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A study on correlation between mean platelet volume and severiy of acute ischemic stroke in diabetes mellitus

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Abstract
Background: Strokes are broadly classified as ischemic or haemorrhagic. Ischemic stroke is due to occlusion of cerebral blood vessel and causes cerebral infarction. About 85 % of all first ever strokes are ischemic, 10 % are due to primary intracerebral haemorrhage and about 5 % are due to subarachnoid haemorrhage. The majority (about 80%) of stroke is ischemic; the remainder result from primary hemorrhage either intracerebral or into the subarachnoid space. Diabetes mellitus is well established independent risk factor of stroke. Under some pathological conditions like diabetes mellitus, obesity, metabolic syndrome, acute myocardial infarction (AMI), and stroke, the platelets may be larger in size and more reactive and this phenomenon seems to play an important role in several vascular diseases. Mean platelet volume (MPV) could be obtained from a simple and routine blood count and has a prognostic significance in stroke and AMI. It is well documented that there is a direct relationship between the platelet physiology and ischemic stroke by a number of observations. So the present study was planned in order to assess the correlation between mean platelet volume and severity of acute ischemic stroke in patient of Diabetes mellitus.
Materials and methods: The present study was a Hospital based, observational, cross sectional study carried out from September 2018 to August 2019, In pt jnm medical college Raipur Chhattisgarh on 40 cases satisfying the inclusion criteria following complete assessment. Patients were assessed for acute ischemic stroke with diabetes mellitus attending medicine OPD or casualty and admitted in medicine ward.
Result: Evaluation done on the basis of complete blood count, fasting blood sugar, post prandial blood sugar, lipid profile, Hb1AC, NCCT of head and BMI
Conclusion: This study has shown an elevation of MPV in diabetes mellitus is associated with increased severity of acute ischemic stroke. Thus, increase in MPV is independently associated with severity of acute ischemic stroke. There is significant association between NIHSS and outcome of stroke in our study. Also, the MPV estimation test considered a simple, cost-effective and meaningful laboratory markers test for early detection and risk stratification of cerebrovascular stroke.

Keywords: mean platelet volume (MPV), acute myocardial infraction (AMI) and national institute of health sciences (NIHSS)

Introduction

World Health Organization defines the clinical syndrome of stroke as rapidly developing clinical signs of focal (or global) disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than vascular origin [1]. Strokes are broadly classified as ischemic or haemorrhagic. Ischemic stroke is due to occlusion of cerebral blood vessel and causes cerebral infarction. About 85 % of all first ever strokes are ischemic, 10 % are due to primary intracerebral haemorrhage and about 5 % are due to subarachnoid haemorrhage. The term diabetes mellitus describes a metabolic disorder with heterogenous etiologies which is characterized by chronic hyperglycaemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both [2]. The long–term relatively specific effects of diabetes include development of retinopathy, nephropathy and neuropathy [3]. People with diabetes are also at increased risk of cardiac, peripheral arterial and cerebrovascular disease. Diabetes mellitus is well established independent risk factor of stroke [4]. Many stroke patients may have undetected diabetes at the time of the stroke; further examination in the hospital or following treatment for stroke may notice previously undetected diabetes. Under some pathological conditions like diabetes mellitus, obesity, metabolic syndrome, acute myocardial infarction (AMI), and stroke, the platelets may be larger in size and more reactive and this phenomenon seems to play an important role in several vascular diseases.

Mean platelet volume (MPV) could be obtained from a simple and routine blood count and has a prognostic significance in stroke and AMI [5]. Platelet activation plays a key part in the process of atherosclerosis and then its potentially major adverse clinical outcomes, such as ischemic stroke and myocardial infarction (MI) [6]. Many existing studies investigate the relationships between MPV and prognosis of coronary diseases [7]. While another study reported that MPV has been shown to be predictive of stroke recurrence [8]. So the present study was planned in order to assess the correlation between mean platelet volume and severity of acute ischemic stroke in patient of Diabetes mellitus.

Materials and Method

The present study was a Hospital based, observational, cross sectional study carried out from September 2018 to August 2019, in pt jnm medical college Raipur Chhattisgarh on 40 cases satisfying the inclusion criteria following complete assessment. Patients were assessed for acute ischemic stroke with diabetes mellitus attending medicine OPD or casualty and admitted in medicine ward.

Inclusion Criteria

- Diabetic patients with ischemic stroke
- Those who are willing to participate in study after written consent
- Age above 18 years

Exclusion Criteria

- Those who are not giving consent.
- Patients with known platelet disorder
- Patients on anticoagulant
- Patients on antiplatelet drugs.
- Patients having anemia with Hb <10gm%
- Patients with coronary artery disease
- Patients of valvular heart disease and Deep vein thrombosis.
- Patients with haemorrhagic stroke.

