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RESEARCH ARTICLE

RELATIONSHIP OF MEAN PLATELET VOLUME WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND ITS SEVERITY- AN OBSERVATIONAL STUDY

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Abstract

Background & Objectives: Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation and inflammation. Mean platelet volume (MPV) may be used as a marker of inflammation. We aimed to study the association between MPV and COPD patients during acute attack and relationship of MPV with severity of COPD by FEV1 (%predicted), BODE Index, PaO2, mMRC grade and 6MWD test.

Methods: 100 patients with COPD (50 with acute exacerbation and 50 with stable COPD) and 30 healthy controls were enrolled in the study. Mean platelet volume (MPV), spirometry, arterial blood gases, body mass index, renal function tests and BODE index (body mass index, airflow obstruction,dyspnoea and exercise) were assessed. Level of MPV was compared between cases and controls.

Results: Of 100 COPD patients, 87(87%) were male and 13(13%)were female.MPV was significantly higher in COPD patients than control and also higher in acute exacerbation group than stable COPD (p=0.001).

Interpretation & Conclusions: In the present study,MPV remain in normal range in all COPD patients, but MPV values were significantly higher in COPD cases compared with control.Increased MPV was associated with acute exacerbation and also increasing with severity of COPD.

Introduction:-

Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterized by persistent respiratory symptoms and airflow limitation that is not fully reversible1. COPD is an increasing public health problem. Currently, COPD is the second most common non-infectious disease and third leading cause of death in the world.2

COPD is characterized by airflow limitation and inflammation. Inflammation marker likes CRP, fibrinogen, ESR, TLC found to be related with COPD.3-6

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Mean platelet volume (MPV) refers the activation and production rate of the platelets. It has been accepted as a marker of inflammation in various diseases. Increased MPV reported in myocardial infarction, diabetes mellitus and hypertension7-9 while decreased MPV reported in ankylosing spondylitis, rheumatoid arthritis and ulcerative colitis.10-12

Both increased13 and decreased14 MPV values have been reported in COPD patients in literature.

Material and Methods:-

This prospective observational study approved by institutional ethical committee was conducted in the department of General Medicine, J.L.N. Hospital, Ajmer from 01/01/2019 to 31/12/2019. This study included 100 COPD (50 with acute exacerbation and 50 with stable COPD) patients of either sex, >30 years of age, who attended OPD and IPD of the Hospital, and 30 healthy controls. Exclusion criteria-

1. Preexisting renal disease were rule out on the basis of past history and blood biochemistry with elevated serum creatinine, BUN, K+, Ca+2, phosphorus, USG showing small renal size or presence of MAB (UACR >300mg/g).
2. CHF (Congestive Heart Failure)
3. Patient having other respiratory disease such as asthma, interstitial lung disease, obstructive sleep apnoea, acute infection, uncontrolled co-morbidities such as lung malignancy were excluded from study.
4. Diabetes mellitus, Hypertension.
5. Viral fever, dengue, malaria
6. Any hematological disease & drugs which affects the platelet count

Detailed history and physical examination was carried out for every individual. Patients were examined clinically, radiologically and ABG analysis to establish diagnosis of COPD, as per GOLD guideline. PFT(Spirometry) was done in stable COPD patients (in acute exacerbation after stabilization of patients).Routine Blood investigations including haemoglobin, total leucocyte count (TLC), differential leucocyte count (DLC), fasting and post-prandial blood glucose, serum creatinine, liver enzymes, serum bilirubin, serum protein, serum albumin and urine microscopy was done in all the participants. Venous blood sample taken for routine investigations including MPV(Mean Platelet Volume). Normal range for MPV was between 7.5-11.5fL. Body mass index (BMI) was calculated by measuring weight and height. Exercise capacity was assessed by the 6-minute walk distance (6MWD). Dyspnoea was assessed using the modified British Medical Research Council (mMRC) dyspnoea scale. The multi-dimensional BODE (body-mass index, airflow obstruction, dyspnoea and exercise) index was calculated from BMI, forced expiratory volume in one second (FEV1 %), mMRC dyspnoea scale, and 6MWD.

Statistical analysis were done using SPSS version 20.0 software.

Results:-

Table 1:- Inter-group comparison of MPV(fL).

	Mean	SD	Minimum	Maximum	P value
stable COPD	8.41	0.5219	7.6	9.8	0.001 (S)
acute ex COPD	9.844	0.8239	8.3	11.2	
control	8.033	0.4459	7.5	9.1	
Total	8.875	1.0092	7.5	11.2	

Table 2:- Comparison of COPD cases and Control.

