بسم الله الرحمن الرحيم

Sudan University of Science & Technology

College Of Graduate Studies

Evaluation of Brain Computed Tomography Findings in Patients with Headache

تقييم نتائج التصوير المقطعي للدماغ في المرضى الذين يعانون الصداع

A Thesis Submitted in Partial Fulfillment for the Requirements of MSc Degree in Medical Diagnostic Radiologic Imaging

By:

EnasYahyaAbdElsalam Bashir

Supervisor:

Dr. Asma Ibrahim Ahmed Alamein

2018

الآيـة

قال تعالى:

﴿وما أوتيتم من العلم إلا قليلا﴾

سورة الإسراء الآية 85

صدق الله العظيم

DeDica tion

To The spirit of my **Precious mother**

To my Dear awesome companion and Kindness

Mohammed BabikerAlfadni

To **myDear Brother**&**Dear Sisters**

To **my Dear Family**

I dedicate This Work & I ask Allah to keep them healthy and happyness

Acknowledgment

All my thanks is due to his almighty Allah for granting me the will and confidence to perform this study.

I don’t have sufficient words to express my gratitude to my supervisor **Dr. Asma Ibrahim**for her priceless inspiration and encouragement from the beginning, it has been a wonderful experience. Her comments and suggestions encouraged me to think critically.

my heartfelt gratitude also goes to my sincerely Mohammed BabikerAlfadni for giving me more support to establish this work .

I would like to express my best regard to Dr :AlaaAldein Mohamed Ahmed

Finally I would like to thanks my family for their love, warmth and confidence that they gave us.

Abstract

The purpose of this descriptive cross sectional study is to evaluate the computed tomography findings of the brain in patients with headache,. The study used 50 patients with headache underwent a computed tomography scan of the brain in Alamal National Hospital, the sample contained both gender, 24 males and 26 females. Patients were examined in this study, ranging in age from 15 years to 65 years and older, was the predominant age group (26 years to 35 years), which accounted for 40% of the sample size. All patients were examined using the modified protocol for imaging the brain and the modification is limited to increasing the field of view only; the justification for this modification is to complete the sections of maxillary sinuses during CT brain examination because of their importance in the study. Data were collected by clinical data collection sheet designed by researcher to include all the variables in the study and the data analyzed using (Statistical Package for Social Sciences). The main findings were that (62%) of the sample had normal CT brain findings, (38%) showed brain disorders. The researcher detected incidental findings direct from the CT monitor on (30) patients which represent (60%) of the sample size, most of CT findings led to the diagnosis of sinusitis. It is worth to be mentioned that the researcher made sure to print additional film to attract attention. The study recommended the Radiologist must give all cuts the full attention, regardless of the type of CT examination.

مستخلص الدراسة

هدفت هذه الدراسة الوصفية المقطعية لتقييم نتائج التصوير المقطعي للدماغ في المرضى الذين يعانون الصداعكما هدفت الدراسة لتحديد أكثر أسباب الصداع تكراراً ومعرفة جدوى إجراء فحوصات الأشعة المقطعية للدماغ للمرضي الذين يعانون من الصداعتم اخذ 50 مريض يعانون من الصداع أجريت لهم أشعة مقطعية للدماغ في مستشفى الأمل الوطني كما احتوت العينة علي كلا الجنسين، 24 من الذكور و 26 من الإناث. المرضى الذين تم فحصهم في هذه الدراسة تتراوح أعمارهم بين من 15عاما إلى 65 عاما فما فوق، وكانت الفئة العمرية الغالبة (26عاما حتى 35عاما) التي كانت تمثل (40، استخدمت الدراسة ٪) من حجم العينة. تم فحص جميع المرضى باستخدام بروتوكول معدل لتصوير الدماغ والتعديل يقتصر على زيادة مجال الرؤية فقط؛ وتبرير هذا التعديل هو استكمال المقاطع التي تظهر فيها الجيوب الفكية عند فحص الدماغ لأهميتهما في الدراسة. تم جمع البيانات بواسطة ورقة جمع بيانات صممها الباحث لتتضمن جميع المتغيرات في الدراسة و تم تحليل البيانات باستخدام أساليب حوسبة (الحزمة الإحصائية للعلوم الاجتماعية). كانت النتائج الرئيسية هي ان (62٪) من العينة كانت نتائج الأشعة المقطعية لهم طبيعية و(38٪) لديهم اضطرابات في الراس. بينما كشف الباحث نتائج عرضية مباشرة من علي شاشة جهاز الأشعة المقطعية في (30) مريض والتي تمثل (60٪) من حجم العينة، ومعظم النتائج تؤدي إلى تشخيص التهاب الجيوب الأنفية. ومن الجدير بالذكر أن الباحث حرص 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
DLP	Dose Length Product
CTDI vol	Volume CT Dose Index
ANH	Alamal National Hospital

Chapter one

Introduction

1.1 Introduction:

Headache is nearly a universal human experience. The lie time incidence of headache is estimated to be at least 90%. Moskowitz has described headache as the symptom produced by the nervous system when it perceives threat and as much is considered part of the protective physiology of the nervous system. When the cause of headache is diagnosed as secondary headache.

Causes include metabolic, infectious, inflammatory, traumatic, neoplastic, immunologic, endocrinologic and vascular entities.

When no clear pathologic condition can be identified, headache is considered to be manifestation of primary headache syndrome. The common primary headache disorders a defined by the international headache society, are migraine, probable migraine, tension type and cluster headache (Anupama and Amanpreet 2014).

The term "sinusitis" refers to a group of disorders characterized by inflammation of the mucosa of par nasal sinuses (Snell and Richard 2010).Because the inflammation nearly always also involves the nose, it is now generally accepted that "rhino sinusitis" is the preferred term to describe the inflammation of the nose and paranasal sinuses.

Patients with chronic headache pain often present to a variety of specialists, including their primary care physician, neurologist, dentist, otolaryngologist because they or their physician believe the headache to be related to underlying sinus pathology. The primary focus of the otolaryngologist is to exclude this possibility.

The diagnosis of headache secondary to acute-sinusitis can be relatively straightforward. Diagnosis headache secondary to chronic sinus disease can be much more difficult depending on patients' presentation(Anupama and Amanpreet 2014).

Endoscopic techniques are now well established. In combination with modem imaging techniques particularly CT; these techniques provide diagnostic possibilities unimagined a few decades ago.

Computed axial tomography (CT scan) uses x-rays and computers to produce images of cross sections of the body.This can aid to diagnosis of headaches and their causes. CT scan can help the doctor rule out others causes of headache such as: brain tumors, abscess, hydrocephalus and sinus blockage injuries. So headache is easily identified by the CT scan.

Brain CT has gained wide spread acceptance at numerous institutions as becoming the imaging modality of choice for studying patients with chronic headache, but CT brain had limitation in providing maxillary sinuses, by the way we can avoid this problem by increasing the FOV (field of view) to show the maxillary sinuses.On the other hand the MRI modality has the priority in detection the causes of headache(Anupama and Amanpreet 2014).

Classification of headache:

The International Headache Society classifies headaches as follows:-

Primary headache**:** Tension headache, migraine and cluster headache. These headaches vary from mild to severe.

Secondary headache:These are due to a structural cause in the heador neck and may be because of infections like meningitis (inflammation of the coverings surrounding the brain), tumor or hemorrhage (bleeding due to rupture of blood vessel) among others. Causes like cervical spondylitis can also trigger secondary headaches.

Other headache:These are neuralgias (nerve pain), that occur due to inflammation of nerves in the head and upper neck (Wikipedia 2016).

1.2 Problem of the Study

Most cases of patients suffering from headache refereeing for CT brain to detect the causes of headache ؛ but CT brain protocol end at the base of the skull and does not include the sinuses which is one of the causes of headache and this lead to miss diagnose and receiving high radiation dose for the patients with no good result

In this study FOV is increased to detect the most common causes of headache with difint results and to minimize repetition of doing CT examination for the patient

.3 Objectives of the Study

1.3.1 General objective

To evaluate the CT brain findings in patients with headache.

1.3.2 Specific objectives

-To determine the most common causes of CT brain in patients with headache.

-To determine the number of positive CT scans of patients presenting with headache.

-To find out the relationship between the clinical information and the CT findings.

- To investigate about the full benefit of CT examinations carried out.

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. The brain consist of:

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 and Richard 2010).

2.1.1.1 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 precentralgyrus, which is a mass of nervous tissue immediately anterior to the central sulcus(Snell and Richard 2010).

Parietal lobe:Lies internal to the parietal bone and forms the superoposterior 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 postcentralgyrus, which is a mass of nervous tissue immediately posterior to central sulcus (Snell and Richard 2010).

