidation).22,23

The role of oxidative stress in various pathological conditions has been recently burning topic of discussion. An increase MDA is indicator of oxidative stress in adult and children and shows that newborns antioxidant defense system is ineffective to fight against oxidative stress. An increase in MDA is an indicator of oxidative stress has been studied in various pathological conditions both in adults and children.24 Newborn’s antioxidant defense system is insufficient hence oxidative damage results. MDA level is one of the biochemical parameters of this stress. The study done by Denisa et al. showed that lipid peroxidation in blood plasma might be activated. Arikan et al. has shown in their study that lipid peroxidation and antioxidant status have been changed during delivery, and these changes affect the fetus by creating oxidative stress.25,26 Gülbayzar et al. showed mean SD levels in cord in the NVD, emergency C/S group, and elective cesarean group and the values were 2.03 ± 0.42 nmol/mL, 2.21 ± 0.95 nmol/mL, and 0.92 ± 0.29 nmol/mL, respectively. They also found levels as significantly higher when compared to that in the elective cesarean group.9 Mocatta et al. determined that cord blood MDA levels in elective C/S were lower as compared to those of NVD. Yigit et al. also showed that cord blood MDA levels in neonates born via spontaneous vaginal delivery were higher compared to those born via C/S.27,28 In another study, the role of perinatal distress on the production of oxygen radicals and on lipid peroxidation was determined and an increased MDA level, regardless of gestational age, in neonates delivered via C/S compared to borned via spontaneous vaginal delivery.29 Our result also shows oxidative stress in cesarean delivery time. The MDA level was significantly higher (P < 0.0001) in cord blood during C/S than vaginal delivery. Our results agree with results of Siddiqi et al. Their MDA level was higher in C/S than NVD.30 Since MDA is direct adduct of polyunsaturated fatty acids (PUFA) this are essential constituents of cellular membrane lipids and many other cellular components, three deductions can be made, (a) Membrane lipids may be more damaged in C/S than NVD, (b) PUFA located in other cellular or extracellular compartment are more damaged and, (c) else both are partly damaged. We would like to emphasize that damage need not to be necessarily expressed in the form of pathology because tissues are always in the state of

**Table 2: Characteristic of mother**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NVD</th>
<th>Cesarean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of mother (mean)</td>
<td>24.9 years</td>
<td>24.00 years</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

NVD: Normal vaginal delivery

**Table 3: Comparison of mean±SD levels of MDA in NVD and C/S**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NVD</td>
<td></td>
<td></td>
<td>Cesarean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDA (nmole/mL)</td>
<td>4.35±0.25*</td>
<td>4.38±0.28</td>
<td>4.38±0.28</td>
<td>6.19±0.48</td>
<td>6.90±0.10</td>
<td>6.47±0.51*</td>
</tr>
</tbody>
</table>

*P<0.0001, highly significant, SD: Standard deviation, NVD: Normal vaginal delivery, C/S: Cesarean section, MDA: Malondialdehyde
Table 4: Correlation of MDA with other parameters

<table>
<thead>
<tr>
<th></th>
<th>MDA</th>
<th>NVD</th>
<th>Cesarean delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>P</td>
<td>R</td>
</tr>
<tr>
<td>Birth weight</td>
<td>0.08</td>
<td>0.73</td>
<td>0.479</td>
</tr>
<tr>
<td>Gestational age</td>
<td>0.047</td>
<td>0.841</td>
<td>0.617</td>
</tr>
</tbody>
</table>

NVD: Normal vaginal delivery, MDA: Malondialdehyde

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REFERENCES


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