Original Article

DOI: 10.17354/ijss/2015/396

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

Suman Jain[1], Ashwati Nair[2], Chanchal Shrivastava[3]

[1]Assistant Professor, Department of Biochemistry, Pacific Institute of Medical Sciences, Udaipur, Rajasthan, India, [2]Research Scholar, Department of Biochemistry, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India, [3]Assistant professor, Department of Physiology, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India

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 ($P \leq 0.0001$). 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

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

Access this article online

www.ijss-sn.com

Month of Submission : 07-2015
Month of Peer Review : 08-2015
Month of Acceptance : 08-2015
Month of Publishing : 09-2015

Corresponding Author: Dr. Suman Jain, Department of Biochemistry, Pacific Institute of Medical Sciences, Udaipur, Rajasthan, India. E-mail: sumannemijain@yahoo.com

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.[8] 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.[9] 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.[10] Studies have shown that the serum concentration of 8-isoprostane, which one of the oxidative stress indices connected with vessel constriction has been increased in women diagnosed as having intrauterine growth restriction (IUGR).[11] 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.[12] Studies have also showed that gravidas with poor pregnancy had increased oxidative damage to their DNA.[13] The oxidative DNA damage was increased in mothers with pregnancy complicated by IUGR.[14] 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.[15] 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 ($r = -0.56$; $P < 0.05$).[16] The present study is aimed to determine oxidative stress at the time of delivery.

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 healthy 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 ($n = 10$).

Inclusion Criteria for Mothers

Healthy mother only on iron folic acid and calcium supplementation were included.

Exclusion Criteria for Mothers

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.[17]

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 1: Characteristic of newborn

Parameter	NVD *n*=20 (%)	C/S (*n*=10)	Total (*n*=30)
Gender			
Male	6 (20)	6	12
Female	14 (46.6)	4	18
Birth time			
Preterm	-	-	-
Term (36-40 weeks)	20	10	30

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

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.[18,19] 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 Siddiqui *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

Parameter	NVD	Cesarean
Age of mother (mean)	24.9 years	24.00 years
Parity		
1	2	2
2	12	4
3	6	4

NVD: Normal vaginal delivery

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

Parameter	NVD			Cesarean delivery		
	Male	Female	Total	Male	Female	Total
MDA (nmole/mL)	4.35±0.25*	4.38±0.28	4.38±0.28	6.19±0.48	6.90±0.10	6.47±0.51*

*$P \leq 0.0001$, highly significant. SD: Standard deviation, NVD: Normal vaginal delivery, C/S: Cesarean section, MDA: Malondialdehyde

Table 4: Correlation of MDA with other parameters

MDA	NVD		Cesarean delivery	
	R	*P*	*R*	*P*
Birth weight	0.08	0.73	0.479	0.161
Gestational age	0.047	0.841	0.617	0.057

NVD: Normal vaginal delivery, MDA: Malondialdehyde

dynamic equilibrium and possess an effective repair system. Our results show that the women and their newborns in C/S are under oxidative stress rather than in NVD.

CONCLUSION

Our study shows that both the mother and their newborn in C/S are exposed to higher oxidative stress as compared with NVD. The antioxidant system of mother is insufficient to fight up with oxidative stress. NVD is advantageous than C/S in regard to oxidative stress.

ACKNOWLEDGMENT

We sincerely thank R.N.T. Medical College and Associated Hospital and Geetanjali Medical College and Hospital, Udaipur for extending the facilities for conducting the work. We are highly grateful to those patients of our hospital who volunteered to donate their blood when needed for this project. Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

