

The Association of Mean Platelet Volume with Intra Ventricular Hemorrhage and Broncho Pulmonary Dysplasia in Preterm Infants

Bolouki Moghaddam K¹, Zarkesh M^{1,*}, Kamali A¹, Dalili S¹, Heidarzadeh A², Hassanzadeh Rad A¹

1. Pediatric growth disorders research center, 17 shahrivar hospital, school of medicine, Guilan University of medical sciences, Rasht, Iran

2. School of Medicine, Guilan University of Medical Sciences, Iran Received: 11 March 2014

Accepted: 12 July 2015

Abstract

Background

Interventricular hemorrhage (IVH) and Broncho pulmonary dysplasia (BPD) commonly occur in premature infants and they associate with platelet dysfunction. The aim of this study was to investigate the association of MPV and occurrence of IVH and BPD.

Materials and methods

In this cross sectional study, 3 groups including IVH, BPD and control were compared. All participants were preterm neonates with <35 weeks of gestation. MPV was recorded during the first 48 hours of life for all cases. Data were reported by descriptive statistics and analyzed by Pearson correlation coefficient, spearman correlation coefficient, paired T test and multinomial regression analysis in SPSS version 17.

Results

Higher MPV level was noted in BPD and

IVH groups versus control group (9.79±0.73 fl and 10±1.04 fl versus 8.33±0.91 fl p<0.0001). Also, most participants in BPD (93.3%) and IVH (73.3%) groups had MPV >9 fl compared to controls (16.7%) (p<0.0001). Regression analysis showed that only MPV related to the occurrence of IVH (OR=2.200 95%CI p=0.013) and elevated MPV significantly increased duration of O₂ therapy (p<0.0001) and mechanical ventilation (p=0.0010).

Conclusion

MPV value at first 48 hours of life can be noted as a simple biomarker for occurrence of BPD and specially IVH in preterm infants

Keywords

Bronchopulmonary dysplasia, Intraventricular hemorrhage, Mean platelet volume, preterm infants

Corresponding Author:

Bolouki Moghaddam K MD, Pediatric Growth Disorder Research Center, 17 Shahrivar Hospitals, Namjoo St., Rasht, Iran. Email: zarkesh@gums.ac.ir

Introduction

Assessing platelets in the neonatal period can indicate several functions both in physiological and pathological conditions including; homeostasis, integrity of blood vessels, transportation and phagocytosis.(1) The mean platelet volume (MPV) averages from 7 to 9 fl for both full- term and preterm neonates.(2, 3) Complete blood count easily provides platelet volume data (4). In adults, MPV level may be elevated in inflammation such as acute myocardial infarction (5). In premature infants, Bronchopulmonary dysplasia (BPD) and intraventricular

hemorrhage (IVH) are two neonatal morbidities. Their risks are inversely related to both gestational age and weight at birth. Previous studies mentioned possible correlation between MPV and occurrence of BPD(6, 7) and IVH in preterm infants.(4) Although High MPV may favor inflammatory and oxidative lung damages(6), coagulation and platelet function have significant roles in the pathogenesis of IVH (8) and larger platelets are more reactive and may be associated with shortened bleeding times,(9) yet it is a controversial

issue.(7)The aim of this study was to investigate the association of MPV and occurrence of IVH and BPD.

Materials and Methods

This is a cross sectional study with control group carried out at neonatal ward and neonatal intensive care unit of 17 shahrivar children hospital Rasht – Iran from April 2011 to April 2015. The studied group consisted of 30 infants with BPD, 30 infants with IVH, and 30 infants without IVH and BPD (control group). All participants were preterm neonates with <35 weeks of gestation. According to the large number of patients with IVH and control groups, an anonymous clinician randomly selected these patients during the study period. Infants with thrombocytopenia (platelet<150,000 ×10⁹/L), congenital malformations and/or metabolic disorders were excluded. Data were gathered by a form including sex, gestational age, type of delivery, birth weight, surfactant and mechanical ventilation need, duration of oxygen therapy and mechanical ventilation, and the MPV level. Blood samples were drawn from each infant by arterial puncture during the first 48 hours of life. Platelet count and MPV determination were performed on the Sysmex coulter counter model (Japan).

