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RESEARCH ARTICLE

RELATIONSHIP BETWEEN RED CELL DISTRIBUTION WIDTH AND CLINICAL STROKE SCORING SYSTEMS IN ACUTE ISCHEMIC STROKE.

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Abstract

Red cell distribution width (RDW) is a hematological parameter routinely obtained as a part of Complete blood count. Recently RDW has emerged as a potential independent predictor of clinical outcome in patients with established cardiovascular disease. However, little is known about the role of RDW as a predictor of severity among persons with ischemic stroke. ¹Hence elevated RDW may be a useful parameter to follow the development of atherosclerosis and hence stroke.

Methods: The present study was conducted in the department of Medicine, KIMS Hospital, Bangalore, on 100 patients diagnosed to have acute ischemic stroke during the period of November 2015 to September 2017. Data was collected by relevant history, clinical examination, investigations.

Results: In the analysis, RDW was found to be significantly elevated in patients with moderate to severe strokes and it was also found that RDW was significantly elevated in stroke patients who suffered mortality during the hospital stay.

Conclusion: The present study showed that RDW potentially is an important parameter for predicting the severity and outcome of acute ischemic stroke.

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Introduction:-

Red cell distribution width (RDW) is a haematological parameter routinely obtained as a part of Complete blood count. Recently RDW has emerged as a potential independent predictor of clinical outcome in patients with established cardiovascular disease. However, little is known about the role of RDW as a predictor of severity among persons with ischemic stroke. In disorders other than anaemia, the prognostic importance of high RDW levels previously received insufficient attention because of lack of knowledge. However, high RDW levels are associated with a poor prognosis in certain disorders such as acute Myocardial Infarction, stroke and peripheral artery disease. ¹Inflammation may contribute to morphologic changes in red cells by changing membrane glycoproteins and ion channels. Chronic inflammation, oxidative stress and neurohumoral activation may contribute to the development of atherosclerosis. Hence elevated RDW may be a useful parameter to follow the development of atherosclerosis and hence stroke.

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Objectives:-

To find out the association between Red Cell Distribution Width(RDW) and Glasgow Coma Scale(GCS), National Institute of Health Stroke Scale(NIHSS), and Canadian Neurological Scale(CNS) in patients with acute ischemic stroke.

Material & methods:-**Sources Of Data :**

Patients diagnosed with ischemic stroke in the inpatient department of General Medicine, KIMS hospital, Bengaluru were taken up for the study considering the inclusion and exclusion criteria.

Duration of the study :

From November 2015 to September 2017

Sample size:

100 patients with ischemic stroke admitted to Department of Medicine

Inclusion criteria:

1. Age more than 18 Years
2. Symptoms of stroke less than 24hours
3. Diagnosis of acute ischemic stroke based on history, physical examination, CT scan and/or diffusion weighted MRI scan performed during the first 24 hours

Exclusion criteria:

1. CT diagnosis of cerebral hemorrhage, subdural hematoma, intracerebral mass.
2. Presence of infection, known immunological disorders, malignancy or pregnancy
3. Presence of anemia, Myocardial Infarction, Peripheral Vascular Disease, hemoglobinopathy, Sickle cell anemia, Thalassemia, or current use of iron, folic acid or Vitamin B12 supplements.

Method of collection of data:

After admission a detailed history regarding the temporal profile of the stroke including risk factors like hypertension, diabetes mellitus, smoking, history of Ischemic Heart Disease (IHD) were obtained.

The severity of stroke was graded as mild (NIHSS < 8), moderate (NIHSS, 9–15), or severe (NIHSS >16). The severity of impaired level of consciousness was rated as mild (GCS, 15), moderate (GCS, 8–14), or severe (GCS <7).

The severity of impaired neurological status was rated as mild (CNS, 8.5–10), moderate (CNS, 2.5–8), or severe (CNS, 0–2).

All patients underwent: Complete blood count; Random blood sugar; 12 lead ECG; 2D Echo; CT/MRI Brain scans.

Statistical analysis:-

The collective data as well as the proportion and percentages of variables projected by appropriate charts, tables and graphs. Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student t test has been used to find the significance of study parameters on continuous scale between two groups. More than 2 groups were analysed using ANOVA and analysis was done using SPSS statistical software ver 10.0.

