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Study of red cell distribution width in ischaemic stroke and its relation with severity of stroke

[1]Ujjawal Mittal, PG. Resident, Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

[2]Ankit Anand, Senior Resident, Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

[3]Sunil Kumar, Assistant Professor and Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

[4]Ankit Grover, Senior Resident, Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

[5]Divyant Rawal, Associate Professor, Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

[6]Sharat Johri, Professor, Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

Corresponding Author: Sunil Kumar, Assistant Professor and Dept of Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, India.

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Abstract

Introduction: Stroke is one of the common causes of death and morbidity in India. RDW being inexpensive and easily available can be used to determine ischaemic stroke and its severity

Objective: To study red cell distribution width in ischaemic stroke and its relation with severity of stroke in a tertiary care center.

Method: Sample Size used in this study is 80 cases and 80 controls. Adult patients with acute ischemic stroke / radiologically proven cerebral infarction, after taking a written informed consent from the patient (if conscious) or a attendant (if unconscious), were included in the study.

Result: Median of RDW (%) in cases was 13.8(13.4-14.5) which was significantly higher as compared to controls (12.8(12.4-12.9). RDW (%) was the significant predictor of stroke at cut off point of >13.1 with 93.70% chances of correctly predicting stroke

Conclusion: According to our study, RDW can predict stroke but do not assess severity of stroke.

Introduction

WHO defines stroke as a clinical syndrome characterized by rapidly developing clinical symptoms and/or signs of focal or global loss of cerebral function, with symptoms lasting for more than 24 hours or leading to death, with no apparent cause other than that of vascular origin.[1] Ischaemic Stroke prevalence in India is reported between 147-922/100,000 through different

community-based studies.[2,3] In various studies which used age standardization with the US population have mentioned, that the frequency of stroke extended from 244/100,000 to 424/100,000. In keeping with Indian ischaemia stroke factsheet which is updated in 2012, the age-adjusted frequency rate for the stroke fluctuated between 84/100,000 and 262/100,000 in various rural area and between 334/100,000 and 424/100,000 in urban areas.[4]

Globally, stroke is one of the most common cause of death and disability-adjusted life-years (DALYs) as per estimates from the Global Burden of Diseases, Injuries and Risk Factors Study.[5] Acute ischaemic stroke is diagnosed by history, physical, neurological examination and imaging. The diagnosis of ischaemic stroke is based mainly on cerebral imaging. Though, it might be helpful to have a biomarker to screen and identify patients who have had ischaemic stroke and in candidates suitable for thrombolytic therapy.

Scoring systems like Glasgow Coma Scale (GCS) and National Institutes of Health Stroke Scale (NIHSS) are utilized in predicting the severity of acute ischaemic stroke (AIS). GCS is a commonly used neurological scale in emergency which provides a reliable and objective way of assessing the level of consciousness in stroke patient.[6] The NIHSS evaluates patients on 11 parameters and it is an excellent predictor of patient outcomes. A baseline NIHSS score greater than 16 indicate strong probability of mortality while a baseline NIHSS scoreless than 6 indicate strong probability of good recovery.[7]

The red blood cell distribution width (RDW) is a measure of the variation of red cell blood volume. RDW is the variation coefficient of standard deviation of the curve of red cell volume distribution. It is a parameter that is easily and in expensively determined by automated flow cytometry as a part of complete blood count. RDW has been found to be an important marker to assess the mortality and morbidity in acute CVA[8]. In stroke inflammatory markers like CRP are raised which leads to reduced survival of red blood cells and red cell damage due to damage of red cell membrane, increased red blood cell fragility and reduced blood cell maturation and longevity, leading to raised RDW[9.]

Material and method

Study Design and Study Population: This is a prospective observational, hospital-based study done in Department of General Medicine, at SRMS - IMS Bareilly, Uttar Pradesh from January 2019 to April 2020 to study RDW in relation to ischaemic stroke and its co relation with severity of stroke using GCS and NIHSS scoring system. Adult patients with acute ischemic stroke / radiologically proven cerebral infarction, after taking a written informed consent from the patient (if conscious) or a surrogate attendant (if unconscious), were included in the study. Sample Size used in this study is 80 cases and 80 controls.

