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Original Research Article

Maternal haemoglobin and neo-natal haemoglobin status: a hospital-based study in Ranchi, Jharkhand, India

Priyanka Chaturvedi[1]*, Deepak Chaturvedi[2], Prita Naz Dubraj[1], A. K. Chaudhary[1]

[1]Department of Pediatrics and Neonatology, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India
[2]Department of Pediatrics and Neonatology, Rani Hospital, Ranchi, Jharkhand, India

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***Correspondence:**
Dr. Priyanka Chaturvedi,
E-mail: priyanka.pandey86@gmail.com

ABSTRACT

Background: Haemoglobin of foetus increases with advancing gestational age. During pregnancy, fetal demand for iron increases maternal daily iron requirement from first trimester to third trimester. Late cord clamping may result in delivery of extra blood as well as iron to newborn. The cause of worry here is that maternal anaemia is a significant cause of direct and indirect morbidity and mortality both for pregnant mother and her foetus/neonate.
Methods: To determine maternal and neonatal haemoglobin status we conducted a cross sectional study comprising 217 pregnant women and their children in Ranchi, Jharkhand, India.
Results: Mean neonatal haemoglobin in controls was 18.13±1.14 g/dl whereas that in cases was 17.21±1.38 g/dl and the difference was statistically significant. Among the 97 cases 23 mothers had babies with neonatal haemoglobin below 14g/dl. In controls only 17 out of 120 mothers had babies with neonatal haemoglobin below 14g/dl (p value<0.01).
Conclusions: Present study demonstrated that the neonatal haemoglobin is lower in anemic mothers and that the decrease appears to be proportional to the degree of anemia.

Keywords: Anemia, Haemoglobin, Neonate, Pregnant women

INTRODUCTION

It has been widely agreed that anaemia is a common finding in pregnancy. It has also been found that there can be a 20% increase in the total number of red blood cells. However, the amount of plasma increase causes dilution of those red cells. Consequently, a haemoglobin level of pregnancy can lower to 10.5 gm/dl representing a normal anaemia of pregnancy. In has also been observed that for a normal pregnancy without iron supplementation, haemoglobin concentration decreases from an average of 12.5-13.0 gm/dl to an average of 11.0-11.5 gm/dl. The cause of worry here is that maternal anaemia is a significant cause of direct and indirect morbidity and mortality both for pregnant mother and her foetus/neonate. The usual reason for women to have low iron levels is blood loss during menstruation. The fact is that during pregnancy, fetal demand for iron increases maternal daily iron requirement from 1 to 2.5 mg/day in early pregnancy and 6.5mg in third trimester.

However, changes in absorption pattern enable healthy pregnant women to cope with extra demand without becoming anaemic, but only if there is adequate iron in diet, iron deficiency anaemia being a major cause. Haemoglobin of foetus increases with advancing gestation age. At term neonatal blood haemoglobin is 16.8gm/dl (14-20gm/dl); haemoglobin level in very low

birth weight infants are 1-2 gm/dl below those in normal infants. A haemoglobin value less than normal range of haemoglobin for birth weight and postnatal age is defined as anaemia. A physiological decrease in haemoglobin content is noticed at 8-12 weeks in term infants-haemoglobin 11gm/dl and at 6 weeks in premature 7-10 gm/dl.[1] Maternal haemoglobin has an effect on the birth weight and thus indirectly on haemoglobin level.

Anaemia at birth manifests as pallor, heart failure or shock. It may be caused by acute or chronic foetal blood loss, haemolysis/under production of erythrocytes. Specific causes like haemolytic disease of new born, tearing / cutting of umbilical cord, placenta previa / abruption and others. Trans-placental haemorrhage with bleeding from foetus into maternal circulation if severe can cause anaemia at birth. Delayed cord clamping (30-180sec) or after cessation of cord pulsation may be beneficial in otherwise well newborn cord in preventing anaemia in full term infants with effects extending beyond the neonatal period (improved haematocrit, iron status). Late clamping may result in delivery of an extra 20-40 ml of blood and 30-35mg of iron to newborn.[1]

