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Sudan University of Science and Technology

College of Graduate Studies

Assessment of Brain Findings in Sudanese Patients with Headache Using Computed Tomography

تقييم نتائج الدماغ لدى المرضى السودانيين المصابين بالصداع بإستخدام الاشعة المقطعية

A Thesis Submitted for Partial Fulfillment for the Requirements of M.Sc. Degree in Diagnostic Radiologic Technology

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الآية

قال تعالي:

ويسالونك عن الروح قل الروح من امر ربي وماواوتيتم من العلم الا قليلا))

صدق الله العظيم

سورةالاسراءالآيه (85)

Dedication

To those who supplied me with power and taught me the value of knowledge

To my father and my mother

To my brothers and sisters and

To my friends and colleagues

I always ask ALLAH for them to be healthy and happy.

ACKNOWLEDGMENT

All my thanks are due to the Almighty Allah for granting me the will and confidence to perform this study.

I have insufficient words to express my gratitude to my supervisor **Dr. Hussen Ahmed** for his priceless encouragement from the very beginning. His comments and suggestions encourage me to think critically.

Finally I would like to thank my family for their love and warmth and for the confidence that they gave me.

Abstract

The purpose of this descriptive cross sectional study was to evaluate the computed tomography findings of the brain in patients with headache. The study used (85) patients with headache who underwent a computed tomography scan of the brain in Amal National Hospital, the sample contained both gender (38 males and 47 females). Patients were examined in this study, ranging in age (18-65 years old) with the predominant age group (26-35 years), which accounted for 40% of the sample. All patients were examined using the modified protocol for imaging the brain and the modification was limited to increasing the field of view only; the justification for this modification was to complete the section of maxillary sinuses during CT brain examination because of their importance in the study. Data were collected by clinical data sheet designed by researcher to include all the variables in the study and the data analyzed using (Statistical Packages for Social Sciences). The main findings were (62%) of them sample had normal CT brain findings, (38%) showed brain disorder. The researcher detected incidental findings direct from the CT monitor on (30) patients which represent (60%) of the sample, most of the incidental findings led to the diagnosis of sinusitis. It is worth to be mentioned that the researcher made sure to print additional films to attract attention. The study recommended the radiologist to give all cuts the full attention, regardless of the type of CT examination.

مستخلص الدراسة

هدفت هذه الدراسة الوصفية المقطعية إلى تقييم نتائج التصوير المقطعي للدماغ في المرضى الذين يعانون الصداع، استخدمت الدراسة (85) مريضاً يعانون من الصداع، أجريت لهم أشعة مقطعية في مستشفى أمل الوطني، كما أحتوت العينة على كلا الجنسين (38 من الذكور و47 من الإناث). المرضى الذين تم فحصهم في هذه الدراسة تتراوح أعمارهم (18–65 سنة) وكانت الفئة العمرية العالية هي (26–35 سنة)، حيث تمثل (40%) من العينة. تم فحص جميع لمرضى باتسخدام بروتوكول معدل لتصوير الدماغ والتعديل يقتصر على زيادة مجال الرؤية فقط؛ وتبرير هذل التعديل هو استكمال المقاطع التي تظهر فيها الجيوب الفكية عند فحص الدماغ لأهميتها في الدراسة. تم جمع البيانات بواسة ورقة جمع بيانات صممتها الباحثة لتتضمن جميع المتغيرات في الدراسة وتم تحليل البيانات باتسخدام أساليب الحوسبة (الحزمة الإحصائية للعلوم الاجتماعية). كانت النتائج الرئيسية هي أن (62%) ظهرت نتائج الأشعة المقطعية لهم طبيعية و(38%) لديهم اضطرابات في الرأس. بينما كشفت الباحثة نتائج عرضية مباشرة من على شاشة جهاز الأشعة المقطعية في (30) مريض والتي تمثل (60%) من العينة، ومعظم النتائج العرضية أدت إلى تشخيص التهاب الجيوب الأنفية. ومن الجدير بالذكر أن الباحثة حرصت على طباعة فيلم إضافي لجذب انتباه الأخصائيين للنتائج العرضية.

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CT	Computed Tomography
FOV	Field of View
MRI	Magnetic Resonance Imaging
CSF	Cerebrospinal Fluid
ICH	Intracranial Hemorrhage
PPD	Purified Protein Derivative
CNS	Central Nervous System
DAS	Data Acquisition System
ADC	Analog to Digital Converter
PNS	Para Nasal Sinuses
SPSS	Statistical Package for Social Sciences
ANH	ALamal National Hospital

Chapter One
Introduction

Chapter One
Introduction

1.1 introduction

Headache is one of the causes of discomfort to a human being. It accounts for about 1% of all ED in the United States of America (1, 2). Headache has many causes including tumors, brain atrophy, and intra-cerebral hemorrhage. Even diseases like Malaria and bacterial infections such as meningitis can all cause severe headache. It can also be acute or chronic. In the case of acute severe headache SAH or meningitis (Bo SH200).

Headache can further be classified as primary or secondary headache. Primary headache is the headache that has no associated cause and secondary headache is the one that has an organic origin. Examples of primary headache include migraine, cluster and tension headache. Primary headache is more common than secondary (Ramadan NM2006).

Tension headaches are often related to stress, depression or anxiety. Approximately 90 percent of all headaches are classified as tension-type headache. The estimated prevalence is said to be 40% in males and 42% in females. The pain is typically generalized all over the head. There appears to be a slightly higher incidence of this type of headache among women, because more females than males seek treatment. This type of headache is not associated with nausea or aggravation by physical activity. This can be further classified into episodic or chronic tension headache. ETH is where by it has a certain frequency which is not systematically known and CTH is when there are 15 episodes in a month for more than three months in a year. CTH emphasize the possible role of central nociceptive pathway sensitization in addition to peripheral myogenic factors (Mathew NT2006).

There are an estimated one million cluster headache sufferers in the United States, of whom 10 percent are afflicted with chronic cluster. Cluster headaches are sharp, extremely painful headaches that tend to occur several times per day for months and then go away for a similar period of time.

Women suffer migraines three times more frequently than do men, and, menstrual migraines affect70 percent of these women. The estimated prevalence is said to be 10% in males and 22% in females. They occur before, during or immediately after the period, or during ovulation. Menstrual migraines are primarily caused by estrogen, the female hormones that specifically regulates the menstrual cycle fluctuations throughout the cycle. When the levels of estrogen and progesterone change, women will be more vulnerable to headaches. Because oral contraceptives influence estrogen levels, women on birth control pills may experience more menstrual migraines. Although the exact cause is not known, many experts consider migraine to be an inherited condition where the brain and its serotonin-controlled blood vessels are involved (Mathew NT2006).

These headaches can often be triggered by many factors, including stress, certain foods, glaring lights, physical exercise and changes in hormone levels.

Migraine headache is a form of primary headache. It also more common in females and the study by Bahou et al estimated a prevalence of 38.2% (Khu JV2008).

It affects more females than males.It has been demonstrated that WMLs are more often found in migraineurs but most migraineurs will not have them and even when found the association with migraine is not understood (Tepper, S.J2004).

