Sudan University of Science and Technology

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Assessment of Acute Stroke Using Computed Tomography

تقييم السكتة الدماغية الحادة باستخدام الأشعة المقطعية

A thesis Submitted for Partial Fulfillment of the Requirements of M.S.c in Diagnostic Radiological Technology

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الآية

قال تعالي :

﴿ لَا يُكَلِّفُ اللَّهُ نَفْسًا إِلَّا وُسْعَهَا لَهَا مَا كَسَبَتْ وَعَلَيْهَا مَا اكْتَسَبَتْ رَبَّنَا لَا تُؤَاخِذْنَا إِنْ نَسِينَا أَوْ أَخْطَأْنَا رَبَّنَا وَلَا تَحْمِلْ عَلَيْنَا إِصْرًا كَمَا حَمَلْتَهُ عَلَى الَّذِينَ مِنْ قَبْلِنَا رَبَّنَا وَلَا تُحَمِّلْنَا مَا لَا طَاقَةَ لَنَا بِهِ وَاعْفُ عَنَّا وَاغْفِرْ لَنَا وَارْحَمْنَا أَنْتَ مَوْلَانَا فَانْصُرْنَا عَلَى الْقَوْمِ الْكَافِرِينَ ﴾

صدق الله العظيم

سورة البقرة الآية (286)

Dedication

I dedicate this work to my family and friends.

Acknowledgement

Firstly thanks to Allah for giving me strength and patience to do this work**.**

I would like to offer my thanks and gratitude to my supervisor: **Dr. Hussain Ahmed Hassan Ahmed** for her great effort and patience during the preliminary and final setup of work.

Thanks also extend to all patients who donated the samples and to the radiologist and technologist of the x-ray department of Aljazeera injuries and orthopedic surgery center in Wad Madani and Wad Madani Technical Hospital for their help in the selection of patients and collection of samples.

Abstract

This is descriptive study and was conducted in three months during the period from November 2016, to February 2017 in Aljazeera injuries and orthopedic surgery center in Wad Madani and Wad Madani technical hospital. This study carried out in a sample of 50 patients (34 men and 16 women) who underwent to brain computed tomography examination.

The objectives of this study is to assess of acute stroke using computed tomography , to measure % percentage of ischemia to hemorrhage , to identify the common site of stroke, to correlate the finding with age , gender, habits and weight and to show the relation between the finding and underlining diseases.

The results of this study were the percentage of ischemia is more frequently than hemorrhage in the sample of study, where the ischemia was 72% and hemorrhage was 28%.

المستخلص

أجريت هذه الدارسة علي 50 مريض (34 من الذكور و16 من الإناث) في أعمار مختلفة وذلك لتقييم دور بروتوكول التصوير بالأشعة المقطعية لمرض السكتة الدماغية الحادة بمستشفي ودمدني التعليمي.

أوضحت الدراسة أن الأشخاص الأكثر عرضة للسكتة الدماغية الحادة الذين كانوا في أعمار متقدمة أكثر تأثرا من المرضي الأصغر سنا.

أوضحت الدراسة أن الذكور كانوا أكثر عرضة للسكتة الدماغية الحادة حيث كان ترددهم 34 في المقابل وجد أن الإناث كان ترددهم 16.

من خلال الدراسة ، تشير البيانات إلي أن كل من السمنة وزيادة الوزن في الذكور والإناث هي عوامل خطورة للسكتة الدماغية الحادة.

أوضحت الفحوصات الأولية للمرض أن غالبية المرضي يعانون من أمراض أخري مصاحبة للسكتة الدماغية الحادة مثل ارتفاع ضغط الدم ومرض السكري .

من هذه الدراسة وجد أن الأشخاص المدخنين كانوا أكثر عرضة للسكتة الدماغية الحادة من الأشخاص غير المدخنين.

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List of Abbreviation

ACA	Anterior Cerebellar Artery
AICA	Anterior Inferior Cerebellar Artery
AV	Arteriovenous Malformation
CI	Confidence Interval
CSF	Cerebrospinal Fluid
CT	Computed Tomography
CVA	Cerebrovascular Accident
DM	Diabetes Mellitus
HT	Hypertension
ICH	Intracranial Hemorrhage
Kg	Kilogram
Lt	Left
MCA	Middle Cerebellar Artery
MS	Multiple Sclerosis
PCA	Posterior Cerebellar Artery
PICA	Posterior Inferior Cerebellar Artery
RR	Relative Risks
RT	Right
TIA	Transient Ischemic Attack
WT	Weight

Chapter One

Introduction

Chapter One

1.1 Introduction:

Since the discovery of x-rays by W C Roentgen in 1895 , medical imaging has contributed significantly to progress in medicine , diagnostic imaging has grown during the last 50 years from a state of infancy to a high level of maturity . And become having an important role in patient management , and especially radiologic diagnosis (Herman 2009).

