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Influence of antenatal anemia on the route of delivery and neonatal outcomes

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SUMMARY

Introduction. Iron is an essential element for life and normal development of the organism. This micronutrient is delivered to the organism with food. The aim of the study was to determine the influence of antenatal anemia in pregnant women on the course of labor and neonatological outcomes.
Material and methods. The prospective study was conducted in a group of 450 pregnant women with singleton pregnancies of physiological course who had complete blood count performed up to seven days before childbirth. Venous blood tests were conducted in the Diagnostic Department of the University Hospital in Krakow, Poland. The statistical analysis involved the Student's t-test for independent samples. Relationships between variables were assessed with the chi-squared test, and odds ratios were calculated using the logistic regression analysis.
Results. Pregnancy was statistically shorter in women with anemia (264.5 days). The odds ratio (OR) for childbirth prior to gestational week 37 in patients with anemia compared with healthy women was 3.56 (95% CI 1.93–6.55). The mean Apgar score in the group of anemic patients was 9.23. It was lower in a statistically significant way than in the group of healthy women. The mean birth weight of children born of anemic mothers was 3,082.5 g. The groups differed in a statistically significant way also in terms ofaverage neonatal body length.
Conclusions. Antenatal anemia is conductive to early conclusion of pregnancy, but is not associated with a risk of emergency Cesarean section. The risk of a lower Apgar score and low birth weight was increased in the group of anemic patients.
Key words: anemia; neonatal outcomes; pregnancy outcomes; pregnancy

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INTRODUCTION

Iron is an essential element for life and normal development of the organism. This micronutrient is delivered to the organism with food. It is a constituent of hemoglobin and myoglobin, by which it affects oxygen transportation to cells. It is a component of cytochromes responsible for transportation of electrons and oxidative enzymes: peroxidase and catalase. It influences the metabolism of tyrosine, formation of high-energy bindings (ATP) and neurotransmitter synthesis. Literature data state that approximately 700 million people worldwide have overt or occult iron deficiency (ID) which leads to iron deficiency anemia (IDA). IDA is the most common nutritional deficit in menstruating, pregnant and breastfeeding women (75%–85% of cases) [1].

According to guidelines issued by the Center for Disease Control and Prevention, anemia in the pregnant is diagnosed when hemoglobin levels and hematocrit values are below 11 g/dl and 33%, respectively, in the first trimester, 10.5 g/dl and 32% in the second trimester as well as 11 g/dl and 33% in the third trimester [2]. High progesterone levels and the resulting changes in the pregnant woman's organism entail reduced bioavailability of numerous nutrients, and the presence of a developing fetus considerably increases the demand for certain food components. According to estimates, every second pregnant women has iron deficiency due to increased hematopoiesis and iron requirement of the developing fetus and placenta. A depleted systemic reserve of iron during pregnancy increases the risk of anemia, particularly in the second and third trimesters. Pregnant women with low dietary iron intake have a 4-fold greater risk of anemia [3]. The average daily requirement of iron for pregnant women increases to 30 mg compared with 18 mg before conception [1]. A recommended daily dose of iron in anemic pregnant patients is 60–120 mg.

A physiological decrease of hemoglobin levels and hematocrit values during pregnancy is caused by a range of changes in the cardiovascular and hematopoietic systems consisting in a 40–60% increase in the plasma volume and an 18–25% increase in the erythrocyte mass. Hemoglobin levels and hematocrit values decrease from the first trimester of pregnancy, reaching the lowest values at the turn of the second and third trimesters. These values persist until the conclusion of pregnancy. The differentiation between physiological changes and iron deficiency anemia at the end of pregnancy is difficult [3].

AIM

The aim of the study was to determine the influence of antenatal anemia in pregnant women on the course of labor and neonatological outcomes.