BPD defined as the need for supplemental oxygen at postnatal 28th day of life (10) and IVH defined by cranial ultrasound findings.

Statistical analysis

Data were reported by descriptive statistics (mean and standard deviation) and analyzed by pearson correlation coefficient, spearman correlation, paired T test and multinomial regression analysis test in SPSS version 17. P value <0.05 was considered statistically significant and 95% confidence interval was noted.

Results

Demographic, clinical and laboratory results of groups are summarized in table 1. Results showed significant difference between BPD and control group regarding gestational age, birth weight, mechanical ventilation and surfactant need, duration of oxygen therapy and MPV(p<0.05). Also, there were significant difference between IVH and control groups regarding gestational age, birth weight, type of delivery, surfactant need, and duration of oxygen therapy.(p<0.05) MPV level was higher in BPD and IVH groups versus control group(P<0.0001). Multivariate stepwise logistic regression analysis of selected variables in BPD and IVH groups demonstrated that only MPV related to the occurrence of IVH (OR=2.200 95%CI P=0.013).

Furthermore, elevated MPV level significantly increased duration of O2 therapy (pearson correlation =361 pvalue < 0.0001) and mechanical ventilation (spearman correlation =0.334 Pvalue =0.001) (Figures 1 and 2).

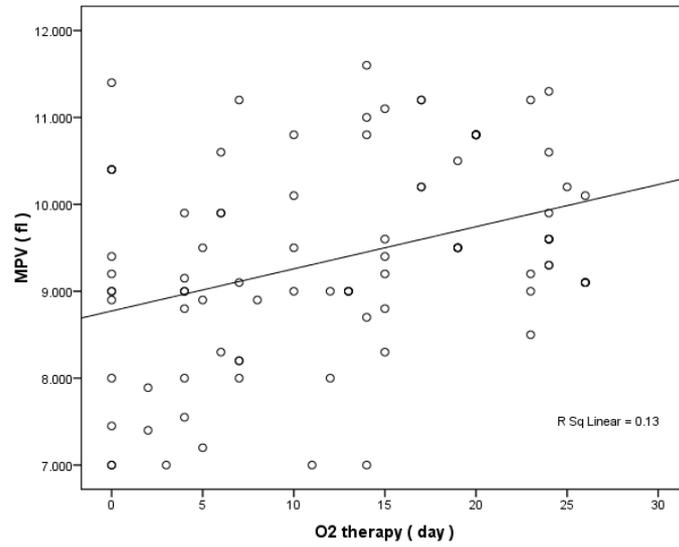


Figure 1. Relationship between MPV and Duration of o2 therapy(day)

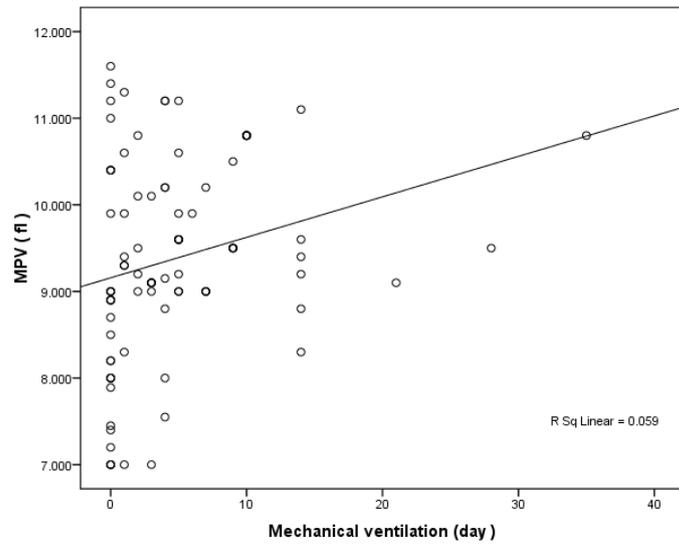


Figure 2. Relationship between MPV and Duration of Mechanical ventilation (day)

Table I: Distribution of nosocomial infections among nosocomial positive patients

