



## STUDY OF HAEMOGLOBIN AND ITS RELATION WITH PLATELET DISTRIBUTION WIDTH (PDW) IN CRITICALLY-ILL PATIENT WITH VENTILATOR SUPPORT.

**Dr. Deepak Mishra**

Assistant Professor, Department Of General Medicine At Mgm Medical College And Hospital, Navi Mumbai

**Dr. Rohit Khapre**

Senior Resident, Department Of General Medicine At Mgm Medical College And Hospital, Navi Mumbai

**Dr. Amrit Kejriwal**

Professor Department Of General Medicine At Mgm Medical College And Hospital, Navi Mumbai

### ABSTRACT

In clinical laboratories, Complete Blood Count (CBC) is very common test ordered by the clinicians. Platelet distribution width (PDW) is the indicator of volume variability in platelets size measured in percentage. There is significant association between the prognosis, Hb and PDW level at Day-1, last day- 5 and Day-5. This study was conducted to observe Haemoglobin and its relation with Platelet Distribution Width (PDW) in critically ill patient with ventilator support. Also to evaluate whether there is any correlation between haemoglobin and Platelet Distribution Width in the patients at the time of admission, (last – 5) day of ventilator, and last day of ventilator. The analysis showed that on comparison between Hb at Day 1 and PDW at Day 1 below normal Hb score is associated with raise PDW. There is significant association between Hb and PDW level at Day-1 and Last Day – 5 and also significant association between the prognosis and Hb level at Day-1, Last day – 5 and Day-5.

**KEYWORDS :** Haemoglobin, Platelet distribution width (PDW), Critical illness.

### INTRODUCTION

*Haemoglobin* (Hb) is the protein contained in red blood cells that is responsible for delivery of oxygen to the tissues. The amount of haemoglobin in whole blood is expressed in grams per decilitre (g/dl). The normal Hb level for males is 14 to 18 g/dl; that for females is 12 to 16 g/dl.<sup>(1)</sup>

Platelets are the smallest blood cells, numbering 150 to 450 x10<sup>9</sup>/L in healthy individuals<sup>(2)</sup>. Platelets are released from the megakaryocyte, likely under the influence of flow in the capillary sinuses. The major regulator of platelet production is the hormone thrombopoietin (TPO), which is synthesized in the liver<sup>(3)</sup>.

In clinical laboratories, Complete Blood Count (CBC) is very common test ordered by the clinicians along with automated haematology analysers. A group of recent parameters which is determined during CBC profiles includes platelet indices, plateletcrit (PCT), mean platelet volume (MPV), and platelet distribution width (PDW).

A regular parameter in the examination of blood on routine basis which gives us fair idea of distribution of platelet size with a range from 8.3% to 56.6% is known as **Platelet Distribution Width (PDW)**.<sup>(4,5,6)</sup>

$PDW = 100 \times (\text{Standard deviation of MPV}) / MPV$ <sup>(7)</sup>

PDW is a distribution curve of platelets measured at the level of 20% relative height in a platelet-size distribution curve, with a total curve height of 100%.<sup>(8)</sup>

PDW directly measures variability in platelet size, changes with platelet activation, and reflects the heterogeneity in platelet morphology. Under physiological conditions, there is a direct relationship between MPV and PDW; both usually change in the same direction. Meanwhile, there are conflicting reports in the literature about the relationship between platelet volume and numbers, which suggests that they are affected by different mechanisms.<sup>(9)</sup>

**Critical Illness** means an illness, sickness or disease which covers conditions like Cancer, Kidney failure, Heart attack, paralysis, etc. all these are life threatening conditions which more often than not results in the death of the patient suffering from it.

Anaemia is a common problem in patients with critical illness or mechanical ventilation<sup>(10,11)</sup>.

Difficult-to-wean patients are more likely to benefit from higher hemoglobin levels compared to those at an early stage of respiratory failure because adequate oxygen delivery mediated by sufficient hemoglobin is crucial during the weaning process.

It is known that lower hemoglobin levels decrease arterial oxygen content, compromise oxygen delivery and increase respiratory muscle load during the weaning process.<sup>(12)</sup>

The present study is aimed to observe Haemoglobin and its relation with Platelet Distribution Width (PDW) in critically ill patient with ventilator support.

Also to evaluate whether there is any correlation between haemoglobin and Platelet Distribution Width in the patients at the time of admission, (last – 5) day of ventilator, and last day of ventilator.

### AIMS AND OBJECTIVES

1. To study the correlation of Hemoglobin and Platelet Distribution Width (PDW) in critically ill patient with ventilator support.
2. To evaluate whether there is any correlation between haemoglobin and Platelet Distribution Width in the patients at the time of admission, (last – 5) day of ventilator, and last day of ventilator.

### MATERIALS AND METHOD

#### Source Of Data:

Patients presented to the casualty of MGM Institute of Health Sciences, Navi Mumbai with critical illness requiring medical and/or surgical ICU (with ventilatory support) during the period of October 2017 to September 2019 were selected for study.

