Analysis of Haematological Parameters in Cerebrovascular Accidents: a Retrospective Study in Tertiary Care Centre

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aim: To analyse hematological parameters in Cerebrovascular disease
Study design :A retrospective study
Place of Study: The study was carried out in Saveetha Medical College and Hospital, Tamil Nadu, India.
Methodology: This is a retrospective study conducted in Saveetha medical college and hospital during the period of December 2020 and May 2021. The study includes 260 cases, of which 130 CVA patients and 130 control group was taken. Haematological parameters were obtained using Sysmex Automated Analyzer XN-1000.
Statistical analysis was done by SPSS software version 23, with descriptive and independent t test. The level of significance was taken as p value<0.05
Results: CVA are due to two main causes, ischaemic (63.84%) and haemorrhagic infarct (36.15%) The age ranges from 47-69 among stroke subjects. The mean age of control(38.80±12.40years) and CVA group(58.177±11.78years). Both ischaemic and haemorrhagic infarcts are more common among male. On haematological parameters study, analysis showed

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platelet was increased in CVA than control group. RBC, PCV, MCV, MCHC, TC, neutrophil, lymphocyte, eosinophil, basophil are significant. Haemoglobin, MCH, RDW and monocyte revealed no significance.

Conclusion: In this study, haematological parameters of ischemic CVA patients were greatly altered. The presence of persistently altered status of haematological parameters cerebral ischemic event indicate that these parameters can be considered a simple inflammatory indicator during the development of ischemic damage.

1. INTRODUCTION

Cerebrovascular disease is defined by abrupt onset of a neurological deficit that is attributable to a focal vascular cause. It is due to injury to the brain as a consequence of altered blood flow [1-3]. It is etiologically grouped into ischemic and haemorrhagic types with consequent tissue infarction. It is the third leading cause of death in the United States, and the most prevalent cause of morbidity and mortality from neurologic disease. The annual incidence of CVD in Western countries is estimated to be 500 to 800 per 100,000 people [4]. Although there are no precise data is available for India, some reports suggest that the incidence is between 13 and 33 per 100,000 people each year. The usual risk factors for vascular events have poor predictive value in individuals with evident vascular disease, emphasising the need for new biomarkers to improve risk stratification. Since haematological parameters are routinely assessed in clinical practice, which is readily available, the main aim of this study was to identify clinical haematological markers and their role in CVA [5-9].

2. PATIENTS AND METHODS

A retrospective study was carried out in line with research regulations, including the approval of the Ethical Committee. Total of 260 patients with CVA changes and normal healthy individuals are taken for this study. Demographic data and haematological parameters of 130 patients with CVA changes and 130 patients of control group were obtained during the period of December 2020 and May 2021.CVA due to ischaemic and haemorrhagic causes were also studied and the diagnosis was obtained by clinical history and radiological findings. Demographic data was obtained from the patients medical records and estimation of haematological parameters was done by Sysmex Automated Haematology Analyser XN-1000 from the department of Haematology, obtained during the time of admission.

2.1 Statistical Analysis

The SPSS, version 19 software tool was used for the data processing. All the values were expressed as mean±standard deviation unless otherwise indicated. The differences in the mean values between the groups were analyzed by using the Student's t-test. A p-value of <0.05 was considered statistically significant.

3. RESULTS

A total of 260 blood samples were collected and divided into two groups, control and stroke group. To better understand the haematological parameters in CVA subjects, they were compared with the normal healthy individuals from the same population. The CVA group comprised of 130 subjects and control group consisted of 130 healthy subjects. The age range of stroke subjects was 47-69 years. Controls and CVA patients were further categorized by gender.

Cerebrovascular events are due to two main causes, ischaemic and haemorrhagic CVA, in our study they account about 63.84% and 36.15% respectively. In ischaemic stroke group 48.2% were females and 51.8% were males. Similarly, in control group 52% were females and 48% were males. Prevalence of cerebrovascular risk factors such as cigarette smoking, hypertension, diabetes were assessed in ischemic stroke patients. The mean age of control and ischemic stroke group was 38.80±12.40 years and 58.177±11.78 years respectively, indicating ischaemic stroke are more common in older age group. The mean values of haematological parameters were presented in Table 3.

