Impact of Anemia in Pregnant Women on the Neonatal Conditions

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Abstract

BACKGROUND: True iron deficiency anemia in pregnant women has been a pressing obstetric issue for many years and is one of the most common complications of pregnancy in the world, particularly in developing countries.

AIM: The aim of the study was to study the condition of neonates born to women with iron deficiency anemia.

METHODS: The retrospective analysis method was used to assess 230 patient medical files in the maternity and pregnancy pathology departments. The patients were divided into 2 groups: 1- patients suffering from iron deficiency anemia (n=113), 2- patients without iron deficiency anemia (n=117). The diagnosis of true iron deficiency anemia in pregnant women was established according to the WHO classification based on the hemogram and indices of transport iron content, total serum iron-binding capacity, and the concentration of ferritin in the blood. The condition of a child was assessed on the basis of the APGAR scale, height and weight at birth, and the presence of diagnosed pathology at birth.

RESULTS: The mass-growth index in the group of neonates born to mothers with anemia statistically was significantly lower compared to the control group. The proportion of neonates with hypotrophy in the group born to mothers with anemia statistically was significantly higher. Body length and birth condition indices assessed according to the APGAR scale were virtually identical across the groups.

CONCLUSIONS: Anemia during pregnancy affects the trophism of a fetus, which is largely reflected in the health of neonates. Treating maternal anemia is important to prevent or decrease the incidence of underweight in infants at birth.

Introduction

Anemia in pregnant women has been a pressing obstetric issue for many years and is one of the most common complications of pregnancy in the world [1], [2], [3]. Notwithstanding the best efforts of national health programs to provide optimal prenatal care for all pregnant women and recommend screening for anemia at their first prenatal visit, more than half of pregnant women worldwide suffer from this problem [4].

Iron deficiency anemia in women is common in all age groups because of the peculiarities of their body physiology, hormonal homeostasis, and the realization of reproductive function. One in three women of reproductive age and one in two pregnant women experience a pronounced iron deficiency [5]. Expectant mothers are traditionally regarded as the most vulnerable group. Statistics indicate that there are at least 50 million pregnant women worldwide affected by this disease [6].

During pregnancy, a woman's body increases the amount of fluid and the volume of circulating blood.

Due to this, the share of hemoglobin in the total blood volume decreases. This is a normal phenomenon, which is why the lower limit for the amount of hemoglobin during pregnancy is set at 110 g/l (while the norm for a non-pregnant woman is 120–140 g/l). However, a further drop in hemoglobin levels is dangerous for the health and even life of an expectant mother.

The most common anemia during pregnancy is iron deficiency anemia (about 75%), sometimes combined with megaloblastic anemia with folic acid deficiency [7].

Iron deficiency anemia in pregnant women raises the risk of complications during labor, studies by Indian scientists indicate that anemia accounts for 20–40% of maternal deaths [8].

However, anemia endangers not just women, but also children; lack of appropriate and timely treatment may lead to the development of iron deficiency in the fetus and newborn [9]; the risk of low birth weight is tripled; premature births are doubled, and the incidence of stillbirths has increased by 1.4 [10], [11].

Certainly, maternal hemic hypoxia plays an important role. However, it can only directly affect fetal

oxygenation when maternal hemoglobin levels drop to 85 g/l and anaerobic oxidation mechanisms are activated [6].

It is, therefore, important to study fetal status in anemic pregnant women. The aim of this study was to examine the condition of neonates born to women with anemia during pregnancy.

Materials and Methods

The retrospective analysis method was used to assess 230 patient medical files in the maternity and pregnancy pathology departments. The patients were divided into two groups: 1- patients suffering from iron deficiency anemia (n = 113) and 2- patients without iron deficiency anemia (n = 117).

The diagnosis of anemia in pregnant women was established according to the WHO classification based on the hemogram and indices of transport iron content, total serum iron-binding capacity, and the concentration of ferritin in the blood. Hemoglobin levels in the blood of pregnant women with mild anemia ranged from 90 to 106 g/l, with erythrocyte levels ranging from 3.7 to 3.3 × 10^{12}/l. The blood hemoglobin levels in women with moderate anemia ranged from 89 to 80 g/l, and erythrocyte levels from 3.2 to 3.0 × 10^{12}/l. The diagnosis of true anemia was confirmed by the detection of poikilocytes and anisocytes in a blood smear.

Indicators of maternal and child health were assessed and interpreted. The condition of a child was assessed on the basis of the APGAR scale, height and weight at birth, and the presence of diagnosed pathology at birth.

Statistical processing of the survey results was carried out using the statistical software STATISTICA 10. The normality of distribution was verified according to the Shapiro–Wilk and Kolmogorov–Smirnov criteria. In the absence of normal sample distribution, the significance of the differences was determined with a non-parametric Mann–Whitney U test for independent samples. For the qualitative characteristics of the sample, the Pearson's Chi-square test was used. The Spearman's rank correlation coefficient was calculated to determine the relationship between the different parameters.

