Comparison of total antioxidant capacity in term small for gestational age (SGA) and appropriate for gestational age (AGA) newborns

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Abstract

Background: Total antioxidant capacity (TAC) is a measure of oxidative stress. Oxidative stress has been implicated in the pathogenesis of many diseases of newborns. The objective of this study was to estimate total antioxidant capacity in term small for gestational age (SGA) newborns and compare it with term appropriate for gestational age (AGA) newborns. The study was done at a tertiary level teaching hospital.

Materials & Methods: 82 newborns (Term AGA 46 and Term SGA 36) were enrolled. Cord blood was taken and TAC of serum was determined by TAC assay kit (from Labor Diagnostika, Germany)

Result: There was no significant difference in the total antioxidant capacity of the term AGA and SGA groups. There was significant difference in the mean birth weight of the AGA and SGA groups. Also, the ponderal index was significantly different.

Conclusion: Weight for gestational age in term newborns do not significantly affect total antioxidant capacity.

Keyword: TAC, SGA, AGA.

Introduction

Oxidative stress is a term used to describe any condition that results in an accumulation of free radicals in the tissues.(1) It occurs as a consequence of imbalance between the formation of oxygen free radicals and inactivation of these species by antioxidant defense system.

Premature infants have lower levels of antioxidants.(2) Vitamin E is low in preterm babies.(3) Vitamin C and A, glutathione, sulphur containing amino acids, ceruloplasmin and transferrin are normally transferred from maternal to fetal circulation only in the later part of third trimester. Antioxidant enzymes are expressed in high concentration only at the end of gestation in preparation for the relatively hyperoxic extrauterine environment. Thus, preterms are more vulnerable to oxidative stress. The perinatal period and delivery in particular is a crucial time for maintaining a balance between the production of free radicals and the incompletely developed antioxidative protection of the fetus and the newborn.(4) Cord blood antioxidant capacity is the result of overall intrauterine experience. Genetic variability, maternal oxidative stress and maternal antioxidant capacity are likely to alter the cord blood antioxidant capacity.

Oxidative stress has been considered in the pathogenesis of the major complications of prematurity including necrotizing enterocolitis(NEC),(5)chronic lung disease(CLD),(6) retinopathy of prematurity(ROP)(7) and intraventricular hemorrhage(IVH).(8) In addition to prematurity, reactive oxygen species have been suggested as playing crucial role in pathogenesis of these diseases.(9) In presence of hypoxia-ischemia, hypoxanthine is generated from the breakdown of adenosine monophosphate. With reperfusion in the presence of oxygen, hypoxanthine is oxidized to uric acid with the generation of superoxide, which can react with hydrogen peroxide in the presence of iron to produce the highly reactive hydroxyl radical. Hydroxyl radical can damage DNA, cause lipid peroxidation, and damage disulfide bonds of proteins. An important source of oxygen and nitrogen free radicals is activated inflammatory cells. Hypoxia-ischemia and reperfusion injury may be important in the pathogenesis of IVH,(10) ROP,(11) and NEC.(12) High inspired oxygen concentration and activated inflammatory cells may be important in causing Bronchopulmonary dysplasia(6)

Materials and Methods

The present study was conducted in the Department of Paediatrics in collaboration with Department of Biochemistry, and Microbiology, Pt. B.D.Sharma, PGIMS, Rohtak from May 2013 to Dec. 2014. 82 new-borns (Term AGA 46 and Term SGA 36) were enrolled after an informed parental consent was obtained. The study protocol was approved by the Institutional Ethical Committee.

Inclusion criteria

- All inborn normal babies with gestation age of 37 to 41 completed weeks.

Exclusion criteria

- Maternal conditions like chorioamnionitis, funisitis or chorionic vasculitis.
- Perinatal asphyxia, sepsis or any malformation in newborn.
- Haemolytic disease of newborn.

- Refusal of parental consent.

Gestational age was assessed from the date of last menstrual period and clinical assessment using the Ballard score.[13]

For classifying infants as appropriate or small for gestation, reference of weight was taken from Lubchenco's chart [14] of intrauterine growth.