Table 1. Demographic data - Age and Gender distribution in CVA patients and control group

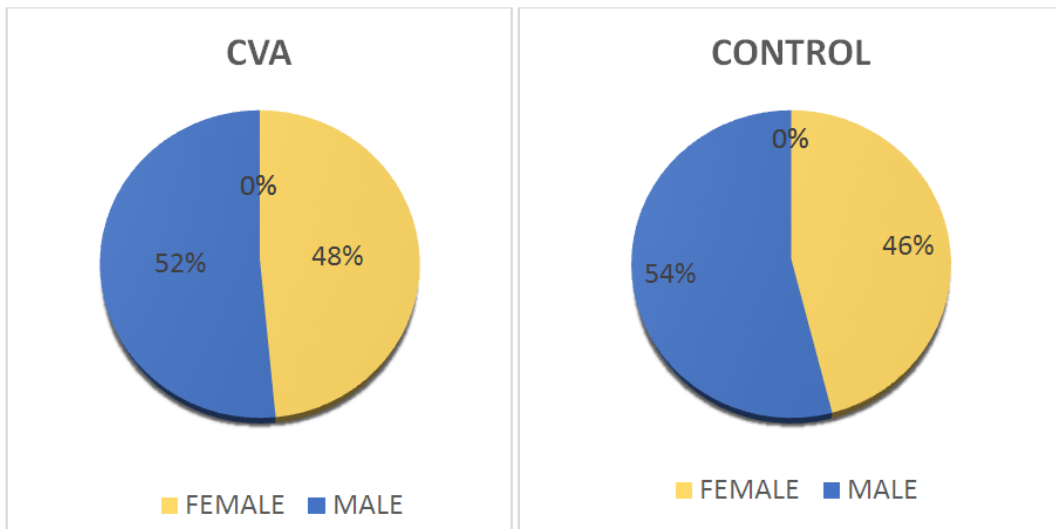| Parameters	CVA (Mean ± SD)	CONTROL (Mean ± SD)
Total no. of cases	130	130
Sex	Male - 84	Male - 63
	Female -46	Female - 67
Age in years	58.177±11.781	38.8 ± 12.4
	Minimum 19	Minimum16
	Maximum 82	Maximum 68

Fig. 1. Age and Gender distribution in CVA patients and control group
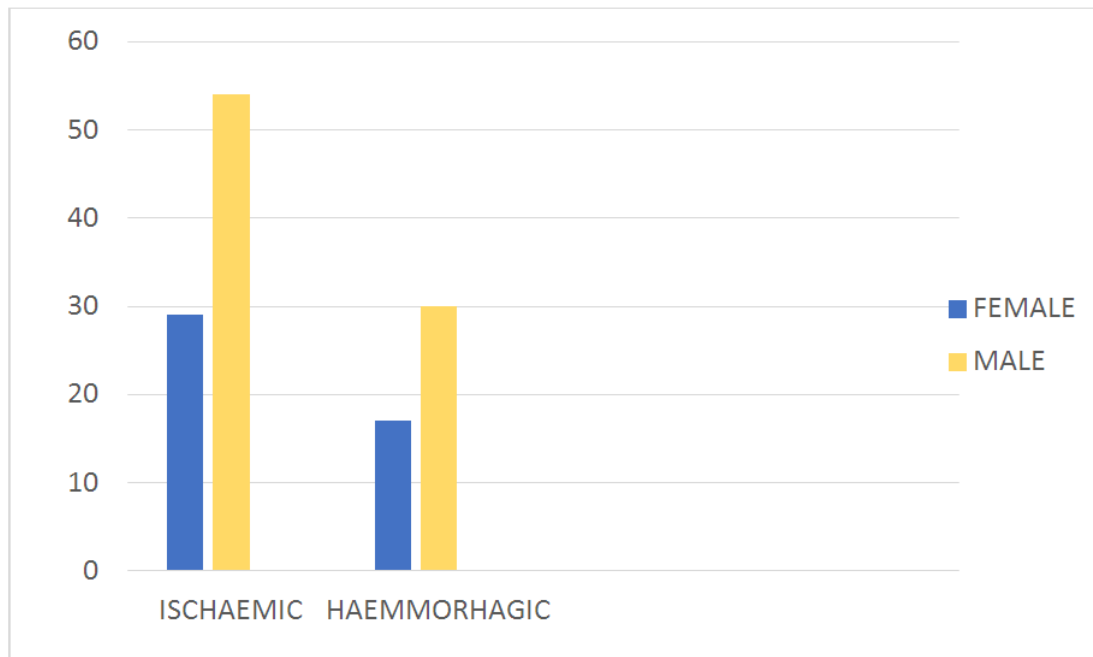