Temporal lobe:Lies inferior to the lateral sulcus and underlies the temporal bone(Snell and Richard 2010).

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(Snell and Richard 2010).

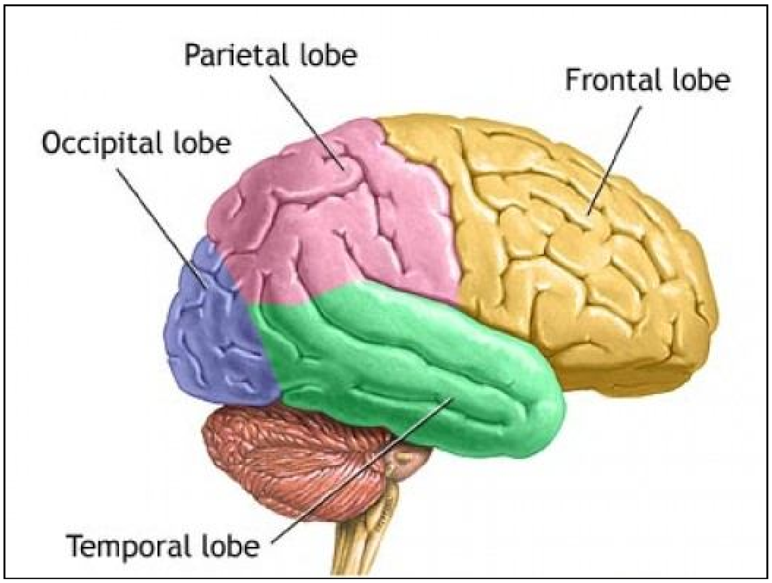

Figure (1.1): Show the lobes of brain

2.1.2 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 hemisphers. Each hemisphers 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.[(3)]

The cerebellum is partitioned internally into three regions: an outer gray matter layer of cortex, an internal region of white matter, and the deepest gray matter layer, which is composed of cerebellar nuclei.

Cerebellar Peduncles:Three thick tracts, called peduncles, link the cerebellum with the brain stem. The superior cerebellar peduncles connect the cerebellum to the mesencephalon. The middle cerebellar peduncles connect the pons to the cerebellum. The inferior cerebellar peduncles connect the cerebellum to the medulla oblongata(Elaine 2004).

2.1.3 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 and Richard 2010).

2.1.3.1 The pons

Is a bulging region on the anterior part of the brainstem that forms from part of the met encephalon. 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 and Richard 2010).

2.1.3.2 The medulla oblongata

Is conical in shape and connects the pons above to the spinal cord below(Snell and Richard, 2010).

2.1.4 Diencephalon

The diencephalon is a part of the prosencephalon 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(Elaine 2004).

2.1.4.1 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(Elaine 2004).

2.1.4.2 Thalamus

Each half of the brain contains a thalamus, a large, ovoid, gray mass of nuclelli. The thalamus forms the superolateral walls of the third ventricle(Elaine 2004).

2.1.4.3 Hypothalamus

It is the anteroinferior region of the diencephalon. The thin, stalklike infundibulum extends inferiorly from hypothalamus to attach to the pituitary gland(Elaine 2004).

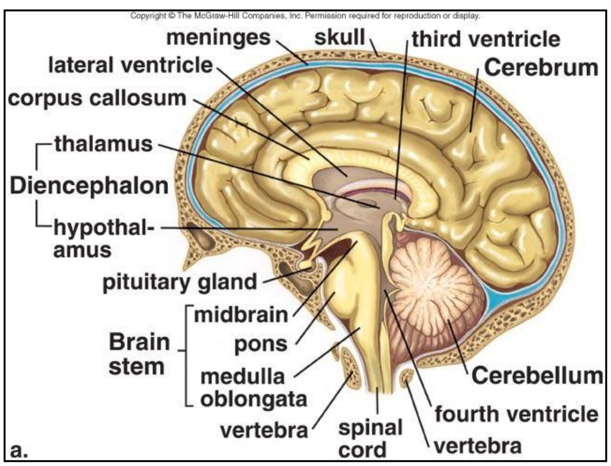

Figure (1.2): Show structures of brain

2.1.5 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 cerebrospinalfluid (CSF) from blood plasma.The two largest are the lateral ventricles in the cerebrum; the third ventricle is in the diencephalon of the fore brain 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 and Richard 2010).

2.1.5.1 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(Elaine 2004).

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.

Ependymal cells of the choroid plexus produce more than two thirds of CSF. The choroid plexus is a venous plexus contained within the four ventricles of the brain, hollow structures inside the brain filled with CSF. The remainder of the CSF is produced by the surfaces of the ventricles and by the lining surrounding the subarachnoid space.

Ependymal cells actively secrete sodium into the lateral ventricles. This creates osmotic pressure and draws water into the CSF space. Chloride, with a negative charge, moves with the positively charged sodium and a neutral charge is maintained. As a result, CSF contains a higher concentration of sodium and chloride than blood plasma, but less potassium, calcium and glucose and protein(Wikipedia 2016).

2.1.6 Basal Ganglia

The basal ganglia are paired masses of gray matter within the white matter of the cerebral hemispheres (Snell and Richard 2010).

2.1.7 Meninges

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

2.1.7.1 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 and Richard 2010).

2.1.7.2 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 mesothelialcells(Snell and Richard 2010).

2.1.7.3Pia 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 (Snell and Richard 2010).

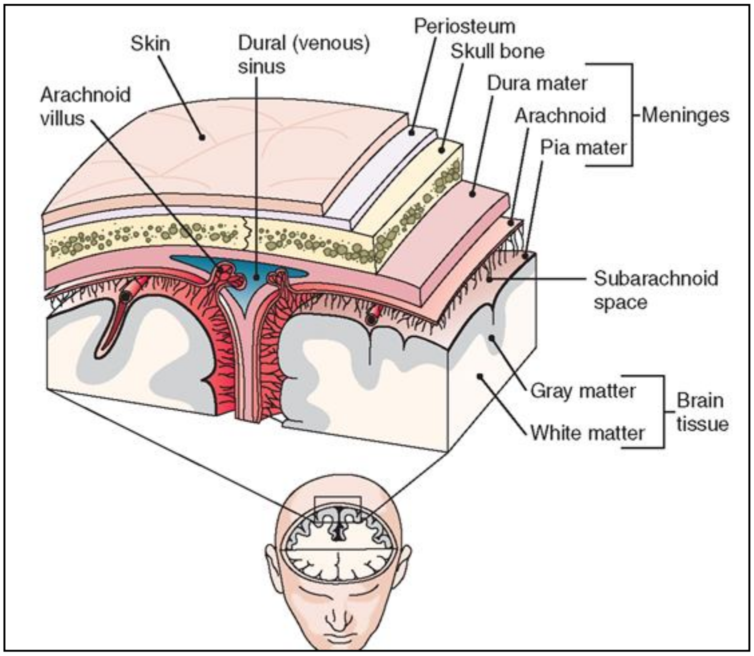

Figure (1.3): Show the layers of meninges (google.com 2016).

2.1.8 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).

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(Elaine 2004).

2.1.9 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 and Richard 2010).

2.1.10 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 and Richard 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(Elaine 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 (Elaine 2004).

2.2.1.2 Parietal lobe

Sensory interpretation of textures and shapes; understanding speech and formulating words to express thoughts and emotions(Elaine 2004).

2.2.1.3 Temporal lobe

Interpretation of auditory and olfactory sensation; storage of auditory and olfactory experiences(Elaine2004).

2.2.1.4 Occipital lobe

Conscious perception of visual stimuli; integration of eye focusing movements; correlation of visual images with previous visual experiences(Elaine 2004).

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(Elaine 2004).

2.2.3 Cerebellum

Controls fine movement, coordinates muscle groups, and maintains balance(Elaine 2004).

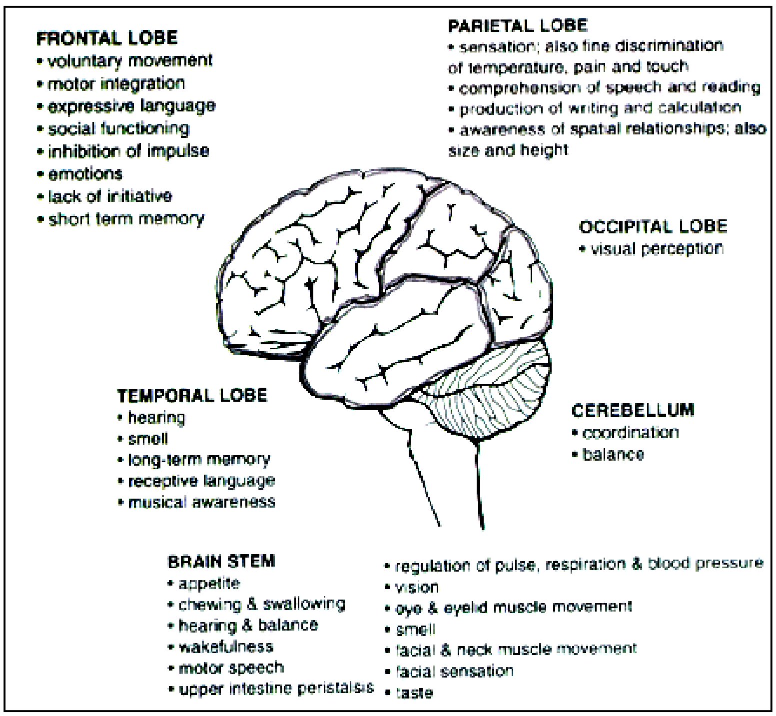

Figure (1.4): Show function of brain(google.com 2016)

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(Elaine 2004).