Computed tomography , more commonly known as a CT or CAT scan, is a diagnostic medical test that, like traditional x-rays, produces multiple images or pictures of the inside of the body . The cross-sectional images generated during a CT scan can be reformatted in multiple planes, and can be viewed on a computer monitor, printed on film or transferred to a CD or DVD . CT of the head uses special x-ray equipment to help assess head injuries , severe headaches, dizziness, and other symptoms of aneurysm, bleeding, stroke and tumors . CT scan is usually one of the first test done in a stroke evaluation, particularly during an acute stroke in the emergency room can identify the type, location, and severity of the lesion (ischemia or hemorrhage), the status of the cerebral vasculature ; the status of cerebral perfusion; and the existence and extent of the ischemic penumbra . Both acute and long –term treatment decisions for stroke patients can then be optimally guided by this information (Mullins et al 2002).

Acute ischemic stroke is a serious medical emergency as urgent as heart attack or serious trauma and need to be diagnosed and treated as quickly as possible in order to minimize brain damage (Marler et al 2011) .

Ischemic stroke can be treated with "clot-busting" drugs (IV tPA)Which should be administrated within 60 minutes or less (golden hour) from arrival time of the patient to the hospital, and within 3 to 4.5 hour from onset of

symptoms . The reason its " golden " is that stroke patients have a much greater chance of surviving and avoiding long-term brain damage if they arrive at the hospital and receive treatment within that first hour (Jeffrey et al 2010).

1.2 Problem of the study:

Brain stroke is very common among patients referred to the radiological department in modern medical center in Sudan. Acute ischemic stroke is one of the leading causes of mortality and morbidity worldwide . Stroke patients had opposed way of treatment either coagulant or anti-coagulant in case of hemorrhage and infarction consequence . CT scanner and MRI examinations are answers the question concerning type of stroke location and size, although number of disease may happen in the brain and can be diagnosed in sectional studies but some of them can't be detected early so the study of the acute stroke with studding the anticoagulant factor related to the clinical findings which shone in brain CT scanning .

1.3 Objectives:

1.3.1 General objectives:

To evaluate the role of CT examination in diagnosis of acute stroke.

1.3.2 Specific objectives:

To masseur % percentage of ischemia to hemorrhage.

To identify the commune site of stroke.

To correlate the finding with age & gender.

To correlate the finding with habits.

To correlate the finding with weight.

To show the relation between the finding and underlining diseases.

1.4 Thesis layout:

Chapter one: Introduction, statement of the problem, objectives of the study, and thesis layout.

Chapter two: The literature review (Anatomy, Pathology, Previous studies).

Chapter three: Methodology and data analysis.

Chapter four: Results.

Chapter five: Discussion, Conclusions and Recommendations.

Appendix and References.

Chapter Two

Literatures Reviews and Background

Chapter Two

Literatures Reviews and Background

2.1 Stroke:

A Stroke is referred to a cerebrovascular accident (CVA), cerebrovascular insult (CVI), or colloquially brain attack is the loss of brain function due to a disturbance in the blood supply to the brain. This disturbance is due to either ischemia (lake of blood flow) or hemorrhage. As a result, the affected area of the brain cannot function normally, which might result in an inability to move one or more limbs on one side of the body, failure to understand or formulate speech, or a vision impairment of one side of the visual filed. Ischemia is caused by either blockage of a blood vessel via thrombosis or arterial embolism, or by cerebral hypo perfusion , hemorrhagic stroke is caused by bleeding of blood vessels of the brain, either directly into the brain parenchyma or into the subarachnoid surrounding brain tissue. Risk factors for stroke include old age, high blood pressure, previous stroke or transient (TIA), diabetes, high cholesterol, tobacco smoking and atrial fibrillation. High blood pressure is the most important modifiable risk factor of stroke (W . Hacke, M. Kaste, E. Bluhmki, et al 2008).