Secondary headache can result from a tumor and bleeding in the brain. Risk factors documented include age, about 40 years and the gender whereby more females are more affected than men .Among illnesses associated with headache hypertension is the most prevalent. This can result into cerebral hemorrhage. Cerebral hemorrhage can be classified as epidural, subdural or subarachnoid .In all these types of cerebral hemorrhage, headache may present as acute severe headache that is accompanied with abnormal neurological symptoms. Subarachnoid hemorrhage (SAH) presents with severe headache and is treated as an emergency. Imaging techniques are of use when done within the first 24 hours upon the acute onset of severe headache. This can be followed by a lumber puncture within 72 hours to rule out meningitis. This was found in the study be Lledo et al .The headache presents differently depending on the site where the lesion is located. For cerebellar lesion, frontal headache is prominent, for the cases where there is papillo-edema full blown headache is observed (Lledo A, 1994).

The middle cranial fossa lesions are mostly associated with occipital headache.

1.2 Problem of the Study:

As years go by and with the new development of technology, imaging modalities are considered to be more reliable in diagnosing of diseases. The issue of radiation has been debated among scholars on whether it is crucial to subject the patients to radiations to determine the cause of headache.

One of the causes of severe acute secondary headache that is the most prevalent is intracerebral bleeding. This is mainly attributed to hypertension. Acute intra cerebral hemorrhage poses high mortality rate especially for subarachnoid hemorrhage. This is one of the documented causes of headache. It is easily identified by the CT scan.

And sometimes causes of headache may be related to maxillary sinuses abnormalities, so alternative in FOV of CT brain to include alteration it may help to diagnosis successful.

1.3 Objectives of the Study:

1.3.1 General objective:

To evaluate the CT brain findings in patients with chronic headache.

1.3.2 Specific objectives:

- To evaluate the frequency of CT brain findings in patients presenting with headache.
- To determine the prevalence of positive CT scans of patients presenting with headache.
- To determine the correlation between the clinical diagnosis and the CT findings.
- To evaluate the distribution of causes of headache among male and female patients.

Chapter Two
Literature Review

Chapter Two
Literature Review

2.1 Anatomy of the brain:

The brain is the part of the central nervous system that lie inside the cranial cavity. It is continuous with the spinal cord through the foramen magnum.

2.1.1 Cerebrum:

The cerebrum is the largest part of the brain and consists of two cerebral hemispheres connected by a mass of white matter called the corpus callosum. Each hemisphere extend from the frontal to the occipital bones above the anterior and middle cranial fossae; and, posteriorly, above the tentorium cerebelli. The hemispheres are separated by a deep cleft, the longitudinal fissure, into which projects the falxcerebri. The surface layer of each hemispheres is called the cortex and is composed of gray matter. The cerebral cortex is through into folds or gyri. Separated by fissures, or sulci. By this means the surface area of the cortex is greatly increased. Several of the large sulci conveniently subdivide the surface of each hemisphere into lobes. The lobes are named for the bones of the cranium under which they lie (Snell, 2010).

2.1.2 Lobes of brain:

Frontal lobe: Lies deep to the frontal bone and forms the anterior part of the cerebral hemisphere. The frontal lobe ends posteriorly at a deep groove called the central sulcus that marks the boundary with the parietal lobe. The inferior border of the frontal lobe is marked by the lateral sulcus, a deep groove that separates the frontal and parietal lobes from temporal lobe. An important anatomic feature of the frontal lobe is the precentral gyrus, which is a mass of nervous tissue immediately anterior to the central sulcus. (Snell, 2010)

Parietal lobe: Lies internal to the parietal bone and forms the super posterior part of each cerebral hemisphere. It terminates anteriorly at the central sulcus, posteriorly at the relatively indistinct parieto-occipital sulcus, and laterally at a lateral sulcus. An important anatomic feature of this lobe is the postcentral gyrus, which is a mass of nervous tissue immediately posterior to central sulcus.

Temporal lobe: Lies inferior to the lateral sulcus and underlies the temporal bone.

Occipital lobe: Forms the posterior region of each hemisphere and immediately underlies the occipital bone.

Insula: is a small lobe deep to the lateral sulcus. It can be observed by laterally reflecting the temporal lobe.

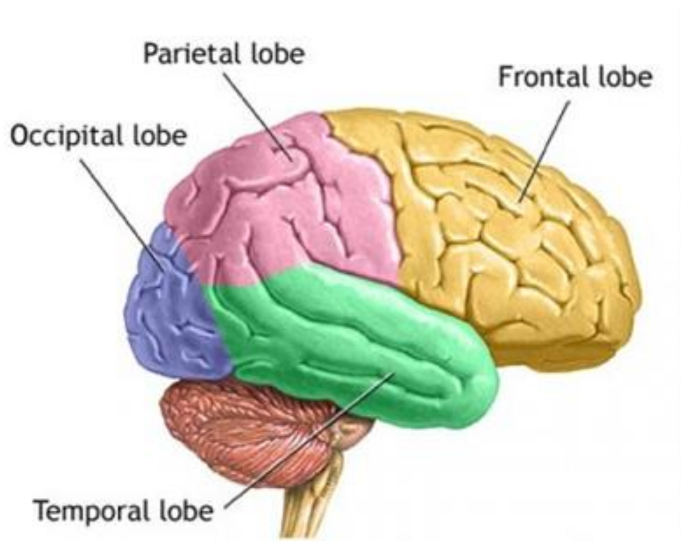

Fig (1): Show the lobes of brain

2.1.3 Cerebellum:

The cerebellum is the second largest part of brain, and it develops from the metencephalon. The cerebellum has complex, highly convoluted surface covered by a layer of cerebellar cortex. The fold of cerebellar cortex are called foli. The cerebellum is composed of left and right cerebellar hemispheres. Each hemisphere consist of two lobes, the anterior lobe and posterior lobe, which are separated by the primary fissure. Along the midline, a narrow band of cortex known as the vermis separates the left and right posterior lobes. Slender flocculonodular lobes lie anterior and inferior to each cerebellar hemisphere (Snell, 2010).

2.1.4 Brainstem:

The brainstem connects the proscencephalon and cerebellum to the spinal cord. Three regions form the brainstem: the superiorly placed mesencephalon, the pons, and the inferiorly placed medulla oblongata. The brainstem is a bidirectional passageway for all tracts extending between the cerebrum and the spinal cord (Snell, 2010).

2.1.5 The pons:

Is a bulging region on the anterior part of the brainstem that forms from part of the metencephalon. Housed within the pons are sensory and motor tracts that run through the pons and connect to the brain and spinal cord. In addition, the middle cerebellar peduncles are transvers fibers that connect the pons to the cerebellum (Snell, 2010).

2.1.6 The medulla oblongata:

Is conical in shape and connects the pons above to the spinal cord below.

2.1.7 Diencephalon:

The diencephalon is a part of the pros encephalon sandwiched between the inferior regions of the cerebral hemispheres. The region is often referred to as the in-between brain. The components of the diencephalon include the epithalamus, the thalamus, and the hypothalamus. The diencephalon provides the relay and switching center for some sensory and motor pathways and for control of visceral activities (Snell, 2010).

2.1.7.1 Epithalamus:

The epithalamus is a (dorsal) posterior segment of the diencephalon and cover the third ventricle. The posterior portion of the epithalamus houses the pineal gland and the habenular nuclei.