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(Elaine 2004).

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)(Elaine 2004).

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(Elaine 2004).

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, asmight 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 et al. 2013).

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 thereis 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 suturesfuse, 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, acompensatory increase in CSF volume can also follow the loss of brain parenchyma (hydrocephalus ex vacuo), as after infarcts or with degenerative diseases (Vinay et al. 2013).

2.3.2 Hemorrhage of brain

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 et al. 2013).

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 childrenand 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 et al. 2013).

2.3.2.3 Subdural hematoma

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 et al. 2013).

2.3.2.4 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 et al. 2013).

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 et al. 2013).

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 et al. 2013).

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 et al. 2013).

2.3.3.3 Tuberculous meningitis

Tuberculous meningitis usually manifests with generalized signs and symptoms of headache, malaise, mental confusion, and vomiting. There is only a moderate increase in CSF cellularity, with mononuclear cells or a mixture of polymer phonuclear and mononuclear cells; the proteinlevel is elevated, often strikingly so, and the glucose content typically is moderately reduced or normal. Infection with Mycobacterium tuberculosis also may result in a well circumscribedintraparenchymal mass (tuberculoma), which may be associated with meningitis. Chronic tuberculousmeningitis is a cause of arachnoid fibrosis, which mayproduce hydrocephalus

Diagnosis: Biopsy of the meninges, blood culture, chest x-ray, CT scan of head and skin test for tuberculosis (PPD) (Vinay et al. 2013).

2.3.3.4 Brain abscesses

Brain abscess (or cerebral abscess) is an abscess caused by inflammation and collection of infected material, coming from local (ear infection, dental abscess, infection of paranasal sinuses, infection of the mastoid air cells of the temporal bone, epidural abscess) or remote (lung, heart, kidney etc.) infectious sources, within the brain tissue. The infection may also be introduced through a skull fracture following a head trauma or surgical procedures. Brain abscess is usually associated with congenital heart disease in young children. It may occur at any age but is most frequent in the third decade of life(Wikipedia 2016).

Symptoms: The symptoms of brain abscess are caused by a combination of increased intracranial pressure due to a space-occupying lesion (headache, vomiting, confusion, and coma), infection (fever, fatigue etc.) and focal neurologic brain tissue damage (hemiparesis, aphasia etc.). The most frequent presenting symptoms are headache, drowsiness, confusion, seizures, hemiparesis or speech difficulties together with fever with a rapidly progressive course. The symptoms and findings depend largely on the specific location of the abscess in the brain. An abscess in the cerebellum, for instance, may cause additional complaints as a result of brain stem compression and hydrocephalus. Neurological examination may reveal a stiff neck in occasional cases (erroneously suggesting meningitis). The famous triad of fever, headache and focal neurologic findings are highly suggestive of brain abscess.

Diagnosis: The diagnosis is established by a computed tomography (CT) (with contrast) examination. At the initial phase of the inflammation (which is referred to as cerebritis), the immature lesion does not have a capsule and it may be difficult to distinguish it from other space-occupying lesions or infarcts of the brain. Within 4–5 days the inflammation and the concomitant dead brain tissue are surrounded with a capsule, which gives the lesion the famous ring-enhancing lesion appearance on CT examination with contrast (since intravenously applied contrast material cannot pass through the capsule, it is collected around the lesion and looks as a ring surrounding the relatively dark lesion)(Wikipedia 2016).

2.3.4 Brain tumor

The annual incidence of tumors of the CNS ranges from 10 to 17 per 100,000 persons for intracranial tumors and 1 to 2 per 100,000 persons for intraspinal tumors; about half to three-quarters are primary tumors, and the rest are metastatic. There are many types of primary brain tumors. Primary brain tumors are named according to the type of cells or the part of the brain in which they begin (Vinay et al. 2013).

2.3.4.1 Gliomas

Gliomas are tumors of the brain parenchyma that are classified histologically on the basis of their resemblance to different types of glial cells. The major types of glial tumors are astrocytomas, oligodendrogliomas, and ependymomas.The most common types are highly infiltrative or “diffuse gliomas,” including astrocytic, oligodendroglial, and mixed forms. In contrast, ependymomas tend to form solid masses (Vinay et al. 2013).

2.3.5 Infarction

Is a type of ischemic stroke resulting from a blockage in the blood vessels supplying blood to the brain. It can be atherothrombotic or embolic. Stroke caused by cerebral infarction should be distinguished from two other kinds of stroke: cerebral hemorrhage and subarachnoid hemorrhage. A cerebral infarction occurs when a blood vessel that supplies a part of the brain becomes blocked or leakage occurs outside the vessel walls. This loss of blood supply results in the death of tissue in that area. Cerebral infarctions vary in their severity with one third of the cases resulting in death. Non hemorrhagic infarcts result from acute vascular occlusions and can be treated with thrombolytic therapies, especially if identified shortly after presentation. This approach is contraindicated in hemorrhagic infarcts,which result from reperfusion of ischemic tissue, either through collaterals or after dissolution of emboli, and often produce multiple, sometimes confluent petechial hemorrhages(Vinay, et al, 2013, Wikipedia 2016).

Symptoms: Infarctions will result in weakness and loss of sensation on the opposite side of the body(Wikipedia 2016).

Diagnosis: Computed tomography (CT) and MRI scanning will show damaged area in the brain, showing that the symptoms were not caused by a tumor, subdural hematoma or other brain disorder. The blockage will also appear on the angiogram (Wikipedia 2016).

2.4 Equipment

2.4.1 Computed tomography

Computed tomography, like conventional radiography, relies on x-ray transmitted through the body. Computedtomography differs from conventional radiography in that it uses a more sensitive x-ray detection system than photographic film,namely gas or crystaldetectors, and manipulates the data using computer. The x-ray tube and detectors rotate around the patient, and the patient lies with part to be. Examined within the gantry housing. By the moving the patient through the gantry, multiple adjacent section can be imaged allowing a picture of the body to the built up (Peter 1998).

There are two method of CT scanning:

1. Slice by slice conventional CT: in this method the table top sporting the patient comes to a stop for each section.
2. Spiral (helical) CT: the patient is transported continuously through the scanner, so in effect the x-ray beam traces spiral path, will the data are collecting continuously, to create volume of data within the computer memory (Karthikeyan 2005).

2.4.2 The main components of the CT scanner

2.4.2.1 Gantry

Is the major component of a CT system which is movable frames that contains the x-ray tube including collimators and filter, detector, data acquisition system (DAS) and rotational component including slip ring system and all associated electronics such as gantry angulation motors and positioning laser lights (Ken, et. al., 1993).

The x-ray tube is produced x-ray. The three main parts of any x-ray tube are the anode, cathode and the filament.

Collimation important component for reducing patient dose and improving image quality by reducing scatter radiation.

Filtration: is filtering the low energy photon.

Detector gather information by measuring the x-ray attenuation through objects (Ken et al. 1993).

2.4.2.2 Operator console

Scan console:

- Technical factors. Slice thickness, number of scans, and angle of gantry.
- Initiates scan, record patient data, sets FOV.

Display console:

- Use to manipulate post scan data.
- Window level and width (Ken et al. 1993).

2.4.2.3 Computer

The computer process convert the signal from analog to digital by using analog to digital converter (ADC). It stores the digital signal during the scan and reconstructed the image after the scan is complete (Ken et al. 1993).

2.5 Previous study

2.5.1(Joseph Maytag et al. n. d)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%. Conclusion: 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.

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.