MATERIAL AND METHODS

It was a retrospective study that enrolled 450 women who gave birth in the Department of Obstetrics and Perinatology of the University Hospital in Krakow, Poland,from January to June 2015. These women were in singleton pregnancies of physiological course and had complete blood count performed up to seven days before childbirth. Venous blood tests were conducted in the Diagnostic Department of the University Hospital in Krakow. The following parameters were analyzed: hemoglobin level, birth weight and body length of the neonate, Apgar score at 1 minute and type of childbirth (natural birth and Cesarean section for obstetric indications).

The patients were divided into two groups: group 1 (n=90) with diagnosed anemia (Hb <11 g/dl) and group 2 (n=360) with normal hemoglobin levels ($\geq$11 g/dl). Patients with significant pregnancy complications, such as arterial hypertension, diabetes, systemic diseases, genital tract and intrauterine infections, premature fluid leakage, vaginal bleeding during pregnancy, fetal and afterbirth defects and twin pregnancies, were excluded from the study.

The Student's t-test for independent samples was used to check the statistical significance of the differences between mean values of the tested parameters in the two groups. Relationships between variables were assessed with the chi-squared test, and odds ratios were calculated using the logistic regression analysis.

RESULTS

Groups 1 and 2 did not differ significantly in terms of demographic and socioeconomic factors. The mean age of patients was 29.43 (range 15–45) and 30.23 years (range 17–40) for Group 1 and 2, respectively. The difference was not statistically significant.

Pregnancy was statistically shorter in women with anemia. In this case, pregnancy lasted 264.5 days (range 185–290), whereas in Group 2, it lasted 273.23 days (range 198–294) (Tab.1). The odds ratio (OR) for childbirth prior to gestational week 37 in Group 1 compared with Group 2 was 3.65 (95% CI 1.93–6.55) (Tab. 2).

The mean Apgar score in the group of anemic patients was 9.23 (range 2–10). It was lower in a statistically significant way than in newborns of healthy women (9.8; range 6–10) (Tab.1). The odds ratio for giving birth to a child with Apgar score lower than 8 at 1 minute was 4.90 (95% CI 2.15–11.17) in Group 1 compared with Group 2 (Tab. 2).

The mean birth weight of neonates born of mothers from Group 1 was 3,082.5 g (range 850–4,220) and it was significantly lower than in Group 2 (3,251.5 g; range 1,200–4,420) (Tab. 1). The odds ratio for neonatal birth weight <2,500 g in Group 1 compared with Group 2 was 4.60 (95% CI 2.15–9.84) (Tab. 2).

The groups differed in a statistically significant way also in terms of the mean neonatal body length, which was 53.03 cm (range 36–61) and 53.96 cm (range 38–61) in anemic patients and in patients with normal hemoglobin levels, respectively (Tab. 1).

Obstetric outcomes were considered in terms of the manner of concluding pregnancy, taking into account natural birth and childbirth by emergency Cesarean section for obstetric indications (failure to progress, fetal asphyxia). The analysis did not include pregnancies terminated by elective Cesarean section (for indications other than obstetric). Anemia did not increase the risk of emergency Cesarean section in a statistically significant way. The odds ratio for Cesarean section due to obstetric indications was 1.69 (95% CI 0.83–3.46) in Group 1 compared with Group 2 (Tab. 2).

DISCUSSION

Despite continuously improving perinatological care, the problem of anemia in pregnant patients is still valid. The analysis of Medline

articles indicates that this condition is common among pregnant patients worldwide.

The Polish Gynecological Society has issued a number of recommendations concerning management and iron supplementation during pregnancy [1,3,4]. The author's own studies did not evaluate the degree of iron supplementation in patients, but merely assessed hemoglobin levels before childbirth. However, Chatterjee et al. have shown that among 589 Australian pregnant women, 88% used iron preparations during pregnancy. The percentage of women using iron supplementation increased as pregnancy progressed and when anemia or iron deficiency was diagnosed. The results demonstrate that merely 18% of patients used iron preparations ensuring therapeutic concentrations of this element in the organism. Only 47% of patients diagnosed with iron deficiency used therapeutic doses (>100 mg Fe daily). The authors emphasize the lack of uniform guidelines concerning iron supplementation in therapeutic doses among pregnant patients [5].

