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CT Scan Patterns of Stroke at the University of Gondar Hospital, North West Ethiopia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: In places like rural Ethiopia where there is no CT or MRI, the diagnosis of stroke remains by clinical signs and symptoms. Knowing the actual proportion of the types of stroke seen locally is helpful in the prevention, diagnosis and thereby treatment of this illness.
Objectives: The aim of the study was to determine CT scan pattern of stroke at the University of Gondar hospital so that the local proportion of stroke subtypes will be known.
Methods: This is a descriptive cross-sectional study which included all patients with a CT scan diagnosis of recent onset stroke in the time period of August 2011 to July 2012 at the University of Gondar Hospital; Northwestern Ethiopia.
Results of the Study: A total of 111 patients, 59(53.2%) male and 52 (46.8%) female were included in the study. The age range was from 16 to 88 years. The mean age for stroke is 49 years. Ischemic stroke was diagnosed in 64(57.7%) patients while the remaining 47 (42.3%) had hemorrhagic type. The hemorrhagic stroke had 30 (63.8%) parenchymal, 8(17%) ventricular, 4 (8.5%) subarachnoid and the remaining 5(10.6%) multifocal sites.
Conclusion: The rate of hemorrhagic type of stroke in this study is 42% which is about three times

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higher than stated by most authors for the largely Caucasian populations in Europe and America and is similar to studies done in Addis Ababa and in different parts of Africa on black patients. Although the percentage of stroke types differs, other studied features of stroke agree with universally accepted patterns.

Keywords: CT scan; hemorrhagic stroke; ischemic stroke; stroke.

ABBREVIATIONS

UOG (University of Gondar); CT (computerized tomography); MRI (magnetic resonance imaging); TIA (transient ischemic attack); RIND (reversible ischemic neurologic deficit); WHO (world health organization); N.W (North West); SPSS (statistical package for social sciences); RT (right); LT(left).

1. INTRODUCTION

Stroke is defined as rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than a vascular origin [1]. Similar neurologic conditions not in the category of stroke include transient ischemic attack (TIA) and reversible ischemic neurologic deficit (RIND) [2]. Stroke is the third most common cause of death in the world and is responsible for a large proportion of physical disability. It is a major health burden in the developed world [2]. Although comprehensive stroke surveillance data for Africa are lacking, the available data showed that age-standardized mortality, case fatality, and prevalence of disabling stroke in Africa are similar to or higher than those found in most high-income regions [2,3,4]. The local prevalence of the disease is not studied but it is among the top causes of inpatient hospitalization in Ethiopian hospitals and second cause of mortality as per WHO report [5,6].

Stroke is a disease of older age group; less than one fourth of stroke occurring under the age of 35 years [7]. It is divided into two as ischemic and hemorrhagic. Ischemic stroke is by far the most common type. It is further divided into thrombotic and embolic [8,9]. Risk factors for stroke are divided into controllable and uncontrollable. Hypertension, high cholesterol, smoking, atrial fibrillation, diabetes, and excessive alcohol intake are controllable while age, male gender, black race and family history of stroke are uncontrollable risk factors. Control of modifiable factors is recommended in the prevention of the disease and has shown a marked improvement in the incidence of the disease in the West [7,10,11].

The treatment of stroke depends on the type of stroke which needs an accurate diagnosis as the treatment of ischemic stroke includes anticoagulant drugs like aspirin which are contraindicated in hemorrhagic stroke due to further exacerbation of bleeding [12].

The definitive diagnosis of stroke is by cross sectional imaging of the brain with CT scan or MRI [4,5,8]. In places like rural Ethiopia where there is no CT or MRI the diagnosis of stroke remains by clinical signs and symptoms. Knowing the actual proportion of the types of stroke seen locally is helpful in the prevention, diagnosis and thereby treatment of the illness especially where imaging modalities are unavailable. Ischemic stroke is considered the major type of stroke accounting for 85% of all stroke seen in Caucasian patients [8,11]. Contrary to this, research done in Africa on black patients showed the frequency of hemorrhagic stroke is high in some cases up to equal proportion to ischemic stroke [3, 6,12,13]. Similar finding is reported in Addis Ababa, Ethiopia showing a high proportion of hemorrhagic stroke [14]. This indicates the high need for a local and national study on true proportions of the subtypes of stroke.