2.5.3 Anishsubedee carried out the study aimed to find out the proportion of intracranial abnormalities in patients with chronic headache without neurologic abnormality with the use of computed tomography (CT) and to compare the results with similar studies done previously. On the 56 patients, 50 had normal CT (89.28 %), four had minor abnormality (7.14%) that did not alter patient management and two had significant lesions (3.57%). Contrast enhanced CT did not improve lesion detection. The minor findings detected were sub-ependymal calcifications of Tuberous sclerosis, calcified neurocysticercosis and old lacunar infarctions in external capsule. Clinically significant lesions detected were small ring enhancing lesion (neurocysticercosis or tuberculoma) and pineal cyst. Results of this study were compared with previous study with similar study design. The Z test showed that the difference in proportions in these studies was not statistically significant ($p = 0.0708$ for minor findings and $p = 0.2033$ for significant findings). Conclusion: The proportion of intracranial abnormalities detected by CT in this study was similar to that of previous studies. The use of intravenous contrast material administration did not improve its yield. This corroborates the evidence that the ability of CT scan in detecting significant intracranial pathology is poor in patients with chronic headache without neurologic abnormality.

Chapter three

Material and methodology

3.1 Material

3.1.1Type of Study

A cross-sectional descriptive study.

3.1.2 Area and Duration of the Study

This study was done in Alamal Hospital, in duration between (Dec2017 to Feb 2018).

3.1.3 The inclusion criteria

The patients suffering headache and referred for CT brain examination**.**

3.1.4 The exclusion criteria

Patients referred for CT brain examination with other clinical indications.

3.1.5 Study variables

The study variables including patient age, gender, history, signs, symptoms and findings.

3.1.6 Data collection

Data will be collect by clinical data collection sheet.

3.1.7 Sampling and Population of the Study

Sample size will be in (50) patients who were clinically had headache, undergo to computed tomography for brain.

3.1.8 Data Analysis and Presentation

The data were analyzed by Statistical Package for Social Sciences (SPSS) and were present in tables and figures.

3.1.9 Ethical considerations

All patients under gone the exam have told that the needs for increase **FOV** for research Purposeand take agreement from them verbally.

3.2 Methodology

3.2.1 CT Machine

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

Figure (3.1) Toshiba CT scanner (64 slices)

3.2.2 Method

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.

3.2.1 Method of scanning

3.2.1.1 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

Table (4.1) Shows distribution of age groups

Valid	Frequency	Percent
15-25	14	%28
26-35	20	%40
36-45	7	%14
56-65	2	%4
>65	7	%14
Total	50	%100.0

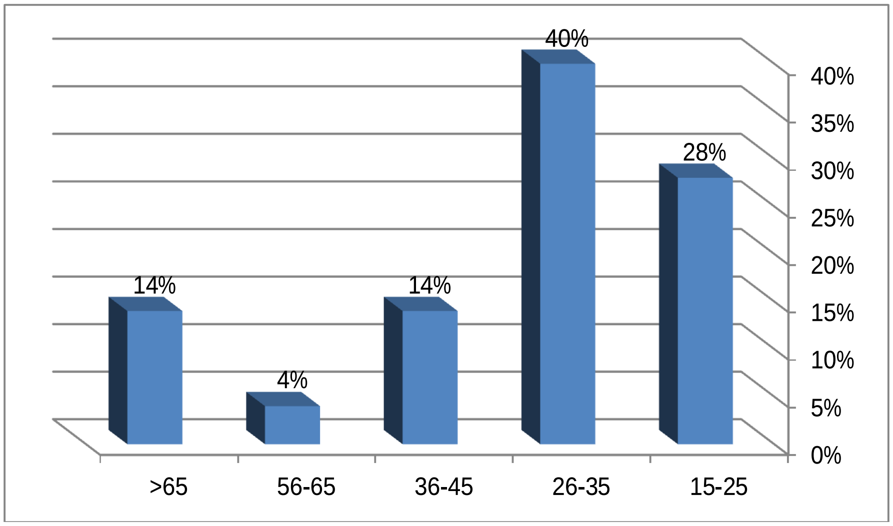

Figure (4.1) Shows distribution of age groups

Table (4.2) Shows number of males and females

Valid	Frequency	Percent
Male	24	%48.0
Female	26	%52.0
Total	50	%100.0

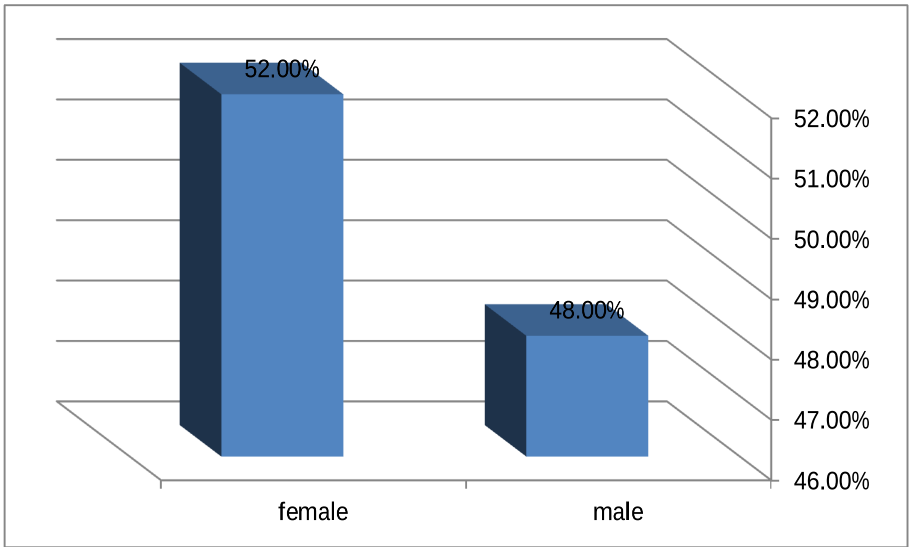

Figure (4.2) Shows number of males and females

Table (4.3) Shows distribution of headache according to its severity and type

Valid	Frequency	Percent
Moderate	18	%36.0
Mild	5	%10.0
Chronic	21	%42.0
Migraine	6	%12.0
Total	50	%100.0

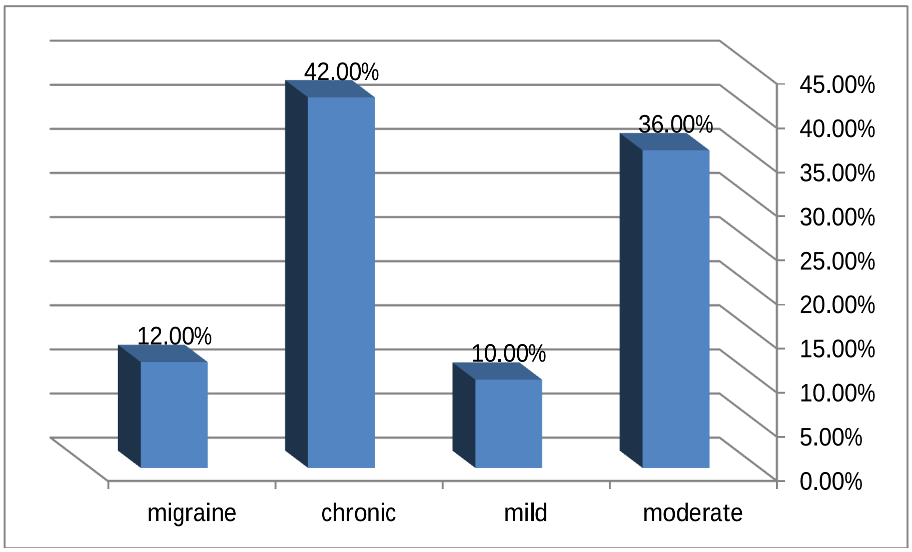

Figure (4.3) Shows distribution of headache according to its severity and type

Table (4.4) Shows the distribution of signs, symptoms and clinical history

Valid	Frequency	Percent
Headache	42	%84.0
headache +vision	1	%2.0
headache+ vomiting	2	%4.0
Headache +vomiting +consciousness	1	%2.0
Headache +trauma	4	%8.0
Total	50	%100.0