After 8 weeks of foetal life, embryonic haemoglobin Gower-1, Gower-2 and Portland are formed. At 9 weeks the major haemoglobin is Haemoglobin F. Haemoglobin A first appears at approximately 1 month of fetal life but does not become the dominant haemoglobin until after birth when Haemoglobin F starts to decline. Haemoglobin A2 is minor haemoglobin that appears shortly before birth and remains at low level after birth. Final haemoglobin distribution pattern is not achieved until at least 6 month of age. Normal haemoglobin pattern >95 % Haemoglobin A, <3.5% Haemoglobin A2 and <2.5% HaemoglobinF.[1] The objectives of the present study were to measure maternal haemoglobin and to determine its association with the neonatal haemoglobin.

METHODS

This cross-sectional hospital based comparative study was conducted on 160 pregnant patients in labour attending Department of Obstetrics and Gynaecology, with their offspring after delivery and were recruited from January 2017 until December 2017. During this period, 217pregnant women were included and gave birth to 256 newborns. Twenty-five pairs of twins, one set of triplets, 10 still-born infants and 13 neonatal deaths were excluded.

Inclusion criteria

- Apparently healthy mothers
- Term neonates
- Born through normal vaginal delivery
- Gestational age of >37 weeks and
- Birth weight of >2.5 kg

Exclusion criteria

- Mothers with h/o APH, Eclampsia, Diabetes mellitus and Multiple pregnancies.
- New-borns with pathologic jaundice, haemolytic anaemia, and congenital malformation.

Data collection

At delivery, a questionnaire was administered to gather information on the women's socio demographic and obstetric background and on the course of the current pregnancy. Before delivery, weight and height were measured. Gestational age at delivery was determined using the Modified Ballard method.[2] Before delivery blood samples were taken from mothers. Also 1 ml of neonatal blood was obtained. Haemoglobin was determined with an automated Pentra XL 80.

Maternal age, parity birth weight, and baby sex were also noted. As per the WHO definition mothers were categorised as anaemic with haemoglobin of less than 11g/dl. Neonates with neonatal haemoglobin below 14g/dl were classified as anaemic. The data was analyzed with SPSS 19.0.

RESULTS

The study population was divided in two groups. Both the groups were comparable with regard to different attributes viz parity, gestation and age. Among 217 pregnant women 97 mothers had haemoglobin <11g/dl and constituted the cases. The control group consisted of 120 mothers and the haemoglobin in this group was >11g/dl. Table 1 indicates the characteristics of case and controls along with average neonatal haemoglobin in both groups.

Table 1: Case and controls with average neonatal haemoglobin in both groups.

	Mean age (Years)	Mean gestation (Weeks)	Parity	Mean Hb* (g/dl)	Mean neonatal Hb* (g/dl)	P-Value
Cases	23.78±3.56	38.49±2.23	2.73	9.68±0.93	17.21±1.38	<0.01
Controls	23.96±3.23	38.34±1.98	2.12	13.24±0.66	18.13±1.14	<0.01

There was significant statistical difference in mean neonatal haemoglobin among cases and controls, mean neonatal haemoglobin in controls was 18.13±1.14g/dl whereas that in cases was 17.21±1.38g/dl. Among the cases 34 mothers had mild anemia (haemoglobin between 10-10.9g/dl). Moderate anemia (haemoglobin between 8-9.9g/dl) was present in 57 mothers. Severe anemia (haemoglobin less than 8g/dl) observed in 6 mothers.

Table 2 depicts the mean neonatal haemoglobin in these groups. Among the 97 cases 23 mothers had babies with neonatal haemoglobin below 14g/dl (23.71%). The percentage of controls having babies with neonatal haemoglobin below 14g/dl was much lower with 17 out of 120 mothers having babies with neonatal haemoglobin below 14g/dl (14.16%) and the difference was statistically significant (p value<0.01).

Table 2: Mean neonatal haemoglobin in both groups.

