Sudan University of Science and Technology
College of Graduate Studies

Study of Traumatic Head Injuries Using Computerized Tomography Among sudanese Population

دراسة إصابات الرأس باستخدام الأشعة المقطعية المحوسبة لدى السودانين

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

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الآية

بسم الله الرحمن الرحيم

قال تعالى {اللهُ لاَ إِلَهَ إِلاَّ هُوَ الْحَيُّ الْقَيُّومُ لاَ تَأْخُذُهُ سِنَةٌ وَلاَ نَوْمٌ لَّهُ مَا فِي السَّمَاوَاتِ وَمَا فِي الأَرْضِ مَن ذَا الَّذِي يَشْفَعُ عِنْدَهُ إِلاَّ بِإِذْنِهِ يَعْلَمُ مَا بَيْنَ أَيْدِيهِمْ وَمَا خَلْفَهُمْ وَلاَ يُحِيطُونَ بِشَيْءٍ مِّنْ عِلْمِهِ إِلاَّ بِمَا شَاء وَسِعَ كُرْسِيُّهُ السَّمَاوَاتِ وَالأَرْضَ وَلاَ يئوده حِفْظُهُمَا وَهُوَ الْعَلِيُّ الْعَظِيمُ}

الاية (255) سورة البقرة

Dedication

To the candles that burn to light my way, my lovely parents,

who made all the cheap and precious for the sake of my arrival to

this Stage

To my dear brothers

For their patience and endless support

To my friends and my colleagues

To the kids & children around the world

To all whom I do love and respect

I dedicate this work.

Acknowledgement

Grateful thanks and grace to Allah the Almighty for guiding and helping me start and finish this research.

I would also like to express sincere thanks and deep gratitude to my faithful supervisor, ***Dr. Salah Ali Fadlalla*** for his useful advice, encouragement and wise guidance through this thesis and sharing his knowledge through all the lectures during the course.

My thanks are extended to Al Tamayuz center staff for their help.

Finally, I would like to sincerely thank my family for their consistent support.

List of abbreviations

ADH	Antidiuretic hormone
CT	Computed Tomography
CSF	Cerebro Spinal Fluid
CNS	Central nervous system
DAI	Diffuse axonal injuries
GHRH	Growth hormone releasing hormone
GH	Growth hormone
ICA	Internal carotid arteries
PNS	Peripheral nervous system
RTA	Road traffic accident
TBI	Traumatic brain injury

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Abstract

The traumatic head injuries such as fractures and hemorrhage cause mortality when not early diagnosed and treated.

The Research aimed to study the traumatic head injrus for Sudanese population using computed Tomography. the study also aims to classify types of trauma according to the causes of trauma and to explain types of fractures and hemorrhages. The study was conducted in Al Tamayuz Center from January 2018 till March 2018.

The study information was collected by data collection sheet for 50 patients(64% were males and 36% were females). The study results showed that road accidents were the most cause of injuries with a percentage of 66%. The types of fracture were as follows: linear fracture 54%, multiple skull fracture 22% and depress fractures 8%. According to CT findings, the study showed that head injuries were subdural hemorrhage which were more common with 32%, hemorrhagic contusion 16%, Epidural hemorrhage 20%, contusion 4%, subarachnoid hemorrhage mid line shift 12% and normal findings constituted 6%.

The researcher concluded that the application of CT technique shows head injures more than conventional radiography.

The researcher proposed some recommendations which could be helpful in future studies in this field.

المستخلص

إصابات الرأس مثل الكسور والنزيف تسبب الوفاة إذا لم تشخص وتعالج مبكرا.

الهدف من البحث دراسة اصابه الرأس في المجتمع السوداني باستخدام الأشعة المقطعيه المحوسبة.

وتهدف ايضا لتقييم وتصنيف إصابات الرأس بناءا على طريقة الإصابة وأنواع الكسور والنزيف الموجود باستخدام الأشعة المقطعية المحوسبة .

أجريت هذه الدراسة في مركز التميز للطوارئ والإصابات في الفترة من يناير 2018 حتى مارس 2018 .

جمعت معلومات هذه الدراسة بواسطة استبيان لـ 50 مريضا 64% رجال و 36% نساء.

أظهرت نتائج هذه الدراسة على أن حوادث الطرق هي المسبب الرئيسي للإصابات بنسبة بلغت 66% واكثر انواع الكسور التي حدثت هي الكسر الخطي بنسبة 54% تليها الكسور المتعددة بنسبة 22% والكسور المنخفضة بنسبة 8%.

كما اظهرت النتائج أن النزيف تحت الجافية هو اكثر نزيف يحدث بنسبة 32% يليها النزيف فوق الجافية بنسبة 20%,الكدمة النزفيه 16%,نزيف فوق العنكبوتيه 12%.

استنتج الباحث بان تطبيق تقنيه الأشعة المقطعيه المحوسبة تظهر انواع الكسور و النزيف للرأس افضل الأشعة التقليديه.

اقترح الباحث بعض التوصيات التي يمكن ان تكون مساعده مستقبلا في دراسة هذا الحقل.

Chapter one

Introduction

1. Introduction:

Traumatic head injury is the leading cause of death and disability in children and young adults in the world as well; significant numbers of people suffer temporary and permanent disability due to head injury. (www.ninds.nih.gov accessed 2016).

It is a complex injury with a broad spectrum of symptoms and disabilities. It is defined as damage to the brain resulting from external mechanical force, such as rapid acceleration or deceleration impact, blast waves, or penetration by a projectile, leading to temporary or permanent impairment of brain function. Traumatic brain injury (TBI) has a dramatic impact on the health of the nation: it accounts for 15–20% of deaths in people aged 5–35 yr. old, and is responsible for 1% of all adult deaths. TBI is a major cause of death and disability worldwide, especially in children and young adults. Males sustain traumatic brain injuries more frequently than do females. (S. K. Haldar, 2016)

Falls, vehicle accidents, and violence. The most common causes of TBI include violence, transportation accidents, construction, and sports. Motor bikes are major causes, increasing in significance in developing countries as other causes reduce. The estimates that between 1.6 and 3.8 million traumatic brain injuries each year are a result of sports and recreation activities. (S. K. Haldar, 2016).

Although the majority of TBIs are mild they can still have serious health implications. Of greatest concern are injuries that can quickly grow worse. All TBIs require immediate assessment by a professional who has experience evaluating head injuries. A neurological exam will assess motor and sensory skills and the functioning of one or more cranial nerves. It will also test hearing and speech, coordination and balance, mental status, and changes in mood or behavior, among other abilities, Medical providers will use brain scans to evaluate the extent of the primary brain injuries and determine if surgery will be needed to help repair any damage to the brain. The need for imaging is based on a physical examination by a doctor and a person's symptoms, Computed tomography (CT) is the most common imaging technology used to assess people with suspected moderate to severe TBI. CT scans create a series of cross-sectional x-ray images of the skull and brain and can show fractures, hemorrhage, hematomas, hydrocephalus, contusions, and brain tissue swelling. CT scans are often used to assess the damage of a TBI in emergency room settings. Currently, this is best performed by CT for several reasons: it is quick, widely available, and highly accurate in detection of acute intra-axial and extra-axial hemorrhage, as well as skull, temporal bone, facial, and orbital fractures. Monitoring equipment is easily accommodated. CT images must be reviewed using multiple windows. A narrow window width is used to evaluate the brain, whereas a slightly wider window width is used to exaggerate contrast between extra-axial collections and the adjacent skull itself. (www.ninds.nih.gov accessed 2016).

2. Problem of study:

Most patients with head injuries are diagnosed firstly by conventional X-ray which does not show intra cranial hemorrhage.

3. Importance of the study:

Computed tomography of the head is useful in tracing the traumatic head injuries and intra cranial hemorrhages, and this will help in early diagnosis and treatment.

4. Objectives of the study:

4.1 General objective:

To Study traumatic head injuries using computerized tomography in Al Tamayuz Center.

4.2 Specific objectives:

- To determine the incidence of traumatic head injuries in Al Tamayuz center.
- To identify the head trauma causes.
- To classify the types of head trauma fractures.
- To classify the types of head trauma hemorrhages.

5. Overview of the study:

The study was contained in five chapters:

Chapter one: consisted of general introduction about this subject in addition to research problem, objectives and significance of the study. Chapter two: includes anatomy of the brain, skull fracture and type of head injury, radiographic appearance of head injuries also importance of CT in head trauma and injuries and previous studies. Chapter three describes the material and methods. Chapter four includes the results, and lastly chapter five includes the discussion, conclusion, recommendations, references and appendices at the end of the study.

Chapter Two

Literature Review

2.1 Theoretical background

2.1.1 Anatomy of the brain:

The brain is a spongy organ made up of nerve and supportive tissues. It is located in the head and is protected by a bony covering called the skull. The base, or lower part, of the brain is connected to the spinal cord. Together, the brain and spinal cord are known as the central nervous system (CNS). The CNS works with the peripheral nervous system (PNS). The PNS is made up of nerves that branch out from the spinal cord to relay messages from the brain to different parts of the body. Together, the CNS and PNS allow a person to walk, talk, and throw a ball and so on. (www.cancer.ca).

