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Research Article

IMAGING EVALUATION OF ACUTE CEREBRAL STROKE

[1]Khalid A. A. Elhussein, [1]Mohamed E. M. Gar-Elnabi, [2]Mohanad Abdallah, [3]Bassam N. Youseif, [3]Waleed A.A Ahmed, [4]Omer A.S. Albushari, [5,*]Musab Mergani Abdallah and [3]Mohaned H.A. Idress

[1]College of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan
[2]Radiology Department, Asia Hospital, Omdurman, Sudan
[3]Radiology Department, Military Hospital, Omdurman, Sudan
[4]Radiology Department, Al-Mo'alem Medical City, Khartoum, Sudan
[5]Faculty of Radiological and Nuclear Medicine Science, National Ribat University, Khartoum, Sudan

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Abstract

This study carried out to evaluate the role of MRI examination in the diagnosis of acute cerebral stroke in the Sudanese population, in the period from April 2019 to June 2020 with 200 patients (male 94, female 106) were the patients referred to the radiology department in modern medical centers in Khartoum with a known and suspected case of cerebral stroke, undergone MRI examination, to evaluate each type of stroke and their locations, and to provide additional information's to support cerebral stroke diagnosis. Correlate between the age group and stroke type for the acute stroke; the dominate was 41-50 years with 17 patients, then 61-70 years with 16 patients the total patients with acute stroke 65 patients. For the subacute stroke, the more frequent group was 51-60 years, with 14 patients with 48 patients for all. For chronic stroke was the lowest frequent among all types with 19 patients; for hyperacute stroke, the most frequent group was 18-30 years with 31 patients, then 31-40 years with 22 patients, the total number of patients with hyperacute stroke was 68 patients. Correlate between the patient's final diagnoses with stroke type, for ischemic, the dominant number of patients was 39 with hyperacute, acute 28 and sub-acute 24 patients, and just 3 patients with chronic stroke with a total number 94 patients. For hemorrhage, the acute stroke was more frequent with 25 patients;hyperacute was 23 patients, with a total number of 64 patients. For both ischemic and hemorrhage stroke, the patients were almost equal for chronic, acute, and sub-acute with 13, 12, and 11 patients respectively, while the hyperacute was 6 patients, were the total number of patients 42. This study concluded that the MRI allows accurate diagnosis of stroke types. MRI is better for detecting acute ischemia and can detect acute and chronic hemorrhage; therefore, it should be the preferred test for accurate diagnosis of patients with suspected acute stroke.

Keywords: MRI, Acute Cerebral Stroke, brain, stroke types.

INTRODUCTION

An Imaging plays a central role in the evaluation of patients with acute stroke. In the setting of acute stroke, Computed Tomography (CT), or Magnetic Resonances Imaging (MRI) imaging is used to differentiate ischemic from hemorrhagic stroke. CT may demonstrate evidence of early ischemic changes, and diffusion-weighted Imaging (DWI) MRI may show very early evidence of infarction. CT angiography and MR angiography add identification of large-vessel arterial occlusions. In addition to these traditional applications of imaging, perfusion studies provide insight into tissue viability in the setting of acute stroke. This information may be helpful for selecting patients likely to benefit from reperfusion therapy and excluding those who are likely to be harmed. MRI is superior to CT in showing acute ischemic changes in the brain parenchyma (Fiebach *et al.,* 2000). Diffusion-weighted imaging shows the ischemic lesion in 80–90% of cases in acute stroke but, in the remaining patients, there will not be DWI-positivity, i.e., the DWI-negative stroke (Makin *et al.,* 2015). Consequently, reliable diagnosis of stroke cannot be made based on only MRI confirmation if ischemia, clinical diagnosis is still needed. MRI is also superior in identifying the underlying cause of stroke based on examination of the brain parenchyma: the pattern of DWI lesions helps to differentiate between large vessel disease and cardiac emboli where, in the latter, several vascular territories are often affected.

Corresponding Author:** ***Musab Mergani Abdallah
Faculty of Radiological and Nuclear Medicine Science, National Ribat University, Khartoum, Sudan.