Inclusion criteria

(a)All patients with acute ischemic stroke within 1 week of stroke.

(b) Age >18 years and <80 years.

(c) CT/MRI evidence of ischemic stroke.

Exclusion criteria

(a) Age <18 years and >80 years.

(b) Haemmorhagic stroke.

(c) Anaemia [Hb- <12gm/dl males and <11gm/dl females].

(d) Thalasemia. (d) Sepsis.

Procedure and Methodology: Data were collected through interviews; physical and neurologic

examinations were conducted by neurologists. When possible, data were obtained directly from patients using the standardized data collection instruments as patient's proforma on lifestyle factors, current medication use, and medical history. Briefly, subjects were categorized into current smokers, ex-smokers, and never smokers and current alcohol consumers, ex-consumers, or non-consumers. When the patient was unable to provide answers, a proxy knowledgeable about the patient's history was interviewed. Absolute Indices includes MCV, MCH, MCHC and RDW CV and SD done by BeneSphera 5- part haematology analyzer. Radiological Examination includes Chest x-ray, electrocardiography, echocardiogram and brain imaging including computed tomography (CT) and magnetic resonance imaging (MRI) with angiographies brain were performed. Stroke was categorized as mild, moderate and severe using National Institute of Heath Stroke Stroke [NIHSS] and GCS.

Statistical Analysis

The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non-parametric test was used.

Observations

This prospective observational study included 80 patients of acute ischemic stroke on CT/MRI admitted within 1 week of onset of stroke having age >18 years and <80 years. 80 age and gender matched controls were included in the study. Detailed history, clinical findings and investigations were recorded of each patient. Stroke was categorized as mild, moderate and severe using National Institute of Heath Stroke Stroke [NIHSS] and GCS. The age distribution of stroke cases and controls showed no significant difference (p value>.05). majority of the patients in cases (31.25%) and controls (33.75%) were in the age group 61-70years. In age group of 51-60 years,

23.75% of patients were cases and 18.75% were controls. In age group 41-50 years,

17.50% of patients were cases and 18.75% were controls. In age group 71-80 years,

17.50% of patients were cases and 15.0% were controls. In age group 31-40 years,

7.50% of patients were cases and 11.25% were controls. In age group 21-30 years,

1.25% of patients were cases and 2.50% were controls. No significant difference was seen in gender distribution between cases and controls (p value>.05). Majority of patients were males; 66.25% in cases and 63.75% in controls and proportion of females was 33.75% in cases and 36.25% in controls. In comparison of investigations between cases and controls- No significant difference was seen in hemoglobin(gm/dl) between cases and controls (p value>.05). Median of hemoglobin(gm/dl) in cases was 13.35(12.275-14.725) and in controls was 12.9(12.2-13.525).

The variable total leucocyte count(cells/cumm) was normally distributed. No significant difference was seen in total leucocyte count(cells/cumm) between cases and controls. Mean ± SD of total leucocyte count(cells/cumm) in cases was 8542.38 ± 1709.82 and controls was 8002.38 ± 2533.55.

Significant difference was seen in RDW (%) between cases and controls. Median of RDW (%) in cases was

13.8(13.4 - 14.5) which was significantly higher as compared to controls (12.8(12.4 - 12.9).

No significant difference was seen in MCV (fl) between cases and controls. Median of MCV (fl) in cases was 95.65(90.45-97.9) and controls was 93.7(92.625-96.2).

Table 1: Distribution of MRI/CT finding of study subjects.

In present study, in majority (78.75%) of patients, MCA infarct was seen followed by PCA infarct (10.00%) and ACA infarct (6.25%). Multi infarct state was seen in only 4 out of 80 patients.