Methodology

Under all aseptic precaution 2ml of venous blood have collected in EDTA vial and transported to laboratory for Mean platelet volume analysis by complete blood count, fasting blood sugar, post prandial blood sugar, lipid profile, and Hb1AC, we was also done clinical assessment, NCCT of head and BMI of patient .on the basis of this parameter we decide operation definition

Ischemic Stroke

Defined as focal neurological deficit due to vascular lesions that is due to cerebral infarction, confirmed on neuro imaging, resulting in partial or complete loss of motor and sensory activities. Patients meeting the criteria for stroke irrespective of sex were included. The presence or absence of following data was recorded for all the patients in a data extraction proform

Hypertension

As per JNC-8 criteria (stage I hypertension as systolicBP between 140-159 mmHg and diastolic BP between 90-99 mmHg, stage II hypertension as systolic BP >160 mmHg and diastolic BP 100 mmHg or more) patient diagnosed as hypertension and on treatment were considered as hypertensive. Patients who were not previously diagnosed as hypertension or not on any anti-hypertensive medications but presented with increased blood pressure at the time of presentation due to cushing‘s reflex were not defined as hypertensive.

Diabetes Mellitus

According to American diabetes association, patientis to be considered diabetes when random blood sugar is above 200 or glycosylated haemoglobin is greater than 6.5 or fasting blood sugar more than 126 and post prandial blood sugar more than 200. So, when patient satisfied above criteria or on any oral anti diabetic drug/ insulin regimen were considered as diabetes.

Smoking

A person who smoked 100 or more cigarettes during his life time was considered as a smoker. A "current smoker" was defined when he/ she smokes 1 cigarette/ bedi per day for 3 months or more duration or consumes tobacco in different form. "Never smoker," is a person who had not comes in to the criteria of current smoking person or ex-smoker.

Family History

Family is considered significant when his/ her sibling / parents/ first degree relative had suffered from stroke or transient ischemic attack previously and undergone treatment.

Obesity

Obesity is defined as patient with BMI > 25 kg/sqm.

Table 1: Grading of obesity

Category	BMI in kg/m2
Underweight	< 18.5
Normal weight	18.5-22.9
Overweight	23-24.9
Obesity grade I	25-29.9
Obesity grade II	30-34.9
Obesity grade III	>35

Alcoholic

A person who is consuming alcohol at present or previously since last 20 years.

NIHSS Scoring System

Maximum score 42 possible

Table 2: NIHSS scoring system

Table 3.2. National Institutes of Health Stroke Scale (maximum = 42)

Response	(Score)	Response	(Score)
Level of consciousness		Motor arm (left and right)	
alert	(0)	no drift	(0)
drowsy	(1)	drift before 10 seconds	(1)
stuporous	(2)	falls before 10 seconds	(2)
coma	(3)	no effort against gravity	(3)
		no movement	(4)
Response to level of consciousness questions*		Motor leg (left and right)	
answers both correctly	(0)	no drift	(0)
answers one correctly	(1)	drift before 5-10 seconds	(1)
answers neither correctly	(2)	falls before 5-10 seconds	(2)
		no effort against gravity	(3)
		no movement	(4)
Response to level of consciousness commands†		Ataxia	
obeys both correctly	(0)	absent	(0)
obeys one correctly	(1)	one limb	(1)
obeys neither	(2)	two limbs	(2)
Pupillary response		Sensory	
both reactive	(0)	normal	(0)
one reactive	(1)	mild	(1)
neither reactive	(2)	severe loss	(2)
Gaze		Language	
normal	(0)	normal	(0)
partial gaze palsy	(1)	mild aphasia	(1)
total gaze palsy	(2)	severe aphasia	(2)
		mute or global aphasia	(3)
Visual fields		Facial palsy	
no visual loss	(0)	normal	(0)
partial hemianopsia	(1)	minor paralysis	(1)
complete hemianopsia	(2)	partial paralysis	(2)
bilateral hemianopsia	(3)	complete paralysis	(3)
Dysarthria		Extinction/inattention	
normal	(0)	normal	(0)
mild	(1)	mild	(1)
severe	(2)	severe	(2)

* Level of consciousness questions: "How old are you?" "What month is this?"
† Level of consciousness commands: "Squeeze my hand" (using nonparetic hand), "Close your eyes."