Microvascular changes in small vessel disease can be diagnosed and quantified, not only forming the basis of a diagnosis of small vessel disease but also in differencing between probable cerebral amyloid angiopathy and deep perforator angiopathy. MRI allows for identifying location and number of micro bleeds, lacunar infarcts, unspecific vascular gliosis, and enhanced perivascular space. The ideal imaging modality for assessment of patients with acute stroke should accurately detect both cerebral ischemia and intracranial haemorrhage, and discriminate cerebrovascular causes from other causes. CT is the most common imaging modality used to assess patients with a suspected stroke. This method is widely available, fast, easy, and less expensive than MRI. However, although CT is sensitive to acute intracranial haemorrhage, it is not sensitive to acute ischaemic stroke. Studies suggest that CT is insufficiently sensitive for the diagnosis of acute ischemia, is subject to substantial inter-rater variability in interpretation, and might not be better than MRI for the detection of acute intracranial hemorrhage (Fiebach *et al.,* 2004; Grotta *et al.,* 1999; Kidwell *et al.,* 2004; Wardlaw *et al.,* 2005). Ischemic stroke is one of the major causes of death and disability. For the last few decades, many efforts have been made to improve the outcome of acute ischemic stroke treatment. However, thrombolytic therapy is still the only proven treatment for patients following an acute ischemic stroke within 3 or 4.5 hours of symptom onset. Multimodal magnetic resonance imaging (MRI) is useful for diagnosing ischemic stroke and determining treatment strategies in the acute phase (Baird and Warach, 1998; Campbell *et al.,* 2012). Early diagnosis of ischemic stroke and its differentiation from

stroke-mimics are important (Lovblad *et al.,* 1998; Chalela *et al.,* 2004). Various imaging findings from MRI sequences help determine stroke mechanisms, which affect prognosis and thereby play an important role in treatment decisions. Lesion mismatch profiles on MRI help us assess potential risks and benefits of thrombolysis by providing information on salvageable tissue or ischemic lesion age (Schlaug *et al.,* 1999; Thomalla *et al.,* 2011; Neumann-Haefelin *et al.,* 1999). Ruling out Intracranial Hemorrhage The initial step in the evaluation of patients with symptoms of acute stroke is to differentiate between hemorrhagic and ischemic stroke. Since intracranial hemorrhage is an absolute contraindication for reperfusion therapies (Adams *et al.,* 1996; Jauch *et al.,* 2010; Jauch *et al.,* 2013). Most stroke protocols begin with non-contrast head CT (NCHCT). NCHCT has been widely accepted as the standard method for the detection of acute intracranial hemorrhage since early reports describing its accuracy with early-generation CT scanners (Jacobs *et al.,* 1976; Paxton and Ambrose, 1974). However, its sensitivity and specificity in detecting intracranial hemorrhage have not been formally studied by comparing to actual pathological/histological specimens. Although CT is the standard method, gradient T2*-weighted MRI sequences (including gradient-recalled echo [GRE] and susceptibility-weighted imaging [SWI] sequences) are equally-if not more-sensitive for the detection of acute intracranial hemorrhage (Fiebach *et al.,* 2004; Bang *et al.,* 2011).

MATERIALS AND METHODS

This study carried out to evaluate the role of MRI examination in the diagnosis of acute cerebral stroke in the Sudanese population, in the period from April 2019 to June 2020 with 200 patients (male 94, female 106) were the patients referred to the radiology department in modern medical centers in Khartoum with a known and suspected case of cerebral stroke, undergone MRI examination, to evaluate each type of stroke and their locations, and to provide additional information's to support cerebral stroke diagnosis.

MRI scanner used: The MRI scanner used in this study was PHILIPS with 1.5 Tesla, and Toshiba 1.5tesla with 8-channel phased array neurovascular coil.

Data collection

The Data were collected from findings that appear in different MRI cuts, and the data represented in tables and graphs. The data included the general patients' data Age and gender and accompanied by the related to Symptoms and clinical information such as clinical signs (A numb or weak feeling in the face, arm or leg, trouble speaking or understanding, unexplained dizziness, blurred or poor vision in one or both eyes, loss of balance or an unexplained fall, headache (usually severe or of abrupt onset) or unexplained change in the pattern of headaches, confusion), the risk factors and patients history (hypertension, D.M, heart disease).