#### Method Of Collection Of Data:

Information was collected through a pre-tested and structured proforma for each patient. Qualifying patients under went through detailed history, clinical examination and laboratory investigation of Hemogram and platelet indices done on XP-

100/XN-1000 HEMATOLOGY machine.

**Type Of Study:** Prospective & Correlational study.

**Investigations Required:**

Following set of investigations were conducted for the selected patients:

- HEMOGRAM details at the time of admission, (last – 5) day of ventilator and last day of ventilator were taken from Central lab of Medical College and Hospital.
- Platelet indices at the time of admission, (last – 5) day of ventilator and last day of ventilator.

**Sample Size:**

A total of 115 patients satisfying inclusion and exclusion criteria visiting casualty and admitted in IPD/ICU of MGM Navi Mumbai with critical illness requiring medical and/or surgical ICU (with ventilatory support) were selected for the study.

**Statistical Analysis:**

The data is analysed with appropriate statistical package of social sciences (SPSS).

**Inclusion Criteria:**

1. Age of above 16 years.
2. Duration of stay in Medical ICU and/or Surgical ICU on ventilator for greater than or equal to 5 days.

**Exclusion Criteria:**

1. Patients who were on ventilator for less than five days
2. Pregnant and maternity women
3. Patients with active hemorrhage
4. Patients with hematological diseases (including hypersplenism, lymphoma or leukemia, rheumatism and bone marrow diseases)
5. Patients who had infused with blood or platelet within 3 months prior to their admission.
6. Patients who had used anti-platelet drugs such as Clopidogrel prior to their admission;
7. Patients who had received radiotherapy or chemotherapy or bone marrow transplantation within 1 month prior to admission.

**Statistical Analysis**

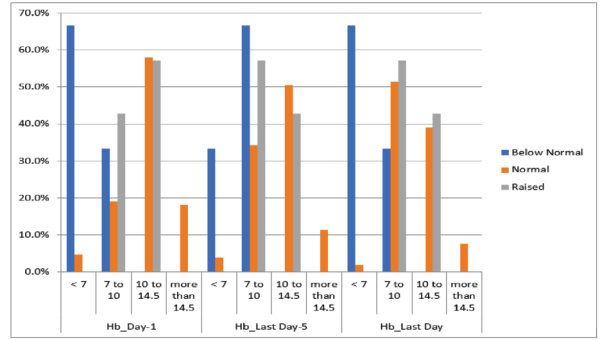
**Correlation of Hb and PDW:**

**Table 1 – Distribution based on correlation between Hb and PDW.**

		PDW		
		Day-1	Last Day - 5	Last Day
Day1	Correlation	-.088	-.193*	-.096
	p-value	.351	.038	.308
	Interpretation	Negative and Non-Significant	Negative and Significant	Negative and Non-Significant
Last Day -5	Correlation	-.088	-.332**	-.115
	p-value	.350	.000	.223
	Interpretation	Negative and Non-Significant	Negative and Significant	Negative and Non-Significant
Last Day	Correlation	-.125	-.282**	-.083
	p-value	.183	.002	.380
	Interpretation	Negative and Non-Significant	Negative and Significant	Negative and Non-Significant

**Table 2 – Chi-square result.**

	Chi-Square	d.f.	p-value	Interpretation
Day 1	24.38	6	.000*	Significant
Last Day-5	10.598	6	0.102	Non-Significant
Last Day	37.63	6	.000*	Significant



**Figure 1- Distribution of patients based on comparison between Hb and PDW.**

**Chi-Square test result for association between Hb and PDW:**

**Interpretation:**

p-value less than that of 0.05 indicates significant of association between the Hb and PDW level at Day-1 and Last day. Below normal Hb score is associated with raised PDW on Day 1 and Last day.

**Hb against PDW:**

**Table 3 – Distribution based on comparison between Hb and PDW.**

		PDW Last Day -5					
		Below Normal		Normal		Raised	
		Count	%	Count	%	Count	%
Hb_Day -1	< 7 g/dl	1	50.0%	4	4.2%	2	11.1%
	7 to 10 g/dl	1	50.0%	16	16.8%	7	38.9%
	10 to 14.5 g/dl	0	0.0%	56	58.9%	9	50.0%
	more than 14.5 g/dl	0	0.0%	19	20.0%	0	0.0%
Hb_Last Day-5	< 7 g/dl	1	50.0%	2	2.1%	2	11.1%
	7 to 10 g/dl	1	50.0%	30	31.6%	11	61.1%
	10 to 14.5 g/dl	0	0.0%	51	53.7%	5	27.8%
	more than 14.5 g/dl	0	0.0%	12	12.6%	0	0.0%
Hb_Last Day	< 7 g/dl	1	50.0%	2	2.1%	1	5.6%
	7 to 10 g/dl	1	50.0%	43	45.3%	15	83.3%
	10 to 14.5 g/dl	0	0.0%	42	44.2%	2	11.1%
	more than 14.5 g/dl	0	0.0%	8	8.4%	0	0.0%

**Chi-Square test result:**

**Table 4 – Chi-square result.**

	Chi-Square	d.f.	p-value	Interpretation
Day 1	17.35	6	0.008*	Significant

Last Day-5	21.89	6	0.001 *	Significant
Last Day	24.26	6	0.000*	Significant

### Interpretation:

p-value less than that of 0.05 indicates significant of association between the Hb and PDW level at Last Day – 5. Below normal Hb score is associated with raised PDW on Day 1, Last Day – 5, Day 5 of PDW.

