*Research Paper*
*Impact Factor: 6.089*
*Peer Reviewed Monthly Journal*
*www.ijmdrr.com*

*IJMDRR*
*E- ISSN –2395-1885*
*ISSN -2395-1877*

# STUDY OF PLATELET PARAMETERS IN STROKE PATIENTS IN RURAL BASED TERTIARY CARE TEACHING HOSPITAL

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***Abstract***
*The Aim of this investigation is to assess the correlation between platelet parameters in patients of ischemic and hemorrhagic brain stroke. The main objectives are study of changes in platelet parameters in ischemic brain stroke patients as compared to hemorrhagic brain stroke patients in relation to time after brain stroke. This study includes 100 patients of brain stroke admitted at intensive care unit and medical ward over a period of 1 year (December 2016 to January 2018) from rural based tertiary care teaching hospital was carried out at Shree Krishna Hospital, Karamsad. Out of 100 patients 85% of the cases were of ischemic stroke and 15% were of hemorrhagic stroke. Out of total 100, 70% were males and 30% were females which indicate male preponderance. The maximum number of cases in this study was in the age group of 61-80 which was followed by age group of 41-60. The minimum age was 19 years and maximum age was 87 years. We observed that there was a statistically significant difference between platelet count, platelet distribution width and plateletcrit with the progression and outcome of the disease in stroke patients, so that can be considered as early warning sign and will help in initiating timely interventions. In our study there were no statistically significant differences of mean platelet volume and platelet large cell ratio between ischemic and hemorrhagic brain stroke.*

***Key Words: Stroke, Platelet parameters, Ischemic, Hemorrhagic***.

## Introduction

Stroke previously termed cerebrovascular accident, is a cerebrovascular event that results in a localized area of brain infarction. Stroke occurs when there is a sudden interruption of blood flow to the brain, causing hypoxia in the process and, the effects include paralysis of a limb or one side of the body and, disturbance in speech, and vision.[1] Stroke results in more than 5 million deaths each year and at least 1 of 6 patients who survive will suffer another stroke within 5 years.[3]

Stroke may be broadly classified into ischemic and hemorrhagic stroke.[2] Ischemic stroke occurs when blood flow in a vessel is compromised by arteriosclerotic plagues and it eventually leads to thrombi formation. Haemorrhagic stroke occurs when a cerebral artery or arteriole ruptures, sometimes but not always at the site of small aneurysm.[1]

The early hours after an acute stroke are crucial, because it is the most useful time for effective interventions. It is important to determine the prognostic factors as early as possible.[4] At present, the absence of a widely available and sensitive diagnostic test for acute cerebral ischemia remains a significant limitation in the diagnosis and management of stroke.[5] At present, diagnosis of stroke is mostly based on CT scan (Computer Tomography) or MRI (Magnetic Resonance Imaging).[2]

Platelet indices are potentially useful markers for the early diagnosis of thromboembolic diseases.[6] Platelet plays an essential role in the development of ischemic stroke as a result of intravascular thrombosis after the rupture of an atherosclerotic plaque.[7] The mean platelet volume (MPV) is a

laboratory marker associated with platelet function and activity[8] and is the most commonly used measure of platelet size.[12] MPV is an independent predictor of the risk of stroke among individuals with a history of stroke or transient ischemic attack.[9,10] Large platelets are more reactive, produce more prothrombotic factors and aggregate more easily. Thus, the detection of large platelets in patients with cerebrovascular disease would lend support to the idea that platelet volume influences thrombotic large vessel occlusion leading to ischemic stroke.[11] Increase in MPV and a reduction in platelet count are features of both the acute and nonacute phase of cerebral ischemia.[14] MPV is increased in certain vascular risk factors states, including hypercholesterolemia and diabetes mellitus, but not essential hypertension. It is increased in acute myocardial infarction, acute ischemic stroke, pre-eclampsia and renal artery stenosis.[16] Circulating Platelet microparticles level is associated with cerebral injury of acute ischemic stroke (AIS), which offers a novel evaluation parameter for AIS patients.[15]