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The study was approved by the Local Bioethics Committee at West Kazakhstan Marat Ospanov Medical University, protocol No. 22 as of April 9, 2019.

Results

The gender distribution of newborns showed that there were 52 boys (44.4%) and 65 girls (55.6%) in the comparison group. Among the neonates of anemic mothers, there were 49 boys (43.40%) and 64 girls (56.6%).
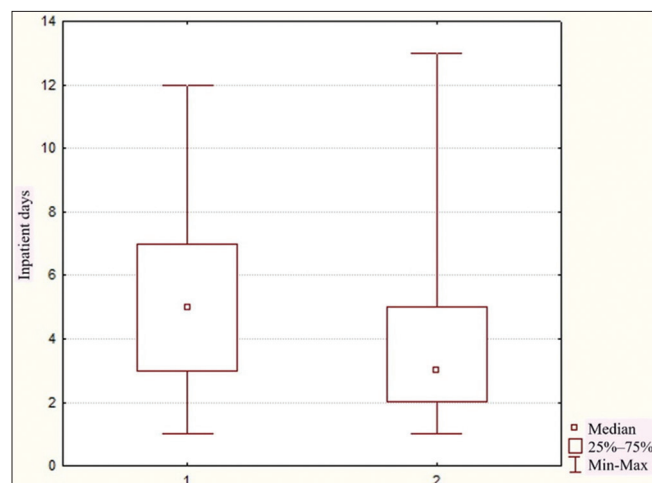

Figure 1: Flow chart of inpatient days distribution

When comparing duration of hospital stay, inpatient days in Group 1 were statistically significantly longer than in Group 2 (Figure 1 and Table 1). In evaluating the correlation relationship, there was a slight effect of several factors on the length of stay in hospital: A woman's age (r = 0.13; p < 0.05), gestational age (r = −0.24; p < 0.05), and heart rate (r = 0.34; p < 0.05) of pregnant women.

Table 1: Indicators of pregnancy condition upon admission to hospital

Indicator	Group 1 (n =1 13) mean (min.-max.)	Group 2 (n = 117) mean (min.-max.)	p
Age, years	28 (24–35)	28 (25–33)	0.8001
Height, cm	162 (158–166)	163 (158–165)	0.8432
Weight, kg	71.5 (63–79)	70.3 (63–80)	0.8171
Gestational age, weeks	39 (38–40)	39 (38–40)	0.0430
Inpatient days	5.3 (3–7)	3.1 (2–5)	0.0012
BP (systole) mmHg	120 (110–130)	119 (110–130)	0.4747
Blood pressure (diastole) mmHg	77 (70–90)	79 (70–90)	0.4123
Pulse per minute	78 (72–80)	67 (62–75)	0.0118

In addition, a difference can be observed in the pulse of the radial artery. The increased heart rate in patients with anemia seems to be associated with a compensatory protection mechanism against hypoxia.

The weight was lower in children born to mothers who had pregnancy accompanied by anemia (Flow chart 2). Body length and birth status on the APGAR scale were not significantly different for each group (Table 2).

The mean value of the mass-growth index of neonates from mothers with true iron deficiency anemia

Table 2: Indicators of neonatal condition at birth

Indicator	Group 1 (n = 113) mean (min.-max.)	Group 2 (n = 117) mean (min.-max.)	p
Height, cm	53.2 (51–55)	54.1 (52–55)	0.2101
Weight, kg	3.440 (3.170–3.680)	3.612 (3.330–3.836)	0.0256
Mass-growth index (Quatelet 1), g/cm	63.4 (56.1–66.8)	66.4 (58.4–70.1)	0.0236
APGAR, scores	9.3 (9–10)	9.5 (9–10)	0.6469

was 63.4 ± 9.7. The proportion of children exhibiting hypotrophic signs was 24.8% (n = 28; CI 16.8–32.7). The mean value of the mass growth index for the control group neonates is 66.4 ± 5.8. The proportion of newborn exhibiting hypotrophic signs was 12.0% (n = 14; CI 6.1–17.8). Thus, mass-growth index in the group of neonates born to mothers with iron deficiency anemia was statistically significantly lower than in the control group. It should also be noted that the proportion of neonates suffering from hypotrophy in the group of neonates born to mothers suffering from anemia statistically was significantly higher (p < 0.005).