2.1.1.1 Structure of the brain:

The brain consists of many parts that function as an integrated whole. The major parts are the medulla, pons, and midbrain (collectively called the brainstem), the cerebellum, the hypothalamus, the thalamus, and the cerebrum. These parts are shown in (Fig. 2-1). (Scanlon et-al 2007).

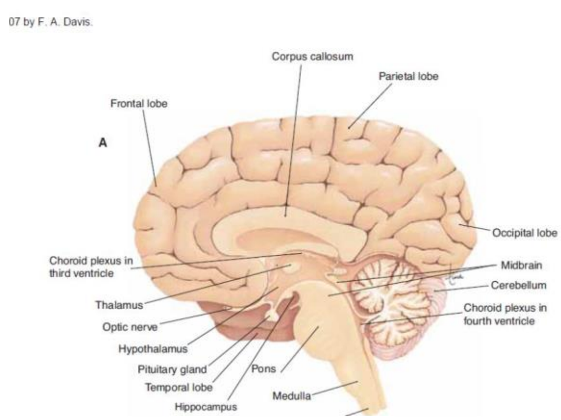


Fig (2-1) Shows mid sagittal section of the brain as seen from the left side. (Scanlon et-al 2007).

2.1.1.1.1 Ventricles:

The ventricles are four cavities within the brain: two lateral ventricles, the third ventricle, and the fourth ventricle (Fig. 2-2). Each ventricle contains a capillary network called a choroid plexus, which forms cerebrospinal fluid (CSF) from blood plasma. Cerebrospinal fluid is the tissue fluid of the central nervous system; its circulation and functions will be discussed in the section on meninges. (Scanlon et-al 2007).

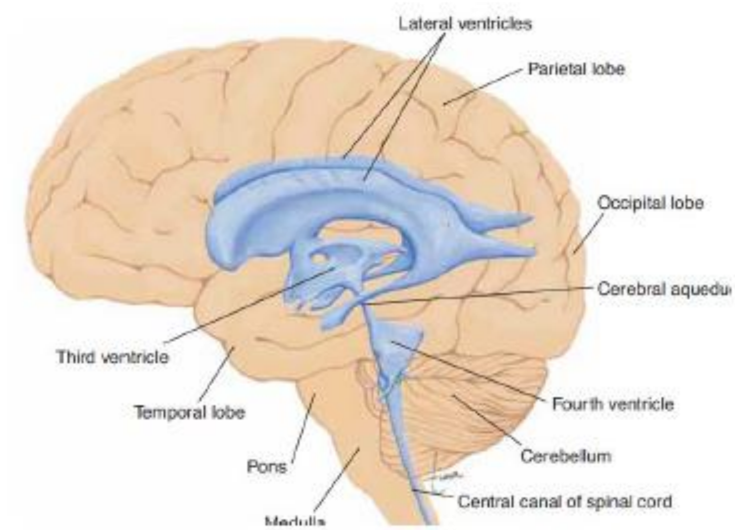


Fig (2-2) Shows Ventricles of the brain as projected into the interior of the brain, which is seen from the left side. (Scanlon et-al 2007).

2.1.1.1.2 Medulla:

The medulla extends from the spinal cord to the pons and is anterior to the cerebellum. (Scanlon et-al 2007).

Its contains all fiber tracts between the brain and spinal cord, as well as vital centers that regulate internal activities of the body. The center of the anterior and posterior surfaces of the medulla oblongata are marked by the anterior and posterior median fissures. The two fissures divide the medulla oblongata into two symmetric halves. Located on either side of the anterior median fissure are two bundles of nerve fibers called pyramids. The pyramids contain the nerve tracts that contribute to voluntary motor control. At the lower end of the pyramids some of the nerve tracts cross decussate; to the opposite side. (Lorrie L 1997).

2.1.1.1.3 Pons:

The pons is situated on the anterior surface of the cerebellum below the midbrain and above the medulla oblongata. It is composed mainly of nerve fibers, which connect the two halves of the cerebellum. It also contains ascending and descending fibers connecting the forebrain, the midbrain, and the spinal cord. Some of the nerve cells within the pons serve as relay stations, whereas others form cranial nerve nuclei.(Richard. Snell 2012).

2.1.1.1.4 Midbrain:

The midbrain extends from the pons to the hypothalamus and encloses the cerebral aqueduct, a tunnel that connects the third and fourth ventricles. (Scanlon et-al 2007).

2.1.1.1.5 Cerebellum:

The cerebellum lies within the posterior cranial fossa beneath the tentorium cerebelli. It is situated posterior to the pons and the medulla oblongata. It consists of two hemispheres connected by a median portion, the vermis. The cerebellum is connected to the midbrain by the superior cerebellar peduncles**,** to the pons by the middle cerebellar peduncles, and to the medulla by the inferior cerebellar peduncles.

The surface layer of each cerebellar hemisphere, called the cortex, is composed of gray matter. The cerebellar cortex is thrown into folds, or folia, separated by closely set transverse fissures. Certain masses of gray matter are found in the interior of the cerebellum, embedded in the white matter; the largest of these is known as the dentate nucleus. (Richard. Snell 2012).

2.1.1.1.6 Hypothalamus:

Located superior to the pituitary gland and inferior to the thalamus, the hypothalamus from the lower part of the lateral wall and floor of the third ventricle. The following structures are found in the floor of the third ventricle from before back ward, the optic chiasma, the tuber cinereum and the infundibulum, the mammillary bodies, and the posterior perforated substance. (Richard. Snell 2012).

2.1.1.1.7 Thalamus:

The thalamus is superior to the hypothalamus and inferior to the cerebrum. The third ventricle is a narrow cavity that passes through both the thalamus and hypothalamus. (Scanlon et-al 2007).

2.1.1.1.8 Cerebrum:

The largest part of the human brain is the cerebrum, which consists of two hemispheres separated by the longitudinal fissure. At the base of this deep groove is the corpus callosum, a band of 200 million neurons that connects the right and left hemispheres. Within each hemisphere is a lateral ventricle. The surface of the cerebrum is gray matter called the cerebral cortex. Gray matter consists of cell bodies of neurons, which carry out the many functions of the cerebrum. Internal to the gray matter is white matter, made of myelinated axons and dendrites that connect the lobes of the cerebrum to one another and to all other parts of the brain. In the human brain the cerebral cortex is folded extensively. The folds are called convolutions or gyri and the grooves between them are fissures or sulci (you can see the folding of the cortex in the frontal section of the brain in Fig (2-3). This folding permits the presence of millions more neurons in the cerebral cortex. The cerebral cortex of an animal such as a dog or cat does not have this extensive folding. This difference enables us to read, speak, do long division, write poetry and songs, and do so many other “human” things that dogs and cats cannot do. The cerebral cortex is divided into lobes that have the same names as the cranial bones external to them. Therefore, each hemisphere has a frontal lobe, parietal lobe, temporal lobe, and occipital lobe (Fig2-4). These lobes have been mapped; that is, certain areas are known to be associated with specific functions. (Scanlon et-al 2007)

2.1.1.1.9 Association Areas:

As you can see in Fig (2-4), many parts of the cerebral cortex are not concerned with movement or a particular sensation. These may be called association areas and perhaps are what truly make us individuals. It is probably these areas that give each of us a personality, a sense of humor, and the ability to reason and use logic. Learning and memory are also functions of these areas. Although much has been learned about the formation of memories, the processes are still incompletely understood and mostly beyond the scope of this book. Briefly, however, we can say that memories of things such as people or books or what you did last summer involve the hippocampus (from the Greek for “seahorse,” because of its shape), part of the temporal lobe on the floor of the lateral ventricle. The two hippocampi seem to collect information from many areas of the cerebral cortex. When you meet a friend, for example, the memory emerges as a whole: “Here’s Fred,” not in pieces. People whose hippocampi are damaged cannot form new memories that last more than a few seconds. The right hippocampus is also believed to be involved in spatial cognition (literally: “space thinking”). For example, if you are in school and a friend asks you the shortest way to your home, you will probably quickly form a mental map. You can see how much memory that involves (streets, landmarks, and so on), but the hippocampus can take it a step further and make your memories three-dimensional and mentally visible. You can see your way home. That is spatial cognition. It is believed that most, if not all, of what we have experienced or learned is stored somewhere in the brain. Sometimes a trigger may bring back memories; a certain scent or a song could act as possible triggers. Then we find ourselves recalling something from the past and wondering where it came from. The loss of personality due to destruction of brain neurons is perhaps most dramatically seen in Alzheimer's disease. (Scanlon et-al 2007).

2.1.1.1.10 Basal Ganglia:

The basal ganglia are paired masses of gray matter within the white matter of the cerebral hemispheres (Fig. 2-2). Their functions are certain subconscious aspects of voluntary movement, and they work with the cerebellum. The basal ganglia help regulate muscle tone, and they coordinate accessory movements such as swinging the arms when walking or gesturing while speaking. The most common disorder of the basal ganglia is Parkinson's disease. (Scanlon et-al 2007).