2.1.7.2 Thalamus:

Each half of the brain contains a thalamus, a large, ovoid, gray mass of nuclelli. The thalamus forms the super lateral walls of the third ventricle.

2.1.7.3 Hypothalamus:

It is the anteroinferior region of the diencephalon. The thin, stalk like infundibulum extends inferiorly from hypothalamus to attach to the pituitary gland.

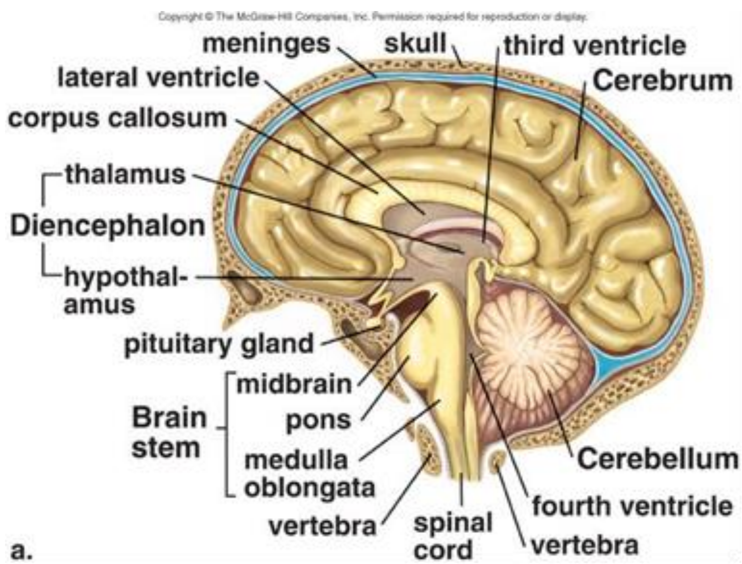

Fig (2): Show structures of brain

2.1.8 Ventricles and Cerebrospinal Fluid:

The ventricles are four cavities within the brain: two lateral ventricles, the third ventricle, and the fourth ventricle. Each ventricle contains a capillary network called a choroid plexus, which forms cerebrospinal fluid (CSF) from blood plasma. The two largest are the lateral ventricles in the cerebrum; the third ventricle is in the diencephalon of the forebrain between the right and left thalamus; and the fourth ventricle is located at the back of the pons and upper half of the medulla oblongata of the hindbrain. The ventricles are concerned with the production and circulation of cerebrospinal fluid (Snell, 2010).

2.1.8.1 Cerebrospinal Fluid (CSF):

The cerebrospinal fluid is found in the ventricles of the brain and in the subarachnoid space around the brain and spinal cord. It has a volume of about 150 ml. It is a clear, colorless fluid and possesses, in solution, inorganic salts similar to those in the blood plasma. The glucose content is about half that of blood, and there is only a trace of protein. Only a few cells are present, and these are lymphocytes.

Production of CSF: The brain produces roughly 500 mL of cerebrospinal fluid per day. This fluid is constantly reabsorbed, so that only 100-160 mL is present at any one time (Snell, 2010).

2.1.9 Basal Ganglia:

The basal ganglia are paired masses of gray matter within the white matter of the cerebral hemispheres.

2.1.10 Meninges:

The connective tissue membranes that cover the brain and spinal cord are called meninges; the three layers are:

2.1.10.1 Dura mater:

The dura mater of the brain is conventionally described as two layers: the endosteal layer and the meningeal layer.

The endosteal layer: is nothing more than the periosteum covering the inner surface of the skull bones. At the foramen magnum, it does not become continuous with the dura mater of the spinal cord. Around the margins of all the foramina in the skull, it becomes continuous with the periosteum on the outside of the skull bones. At the sutures, it is continuous with the sutural ligaments. It is most strongly adherent to the bones over the base of the skull.

The meningeal layer: is the dura mater proper. It is a dense, strong fibrous membrane covering the brain and is continuous through the foramen magnum with the dura mater of the spinal cord (Snell, 2010).

2.1.10.2 Arachnoid membrane:

The arachnoid mater is a delicate, impermeable membrane covering the brain and lying between the pia mater internally and the dura mater externally. It is separated from the dura by a potential space, the subdural space, filled by a film of fluid; it is separated from the pia by the subarachnoid space, which is filled with cerebrospinal fluid. The outer and inner surfaces of the arachnoid are covered with flattened mesothelial cells.

2.1.10.3 Pia mater:

The pia mater is a vascular membrane covered by flattened mesothelial cells. It closely invests the brain, covering the gyri and descending into the deepest sulci. It extends out over the cranial nerves and fuses with their epineurium. The cerebral arteries entering the substance of the brain carry a sheath of pia with them. Thepia mater forms the telachoroidea of the roof of the third and fourth ventricles of the brain, and it fuses with the ependyma to form the choroid plexuses in the lateral, third, and fourth ventricles of the brain.

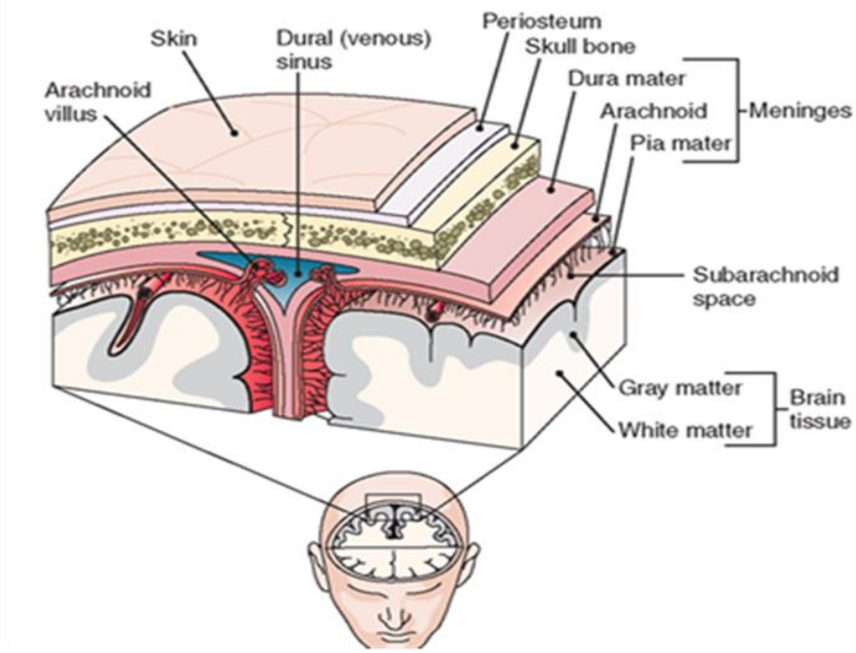

Fig (3): Show the layers of meninges

2.1.11 Cranium:

Surrounding the brain is a region of the skull known as the cranium is generally considered to consist of twenty-two bones. Eight cranial bones and fourteen facial skeleton bones.

In the neurocranium these are the: occipital bone, two temporal bones, and two parietal bones, the sphenoid, ethmoid and frontal bones.

Collectively, these bones provide a solid bony wall around the brain, with only a few openings for nerves and blood vessels. Our occipital bone contains the foramen magnum, the hole through which the spinal cord enters the skull to attach to the brain. The occipital bone also forms the atlanto-occipital joint with the atlas (the first cervical vertebra in our spine) (Snell, 2010).