Maternal Hb * (g/dl)	Mean Hb* (g/dl)	Number of Patients	Mean neonatal Hb* (g/dl)	P-value
10-10.9	10.49±0.42	34	16.09±0.98	<0.01
8-9.9	9.34±0.84	57	15.87±1.13	<0.01
<8	7.17±0.53	6	15.32±1.49	<0.01

DISCUSSION

It was found that the mean neonatal haemoglobin among all cases was 17.21g/ dl and that among control cases was 18.13g/dl. This difference between the two groups is statistically significant. The findings for neonatal haemoglobin in our study were similar to studies in the west. The studies there have also indicated an overall average haemoglobin of healthy term neonates to be 16.8 g/dl.[3,4] Also, the neonatal haemoglobin appears to show a linear relationship with maternal haemoglobin.

As a result, mothers who had more severe anaemia had babies with lower neonatal haemoglobin. The same has also been supported by previous studies which have shown that there is a direct relationship between maternal and foetal haemoglobin.[5,6]

From the study, it has been established that mothers who had anaemia were more likely to deliver anaemic babies i.e. babies with neonatal haemoglobin <14g/dl. (Odds ratio 1.52 with relative risk 27). Also, the previous studies have indicated that iron supply to the placenta and the foetus is affected in maternal anaemia and the foetus takes iron in direct proportion to the levels available in the mother.[6] It leads to reduced neonatal haemoglobin in babies born to mothers who are anaemic. There is a high correlation with such babies more likely to develop significant anaemia at an earlier age than babies born to non-anaemic mothers.

However, in contrast to present study, some previous investigators have failed to find a relationship between maternal and neonatal haemoglobin. They have also erroneously concluded that the foetus continues to extract iron efficiently from the mother no matter what is her iron status.[7,8]

The fact is well-established that iron is actively transported from the mother to the foetus. It is to be noted that in the iron deficiency state, there is up-regulation of iron transport proteins in the placenta thus ensuring an adequate iron supply to the growing foetus even in the anaemic mother.[9] This does not mean there is adequate iron supply to the foetus as most of the previous studies have demonstrated linear relationships of neonatal iron and ferritin levels with maternal haemoglobin and ferritin levels.[10] Current study has also demonstrated that the neonatal haemoglobin is lower in anaemic mothers and that the decrease appears to be proportional to the degree of anaemia. This brings the finding to the front that placental iron transport mechanisms may not work at higher degrees of anaemia thus leading to a fall in neonatal haemoglobin.[11] The following limitations were there in our study:

- We did not have the opportunity to assess the iron status of the mothers directly and it was assumed that iron deficiency was the cause of anaemia.
- We could also not assess the haemoglobin in mothers during the first and second trimesters which would have been more relevant to assess the overall iron status of the mother and its impact if any on the neonatal haemoglobin.
- However, it is assumed that mothers who were anaemic during labour had poor iron intake throughout their pregnancy and this was reflected in the neonatal haemoglobin.
- Only neonates were taken in present study while the outcome of maternal anaemia is mostly evident after 3 months.

In view of all the above, we suggest that further studies to assess the maternal iron and ferritin levels should be done to provide more insights on the mechanism of iron accumulation in the foetus. It is well established that anaemic woman has a higher chance of delivering a baby with lower iron levels and potential to develop earlier and more severe anaemia.

It is supported by all previous studies. Our suggestion is to make sure that adequate antenatal care for all pregnant women is provided with special focus on iron supplements. This would improve neonatal health and certainly reduce mortality and morbidity in the first year.

CONCLUSION

Though the cases had lower haemoglobin than controls neonatal anaemia was not manifest in most cases but may become evident after 3 months of age, the reason being that the nadir of haemoglobin occurs at 8-12 weeks of life as a physiologic response. The foetus avails itself of maternal blood as normal infants are parasitic on maternal iron and look after their own well-being efficiently in utero and maintain so shortly after birth and decline only after some time of birth. Hence studies considering follow up / taking in to account haemoglobin after the neonatal period would throw further light.

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