2.1.1.1.11 Corpus Callosum:

As mentioned previously, the corpus callosum is a band of nerve fibers that connects the left and right cerebral hemispheres. This enables each hemisphere to know of the activity of the other. This is especially important for people because for most of us, the left hemisphere contains speech areas and the right hemisphere does not. The corpus callosum, therefore, lets the left hemisphere know what the right hemisphere is thinking about, and the right hemisphere know what the left hemisphere is thinking and talking about. A brief example may be helpful. If you put your left hand behind your back and someone places a pencil in your hand (you are not looking at it) and asks you what it is, would you be able to say? Yes, you would. You would feel the shape and weight of the pencil; find the point and the eraser. The sensory impulses from your left hand are interpreted as "pencil" by the general sensory area in your right parietal lobe. Your right hemisphere probably cannot speak, but its thoughts can be conveyed by way of the corpus callosum to the left hemisphere, which does have speech areas. Your left hemisphere can say that you are holding a pencil. Other aspects of the “division of labor” of our cerebral hemispheres are beyond the scope of this book, but it is a fascinating subject that you may wish to explore further. (Scanlon et-al 2007).

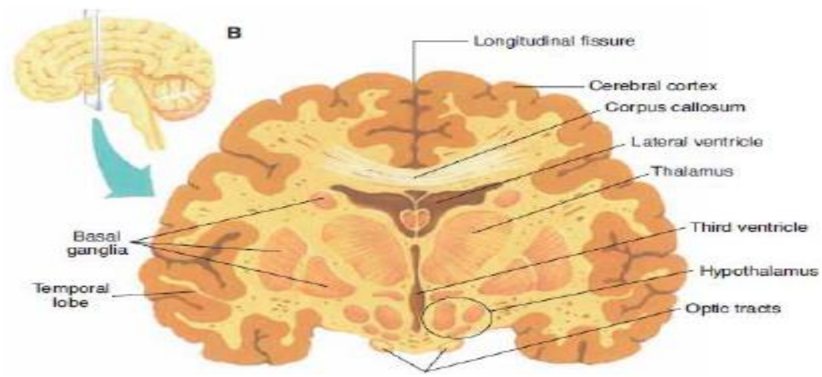


Fig (2-3) Shows Frontal section of the brain in anterior view. (Scanlon et-al 2007).

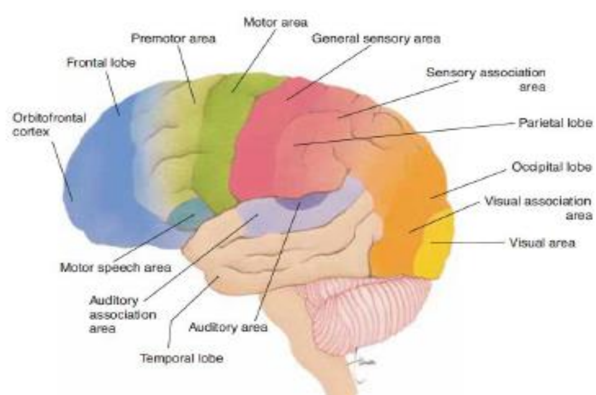


Fig (2-4) Shows Left cerebral hemisphere showing some of the functional areas that have been mapped. (Scanlon et-al 2007).

2.1.2 Blood Supply of the Brain:

The brain is one of the most metabolically active organs in the body, receives 17% of the total cardiac output and about 20% of the oxygen available in the body. (what-when-how.com, 2016).

2.1.2.1 Arterial Supply of the Brain:

Blood supply to the brain is derived from two arteries: (1) the internal carotid artery and (2) the vertebral artery. These arteries and their branches arise in pairs that supply blood to both sides of the brain. The basilar artery is a single artery located in the midline on the ventral side of the brain. The branches of the basilar artery also arise in pairs. The origin of the arteries supplying blood to the brain, their major branches, and the neural structures supplied by them are described in the following sections. (what-when-how.com, 2016).

2.1.2.3 Internal Carotid Arteries:

The internal carotid arteries (ICA) originate at the bifurcation of the left and right common carotid arteries, at the level of the fourth cervical vertebrae (C4). They move superiorly within the carotid sheath, and enter the brain via the carotid canal of the temporal bone. They do not supply any branches to the face or neck. Once in the cranial cavity, the internal carotids pass anteriorly through the cavernous sinus. Distal to the cavernous sinus, each ICA gives rise to: Ophthalmic artery – Supplies the structures of the orbit, Posterior communicating artery – Acts as an anastomotic 'connecting vessel' in the Circle of Willis (see 'Circle of Willis' below), Anterior cerebral artery – Supplies part of the cerebrum. (teachmeanatomy.info).

The internal carotids then continue as the middle cerebral artery, which supplies the lateral portions of the cerebrum. (teachmeanatomy.info).

2.1.2.3 Vertebral Arteries:

The right and left vertebral arteries arise from the subclavian arteries, medial to the anterior scalene muscle. They then ascend up the posterior side of the neck, through holes in the transverse processes of the cervical vertebrae, known as foramen transversarium. The vertebral arteries enter the cranial cavity via the foramen magnum**.** Within the cranial vault, some branches are given off:

- Meningeal branch – supplies the falx cerebelli, a sheet of dura mater.
- Anterior and posterior spinal arteries – supplies the spinal cord, spanning its entire length.
- Posterior inferior cerebellar artery – supplies the cerebellum.

After this, the two vertebral arteries converge to form the basilar artery. Several branches from the basilar artery originate here, and go onto supply the cerebellum and pons. The basilar artery terminates by bifurcating into the posterior cerebral arteries. (teachmeanatomy.info)

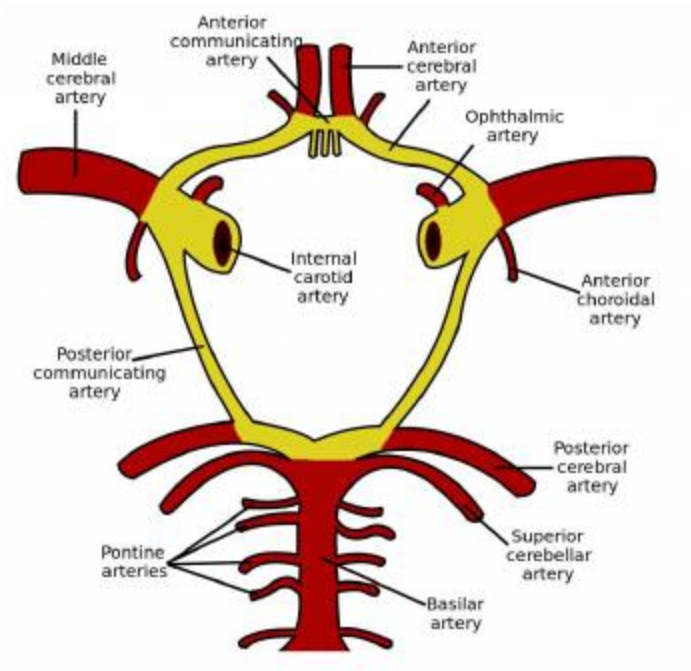
2.1.2.4 Arterial Circle of Willis:

The terminal branches of the vertebral and internal carotid arteries all anastomose to form a circular blood vessel, called the Circle of Willis.

There are three main (paired) constituents of the Circle of Willis:

- Anterior cerebral arteries: These are terminal branches of the internal carotids.
- Internal carotid arteries: Present immediately proximal to the origin of the middle cerebral arteries.
- Posterior cerebral arteries: These are terminal branches of the vertebral arteries.
- To complete the circle, two ‘connecting vessels’ are also present:
- Anterior communicating artery: This artery connects the two anterior cerebral arteries.

- Posterior communicating artery: A branch of the internal carotid, this artery connects the ICA to the posterior cerebral artery. (teachmeanatomy.info).



(Fig 2-5) Shows Circle of Willis. (teachmeanatomy.info).

2.1.2.5 Regional Blood Supply to the Cerebrum:

There are three cerebral arteries; anterior, middle and posterior. They each supply a different portion of the cerebrum. The anterior cerebral arteries supply the anteromedial portion of the cerebrum. The middle cerebral arteries are situated laterally, supplying the majority of the lateral part of the brain. The posterior cerebral arteries supply both the medial and lateral parts of the posterior cerebrum. (teachmeanatomy.info).

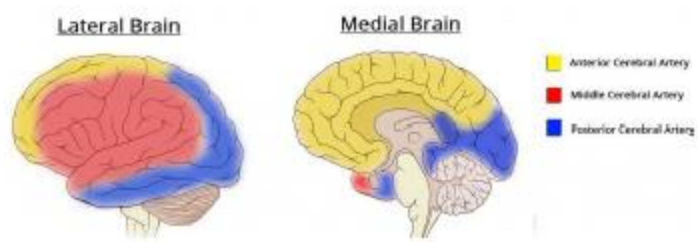


Fig (2-6) Shows the blood supply to the cerebrum. (teachmeanatomy.info).

