Pediatric Anesthesia and Critical Care Journal 2020;8(1):15-21
doi:10.14587/paccj.2020.3

PACCJ

Investigating the relationship between placental location and neonatal blood magnesium levels in mothers with preeclampsia referring to Amir al-Momenin Hospital in Zabol, Iran in 2019: a cross-sectional study

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Keypoints

This study was performed to investigate the relationship between placental location and neonatal magnesium levels in mothers with preeclampsia.

Abstract

Introduction

Magnesium sulfate has many side effects on the fetus and pregnant mother. On the other hand, considering different blood supply rates to the anterior and posterior regions of the uterus, we decided to conduct this study to investigate the relationship between placental location and neonatal magnesium levels in mothers with preeclampsia.

Materials and methods

This descriptive study was performed on 74 pregnant women and their newborns referring to Amir-al-Momenin Hospital in Zabol city, south of Iran from 1 February, 10 2019 to Aguest, 10 2019. The data collection tool was a researcher-made checklist consisting of two parts: Information about maternal and neonatal demographic characteristics. Blood samples were taken from neonatal cord and the magnesium level was measured

Results

The mean ± SD of mother's age in the case and control groups was 24.62 ± 1.14 and 22.97 ± 1.14 years, respectively. Neonatal blood magnesium level in case and control groups was 2.58 ± 0.339 and 1.87 ± 0.37, respectively. Statistical analysis showed a significant difference between the two groups only regarding neonatal weight and blood magnesium level (p = 0.001). The results also showed no relationship between placental location and neonatal magnesium level (p = 0.698).

Conclusion

The results of the present study indicate no relationship between the placental location and neonatal blood magnesium level, and it is thus recommended to carry out further studies with larger sample size to investigate such more accurately.

Keywords

Placental location; Preeclampsia; Magnesium

Introduction

Preeclampsia is a multi-system pregnancy-related disorder [1)] . The pathophysiology of preeclampsia is not well understood, but one of the most important contributing factors is vasospasm, which causes hemorrhage, necrosis, and end-organ damage by causing vascular damage and local hypoxia [2)] . In pregnancies complicated by pre-eclampsia, 30-50% decrease is seen in uterine blood flow, which results in a compensatory increase in the number of placental capillaries to increase blood supply. An

increase in chorionic villus leads to early placental maturation [3]. Preeclampsia is diagnosed based on high blood pressure (systolic blood pressure > 14 and diastolic blood pressure ≥9) after week 20 of pregnancy and proteinuria (more than 300 mg/24 h or ≥ 1 in random urine samples) [4]. Preeclampsia is more common in primiparous women (6-7%) than in women with multiparous women (3-4%) [5]. Prevalence of preeclampsia in hospitalized patients in India was 7-10% [6]. The prevalence of this disorder was reported to be 1-8% in sporadic studies carried out in Iran [7]. The main risk factors for preeclampsia are chronic hypertension, obesity (BMI ≥ 35), and severe anemia. Other risk factors include clinical conditions and kidney and heart diseases and diabetes, as well as high maternal age and being primiparous [8]. Hypertension during pregnancy is of particular clinical importance because it is one of the causes of maternal and fetal mortality and morbidity and is one of the causes of occupation of hospital beds and use of prenatal care facilities and resources, on the other hand [7]. Fetal complications of preeclampsia include premature placental abruption (preterm birth), stillbirth, intrauterine oxygen deficiency, and fetal growth restriction [9]. Acute complications of preeclampsia include eclampsia, stroke, HELLP syndrome, renal hemorrhage or rupture, pulmonary edema or aspiration, adult respiratory distress syndrome, acute renal failure (renal filler) and death. Its chronic complications include chronic hypertension, diabetes mellitus, chronic renal failure, renal artery disease, nerve defect, and abortion [10]. The evaluation of these patients is usually controversial and many drugs are selected for treatment ranging from chloroform, potassium bromide, and morphine to diazepam, magnesium sulfate, and phenytoin. The most commonly used treatment for preeclampsia is magnesium sulfate. Magnesium sulfate has a variety of birth indications, such as tocolysis in preterm labor; currently for the prevention of eclampsia, the treatment of women with preeclampsia and eclampsia, and protection of the fetal nervous system, the regulation of imminent premature births, deliveries less than 32 weeks in Canada [11]. After being administrated to the mother, magnesium sulfate passes rapidly through the placenta to maintain a balance with fetal serum.