A stroke is a medical emergency and can cause permanent neurological damage or death. An ischemic stroke is occasionally treated in a hospital with thrombolysis (also known as a "clot buster"), and some hemorrhagic strokes benefit from neurosurgery, treatment to recover any lost function is termed stroke rehabilitation, ideally in a stroke unit and involving health professions such as speech and language therapy, physical therapy and occupational therapy, prevention of recurrence may involve the administration of antiplatelet drugs such as aspirin, control of high blood pressure, and the use of statins , some people may benefit from carotid endarterectomy and the use of

anticoagulants. Stroke was the second most frequent cause of death worldwide in2011, accounting for 6.2 million death (~11% of the total), approximately 17 million people had a stroke in 2010 and 33 million people have previously had a stroke and were still alive. Between 1990 and 2010 the number of strokes decrease by approximately 10% in the developed world and increased by 10% in the developing world , overall two thirds of strokes occurred in those over 65 years old (Gorelick PB 2009).

2.2 Brain anatomy:

The brain is one of the most complex and magnificent organs in the human body. Our brain gives us awareness of ourselves and of our environment, processing a constant stream of sensory data. It controls our muscle movements, the secretions of our glands, and even our breathing and internal temperature, every creative thought, feeling, and plan is developed by our brain. The brain's neurons record the memory of every event in our lives (Siesjo BK 1989).

There are different ways of dividing the brain anatomically into regions. Acommon method and divide the brain into three main regions based on embryonic development: the forebrain, midbrain and hindbrain, under these divisions:

The forebrain (or prosencephalon) is made up of our incredible cerebrum, thalamus, hypothalamus and pineal gland among other features, neuroanatomists call the cerebral area the telencephalon and use the term diencephalon (or interbrain) to refer to the area where our thalamus, hypothalamus and pineal reside (C, and John D. Hall. 1996).

The midbrain (or mesencephalon), located near the very center of the brain between the interbrain and the hindbrain, is composed of a portion of the brainstem (C, and John D. Hall. 1996).

The hindbrain (or rhombencephalon) consists of the remaining brainstem as well as our cerebellum and pons, neuroanatomists have a word to describe the brainstem sub-region of our hindbrain, calling it the myelencephalon, while they use the word metencephalon in reference to our cerebellum and pons collectively (Guyton, Arthur C, and Johan D. Hall. 1996).

2.2.1 Hindbrain (Rhombencephalon):

Connecting the brain to the spinal cord, the brainstem is the most inferior portion of our brain . Many of the most basic survival functions of the brain are controlled by the brainstem.

The brainstem is made of three regions: the medulla oblongata, the pons, and the midbrain. A net-like structure of mixed gray and white matter known as the reticular formation is found in all three regions of the brainstem. The reticular formation controls muscle tone in the body and acts as the switch between consciousness and sleep in the brain (Afshar et all 1978).

The medulla oblongata is a roughly cylindrical mass of nervous tissue that connects to the spinal cord on its inferior border and to the pons on its superior border, the medulla contains mostly white matter that carries nerve signals ascending into the brain and descending into the spinal cord, within the medulla are several regions of gray matter that process involuntary body functions related to homeostasis, the cardiovascular center of the medulla monitors blood pressure and oxygen levels and regulates heart rate to provide sufficient oxygen supplies to the body's tissues, the medullary rhythmicity center controls the rate of breathing to provide oxygen to the body, vomiting, sneezing, coughing, and swallowing reflexes are coordinated in this region of the brain as well, the pons is the region of the brainstem found superior to the medulla oblongata, inferior to the midbrain, and anterior to the cerebellum, together with the cerebellum, it forms what is called the metencephalon, about an inch long and somewhat

larger and wider than the medulla, the pons acts as the bridge for nerve signals traveling to and from the cerebellum and carries signals between the superior regions of the brain and the medulla and spinal cord (Naidich et al 2009).

2.2.2 Cerebellum:

The cerebellum is a wrinkled, hemispherical region of the brain located posterior to the brainstem and inferior to the cerebrum, the outer layer of the cerebellum, known as the cerebellar cortex, is made of tightly folded gray matter that proides the processing power of the cerebellum, deep to the cerebellar cortex is a tree-shaped layer of white matter called the arbor vitae, which means 'tree of life' the arbor vitae connects the processing regions of cerebellar cortex to the rest of the brain and body (Duvernoy & H.M 1999).

The cerebellum helps to control motor functions such as balance, posture, and coordination of complex muscle activities sensory inputs from the muscles and joints of the body and uses this information to keep the body balanced and to maintain posture also controls the timing and finesse of complex motor actions such as walking, writing, and speech (Duvernoy &H.M 1999).

2.2.3 Midbrain (Mesencephalon):

The midbrain also known as the mesencephalon, is the most superior region of the brainstem, found between the pons and the diencephalon, the midbrain can be further subdivided into 2 main regions:the tectum and the cerebral peduncles (Duvernoy &H.M 1999).