<4 = Good prognosis -- No tPA 4-20 = mild to moderate - ideal tPA >20 = severe defiicit --No tPA

Score=0 No Stroke
Score=1-4 Minor Stroke
Score=5-15 Moderate Stroke
Score=15-20 Moderate to Severe Stroke
Score=21-42 Severe Stroke

Results and Observation

Prevalence of overweight in our study was 72.5% and that of overweight was 2.5%.

Table 3: Distribution according to BMI grades

		Frequency	Percent
BMI grades	Normal	10	25.0
	Overweight	29	72.5
	Obese	1	2.5
	Total	40	100.0

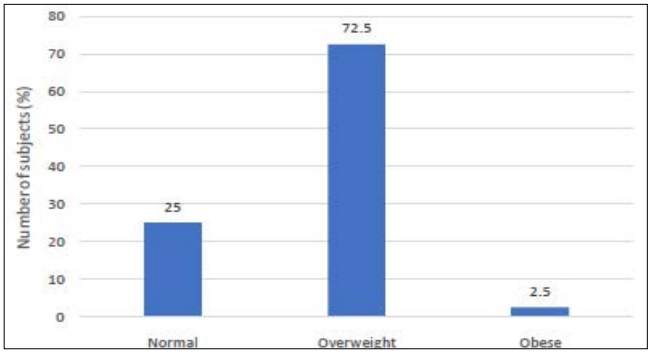

Fig 1: Bar diagram showing Distribution according to BMI grades

Prevalence of hypertension was 47.5%, alcoholism 50% and smoking 40% Past history of CVA was found in one patient i.e. 2.5%.

Table 4: Distribution according to clinical features

	Yes		No	
	Frequency	Percent	Frequency	Percent
Smoking	16	40.0	24	60.0
Alcohol	20	50.0	20	50.0
Hypertension	19	47.5	21	52.5
CAD	0	0.0	40	100.0
H/o Atrial fibrillation	0	0.0	40	100.0
H/O Antiplatelet or anticoagulants	0	0.0	40	100.0
H/O Chemotherapy drugs	0	0.0	40	100.0
Past H/O CVA	1	2.5	39	97.5
H/O Tia	0	0.0	40	100.0

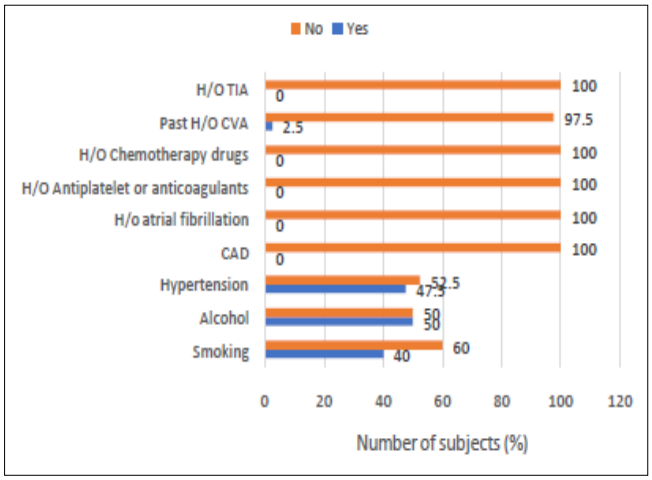

Fig 2: Bar diagram showing Distribution according to clinical features

All 9 deaths in our study were having NIHSS grade 5 which is statistically significant compared to those who survived. (p<0.05).

Table 5: Distribution according to outcome and NIHSS grade

		Death		Survived		Total
		Frequency	Percent	Frequency	Percent	
NIHSS grade	Grade2	0	0.0	4	12.9	4
	Grade 3	0	0.0	13	41.9	13
	Grade4	0	0.0	9	29.0	9
	Grade5	9	100.0	5	16.1	14
	Total	9	100.0	31	100.0	40

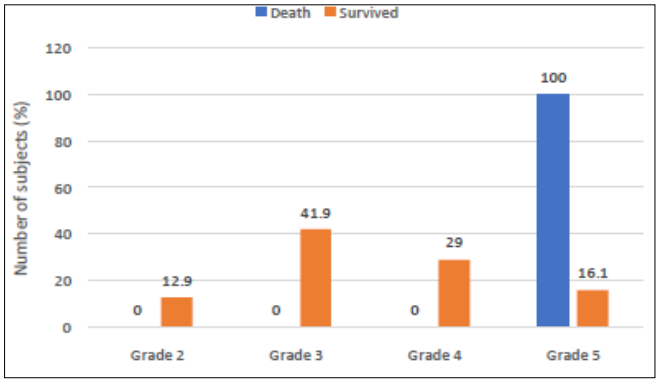

Fig 3: Distribution according to outcome and NIHSS grade

All 9 deaths in our study had hemiparesis i.e. 100% compared to 25(80.6%) of survived patients. This difference in the proportion of cases with hemiparesis between survived and death was found to be statistically not significant (p>0.05).