Measurement of magnesium in cord blood samples of neonates born to mothers with preeclampsia treated with magnesium sulfate indicates higher magnesium levels in these infants [6,9]. Respiratory depression and decreased reflexes have been observed in children whose mothers were treated with intravenous magnesium sulfate. However, nothing was observed in the case of intramuscular magnesium sulfate treatment [7]. Magnesium sulfate has many side effects, including vascular collapse, respiratory paralysis, hypothermia, pulmonary edema, reduced refluxes, hypotension, flushing, insomnia, increased sweating, decreased cardiac function, hypocalcemia, hypophosphatemia, hyperkalemia, and vision changes [12].

In most pregnancies, placental location occurs in the upper part of the uterine fundal region. Previous studies have shown that placenta attaches to the anterior, posterior, and fundal portions of the womb in 37%, 24%, and 34% of cases, respectively.

The placental location and morphology can change during pregnancy [13].

The blood supply to the anterior and posterior regions of the uterus may vary and may cause changes in infant birth weight and Doppler parameters [14]. Considering that hypertension during pregnancy is one of the causes of mortality and morbidity in mother and fetus, on the one hand, and it is one of the resin for occupation of hospital beds, utilization of prenatal care facilities and resources [6], the use of magnesium sulfate for the treatment and prevention of eclampsia and the side effects of magnesium sulfate [12], as well as different blood supply to the anterior and posterior regions of the uterus [14], on the other hand, were decided to investigate the relationship between placental location and neonatal blood magnesium levels in mothers with preeclampsia.

This study aimed to determine the relationship between placental location and neonatal blood magnesium levels in mothers with preeclampsia.

Materials and methods

Study design

This case-control study was performed on 74 mothers and their infants referring to an educational hospital in Zabol, eastern Iran from 1 February, 10 2019 to Aguest, 10 2019.. The case group consisted of mothers with preeclampsia and their neonates (mothers treated with magnesium sulfate based on intra muscular regimen of Pritchard) and the control group included healthy mothers and their neonates (these mothers did not use any particular medication during pregnancy). Neonates in both groups (case and control) were divided into three subgroups; neonate with anterior, posterior, and lateral placentas in the embryonic period, and the relationship between placental location and neonatal magnesium level was assessed, accordingly. Case and control groups were selected based on inclusion and exclusion criteria. Inclusion criteria included mothers with preeclampsia. Exclusion criteria also included pregnancy-related diseases other than preeclampsia such as diabetes, systemic diseases, pre-pregnancy hypertension, multiple pregnancy, polyhydramnios or oligohydramnios, preterm birth, stillbirth, or abortion. Simple random sampling was used to select participants.

Sample Size and Instruments

In the present study, a similar study was used to determine sample size. Taking into account the probability of a Type 1 error ($p>0.05$), power of 90%, 95% confidence interval, total pregnant women referring to the hospital (n=9200 patients, prevalence of preeclampsia in Iran 2.5%), the sample size was estimated 74 individuals. A researcher-made checklist consisting of 2 sections was used to collect data. The first part consisted of information on maternal demographic characteristics (maternal age) and the second part included information on infant demographic characteristics (placental location, Apgar score, gender, and birth weight).

Data collection

After coordinating with the authorities in charge of the related department and selecting the participants, the study objectives were explained to the participants enrolled in the study. The placental location was determined and recorded in these mothers by a radiologist by ultrasound at 20 -23 gestational weeks. The neonatal blood samples were taken immediately after birth from the cord and sent to a hospital-based laboratory to measure magnesium levels. Maternal blood samples were also taken to measure magnesium levels. Apgar score was measured by a skilled obstetrician in the delivery room first minute after birth. Then, placental weight (PW) and infant birth weight (IBW) were measured using a standard scale with appropriate measurement accuracy. PW was measured in the delivery room by removing and drying clots and extra blood from the placenta using gauze and cutting foetal membranes around the placenta 1-2 cm away from the placenta by a trained obstetrician. IBW weight was also measured in the neonatal ward and the information was recorded in the relevant checklist.