		N	Mean	SD	P value
Age	Case	100	60.4300	9.42193	0.72
	Control	30	59.7667	7.26676	
FEV1 (%Pred)	Case	100	57.2200	13.35345	0.001 (S)
	Control	30	89.0000	2.42117	
BMI	Case	100	20.9820	1.94782	0.39
	Control	30	21.3100	1.49421	
PaO_2	Case	100	64.9200	9.68669	0.001 (S)
	Control	30	89.8000	3.23131	
BODE	Case	100	4.5800	2.44611	0.001 (S)

	Control	30	.8667	.77608	
mMRC	Case	100	2.4000	.63564	0.001 (S)
	Control	30	.1667	.37905	
6MWD	Case	100	238.4300	103.89109	0.001 (S)
	Control	30	363.9000	28.25908	
MPV	Case	100	9.1270	.99502	0.001 (S)
	Control	30	8.0333	.44593	

Severity of COPD-

For severity of COPD correlation of different parameters like FEV1% predicted, BODE index, PaO2, mMRC dyspnoea scale, 6MWD values with UACR (microalbuminuria) and MPV was carried out using Pearson's correlation analysis.

Table 3:- Comparison of MPV with COPD severity parameters.

			MPV					
			7.5-8.4	**8.5-9.4**	**9.5-10.4**	**10.5-11.4**	**Total**	**Mean ±SD**
FEV1 (%pred)	**51-80 (GOLD stage-2)**	N	32	33	7	0	72	8.61±0.59
		%	44.40%	45.80%	9.70%	0.00%	100.00%	
	30-50 (GOLD stage-3)	N	0	0	12	12	24	10.4±0.52
		%	0.00%	0.00%	50.00%	50.00%	100.00%	
	<30 (GOLD stage-4)	N	0	0	0	4	4	10.75±0.12
		%	0.00%	0.00%	0.00%	100.00%	100.00%	
BODE INDEX	**0-3**	N	29	3	0	0	32	8.1±0.25
		%	90.60%	9.40%	0.00%	0.00%	100.00%	
	4-6	N	3	30	9	0	42	9.05±0.41
		%	7.10%	71.40%	21.40%	0.00%	100.00%	
	7-10	N	0	0	10	16	26	10.507±0.47
		%	0.00%	0.00%	38.50%	61.50%	100.00%	
PaO_2	**71-80**	N	28	2	0	0	30	8.05±0.35
		%	93.30%	6.70%	0.00%	0.00%	100.00%	
	61-70	N	2	23	9	0	34	9.11±0.48
		%	5.90%	67.60%	26.50%	0.00%	100.00%	
	51-60	N	2	8	10	10	30	9.83±0.86
		%	6.70%	26.70%	33.30%	33.30%	100.00%	
	<50	N	0	0	0	6	6	10.88±0.23
		%	0.00%	0.00%	0.00%	100.00%	100.00%	
mMRC	**2**	N	30	25	12	1	68	8.72±0.74
		%	44.10%	36.80%	17.60%	1.50%	100.00%	
	3	N	2	8	6	8	24	9.7±0.93
		%	8.30%	33.30%	25.00%	33.30%	100.00%	
	4	N	0	0	1	7	8	10.77±0.28
		%	0.00%	0.00%	12.50%	87.50%	100.00%	
6MWD	**301-400**	N	29	3	0	0	32	8.1±0.25
		%	90.60%	9.40%	0.00%	0.00%	100.00%	
	201-300	N	1	16	3	0	20	9.01±0.408
		%	5.00%	80.00%	15.00%	0.00%	100.00%	
	101-200	N	2	14	16	16	48	9.85±0.84
		%	4.20%	29.20%	33.30%	33.30%	100.00%	

Interpretation & Conclusions:-

In our study, out of 100 COPD patients, 31(31%) patients were <60 years. So majority of patients lie in elderly age group.Out of 100 COPD patients 13 were female and 87 were male. In 30 control group 4 were female and 26 were male. So majority were male in our study.

MPV and COPD (Table 1 and 2)- In our study we found- 1.MPV values were in normal range (7.5-11.5fL) in all COPD cases and control. 2.Mean value of MPV in acute ex COPD (9.8±0.82fL) was comparatively higher than MPV in stable COPD (8.4±0.52fL) ($p<0.001$). 3. Mean value of MPV in 100 COPD patients was 9.12±0.99 and in 30 control group it was 8.03±0.44. Difference of mean value was statically significant (p value=0.001). 4. Mean value of MPV in acute ex COPD was comparatively higher than control ($p<0.001$). 5. Mean value of stable COPD was comparatively higher than control ($p=0.037$)

Our study and results corresponds to these studies-1.Mehmet Zahid Kocak15 found MPV increases during acute exacerbation of COPD. 2.Mario Malerba et al16 found MPV was higher in COPD than in controls and also higher in COPD patients during acute exacerbation compared with stable COPD. 3. Zhang M et al13 found MPV is significantly increased in convalescent COPD patients compared with healthy controls, and further increased in COPD patients with an acute exacerbation. 4. Paschalis Steiropoulos et al17 found in COPD, MPV was higher than in control group. 5. Ragulan R et al18 study also suggested that MPV may be useful for identifying patients who are at high risk for exacerbation of COPD. 6. Bansal R et al19 found Mean platelet volume (MPV) was significantly higher in COPD group than that in controls.