5ml of cord blood in plain glass tubes was collected immediately after the infant delivery and allowed to clot and centrifuged. Serum was collected in plain plastic tubes and sent to the laboratory for analysis. It was kept at 2-8° C in any anticipated delay and was sent as soon as possible thereafter.

TAC of serum was determined by antioxidant assay kit (from LDN Labor Diagnostika, Germany). The determination of the total antioxidant capacity was based on the reaction of peroxides with peroxidase followed by a colour reaction of the chromogenic substrate tetramethylbenzidine. Its blue colour turned to yellow after addition of the stop solution and measured photometrically at 450 nm.

Results

In our study, cord blood from 82 full term new-borns was taken (46-AGA and 36 SGA) and TAC was measured. Table 1 shows the anthropometric measurements of various parameters in two groups. All measurements have significant difference between AGA and SGA groups. The SGA neonates are smaller, shorter, have smaller head and chest.

Table 1: Showing various anthropometric measurements in study and control groups

Parameter	AGA(46)	SGA(36)	Significance (P value)
Birth weight (Mean±SD)	2864.130±343.61	2138.888±216.83	<0.01
Length (Mean±SD)	47.92±0.940	46.11±0.790	<0.05
Head circumference (Mean±SD)	34.19±0.866	33.45±0.725	<0.05
Chest circumference (Mean±SD)	31.46±0.870	30.73±0.706	<0.05

SD-standard deviation)

Mean values of TAC are shown in Table-2. P-value was 0.128 which was not significant.

Table 2: Levels of TAC in study and control groups

AGA/SGA	No.	MEAN TAC	SD
AGA	46	1.107	0.136
SGA	36	1.065	0.101

Mean birth weight of AGA and SGA is shown in Table-3.p-value was less than 0.01 which was highly significant. Pearson correlation factor(r) for AGA was 0.172 and for SGA was 0.241. There was no significant correlation between birth weight and TAC for both groups.

Table 3: Showing mean birthweight and its correlation with TAC in study and control groups

AGA/SGA	MEAN B. Wt. (gms.)	SD	MEAN TAC	R
AGA	2864.130	343.61	1.107	0.172
SGA	2138.888	216.83	1.065	0.241

Similarly there was no correlation found between TAC and length, head circumference, chest circumference.

Mean value of ponderalindex (PI) for both AGA and SGA is shown in Table-4.p-value was <0.01 which was highly significant. Pearson correlation factor(r) was 0.119 for AGA and 0.260 for SGA. There was no significant correlation between PI and TAC in both groups.

Table 4: Showing mean PI and its correlation with TAC in study and control groups

AGA/SGA	NO.	MEAN PI	SD	MEAN TAC	R
AGA	46	2.59	0.237	1.107	0.119
SGA	36	2.03	0.182	1.065	0.260

Discussion

In our study, 82 full term neonates were enrolled and their TAC in cord blood was measured. We found no significant difference in TAC of both groups.

Gupta et al[15] reported that cord blood of term SGA neonates born to undernourished mothers have low levels of oxygen free radical scavenging system including superoxide dismutase, catalase and reduced glutathione (indicating deficient anti-oxidant defence mechanisms) and higher levels of malondialdehyde (a measure of lipid peroxidation and oxidative damage) as compared to term AGA neonate born to well-nourished mothers. Maternal albumin and haemoglobin appeared to be the most important parameters to influence the markers of oxidative stress. Thus, biochemical indicators of nutrition were more closely linked to oxidative stress as compared to anthropometric characteristics. They found a ponderal index of <2 in term SGA neonates indicating asymmetrical growth retardation In our study there was significant difference in mean birth weight and ponderal index. Mean value of ponderal index in SGA neonates was slightly more than 2. In our study, nutritional status of mother was not considered.

Chakravarty et al[16] found a positive correlation between antioxidant defence mechanisms in maternal and cord blood in full term as well as in preterm (wherever antioxidant levels were less in mothers blood, the levels were less in cord blood as well)

Rogers et al[17] found a positive correlation between antioxidant capacity of cord blood and gestational age less than 32 weeks but antioxidant

capacity did not correlate with gestational age after 32 weeks. In our study, involved neonates were full term and there was no significant difference between total antioxidant levels in both groups.