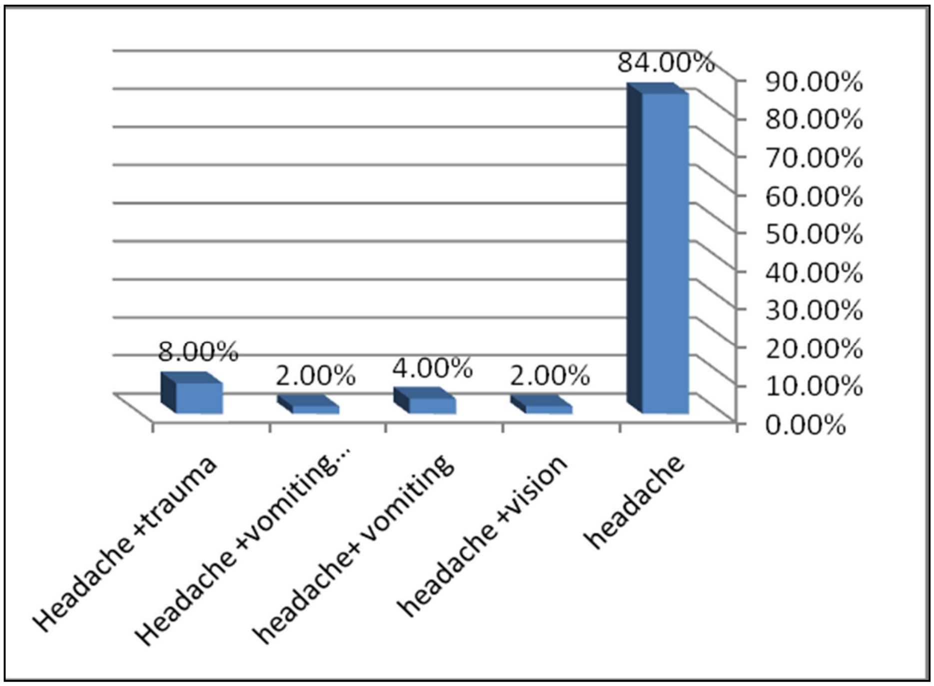

Figure (4.4)Shows the distribution of signs, symptoms and clinical history

Table (4.5) Shows the distribution of CT brain Findings

Valid	Frequency	Percent
normal	31	62.0
hematoma	5	10.0
atrophy	8	16.0
hydrocephalus	3	6.0
Infarction	3	6.0
Total	50	100.0

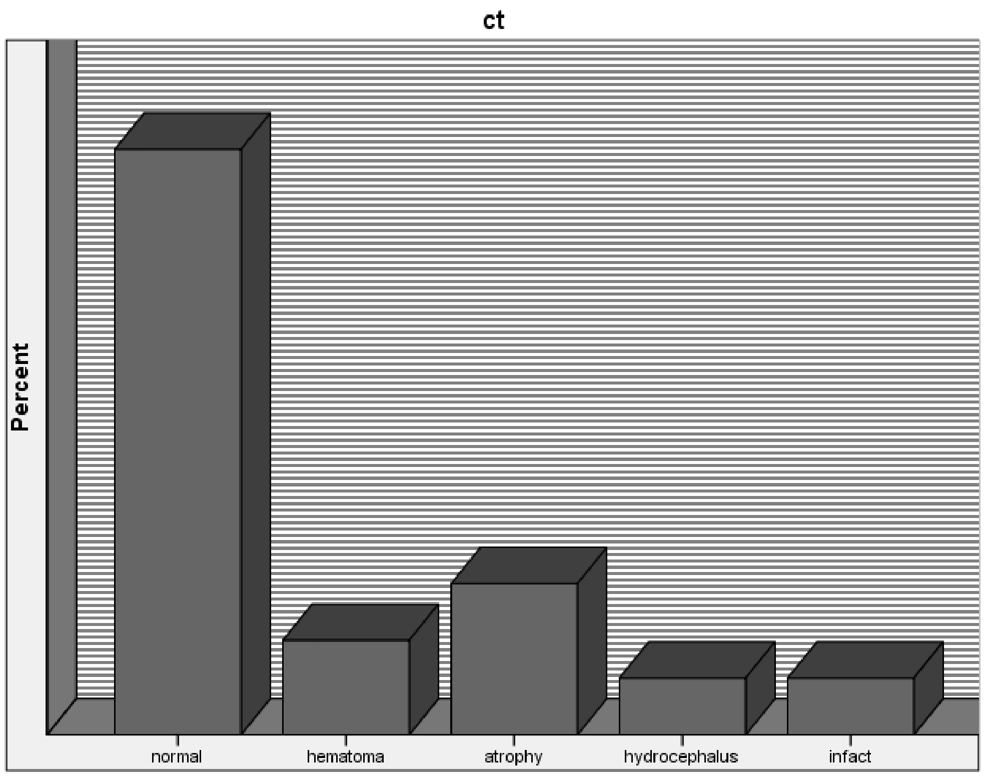

Figure (4.5) Shows the distribution of CT brain Findings

Table (4.6) Shows the distribution of CT brain Findings

in the final report

Valid	Frequency	Valid Percent
Mentioned	14	%46.7
Not mentioned	16	%53.3
Total	30	%100.0

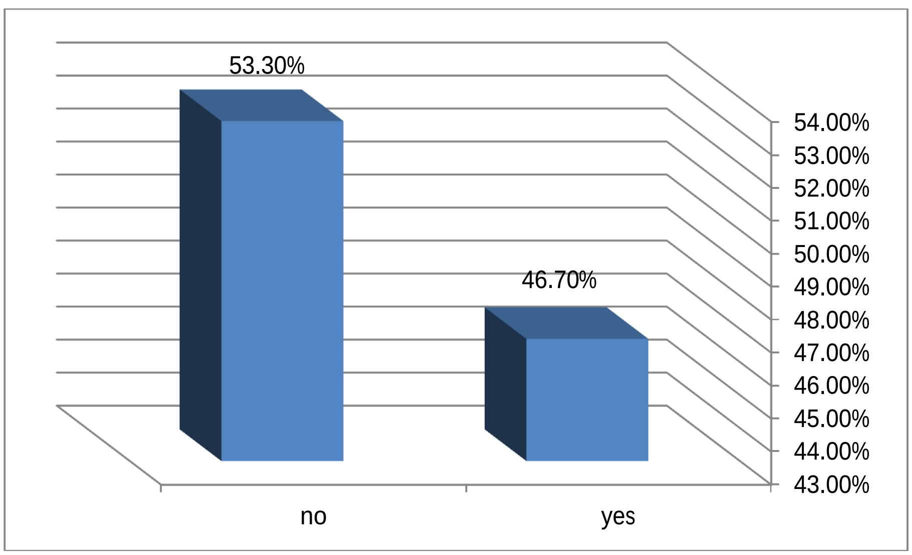

Figure (4.6) Shows the distribution of CT brain Findingsin the final report

Table (4.7) Shows the relationship between the CT brain findings and the gender

Count			
Ct finding	**Gender**		**Total**
	Male	**Female**	
Normal	17	14	31
hematoma	4	1	5
Atrophy	3	5	8
hydrocephalus	0	3	3
Infarction	0	3	3
Total	24	26	50

P value= .074

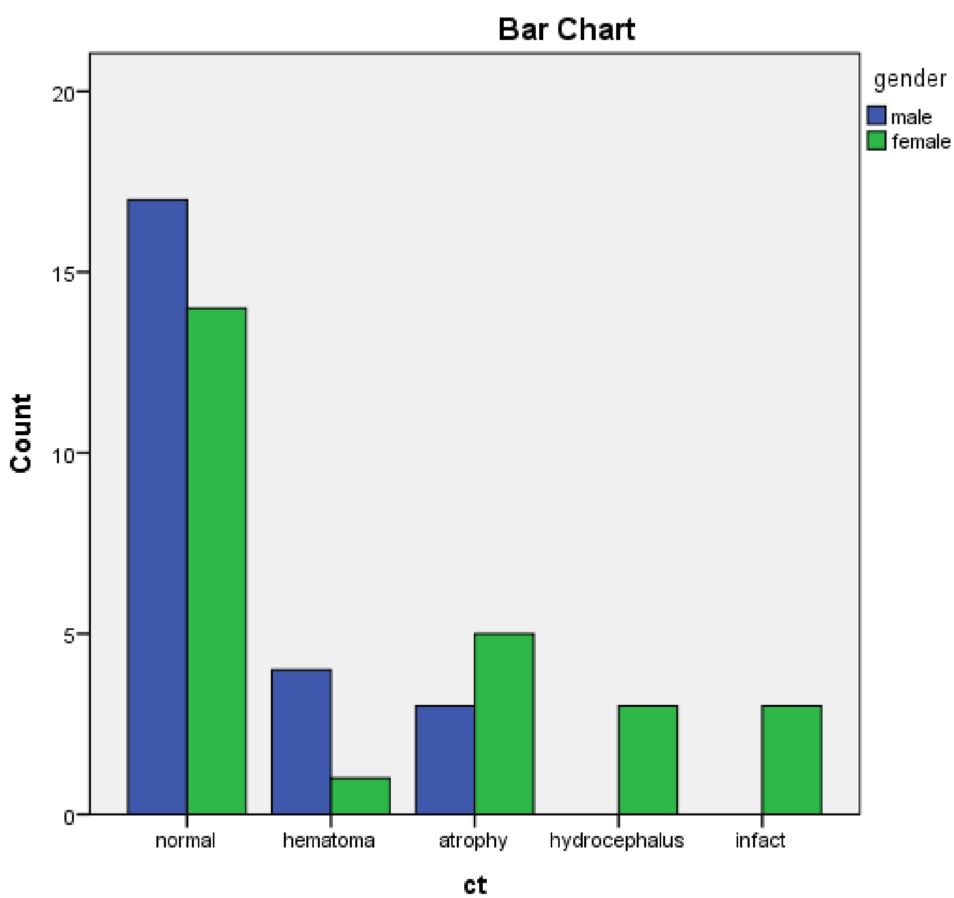

Figure (4.7) Shows the relationship between the CT brain findings and the gender

Table (4.8) Shows the relationship between the CT brain findings and type and severity of headache