MRI Technique

All patients were scanned in the supine position in the MRI scanner, and their heads were placed within an 8-channel phased array neurovascular coil for the Whole-brain and the following MRI technique was used: The whole brain was scanned with a slice thickness of 5 mm and a 1.5 mm interslice gap, producing 19 axial images. The imaging protocol consisted of T1-weighted spin-echo (TR/ TE; 530/15 ms), T2-weighted fast-spin echo (TR/TE;5000/120). Fluid-Attenuated Inversion Recovery (FLAIR) (TR/TE; 9000/105 ms, Inversion Time 2500 ms) and Diffusion-Weighted Imaging (DWI) (TR/TE;5000/135 ms).

RESULTS

Table 1. Shows a correlation between the age group with causes

Age Group	Causes						Total
	NO Causes	Hypertension	Diabetes Mellitus	DM & Hypertension	Heart Disease	Hypertension & Heart Disease	
18-30	35	9	0	0	0	0	44
31-40	21	11	2	0	0	0	34
41-50	3	12	13	4	1	0	33
51-60	4	12	12	2	1	0	31
61-70	2	11	9	8	0	3	33
71-80	0	12	2	5	2	1	22
81-90	0	0	0	0	0	3	3
Total	65	67	38	19	4	7	200

Table 2. Shows the correlation between the age group with the type of stroke

Age Group	Type of stroke				Total
	Acute	Sub-acute	Chronic	Hyper-acute	
18-30	10	3	0	31	44
31-40	7	5	0	22	34
41-50	17	9	3	4	33
51-60	7	14	5	5	31
61-70	16	9	5	3	33
71-80	8	7	4	3	22
81-90	0	1	2	0	3
Total	65	48	19	68	200

Table 3. Shows the correlation between the age group with the final diagnosis

Age Group	Final Diagnosis			Total
	Ischemic	Hemorrhage	Ischemic & Hemorrhage	
18-30	28	15	1	44
31-40	22	9	3	34
41-50	16	10	7	33
51-60	15	10	6	31
61-70	10	10	13	33
71-80	3	10	9	22
81-90	0	0	3	3
Total	94	64	42	200

Table 4. Shows the correlation between the causes with the final diagnosis

Causes	Final Diagnosis			Total
	Ischemic	Hemorrhage	Ischemic & Hemorrhage	
No Causes	42	20	3	65
Hypertension	25	30	12	67
Diabetes Mellitus	23	4	11	38
Diabetes Mellitus & Hypertension	3	9	7	19
Heart Disease	1	1	2	4
Hypertension & Heart Disease	0	0	7	7
Total	94	64	42	200

Table 5. Show the correlation between the types of stroke with final diagnosis

Type of stroke	Final Diagnosis			Total
	Ischemic	Hemorrhage	Ischemic & Hemorrhage	
Acute	28	25	12	65
Sub-acute	24	13	11	48
Chronic	3	3	13	19
Hyper-acute	39	23	6	68
Total	94	64	42	200

DISCUSSION

This study was done to evaluating the role of MRI for the acute cerebral stroke in the Sudanese, in the period from April 2019 to June 2020 with 200 patients (male 94, female 106) was the patients referred to a known and suspected case of cerebral stroke, undergone MRI examination was the data presented as tables and figures. Table 1. showsa correlation between the age group with causes, were the age group divided into seven groups from 18 up to 90 years while the causes were 5, the for first group 18-30 years the most causes were hypertension with 9 patients and the other patients without causes 35 patients. The group 31-40 years 11 with hypertension and 2 Diabetes Mellites while 21 with no causes. 41-50 years 12 patients with HT and 13 DM and 4 patients DM & HT while one patient with Heart disease. 51-60 years show 12 patients for both HT and DM while 4 patients DM & HT and one HD. 61-70 years found 11 patients HT and 9 patients DM and 8 patients DM & HT while 3 patients HT & HD. And 71-80 years found 12 patients HT two patients for both DM and HD while 5 patients for DM & HT and one patients HT &HD. The last group 81-90 years show just one cause the HT & HD with 3 patients. Correlate between the age group and stroke type were the type of stroke was four types acute, sub-acute, chronic, and hyper chronic. For the acute stroke, the dominate was 41-50 years with 17 patients, then 61-70 years with 16 patients, the total patients with acute stroke 65 patients. For the subacutestroke, the more frequent group was 51-60 years, with 14 patients with 48 patients for all. For chronic stroke was the lowest frequent among all types with 19 patients. For hyperacute stroke, the most frequent group was 18-30 years with 31 patients, then 31-40 years with 22 patients, were the total number of patients with hyperacute stroke was 68 patients, as shown in table 2.Table 3.showa correlation between age group with the final diagnosis, were the category of diagnosis ischemic, hemorrhage and ischemic, and hemorrhage. For the patients who diagnose with ischemic the dominant age group was 18-30 years with 28 patients, then 31-40 years with 22 patients with a total number of patients 94 patients.

