ORIGINAL ARTICLE

Evaluation of Computed Tomography and Magnetic Resonance Imaging Findings in Adult Patients Presenting with Non-Traumatic Headache

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ABSTRACT

Background: Headache is pain that arises from the head or upper neck and is a common symptom of neurological disorder with an increase in the global health burden. Headache can be classified as primary or secondary or based on duration as acute or chronic.

Objective: To describe the pattern and common findings on computerized tomography (CT) and magnetic resonance imaging (MRI) among adult patients presenting with non-traumatic headache in our environment.

Methodology: This was a descriptive prospective study carried out in a diagnostic centre in Port Harcourt metropolis over an eighteen-month period. Two hundred and thirty-four (234) patients with a presenting symptom of headache who were sent for neuro-imaging, either computerized tomography (CT) or magnetic resonance imaging (MRI) of the brain were recruited for the study. The neuro-imaging results were classified as significant findings or normal.

Results: The study age group ranged from 20-83 years with a mean age of 51.7 ± 14years. Females were 131 (56%) and males 103 (44%). Neuroimaging studies detected 91(39%) patients with significant findings; Paranasal sinusitis 44(19%) was the most common significant positive finding. Intracranial space occupying lesions 13(5.5%) was more in females, 9(3.8%) than males, 4(1.7%); p=0.03.

Conclusion: Paranasal sinusitis is the most common CT/MRI finding in the studied group of adult patients in our environment with a higher female prevalence in intracranial space occupying lesions.

Key words: *Neuroimaging, Patterns, Secondary headache, Paranasal sinusitis*

INTRODUCTION

Headache is a common disorder of the nervous system with a wide spectrum of causes. The global health burden of headache is such that headache disorders are the third leading cause of disability worldwide.[1] Headache is a common presenting complaint and can be classified as primary or secondary, and based on duration as acute or chronic headache.[2,3] The major primary causes of headache classified by the international headache society (IHS) include migraine headache, tension type headache, trigeminal autonomic cephalgias or cluster headaches and other primary headache disorders. Secondary causes are headaches due to organic causes or trauma. Secondary headaches were further classified by the IHS into headache due to trauma or injury to the head and neck, vascular disorders, non-vascular disorders, substance abuse or its withdrawal, infection, homeostasis, disorders of the cranium, psychiatric disorders, painful neuropathies and other facial pains.[2, 4]

Headache may be associated with other symptoms, which constitute the red flag signs and symptoms indicative of secondary causes of headache.[5] Detailed neurologic examinations by the clinician can elicit these red flags which include recent onset of headache, morning headaches, headaches after 50 years, focal neurologic signs and symptoms, persistent and severe headache, headache of new onset with an underlying medical condition, associated features of raised intracranial pressure (vomiting, papilloedema).[5] Others are headaches secondary to recent trauma, headaches associated with seizures, change in cognitive and conscious level, headaches induced by exercise, coughing, sneezing, visual disturbances and headache associated with systemic illnesses.[5]

Previous studies have stated that neuro-imaging plays little or no role in evaluation of primary headache, as most studies are normal.[4,6] However, on the basis of ruling out secondary causes of headache, which may not always present with red flags to the clinician, neuro-imaging becomes important so as to rule out life threatening causes of headache such as space occupying lesions and aneurysms.[6]

The need to investigate headache may be multifactorial, from therapeutic to reassurance of anxious patients. Intracranial imaging is not usually needed in cases of headache with typical features of primary headache as classified by the IHS.[2] Computerised tomography (CT) and magnetic resonance imaging (MRI) scans play important roles in diagnosing secondary causes of headache. They help in identifying significant and treatable causes of headache which impact on the quality of life.

CT scan gives good cross-sectional anatomy of the neuro-cranium, and high-quality three-dimensional images with rapid acquisition. CT is faster in image acquisition than MRI, making it more suitable in acute headache and patients who are difficult to restrain from motion.[5,7] It is more suitable for claustrophobic patients and obese patients due to larger gantry size. In assessing bony detail, presence of calcification and metallic foreign bodies, CT scan gives better detailed information. Compared with MRI scan, CT scan is more affordable and accessible in our environment. However, CT scan poses a risk of ionizing radiation and allergic reactions to patients due to its use of ionizing radiation and iodinated contrast media.[5,7] MRI imaging gives multiplanar images with the use of strong magnetic field and absence of ionizing radiation. MRI gives better anatomical detail and soft tissue contrast between the tissues in the body. It also provides better image analyses of the posterior fossa.[8,9] The risks of allergic reactions to contrast agents are reduced with MRI scans. However, MRI is limited in cases of claustrophobia, patients with aneurysmal clips, pace makers, metallic implants and nerve stimulators.[9]

In evaluating patients with headache, studies have shown that MRI has a higher yield of significant positive findings of patients presenting with headache especially in examining white matter lesions. However there has not been statistical difference in the value of MRI and CT in the incidence of abnormal findings in patients presenting with headache.[7,9] It has been observed that they both play complimentary roles, hence their use in the current study in evaluating patients with non-traumatic headache to assess the patterns and common findings.

