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Original Research Article

A Case Control Study to Investigate Cord Blood Mean Platelet Volume (MPV) of Infants of Diabetic Mothers (IDM)

Abhishek Kumar[1], Rashmi Sharma[2], Akash Bharadwaj[3], Rita Kumari[4]

[1]Tutor, Department of Physiology, Nalanda Medical College, Patna, Bihar, India
[2]Tutor, Department of Physiology, Nalanda Medical College, Patna, Bihar, India
[3]Tutor, Department of Physiology, Nalanda Medical College, Patna, Bihar, India
[4]Associate Professor and HOD, Department of Physiology, Nalanda Medical College, Patna, Bihar, India

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Corresponding author: Dr. Akash Bharadwaj
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Abstract

Aim: The aim of the present study was to investigate cord blood mean platelet volume (MPV) of infants of diabetic mothers (IDM).

Methods: Present study was conducted at Department of Physiology in Nalanda Medical College, Patna, Bihar, India. It was a prospective case control study conducted in 100 newborns. The approval of ethics committee was obtained. They were divided in to 50 Diabetic women with singleton pregnancy between 37-40 gestational weeks (study group) and 50 age matched healthy pregnant women as control group.

Results: The result showed significant difference in maternal, BMI and HbA1c between the study groups. Apgar score assessment at birth did not show any significant difference between two groups. Demographic characteristics of the newborns between two groups were not significant. Platelet count was significantly higher in control group than in diabetic group. MPV was significantly higher in IDM group. There was no significant difference in Platelet distribution width (PDW) between two groups.

Conclusion: Mean Platelet volume and other platelet-related parameters is a simple procedure, available in most hospital laboratories. It is useful for representing the potential oxidative stress of IDM. Hence, there is need to create more awareness by pre-pregnancy counselling of know diabetics as well as screening for potential gestational diabetics. MPV may be used as a marker for follow-up of diabetic patients.

Keywords: Cord blood, Gestational diabetes mellitus, Mean platelet volume, Morbidity, Oxidative stress

Introduction

Maternal hyperglycemia leads to elevated blood glucose levels in the fetus and a metabolically abnormal fetal milieu. This may result in birth defects, spontaneous abortions, macrosomia, asphyxia, respiratory distress syndrome and other metabolic complications. [1-3] Infants of diabetic mothers may be at an increased risk for developing diabetes and/or obesity later in life. [1] Controlling hyperglycemia during pregnancy reduces these complications in their offspring. In addition to hyperglycemia, hyperketonemia also occurs in type 1 and some type 2 diabetic patients. [4] Hyperketonemia can cause increased

circulating levels of pro-inflammatory cytokines. [5-7]

Gestational diabetes mellitus (GDM) refers to the state of hyperglycemia during the second half of pregnancy, with no pre-existing diagnosis of diabetes mellitus, affecting about 14% of pregnancies worldwide. [8] An uncomplicated pregnancy is characterized by insulin resistance, which increases with advancing gestation in order to secure a high glucose supply to the fetus; this may be attributed to hormones and cytokines, including TNFa, IL-6 and adipokines (resist in and leptin) produced by the placenta. [9,10] TNFa is considered as the most important factor that can predict insulin resistance in pregnancy, by impeding insulin actions via impaired intracellular signaling. [11] The adipokines leptin and resist in have also emerged as potential causes of insulin resistance, as they interfere with insulin receptor substrate-1 and lead to its degradation. [12] In GDM, the decreased insulin sensitivity that occurs during pregnancy is exaggerated, due to an alteration of the inflammatory profile; there is excessive production of pro-inflammatory molecules by the placenta, which leads to a hyperglycemic phenotype. [13]