Count

		Duration				Total
		moderate	Mild	chronic	migraine	
Ct finding	Normal	12	4	10	5	31
	hematoma	3	0	2	0	5
	Atrophy	3	1	4	0	8
	hydrocephalus	0	0	2	1	3
	Infarction	0	0	3	0	3
Total		18	5	21	6	50

P value= .478

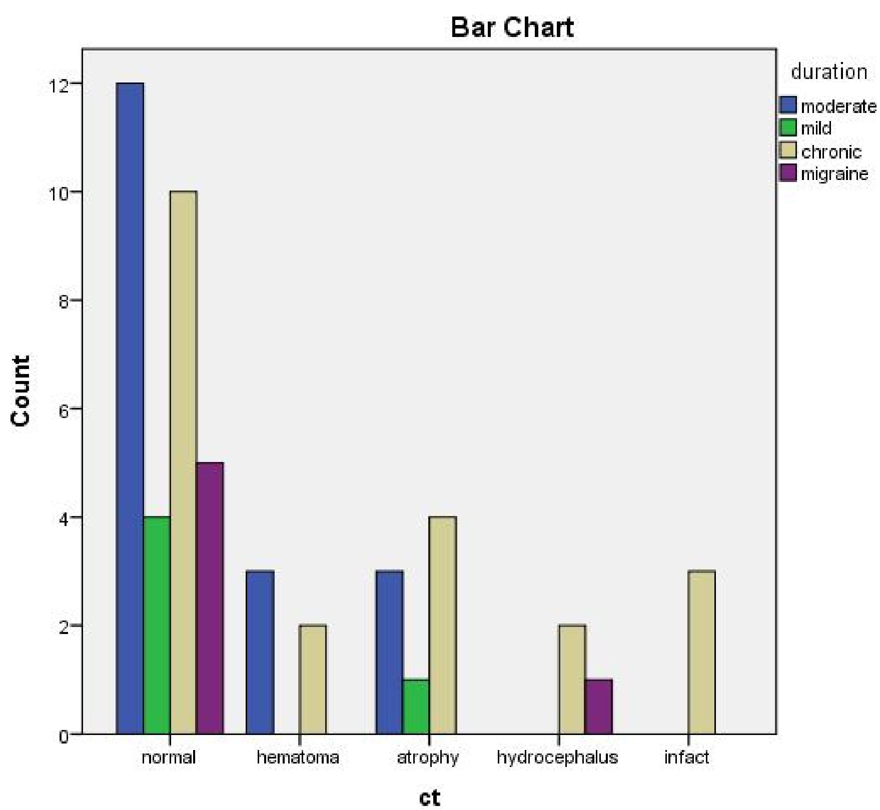

Figure (4.8)Shows the relationship between the CT brain findings and type and severity of headache

Table (4.9) Shows the relationship between CT brain findings and signs, symptoms and history

Ct finding	Clinical					Total
	headache	headache +vision	headache+ vomiting	headache +vomiting +unconsicousness	headache +trauma	
Normal	26	0	1	0	4	31
Hematoma	4	0	1	0	0	5
Atrophy	6	1	0	1	0	8
hydrocephalus	3	0	0	0	0	3
Infarction	3	0	0	0	0	3
Total	42	1	2	1	4	50

P value= .651

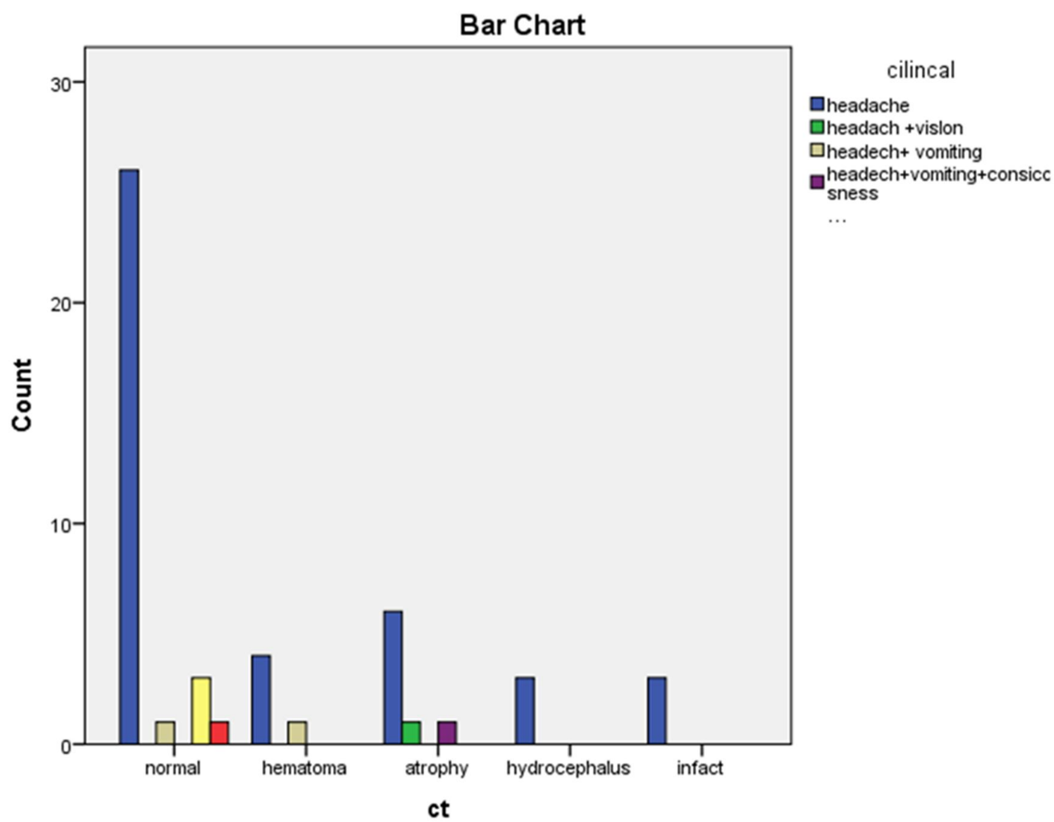

Figure (4.9) Shows the relationship between CT brain findings and signs, symptoms and history

Table (4.10) Shows the relationship between the CT brain findings and the patient's age

Valid of CT brain finding	Age					Total
	15-25	26-35	36-45	56-65	>65	
normal	13	14	4	0	0	31
hematoma	1	2	0	0	2	5
atrophy	0	1	1	1	5	8
hydrocephalus	0	3	0	0	0	3
Infarction	0	0	2	1	0	3
Total	14	20	7	2	7	50

P value=.000

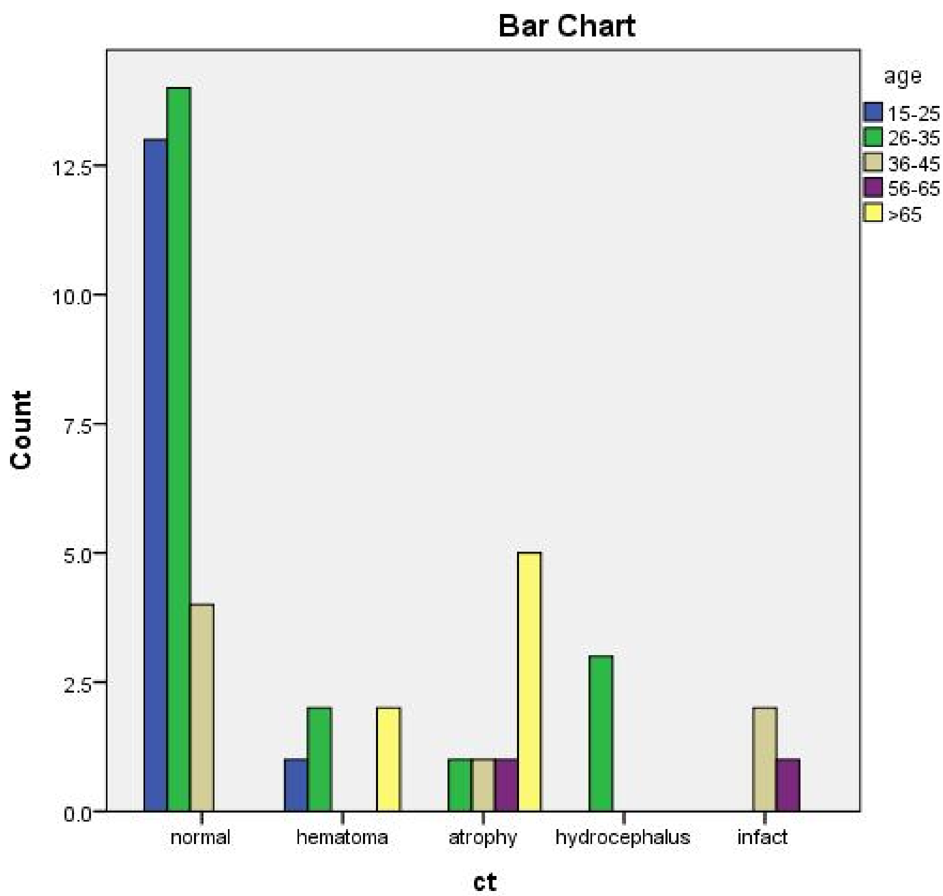

Figure (4.10) Shows the relationship between the CT brain findings and the patient's age