METHODOLOGY

Study Design
This was a descriptive prospective study carried out in a diagnostic centre in Port Harcourt metropolis over eighteen-months (January 2017 to June 2018). Ethical approval was given by the Georges Diagnostic Centre before commencement of the study. Two hundred and thirty-four (234) patients with a presenting symptom of headache who were sent for neuro-imaging, either computerized tomography scan or magnetic resonance imaging of the brain that met the inclusion criteria were recruited for the study after obtaining their consent. The neuroimaging results were classified as significant or normal findings.

Patients 18 years and above with complaints of headache referred for neuroimaging investigation (CT or MRI scan) were included while acute head injury patients or patients with previous history of neurosurgery (aneurysm clip, ventriculo-peritoneal shunts etc) were excluded.

Imaging Technique
CT scan were done with General Electric Machine 16 slice multidetector CT; 5mm contiguous slices were taken from the base of the skull to the vertex, which were then reconstructed into 2.5mm slices in both soft tissue and bone window. MRI scans were done with a 0.2 Tesla Magnetom General Electric Scanner. MRI protocol included pre and post contrast sagittal; axial and coronal T1 weighted images, T2 weighted and Fluid attenuation recovery (FLAIR) sagittal, axial and coronal images. Contrast medium was given after native scans to all patients. Iopamidol was given as contrast agent for CT scans and Magnevist for MRI scans.

Imaging Analysis
Results were analysed into two broad categories as normal findings and significant findings. The significant findings included paranasal sinusitis, intracranial haemorrhage, infarction, brain tumour, space occupying lesion (SOL), degenerative disease, brain atrophy and infections (meningitis/encephalitis, intracerebral abscess)

Statistical analysis was done using Statistical Package for Social Science (SPSS Version 20; Chicago Inc., USA). Proportion differences were analysed using Chi-Square tests and *p* value of $p<0.05$ was taken as statistically significant.

RESULTS
The age range of patients ranged from 20-83 years with a mean age of 51.7 ± 14years. Females were 131 (56%) and males 103 (44%) (Table 1).

Table 1. Age distribution of patients

Age group (years)	Male No (%)	Female No. (%)	Total No. (%)
20-29	6 (2.6)	9 (3.9)	15 (6.4)
30-39	27(11.5)	39 (16.7)	66 (28.2)
40-49	18 (7.7)	28 (12.0)	46 (19.7)
50-59	23 (9.8)	22 (9.4)	45 (19.2)
60-69	13 (5.6)	20 (8.6)	33 (14.1)
70-79	12 (5.1)	10 (4.3)	22 (9.4)
80-89	4 (1.7)	3 (1.3)	7 (3.0)
Total	**103 (44)**	**131 (56)**	**234 (100)**

Table 2. Neuroimaging modalities according to gender

Imaging Modality	Female No.(%)	Male No. (%)	Total No. (%)
CT Scan	85 (65.9)	64 (62.1)	149 (63.7)
MRI Scan	46 (35.1)	39 (37.9)	85 (36.3)
Total	**131(100)**	**103(100)**	**234 (100)**

Table 3. Distribution of neuroimaging findings according to sex

S/N	Imaging Diagnosis	Male No. (%)	Female No. (%)	Total No. of cases (%)	Chi Square test	P-value
1	Normal	61 (42.7)	82 (57.3)	143(59)		
2	Paranasal sinusitis	19 (43.2)	25 (56.8)	44 (19)		
3	Intracranial haemorrhage	5 (62.5)	3 (37.5)	8 (3.2)		
4	Infarction/Gliosis	8 (66.7)	4 (33.3)	12 (4.8)	12.0	0.131
5	Brain tumour (SOL)	4 (30.7)	9 (69.3)	13 (5.2)		
6	Degenerative disease	1 (33.3)	2 (66.7)	3 (1.2)		
7	Brain atrophy	6 (54.5)	5 (45.5)	11 (4.5)		
8	Metastases	1 (33.3)	2 (66.7)	3 (1.2)		
9	Infection	2 (100.0)	0 (0.0)	2 (0.8)		
10	Granuloma/ calcification	4 (57.1)	3 (42.9)	7 (2.8)		
	TOTAL	**111(45.1)**	**135(54.8)**	**246(100)**		

The study revealed more patients referred for CT scans 149(63.7%) than MRI scan 85(36.3%) (Table 2).