The frontal, ethmoid, and sphenoid bones contain small hollow spaces known as paranasal sinuses. The sinuses help to reduce the weight of these bones and increase the resonance of the voice during speech, singing, and humming.

The bones of the facial skeleton are the:vomer, two nasal conchae, two nasal bones, two maxilla, the mandible, two palatine bones, two zygomatic bones, and two lacrimal bones. (Snell, 2010)

2.1.12 Blood supply:

The brain is supplied by the two internal carotid arteries and the two vertebral arteries. The for arteries anastomosis in the inferior surface of the brain and form circle of Willis.

The internal carotid artery: it begins at the bifurcation of the common carotid artery at the level of the upper border of the thyroid gland. It supplies the brain, eyes, the forehead, and part of nose. (Snell, Richard2010)

2.1.13 Cranial Nerves:

There are 12 pairs of cranial nerves, which leave the brain and pass through foramina and fissures in the skull. All the nerves are distributed in the head and neck, except cranial nerve X, which also supplies structures in the thorax and abdomen. The cranial nerves are named as follows:

- Cranial nerve I (Olfactory nerve).
- Cranial nerve II (Optic nerve).
- Cranial nerve III (Oculomotor nerve).
- Cranial nerve IV (Trochlear nerve).
- Cranial nerve V (Trigeminal nerve).
- Cranial nerve VI (Abducens nerve).
- Cranial nerve VII (Facial nerve).
- Cranial nerve VIII (Vestibulocochlear nerve).
- Cranial nerve IX (Glossopharyngeal nerve).
- Cranial nerve X (Vagus nerve).
- Cranial nerve XI (Spinal accessory nerve).

- Cranial nerve XII (Hypoglossal nerve). (Snell, 2010)

2.2 Physiology of brain:

The human brain serves many important functions ranging from imagination, memory, speech, and limb movements to secretion hormones and controlled by many distinct parts that serve specific tasks. These components and their functions are listed below (Marieb 2004).

2.2.1 Cerebrum:

Consist of 2 cerebral hemispheres that are incompletely separated by the great longitudinal fissure. Each hemisphere consist of 4 lobes:

2.2.1.1 Frontal lobe:

Higher intellectual functions (concentration, decision making, planning): personality; verbal communication; voluntary motor control of skeletal muscles (Marieb2004).

2.2.1.2 Parietal lobe:

Sensory interpretation of textures and shapes; understanding speech and formulating words to express thoughts and emotions.

2.2.1.3 Temporal lobe:

Interpretation of auditory and olfactory sensation; storage of auditory and olfactory experiences.

2.2.1.4 Occipital lobe:

Conscious perception of visual stimuli; integration of eye focusing movements; correlation of visual images with previous visual experiences (Marieb2004).

2.2.2 Brainstem:

The brainstem plays a role in conduction. That is, all information relayed from the body to the cerebrum and cerebellum and vice versa must travers the brainstem. It has integrative functions being involved in cardiovascular system control, respiratory control, pain sensitivity control, alertness, awareness, and consciousness (Marieb2004).

2.2.3 Cerebellum:

Controls fine movement, coordinates muscle groups, and maintains balance.

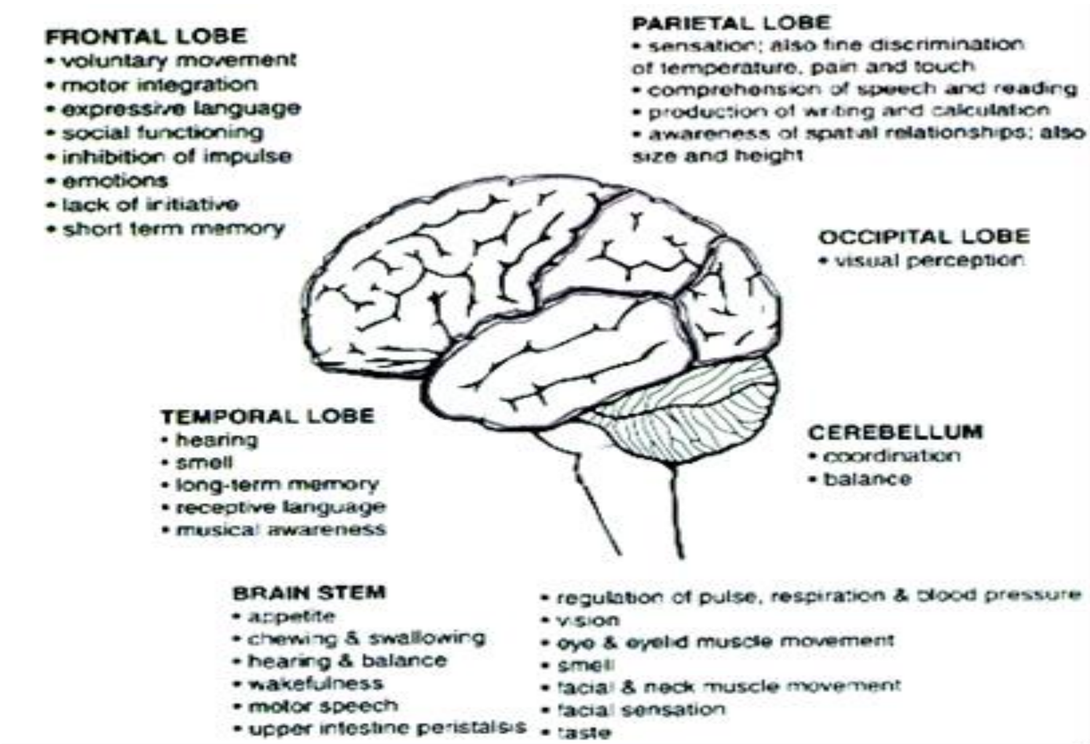

Fig (4): Show function of brain

2.2.4 Hypothalamus:

Hypothalamus is a structure that communicates with the pituitary gland in order to manage hormone secretions as well as controlling functions eating, drinking, sleep, body temperature and emotions (Marieb2004).

2.2.5 Thalamus:

The thalamus is a structure that is located above the brainstem and it serves as a relay station for nearly all messages that travel from the cerebral cortex to the rest of the body/brain and vice versa. As such, problems within the thalamus can cause significant symptoms with regard to a variety of functions, including movement, sensation, and coordination. The thalamus also functions as an important component of the pathways within the brain that control pain sensation, attention, and wakefulness (Marieb2004).

2.2.6 Pituitary gland:

The pituitary gland is a small structure that is attached to the base of the brain in an area called the sellaturcica. This gland controls the secretion of several hormones which regulate growth and development, function of various organs (kidneys, breasts, and uterus), and the function of other glands (thyroid gland, gonads, and the adrenal glands) (Marieb2004).

2.2.7 Basal ganglia:

The basal ganglia are clusters of nerve cells around the thalamus which are heavily connected to the cells of the cerebral cortex. The basal ganglia are associated with a variety of functions, including voluntary movement, procedural learning, eye movements, and cognitive/emotional functions (Marieb2004).