2.1.3 Physiology ofthe brain

2.1.3.1 Medulla:

Its functions are those we think of as vital (as in "vital signs"). The medulla contains cardiac centers that regulate heart rate, vasomotor centers that regulate the diameter of blood vessels and, thereby, blood pressure, and respiratory centers that regulate breathing. You can see why a crushing injury to the occipital bone may be rapidly fatal—we cannot survive without the medulla. Also in the medulla are reflex centers for coughing, sneezing, swallowing, and vomiting. (Scanlon et-al 2007).

2.1.3.2 Pons:

Within the pons are two respiratory centers that work with those in the medulla to produce a normal breathing rhythm. The many other neurons in the pons (pons is from the Latin for "bridge") connect the medulla with other parts of the brain. (Scanlon et-al 2007).

2.1.3.3 Midbrain

Several different kinds of reflexes are integrated in the midbrain, including visual and auditory reflexes. If you see a wasp flying toward you, you automatically duck or twist away; this is a visual reflex, as is the coordinated movement of the eyeballs. Turning your head (ear) to a sound is an example of an auditory reflex. The mid brain is also concerned with what are called righting reflexes, those that keep the head upright and maintain balance or equilibrium. (Scanlon et-al 2007).

2.1.3.4 Cerebellum:

As you already know, many of the functions of the cerebellum are concerned with movement. These include coordination, regulation of muscle tone, the appropriate trajectory and end point of movements, and the maintenance of posture and equilibrium. Notice that these are all involuntary; that is, the cerebellum functions below the level of conscious thought. This is important to permit the conscious brain to work without being overburdened. If you decide to pick up a pencil, for example, the impulses for arm movement come from the cerebrum. The cerebellum then modifies these impulses so that your arm and finger movements are coordinated, and you don’t reach past the pencil. The cerebellum seems also to be involved in certain sensory functions. For example, if you close your eyes and someone places a tennis ball in one hand and abase ball in the other, could you tell which was which? Certainly you could, by the “feel” of each: the texture and the weight or heft. If you pick up a plastic container of coffee (with a lid on it) could you tell if the cup is full, half-full, or empty? Again, you certainly could. Do you have to think about it? No. The cerebellum is, in part, responsible for this ability. To regulate equilibrium, the cerebellum (and midbrain) uses information about gravity and movement provided by receptors in the inner ears. (Scanlon et-al 2007).

2.1.3.5 Hypothalamus

Hypothalamus is a small area of the brain with many diverse functions include Production of antidiuretic hormone (ADH) and oxytocin; these hormones are then stored in the posterior pituitary gland. ADH enables the kidneys to reabsorb water back into the blood and thus helps maintain blood volume. Oxytocin causes contractions of the uterus to bring about labor and delivery, Production of releasing hormones (also called releasing factors) that stimulate the secretion of hormones by the anterior pituitary gland, a single example will be given here: The hypothalamus produces growth hormone releasing hormone(GHRH), which stimulates the anterior pituitary gland to secrete growth hormone (GH), Regulation of body temperature by

promoting responses such as sweating in a warm environment or shivering in a cold environment, Regulation of food intake; the hypothalamus is believed to respond to changes in blood nutrient levels, to chemicals secreted by fat cells, and to hormones secreted by the gastrointestinal tract. For example, during a meal, after a certain duration of digestion, the small intestine produces a hormone that circulates to the hypothalamus and brings about a sensation of satiety, or fullness, and we tend to stop eating, Integration of the functioning of the autonomic nervous system, which in turn regulates the activity of organs such as the heart, blood vessels, and intestines, Stimulation of visceral responses during emotional situations. When we are angry, heart rate usually increases. Most of us, when embarrassed, will blush, which is vasodilation in the skin of the face. These responses are brought about by the autonomic nervous system when the hypothalamus perceives a change in emotional state. The neurologic basis of our emotions is not well understood, and the visceral

responses to emotions are not something most of us can control, and Regulation of body rhythms such as secretion of hormones, sleep cycles, changes in mood, or mental alertness. This is often referred to as our biological clock, the rhythms as circadian rhythms, meaning “about a day.” If you have ever had to stay awake for 24 hours, you know how disorienting it can be, until the hypothalamic biological clock has been reset. (Scanlon et-al 2007).

2.1.3.6 Thalamus:

Many of the functions of the thalamus are concerned with sensation. Sensory impulses to the brain (except those for the sense of smell) follow neuron pathways that first enter the thalamus, which groups the impulses before relaying them to the cerebrum, where sensations are felt. For example, holding a cup of hot coffee generates impulses for heat, touch and texture, and the shape of the cup (muscle sense), but we do not experience these as separate sensations. The thalamus integrates the impulses from the cutaneous receptors and from the cerebellum, that is, puts them together in a sort of electrochemical package, so that the cerebrum feels the whole and is able to interpret the sensation quickly. Some sensations, especially unpleasant ones such as pain, are believed to be felt by the thalamus. However, the thalamus cannot localize the sensation; that is, it does not know where the painful sensation is. The sensory areas of the cerebrum are required for localization and precise awareness. The thalamus may also suppress un important sensations. If you are reading an enjoyable book, you may not notice someone coming into the room. By temporarily blocking minor sensations, the thalamus permits the cerebrum to concentrate on important tasks. Parts of the thalamus are also involved in alertness and awareness (being awake and knowing we are), and others contribute to memory. For these functions, as for others, the thalamus works very closely with the cerebrum. (Scanlon et-al 2007).

2.1.3.7 Cerebrum and its lobes:

2.1.3.7.1 Frontal Lobes:

Within the frontal lobes are the motor areas that generate the impulses for voluntary movement. The largest portions are for movement of the hands and face, those areas with many muscles capable of very fine or precise movements. It is the large size of the motor area devoted to them that gives these muscles their precision. The left motor area controls movement on the right side of the body, and the right motor area controls the left side of the body. This is why a patient who has had a cerebrovascular accident, or stroke, in the right frontal lobe will have paralysis of muscles on the left side. Anterior to the motor areas are the premotor areas, which are concerned with learned motor skills that require a sequence of movements. Tying shoelaces, for example, seems almost automatic to us; we forget having learned it. It is not a reflex, however; rather the premotor cortex has learned the sequence so well that we are able to repeat it without consciously thinking about it. The parts of the frontal lobes just behind the eyes are the prefrontal or orbitofrontal cortex. This area is concerned with things such as keeping emotional responses appropriate to the situation, realizing that there are standards of behavior (laws or rules of a game or simple courtesy) and following them, and anticipating and planning for the future. An example may be helpful to put all this together: Someone with damage to the prefrontal area might become enraged if his pen ran out of ink during class, might throw the pen at someone, and might not think that a pen will be needed tomorrow and that it is time to go buy one. As you can see, the prefrontal cortex is very important for social behavior, and greatly contributes to what makes us human. Also in the frontal lobe, usually only the left lobe for most right-handed people is Broca's motor speech area, which controls the movements of the mouth involved in speaking. (Scanlon et-al 2007).

2.1.3.7.2 Parietal Lobes:

The general sensory areas in the parietal lobes receive impulses from receptors in the skin and feel and interpret the cutaneous sensations. The left area is for the right side of the body and vice versa. These areas also receive impulses from stretch receptors in muscles for conscious muscle sense. The largest portions of these areas are for sensation in the hands and face, those parts of the body with the most cut aneous receptors and the most muscle receptors. The taste areas, which overlap the parietal and temporal lobes, receive impulses from taste buds on the tongue and elsewhere in the oral cavity. (Scanlon et-al 2007).

2.1.3.7.3 Temporal Lobes:

The olfactory areas in the temporal lobes receive impulses from receptors in the nasal cavities for the sense of smell. The olfactory association area learns the meaning of odors such as the smell of sour milk, or fire, or brownies baking in the oven, and enables the thinking cerebrum to use that information effectively. The auditory areas, as their name suggests, receive impulses from receptors in the inner ear for hearing. The auditory association area is quite large. Part of it is concerned with the meanings of words we hear, that is, with speech. Other parts are for the interpretation of sounds such as thunder during a storm, an ambulance siren, or a baby crying. Without proper interpretation, we would hear the sound but would not know what it meant, and could not respond appropriately. Also in the temporal and parietal lobes in the left hemisphere (for most of us) are other speech areas concerned with the thought that precedes speech. Each of us can probably recall (and regret) times when we have "spoken without thinking," but in actuality that is not possible. The thinking takes place very rapidly and is essential in order to be able to speak. (Scanlon et-al
2007).