Newborns from diabetic mothers are more frequently born prematurely, large for the gestational age and with risk of respiratory distress syndrome (RDS) and subsequently, exposed to a higher risk of perinatal distress, hypoxia, metabolic stress and hematologic alterations5. Probably, classically described modifications such as myocardial hypertrophy, accelerated growth, polycythemia, modified blood rheology and cerebral perfusion found in the intra-uterine life are due to the chronic adaptation mechanisms to the continuous metabolic stress of hyperglycemia. [14,15] Hypoglycemia, hypocalcemia, hyperbilirubinemia and polycytemia are some of the complications seen in the IDM. Besides increase in perinatal mortality, there is increased risk of developing obesity, impaired glucose tolerance and DM in childhood period. [16] Patients with DM show altered platelet function, including decreased nitric oxide synthase activity and increased peroxynitrite production. [17-19] Platelet volumes are direct indicators of increased platelet synthesis. [20]

The aim of the present study was to investigate cord blood mean platelet volume (MPV) of infants of diabetic mothers (IDM).

Materials and Methods

Present study was conducted at Department of Physiology in Nalanda Medical College, Patna, Bihar, India. It was a prospective case control study conducted in 100 newborns. The approval of ethics committee was obtained. They were divided in to 50 Diabetic women with singleton pregnancy between 37-40 gestational weeks (study group) and 50 age matched healthy pregnant women as control group.

Patients who refused to participate, those suffering from cardiovascular disease, thyroid disorder, anaemia, toxemia of pregnancy and multiple gestation were excluded. All subjects were informed in detail about aim, objectives and procedure of the study and written consent was taken for conduct of study. Maternal weight, height and body mass Index (BMI) was calculated. Their blood glucose and HbA1c levels were measured.

APGAR scores at 1st minute and 5th minutes, birth weight & length was recorded and Ponderal index (PI) was calculated. It is a weight-height related parameter used to predict fetal growth pattern in small-for-gestational age infants and for large-for-gestational age (LGA) infants. It is calculated using formula: PI = weight (g) x 100/(height,incm3).[21] After resection of the umbilical cord, the cord stump remaining on the placenta was

cleaned and 2ml of blood was collected and analyzed for Platelet profile (Platelet count, Mean platelet volume (MPV) Platelet distribution width (PDW) using automated hematological analyzer.

Statistical Analysis

Data were recorded using the SPSS 15.0 statistical software package (SPSS Inc., Chicago, IL, USA). Descriptive data was expressed as Mean±S.D and student's t-test was used for comparison between the groups. p-value <0.05 was considered to be significant.

Results

Table 1: Maternal characteristics of case and control groups

Characteristics	Diabetic pregnant women (n=50) Mean±SD	Normal pregnant women (n=50) Mean±SD	p-value
Age of mother (yrs)	32.8 ±4.2	30.2±2.6	>0.05
Gestation at delivery (wks)	38.4±1.1	38.8±1.2	>0.05
Body mass Index (kg/ m2)	25.5±2.7	22.4±1.5	<0.05
HbA1c	5.5± 1.1	4.6±0.5	<0.05

The result showed that there was significant difference in maternal BMI and HbA1c between the study groups.

Table 2: Apgar score assessment at birth

Apgar score		Newborn of Diabetic mother (n=50)	Newborn of healthy mother (n=50)
Apgar 1 min	8-10	28	32
	5-7	15	16
	<5	7	2
Apgar 5min	8-10	35	40
	5-7	13	10
	<5	2	-

Apgar score assessment at birth did not show any significant difference between two groups.

Table 3: Anthropometric parameters of newborn at birth

Characteristics	Newborn of Diabetic mother (n=50) Mean±SD	Newborn of healthy mother(n=50) Mean±SD	p-value
Neonate Birth weight (gms)	3050.2±535.5	2952.8±560.8	>0.05
Ponderal Index (g/cm3)	2.6±0.2	2.8±0.2	>0.05

Demographic characteristics of the newborn between two groups were not significant.