Table 3: Neonatal pathology detected at birth

Pathological conditions	Group 1		Group 2		p
	n	%	n	%	
Fetal impairment	5	4.4	3	2.5	0.441
Antenatal fetal death	4	3.5	1	0.8	0.162
Congenital heart defect	3	2.6	3	2.5	0.965
Cryptorchidism	1	0.8	0		0.307
Single umbilical artery	1	0.8	1	0.8	0.980
Shoulder dystocia	0	0	1	0.8	0.324
Threatening fetal condition	2	1.7	0		0.148
Delayed intrauterine development of the fetus	1	0.8	0		0.307

Pathological and critical disorders detected in neonates were often diagnosed in the group of children born to mothers with anemia. These included heart defects, intra-uterine fetal retardation, and prenatal death of the fetus. However, the survey findings were not statistically significant (Table 3 and Figure 2).
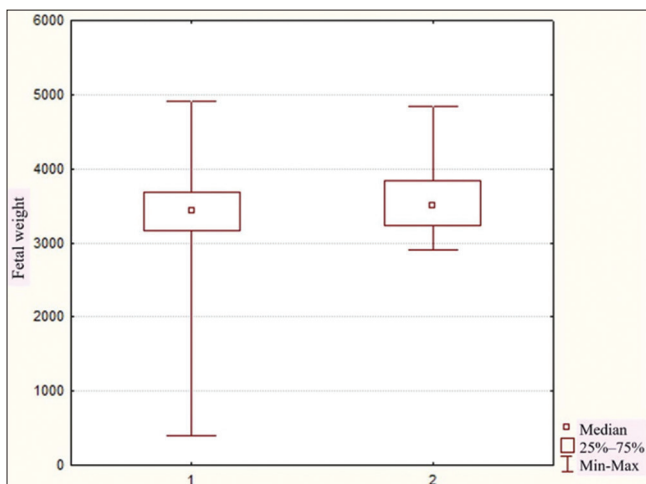

Figure 2: Chart of the fetal birth weight range

Discussion

This study revealed a statistically significant relationship between maternal true iron deficiency anemia and low birth weight. At the same time, body length and rapid APGAR scores of a newborn were independent of maternal anemia. The weight of a newborn indirectly reflects its maturity and prematurity.

Mass-growth index (Quetelet I) reflects the nutritional status of the intrauterine phase. It was calculated as the ratio between body weight (g) and body length (cm). Under normotrophy, the value of the index is 60–70. In the present study, the mean values of the mass-growth index in both groups were within normal limits, but in the group of infants born to mothers with iron deficiency anemia, the mass-growth index values were statistically lower, which was associated with the lower birth weight in this group. In this group, there were also significantly more cases where the mass-growth index values were below the normal values (hypotrophy). Thus, the data obtained may indicate the effect of maternal iron deficiency anemia on the nutritional status of the fetus. Anemia in a pregnant woman can lead to oxygen starvation of the fetus, which leads to a delay in its intrauterine development, resulting in the birth of a baby with low birth weight [12].

Many studies report the impact of anemia on birth weight and an increased risk of premature birth [12], [13], [14], [15]. For example, the study on the relation of maternal anemia with adverse pregnancy and labor outcomes suggests that infants born to anemic women had twice the risk of low birth weight and a higher risk of preterm birth [13]. Another study showed that the frequency of low birth weight babies was significantly higher in mothers with anemia in the third trimester. Preterm births were more frequent in mothers with anemia in the second and third trimesters [15]. A systematic review and meta-analysis of the literature on the association of maternal anemia during pregnancy (especially in the first trimester) with low birth weight in newborns showed a direct correlation [16]. Consequently, maternal anemia must be treated in a timely manner to prevent this anomaly at birth. Another study found a high prevalence of anemia and iron deficiency in early pregnancy and its association with an increased risk of unfavorable pregnancy and neonatal outcomes [17]. Distinct studies suggest that low levels of iron during pregnancy, especially in the third trimester, may be associated with adverse neurological development in offspring [18].

It is important to note that non-pregnant women require 1.5 mg of iron per day. However, during pregnancy, this amount steadily increases in the first trimester by 1 mg/day, in the second trimester by 2 mg/day, and in the third trimester by 3–5 mg/day [19]. Iron requirements during pregnancy may exceed 1000 mg, including 500 for erythrocytic multiplication, 300–350 for developing fetus and placenta with various losses during labor [20]. Iron loss is most pronounced at 16–20 weeks of gestation, which coincides with the beginning of the hematopoiesis process in the fetus and the increase in blood weight in pregnant women [21]. Approximately 800–950 mg of iron is spent from a mother's depot during pregnancy and after delivery. The body is capable of restoring iron reserves in 4–5 years. If a woman anticipates an earlier pregnancy, she will inevitably develop anemia [22]. A comprehensive approach to preventing anemia in women of reproductive age is therefore required to improve the hematological status, as also health indicators of mother and child [17], [23].

Conclusions

Thus, anemia in pregnancy affects fetal trophism, which is largely reflected in the health of neonates. Maternal anemia may be considered a risk factor in pregnancy outcomes. Given the relationship between maternal anemia and low birth weight, treatment of maternal anemia is important to prevent or reduce the incidence of low birth weight infants.

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