Fig. 2. Data showing number of CVA patients with ischaemic and haemmorhagic infarcts
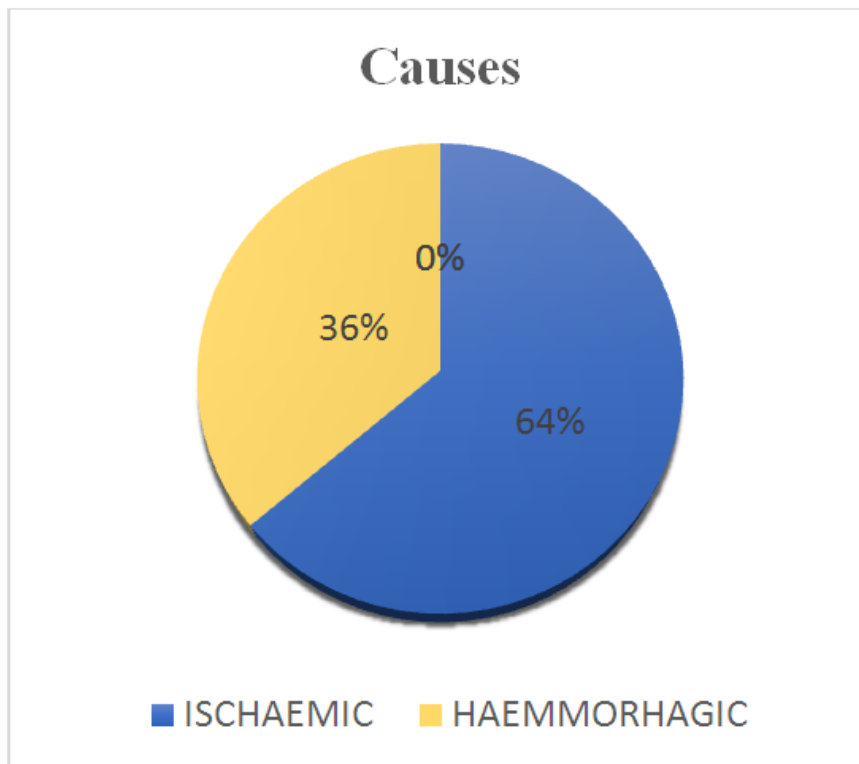
Fig. 3. Percentage of Causes of ischaemic and haemmorhagic

Table 2. Risk factors of cerebrovascular events

S.No	Factors	Yes	No
1	Diabetes mellitus	52.3%	47.7%
2	Hypertension	64%	36%
3	Smoking	42%	58%
4	Use of Alcohol	8%	92%
5	Family history	15%	75%

Table 3. Comparison of haematological parameters in CVA and case control

S. No	Haematological parameters	Control	CVA	p value
1	Hb	12.495±1.632	11.98±2.579	0.061
2	RBC	4.181±0.637	4.398±0.800	0.016
3	PCV	45.81±3.422	37.977±7.235	<0.001
4	MCV	87.038±6.938	85.169±12.836	0.026
5	MCH	27.862±2.337	27.430±4.303	0.316
6	MCHC	33.685±2.131	31.342±2.821	<0.001
7	RDW	14.37±1.372	14.574±3.939	0.58
8	Platelet	2.203±0.742	2.696±1.371	<0.001
9	TC	7641.385±1220.634	10810.946±3321.782	<0.001
10	Neutrophil	69.112±7.232	73.970±13.224	<0.001
11	Lymphocyte	32.4±5.860	18.938±10.122	<0.001
12	Eosinophils	0.276±0.208	2.846±3.576	<0.001
13	Monocytes	4.91±1.531	4.819±2.179	0.697
14	Basophils	0.133±0.074	0.248±0.195	<0.001

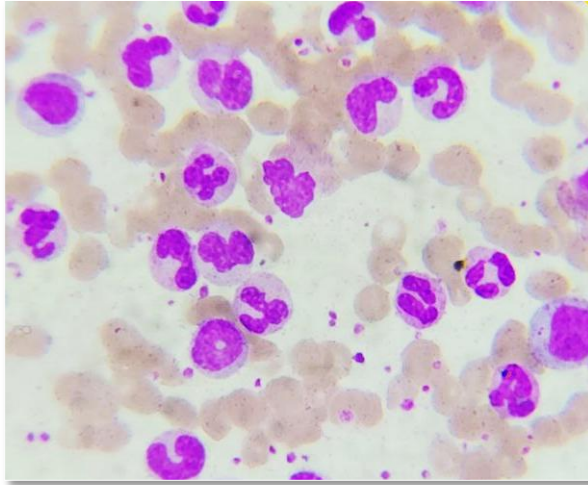*Significant P≤0.05, **Highly Significant P≤0.01*
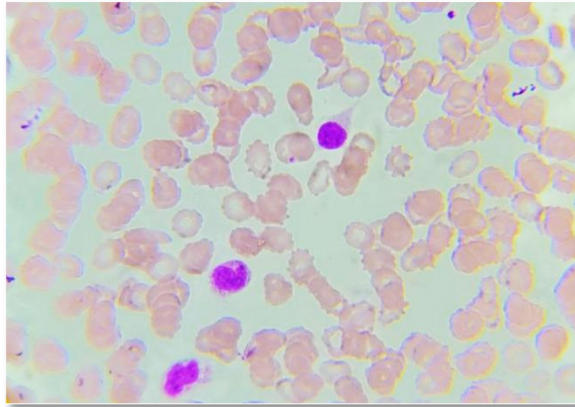
Fig. 4. Toxic granules in neutrophils