MRI/CT finding	Frequency	Percentage
ACA infarct	5	6.25%
MCA infarct	63	78.75%
Multi infarct state	4	5.00%
PCA infarct	8	10.00%
Total	80	100.00%

Table 2: Comparison of past history between cases and controls.

Past history	Cases (n=80)	Controls (n=80)	Total
Hypertension	47 (58.75%)	30 (37.50%)	77 (48.13%)
Diabetes mellitus	28 (35%)	21 (26.25%)	49 (30.63%)
CAD	6 (7.50%)	7 (8.75%)	13 (8.13%)

Proportion of patients with past history of diabetes mellitus, hypertension and CAD in cases was 35.00%, 58.75% and 7.5% and in controls was 21%, 30% and 8.75% respectively.

Table 3: Distribution of GCS and NIHSS scoring of study subjects.

Scoring	Frequency	Percentage
GCS		
Mild (13-15)	45	56.25%
Moderate (9-12)	27	33.75%
Severe (≤8)	8	10%
NIHSS		
Mild (1-4)	3	3.75%
Moderate (5-15)	60	75.00%
Severe (≥16)	17	21.25%

In present study, 56.25% of patients had mild stroke, 33.75% of patients had moderate stroke and 10% of patients had severe stroke according to GCS. Mean value of GCS of study subjects was 12.58 ± 2.7 with median (IQR) of 13.5(11-15). 3.75% of patients had mild stroke, 75% of patients had moderate stroke and 21.25% of patients had severe stroke according to NIHSS. Mean value of NIHSS of study subjects was 11.21 ± 5.55 with median (IQR) of 10(7-14.25).

Table 4: Association of cases and controls with RDW%.

Group	≤13.1 (n=79)	>13.1 (n=81)	Total	P value
Cases	7 (8.75%)	73 (91.25%)	80 (100%)	<.0001
Controls	72 (90%)	8 (10%)	80 (100%)	
Total	79 (49.38%)	81 (50.63%)	160 (100%)	

Significant association was seen in the distribution of group with RDW%. (p value<.05) Proportion of patients with RDW% <=13.1 was 90% of controls which was significantly higher as compared to 8.75% of cases. Proportion of patients with RDW% >13.1 was 91.25%

of cases which was significantly higher as compared to 10% of controls.

Scoring systems: Gcs and Nihss

Table 5: Association of RDW (%) with GCS.

	RDW (%)					
	Mild (13-15) (n=45)	Moderate (9-12) (n=27)	Severe (≤8) (n=8)	Total	P value	Test performed
Mean ± Stdev	14.18 ± 1.19	13.83 ± 0.89	14.05 ± 1.01	14.05 ± 1.08	0.765	Kruskal Wallis test; Chi square= 0.532
Median (IQR)	13.9 (13.475-14. 525)	13.8 (13.325-14.575)	13.85 (13.45-14.1)	13.8 (13.4-14.5)		

No significant association was seen in RDW (%) with GCS. (p value >.05) Median (IQR) of RDW (%) in mild stroke was 13.9(13.475-14.525), moderate stroke was 13.8(13.325-14.575) and severe stroke was 13.85(13.45-14.1).

Table 6: Association of RDW (%) with NIHSS.

	RDW (%)					
	Mild (1-4) (n=45)	Moderate (5-15) (n=27)	Severe (≥16) (n=8)	Total	P value	Test performed
Mean ± Stdev	14.27 ± 0.5	14.05 ± 1.15	14 ± 0.9	14.05 ± 1.08	0.67	Kruskal Wallis test; Chi square=0.799
Median (IQR)	14.2 (14-14.5)	13.8 (13.375-14.5)	13.9 (13.6-14.2)	13.8 (13.4-14.5)		

No significant association was seen in RDW (%) with NIHSS. (p value >.05) Median (IQR) of RDW (%) in mild stroke was 14.2(14-14.5), moderate stroke was 13.8(13.375-14.5) and severe stroke was 13.9(13.6-14.2).