Result of a study by Gopinathan et al revealed that antioxidant capacity of plasma from neonates born before 32 weeks' gestation did not show any significant correlation with gestational age.[18]

In conclusion the anthropometric parameters in term neonates do not influence the antioxidant capacity. Limitations of our study was that we have not measured mother's, nutritional status, pregnancy risk factors, total antioxidant capacity which may affect cord blood total antioxidant capacity

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References

1. Fiona.B.Pipkin, Maternalphysiology in pregnancy. In: Geoffrey Chamberlain, Phillip J ester, editors. Turn Bull′s Obstetrics.3rdedition.Churchill Livingstone,2002.p.77-78.
2. Richard D.Bland, The Newborn Infant. In: Colin D. Rudolph, Abraham M. Rudolph, Margaret K. Hostetter, George Lister, Norman J. Siegel, editors. Rudolph's paediatrics 21st edition. New York: McGraw Hill.2003:p.110
3. Ola DirikSangstad, Hypoxia induced free radical disease in the neonatal period Orientlongman;2000. p.229-34.
4. Saker, M., N.S. Mokhtari, S.A. Merzouk, H. Merzouk, B.Belarbi and M. Narce, 2008. Oxidant and antioxidant status in mother and their newborns according to birth weight. Eur. J. Obstet. Gynecol.Reprod. Biol.,141:95-99.
5. Okur, H, M. Kucukaydin, K. Kose,O. Kontas, P. Doan and A. Kazez, 1995. Hypoxia-induced necrotizing enterocolitis in the immature rat: The role of lipid peroxidation and management by vitamin E. J. Paediatr. Surg, 0:1446-49.
6. Saugstad,O. D., 1997. Bronchopulmonary dysplasia and oxidative stress: Are we closer to an understanding of the pathogenesis of BPD.Acta Paediatr.,86:1277-82.
7. Perrone, S., P. Vezzosi, B. Marzocchi and P. Paffetti et al., 2009. Biomarkers of oxidative stress in babies at high risk for retinopathy of prematurity. Front Biosci.,1:547-52.
8. Kelly, F.J., 1993. Free radical disorders of preterm infants. Br. Med. Bull.,49:668-87
9. Saugstad OD Hypoxanthine as an indicator of hypoxia: its role in health and disease through free radical production. Pediatr Res. 1998;23143-50
10. Abdel-Rehman AM Rosenberg AA Prevention of intraventricular hemorrhage in the premature infant. ClinPerinatol.1994; 21505-21
11. Lucey JF Dangman B A reexamination of the role of oxygen in retrolental fibroplasias. Pediatrics.1984;7382-96
12. Crissinger KD Regulation of hemodynamics and oxygenation in the developing intestine: insight into the pathogenesis of necrotizing enterocolitis. Acta Paediatr Suppl.1994; 396:8-10.
13. Ballard JL, Khoury JC, Wedig K, Wang L, Eilers-Walsman BL, Lipp R. New Ballard score, expanded to include extremely premature infants. J Pediatr 1991;119:417-23.
14. 14.Battaglia FC, Lubchenco LO. A practical classification of newborn infants by weight and gestational age. J Pediatr1967; 71:159-63.
15. 15 Gupta P, Narang M, Banerjee BD, Basu S. Oxidative stress in term small for gestational age neonates born to undernourished mothers: a case control study. BMC Pediatrics2004;4:14.
16. Chakravarty S, Sontakke AN. A correlation of antioxidants and lipid peroxidation between maternal and cord blood in full term and preterm deliveries. Curr Pediatr Res2012;16:167-74.
17. Rogers S, Witz G, Anwar M, Hiatt M, Hegyi T. Antioxidant capacity and oxygen radical diseases in the preterm newborn. JAMA2004;154:544-8.
18. GopinathanV ,MillerNJ, MilnerADRice-Evans CA Billirubin and ascorbate antioxidant activity in neonatal plasma. FEBS Lett. 1994;349197-200.