The study reported above showed a 4.9 times greater risk of a low Apgar score at 1 minute (<8) and a 4.6 times greater risk of low birth weight (<2,500 g) in patients with anemia. Menon et al. have drawn similar conclusions. They investigated the influence of anemia in the second and third trimesters of gestation on selected neonatal anthropometric parameters and outcomes at the third week of life based on the Brazelton scale. They demonstrated that mothers with normal hemoglobin levels in the second trimester of gestation more frequently had children with greater birth weight (0.26 SD), body length (0.50 SD) and head circumference (0.26 SD). Women with anemia in the third trimester presented lower Brazelton orientation scores. However, no significant differences were noted in term of anthropometric measurements. The results could be affected by a broad range of the time of blood sampling (13–22 Hbd and 29–42 Hbd, for the second and third trimesters, respectively) [6].

Imdad et al., based on a meta-analysis of 30 studies, investigated the influence of routine iron supplementation during pregnancy on the occurrence of antenatalanemia and neonatological parameters. The joint results of 12 analyzed studies showed that iron supplementation during pregnancy decreased the risk of too low birth weight in neonates (OR=0.80) by having a statistically significant impact on the mean birth weight. Imdad did not observe any influence of iron supplementation on the risk of premature birth. The results obtained by these authors confirm our observations concerning a statistically significant increase in the risk of a low Apgar score and low neonatal birth weight in the group of anemic patients [7]. However, our analysis yielded different results concerning the length of pregnancy in anemic women. The odds ratio (OR) for childbirth prior to gestational week 37 in Group 1 compared with Group 2 was 3.65 (95% CI 1.93–6.55), which means a statistically significant risk increase.

Bencaiova et al. conducted a study among 382 pregnant women and concluded that despite supplementary treatment, the mean iron level during childbirth was decreased. This can

Tab. 1. Average mother's age, length of pregnancy, birth weight, birth body length, Apgar score in anemia group and in the group with normal hemoglobin level

	Group I	Group II	Significance
Average mother's age [years]	29,43	30,23	p=0,185
Average length of pregnancy [days]	264,5	273,2	p<0,001
Average birth weight [g]	3082,50	3251,46	p<0,01
Average birth body length [cm]	53,03	53,96	p<0,04
Average Apgar score	9,23	9,8	p<0,001

Student's t-test p to compare the mean values in the groups with and without anemia

Tab. 2. The risk of Apgar score<8, birth body weight <2500g, childbirth before 37th week of pregnancy and emergency Cesarean section in Group 1 compared with Group 2

	Odds ratio	95% CI	Significance
Apgar score<8	4,9	2,15-11,17	p<0,0002
Birth weight<2500 [g]	4,6	2,15-9,84	p<0,0001
Childbirth <37th week of pregnancy	3,56	1,93-6,55	p<0,0001
Emergency Cesarean section	1,69	0,83-3,46	p=0,15

Logistic regression analysis for given endpoints

result from physiological changes associated with an increased circulating blood volume during pregnancy. Bencaiova et al. did not obtain statistical significance for a relationship between a low hemoglobin level and the frequency of concluding pregnancy by Cesarean section, which is confirmed in our study. Anemia did not have a significant influence on the risk of Cesarean section conducted for obstetric indications.

According to Bencaiova et al., anemia did not affect the perinatological outcomes significantly, which differs from our conclusions. This difference can result from the fact that Bencaiova et al. analyzed only mild forms of anemia in early pregnancy, whereas the study reported above concerned women using iron supplementation [8].

CONCLUSIONS

1. Antenatal anemia is conductive to early conclusion of pregnancy, but is not associated with a risk of emergency Cesarean section.
2. The risk of a lower Apgar score and low birth weight was increased in the group of anemic patients.

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