Some studies results were contradictory to our results- G Karadeniz et al20, Eman R Ali21,Wang RT et al14 and Ulasli SS et al22 found MPV values were significantly lower in acute exacerbation group compared to stable COPD and control group.

MPV with severity of COPD (Table 3)

MPV and FEV1%pred : In 100 COPD patients 72 (72%) patients had FEV1 in the range of 51-80% predicted, 24(24%) patients in the range of 30-50% and 4(4%) patients had FEV1 <30%. In the control group, 30(100%) had FEV1>80%.There was a strong negative correlation ($r=-0.91$, $p<0.001$) between FEV1%pred and MPV values amongst 100 cases.

The mean MPV values on one way analysis of variance (ANOVA) amongst the three group of cases with FEV1 51-80%(8.61±0.59), 30-50%(10.4±0.52) and <30% (10.75±0.12)were statistically significant($p=0.001$).

MPV and BODE index : In 100 COPD patients 32 (32%) patients had BODE in the range of 0-3, 42(42%) patients in the range of 4-6 and 26(26%) patients had BODE 7-10. In the control group, 30(100%) had BODE 0-3. There was a significant positive correlation between BODE index and MPV values ($r=0.89$, $p<0.001$) amongst cases.

The difference in mean of MPV values was statistically significant ($p=0.001$) amongst the 3 group of cases with BODE index 0-3(8.1±0.25), 4-6(9.05±0.41) and 7-10(10.5±0.47).

MPV and PaO2 : In 100 COPD patients, 30(30%) patients had PaO2 in the range of 71-80mmHg, 34(34%) patients in the range of 61-70mmHg , 30(30%) patients had PaO2 51-60mmHg and 6(6%) had PaO2<50mmHg. In the control group, 30(100%) had PaO2>80mmHg.There was a significant negative correlation between PaO2 and MPV values($r=-0.82$, $p<0.001$) amongst the cases (fig 1).

The mean MPV values on one way analysis of variance(ANOVA) amongst the four group of cases with PaO2 71-80mmHg(8.05±0.35), 61-70 mmHg(9.11±0.48) , 51-70mmHg (9.83±0.86) and PaO2<50mmHg(10.88±0.23) were statistically significant($p=0.001$).

MPV and mMRC : In 100 COPD patients 68 patients had mMRC = 2, 24 patients had mMRC=3 and 8 patients had Mmrc=4. In the control group, 30(100%) had mMRC<2. There was a strong positive correlation ($r=0.64$, $p<0.001$) between Mmrc and MPV values amongst 100 cases.

The mean MPV values on one way analysis of variance (ANOVA) amongst the three group of cases with Mmrc=2(8.72±0.74), Mmrc=3(9.7±0.93) and Mmrc=4 (10.77±0.28)were statistically significant(p=0.001).

MPV and 6MWD : In 100 COPD patients 32(32%) patients had 6MWD in the range of 301-400, 20(20%) patients in the range of 201-300 and 48(48%) patients had 6MWD 101-200. In the control group, 30(100%) had 6MWD>300. There was a strong negative correlation (r=-082, p<0.001) between 6MWD and MPV values amongst 100 cases.

The mean MPV values on one way analysis of variance(ANOVA) amongst the three group of cases with 6MWD 301-400(8.1±0.25), 201-300(9.01±0.41) and 101-200 (9.85±0.84) were statistically significant (p=0.001).

Mario Malerba et al16 found MPV increased with severity of COPD as assessed by post-bronchodilator FEV1categorised i-iv (p>0.05).

In the study of Hua Cui et al23 Multiple linear regression analyses revealed that MPV was negatively correlated with FEV1% predicted (β=-0.384, p=0.0001).

Serdar Kalemci et al24 found significant increase in MPV as the COPD severity increases. They also studied on PDW, Platecrit, PLR and RDW.

Bansal R et al19 found Lesser the paO2, higher was the mean platelet volume in these patients. There was a significant correlation between paO2 and MPV in this group (p < 0.05).

Elevated MPV in our study explained by several mechanisms– Platelets are activated in response to inflammatory stimuli and activated platelets become larger in size.25 Inflammatory burden of acute exacerbation of COPD may interact with thrombopoiesis in bone marrow and cause production of larger platelets. However, by time, activated platelets involve and utilize at site of inflammation and remaining smaller platelets may cause a reduction in MPV levels in these population. Conflicting results in literature about MPV and COPD association could be explained with this phenomenon. In fact, beside inflammatory condition, MPV could be influenced by many co-factors, such as, method of the laboratory assay and the time between blood sampling and laboratory assessment.26

In conclusion Increased Mean Platelet Volume (MPV) was associated with acute exacerbation of COPD and Mean Platelet Volume (MPV) was increasing with severity of COPD by FEV1% predicted, BODE index, PaO2, mMRC grade and 6MWD test.

So, MPV may be useful as a marker of acute attack and severity of COPD.

Conflicts of Interest:
None

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