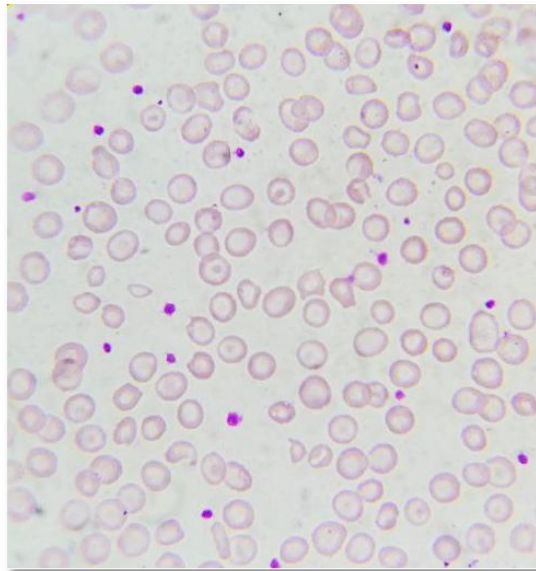**Fig. 5. Reactive lymphocytes in peripheral smear**

Fig. 6. Thrombocytosis observed in a CVA case

Significant difference between the mean values of RBC haematocrit (HCT), PCV mean corpuscular haemoglobin concentration (MCHC), platelet, total leucocyte, neutrophil, lymphocyte, eosinophils and basophils was observed.

On correlation of mean haemoglobin in CVA patients 11.98±2.579, value among control group was 12.495±1.632. There is a decrease in hemoglobin values in CVA patients than the control group.

On correlation of mean RBC in CVA patients 4.398±0.800, value among control group was 4.181±0.637. There is a increase in RBC values in CVA patients than the control group.

On correlation of mean PCV in CVA patients 37.977±7.235 , value among control group was 45.81±3.422. There is a decrease in PCV values in CVA patients than the control group.

On correlation of mean MCV in CVA patients 85.169±12.836, value among control group was 87.038±6.938. There is a decrease in MCV values in CVA patients than the control group.

On correlation of mean MCH in CVA patients 27.430±4.303, value among control group was 27.862±2.337. There is a decrease in MCH values in CVA patients than the control group.

On correlation of mean MCHC in CVA patients 31.342±2.821, value among control group was 33.685±2.131. There is a decrease in MCHC values in CVA patients than the control group.

On correlation of mean RDW in CVA patients 14.574±3.939, value among control group was 14.37±1.372. There is a increase in RDW values in CVA patients than the control group.

On correlation of mean platelet count in CVA patients 2.696±1.371, value among control group was 2.203±0.742. There is a increase in platelet count values in CVA patients than the control group.

On correlation of mean total leucocyte in CVA patients 10810.946±3321.782, value among control group was 7641.385±1220.634 There is a increase in total luecocyte values in CVA patients than the control group.

On correlation of mean neutrophil in CVA patients 73.970±13.224, value among control group was 69.112±7.232. There is a increase in neutrophil values in CVA patients than the control group.

On correlation of mean lymphocyte in CVA patients 18.938±10.122, value among control group was 32.4±5.860. There is decrease in lymphocyte values in CVA patients than the control group.

On correlation of mean eosinophils in CVA patients 2.846±3.576, value among control group was 0.276±0.208. There is a increase in eosinophil values in CVA patients than the control group.

On correlation of mean monocytes in CVA patients 4.819±2.179, value among control group was 4.91±1.531. There is a decrease in monocyte values in CVA patients than the control group.

On correlation of mean basophil in CVA patients 0.248±0.195, value among control group was 0.133±0.074. There is a increase in basophil values in CVA patients than the control group.

