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RELATIONSHIP BETWEEN SOME HAEMATOLOGICAL INDICES (WBC, LYMPHOCYTES, MONOCYTES, NEUTROPHILS, EOSINOPHILS AND BASOPHILS) AND COMPUTED TOMOGRAPHY-DIAGNOSED AETIOLOGIES OF SEIZURE DISORDERS IN KATSINA STATE, NIGERIA.

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ABSTRACT

Introduction: Haematological changes was reported in seizure disorder, but this does not occur in one hundred percent of the patients with seizure disorder which makes it necessary to validate the haematological changes using a superior diagnostic modaliy.

Objective: The objective of this study was to establish whether there was interdependence between those haematological parameters and CT-diagnosed aetiologies.

Methodology: Ethical clearance was obtained from the Federal Teaching Hospital Katsina and then retrospective study of 326 brain CT images with positive findings of seizure etiologies from December 2019 to August 2021 was done.

Results: The result for low, normal and high haematological parameters were 8 (2.46 %), 213 (65.54 %) and 104 (32 %) for WBC; 154 (47.53 %), 150 (46.30 %) and 20 (6.17 %) for lymphocytes; 21 (6.48 %), 216 (66.6 %) and 87 (26.85 %) for monocytes; 67 (20.55 %), 200 (61.35%) and 59 (18.1 %) for neutrophils; 0 (0 %), 310 (95.38%) and 15 (4.62 %) for eosinophils; 0 (0 %), 316 (98.44 %) and 5 (1.56 %) for basophils. Chi square showed that there was interdependence between WBC, lymphocytes, monocytes, neutrophils and computed tomography-diagnosed aetiologies of Seizure disorders but not with eosinophils and basophils.

Conclusion: WBC, lymphocytes, monocytes and neutrophils are useful biomarkers validated using CT imaging. However, not seeing any haematological changes does not exclude the possibility of seizure aetiologies, it is recommended that CT should be used for confirmed diagnosis of some seizure aetiologies in the emergency department.

Introduction

Changes in blood parameters has been documented to be associated with various forms of pathological conditions. Such haematological changes have also been recorded in patients with brain seizure disorder [1]. When brain seizure is recurrent, it is referred to as epilepsy. White blood cell (WBC), neutrophil, and lymphocyte levels were reported to be significantly higher during seizures compared with seizure-free periods in patients with epilepsy. When the WBC, neutrophil, and lymphocyte values during seizure-free periods were compared with healthy subjects, it was found to be significantly lower [2].

Epilepsy is a public health emergency in Africa because it is associated with some serious aetiologies, late diagnosis and inadequate management [3,4]. It is therefore important that the aetiology is detected early so that appropriate management can be implemented. Full blood count (FBC) is one test that is readily available which can be used to detect changes in the blood tissue of patients with seizure disorder. Even though, studies have shown that changes were recorded in the blood tissue, these changes were not recorded in all the blood tissue of the patients with seizure disorder. This implies that changes in blood tissue may not be a reliable predictor of seizure disorder. Therefore, it is necessary that haematological changes are validated using a more reliable tool.

Computed tomography (CT) is the most readily available neuroimaging modality in developing countries and it can demonstrate seizure aetiologies such as tumours, haemorrhages, subdural haematomas, cerebral infarction, vascular anomalies, structural abnormalities [5,6]. This study focused on establishing relationship between haematological changes (in WBC, lymphocytes, monocytes, neutrophils, eosinophils and basophils) and computed tomography-diagnosed aetiologies of seizure disorders in Katsina state.

1. Material and Methods

2.1 Materials

The following materials were used: General Electric (GE) CT scanner ST 1 Rev. ACTs (manufactured 2018), Data captured sheet deployed using Kobo tool box and the Electric health record (EHR) of the Federal Teaching Hospital (FTH) Katsina.

2.2 Method

A retrospective study was carried on 326 patients with CT-diagnosed seizure aetiologies from December 2019 to August 2021. Ethical approval with reference number FTHKTHREC.REG. NHREC/24/06/22C/038 was obtained from the Human Research and Ethics Committee of the Federal Teaching Hospital Katsina. Anonymity of the subjects was maintained. All information obtained were used only for the purpose of this research and nothing more; readers cannot link any information obtained during the research to any subject. Haematological data such as WBC count, lymphocytes, monocytes, neutrophils, eosinophils and basophils of the various patients with CT-diagnosed seizure aetiologies such as traumatic brain injury, sub dural hematoma, epidural hematoma, stroke, sub arachnoid hemorrhage, contusion, arteriovenous malformation (AVM), brain tumour and others were collected from the EHR.