2.1.3.7.4 Occipital Lobes:

Impulses from the retinas of the eyes travel along the optic nerves to the visual areas in the occipital lobes. These areas "see." The visual association areas interpret what is seen, and enable the thinking cerebrum to use the information. Imagine looking at a clock. Seeing the clock is far different from being able to interpret it. At one time we learned to interpret the Clock face and hands, and now we do not have to consciously decide what time the clock is reading. We can simply use that information, such as hurrying a bit so as not to be late to class. Other parts of the occipital lobes are concerned with spatial relationships; things such as judging distance and seeing in three dimensions, or the ability to read a map and relate it to the physical world. The cerebral cortex has the characteristic of neural plasticity, the ability to adapt to changing needs, to recruit different neurons for certain functions, as may occur during childhood or recovery from a stroke. Another example is the visual cortex of a person who is born blind. The neurons in the occipital lobes that would have been used for vision will often be used for another function; some may become part of an auditory area that is used to localize sounds and estimate their distance. Those of us who can see may not relyon hearing for localization; we simply look at where we think the sound came from. A blind person cannot do this, and may have an extensive mental catalogue of sounds, meanings of sounds, distances of sounds, and so on, some of these in the part of the cortex that normally is for vision. The younger the person, the more plastic the brain. The brains of children are extraordinarily adaptable. As we get older, this ability diminishes, but is still present. (Scanlon et-al 2007).

2.1.4 Pathology of the brain:

Cerebral Trauma is most frequent in young males who may then survive with varying degrees of incapacity for many years. Injuries affecting the brain fall into three groups:

2.1.4.1 Epidural hematoma:

Develop after rupture of one of the meningeal arteries, usually the middle meningeal, that run between the drug and the skull. Since the drug is in part, the periosteum of the skull and is therefore firmly attached to it, a skull fractures is usually present. Because they are a product of arterial bleeding. Epidural hematomas accumulate quickly and cause rapid and progressive rise in intracranial pressure, which usually develops within minutes to a few hours of the trauma typically; patients recover from the initial trauma. If not immediately drained it will produce brain herniation, medullary compression leads to respiratory. (Robbins, 1987).

Fig (2.7): ShowsCT Brain Epidural Hematoma. (medmnemonics.wordpress.com).

2.1.4.2 Subdural Hematoma:

Occur after rupture of some of the bridging veins that connect the venous system of the brain with the large venous sinuses that are enclosed within the dura. Since the brain in its both or C.S.F can move, whereas the venous sinuses are fixed, the displacements of the brain that occur in trauma can tear some of these dedicate veins at the point where they penetrate the durra, with subsequent bleeding into the subdural space, SDH occur most frequently over the convexities of the hemispheres , where the freedom of movement of the brain is greatest, and are brain that occur in trauma can tear some of these dedicated veins at the point where they penetrate the dura, with subsequent bleeding into the subdural space, SDH occur most frequently over the convexities of the hemispheres , where the freedom of movement of the brain is greatest, and are Relatively infrequent in locations such as the Posterior fossa, where little movement is possible , they may be either acute or chronic.(Robbins, 1987).

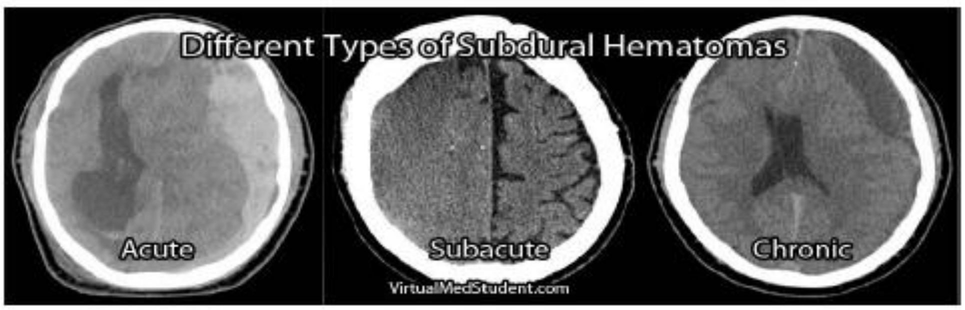


Figure (2.8): ShowsCT Brain Subdural Hematoma. (www.virtualmedstudent.com).

2.1.4.2.1 Acute subdural hematoma:

Brain disorder involving a collection of blood in the space between the inner and the outer membranes covering the brain where symptoms usually develop within a short time after a head injury. (Robbins, 1987).

Figure (2.9): ShowsCT Brain Acute Subdural hematoma. (Robbins, 1987).

2.1.4.2.2 Chronic subdural hematoma:

A brain disorder involving a collection of blood in the space between the inner membranes that cover the brain and the outer membrane covering the membranes of the brain with symptoms occurring 2 weeks or move after the causative injury. (Robbins, 1987).

Figure (2.10): ShowsCT Brain Chronic Subdural hematoma. (Robbins, 1987).

2.1.4.3 Parenchyma injuries:

Trauma to brain itself can be grouped under five headings:

2.1.4.3.1 Concussion:

Is a transient loss of consciousness following head trauma. The duration of unconsciousness is usually short but may last for some hours. (Robbins, 1987).

2.1.4.3.2 Contusions:

Blunt trauma crushes or bruises brain tissue without rupturing the Pia. The most common sites of contusions are directly related to trauma, in which case they may be at the site of impact coup lesions) or at a point opposite (countercoup lesions). Where the brain in motion strikes against the inner surface of the skull. (Robbins, 1987).

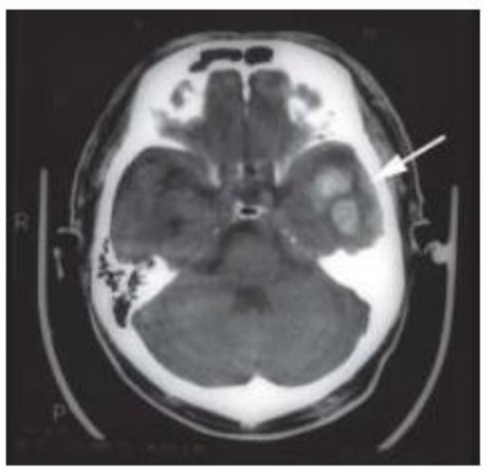


Figure (2.11): ShowsLeft temporal hemorrhagic contusion. (Robbins, 1987).

2.1.4.3.3 Lacerations:

Are tears produced by severe blunt trauma sometimes with an associated fracture followed by hemorrhage and necrosis. Resolution of lacerations is similar to that of contusions, except that is resulting in an irregular, yellow brown, gliotic scar that in valve not only cortex but also the deep underlying structures. (Robbins, 1987).

2.1.4.3.4 Diffuse axonal injury:

It occurs in patients who have severe neurologic impairment but do not have massive grossly visible brain damage. Microscopically there is diffuse damage to white matter in the form of ruptured axon; the patient is comatose complication of trauma. It occurs in patients who have severed neurologic impairment but do not have massive grossly visible brain damage. Microscopically there is diffuse damage to white matter in the form of ruptured axons, the patient is comatose. (Robbins, 1987).

2.1.4.4 Complication of trauma:

Brain edema brains her nation, brain stem compression infections hydrocephalus, epilepsy. (Robbins, 1987).

2.1.4.5 Fractures:

Fracture or break in the cranial (skull — bones) fractures of the skull are common complications of trauma to the head, these fractures may be closed or open, linear or comminuted and may or may not be depressed. They may be occult or evident from the presence of blood or CSF draining from the nose or ears. (Robbins, 1987).

2.1.4.5.1 Linear skull fracture:

Does a break in cranial bone resemble at inline, without depression or distortion of bone (Robbins, 1987).

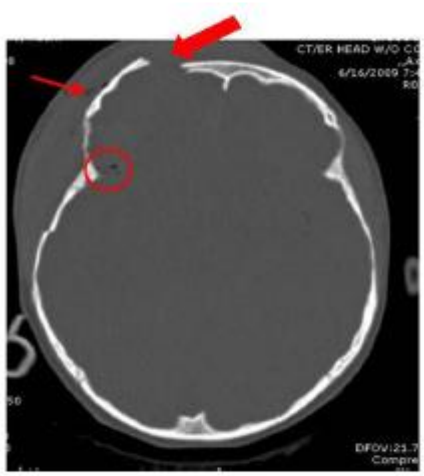


Figure (2.12): ShowsCT Brain Linear Skull Fracture. (Robbins, 1987).

2.1.4.5.2 Depressed skull fracture:

Is a break (in a cranial bone) or crushed, portion of skull) with depression of the bone in toward the brain. (Robbins, 1987).

Figure (2.13): ShowsCT Brain Depressed Skull Fracture. (Robbins, 1987).

2.1.4.5.3 Compound fracture:

Involves break in or loss of skin and splintering of the bone. (Robbins, 1987).

2.2 Previous studies:

study done by Abd Elrahim et al 2012 in emergency neurosurgery department of Teaching Khartoum Hospital, is the only specialized department in Sudan, which deals with the management of head injury patients. The objective of the study is to maintain the efficiency of CT in diagnosing head injuries as a first accurate radiological Investigation in emergency department. This study is descriptive case study concerning patients with head injuries in order to compare between CT and conventional skull x-ray investigations. The incidence of the head injuries is Higher in males rather than females, and the occurrence had been at the age of 16-30 years. Most of the head injuries were caused by road traffic accidents (RTA) (158 cases – 63.2%). No difference between the CT scanning and the Conventional skull x-ray in demonstrating the linear fractures of the skull (100% to 98.7%). The incidence of the head injuries is higher in males rather than females, and the occurrence had been at the age of 16-30 years. Most of the head injuries were caused by road traffic accidents (RTA) (158 cases – 63.2%).