Cerebrovascular diseases, such as atherosclerosis, arteriolosclerosis, and cerebral amyloid angiopathy, are well-established risk factors for ischemic stroke. Activated platelets release amyloid β (Aβ) peptide, which accumulates in cerebral micro-vessels in an age-dependent manner, stimulates platelet aggregation, and is known to play a critical role in the pathogenesis of atherothrombosis and cerebral amyloid angiopathy. Thus, A β may play an important role in the mechanism that lead to stroke. L5 is the most electronegative sub fraction of low-density lipoprotein (LDL) and an important regulator of cerebral ischemia and the elevated plasma L5 levels may serve as a potential biomarker for the prediction of ischemic stroke. Plasma L5 levels, serum Aβ levels, and platelet expressions of lectin-like oxidized LDL receptor-1(LOX-1) are significantly increased in patients with acute ischemic stroke within 24 hours after the onset of ischemia. [13]

## Materials and Methods

**Source of data:** This is a prospective study conducted at Central Diagnostic Laboratory (CDL), Shree Krishna Hospital, Karamsad. All cases of cerebral stroke including Ischemic stroke and Haemorrhagic stroke admitted in Intensive care unit and medical wards of Shree Krishna hospital are detected at pathology laboratory were selected and studied for changes in platelet parameters with respect to time.

**Ethical Clearance:** This prospective study was conducted after the approval of Institutional Ethics Committee (IEC) of H. M Patel Center for Medical Care and Education, Karamsad. The duration of the study is from December 2016 to January 2018.

## Methodology

The study included 100 patients with Ischemic and Haemorrhagic brain stroke and detailed information regarding name, age, sex, lab number, hospital number, type of cerebral stroke and date/time of collection of samples was taken from intensive care unit and medical wards. Blood samples for haematological study were taken. Venous blood was collected in EDTA vacutainer.

All the Platelet parameters including Platelet count (PC), Mean platelet volume (MPV), Platelet distribution width (PDW), Platelet large cell ratio (P-LCR) and Plateletcrit (PCT) were measured using EDTA blood sample in automated Haematology analyzer (XN-550 and XN-350).

**XN-550** **XN-350**

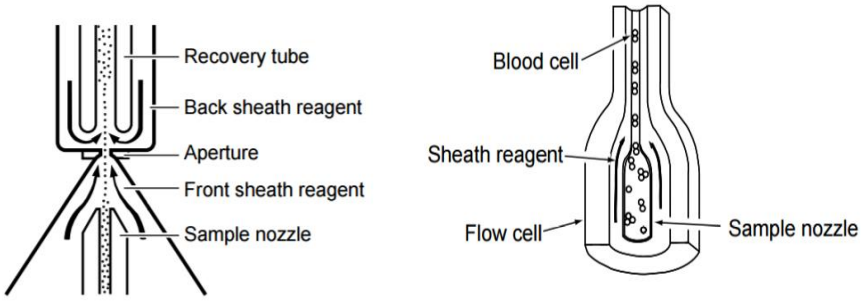
**Principle of XN-550 and XN-350**

This device performs haematology analyses based on the hydrodynamic ally focused impedance measurement, the fluorescence flow cytometry method (using a semiconductor laser), and cyanide free SLS method for determining haemoglobin.

**Hydrodynamic ally focused impedance measurement:**

The RBC detector counts RBC and PLT by Hydrodynamic ally focused impedance measurement. At the same time, the hematocrit (HCT) is calculated via the RBC pulse height detection method. Inside the detector, the sample nozzle is positioned in front of the aperture and in line with the center. After diluted sample is forced from the sample nozzle into the conical chamber, it is surrounded by front sheath fluid and passes through the aperture center.

After passing through the aperture, the diluted sample is sent to the recovery tube. This prevents the blood cells in this area from drifting back, and prevents the generation of the pseudo platelet pulses. The Hydrodynamic ally focused impedance measurement improves blood cell count accuracy and repeatability. Because the blood cells pass through the aperture in a line, this method also prevents the generation of abnormal blood cell pulses.