Table 1: **Reference values for haematological parameters**

S/no	**Blood parameter**	**Low**	**Normal**	**High**
1	WBC	< 4 E-03/uL	(4 - 6) E-03/uL	> 6 E-03/uL
2	Lymphocytes	< 25 %	(25 - 50) %	> 50 %
3	Monocytes	< 2 %	(2 - 10) %	> 10 %
4	Neutrophils	< 50 %	(50 - 80) %	> 80%
5	Eosinophils	< (0 - 5) %	(0 - 5) %	> (0 - 5) %
6	Basophils	< (0 - 2) %	(0 - 2) %	> (0 - 2) %

2.3 Statistical analysis

Statistical analysis was performed using Microsoft Excel 2016. Tables and graphs were used to show the frequency distribution of the various haematological parameters. The haematological parameter were categorized as Low, Normal and High by using reference values shown in Table 1. Chi-square test was used to analyze for relationship between the haematological parameters and the various CT-diagnosed aetiologies of seizure.

1. Results and Discussion

Table 2 shows the frequency distribution of seizure patients according to their WBC. A total of 325 WBC results of seizure patients were analyzed. Thirty-two percent (32%) of the subjects recorded elevated levels of WBC while 2.46% had low WBC values. The WBC ratio of 0.49:1:0.04 for High: Normal: Low was recorded. The ratio means that for every 100 seizure patients with normal WBC, there are 49 patients with elevated WBC values and 4 with low WBC values. Variable frequencies of patients with elevated WBC were recorded across all seizure etiologies except for AVM and acute epidural hematoma where no patient recorded elevated WBC values. Inferential statistical testing using Chi square test revealed that there was relationship between the frequency of occurrence of WBC levels in seizure patients and seizure etiologies. Similar studies in agreement with this finding was by Vega et al. [7], Sohn et al. [8] and Shah et al. [9] which reported 37%, 56.03% and 33.33% of seizure patients with elevated levels of WBC respectively. The findings of Sarkis et al. [10] was already in agreement with this study. Seizure disorder has been reported to bring about an inflammation like response which increases the serum levels of catecholamine which increases WBC count [11]. Post convulsive leukocytosis and seizure free period leukopenia have been reported in seizure patients [7-9] which might be a possible explanation for the WBC findings of this study. An alternative explanation might be due to inflammation since Sohn et al. [8] reported no difference in WBC count was observed in the presence or absence of infection in seizure patients.

Table 3 shows the frequency distribution of seizure patients according to their lymphocytes values. A total of 324 results were compiled which revealed that 6.17 %, 46.30 % and 47.53% of the subjects recorded high, normal and low lymphocyte count. Both the high and low lymphocytes count are biomarkers in seizure patients but there is greater percentage of patients with low lymphocytes spread across the various seizure aetiologies. The lymphocytosis occurs when the body is fighting infection while low lymphocytes count implies that the individual is at a higher risk of infection. Güneş and Büyükgö [12]; Özdemir et al. [13] and Mete et al. [14] all reported significant low lymphocyte counts in seizure patients which was also reported in about 50% of patients in the present study. Chi square also revealed a significant statistical correlation relationship between the frequency of occurrence of lymphocytes and seizure etiologies. Therefore, lymphocyte count is a biomarker of seizure aetiology.

Table 4 shows the frequency distribution of seizure patients according to their monocytes. The results revealed that 26.85%, 66.67 % and 6.48% were recorded for high, normal and low monocytes count, respectively. The high monocytes count implies that the body is actively defending the body against infection while monocytopenia implies that the immune system is suppressed meaning the patient is more susceptible to infection. Chi square revealed that there is significantly statistical relationship between the frequency of occurrence of neutrophils and seizure etiologies. Therefore, this monocyte count can be considered as a biomarker in patients' with seizure aetiologies.

Table 5 shows the frequency distribution of seizure patients according to their neutrophils levels. Out of a total of 326 subjects, 18.10 % and 20.55 % presented with high and low neutrophil values respectively. These were also distributed at varying amounts across the various seizure aetiologies. A low neutrophils count implies that the subject is prone to higher risk of infection while a high neutrophils count means that the body is fighting infection. Morkavuk et al. [15] and Güneş and Büyükgöl [12] reported higher neutrophils count in seizure patients which is in agreement with this study.