Second study INTERNATIONAL STUDY done by Dr. Broder JS 2010that showed Non contrast computed tomography (CT) provides important diagnostic information for patients with traumatic brain injury. A systematic approach to image interpretation optimizes detection of pathologic air, fractures, hemorrhagic lesions, brain parenchyma injury, and abnormal cerebrospinal fluid spaces. Bone and brain windows should be reviewed to enhance injury detection. Findings of midline shift and mass effect should be noted as well as findings of increased intracranial pressure such as hydrocephalus and cerebral edema, because these may immediately influence management. Compared with CT, magnetic resonance imaging may provide more sensitive detection of diffuse axonal injury but has no proven improvement in clinical outcomes. This article discusses key CT interpretation skills and reviews important traumatic brain injuries that can be discerned on head CT. It focuses on imaging findings that may deserve immediate surgical intervention. In addition, the article reviews the limits of non contrast CT and discusses some advanced imaging modalities that may reveal subtle injury patterns not seen with CT scan.

Study done by Gallagher CN 2010 CT and MRI are now the imaging techniques for acute and subacute brain injury, respectively. Diffusion tensor imaging is being developed to provide more information on structural damage in brain injury. There are several research techniques available for brain injury, particularly relating to cerebral blood flow and metabolism

Last study done by Brody DL et al 2015 Brain imaging plays a key role in the assessment of traumatic brain injury. In this review, we present our perspectives on the use of computed tomography (CT), conventional magnetic resonance imaging (MRI), and newer advanced modalities such as diffusion tensor imaging. Specifically, we address assessment for immediately life-threatening intracranial lesions (non contrast head CT), assessment of progression of intracranial lesions (noncontrast head CT), documenting intracranial abnormalities for medico legal reasons (conventional MRI with blood-sensitive sequences), presurgical planning for post-traumatic epilepsy (high spatial resolution conventional MRI).

Chapter Three

Materials and Methods

3.1 Materials: -

3.1.1 Machine used:

The machine used is CT scan 4 slices (Toshiba).

3.1.2 Study population

The study includes 54 traumatic patient's males and females visiting the emergency department with different ages.

3.1.3 Inclusion criteria:

Sudanese group of patients with head trauma.

3.1.4 Exclusion criteria:

Patients who had non traumatic head trauma and normal patients.

3.1.5 Patient preparation:

According to CT protocol patients emptied their bladders before scan because use of I.V contrast medium cause the bladder to fill rapidly and the scan should not be interrupted for a bath room break. All metallic objects were removed from the head to be studied (earning, pins and necklaces), no patient motion.

3.1.6 Patient position:

Supine Head first. Arms along the side of the body and head immobilized in the head holder.

3.1.7 CT head protocol used

All patients under CT study with the following parameters KVP (120-140) MA (150-300), with time .75-1.5 second, Slice thickness: thin slice at the base of skull (2-4) ml, thick slice above to the base (5-10) ml.

Breath hold: None.

I.V Contrast: None.

Scout: Lateral

Start location and end: From foramen magnum to vertex.

Slice plane: Axial.

3.2 Methods: -

3.2.1 Methods of data collection:

The data were collected by the researcher during study period.Other information were collected from references, Text books and Web sites.

3.2.2 Methods of data analysis:

The data were analyzed using Microsoft excel program and SPSS (Inc, Chicago, Illinois version 19).

3.2.3 Study area:

The data were collected from Al Tamayuz Center.

3.2.4 Study duration:

The research was conducted from January 2018 to March 2018.

Chapter Four

Results

Table (4.1): Demonstrates the frequency distribution of gender in head injury patients:

Gender	Frequency	Percent %
Male	32	64
Female	18	36
Total	**50**	**100**

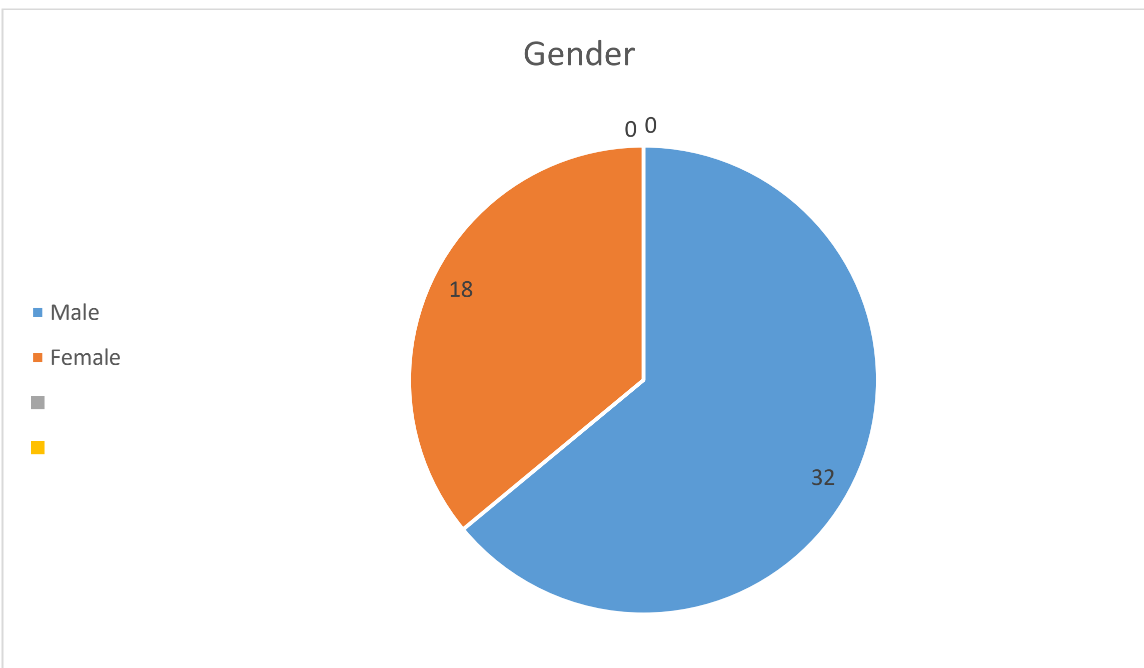


Figure (4.1) Shows frequency distribution of gender in head injury patients.

Table (4.2): Demonstrates the frequency distribution of age group in head injury patients:

Age	Frequency	Percent %
less than 25	24	48
From 25-35	14	28
From 36-45	7	14
From 46-56	3	6
more than 57	2	4
Total	**50**	**100**

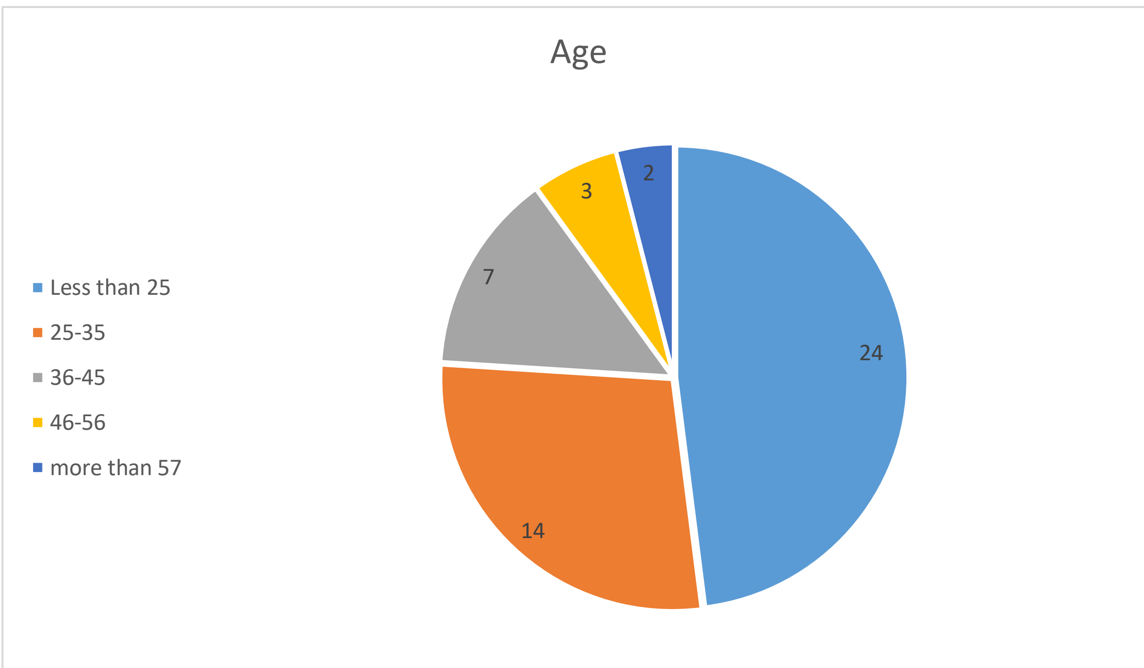


Figure (4.2): Shows frequency distribution of age group in head injury patients.