**Flow cytometry method using a semiconductor laser:**

Cytometry is used to analyze physiological and chemical characteristics of cells and other biological particles. Flow cytometry is a method used to analyze those cells and particles as they are passed through extremely small flow cells. A blood sample is aspirated and measured, diluted to the specified ratio, and stained. The sample is then fed into the flow cells by the sheath flow mechanism.

This mechanism improves cell count accuracy and repeatability. Since the blood cell particles pass in a line through the center of the flow cell, the generation of abnormal blood pulses is prevented and flow cell contamination is reduced. A semiconductor laser beam is directed onto the blood cells passing through the flow cell. The forward scattered light, lateral scattered light and lateral fluorescent light are

captured by the photodiode. These lights are converted into electrical pulses, thus making it possible to obtain blood cell information.

Forward scattered light and lateral scattered light: - When obstacles pass through a light path, the light beam scatters from each obstacle in various directions. This phenomenon is called light scattering. By detecting the scattered light, it is possible to obtain information on cell size and material properties.

Likewise, when a laser beam is directed onto blood cell particles, light scattering occurs. The intensity of the scattered light depends on factors such as the particle diameter and viewing angle. This instrument detects forward scattered light, which provides information on blood cell size; and lateral scattered light, which provides information on the cell interior (such as the size of the nucleus).

**Lateral fluorescent light**

When light is directed onto fluorescent material, such as labeled blood cells, light of longer wavelength than the original light is produced. The intensity of the fluorescent light increases as the concentration of the marker becomes higher. By measuring the intensity of the fluorescent emitted, we can obtain information on the degree of blood cell labeling. Fluorescent light is emitted in all directions. This instrument detects the fluorescent light that is emitted sideways.

**SLS-hemoglobin method**

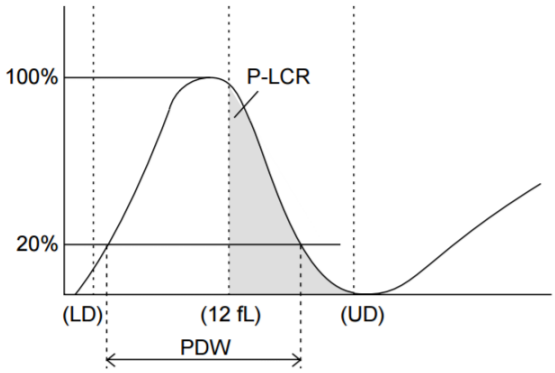
It rapidly converts hemoglobin to ox hemoglobin. This method is cyanide free and does not use poisonous substances, making it a suitable method for automation. Further, since met hemoglobin can be analyzed, control samples such as control blood containing met hemoglobin can also be accurately analyzed.

**Platelet analyses**

Platelet distribution – The **platelet count** is measured as a particle count between 2 discriminators (lower discriminator (LD) and upper discriminator (UD)), which are automatically set up in the ranges of 2 to 6 fL and 12 to 30 fL, respectively. The platelet distribution is checked for abnormal relative frequencies, abnormal distribution width, and the existence of more than 1 peak at the LD.

- **PDW (Platelet distribution width):** With the peak height assumed to be 100%, the distribution width at the 20% frequency level is PDW. The unit used is fL (femtoliter) (1 fL= $10^{-15}$L).
- **P-LCR (Platelet-large cell ratio):** The P-LCR is the proportion of large platelets that are larger than the 12fL discriminator. It is calculated as a ratio comparing the number of platelets between the fixed discriminator (12fL) and UD, to the number of particles between LD and UD.
- **MPV (Mean platelet volume):** The MPV is calculated from the following equation:

$$\text{MPV (fL)} = \frac{\text{PCT (\%)}}{\text{PLT } (\times 10^4/\mu\text{L})} \times 100$$




- **PCT (Plateletcrit):** PCT is called platelet hematocrit or platelet volume ratio, and is weighted toward the PLT frequency.