From the 234 patients, 143(61%) had normal findings and 91(39%) patients had significant findings; paranasal sinusitis 44(19%) was the most common significant positive finding. Other common significant findings were brain space occupying lesions 13(5.5%), infarction/gliosis 12(5.1%), brain atrophy 11(4.7%) as shown in Table 3. Chi-square test did not show any significance with gender and most significant findings, however; intracranial space occupying lesions 13(5.5%) was more commonly seen in females 9(3.8%) than males with a positive significant value p=0.03.

Figure 1. (A) Axial CT Image of the paranasal sinus showing Isodense collection in the right maxillary antrum and mucosal thickening in the left (white arrow), also noted are isodense collection bilaterally in the sphenoid (curved arrow) and ethmoidal sinuses (black arrow) all to sinusitis. (B) Axial T2 weighted MR image showing hyperintense collection and mucosal thickening in the bilateral maxillary sinuses (white arrows) due to sinusitis

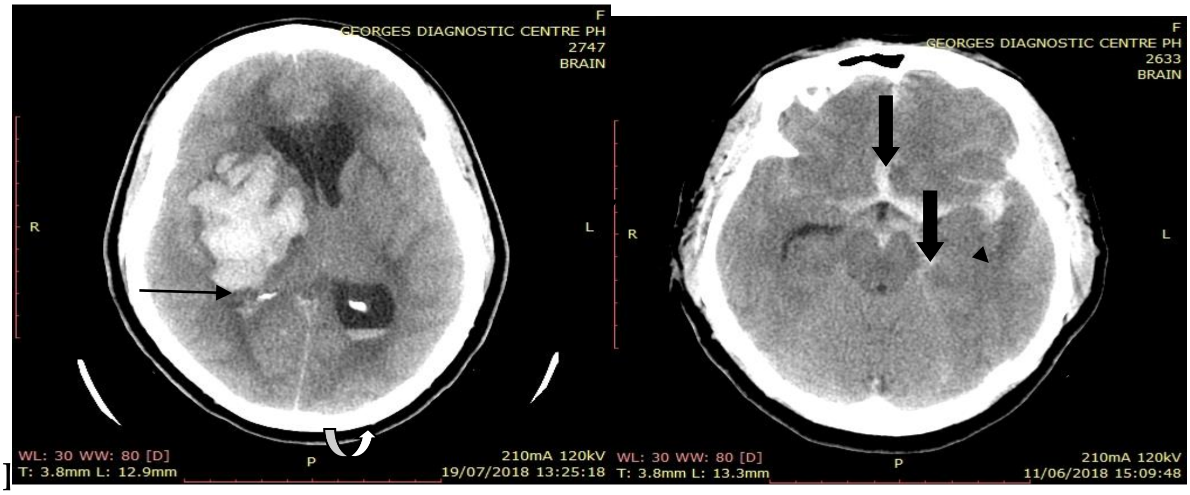
A B

Figure 2. (A) Axial T2 weighted MRI image of the brain showing a well-defined hyperintense left parietal lobe oval shaped mass lesion with mild perilesional oedema and cortical buckling. (B) Axial CT image of the brain showing a well-defined hyperattenuating homogenously enhancing oval shaped right frontal lobe mass lesion (white arrow) with significant perilesional oedema (black arrow). (C) Axial CT image showing a well-circumscribed hyperattenuating homogenously enhancing mass in the left parietal lobe with mild perilesional oedema and effacement of the ipsilateral posterior horn of the lateral ventricle (white arrow)

A B C

Figure 3. (A**)** Axial CT image of the brain showing an acute intracerebral haemorrhage in the right basal ganglia (black arrow) with intraventricular extension (curved arrow) and mass effect. (B) Axial CT image showing subarachnoid haemorrhage within the basal cisterns, sylvian fissure and anterior inter-hemispheric fissure (black arrows)

A **B**



DISCUSSION

Headache affects all ages and races with no geographical areas of predilection. The prevalence of headache disorder globally is said to be 50% with headache of 15 or more days every month affecting 1.7-4% of the adult population.[1] A study by Onwuekwe *et al*. in Enugu Nigeria documented a headache prevalence of 88% among health workers similar to studies done in the United States with a prevalence of 84.4% among health workers.[10, 11]

The study showed a higher percentage of patients were referred for CT scan than MRI scan. This is due to the fact that CT scan is more readily available and cheaper in our environment than MRI.