For primary type of headache, females have been identified to be more at risk, for migraine type of headache, the M: F ratio is 1:3 and for tension type of headache M: F ratio is 1:6. This decreases with age. Several factors have been associated with this, not sleeping for long hours, no relaxation after work, no vocational training. Migraine headache (90%) has been identified to be more common than the tension headache (10%) (12). Migraine headaches usually present with aura. Migraine can be found in patients with epilepsy and is usually without aura. In a study that was done by Yankosvky et al, that included 100 patients 25 (40%) patients had headache without aura. There was an association between headache and epilepsy. The headache was mostly located in the frontal-temporal lobe. Other patients had congenital malformation. The methodology for the study was satisfactory. The consideration for the location of the headache was also there. In a study that was done in Germany considered 110 epileptic patients. There was a prevalence of 47% epileptic related headache. This type of headache that is mostly in epileptic patients was post-ictal (14). The fact that the patients were recruited from epileptic center gives a bias since the disease itself might not have been the cause of headache (Yankovsky AE2005).

In another observational hospital based study in France by Valade et al headache patients presenting at the emergency department.

There were 22 hospitals involved and the duration was 7 days. A total of over 14.000 patients were included. Mostly were women 75%. 0.6% had migraine headache (Yankovsky AE2005).

2.3 Pathology of Brain

2.3.1 Patterns of Injury in the Nervous System

2.3.1.1 Edema

Cerebral edema is the accumulation of excess fluid within the brain parenchyma. There are two types, which often occur together particularly after generalized injury.

• Vasogenic edema: occurs when the integrity of the normal blood-brain barrier is disrupted, allowing fluid to shift from the vascular compartment into the extracellular spaces of the brain. Vasogenic edema can be either localized (e.g., increased vascular permeability due to inflammation or in tumors) or generalized.

• Cytotoxic edema: is an increase in intracellular fluid secondary to neuronal and glial cell membrane injury, as might follow generalized hypoxic-ischemic insult or after exposure to some toxins. The edematous brain is softer than normal and often appears to “over fill” the cranial vault. In generalized edema the gyri are flattened, the intervening sulci are narrowed, and the ventricular cavities are compressed (Vinay Kumar2013).

2.3.1.2 Hydrocephalus

Hydrocephalus refers to the accumulation of excessive CSF within the ventricular system. This disorder most often is a consequence of impaired flow or resorption; over production of CSF, typically seen with tumors of the choroid plexus, only rarely causes hydrocephalus. If there is a localized obstacle to CSF flow within the ventricular system, then a portion of the ventricles enlarges while there mainder does not. This pattern is referred to as non-communicating hydrocephalus and most commonly is caused by masses obstructing the foramen of Monro or compressing the cerebral aqueduct. In communicating hydrocephalus, the entire ventricular system is enlarged; it is usually caused by reduced CSF resorption. If hydrocephalus develops in infancy before closure of the cranial sutures, the head enlarges. Once the sutures fuse, hydrocephalus causes ventricular expansion and increased intracranial pressure, but no change in head circumference. In contrast with these states, in which increased CSF volume is the primary process, a compensatory increase in CSF volume can also follow the loss of brain parenchyma (hydrocephalus ex vacuo), as after infarcts or with degenerative diseases (Vinay Kumar2013).

2.3.2 Hemorrhage of brain (Vinay Kumar2013)

2.3.2.1 Intracranial Hemorrhage (ICH)

Hemorrhages within the brain are associated with hypertension and other diseases leading to vascular wall injury, structural lesions such as arteriovenous and cavernous malformations, and tumors. Subarachnoid hemorrhages most commonly are caused by ruptured aneurysms but also occur with other vascular malformations. Subdural or epidural hemorrhages usually are associated with trauma (Vinay Kumar2013).

2.3.2.2 Epidural hematoma

This is an accumulation of blood between the skull and the outermost covering of the brain.

Dural vessels especially the middle meningeal artery are vulnerable to traumatic injury. In infants, traumatic displacement of the easily deformable skull may tear a vessel, even in the absence of a skull fracture. In children and adults, by contrast, tears involving dural vessels almost always stem from skull fractures. Once a vessel is torn, blood accumulating under arterial pressure can dissect the tightly applied dura away from the inner skull surface, producing a hematoma that compresses the brain surface. Clinically, patients can be lucid for several hours between the moment of trauma and the development of neurologic signs. An epidural hematoma may expand rapidly and constitutes a neurosurgical emergency necessitating prompt drainage and repair to prevent death (Vinay Kumar2013).

This is collection of blood on the surface of the brain. Rapid movement of the brain during trauma can tear the bridging veins that extend from the cerebral hemispheres through the subarachnoid and subdural space to the dural sinuses. Their disruption produces bleeding into the subdural space. Subdural hematomas typically become manifest within the first 48 hours after injury. They are most common over the lateral aspects of the cerebral hemispheres and may be bilateral. Neurologic signs are attributable to the pressure exerted on the adjacent brain. Symptoms: May be localizing but more often are non-localizing, taking the form of headache, confusion, and slowly progressive neurologic deterioration (Vinay Kumar2013).

2.3.2.3 Subarachnoid hemorrhage

This is when there is bleeding between the brain and the thin tissue that cover the brain. It tends to run in families. A Subarachnoid hemorrhage is usually preceded by a sudden, sharp headache. This type of ICH can be caused by alcohol or drug abuse.

• Symptoms: loss of consciousness and vomiting.

• Diagnosis: diagnostic testing for ICH may include a CT scan. This type of test creates images of the brain, which can detect skull fractures or confirm bleeding. MRI may help your doctor see the brain more clearly to better identify the cause of the bleeding. An angiogram uses X-ray technology to take pictures of blood flow within an artery. Blood tests can identify immune system disorders, inflammation, and blood clotting problems that can cause bleeding in the brain (Vinay Kumar2013).

2.3.3 Infections of the Nervous System

The brain and its coverings, as with all other parts of the body, can be affected by infections. Some infectious agents have a relative or absolute predilection for the nervous system (such as rabies), while others can affect many other organs as well as the brain (such as Staphylococcus aureus and other bacteria) (Vinay Kumar2013).

2.3.3.1 Epidural and subdural infections

These spaces can be involved with bacterial or fungal infections, usually as a consequence of direct local spread. Epidural abscess, commonly associated with osteomyelitis, arises from an adjacent focus of infection, such as sinusitis or a surgical procedure. When the process occurs in the spinal epidural space, it may cause spinal cord compression and constitute a neurosurgical emergency. Infections of the skull or air sinuses may also spread to the subdural space, producing subdural empyema. The underlying arachnoid and subarachnoid spaces are usually unaffected, but a large subdural empyema may produce a mass effect (Vinay Kumar2013).

2.3.3.2 Meningitis:

Meningitis is an inflammatory process of the leptomeninges and CSF within the subarachnoid space. Meningoencephalitis develops with spread of the infection from the meninges into the underlying brain. Infectious meningitis is broadly classified into acute pyogenic (usually bacterial), aseptic (usually viral), and chronic (usually tuberculous, spirochetal, or cryptococcal) on the basis of the characteristics of inflammatory exudate on CSF examination and the clinical evolution of the illness (Vinay Kumar2013).