4. DISCUSSION

Cerebrovascular accident, a hidden growing epidemic, is an important cause of mortality and disability worldwide. It remains the third leading cause of death and the leading cause of severe disability in India. Stroke is a sudden loss of neurologic function resulting from focal disturbance of cerebral blood flow due to ischemia or hemorrhage. Hypertension, carotid artery stenosis, atrial fibrillation, smoking, diabetes mellitus, dyslipidemia, sickle cell disease, poor diet, physical inactivity and obesity are well-established risk factors for ischemic stroke. Less well other risk factors like alcohol drug abuse, the metabolic syndrome, prolonged oral contraceptive use, breathing, migraine and hypercoagulability. When an ischemic stroke occurs, the blood supply to the brain is interrupted, and brain cells are deprived of the glucose and oxygen they need to function. Meta-analytical studies were done regarding the association of hematological parameters in cerebrovascular accident patients [10,11].

In this study, we evaluated the routinely measured hematological parameters for the prediction of recurrent vascular events in patients with cerebrovascular disease.

There was association between cerebrovascular accidents and haematological parameters, as

there was a substantial difference in haematological parameters in ischemic participants compared to control subjects [12-15].

This study showed a proportional increase of platelet count, mean platelet volume (MPV) and platelet lymphocyte ratio (PLR) corresponding to higher grades of colorectal cancers.

We observed that hemoglobin levels were reduced in CVA patients. During ischemic stroke erythrocyte undergoes oxidative and proteolytic changes resulting in a changed cellular and inflammatory process.

We also observed that WBC levels were increased in CVA patients. *Sharif et al.* that WBC significantly increased in ischemic stroke patients as compared to control group subjects [4] Immediately after an ischemic stroke, an increased expression of a of cytokines and chemokine precedes WBC infiltration into the ischemic tissue [16].

This study reported increased platelet count in CVA as compared to control group. The result implies that enhanced platelet responsiveness and persistent systemic activation of circulating platelets is a critical mechanism in the pathophysiology of acute cerebrovascular disease Platelets play a critical role in acute and chronic inflammation [17-21]. Platelet activation plays a pivotal role in the pathogenesis of thrombotic vascular disorders, such as ischemic stroke and TIA.

We also observed that MPV PCT PDW levels were reduced in CVA patients. Ashtari et al. preliminary evaluation related to the ranges of hematological variable showed that WBC and PLT count increased in the same manner as in our study. MCV values also increased in ischemic stroke group [5].

Many studies [22,23] have showed that the higher mortality is associated with elevated platelet count in several diseases. Systemic inflammation leads to release of several pro-inflammatory mediators, such as interleukin (IL)-1, IL-3 and IL-6 ,which stimulate megakaryocyte proliferation. Hematological parameters reflects the balance between systemic inflammatory response and immune system function, which was has been confirmed by several studies. O'malley T et al platelet count was reduced in stroke patients compared with control subjects .The systolic and diastolic blood pressures on

presentation were significantly higher in stroke patients than in at-risk control and normal control subjects [20]. Hon - Kan Yip et al stated that Platelet activation was significantly increased in acute ischemic stroke and subsequently decreased thereafter [21] Füsun Mayda-Domaç et al quoted that MPV, may be an early and important predictor for the prognosis of ischemic stroke, whereas for hemorrhagic stroke platelet count has a role for outcome [24]. In Kömürcü HF etal study it stated that leukocyte and neutrophil counts were higher after acute ischemic stroke. There was a significant increase in neutrophil-to-lymphocyte ratios. There was an increase in platelet-to-lymphocyte ratios [25].

5. CONCLUSIONS

The presences of persistently altered status of hematological parameters in patients with a recent cerebral ischemic event indicate that this aspect of hematological parameters can be considered a simple inflammatory marker occurring during the development of ischemic damage. However further studies are required by correlating with severity of cerebrovascular disease and larger sample size are required to confirm the findings of the present study.

6. LIMITATIONS

There were some limitations in our study. Firstly, this was a retrospective study, therefore, complete information was not available for all the patients. Secondly, though our study was based on the data of the single tertiary care centre in Tamilnadu, a large-scale study involving other Tertiary hospitals are required.

CONSENT

It is not applicable.

ETHICAL APPROVAL

This study was approved by Ethics Committee of Saveetha Medical and Hospital. As this study was a retrospective study, there was no patient's privacy data such as patient name, ID number, telephone and address were involved. Only demographic information and laboratory testing data of patients were collected and analyzed in this study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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