Table 6: Distribution according to outcome and stroke clinical features

		Death		Survived		Total
		Frequency	Percent	Frequency	Percent	
Clinica l profile of stroke	Hemiparesis	9	100.0	25	80.6	34
	Monoparesi S	0	0.0	6	19.4	6
Total		9	100.0	31	100.0	40

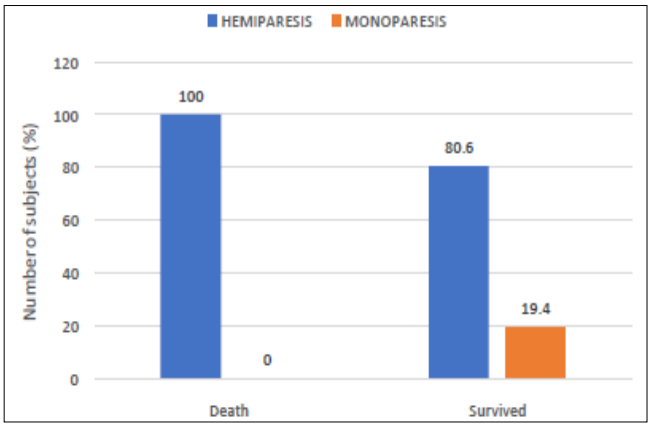

Fig 4: Bar diagram showing Distribution according to outcome and stroke clinical features

Overall mean MPV in our study was 9.29±1.29. MPV in grade 2 was 9.15±0.69, MPV in grade 3 was 8.67±0.84, in grade 4 was 9.22±1.25 and in grade 5 was 9.96±1.54.When we compared the MPV in different NIHSS grades, the difference in the mean MPV was not found to be significant (>0.05). it means, MPV score hardly varies with respect to NIHSS grades.

Table 7: Comparison of mean platelet value according to NIHSS grade

	NIHSS grades	Mean	Std. Deviation	t	p	Inference	
Mean platelet volume	Grade 2	4	9.15	0.69	2.56	0.07(>0.05)	Not significant
	Grade 3	13	8.67	0.84			
	Grade 4	9	9.22	1.25			
	Grade 5	14	9.96	1.54			
	Total	40	9.29	1.29			

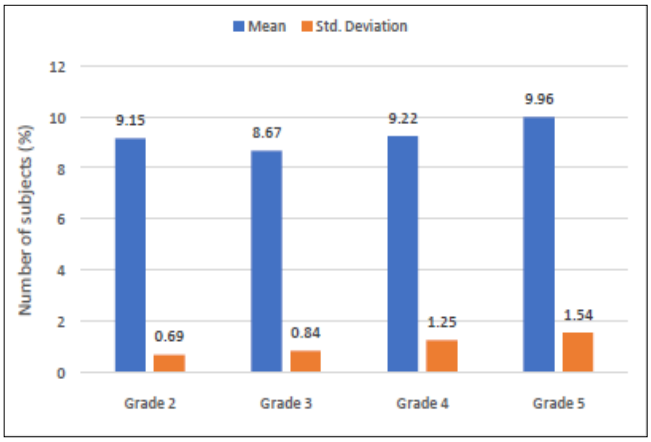

Fig 5: Bar diagram showing Distribution Comparison of mean platelet value according to NIHSS grade

We observed statistically significant positive corelation between MPV and NIHSS score. (p<0.05).

Table 8: Correlation of MPV with age and NIHSS score

		NIHSS score
Mean platelet volume	Pearson Correlation	.390
	p value	0.013
	Inference	Positive correlation