Table 4: Cord blood Platelet profile in neonate of diabetic and non- diabetic mothers

Parameters	Newborn of Diabetic mother (n=50) Mean±SD	Newborn of healthy mother (n=50) Mean±SD	p-value
Platelet count Lakh/ mm^3	1.99±8.82	2.40±6.34	<0.05
MPV fL	8.42±1.52	7.33±0.57	<0.05
PDW%	13.37±4.57	13.30±0.70	>0.05

Platelet count was significantly higher in control group than in diabetic group. MPV was significantly higher in IDM group. There was no significant difference in Platelet distribution width (PDW) between two groups.

Discussion

Diabetes mellitus is the commonest endocrinal disorder, causing considerable morbidity and mortality to both mother and fetus. [22] Its incidence is increasing among urban population at an alarming rate, due to stress inducing life style. It involves derangement of carbohydrate, fat and protein metabolism characterized by hyperglycemia, hyperlipidemia and negative nitrogen balance. [23] The term "Infant from diabetic mother" (IDM) refers to those from pregnancies complicated by diabetes mellitus (DM type 1, type 2) or gestational diabetes mellitus (GDM). [24] GDM-complicated pregnancies are considered high-risk, as they have been linked to adverse outcomes, both maternal and fetal. Maternal complications during pregnancy include spontaneous miscarriage, and pre-eclampsia/pregnancy-induced hypertension; with long-term recurrent GDM in subsequent pregnancies, type 2 diabetes and metabolic syndrome may occur. The offspring of a mother with GDM has immediate and long-term complications, such as macrosomia due to hyperinsulinism, increased risk for trauma at birth, hypoglycemia, hypocalcemia, jaundice, cardiomyopathy, respiratory distress and an increased risk of congenital malformations and type 2 diabetes and metabolic syndrome in the long term. All of these are responsible for the higher mortality and morbidity rates observed in these neonates, which are directly proportional to the maternal glycemic control. [25]

The result showed that there was significant difference in maternal BMI and HbA1c between th e two groups. Apgar score assessment at birth did not show any significant difference between two groups. Demographic characteristics of the newborns between two groups were not significant. Platelet count was significantly higher in control group than in diabetic group. MPV was significantly higher in IDM group. There was no significant difference in Platelet distribution width (PDW) between two groups. MPV is a marker of platelet function and activation. [22,23] Patients with high MPV had low platelet counts. It has been reported that platelet survival is shorter in diabetic patients. [26] This may be explained by variables such as platelet production and mean platelet survival. The platelet distribution width displays a good correlation with the MPV. [22,23] The platelet count is slightly lower in pregnant than in non-pregnant women. [27] It also decrease with increase in duration of pregnancy. [28] Normally interleukins, specially IL-6 is required to convert uncommitted stem cell to committed stem cells of megakaryocytic series. The IL-6 in neonate of diabetic mother loses its hemopoietic potency due to immune-modulatory effect of diabetic maternal IL-6 resulting in decreased platelet count. It is also attributed to fetal hypoxia due to placental abnormality in diabetic group. Kinalski et al study in diabetic mothers

suggested that their fetuses experience increased oxidative stress. [29] The results show that acetoacetate, but not β-hydroxybutyrate, increased MCP-1 secretion in U937 monocytes exposed to high glucose.

Patients with diabetes have increased platelet activation compared to non-diabetic. [23,30] Their hyperactivity may potentially have a role in the development of vasculopathies. [19,20] It is accompanied by increased thromboxane synthesis and/or decreased prostacycline production. Larger platelets are both more reactive and aggregable. [31] They contain denser granules, secrete more serotonin and b-thromboglobulin, and produce more thromboxane A2 than smaller platelets. This relates to a relationship between platelet function and micro and macrovascular complications of diabetes mellitus.

Conclusion

Mean Platelet volume and other platelet-related parameters is a simple procedure, available in most hospital laboratories. It is useful for representing the potential oxidative stress of IDM. Hence, there is need to create more awareness by pre-pregnancy counselling of know diabetics as well as screening for potential gestational diabetics. MPV may be used as a marker for follow-up of diabetic patients.

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