The tectum is the posterior region of the midbrain, containing relays for reflexes that invole auditory and visual information, the pupillary reflex(adjustment for light intensity), accommodation reflex (focus on near or far away objects), and startle reflexes are among the many reflexes relayed through this region, forming the anterior region of the midbrain, the cerebral

peduncles contain many nerve tracts and the substantia nigra , nerve tracts passing through the cerebral peduncles connect regions of the cerebrum and thalamus to the spinal cord and lower regions of the brainstem, the substantia nigra is a region of dark melanin-containing neurons that is involved in the inhibition of movement, degeneration of the substantia nigra leads to aloss of motor control known as parkinson's disease (Duvernoy & H.M 1999).

2.2.4 Forebrain (Prosencephalon):

Superior and anterior to the midbrain is the region known as the interbrain, or diencephalon, the thalamus, hypothalamus, and pineal glands make up the major regions of the diencephalon.

The thalamus consists of a pair of oval masses of gray matter inferior to the lateral ventricles and surrounding the third ventricle. Sensory neurons entering the brain from the peripheral nervous system from relays with neurons in the thalamus that continue on to the cerebral cortex. In this way the thalamus acts like the switchboard operator of the brain by routing sensory inputs to the correct regions of the cerebral cortex, the thalamus has an important role in learning by routing sensory information into processing and memory centers of the cerebrum (Woolsey et al 2003). The hypothalamus is a region of the brain located inferior to the thalamus and superior to the pituitary gland, the hypothalamus acts as the brain's control center for body temperature, hunger, thirst, blood pressure, heart rate, and the production of hormones, in response to change in the condition of the body detected by sensory receptors, the hypothalamus sends signals to glands, smooth muscles, and the heart to counteract these changes, for example, in response to increases in body temperature, the hypothalamus stimulates the secretion of sweat glands in the skin , the hypothalamus also sends signals to the cerebral cortex to produce the feelings of hunger and thirst when the body is lacking food or water, these signals stimulate the conscious mind to seek out food or water to correct this

situation , also directly controls the pituitary gland by producing hormones , some of these hormones, such as oxytocin and antidiuretic hormone, are produced in the hypothalamus and stored in the posterior pituitary gland , other hormones, such as releasing and inhibiting hormones, are secreted into the blood to stimulate or inhibit hormone production in the anterior pituitary gland (Woolsey et al 2003).

The pineal gland is a small gland located posterior to the thalamus in a sub-region called the epithalamus, the pineal gland produces the hormone melatonin. Light striking the retina of the eyes sends signals to inhibit the function of the pineal gland. In the dark, the pineal gland secretes melatonin, which has a sedative effect on the brain and helps to induce sleep. This function of the pineal gland helps to explain why darkness is sleep-inducing and light tends to disturb sleep. Babies produce large amounts of melatonin, allowing them to sleep as long as 16 hours per day. The pineal gland produce less melatonin as people age, resulting in difficulty sleeping during adulthood (Van Buren et al 1972).

2.2.5 Cerebrum:

The largest region of the human brain, our cerebrum controls higher brain function such as language, logic, reasoning, and creativity, the cerebrum surrounds the diencephalon and is located superior to the cerebellum and brainstem, a deep furrow known, dividing the cerebrum into the left and right hemisphere , each hemisphere can be further divided into 4 lobes: frontal, parietal, temporal, and occipital, the lobes are named for the skull bones that cover them, the surface of the cerebrum is a convoluted layer of gray matter known as the cerebral cortex. Most of the processing of the cerebrum takes place within the cerebral cortex, the bulges of cortex are called gyri (singular : gyrus) while the indentations are called sulci (singular: sulcus).

Deep to the cerebral cortex is a layer of cerebral white matter , white matter contains the connections between the regions of the cerebrum as well as between the cerebrum and the rest of the body, aband of white matter called the corpus callosum connects the left and right hemispheres of the cerebrum and allows the hemispheres to communicate with each other (Schitzlein,H.N.,Murtagh and F.R 1990).

Deep within the cerebral white matter are several regions of gray matter that make up the basal nuclei and the limbic system, the basal nuclei, including the globus pallidus, striatum, and subthalamic nucleus, work together with the substantia nigra of the midbrain to regulate and control muscle movements, specifically, these regions help to control muscle tone, posture, and subconscious skeletal muscle, the limbic system is another group of deep gray matter regions, including the hippocampus and amygdala, which are involved in memory, survival, and emotions , the limbic system helps the body to react to emergency and highly emotional situations with fast, almost involuntary actions (Schitzlein,H,N,Murtagh and F.R 1990).