		IVH (N=30)	BPD (N=30)	non BPD- non IVH (control) (N=30)	P value				
Gestational age (week)	Mean±SD	2.43±29.60	0.997±29.80	1.88±32.40	<0.0001¹				
					<0.0001²				
					<0.0001³				
Birth Weight(gr)	Mean±SD	313.14±1306/67	139.99±1194	1797 ±401.02	<0.0001¹				
					<0.0001²				
					<0.0001³				
Sex :	N(%)				0.069¹				
					male(N)	10(33.3%)	12(40%)	17(56.6%)	0.196²
					Female	20(66/7%)	18(60%)	13(43.3%)	0.171³
Mode of delivery:	N(%)				0.024¹				
					NVD	-	6(20%)	6(20%)	1.0²
					C/S	30(100%)	24(80%)	24(80%)	0.02³
Need to MV(N)	N(%)				0.29¹				
					No	14(46.7%)	30(100%)	10(33.3%)	<0.0001²
					Yes	16(53.4%)	-	20(66.7%)	<0.0001³
need for surfactants(N)	N(%)				0.035¹				
					No	14(46.6%)	12(40%)	22(73.3%)	0.009²
					Yes	16(53.4%)	18(60%)	8(26.7%)	0.024³
O₂ therapy(day)	Mean±SD	15/16±9.5 1	29.86±3.73	6.23±5.51	<0.0001¹				
					<0.0001²				
					<0.0001³				
MPV(fl)	Mean±SD	1.04±10.00	0.73±9.79	0.91±8.33	<0.0001¹				
					<0.0001²				
					<0.0001³				
MPV	N(%)				<0.0001¹				
					≤9fl	8(26/7%)	2(6.7%)	25(83/3%)	<0.0001²
					>9 fl	22(73/3%)	28(93.3%)	5(16.7%)	<0.0001³

1=P value between IVH and control group

2= P value between BPD and control group

3=Overall P value

MV=Mechanical ventilation

MPV=Mean platelet volume

Discussion

Some recent studies suggested that MPV might predict the development of respiratory distress syndrome (RDS), BPD, IVH, necrotizing enterocolitis, and sepsis in preterm infants. (4, 11-13) We found that MPV values were significantly higher in IVH and BPD groups than control one. Our results showed that preterm infants with BPD significantly need more O₂ therapy and mechanical ventilation as compared to control group. These findings were in accordance with Hussein et al in Egypt (13) and Dani et al in Italy (7). They reported significantly higher need to mechanical ventilation and O₂ therapy in preterm infants with BPD ($P < 0.001$).

In the current study, MPV > 9 fl was significantly more in BPD group compared to the control group ($P < 0.0001$). Dani et al and Hussein et al reported that MPV > 11 fl was significantly higher in BPD than non-BPD group (7, 13). Dani et al noted that higher MPV might favor development of BPD by worsening respiratory distress syndrome through surfactant inhibition (7). Disruption of alveolocapillary membrane integrity in RDS resulted in leakage of coagulation factors into alveolar spaces. High levels of activated procoagulant factors and insufficient fibrinolysis led to alveolar fibrin deposition and hyaline membrane formation in infants with higher MPV (14). Fibrinogen and related products are known to be potent inhibitors of surfactant (15). Cekmez et al in Turkey found that higher MPV in the first hours of life might be a risk factor for occurrence of BPD and IVH in preterm neonates with < 34 weeks of gestation. They mentioned that higher MPV may be associated with inflammatory and oxidative processes. They noted neonatal diseases such as BPD and IVH as multifactorial problems (4).

In the light of our study, MPV at first 48 hours of life was significantly higher in

preterm infants with IVH than control group. This was inconsistent with Dani et al who assessed preterm infants with < 30 weeks of gestation. They found similar MPV level in premature infants with and without IVH ($P = 0.256$) (7). Hussein et al reported that MPV at 24-48 hours of life was significantly higher in patients with IVH versus non-IVH group ($p < 0.001$) (13).

In our study by logistic regression test only MPV was noted as an independent risk factor for development of IVH. Also Hussein et al which assessed very low birth weight infants mentioned the same results. They noted MPV > 11 fl as an independent risk factor which increased the risk of IVH (not BPD) with OR = 65.6 95% CI ($p < 0.001$). In addition, they noted male gender, birth weight < 1250 gr and Apgar score < 8 at 5th minute as other independent risk factors of IVH (13). But Nouripoor et al indicated higher MPV during the first 72 hours of life as an independent risk factor for occurrence of BPD in preterm infants with RDS (OR = 1.6, 95% CI: 1.08-2.38 $p = 0.019$). They didn't assess the relationship between MPV and IVH (6).