### OBSERVATION AND RESULTS

The analysis showed that on comparison between Hb at Day 1 and PDW at Day 1, Below normal Hb score is associated with raise PDW, none of the patients having Hb level between 10 gm/dl to 14.5 gm/dl have below normal PDW level, 1 patient having Hb level between 7 gm/dl to 10 gm/dl have below normal PDW level and only 3 patients having <7 gm/dl Hb level have below normal PDW level. 19 patients having more than 14.5 gm/dl Hb level have normal PDW level, 61 patients having Hb level between 10 gm/dl to 14.5 gm/dl have normal PDW level, 20 patient having Hb level between 7 gm/dl to 10 gm/dl have normal PDW level and only 5 patients having <7 gm/dl Hb level have below normal PDW level. None of the patients having more than 14.5 gm/dl Hb level have raised PDW level, 4 patients having Hb level between 10 gm/dl to 14.5 gm/dl have raised PDW level, 3 patient having Hb level between 7 gm/dl to 10 gm/dl have raised PDW level and none of the patients having <7 gm/dl Hb level have raised PDW level. The analysis showed that on last day - 5, none of the patients having more than 14.5 gm/dl Hb level have below normal PDW level, none of the patients having Hb level between 10 gm/dl to 14.5 gm/dl have below normal PDW level, 2 patients having Hb level between 7 gm/dl to 10 gm/dl have below normal PDW level and only 1 patient having <7 gm/dl Hb level have below normal PDW level. 12 patients having more than 14.5 gm/dl Hb level have normal PDW level, 53 patients having Hb level between 10 gm/dl to 14.5 gm/dl have normal PDW level, 36 patients having Hb level between 7 gm/dl to 10 gm/dl have normal PDW level and only 4 patients having <7 gm/dl Hb level have below normal PDW level. None of the patients having more than 14.5 gm/dl Hb level have raised PDW level, 3 patients having Hb level between 10 gm/dl to 14.5 gm/dl have raised PDW level, 4 patient having Hb level between 7 gm/dl to 10 gm/dl have raised PDW level and none of the patients having <7 gm/dl Hb level have raised PDW level. The analysis showed that on last day, none of the patients having more than 14.5 gm/dl Hb level have below normal PDW level, none of the patients having Hb level between 10 gm/dl to 14.5 gm/dl have below normal PDW level, 1 patient having Hb level between 7 gm/dl to 10 gm/dl have below normal PDW level and only 2 patients having <7 gm/dl Hb level have below normal PDW level. 8 patients having more than 14.5 gm/dl Hb level have normal PDW level, 41 patients having Hb level between 10 gm/dl to 14.5 gm/dl have normal PDW level, 54 patients having Hb level between 7 gm/dl to 10 gm/dl have normal PDW level and only 2 patients having <7 gm/dl Hb level have below normal PDW level. None of the patients having more than 14.5 gm/dl Hb level have raised PDW level, 3 patients having Hb level between 10 gm/dl to 14.5 gm/dl have raised PDW level, 4 patient having Hb level between 7 gm/dl to 10 gm/dl have raised PDW level and none of the patients having <7 gm/dl Hb level have raised PDW level (Table 5).

The analysis showed that there is significant of association between Hb and PDW level at Day-1 and Last Day – 5. The analysis showed that there is significant of association between Hb and PDW level at Day-1, Last day-5 and Last Day .

### DISCUSSION

The present study is aimed to investigate the role of serial PDW (platelet distribution width) in prolonged (greater than 5 days) ventilatory patients in ICU as a prognostic indicator. The analysis of the data showed that PDW value could be a very

important indicator for clinicians in critically ill patients and it has an important role in predicting the prognosis of critically ill patients. The analysis also showed that there is an association between the prognosis and PDW level at Day-1, Last day – 5 and Day-5. Fan X. et. al. (2018)<sup>(13)</sup> suggested from their study that PDW value of a patient with Haemorrhagic Fever with Renal Syndrome (HFRS) at the first day of hospitalization is an important marker for calculating the level of severity of HFRS. But on the other hand the PDW value may not be a strong indicator when it comes to predicting the prognosis of HFRS patients. Yilmaz H. et. al. (2016)<sup>(14)</sup> showed that PDW is an important parameter when it comes to determining the severity of disease and predicting the prognosis of patients with Crimean-Congo Haemorrhagic fever (CCHF).

### CONCLUSIONS

This study concludes that the Platelet Distribution Width (PDW) value could be a very important cost effective indicator for clinicians in critically ill patients. PDW in ventilated patients and increasing trend in PDW may predict mortality in near future , so care should be taken before mortality occurs and precautions may be taken 96-120 hours before to prevent mortality.

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