Table 6 shows the frequency distribution of seizure patients according to their Eosinophils. The frequencies of the seizure patients were 15 (4.62%) and 0 (0.00%) for high and low eosinophil values respectively. Several explanations may account for the eosinophilia such as allergy and parasitic infection. Eosinophilia

due to Valproate intake in children with seizure disorder may also be a possible explanation [16]. Chi square revealed that there is no relationship between the frequency of occurrence of eosinophil and seizure aetiologies. Therefore, this implies that eosinophil count is not a biomarker in patients with seizure aetiologies.

Table 7 shows the frequency distribution of seizure patients according to their basophil count. Only 5 (1.56 %) of the total seizure disorder patients who had undergone blood test presented with basophilia while no patient presented with low basophil count. Basophilia may be due to the following possible causes: infection, or it may be a sign of serious medical conditions like leukemia or autoimmune disease granulocytic (myelZ0ocytic) leukemia, myeloid metaplasia, myeloproliferative disorders, Hodgkin disease, chronic hemolytic anemia, splenectomy and ionizing radiation [17]. Statistical test using Chi square revealed that there was relationship between the frequency of occurrence of basophil and seizure aetiologies. Therefore, this implies that the basophil count is not a biomarker for seizure aetiologies.

Table 2: **Frequency distribution of WBC according to seizure aetiologies**

WBC	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	0	0	0	0	0	0	0	1	1	2	4	0	8
Normal (4 - 6) E-03/uL	2	2	1	2	5	4	7	20	19	32	25	52	42	213
High	0	2	3	4	1	0	5	11	13	10	17	16	22	104
Total	0	4	4	6	6	4	12	31	33	43	44	72	64	325

Table 3: **Frequency distribution of lymphocytes according to seizure aetiologies**

Lymphocytes	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	3	2	3	1	1	7	17	25	21	20	40	14	154
Normal (25 - 50) %	2	0	2	3	4	3	5	13	8	19	22	30	39	150
High	0	1	0	0	1	0	0	1	0	2	2	2	11	20
Total	2	4	4	6	6	4	12	31	33	42	44	72	64	324

Table 4: **Frequency distribution of monocyte count according to seizure aetiologies**

Monocytes	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	0	0	0	1	0	0	2	1	6	3	2	6	21
Normal (2 - 10) %	2	4	4	2	3	2	7	17	23	29	33	52	38	216
High	0	0	0	4	2	2	5	12	9	6	8	18	21	87
Total	2	4	4	6	6	4	12	31	33	41	44	72	65	324

Table 5: **Frequency distribution of neutrophil count according to seizure aetiologies**

Neutrophils	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	1	0	3	1	2	0	6	6	5	5	11	27	67
Normal (50 - 80) %	3	2	1	2	5	2	7	16	20	28	31	48	35	200
High	0	1	3	1	0	0	5	9	7	9	8	13	3	59
Total	3	4	4	6	6	4	12	31	33	42	44	72	65	326

Table 6: **Frequency distribution of eosinophil count according to seizure aetiologies**

Eosinophils	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Normal (0 - 5) %	3	4	4	5	6	4	12	27	31	40	43	70	61	310
High	0	0	0	1	0	0	0	4	2	2	1	2	3	15
Total	3	4	4	6	6	4	12	31	33	42	44	72	64	325

Table 7: **Frequency distribution of basophil count according to seizure aetiologies**

Basophils	AVM	Acute Epidural Hematoma	SAH	Chronic Subdural Hematoma	Brain Tumour	Acute Subdural Hematoma	Contusion	Traumatic Brain Injury	Skull Fracture	Cerebral Atrophy	Hemorrhagic Stroke	Ischemic Stroke	Others	Total
Low	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Normal (0 - 2) %	2	4	4	5	6	4	12	31	33	40	43	72	60	316
High	0	0	0	1	0	0	0	0	0	1	1	0	2	5
Total	2	4	4	6	6	4	12	31	33	41	44	72	62	321

4. Conclusion

Haematological changes in WBC, lymphocytes, monocytes and neutrophils have significant statistical relationship with the various CT-diagnosed seizure aetiologies but not with eosinophils and basophils. Therefore, the aforementioned haematological parameters which showed significant statistical relationship have been validated as important biomarkers in patients with brain seizure, however, some of those biomarkers might also be present due to blood diseases as co-morbidities.

Conflict of interest

The authors have no conflict of interest.

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