REFERENCES

1. Kinalski M, Sledziewski A, Telejko B, Kowalska I, Kretowski A, Zarzycki W, *et al.* Lipid peroxidation, antioxidant defence and acid-base status in cord blood at birth: The influence of diabetes. Horm Metab Res 2001;33:227-31.
2. Khanna K, Nikunji N, Khanna HD. A study of antioxidant and their preventive potential in cervical dysplasia. Asian J Obs Gynae Pract 2002;l6:3-11.
3. Diplock AT. Antioxidant nutrients and disease prevention: An overview. Am J Clin Nutr 1991;53 1 Suppl:189S-193.
4. Halliwell B, Gutteridge JM. Free Radicals in Biology and Medicines. 3rd ed. UK: Oxford Science Publications; 1990. p. 192.
5. Rajneesh CP, Manimaran A, Sasikala KR, Adaikappan P. Lipid peroxidation and antioxidant status in patients with breast cancer. Singapore Med J 2008;49:640-3.
6. Lopaczynski W, Zeisel SH. Antioxidants: Programmed cell death and cancer. Nutr Res 2001;21:295-307.
7. Parola M, Leonarduzzi G, Robino G, Albano E, Poli G, Dianzani MU. On the role of lipid peroxidation in the pathogenesis of liver damage induced by long-standing cholestasis. Free Radic Biol Med 1996;20:351-9.
8. Lurie S, Matas Z, Boaz M, Fux A, Golan A, Sadan O. Different degrees of fetal oxidative stress in elective and emergent cesarean section. Neonatology 2007;92:111-5.
9. Gülbayzar S, Arica V, Hatipoglu S, Kaya A, Arica S, Karatekin G. Malondialdehyde level in the cord blood of newborn infants. Iran J Pediatr 2011;21:313-9.
10. Weber D, Stuetz W, Bernhard W, Franz A, Raith M, Grune T, *et al.* Oxidative stress markers and micronutrients in maternal and cord blood in relation to neonatal outcome. Eur J Clin Nutr 2014;68:215-22.
11. Karowicz-Bilinska A, Kowalska-Koprek U, Suzin J, Sieroszewski P. Analysis of 8-isoprostane concentration as a marker of oxidative stress in pregnant women diagnosed with IUGR. Ginekol Pol 2003;74:1137-42.
12. Bazowska G, Jendryczko A. Concentration of malondialdehyde (MDA) in amniotic fluid and maternal and cord serum in cases of intrauterine growth retardation. Zentralbl Gynakol 1994;116:329-30.
13. Scholl TO, Stein TP. Oxidant damage to DNA and pregnancy outcome. J Matern Fetal Med 2001;10:182-5.
14. Takagi Y, Nikaido T, Toki T, Kita N, Kanai M, Ashida T, *et al.* Levels of oxidative stress and redox-related molecules in the placenta in preeclampsia and fetal growth restriction. Virchows Arch 2004;444:49-55.
15. Kamath U, Rao G, Kamath SU, Rai L. Maternal and fetal indicators of oxidative stress during intrauterine growth retardation (IUGR). Indian J Clin Biochem 2006;21:111-5.
16. Dolapo PO, Daniel AA, Adeniran SA, Abolape AI, Patric TA. Cord blood oxidative stress markers correlate with birth and placenta. J Asian Sci Res 2013;3:365-72.
17. Yagi K. Lipid peroxides and human diseases. Chem Phys Lipids 1987;45:337-51.
18. Idogen ES, Odiegwu ME, Momoh SM, Okonofua FE. Effect of pregnancy on total antioxidant capacity in Nigerian women. Park J Med Sci 2008;24:2292-5.
19. Luqman A, Salinu MA, Gafar A, Aremu I, Solasoya A. Effect of vitamin C on malondialdehyde in pregnant Nigerian women. J Basic Appl Sci 2008;4:105-8.
20. Tonini CL, Campagnaro BP, Louro LP, Pereira TM, Vasquez EC, Meyrelles SS. Effects of aging and hypercholesterolemia on oxidative stress and DNA Damage in bone marrow mononuclear cells in apolipoprotein E-deficient mice. Int J Mol Sci 2013;14:3325-42.
21. Calderon TC, Wu W, Rawson RA, Sakala EP, Sowers LC, Boskovic DS, *et al.* Effect of mode of birth on purine and malondialdehyde in umbilical arterial plasma in normal term newborns. J Perinatol 2008;28:475-81.
22. Mittler R, Vanderauwera S, Gollery M, Van Breusegem F. Reactive oxygen gene network of plants. Trends Plant Sci 2004;9:490-8.
23. Gerato PL, Polle A, Lea PJ, Azevedo RA. Making the life of heavy metal stressed plants a little easier. Funct Plant Biol 2005;32:481-94.
24. Bilgil G, Dizdarer C, Kalkan S. Relationship between factors in the perinatal period and malondialdehyde concentration in cord blood. Ege J Pediatr 2005;12:7-12.
25. Denisa M, Gustav K, Jaroslav H, Branislav I, Jana P, Zelmira B, *et al.* Lipid peroxidation and biological parameters in umbilical cord blood of well-adapted term newborns. Biologia 2009;64:409-13.
26. Arikan S, Konukoglu D, Arikan C, Akçay T, Davas I. Lipid peroxidation and antioxidant status in maternal and cord blood. Gynecol Obstet Invest 2001;51:145-9.
27. Mocatta TJ, Winterbourn CC, Inder TE, Darlow BA. The effect of gestational age and labour on markers of lipid and protein oxidation in cord plasma. Free Radic Res 2004;38:185-91.
28. Yigit S, Yurdakök M, Kilinç K, Oran O, Erdem G, Tekinalp G. Serum malondialdehyde concentration as a measure of oxygen free radical damage in preterm infants. Turk J Pediatr 1998;40:177-83.
29. Kirimi E, Peker E, Tuncer O, Yapicioglu H, Narli N, Satar M. Increased serum malondialdehyde level in neonates with hypoxic-ischaemic encephalopathy: Prediction of disease severity. J Int Med Res 2010;38:220-6.
30. Siddiqui H, Noor N, Moin S, Parveen S. Evaluation of oxidative stress markers in maternal and cord blood: Vaginal delivery versus elective caesarean section. Int J Curr Med Res 2014;2:24-7.

How to cite this article: Jain S, Nair A, Shrivastava C. Evaluation of Oxidative Stress Marker Malondialdehyde Level in the Cord Blood of Newborn Infants. Int J Sci Stud 2015;3(6):73-76.
Source of Support: Nil, **Conflict of Interest:** None declared.