2.3.4 Metastases to the brain as the cause of secondary headache:

Metastases are also considered as the cause of headache in patients with cancer. And this is one of the red flag criteria documented by the IHS. A study that was done in Sweden revealed an incidence of 0.023 of colorectal cancer patients with metastasis to the brain by CT scan. This plays a role in staging and determining the prognosis of the patient. For these patients, headache was one of the major complaints. A survey was done involving 43 cancer patients, by Greenberg et al. Patients who had metastasis on skull base n presented with headache and several syndromes (21) depending on the specific anatomical location. The methodology was not clear for this study. A case of similar situation was reported in a patient who presented with headache and had metastasis to the pituitary gland .Two case reports by W. Kong et al in Hong Kong also revealed two male patients who had metastasis to the skull base who had similar presentation (Gaini SM2004).

The presence of preexisting morbidity is made apparent in the study by Bahou et al in Singapore. A total of 1498 stroke patients presenting with headache were studied in a period of 6 years retrospectively. The prevalence of ICH was found to be 6.7% and hypertension was the common predisposing factor. The location and duration of headache in this study were not considered (Gaini SM2004).

In a prospective hospital based study that was done in Nigeria by Arogundade RA et al recruited 160 cancer adult patients for a period of five years. Most patients were females 68% and the age mean age was 48 years. CT scan was done and revealed that about 60.6% of the inter-cerebral primary tumor patients presented with chronic headache. And of these tumors encountered, majority (60.8%) were glioma (25). The location of the pathology was identified and the duration of headache. The methodology was of convenience since all patients were recruited. The investigation was thoroughly noted, CT scan of both with and without contrast in a multiplane fashion. The CT scan diagnosis was compared with the post-surgical diagnosis.

2.4 CT Roles In Dignoses of Headeche can quilts and limitation:

The IHS have put the following warning signs and termed them as red flags for potential secondary headaches that need further investigation. New onset of headache in patients more than 50 years of age, focal neurological symptoms, non-focal neurological symptoms. Others include new onset of headache in a cancer patient, new onset of headache in a patient with HIV infection, patients with risk of cerebral venous sinus thrombosis (Lledo A, 1994).

Also headache with abnormal neurological examination, headache with fever and neck stiffness, Headache that changes with posture and headache precipitated by physical activity.

Headaches are investigated differently depending on the cause (Lledo A, 1994). Imaging investigations CT scan and MRI have proved to be useful when the neurological physical examination is abnormal. For the remaining types of headaches diagnosis can solely be based on the clinical conclusion. Other investigations include full blood count, hormonal assay, CRP, pregnancy tests and eye exams (FUNDOSCOPY) depending on presenting features. For the neuro-imaging investigations for headache, the CT scan has proved to be by far the easiest, quickest, cheap method for adult patients. CT scan is widely used to detect tumors, vascular function in cases of stroke. There are two types of CT studies, the non-enhanced and an enhanced CT study. The enhancement is done with the use contrast media which are made from water soluble compounds (Lledo A, 1994).

This imaging technique can be used in combination with other modalities. In cases of suspected embolism, CT angiography can be used. In the case of pediatric patients attending emergency rooms, a lumber puncture is of more value than the CT scan. This is because the main illness documented is meningitis.

2.5 Previous Studies:

2.5.1 Joseph Maytag (et al) carried out study aimed to determine the value of performing computed tomography (CT) or magnetic resonance imaging (MRI) studies in children with chronic headaches. A retrospective chart review was conducted of all children referred to the pediatric neurology clinic for evaluation of headaches over a 2-year period. Charts were reviewed for headache characteristics, clinical indications for performing CT and MRI studies, and imaging results. Particular attention was paid to evidence of brain tumors, vascular anomalies, or hydrocephalus. A total of 133 records were studied. Subjects ranged in age from 3 to 18 years. Most patients were diagnosed as having either vascular migrainous headaches (52%) or chronic tension headaches (21%). Other headache diagnoses were mixed tension-migraine, psychogenic, and post-traumatic. Headaches were unclassified in 25 patients (19%). Seventy-eight patients (59%) had brain imaging: 45 had MRI, 27 had CT, and 6 patients had both. In most cases, brain imaging studies were performed in patients with atypical headache pattern, presence of neurologic abnormalities during the headache, general symptoms (ie, weight loss or fatigue), or because of parents' or doctors' concerns about brain tumors. Cerebral abnormalities were found on brain imaging in four patients, but none indicated the presence of a treatable disease and all were deemed unrelated to the presenting complaint. Our findings of no relevant abnormalities in a series of 78 brain imaging studies indicate that the maximal rate at which such abnormalities might appear in this population is 3.8%.CONCOLUSION: These results indicate that brain imaging studies have very limited value in evaluating headaches in pediatric patients without clinical evidence of an underlying structural lesion. (https://en.wikipedia.org/wiki/Brain_abscess accessed on 29/2/2016 05:00pm).

2.5.2 Margreth William Magambo carried out study on 85 patients were prospectively evaluated with CT scan at MNH in 2011 to evaluate the causes of secondary headache. Characteristic of the type of headache was noted as documented in the request form. The underlying conditions were outlined. Evaluation for the cause of headache was done using a helical PHILLIPS CT 8 planner scan machine (Phillips, Eindhelsen, Netherlands).Collected data was analyzed using SPSS programmer version 15. For the continuous data mean and standard deviation were considered while for the categorical was by proportion and percentage. The association between headache and the risk factors will be established using chi square and linear regression to establish the statistical significance. The study included 85 patients, with more females than males. The study showed that the prevalence of positive findings among patients that presented with headache was 31.9%. The most prevalent pathology found was sinusitis which was located in the maxillary sinus. Among the CT scan findings and the suspected diagnosis, brain metastasis showed to have strong correlation. Both sinusitis, brain atrophy and brain infection had positive correlation and brain infarction had negative correlation between the clinical deduced diagnosis and the CT scan findings. Some study subjects had preexisting morbidity and the most frequent one was hypertension. No significant difference was noted among patients who had hypertension and those who had not as far as the CT SCAN findings (P 4.254). There were neurological complaints apart from headache and the commonest one documented was loss of consciousness. This however did not have an effect on the CT scan findings whether normal or abnormal (P 0.016). Conclusion CT scan has a role in determining the cause of headache. Primary headache is more common than secondary headache. More emphasis should be put to women presenting with headache. The commonest cause of secondary headache is maxillary sinusitis.

(https://en.wikipedia.org/wiki/Cerebral_infarction accessed on 29/2/2016 07:00pm).

2.5.3. Another study that was done in ASPN by Becker et al, involved 394 CT scans that were ordered because clinicians suspected the patients with headache had either SAH or a tumor. The study duration was 19 months. Out of all the subjects, 14 out of the 293 reviewed showed SAH and SDH (18, 19). The methodology was satisfactory since patients were recruited from different hospitals. The CT scan algorithm used was not noted. There was no consideration of the location of pathology or duration of headache. No documentation of the preexisting disease such as hypertension. There was also no correlation between the clinical deduced diagnosis and the CT scan findings (Gaini SM2004).

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3. Materials:

3.1.1 Study group:

All the patients with the age above 18 years complaining of headache were recruited for the study. These patients had CT scan requested by their doctors.

3.1.2 Type and duration of study:

This was a cross sectional descriptive study. This involved studying the causes of secondary headache in patients (85 PTs; F47; M38) at ANH, CT scan unit. The study duration was from January-March 2018.

3.1.3 Sample size

The study included (85) patients who were clinically had headache, undergone computed tomography for brain.

3.1.4 Inclusion criteria:

All the patients who were above 18 years, consented and presented with clinically suspected secondary headache.