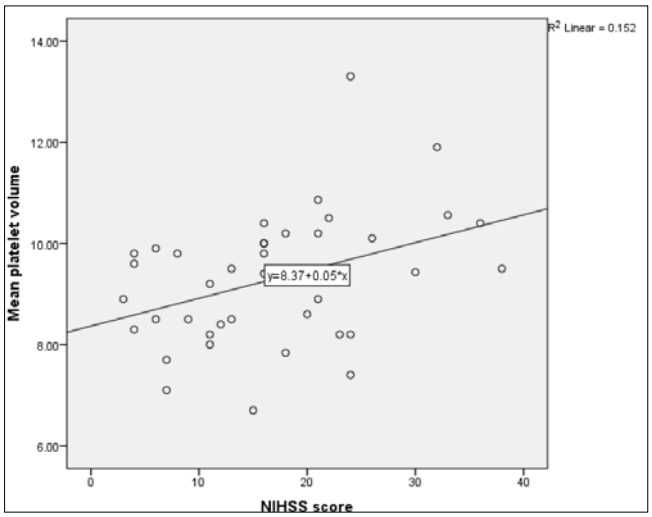

Fig 6: Scatter diagram showing Distribution Correlation of MPV with NIHSS score

Discussion

Age and Gender

We included total 40 patients fulfilling the eligibility criteria in our study. Out of these 40 patients, majority were from 51-60 years age group i.e. 15(37.5%) followed by 10 (25%) from 61-70 yrs, 8(20%) from 41-50 yrs and least i.e. 1(2.5%) from below 40 years age group. Mean age of the study population was 59.25±10.28 years. Males were predominant in number i.e. 24(60%) and females were 16(40%). Male to female ratio was 1.5:1 Gupta R *et al* [10]. In his study included 50 patients of stroke with majority between 50-50 years (13) and 41-50 years (12). Males were predominant in number 64% and females were 34%. Mohamed AA *et al* [11]. carried out metanalysis study with aim to determine whether an association exists between MPV and plateletcrit (PCT) and outcome of acute ischemic stroke. They examined 157 patients with ischemic stroke, admitted to the Sohag University Hospital. A total of 157 patients with first- ever ischemic stroke with a mean age of 56.7 ± 16.2 years, and 36.9% males and 63.1% females were included to this study Narasimhamurthy *et al*. [12]. reported that majority of his cases were males. The mean age of males was 59.8years and of females was 61 years. The mean age of the cases was 60.3 years. There was a male preponderance inthis study which was also seen in other studies compared. Elsayed AM *et al* [9]. conducted cross-sectional study was conducted in Kuwait City Medical Hospitals, the state of Kuwait involving 50 patients presented with cerebrovascular stroke besides 20 control subjects. The group of stroke patients composed of 23 females and 27males, while the healthy controls comprised 12 females and 8males (p >0.05). The mean ages of the stroke patients were61.4±13.5 y.The findings of the above-mentioned studies were almost comparable with our findings.

MPV and its Correlation with Risk Factors

Overall mean MPV in our study was 9.29±1.29.In our study, MPV in grade 2 was 9.15±0.69, MPV in grade 3 was 8.67±0.84, in grade 4 was 9.22±1.25 and in grade 5 was 9.96±1.54. When we compared the MPV in different NIHSS grades, the difference in the mean MPV was not found to be significant (>0.05). it means, MPV score hardly varies with respect to NIHSS grades. We observed positive correlation between MPV and age. We also observed positive correlation between MPV and BMI. We observed statistically significant positive correlation between MPV and NIHSS score. (p<0.05). We observed statistically significant negative correlation of MPV with TC and LDL. (p<0.05). We observed statistically non-significant negative correlation of MPV with TG, HDL and VLDL. (p<0.05) Several studies reported that high MPV levelsis associated with overall vascular mortality in the generalpopulation [13, 14]. In contrast, some studies did not reveal any relationship between platelet volume and function with the outcome of ischemic stroke which may be explained by time-dependent platelet swelling invitro and the influence of MPV by various comorbidities and concomitant drug therapies like antiplatelet andperindopril [15]. There is a current growing evidence that platelet indices including MPV and PCT are significantly correlated with vascular risk factors and can predict prognosis of acute ischemic stroke.In our study dyslipidemia has negative correlation with MPV. This study is similar to Lippi G. *et al*. [16]. who also found no significant association between metabolic syndrome and MPV.Butterworth *et al*. [17]. found the mean MPV were 8.04±1.04 (7.69±0.83) for EDTA and 7.35±1.05 (7.09±0.74) for citrate. Similarly, O"Malley *et al*. [18]. found greater MPV values in patients with acute ischemic stroke than in controls. Conversely, Cho *et al*. [19]. Did not find any significant difference between patients and controls in relation to MPV values, but most of the studies proved that MPV levels were higher in stroke patients [20].

Conclusion

This study has shown an elevation of MPV in diabetes mellitus is associated with increased severity of acute ischemic stroke. Thus, increase in MPV is independently associated with severity of acute ischemic stroke. There is significant association between NIHSS and outcome of stroke in our study. Also, the MPV estimation test considered a simple, cost-effective and meaningful laboratory markers test for early detection and risk stratification of cerebrovascular stroke.

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Conflicts of Interest: There are no conflicts of interest

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