Increased MPV elevated duration of O₂ therapy and mechanical ventilation significantly. To our knowledge, this is the first study which investigated the possible relationship between MPV and duration of O₂ therapy and mechanical ventilation.

According to our results, it seems that preterm infants with higher MPV in the first 48 hours of life need better care to prevent IVH and BPD. Therefore, assessing risk factors of IVH and BPD such as monitoring blood pressure and ventilator setting can be recommended.

The limitation of this study was the inability to evaluate MPV with BPD stages and IVH grades. We also could not follow up further MPV changes after 48 h of birth.

Conclusion

MPV value at first 48 hours of life can be noted as a simple biomarker for occurrence of BPD and specially IVH in preterm infants

References

1. Israels SJ, Rand ML, Michelson AD, editors. Neonatal platelet function. Seminars in thrombosis and hemostasis; 2003.
2. Christensen RD, Henry E, Jopling J, Wiedmeier SE, editors. The CBC: reference ranges for neonates. Seminars in perinatology; 2009: Elsevier.
3. Arad ID, Alpan G, Sznajderman SD, Eldor A. The mean platelet volume (MPV) in the neonatal period. American journal of perinatology. 1986;3(1):1-3.
4. Cekmez F, Tanju I, Canpolat F, Aydinöz S, Aydemir G, Karademir F, et al. Mean platelet volume in very preterm infants: a predictor of morbidities? Eur Rev Med Pharmacol Sci. 2013;17(1):134-7.
5. Celik T, Kaya MG, Akpek M, Gunebakmaz O, Balta S, Sarli B, et al. Predictive value of admission platelet volume indices for in-hospital major adverse cardiovascular events in acute ST-segment elevation myocardial infarction. Angiology. 2015;66(2):155-62.
6. Nourripoor S, Tabasizadeh H, Afjehi A, Ghorbani R, Seifhashemi M, Masoudian N. Could mean platelet volume predict developing of bronchopulmonary dysplasia in preterm infants with respiratory distress syndrome? Iranian Journal of Neonatology IJN. 2013;4(3):35-41.
7. Dani C, Poggi C, Barp J, Berti E, Fontanelli G. Mean platelet volume and risk of bronchopulmonary dysplasia and intraventricular hemorrhage in extremely preterm infants. American journal of perinatology. 2011;28(7):551-6.
8. Counsell SJ, Maalouf EF, Rutherford MA, Edwards DA. Periventricular haemorrhagic infarct in a preterm neonate. European Journal of Paediatric Neurology. 1999;3(1):25-7.
9. Vizioli L, Muscari S, Muscari A. The relationship of mean platelet volume with the risk and prognosis of cardiovascular diseases. International journal of clinical practice. 2009;63(10):1509-15.
10. Deakins KM. Bronchopulmonary dysplasia. Respiratory care. 2009;54(9):1252-62.
11. Canpolat FE, Yurdakök M, Armangil D, Yiğit Ş. Mean platelet volume in neonatal respiratory distress syndrome. Pediatrics International. 2009;51(2):314-6.
12. Oncel MY, Ozdemir R, Yurttutan S, Canpolat FE, Erdeve O, Oguz SS, et al. Mean platelet volume in neonatal sepsis. Journal of clinical laboratory analysis. 2012;26(6):493-6.
13. Hussein NF, Helaly NSE, Ghanya EAA, Anisb SK. Relationship between Mean Platelet Volume and Bronchopulmonary Dysplasia and Intraventricular Hemorrhage in Very Low Birth Weight Neonates. Journal of American Science. 2012;8(5).
14. Merritt TA, Deming DD, Boynton BR, editors. The 'new' bronchopulmonary dysplasia: challenges and commentary. Seminars in Fetal and Neonatal Medicine; 2009: Elsevier.
15. Yurdakök M, Oran O, Dündar S, Tekinalp G, Kirazli S. Reduced fibrinolytic state in early respiratory distress syndrome. American journal of hematology. 1993;42(2):233-4.