Table (4.11) Shows the relationship between the incidental findings and the patient's age

incidental	Finding	Age					Total
		15-25	26-35	36-45	56-65	>65	
	Negative	4	6	3	1	6	20
	Positive	10	14	4	1	1	30
Total		14	20	7	2	7	50

P value= 0.099

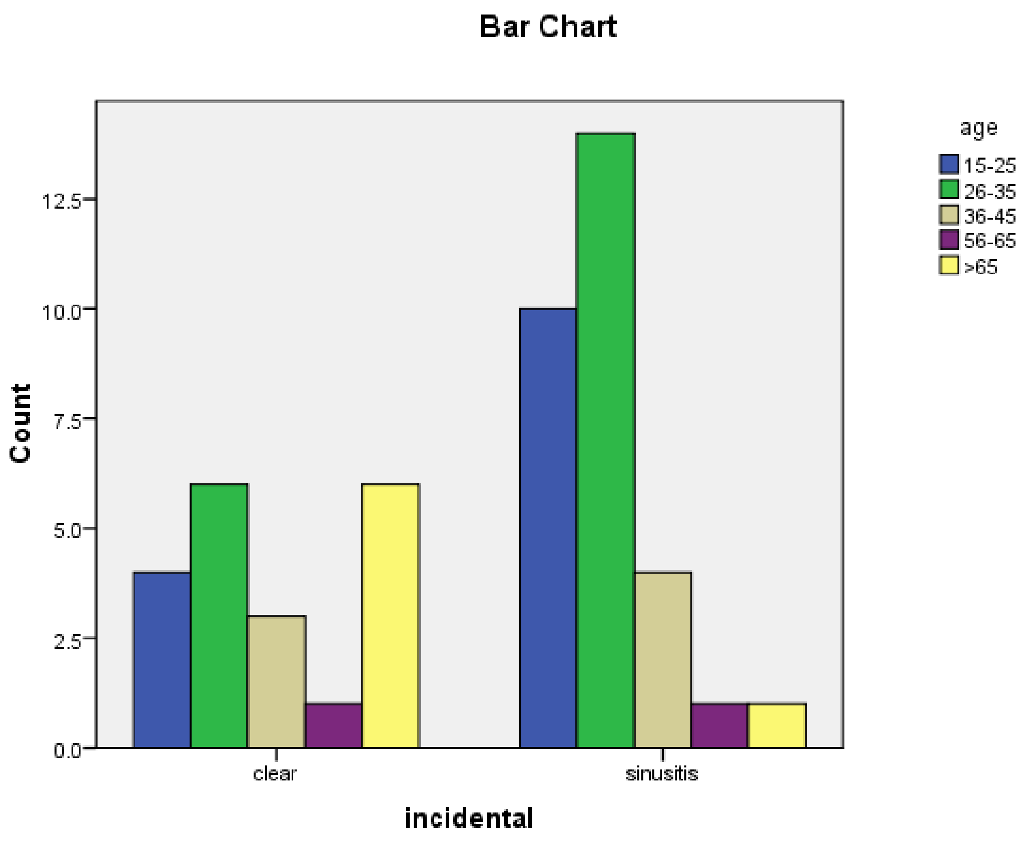

Figure (4.11) Shows the relationship between the CT brain findings and the patient's age

Table (4.12) Shows the relationship between the incidental findings and its mentioning in the final report

	Finding	Radiologist		Total
		Yes	no	
incidental	Negative	0	0	0
	Positive	14	16	30
Total		14	16	30

P value= 0.000

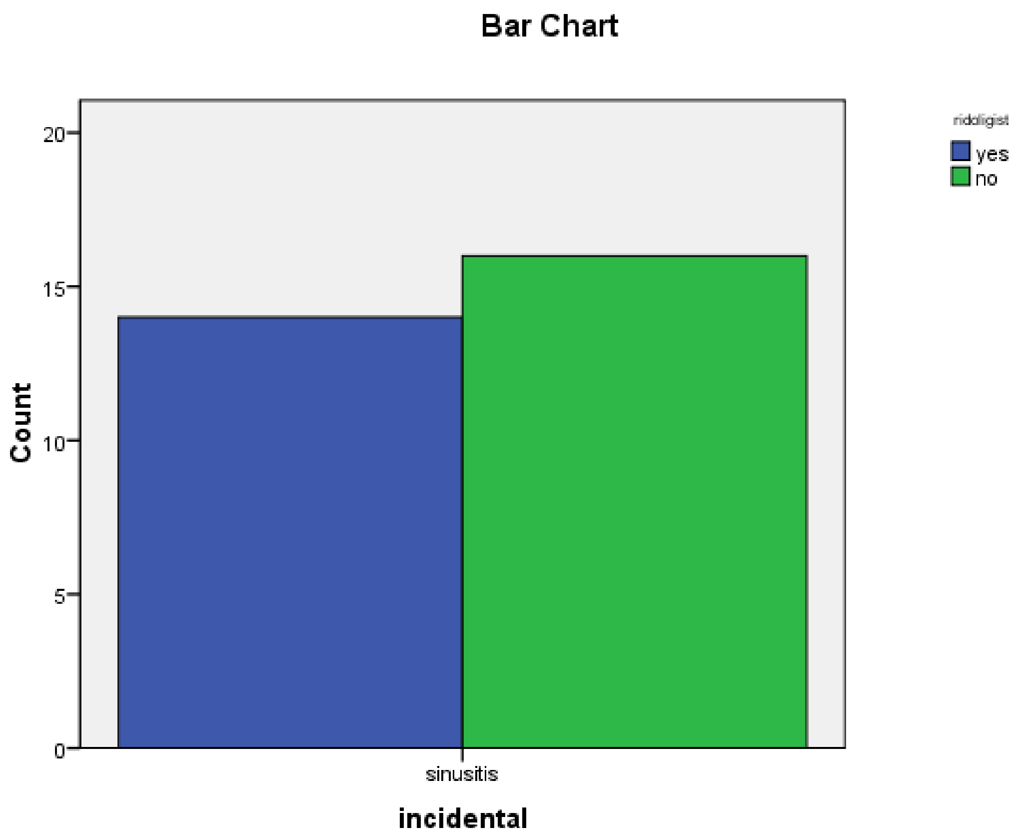

Figure (4.12) Shows the relationship between the CT brain findings and its mentioning in the final report

Table (4.13) Shows the relationship between the CT brain findings and incidental finding

Count			
CT finding	Incidental		Total
	negative	positive	
normal	9	22	31
hematoma	3	2	5
atrophy	4	4	8
hydrocephalus	2	1	3
infarction	2	1	3
Total	20	30	50