The hemorrhage stroke was 15 patients for patients from 18-30 years with total number of 64 patients. For both ischemic and hemorrhagestroke, the most age group frequent was 61-70 years with 13 patients with a total number of 42 patients. Table 4. correlate between the causes and final diagnose, were the causes was hype tension, diabetes mellites, DM & HT, HD and HT & HD. The patients without causes and with different diagnose 42 ischemic stroke, 20 hemorrhage and 3 patients with both ischemic and hemorrhage stroke. For hypertension patients their diagnose was 25 with ischemic stroke, 30 with hemorrhage stroke, and 12 patients with ischemic and hemorrhage stroke. The Diabetes mellites 23 patients with ischemic, 4 hemorrhage, and 11 patients with ischemic and hemorrhage stroke. For DM & HT were3 patients with stroke, 9 hemorrhages and 7 with ischemic and hemorrhage stroke. For HD cause was just one patient for both ischemic and hemorrhage and 2 patients ischemic and hemorrhage. Last HT & HD cause with 7 patients for ischemic and hemorrhage. Correlate between the patient's final diagnoses with stroke type, were the diagnose was ischemic, hemorrhage, and ischemic & hemorrhage. For ischemic, the dominant number of patients was 39 with hyperacute, acute 28, and sub-acute 24 patients and just 3 patients with chronic stroke with a total number of 94 patients. For hemorrhage, the acute stroke was more frequent with 25 patients, hyperacute was 23 patients, with a total number of 64 patients. For both ischemic and hemorrhage stroke, the patients were almost equal for chronic, acute, and sub-acute with 13, 12, and 11 patients, respectively, while the hyperacute was 6 patients, were the total number of patients 42 as shown in table 5.

Conclusion

Correlate between the age group and stroke type were the type of stroke was four types acute, sub-acute, chronic, and hyper chronic. For the acute stroke, the dominate was 41-50 years with 17 patients, then 61-70 years with 16 patients, the total patients with acute stroke 65 patients. For the subacute stroke, the more frequent group was 51-60 years, with 14 patients with 48 patients for all. For chronic stroke was the lowest frequent among all types with 19 patients; for hyper-acute stroke, the most frequent group was 18-30 years with 31 patients, then 31-40 years with 22 patients, were the total number of patients with hyperacute stroke was 68 patients. Correlate between the patient's final diagnoses with stroke type, were the diagnose was ischemic, hemorrhage, and ischemic & hemorrhage. For ischemic, the dominant number of patients was 39 with hyperacute, acute 28, and sub-acute 24 patients and just 3 patients with chronic stroke with atotal number of 94 patients. For hemorrhage, the acute stroke was more frequent with 25 patients; hyperacute was 23 patients, with a total number of 64 patients. For both ischemic and hemorrhage stroke, the patients were almost equal for chronic, acute, and sub-acute with 13, 12, and 11 patients respectively, while the hyperacute was 6 patients, were the total number of patients 42.

Abbreviations

CT: Computed Tomography;
MRI: Magnetic Resonances Imaging;
DWI: Diffusion-Weighted Imaging;
GRE: Gradient-Recalled Echo;
SWI: Susceptibility-Weighted Imaging;
TR: Repetition Time;
TE: Echo Time;
FLAIR: Fluid-Attenuated Inversion Recovery;
DM: Diabetes Mellitus;
HD: Heart Disease; ms: milliseconds

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Competing interests: Authors declare that there is no competing interest.

Authors' contribution: KE, MG: conceived the study, supervised data collection, and led the writing of the manuscript; MA, BY and WA: participated in interpretation of results and re-writing of earlier version of the manuscript; OA, MA and MI carried out the analysis and revised the manuscript. All authors read and approved the final manuscript.

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