Primary causes of headache are said to occur more in females than in males. The cause of this is multifactorial. In the current study we had more females, 131 (56%) as compared to males, 103 (44%) which is in agreement with previous researches.[10,12,13] A study by Itanyi *et al.*in Abuja, Nigeria also showed a higher female preponderance of 64%.[14] The reason for this may also be that females have better seeking behaviour than the males. It may also be that there is a strong association between female hormones and primary headache particularly migraine headache.[15, 16]

This prospective study of 234 patients with headache showed that 39% had a secondary cause of headache by following CT or MRI scan. Our study agrees with other studies that CT and MRI both have low yield as a screening tool in patients with headache; however, it also showed that in our environment the occurrence of significant intracranial pathologies in patients with headache is also increasing. Related studies by Imarhiagbe *et al.* in Benin, Nigeria, Ezekala-Adikaibe *et al.* in Enugu, Nigeria and Itanyi *et al.* have abnormal findings in 47.3%, 47% and 49.2% respectively, of patients presenting with headache slightly higher than in the current study.[3,6,14,17,18]The place of history taking and physical examination cannot be over emphasized in excluding primary causes of headache and evaluating the primary causes through thorough physical examination

Our population sample showed that paranasal sinusitis (19%) was more common than any other imaging abnormality associated with headache (Figure 1). Despite the fact that plain radiography is the first imaging modality in investigating paranasal sinus disease because it is readily available and affordable, MRI and CT have higher sensitivity in imaging paranasal sinus diseases. Rai *et al.* in their study also had paranasal sinusitis as the most common abnormality (11.6%) but lower than our study's findings.[3]

Headaches associated with space occupying lesions have no clinical pattern of presentation.[19,20] There were more females in the study with space occupying lesions. Sajjad *et al.* in their study on space occupying lesions revealed that females constituted 65 % of 62 patients diagnosed with brain tumours.[21] This correlates with the current study of 69.3 % of 13 though the number of patients diagnosed with brain tumour in the current study is smaller than their's. The incidence of space occupying lesions as a cause of headache has increased in our environment as previous studies done in Nigeria have recorded an increasing incidence.[14,17,18]

Hypertension is the major cause of ischemic or haemorrhagic cerebral infarction in our environment. The clinical signs of an infarct include weakness of the limb, facial deviation, dysarthria and, in some cases, headache may be the only presenting symptoms. The study revealed that 5.1% of subjects had ischemic infarcts as the cause of their headache without any other physical signs. Onwuchekwa *et al.*in their study documented a lower incidence of 1.25% of infracts in 80 subjects presenting with headache.[22]

Intracranial haemorrhage is a well-known cause of headache. A high index of suspicion and clinical acumen is required especially in non-traumatic cases. Subarachnoid haemorrhages (SAH) are said to present with thunder clapping headaches and most times can be easily diagnosed based on clinical findings. Neuroimaging especially CT scan is of utmost importance in the first 24hours in evaluating SAH as sensitivity decreases after that.[23] CT scan study done by Perry *et al.*in 3132 patients presenting with thunderclap headache showed a sensitivity of 92.9% and specificity of 100% in diagnosing SAH.[24]

Infections of the brain parenchyma are common causes of headache, however headache due to intracranial infections accounts for < 1% of acute headache presenting in the emergency department.[25] These infections include meningitis, encephalitis, meningoencephalitis, cerebral abscess, neuro-cysticercosis and toxoplasmosis. MRI is a very useful imaging modality in evaluating infections because it gives better detailed result. Infections appear as T2 weighted hyperintensity in keeping with oedematous changes in cases of encephalitis, mass effect and gyral enhancement.[26] Leptomeningeal enhancement is demonstrated in cases of meningitis. CT scan is also used in assessing these infections but not as sensitive as MRI. A study by Itanyi *et al.* on computed tomography imaging features of chronic headache in Abuja, Nigeria reported a 4% low incidence of headache due to inflammatory causes in their study population with 3.2% due to meningoencephalitis.[14] Our study also showed a 0.8% cause of headache due to infection.

Brain atrophy is brain parenchymal volume loss. Brain atrophy could be focal or generalized. The causes of brain atrophy are multifactorial and could be due to age related causes, cerebrovascular disease, post infective, post traumatic, drug abuse, alcohol abuse and neurodegenerative diseases. Studies have also shown that headache may be associated with brain volume loss. A study by Gudmundsson *et al*. on migraine, depression and brain volume reported the presence of brain volume loss in 538 patients with migraine headache as opposed to 2,954 patients without headache. They also reported that both migraine headache and depression were co-morbid disorders associated with brain volume loss.[27] Also a study by May on morphing voxels: the hype around structural imaging of headache patients reported a damage or loss in brain grey matter in patients with headache.[28] We demonstrated a 4.7% loss in brain volume in the current study of patients with headache. These findings are lower than that reported by Itanyi *et al*. where they observed 14.9% of cases with brain atrophy.[14]

CONCLUSION

Neuroimaging has some value in evaluation of secondary headache in our environment with the increasing incidence of space occupying lesions as seen in the present study. It however has a low yield in evaluation of primary headaches.

Limitation of the Study

The study was limited by the high cost of the imaging modalities. Those who could not afford the cost of the investigations were not recruited despite being referred with presenting symptom of headache.

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