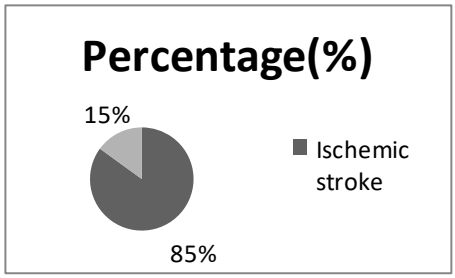
**Observations and Results**

This study of platelet parameters in stroke patients in rural based tertiary care teaching hospital was carried out in Shree Krishna Hospital, Karamsad from period of December 2016 to January 2018. In this study, two types of brain stroke patients were included, that is Ischemic stroke and Haemorrhagic stroke and platelet parameters are studied for first four consecutive days for their changes with respect to time and to know their association with the progression of the disease process.
Patients are grouped based on type of stroke, gender and age.

**Table 1: -Total number of cases with Different types of brain stroke:**

| Type of Stroke | No of cases | Percentage (%) |
|---|---|---|
| Ischemic stroke | 85 | 85 |
| Haemorrhagic stroke | 15 | 15 |
| Total | 100 | 100 |

**Chart-1**

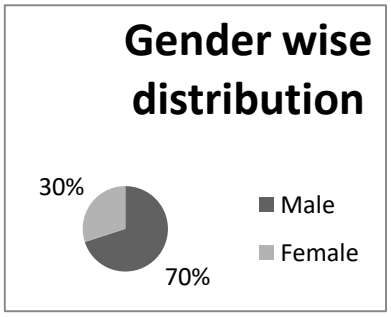



Out of 100 cases, 85 are of Ischemic stroke and 15 of Haemorrhagic stroke. Incidence of Ischemic stroke is
85% and haemorrhagic stroke is 15%.

**Table 2: - Gender wise distribution of cases:**

| Gender | No of cases | Percentage (%) |
|---|---|---|
| Male | 70 | 70 |
| Female | 30 | 30 |
| Total | 100 | 100 |

**Chart-2**

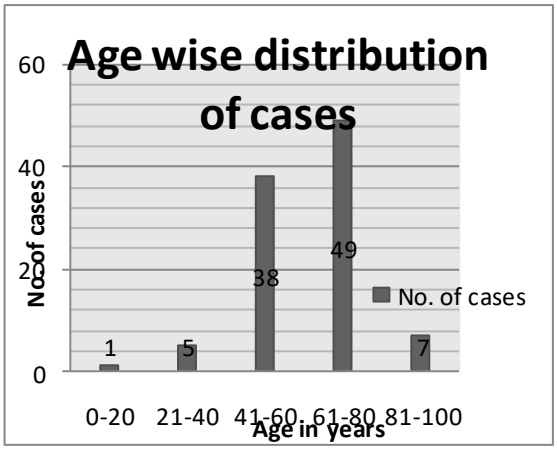



The numbers of Male affected in this study are more compared to Female.

**Table 3:- Age wise distribution of Patients**

| Age group | No of cases (n=100) | Percentage (%) |
|---|---|---|
| 0-20 | 1 | 1 |
| 21-40 | 5 | 5 |
| 41-60 | 38 | 38 |
| 61-80 | 49 | 49 |
| 81-100 | 7 | 7 |
| Total | 100 | 100 |

**Chart-3**




Most of the cases are between age group 61 to 80 years.