Data analysis

Descriptive and analytical tests were used for data analysis. Simple linear regression was used to determine the relationship between PW and IBW. ANOVA was used to determine the relationship between placental location with PW and IBW. Independent T-test was used to determine the relationship between placental weight and fetus's gender. Since both placental location and fetus's gender were qualitative variables, chi-square test was used to determine the relationship between them.

Results

Demographic characteristics

Mean ± SD of mothers' age in case and control groups was 24.62 ± 1.14 and 22.97 ± 1.14 years, respectively. Neonatal weight in case and control groups was 2319.46± 162 and 3039.22 ± 227 gr, respectively. Neonatal blood magnesium level in case and control groups was 2.58 ± 0.339 and 1.87 ± 0.37, respectively. Most of the infants were male in the case group (51.4%) and female in the control group (54.1%). Most participants in both groups had no history of addiction. Anterior placenta had the highest frequency in booth groups. Statistical analysis

showed a significant difference between the two groups only regarding IBW and blood magnesium level (p = 0.001).

The results also showed that the mean neonatal blood magnesium in the anterior placenta was higher in the case group than the control group and this difference was statistically significant (p =0.0003). In those with posterior and fundal placenta, mean magnesium was significantly higher in cases than in controls (p = 0.014 and p = 0.0001, respectively). (Table 1)

Table 1. Demographic characteristics of mothers and infants

Variables		Case group (N=37) Mean±SD	Control group (N=37) Mean±SD	P value
Mother age		24.62±1.14	22.97±1.14	0.666
Apgar score		9.19±0.1	9.49±0.50	0.026
Infants weight		2319.46 ± 162 gr	3039.22 ± 227 gr	0.001
Neonatal blood magnesium levels		2.58±0.339	1.87±0.37	0.001
Infant gender		N (%)		
	Boy	18(49.6%)	20(54.1%)	0.816
	Girl	19(51.4)	17(45.9%)	
History of addiction	Yes	4(10.8)	0(0)	0.115
	No	33((89.2)	37(100)	
Placental location	Anterior	11(29.7)	8(21.6)	0.694
	Posterior	10(27)	10(27)	
	Fundal	16(43.3)	19(51.4)	
Mean magnesium level based on by placental location	Anterior	2.69(0.17)	1.99 (0.26)	0.0003
	Posterior	2.30 (0.50)	1.74 (0.13)	0.014
	Fundal	2.69 (0.20)	1.90 (0.47)	0.001

Main results

The results of linear regression model show statistically significant differences between case and control groups in terms of neonatal magnesium levels in three placental locations as follows: anterior (coefficient = -0.70, p <0.001), posterior (coefficient = -0.56, p = 0.003), and fundal (coefficient = -0.79, p <0.001). However, placental type has no effect on relationship between preeclampsia and neonatal blood magnesium (p = 0.698). In other words, placental type has no effect on the neonatal blood magnesium levels (Table 2).

Table 2. Relationship between placental location and neonate magnesium level

Placental location	CI (95%)	P value	Coefficient	P value
Anterior	-0.91, -0.50	<0.001	-0.70	0.698
Posterior	-0.90, -0.22	0.003	-0.56	
Fundal	-1.05, -0.54	<0.001	-0. 79	

Discussion

The aim of the present study was to investigate the relationship between placental location and neonatal blood magnesium levels in mothers with preeclampsia. The results showed no significant relationship between placental location and neonatal blood magnesium level, which is consistent with previous studies by Mohammadi and Moshfegh. There was also no significant difference between the infant's gender in this study [15,16] . In the present study, about the addiction rate the difference was not statistically significant with the control and case group. In a study on the perinatal effects of heroin and amphetamine use in pregnancy, Thaithumyanon, P et al., stated that 5.2% of mothers with preeclampsia used the above drugs [17] . In a study of Namboodiri V et al. concluded that heroin addiction in pregnancy leads to complications such as preeclampsia [18]. One of the reasons why this variable is not significant in our study may be the small sample size of our study.