Results:-

During the study period from November 2015 to September 2017, those who met the inclusion and exclusion criteria were included in the study.

A total of 100 subjects were studied. The majority of subjects were male (63%). The cases of stroke were common in the age 5th-7th decade, making 51% of it. Hypertension was present in majority of the cases i.e, 69%, and the next common risk factor was diabetes mellitus in 51% and smoking 33%. In our study it was found that Right Hemiparesis was the most common neurological deficit at admission (29%) and Left sided weakness was the second most common neurological deficit (25%). 4% of the patients were in a state of altered sensorium. Our study also

showed that Left MCA territory was the most common vascular territory involved (34%) with Right MCA being the second most common arterial territory involved (31%). In our study, the effect of RDW on stroke severity was moderate.

The RDW was 14.9 ± 1.76 , 13.72 ± 1.85 , 16.8 ± 3.24 in mild, moderate and severe categories of GCS respectively, at admission. And this difference was statistically significant ($p=0.002$).

The RDW was 13.50 ± 1.63 , 14.75 ± 1.84 , 15.45 ± 2.68 , 18.10 ± 2.86 in mild, moderate, moderate to severe and severe categories of NIHSS respectively, at admission. And this difference was statistically significant ($p=0.0001$).

The RDW was 14.44 ± 1.59 , 17.80 ± 1.85 , 15.24 ± 2.36 in mild, moderate and severe categories of CNS respectively, at admission. And this difference was statistically significant ($p=0.005$).

Table 1:-Relation between stroke severity, neurological scales, and red cell distribution width in stroke patients.

Scale	Mild Stroke	No. of patients	Moderate Stroke	No. of patients	Severe Stroke	No. of patients	P value
GCS	14.9 ± 1.76	53	13.72 ± 1.85	24	16.80 ± 3.24	23	0.002
NIHSS	13.50 ± 1.63	2	14.75 ± 1.84	70	18.10 ± 2.86	12	0.0001
CNS	14.44 ± 1.59	44	17.80 ± 1.85	2	15.79 ± 2.39	54	0.005

The RDW was 14.71 ± 1.71 , 14.66 ± 2.00 , 15.02 ± 2.18 , 17.01 ± 3.08 in patients who improved, were at status quo, who had morbidity at discharge or who died during the course in hospital, respectively. And this difference was statistically significant ($p=0.002$).

Table 2:-Outcome Vs RDW

Outcome	N	RDW	
		Mean	SD
Improved	32	14.71	1.7112
Status quo	22	14.66	2.0000
Morbidity	26	15.02	2.1850
Mortality	20	17.01	3.0895

In the present study, RDW and the outcome of the patients were found to be statistically significant and RDW correlated well with the mortality of the patients.

Clinically, the severity of stroke is evaluated by several bedside scoring systems or imaging studies. Kara et al¹ studied the RDW in 128 patients with acute ischaemic stroke (AIS; symptoms <24 hours) and compared their scoring systems to the levels of RDW. They have found that significantly higher levels of RDW could predict increased risk of total stroke occurrence with the bedside scoring systems.

Therefore, it is likely that RDW could predict the severity and functional outcomes in patients with stroke.

This study confirmed that RDW played an important role in the progression of an ischaemic stroke.

In the current study, patients did not have atrial fibrillation, 71% of patients had normal ECG with 76% of patients also having a normal echo. 10% had LVH with strain. 16% of patients had Concentric LVH in echo and 8% of patients had Diastolic dysfunction on 2D Echo. However, the cardiac findings neither correlated with the RDW nor with the severity of stroke.

Identification of additional prognostic markers of clinical outcomes among individuals with or at risk of stroke, especially if they can be readily, routinely and cheaply obtained, would be welcome.