**Correlation of Platelet Parameters between Ischemic stroke and Hemorrhagic stroke**

- **Platelet count** on day 1, day 2 and day 3 shows no statistically significant difference between ischemic stroke and Haemorrhagic stroke because p value is >0.05. Platelet count on day 4 shows statistically significant difference between ischemic stroke and Haemorrhagic stroke with p value <0.05.
- **Mean Platelet Volume** on day 1, day 2, day 3 and day 4 shows no statistically significant difference between ischemic stroke and Haemorrhagic stroke because p value is >0.05.
- **Platelet distribution width** on day 1, day 3, day 4 shows no statistically significant difference between ischemic stroke and Haemorrhagic stroke because p value is >0.05. Platelet distribution width on day 2 shows statistically significant difference between ischemic stroke and Haemorrhagic stroke with p value <0.05.
- **Platelet large cell ratio** on day 1, day 2, day 3, day 4 shows no statistically significant difference between ischemic stroke and Haemorrhagic stroke because p value is >0.05.
- **Plateletcrit** on day 1, day 2, day 3 shows no statistically significant difference between ischemic stroke and Haemorrhagic stroke because p value is >0.05. Plateletcrit on day 4 shows statistically significant difference between ischemic stroke and Haemorrhagic stroke with p value <0.05.

| Variables | Ischemic Stroke | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Platelet Parameters** | **Platelet count ($10^3$/µL)** | | | | **Mean Platelet Volume (fl)** | | | | **Platelet Distribution Width (fl)** | | | | **Platelet large cell ratio** | | | | **Plateletcrit (%)** | | | |
| **Days** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| **Observations** | 85 | 73 | 60 | 45 | 85 | 73 | 60 | 45 | 85 | 73 | 60 | 45 | 85 | 73 | 60 | 45 | 85 | 73 | 60 | 45 |
| **Mean value** | 273.28 | 270.79 | 269.35 | 258.42 | 9.99 | 10.21 | 10.27 | 10.27 | 10.84 | 11.20 | 11.24 | 11.28 | 24.44 | 26.02 | 26.39 | 26.52 | 0.27 | 0.27 | 0.26 | 0.26 |
| **Standard Deviation** | 70.13 | 78.05 | 89.75 | 90.10 | .83 | .85 | .83 | .89 | 1.76 | 1.92 | 1.93 | 1.82 | 6.65 | 6.79 | 6.67 | 6.77 | 0.06 | 0.06 | 0.06 | 0.07 |
| **95% Confidence interval** | 258 to 288 | 252 to 289 | 246 to 292 | 231 to 285 | 9.8 to 10.1 | 10.0 to 10.4 | 10.0 to 10.4 | 10.0 to 10.5 | 10.4 to 11.2 | 10.7 to 11.6 | 10.7 to 11.7 | 10.7 to 11.8 | 23.0 to 25.8 | 24.4 to 27.6 | 24.6 to 28.1 | 24.4 to 28.5 | 0.25 to 0.28 | 0.25 to 0.28 | 0.24 to 0.28 | 0.23 to 0.28 |
| **Degree of freedom** | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 |
| **t value** | 1.3541 | 0.3927 | 1.5083 | 2.5607 | -0.2485 | -1.7898 | -0.4727 | -0.4342 | -0.8528 | -2.0440 | -0.5349 | -0.2650 | -0.4331 | -1.8049 | -0.6325 | -0.4408 | 1.4683 | 0.3809 | 1.6472 | 2.8285 |
| **p value** | 0.1788 | 0.6955 | 0.1359 | 0.0133 | 0.8042 | 0.0770 | 0.6378 | 0.6659 | 0.3958 | 0.0440 | 0.5944 | 0.7921 | 0.6659 | 0.0746 | 0.5291 | 0.6612 | 0.1452 | 0.7042 | 0.1039 | 0.0066 |