The present study revealed no significant relationship between case and control groups in terms of maternal age; however, Lotfali Zadeh reported that the incidence of preeclampsia in mothers younger than 15 years, over 35 years, and aged 15-35 years was 12.5%, 65.5%, and 2.22%, respectively. There was a significant difference between the prevalence of preeclampsia at both ends of

the reproductive age with age group of 15-35 years [19]. Piri et al. also showed in a study that there was a significant relationship between maternal age and preeclampsia and eclampsia [20]. The non-significance of this variable in our study could be due to various reasons such as the low age of pregnancy in this province as well as the low sample size in this study, and consequently the establishment of a mean lower age of mothers with preeclampsia. The present study showed statistically significant difference between the two groups in terms of IBW. Madzadzadeh et al. showed in a study that there was a significant difference between hypertension and low birth weight in pregnancy weeks 36 and 37, which was significantly different in different weeks based on the number pregnancies. This difference was significant in the hypertensive and non-hypertensive primiparous women in pregnancy weeks 36, in multiparous women less than 5 pregnancies in pregnancy week 39. However, there was no significant difference in women with fifth and more pregnancies. The findings of the study showed that the IBW was lower in hypertensive mothers than non-hypertensive ones [21]. The present study did not investigate pregnancy week and low birth weight and its association with preeclampsia. However, the relationship between birth weight in the case and control groups was consistent with the study so that IBW was lower in mothers with preeclampsia than healthy mothers. Kumar et al. also showed in a study that there was a significant relationship between IBW and preeclampsia [6], which is consistent with our study. However, one of the causes of this significant difference is the low birth weight in infants whose mothers suffering from preeclampsia. The present study showed a significant difference between the case and control groups in terms of Apgar score, that is a lower Apgar score was observed in the case group, which was consistent with the results of the Kumar's study showing that 91.2% of the neonates in the case group (mothers with preeclampsia) had Apgar scores less than 7 at minute 1 after birth score less than 1 and 39.9% of them had Apgar scores less than 7 at 5 minute after birth.

The present study demonstrated a significant difference between case and control groups in terms of the neonatal blood cord magnesium levels, which is consistent with the results of Kumar et al.' study [6]. Mason's study showed that the total magnesium levels and Ionized serum umbilical cord blood magnesium levels in the case group (pregnant women with preeclampsia who were treated with magnesium sulfate) were significantly higher than the control group [22]. Another study reported that magnesium enters the fetus through the umbilical cord blood and increases magnesium concentration relative to the normal status [23].

The present study showed the placental type, or indeed the placental location had no effect on preeclampsia, which is consistent with the results of a study on placental location in the second trimester of pregnancy and its association with preeclampsia and preterm birth and intrauterine growth restriction by Mohammadi et al. In this study, the placental location was divided into two categories of low and high. In this ossification, the low-lying placentas were those located at a distance of 2.5 cm from the internal cervical os and the other placentas that had a higher position in the uterus were considered as high placentas. These two categories were also divided into anterior and posterior placentas according to their location. The results of the analysis showed that the incidence of preeclampsia was 4.5% in the individuals with high placenta and 9.5% in those with low placentas, which was not statistically significant [24]. The results also showed that placental location does not affect neonatal blood magnesium sulfate levels in mothers with preeclampsia undergoing magnesium sulfate treatment. In fact, it can be said that the placental type can't affect the neonatal blood magnesium level.

Conclusion

According to the results of the study, which show no relationship between placental location and neonatal blood magnesium levels, it is suggested to carry out further studies like the present study, to investigate the relationship between variables such as maternal addiction,

placental weight, fetal gender with magnesium level in neonates with mothers who are suffering from preeclampsia and are undergoing magnesium sulfate treatment.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Zabol University of Medical Sciences (ZBMU.1.REC.1396.129). Written and oral consent was obtained from all participants before the study.

Consent for publication

Not applicable.

Availability of data and material

All is available with the authors upon request.

Competing interests

None

Funding

None

Acknowledgements

We would like to thanks the research deputy of Zabol University of Medical Science and patients to participants.

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