This study is intended to show the local proportion of subtypes of stroke and other CT scan patterns of the disease. It is obvious that knowing the epidemiology of a disease is helpful in its prevention and management. The two subtypes of stroke have different causes and management. Then knowing the local proportion of stroke types will be helpful in the clinical judgment of stroke subtypes in which clinical presentation is not in favour of one type and there is no neuroimaging; in such cases the tendency is to consider the commonest subtype.

It also guides the prevention of the disease giving emphasis based on the proportion of the subtypes.

2. METHODS

2.1 Study Design

Descriptive cross sectional study was done on all 111 patients with CT scan diagnosis of recent onset stroke at the University of Gondar (UOG) Hospital, Northwest Ethiopia from August 2011 to July 2012.

2.2 Study Area

University of Gondar Hospital is located in Northwestern part of Ethiopia, 727 km from Addis Ababa. It is a referral and teaching hospital giving services to both urban and rural population of over five million in the surrounding area. The university is one of the centers of excellence in Ethiopia especially in the health sector under the Collage of Medical and Health Sciences. The radiology department is one of the many departments in the collage and gives radiologic medical services with use of a 4 slice CT scan machine on which the study is done. Two radiologists and three CT technician radiographers work on the CT machine. On average twenty five patients get CT scan examinations per week and CT scan of the head is the most common indication.

2.3 Source Population

All patients who undergo CT scan of the head at the radiology department of University of Gondar Hospital.

2.4 Sampling and Sample Size

All consecutive 111 patients with CT scan diagnosis of recent onset stroke at the University of Gondar Hospital from August 2011 to July 2012 are included in the study.

2.5 Data Collection, Compilation and Analyses

All patients included in the study are either from the outpatient department or inpatient wards of the hospital referred for CT scan of the head based on clinical suspicion of stroke and its differential diagnoses irrespective of the severity of presentation.

A protocol was developed from multiple sources of stroke CT imaging which is partly stated down and that was used in the study. A pre contrast CT scan of the head was done to all these patients based on clinical requests and the CT scan findings of all this patients were evaluated by a radiologist and stroke diagnosed. CT scan findings with focal hyper density in the range of 40 to 80 Hounsfield Unit was considered as hemorrhagic stroke and signs like hyper dense artery sign, insular ribbon sign, lentiform nucleus sign, focal parenchyma hypo density and loss of gray white matter differentiation is taken as diagnostic clue for ischemia. Those patients with CT findings of parenchymal changes not pathognomonic for stroke were further evaluated with a repeat pre and post contrast study to further explore the diagnosis. Emergency patient hospital arrival in Ethiopia including stroke is not developed and usual stroke patients CT scanning time was after the hyper acute phase of stroke extending up to the sub acute phase. That makes missing ischemic stroke in the first three hours is less likely and patients who had CT scan in the sub acute period having no difficulty to differentiate the subtypes of stroke are included in the study. CT imaging criteria like following vascular territory and petechial pattern together with the duration from onset to imaging were used to differentiate primary hemorrhage from hemorrhagic transformation of infarction. Patients with CT scan pattern of chronic stroke were excluded in the sample as differentiation of the subtype of stroke is difficult with CT.

All information on the images of patients in the study which have relevance to the study were recorded by a radiologist prospectively. Demographic data was acquired from patients' charts. Questionnaire was prepared and used to record the data which includes demographic data and the CT scan findings. The collected data was entered and analyzed on SPSS version 16.0. Descriptive statistics such as mean, range and proportions along with tabular presentation of the findings was done to characterize the pattern of stroke.

2.6 Ethical Clearance

Ethical clearance was obtained from the UOG hospital administration to use the patients' radiologic and epidemiological data for this specific research without mentioning patients' identity at any of the course of the study. Verbal consent is obtained from patients or their relatives when the patients are not clinically fit to do so.

3. RESULTS

There were 111 patients 59 (53.2%) male and 52 (46.8%) female patients which were included in the study with CT scan evidence of recent onset stroke. The mean age of patients was 49 years. The age range was from 16 to 88 years. The 35-50 years and 51-88 years age intervals had the highest rates of stroke with 45% and 38.7% of patients respectively in this category. Patients below age 35 years constituted 16.2% of stroke (Table 1).