3.1.5 Exclusion criteria:

All those who were categorized as cases of head injury from trauma and presented with headache as part of the complaint.

The patients who refused to participate in the study.

3.1.7 Data collection:

A short interview was conducted to obtain demographic data. This was conducted by the chief investigator.

3.1.8 CT Machine

Multi slice CT Scanner (MSCT) 64 slice (TOSHIBA), the scanner installed in 2010.

3.2 Methods:

All patients' undergone CT brain with modified CT brain protocol, the modification limited to increasing the field of view only to complete the axial cuts of the maxillary sinuses while scanning the brain. The collection of patient data done through collecting CT reports and collecting the incidental findings direct from the CT monitor.

CT technique:

Patient Preparation: Empty the bladder before scanning. No patient motion with clear instructions.

Patient position: Patient supine, Head is rest on the head holder, No head rotation and no head tilt. A localizer radiograph is taken prior to the actual CT procedure. Axial scan started from the base of skull to vertex with 5mm slice thickness, 5 mm spacing.

Chapter Four

Results

Chapter Four
Results

Table (4.1) Socio and demographic distribution of patients presenting with headache (N=85):

			Sex
Age group (years)	**Female (%)**	**Male (%)**	**Total (%)**
18-25	4 (8.5)	7 (18.4)	11 (12.9)
26-33	7 (14.9)	6 (15.8)	13 (15.3)
34-41	16 (34.0)	9 (23.7)	25 (29.4)
42-49	7 (14.9)	4 (10.5)	11 (12.9)
50-57	6 (12.8)	4 (10.5)	10 (11.8)
58-65	5 (10.6)	2 (5.3)	7 (8.2)
66-73	2 (4.3)	3 (7.9)	5 (5.9)
74-81	0 (0.0)	3 (7.9)	3 (3.5)
Total	**47 (100)**	**38 (100.0)**	**85 (100)**

Table (4.2) Prevalence of the positive CT scans of the patient presenting with headache (N=85):

CT scan Findings	**Total (%) (N=85)**
Normal	58 (68.2)
Abnormal	27 (31.8)
Total	**85 (100.0)**

Table (4.3) Percentage distribution of CT scan findings by sex (N=85):

		Sex			X^2
CT scan findings		**Female (n=47)**	**Male (n=36)**	**Total (N=85)**	**(P-value)**
Brain atrophy	**Yes**	3 (6.4%)	1 (2.6%)	4 (4.7%)	
	No	44 (93.6%)	37 (97.4%)	81 (95.3%)	0.621 (0.663)
Brain tumor	**Yes**	1 (2.1%)	1 (2.6%)	2 (2.4%)	
	No	46 (97.9%)	37 (97.4%)	83 (97.6%)	1.000 (0.213)
Metastasis	**Yes**	2 (4.3%)	1 (2.6%)	3 (3.5%)	
	No	45 (95.7%)	37 (97.4%)	82 (96.5%)	1.000 (0.164)
Hemorrhage	**Yes**	0 (0.0%)	2 (5.3%)	2 (2.4%)	
	No	47 (100.0%)	36 (94.7%)	3 (97.6%)	0.176 (2.531)
Infarction	**Yes**	1 (2.1%)	2 (5.3%)	3 (3.5%)	
	No	46 (97.9%)	36 (94.7%)	82 (96.5%)	0.584 (0.612)
Normal	**Yes**	31 (66.0%)	28 (73.7%)	58 (68.2%)	
	No	16 (34.0%)	10 (26.3%)	27 (31.8%)	0.493 (0.601)

Table (4.4.) Correlation between deduced diagnosis and the CT scan findings among patients presenting with headache (N=85):

	CT scan findings (n=85)		**Pearson's correlation Coefficient**	**P value**
Written Diagnosis	Yes (%) (N=16)	No (%) (N=69)		
Sinusitis	7 (43.8)	20 (2.9)	0.929	0.000
Tumor	2 (12.5)	17 (50.8)	0.040	0.692
Hemorrhage	0 (0)	3 (4.3)	0.200	0.470
Infection	2 (12.5)	2 (2.9)	0.861	0.000
Brain atrophy	0 (0)	2 (2.9)	-0.001	0.540
Degenerative changes	1 (6.3)	1 (0)	1.000	0.000
Metastasis	2 (12.5)	2 (2.9)	1.000	0.000
None	1 (6.3)	14 (20.3)	0.400	0.652
Infarction	1 (6.3)	8 (4.3)	-0.030	0.787

Table (4.5) Distribution of CT scan findings by duration of headache (N=85):

Pathology (%)	Duration		
	Acute (%)	**Chronic (%)**	**Total (%)**
Hemorrhage	1 (2.9)	1 (2.0)	2 (2.4)
Infarction	3 (8.6)	0 (0.0)	3 (3.5)
Brain atrophy	1 (2.9)	3 (6.0)	4 (4.7)
Degenerative disease	0 (0.0)	1 (2.0)	1 (1.2)
Brain tumor	0 (0.0)	2 (4.0)	2 (2.4)
Sinusitis	2 (5.7)	6 (12.0)	8 (9.4)
Metastasis	3 (8.6)	0 (0.0)	3 (3.5)
Brain infection	1 (2.9)	2 (4.0)	3 (3.5)
No pathology	23 (68.6)	35 (70.0)	58 (68.2)
Total	**35 (100.0)**	**50 (100.0)**	**85 (100.0)**

Table (4.6) Percentage distribution of pre-existing morbidity by CT scan findings (N=85):

	CT scan findings			
Morbidity	**Normal (n =58)**	**Abnormal (n=27)**	**Total (N=85)**	**P value**
Hypertension	7 (12.1%)	8 (29.6%)	15 (17.6%)	0.119 (0.004)
HIV	1 (1.7%)	2 (7.4%)	3 (3.5%)	0.421 (1.700)
Ear problem	1 (1.7%)	0	1 (1.2%)	1.000 (0.471)
Cancer	0	4 (14.8%)	4 (4.7%)	0.009 (9.459)

Table (4.7) Percentage distribution of neurological symptoms by CT scan findings (N=85):

	CT scan findings		
Symptoms	**Normal (n=58)**	**Abnormal (n=27)**	**Total (N=85)**
Loss of Balance	4 (6.9%)	2 (7.4%)	6 (7.1%)
Loss of consciousness	7 (12.1%)	3 (11.1%)	10 (11.8%)
Seizures	4 (6.9%)	2 (7.4%)	6 (7.1%)
Neck stiffness	1 (1.7%)	1 (3.7)	2 (2.3%)
Paralysis	1 (1.7%)	0	1 (1.2%)
Blurred vision	4 (6.9%)	2 (7.4%)	6 (7.1%)
Loss of memory	3 (5.2%)	0	3 (3.5%)

Table (4.8) Distribution of CT scan findings by duration of headache (N=85):

	Duration		
Pathology	**Acute (%)**	**Chronic (%)**	**Total (%)**
Hemorrhage	1 (2.9)	1 (2.0)	2 (2.4)
Infarction	3 (8.6)	0 (0.0)	3 (3.5)
Brain atrophy	1 (2.9)	3 (6.0)	4 (4.7)
Degenerative disease	0 (0.0)	1 (2.0)	1 (1.2)
Brain tumor	0 (0.0)	2 (4.0)	2 (2.4)
Sinusitis	2 (5.7)	6 (12.0)	8 (9.4)
Metastasis	3 (8.6)%	0 (0.0)	3 (3.5)
Brain infection	1 (2.9)	2 (4.0)	3 (3.5)
No pathology	23 (68.6)	35 (70.0)	58 (68.2)
Total	**35 (100.0)**	**50 (100.0)**	**85 (100.0)**

Chapter five

Discussion, conclusion and recommendations

Chapter five
Discussion, conclusion and recommendations

5.1 Discussion:

This cross sectional study included a total of 85 participants. There were more female candidates (47) than male candidates (38). This is similar to the study that was done by Morgenstern, L.B., et al in Houston, Texas 66% of the patients were females. Another study that was conducted in France by Valade et al had 75% of female patients among those complaining of headache. The most prevalent age group was between 26 to 33 years (15.3) which also correlates with the study that was done in France by Valade et al that had the mean age 36 years.