Table 3:-Mean values of few of the haematological and laboratory parameters among the study population

Particulars	Study Population [n=100] (Mean±SD)
Haemoglobin	13.33±1.65
Total Leucocyte Count	8153.91±3115.78
Platelet Count	211866.67±168102.21
INR	1.05±0.50
PCV	37.30±7.98
Random blood sugar	151.42±31.96
ESR	25.13±13.152

Discussion:-

The median RDW values were significantly greater in patients who had more severe rather than milder strokes rated with all three scoring systems (GCS, CNS, and NIHSS). The median RDW values were significantly greater for patients who have had moderate rather than mild stroke rated by CNS and for patients who have had severe rather than mild stroke rated by GCS and NIHSS.

Inflammation is important in the development of ischemic stroke, atherosclerosis, and ischemia. As a marker of inflammation, RDW is correlated with other inflammatory markers such as CRP². Inflammation may affect bone marrow function and iron metabolism. The inflammatory cytokines may cause elevated RDW levels by inhibiting red cell maturation and enabling the release of new and large reticulocytes to the circulation³. Therefore, high RDW is an integrated risk factor for conditions of general suboptimal health associated with lower systemic corrective maintenance, recovery, and defense capacity. High oxidative stress may prolong the survival of red blood cells, increase the premature release of large red blood cells into the peripheral circulation, and cause elevation in RDW¹. Furthermore, inflammation may contribute to morphologic changes in red blood cells by changing membrane glycoproteins and ion channels. Chronic inflammation, oxidative stress, and neurohumoral activation may contribute to the development of atherosclerosis, and elevated RDW may be useful as a simple parameter to follow the development of atherosclerosis.

A short time from onset of complaints to presentation to the hospital is important for attempts to obtain effective reperfusion in patients who have had ischemic stroke. A major problem in these patients is the delay in diagnosis with clinical examination and imaging methods such as CT and magnetic resonance imaging. Therefore, a rapid blood test would be useful for the diagnosis of ischemic stroke. The optimal blood test would support the clinical findings and imaging results and provide information about cerebral damage⁴.

In addition, the test should be simple, rapid, inexpensive, and performed at the bedside. A specific blood marker that could be determined in the early stage of stroke in small hospitals would be useful to screen patients who may require further evaluation for diagnosis and treatment under emergency situations because of the risk of permanent neurological injury.

As such potentially RDW may have great clinical utility as a prognosticator⁵. However, clarifying the precise pathophysiologic mechanism underlying the clinical observations noted in our study is challenging. Several hypothetical explanations have been suggested to explain what now appears to be a consistent impact of higher RDW on adverse outcomes in patients with various types of vascular disease, and other general medical conditions. So for instance, RDW is frequently higher in situations of impaired red cell generation like iron, vitamin B12 deficiency, or folate deficiency, among others, suggesting that higher RDW may be an integrated risk factor for overall sub-optimal health status indicating diminished capacity for systemic repair, recovery and defence⁶.

Another prevailing theory is that elevated RDW may be indicative of rapid red blood cell demise in the context of an underlying inflammatory state. This may be an attractive hypothesis since atherosclerosis, the main culprit behind the majority of stroke and myocardial infarction occurrences, is in part an inflammatory condition⁷⁻⁸.

Conclusion:-

In conclusion, the present study showed that RDW, a routinely used, simple and inexpensive test, potentially is an important parameter for predicting the severity of stroke and may predict prognosis. We used GCS, CNS, and NIHSS to determine stroke severity and observed that increased stroke severity and increased in hospital mortality

was associated with higher RDW. Therefore, RDW is a good predictor for stroke severity. More systematic studies with good power and precise scientific methodology are required to evaluate the association between ischemic stroke and hematologic parameters, assess the pathophysiology, and confirm the validity of the present results.

Limitations of the present study include the relatively small number of patients. In addition, RDW was measured only once, and RDW may change during the course of the patient in the hospital. Therefore, we could not evaluate fluctuations in RDW and variations in RDW with time.

In summary, the present study showed that RDW, a widely used and inexpensive test, potentially is an important parameter for the diagnosis of stroke and may predict prognosis. We used GCS, CNS, and NIHSS to determine stroke severity and observed that increased stroke severity was associated with higher RDW. Therefore, RDW is a strong predictor for stroke severity. More studies are required to evaluate the association between ischemic stroke and hematologic parameters, assess the pathophysiology, and confirm the validity of the present results.

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Disclosure

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