Table (4.3): Demonstrates the frequency distribution of mode of trauma:

Mode of trauma	Frequency	Percent %
RTA	33	66
Kicked by stone	3	6
Assaulted by stick	5	10
Assaulted by iron	2	4
Fall down	6	12
Gun shot	1	2
Total	**50**	**100**

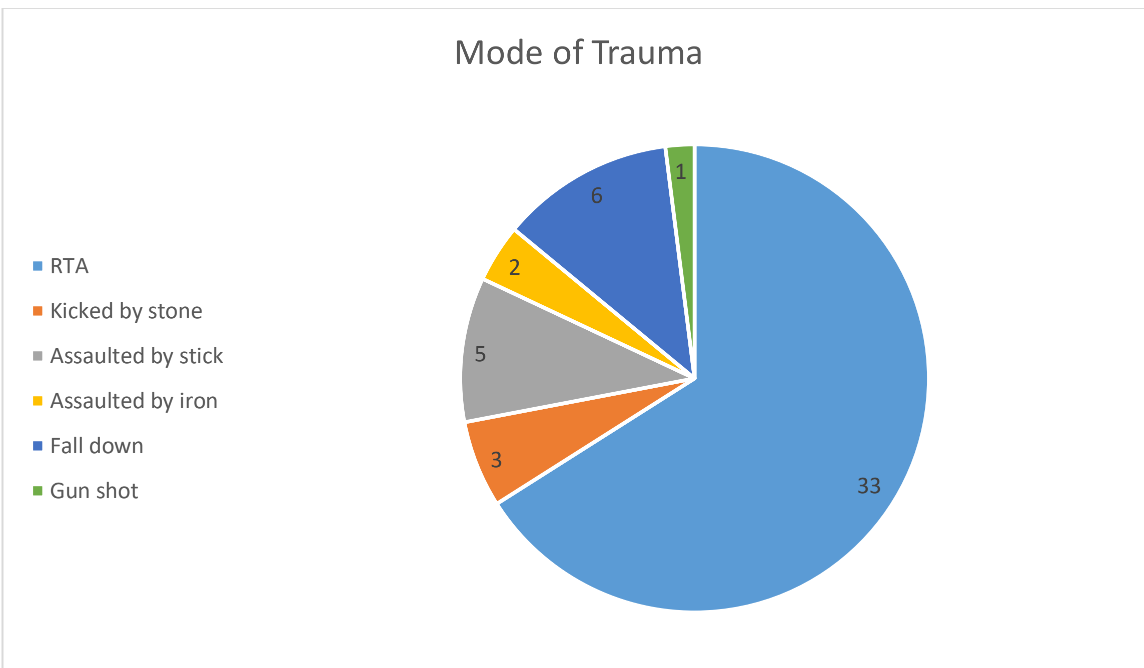


Figure (4.3): Shows frequency distribution of mode of trauma.

Table (4.4): Demonstrates the frequency distribution of type of fractures as shown by CT:

Types of Fractures	**Frequency**	**Percent %**
Depress	4	8
Multiple	11	22
Linear	27	54
No fracture	8	16
Total	**50**	**100**

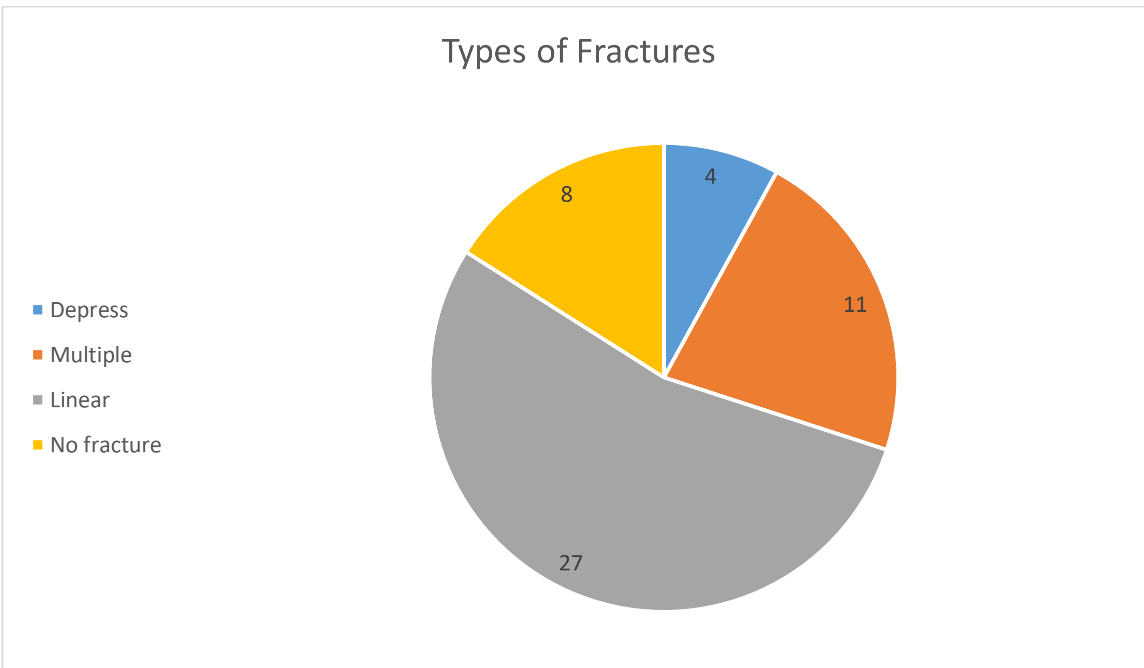


Figure (4.4): Shows frequency distribution of type of fracture as shown by CT.

Table (4.5): Demonstrates the frequency distribution of CT finding as shown by CT:

CT Finding	Frequency	Percent %
Hemorrhagic contusion	8	16
Subdural Hemorrhage	16	32
Epidural Hemorrhage EPI	10	20
Contusion	2	4
SAH Midline shift	6	12
Chronic subdural hemorrhage	5	10
Normal	3	6
Total	**50**	**100**

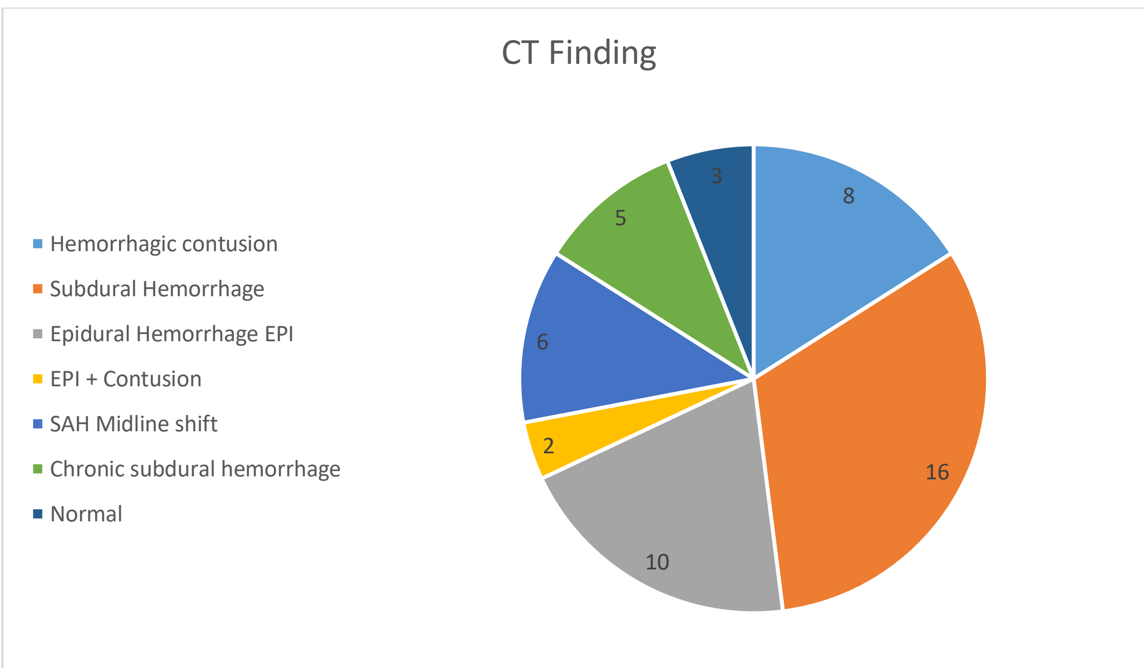


Figure (4.5): Shows frequency distribution of CT finding as shown by CT.

Chapter Five

Discussion, Conclusion, Recommendation

5.1 Discussion:

This study was done in Khartoum state included 50 patients (32 males 64% and 18 females 36%) who came to Al Tamayuz Center with head trauma as shown in table (4.1) and graph (4.1).

According to age as shown in Table (4.2) and graph (4.2) found that the most common group affected were in this order: less than 25 years (48%), 25-35years (28%), 36-45 years(14%), (46-56 year) (6%) and more than 57 years(4%).

Road traffic accidents constituted the main cause of head trauma (66%), falling down (12%), stick beating (10%), iron beating(10%), stone hit(6%), gun shot (2%) as shown in Table (4.3) and graph (4.3).As for traffic accident this study result was similar to the study of Abd Alrahim et al 2012.