P value=.466

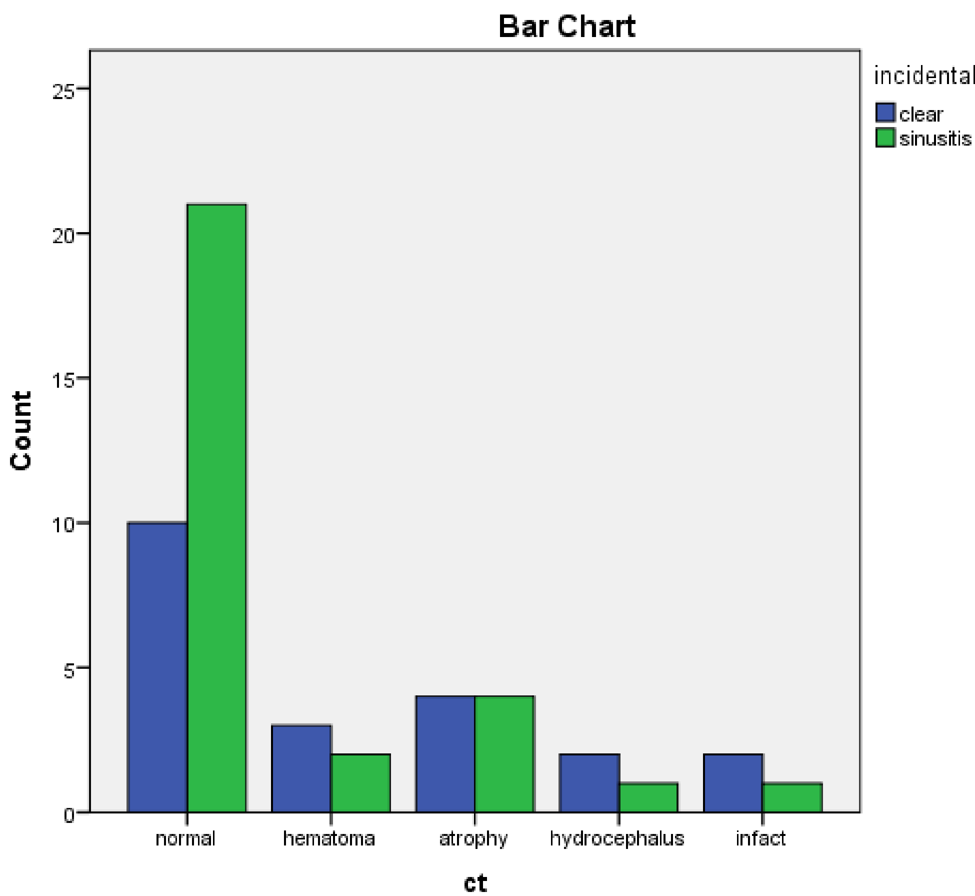

Figure (4.13) Shows the relationship between the CT brain findings and incidental finding

Table (4.14) Shows the relationship between the incidental findings and type and severity of headache

	Finding	Type of headache				Total
Incidental		moderate	Mild	chronic	migraine	
	Negative	5	0	11	4	20
	Positive	13	5	10	2	30
Total		18	5	21	6	50

P value= 0.056

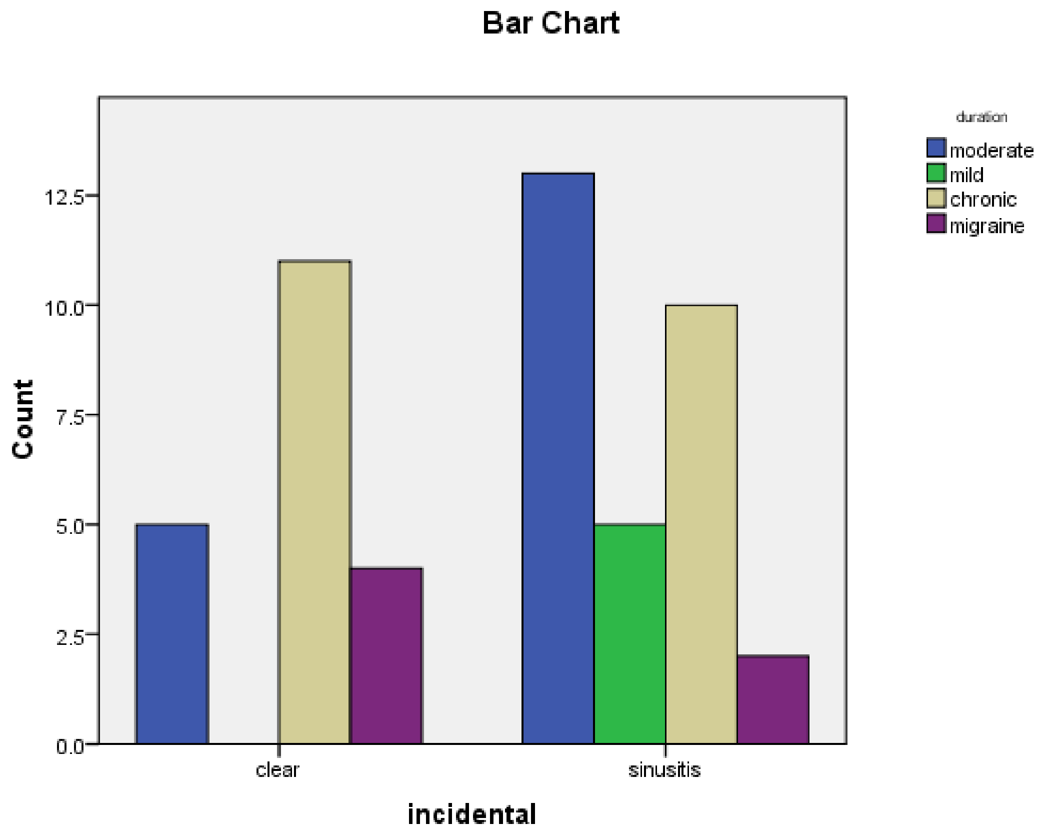

Figure (4.14) Shows the relationship between the incidental findings and type and severity of headache

Chapter five

Discussion, conclusion and recommendation

5.1 Discussion

The study was attempted to evaluate the findings of brain computed tomography in patients suffering headache as well as to evaluate the incidental findings that may present. The research used 50 patients whom were subjected to CT brain procedures ,both gender were scan, 24 males and 26 females as shown in figure (4.2).

The patients ages in this study ranging from 15years old up to over 65 years old, the dominant age group was (26Y up to 35y) which was (40%) of the sample size as shown in figure (4.1).

All patients in this study vary in the severity of headache, (42%) of the sample suffering chronic headache attack, (36%) of the sample suffering moderate headache attack, while (10%) suffering mild attack. The rest (12%) suffering migraine.

All the patients were examined by using modified CT brain protocol, the modification limited to increasing the field of view only; the justification for this modification is to complete the axial cuts of the maxillary sinuses while scanning the brain. The main findings were that (62%) of the sample had normal CT brain findings, (16%) showed brain atrophy, (10%) showed the findings of hematoma, (6%) showed the findings of hydrocephalus and (6%) showed the findings of brain infarction as shown in figure(4.5).

There was (42) patients out of (50) patients suffering headache only with no other signs, symptoms or history of trauma, while the rest beside headache suffering problem in vision, vomiting, unconsciousness, and history of trauma as shown in figure (4.4).

The study found that the majority of patients suffering migraine had normal CT brain, as (5) out of (6) patients of migraine had normal CT brain while only one had hydrocephalus as shown in figure (4.8). Based on this result, patients suffering migraine suggested not to having CT brain examinations.

Also all patients with mild headache suggested not to having CT brain examinations, as (4) out of (5) patients with mild headache had normal CT brain as shown in figure (4.8).

(47.6%) of patients with chronic headache had normal CT brain, while (66.6%) of patients with moderate headache had normal CT brain findings as shown in figure (4.8). Based on the percentages above the researchers think that the CT examination for the brain in cases of moderate and chronic headache could be conducted especially under adequate clinical examinations.

The patients above 65 years old in this study had no normal CT brain, as there are (7) patients above 65Y, (5) of the head brain atrophy while the rest (2) had hematoma.

The age group (26-35) was most frequent in detection of the incidental findings as it showed (12) cases, while the age group (15-25) followed as it showed (10) cases as shown in figure (4.11).

Increasing of the radiation dose benefited the patients by avoiding a new CT examinations that duplicate the dose when the previous exam did not meet the diagnostic needs.

5.2 Conclusion

From the study it's well established that CT imaging plays a major role in detecting the cause of secondary headache.

When used properly it does confirm and gives final diagnosis. Most cases had a primary type of headache. The commonest cause that was found among patients with suspected secondary headache was sinusitis which located in the maxillary sinuses. The majority of cases which represent 61.2% had no any significant finding regarding brain, this indicate that CT scan brain alone is not sufficient for patient with headache ; the clinical examination, signs and symptoms can play a better role in determining the investigation of choice. For the cases of migraine history is mandatory as well as hormone assay and MRI can play a better role than CT scan.

5.3 Recommendation

1. For more future studies the researcher advice to increase the sample size and conduct the studies on other hospital to evaluate the CT technologist practice in addition to the radiologist.
2. Improve our health policy and any persons suffer from headache should attend hospitals for further investigation.
3. Educating and practice is important rule in increasing the health standard.
4. The doctors must do adequate clinical examination before sending the patient to brain CT scan.
5. Radiologist must give all cuts the full attention, regardless of the type of CT examination.
6. The CT technologist try to provide the radiologist with maximum numbers of film allowed by the department policy.

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