Ischemic stroke was diagnosed in 64 (57.7%) patients while the remaining 47 (42.3%) had hemorrhagic type of stroke on the CT scan (Table 1).

The hemorrhagic stroke CT scan patterns were further evaluated for site of hemorrhage and it was found that 30 (63.8%) parenchymal, 8(17%) ventricular, 4 (8.5%) subarachnoid and the remaining 5(10.6%) being multifocal. Almost half, 23 (48.9%), of the hemorrhagic stroke occurred in the cerebral hemispheres more in the left 14(29.8%) than the right 9(19.1%). Six patients (12.8%) had hemorrhage at the region of the thalamus and basal ganglia. One patient (2.1%) was found to have cerebellar hemispheric hemorrhage. The rest of hemorrhagic stroke occurred in the ventricles 13 (27.7%) and subarachnoid 6 (12.8%) region among which 5(10.6%) were multifocal (Table 1).

Overall rate of ventricular and subarachnoid hemorrhagic stroke is 13(11.7%) and 6(5.4%) respectively. There was only 1 patient (0.9%) with ventricular hemorrhage and subarachnoid extension. In addition 1 patient (0.9%) had parenchymal hemorrhage with ventricular and subarachnoid extension. Three patients (2.7%) had parenchymal hemorrhage with ventricular extension. Isolated ventricular and subarachnoid hemorrhage was seen in 8(7.2%) and 4(3.6%) patients (Table 1).

Almost all 60 (95%) of the ischemic infarcts had acute ischemia CT scan pattern while the rest 4 (5%) had sub acute ischemic infarction. There were 2(1.8%) patients with CT scan pattern of hemorrhage on a background ischemic parenchyma (Table 1).

The site of stroke in the brain parenchyma was analyzed and showed that in the majority patients 82(83.7%) of parenchymal strokes occurred in the cerebral hemispheres, 12 (12.3 %) in the thalamus and basal ganglia region, 3 (3.1%) in the cerebellum and 1 (1%) patient at the midbrain. Cerebral predominance of brain parenchymal stroke was found similar for both ischemic stroke 55(87.6%) and hemorrhagic stroke 27(79.4%). The parietal lobe was the most affected lobe among 33(29%) of stroke patients. It is followed by temporal lobe and frontal lobe which occurred in 14(12.6%) and 12(10.8%) of stroke patients respectively (Tables 1 and 2).

Left cerebral hemisphere was involved more than the right with ischemic infarction 27 (42.2%) and 24 (37.5%) respectively. Six (9.4%) patients had ischemic focus at the thalamus and basal ganglia region. The remaining ischemia occurred at the cerebellum 2 (3.2%), brain stem 1 (1.6%) and at multifocal sites 4 (6.1%) (Table 2).

4. DISCUSSION

The result of this study showed men were slightly more affected than female patients, supporting a higher male stroke predisposition as reported in most published research [2,3]. Similar to results in other studies most stroke has occurred in older patients only a fourth of patients being under 35 [4]. Ischemic stroke was found to be higher than hemorrhagic stroke, but like the studies done in Addis Ababa Ethiopia and studies done in other parts of Africa on black patients the proportion of hemorrhagic stroke was high, being three times higher than the studies on Caucasian patients in which hemorrhagic stroke accounts for only 15 % [3,11,13,14].

The cerebral hemispheres were found to be the most common sites of parenchymal hemorrhage followed by the region of the thalamus and basal ganglia. Cerebellar hemorrhage was a rare site similar to findings in other studies. The frequency of ventricular and subarachnoid hemorrhage was higher as compared to literature documented figures [9,11].

Like the hemorrhagic stroke, ischemic stroke has mainly occurred in the cerebral hemispheres. The left cerebral hemisphere was the more affected hemisphere and the parietal lobe followed by temporal and frontal lobes were the predominant lobes affected in both types of stroke similar to universally accepted concept of middle cerebral artery territory being the most common site of stroke [8,9]. Hemorrhagic transformation of an infarct was found to be rare. Parenchymal hemorrhage with ventricular or subarachnoid extension was also rare. All these findings are similar to universally accepted concepts of stroke in most reviewed literature [8,9,11].