Hence RDW as such was significantly raised in cases as compared to controls but showed not co relation with severity of stroke assessed by NIHSS and GCS scoring system.

Discussion

Stroke is one of the leading causes of death and disability in India. Among different subtypes of stroke, ischaemic stroke plays major part as compared to haemorrhagic stroke. Hence we need a faster, cheap and readily available tool for assessment of severity of stroke and prognostication. RDW being a simple laboratory value can help in prediction of stroke and according to some studies can assess severity of stroke in addition with various stroke scales like NIHSS and CNS (Canadian neurological scale). The present study 'To study relation of RDW with stroke and its co relation with stroke severity' is prospective case control study of the patients of ischemic stroke admitted in SRMS – IMS a tertiary care center in Rohilkhand region, Bareilly, India from 1st January 2019 to 30th April 2020. To determine severity of stroke GCS and NIHSS were included in the study. RDW is done as basic blood examination along with CBC and absolute indices.

Ischaemic stroke is defined by imaging studies NCCT/MRI brain. Additionally, 2D Echo was performed in all cases.

Moreno JM et al (2013) conducted a case-control study in which 224 patients suffering a first ischemic stroke confirmed by MRI were included. Aim of this study was to know the relationship between RDW and ischaemic stroke. The study showed that RDW in cases ranged between 12.27% to 26.17% and in controls ranged between 11.30% to 21.70%. Patients with RDW >14.61%were significantly more likely to have a stroke compared with patients in the lower quartile. Therefore, RDW is concluded as a positive predictor of stroke. E. Akinci et al (2014) conducted a prospective study showing association of RDW levels with early mortality in patients of acute ischaemic stroke. Total 692 patients were included in the study, 506 (73.1%) were having atherosclerotic disease and 186 (27.9%) were having cardioembolic stroke. NIHSS was calculated in all patients. The study concluded that RDW levels do not vary depending on the stroke type and there was no positive co relation with NIHSS though raised RDW value was found in stroke. Vijayashree et al (2014) conducted a case control study to determine the relevance of RDW in ischaemic stroke. 52 cases and 54 controls were included in the study. In the study, the severity of stroke was graded according to NIH stroke scale into mild, moderate and severe categories. The participants were also divided into two groups based on RDW values of ≤12.9 and ≥ 13.0 respectively. RDW values greater than 13 were associated with increase in the risk of stroke but the level of RDW does not show a linear relationship with the severity of stroke. Therefore, RDW values can predict the occurrence of stroke but not severity of ischaemic stroke. Jia et al (2015) in a cross-sectional study involving 432 patients with primary ischemic stroke (within 72 h). All subjects were confirmed by MRI and they further underwent physical examination, laboratory tests and carotid ultrasonography. This Study suggested that RDW levels were higher in patients with ischemic stroke. These results leads to connection of RDW with ischemic stroke and further confirmed the role of RDW in the ischemic stroke. Yogitha Cand Anil Kumar. S (2019) conducted a study in KIMS hospital, Bangalore to know to relationship of RDW with neurological scoring systems in ischaemic stroke. 100 patients diagnosed with ischaemic stroke during the period of November 2015 to September 2017 were included in the study. GCS, NIHSS and CNS scoring systems were included in the study. RDW was found to be elevated significantly in patients with moderate to severe stroke and it was also found that RDW was significantly elevated in stroke patients who suffered mortality during the hospital stay.

Conclusion

This study was done to know the association of RDW with ischemic stroke and with severity of stroke using GCS and NIHSS scoring system. Median of RDW (%) in cases was 13.8(13.4-14.5) which was significantly higher as compared to controls 12.8(12.4-12.9). RDW (%) was the significant predictor of stroke at cut off point of >13.1 with 93.70% chances of correctly predicting stroke. There was no relationship with severity of stroke and RDW value. According to our study, RDW can predict stroke but cannot assess severity of stroke.

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