The prevalence of positive CT scans was 31.8% that showed more significant findings. In total, among 85 study subjects, 58 (69.4%) did not show any significant findings in the CT scan done. This finding correlates with the studies there were done whereby most of the CT scans of headache patients were actually normal. The commonest cause of secondary headache sinusitis which was located in the maxillary sinus 7.9% in males and 10.6% in females. There was no statistical significant difference of this finding among male and females (P 0.186). The least finding for males was brain tumor and for females was brain atrophy. No female had brain hemorrhage and no male had degenerative changes of the spine for this study. This finding was already suspected in most patients that were from the ENT clinic. This is different from the studies that were done that documented tumors and hemorrhage to be the major causes of secondary type of headache.

In a study that was done by Morgesten et al demonstrated subarachnoid hemorrhage to be the cause of headache. The same was concluded from the study that was done by Lledoal. The socio demographic distribution of diseases pattern of African countries favors infections more than malignancies. However in Korea where hypertension is the most prevalent existing morbidity, intra cerebral hemorrhage was the reported cause of secondary headache. The CT scan becomes necessary only when the issue of time is in question. Also it can be used to evaluate any other co-existing malignancy. The evaluation should start with plain skull x rays in appropriate views. As long as the cons outweigh the pros then there is a need to have the plain X-rays and later on assess the need for further investigation which will include the CT scan.

There was a strong correlation between the clinically diagnosed metastasis and CT scan findings of metastasis (Cc 1). There was a positive correlation between the clinical and CT finding for sinusitis (Cc 0.989). A negative correlation was noted for brain infarction (Cc-0.30). Sinusitis can be diagnosed in the primary settings by the use of plain x ray with appropriate views. For the patients who had primary tumors 4 (12.8%) when they presented with headache the most likely cause was found to metastasis to the brain although other studies indicated other conditions to be associated with other symptoms. In a study by Fridley, J, et al revealed the presence of pituitary gland metastasis from small lung cell carcinoma. The main complaint was headache and seizure. This study did not consider the location of metastasis.

A study that was done in Hong Kong by W. Kong et al documented a case of hepatocellular carcinoma with metastasis in the pituitary gland presenting with supra-orbital headache and vomiting ().

The headaches were classified as being acute less than 4 weeks or chronic more than 4 weeks. Many had presented with chronic type of headache (58.8%). Among both the patients had no pathologies detected by CT scan, 68.6% acute and 70.0% for the chronic cases. Metastasis had presented as acute cases (8.6%)

with no reported chronic case. The degenerative changes of the spine and brain tumors both presented as chronic cases and not acute. The age that presented with highest number of pathologies was above 50 years. The highest age group with pathologies was 58-65 years. (25.9%) although there was no statistical significance difference with other age groups in all pathologies. The socio demographic distribution of Tanzania shows that there are more young people than older group.

Among the participants presented with a preexisting morbidity reached 16 and the most common was hypertension 15 subjects (17.65%). There was significant difference in the CT scan findings among subjects who had hypertension and those who had no hypertension (P 0.005). The data is congruent with the study that was done by W. Kong et al that had identified hypertension as a preexisting morbidity. This variable was taken from the participant's medical history. There might have been new diagnosed cases that were missed.

The least preexisting morbidity was an ear problem. There was no significant difference in findings for those who had and who had no ear problem. Three patients admitted being sero-converted. Some subjects chose not to disclose their status hence this might have also contributed to the lower number. Others might have not known of any other disease they had at that time and others may have chosen not to volunteer that information.

For the 85 subjects that were included for the study, 47 (55.3%) investigation forms had no written diagnosis. This can be from the fact that a doctor might be having many patients and not time to write the diagnosis but also the diagnosis might have not been known due to the symptoms being vague. There were 3 participants that were at a suspicion of having migraine (1.2%). Migraine is principally investigated by MRI as the imaging modality of choice. Their CT scans were bound to be normal. In a study that was done in New England Centre of Headache in USA showed that keeping a longitudinal diary can also assist in the diagnosis of migraine.

Studies sighted earlier on showed the presence of neurological symptoms apart from headache increased the probability of having positive CT scan findings (21). In this study patients were asked about other symptoms. For the ones that could not volunteer this information the investigation form was used. More females reported to have symptoms than males. The most frequent presenting neurological symptoms for the positive CT scans was loss of consciousness (11.8%). For both males and females. For the patients who had this complaint 11.1% had abnormal CT scan. Although this finding was not of statistical significance when compared with those who had no this complaint ($P > 0.05$). Loss of consciousness can be attributed to many conditions and one of them includes seizure disorders. In a study done by Poch et al, the patients with seizure disorders reported to present with headache as well (15). However this study did not put into consideration whether the EEG was done and the result known. Also the patients were not identified as being epileptic from the beginning. The consideration for the time the headache was experienced was also not put into consideration in this study. The prevalence of epileptic disorders for Tanzania is not documented. From the literature, the ideal imaging modality used for such disorders is MRI. The study only looked at CT scans results.

5.2 Conclusion:

From the study was noticed that CT imaging plays a major role in detecting the cause of secondary headache. When used properly it does confirm and give an alternate diagnosis. Most cases had primary type of headache. The commonest cause that was found among patients with suspected secondary headache was sinusitis located in the maxillary sinus. Majority (68.2%) had no any significant findings. Many patients presented with hypertension as an existing morbidity and the frequent encountered neurological manifestation as loss of consciousness.

Some of the written diagnoses were best investigated by other imaging modalities. Some patients when asked about any other imaging investigation done were not aware of the results and also knowledge as for the reason for being asked to do the CT scan. CT scans have been shown to have a role in evaluating the causes of headache. Most of the subjects recruited had no significant findings (68.2%). This demonstrates that CT scan alone may not be the way for patients with headache; other investigations should be undertaken before reaching for the CT scan such cases the clinical findings and other laboratory findings can play a better role than the imaging modalities.

For the cases of migraine history is mandatory as well as hormonal assay and MRI can play a better role than CT scan.

5.3 Recommendations:

Other broader studies that will include more subjects and in other hospitals to be done. This will help give the true picture of situation in the society as a whole.

More emphasis should be given to female patients presenting with headache especially above the age of 40 since they are most likely to be having secondary headache.

Cancer patients should undergo CT scan when presenting with first time headache due to high likelihood of having brain metastasis.

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Appendix