Table 1. Demographic data and type and site of stroke collected from patients' charts and CT scan images

Variables	Category	Frequency (n)	Percentage
Age	16-35	18	16.2
	36-50	50	45.0
	51-88	43	38.7
Sex	Male	59	53.2
	Female	52	46.8
Type of stroke	Hemorrhagic	47	42.3
	Ischemic	64	57.7
Type of hemorrhage	Parenchymal	30	63.8
	Ventricular	8	17.0
	Subarachnoid	4	8.5
	Parenchymal & ventricular	3	6.4
	Ventricular with SA extension	1	2.1
	Parenchymal with ventricular and SA extension	1	2.1
Site of Hemorrhage	RT Cerebral	9	19.1
	LT Cerebral	14	29.8
	Sub cortical gray matter	6	12.8
	Cerebellar	1	2.1
	Ventricular	8	17.0
	Subarachnoid space	4	8.5
	Multifocal	5	10.6
Hemorrhage with infarction	Hemorrhage with in ischemic infarct	2	0.8
	No hemorrhage together with ischemia	109	98.2
Type of ischemic infarct	Acute	57	93.4
	Sub acute	4	6.6
Site of ischemia	Right cerebral	24	37.5
	Left cerebral	27	42.2
	Sub cortical gray matter and thalamic region	6	9.4
	Brain stem	1	1.6
	Cerebellum	2	3.1
	Multifocal	4	6.3
Lobar site of stroke	Parietal cerebral	33	29.7
	Frontal cerebral	12	10.8
	Occipital cerebral	3	2.7
	Temporal cerebral	14	12.6
	Multiple Lobe	20	18.0
	Sub cortical gray matter	12	10.8
	Cerebellar	3	2.7
	Brain stem	1	.9
	Total parenchymal stroke	98	88.3
	Non parenchymal	13	11.7

Table 2. Cross tabulations on: patient sex versus type of stroke; parenchymal site of stroke versus type of stroke; and parenchymal versus site of ischemia labeled as 1, 2, 3 respectively

Variable	Category	Type of stroke on CT (%)					Total (%)
		Hemorrhagic	Ischemic				
1. Sex	Male	23	36				59
	Female	24	28				52
2. Parenchymal site of stroke	Parietal cerebral	10	23				33
	Frontal cerebral	3	9				12
	Occipital cerebral	2	1				3
	Temporal cerebral	6	8				14
	Multiple site	6	14				20
	Sub cortical gray matter	6	6				12
	Cerebellar	1	2				3
	Brain stem	0	1				1
		Site of ischemia					
		Right cerebral	Left cerebral	Sub cortical gray matter	Brain steam	Cerebellar	Multifocal
3. Parenchymal site of stroke	Parietal	15	8	0	0	0	0
	Frontal	3	6	0	0	0	0
	Occipital	1	0	0	0	0	0
	Temporal	3	4	0	0	0	1
	Multiple lobes	2	9	0	0	0	3
	Sub cortical gray matter	0	0	6	0	0	0
	Cerebellar	0	0	0	0	2	0
	Crain stem	0	0	0	1	0	0
		24	27	6	1	2	4

The weakness of this research is lack of detailed demographic data for patients, lack of clinical presentation and associated risk factors in the patients which are all important in the prevention, diagnosis and treatment of stroke. Initially it was intended to include these variables in the study but no proper documentation of these data could be obtained from the patients' charts.

5. CONCLUSION

This research showed that even if ischemic stroke is the major type of stroke, the proportion of hemorrhagic stroke is high in Gondar and only slightly lower than the ischemic type similar to studies done on black patients in different parts of Africa. This finding of a higher proportion of hemorrhagic stroke should be taken in to consideration in the management protocol of stroke patients with no prior neuroimaging in this locality. Other CT scan patterns of stroke in this study were similar to universally accepted concepts on stroke; the cerebral hemispheres being the major site of stroke followed by the region of the thalamus and basal ganglia. Hemorrhagic transformation of an infarct is rare. Further study of stroke is recommended with assessment of clinical patterns of presentation and associated risk factors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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