| **Variables** | **Haemorrhagic Stroke** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Platelet Parameters** | **Platelet count ($10^3$/µL)** | | | | **Mean Platelet Volume (fl)** | | | | **Platelet Distribution Width (fl)** | | | | **Platelet large cell ratio** | | | | **Plateletcrit (%)** | | | |
| **Days** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| **Observations** | 15 | 15 | 13 | 10 | 15 | 15 | 13 | 10 | 15 | 15 | 13 | 10 | 15 | 15 | 13 | 10 | 15 | 15 | 13 | 10 |
| **Mean value** | 245.4 | 258.46 | 228.69 | 180.5 | 10.05 | 10.7 | 10.4 | 10.4 | 11.30 | 12.57 | 11.57 | 11.46 | 25.29 | 29.84 | 27.76 | 27.59 | 0.24 | 0.26 | 0.22 | 0.18 |
| **Standard Deviation** | 91.24 | 209.72 | 79.58 | 70.19 | 1.03 | 1.35 | 1.15 | .92 | 2.72 | 3.87 | 2.38 | 2.44 | 8.72 | 10.30 | 8.77 | 7.55 | 0.08 | 0.18 | 0.08 | 0.07 |
| **95% Confidence interval** | 194 to 295 | 142 to 374 | 180 to 276 | 130 to 230 | 9.4 to 10.6 | 9.9 to 11.4 | 9.7 to 11.0 | 9.7 to 11.0 | 9.8 to 12.8 | 10.4 to 14.7 | 10.1 to 13.0 | 9.7 to 13.2 | 20.4 to 30.1 | 24.1 to 35.5 | 22.4 to 33.0 | 22.1 to 32.9 | 0.19 to 0.29 | 0.15 to 0.36 | 0.17 to 0.27 | 0.13 to 0.24 |
| **Degree of freedom** | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 | 98 | 86 | 71 | 53 |
| **t value** | 1.3541 | 0.3927 | 1.5083 | 2.5607 | -0.2485 | -1.7898 | -0.4727 | -0.4342 | -0.8528 | -2.0440 | -0.5349 | -0.2650 | -0.4331 | -1.8049 | -0.6325 | -0.4408 | 1.4683 | 0.3809 | 1.6472 | 2.8285 |
| **p value** | 0.1788 | 0.6955 | 0.1359 | 0.0133 | 0.8042 | 0.0770 | 0.6378 | 0.6659 | 0.3958 | 0.0440 | 0.5944 | 0.7921 | 0.6659 | 0.0746 | 0.5291 | 0.6612 | 0.1452 | 0.7042 | 0.1039 | 0.0066 |

**Discussion**

The present study was study of platelet parameters in stroke patients in rural based tertiary care teaching hospital was carried out at Shree Krishna Hospital, Karamsad. This study included 100 patients of brain stroke admitted at intensive care unit and medical ward.

In this study, patients with Ischemic brain stroke were compared with Haemorrhagic brain stroke for the changes in platelet parameters in relation to time. Out of 100 patients 85% of the cases were of

Ischemic stroke and 15% were of Haemorrhagic stroke. Out of 100 patients, 70% were males and 30% were females. So the numbers of males affected in this study were more than the females.

The maximum number of cases in this study was in the age group of 61-80 which was followed by age group of 41-60. The minimum age was 19 years and maximum age was 87 years. The mean age was 61.86±13.79.

Descriptive statistics [mean (SD), Frequency (%)] was used to depict the profile of study participants as well as the variations in platelet parameters. Two sample t-test with equal variance has been used to access association of platelet parameters with ischemic and haemorrhagic stroke. Statistical significance was made at p value <0.05.

We observed that there were changes in some of the platelet parameters with respect to time which helped to know their association with the progression of the disease process.

It was observed that there was a significant difference of platelet count (PLT) on day 4 with p value 0.0133, platelet distribution width (PDW) on day 2 with p value 0.0440 and Plateletcrit (PCT) on day 4 with p value 0.0066 between ischemic stroke and haemorrhagic stroke. There was no significant difference of mean platelet volume and platelet large cell ratio between ischemic and haemorrhagic stroke.

**Conclusion**

There was a statistically significant difference established between platelet count, platelet distribution width and plateletcrit with the progression and outcome of the disease in stroke patients, so that can be taken as early warning sign and will help in starting timely interventions. This study did not find a statistically significant difference of mean platelet volume and platelet large cell ratio between ischemic and haemorrhagic stroke.

We observed that there were changes in some of the platelet parameters with respect to time which helped to know their association with the progression of the disease process but as our study includes 100 patients so further studies are needed with large sample size to prove the correlation between platelet parameters and stroke. Further research is required into the role of platelet volume in stroke pathology, outcome, and most importantly, in individuals at risk for stroke. Therefore, further studies are recommended on mean platelet volume.

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