As for the types of fractures shown by CT, the study showed that linear fracture is the most common fracture (54%), followed by multiple fracture (22%) and depress fracture(8%)as shown in Table (4.4) and graph (4.4).

Subdural hemorrhages were the most common (32%), then epidural hemorrhages (20%), hemorrhagic contusion (26%), subarachnoid hemorrhages with midline shift (12%), chronic subdural hemorrhages (10%) and contusion (4%) as shown in Table (4.5) and graph (4.5). These results were consistent with the study of Gallagher CN 2010.

5.2 Conclusion:

The study concluded that: CT is first choice of imaging head injuries compared with other modalities due to many advantages. it needs short time for procedure and accurately identifies the traumatic head injuries such as fractures and hemorrhages.

The study showed that most of head injuries were caused by RTA.

The most common fracture showed by this studying was linear 54% and fewest one was depress 8%.

The subdural hemorrhage was the commonest hemorrhage by percentage 32 and contusion was the fewest 4%.

The study proposed some recommendations which could help in the improvement of dealing with the traumatic head injuries using computed tomography in Sudan.

Future studies on this topic should include other CT centers in Sudan, and done on greater numbers of patients.

5.3 Recommendations

CT scan should be available in all teaching hospitals in Sudan.

Physician should request CT brain in all cases of Traumatic brain injuries to save the time.

To reduce the incidence of TBI in RTA seat belts, motor cycle helmets, speed limits in high way road should be applied.

For future studies a wide study on this topic should be conducted in other parameter and other states.

As for the future ,the researcher recommends that other hospitals in other states should be included using larger samples and other parameters.

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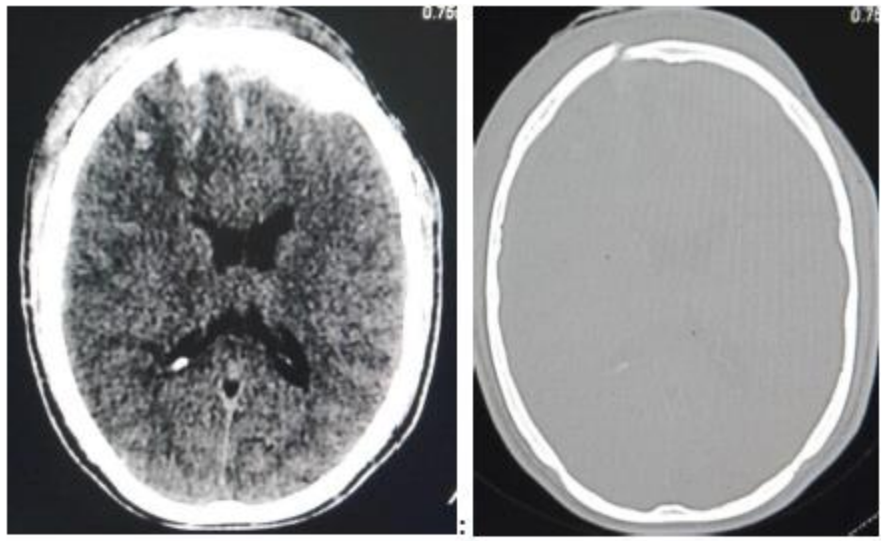
Appendices

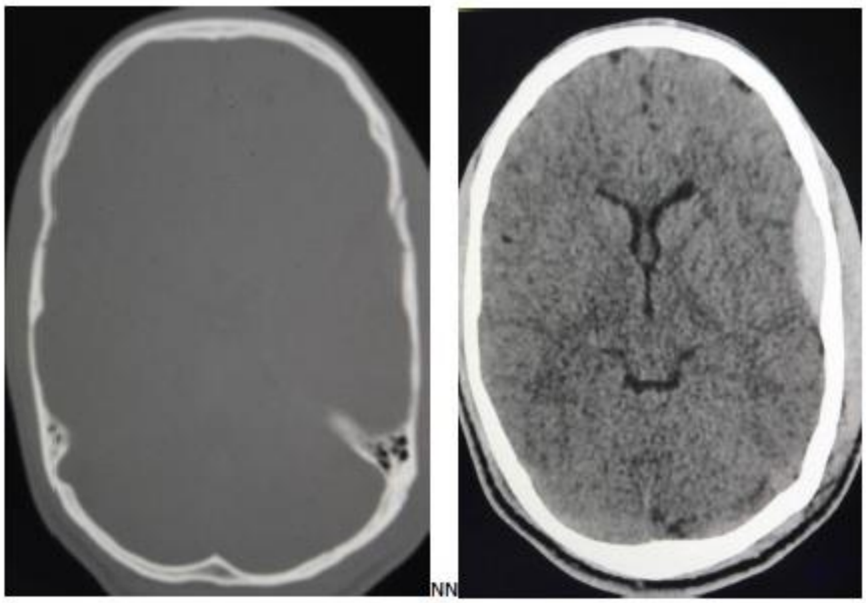
Appendix (1)



(A) (B)

A- show Axial Soft tissue window for 33-year-old Man diagnosed as Contusion. B- Axial Bone window for 33-year-old Man diagnosed as linear fracture in frontal bone.(ALamayuz center)

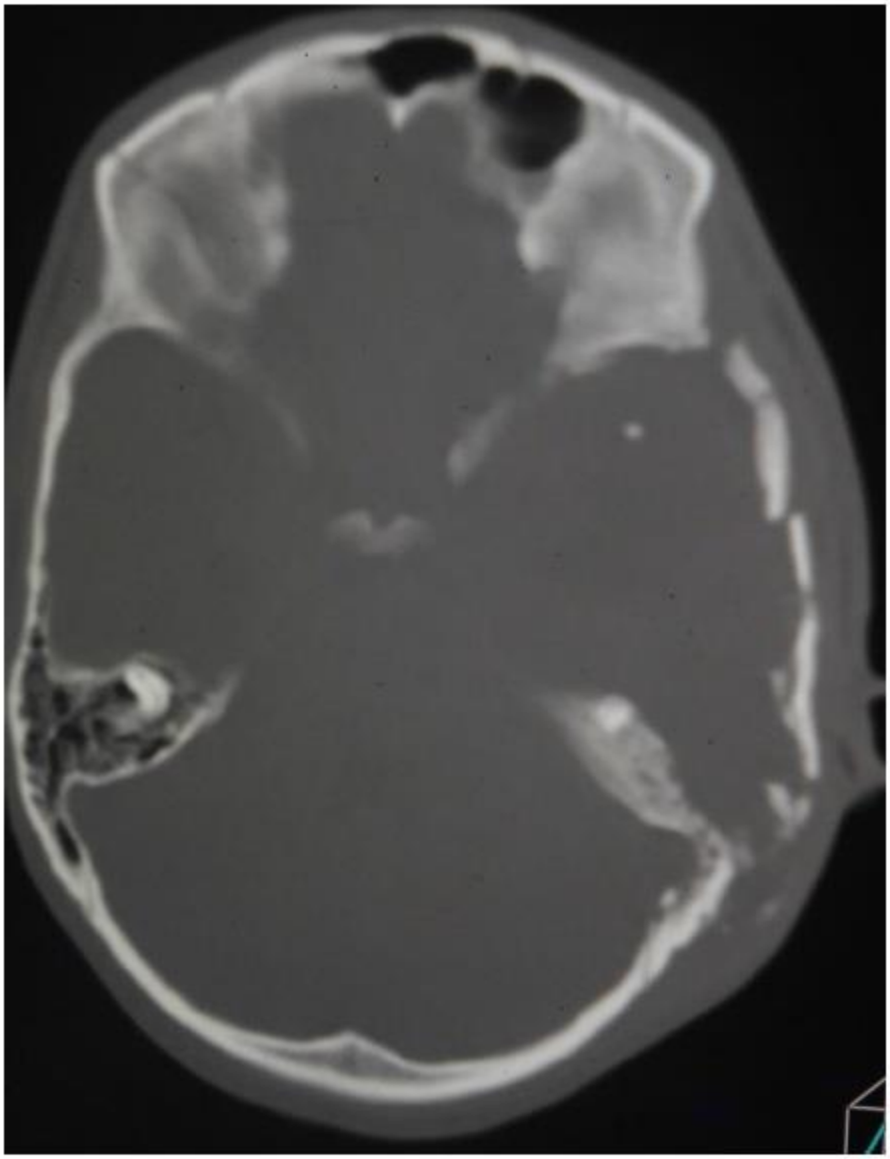
Appendix (2)



(A) (B)

A- Axial Bone window for 25-year-old Female diagnosed as linear fracture in RT. Temporal bone. (B) Axial Soft tissue window for 25-year-old Female diagnosed as Epidural hemorrhage RT. Temporal bone. (ALTAMAYUZ CENTER)

Appendix (3)



Axial Bone window for 30-year-old male diagnosed as Comminuted fracture.(ALTAMAYUZ CENTER)

Appendix (4)

Data Sheet Collection

NO	Gender	Age	Mode of trauma	CT findings	Type of fracture	Type of hemorrhage
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