2.2.6 Meninges:

Three layers of tissue, collectively known as the meninges, surround and protect the brain and spinal cord, the dura mater forms the leathery, outermost layer of the meninges , dense irregular connective tissue made of tough collagen fibers gives the dura mater its strength , the dura mater forms a pocket around the brain and spinal cord to hold the cerebrospinal fluid and prevent mechanical damage to the soft nervous tissue , the arachnoid mater is found lining the inside of the dura mater, much thinner and more delicate than the dura mater, it contains many thin fibers that connect the dura mater and pia mater, as its fibers resemble a spider web, beneath the arachnoid mater is a fluid-filled region known as the subarachnoid space , as the innermost of the meningeal layers, the pia mater rests directly on the surface of the brain and spinal cord. The pia

mater's many blood vessels provide nutrients and oxygen to the nervous tissue of the brain, the pia mater also helps to regulate the flow of materials from the bloodstream and cerebrospinal fluid into nervous tissue (Morel et al 1997).

2.2.7 Cerebrospinal Fluid:

Cerebrospinal fluid (CSF) a clear fluid that surrounds the brain and spinal cord provides m

Many important functions to the central nervous system, rather than being firmly anchored to their surrounding bones, the brain and spinal cord float within the CSF. CSF fills the subarachnoid space and exerts pressure on the outside of the brain and spinal cord , the pressure of the CSF acts as a stabilizer and shock absorber for the brain and spinal cord as they float within the hollow spaces of the skull and vertebrae, inside of the brain, small CSF-filled cavities called ventricles expand under the pressure of CSF to lift and inflate the soft brain tissue , cerebrospinal fluid is produced in the brain by capillaries lined with ependymal cells known as choroid plexuses , blood plasma passing through the capillaries is filtered by the ependymal cells and released into the subarachnoid space as CSF, the CSF contains glucose, oxygen, and ions, which it helps to distribute throughout the nervous tissue. CSF also transports waste products away from nervous tissues, after circulating around the brain and spinal cord, CSF enters small structures known as arachnoid villi where it is reabsorbed into the bloodstream , arachnoid villi are finger-like extensions of the arachnoid mater that pass through the dura mater and into the superior sagittal sinus , the superior sagittal sinus is a vein that runs through the longitudinal fissure of the brain and carries blood and cerebrospinal fluid from the brain back to the heart , the brain is the most metabolically active organ in the body , while representing only 2% of the body's mass, it requires 15-20% of the total resting cardiac output to provide the necessary glucose and oxygen for its metabolism (Orrison Jr., W.W 2008).

2.2.8Arterial distributions:

Knowledge of cerebrovascular arterial anatomy and the territories supplied by the cerebral arteries is useful in determining which vessels are involved in acute stroke. Atypical patterns of brain ischemia that do not conform to specific vascular distributions may indicate a diagnosis other than ischemic stroke, such as venous infarction (Nowinski et al 2006).

In a simplified model, the cerebral hemispheres are supplied by 3 paired major arteries, specifically, the anterior, middle, and posterior cerebral arteries , the anterior and middle cerebral arteries carry the anterior circulation and arise from the supraclinoid internal carotid arteries , the anterior cerebral artery (ACA) supplies the medial portion of the frontal and parietal lobes and anterior portions of basal ganglia and anterior internal capsule, the middle cerebral artery (MCA) supplies the lateral portions of the frontal and parietal lobes, as well as the anterior and lateral portions of the temporal lobes, and gives rise to perforating branches to the globus pallidus, putamen, and internal capsule, the (MCA) is the dominant source of vascular supply to the hemisphere, the posterior cerebral arteries arise from the basilar artery and carry the posterior circulation the posterior cerebral artery (PCA) gives rise to perforating branches that supply the thalami and brainstem and the cortical branches to the posterior and medial temporal lobes and occipital lobes (Nowinski et al 2006).

The cerebellar hemispheres are supplied as follows:

Inferiorly by the posterior inferior cerebellar artery (PICA), arising from the vertebral artery.

Superiorly by the superior cerebellar artery (Nowinski et al 2006).

Anterolaterally by the anterior inferior cerebellar artery (AICA), from the basilar artery (Nowinski et al 2006).

2.3Pathophysiology:

Stroke is defined as an "acute neurologic dysfunction of vascular origin with sudden (within seconds) or at least rapid(within hours) occurrence of symptoms and signs corresponding to the involvement of focal areas in the brain" (Goldstein et al 1989).

The two main types of stroke are ischemic and hemorrhagic, accounting for approximately 85% and 15% respectively (Wise RJ et al 1999).

When an ischemic stroke occurs, the blood supply to the brain is interrupted, and brain cells are deprived of the glucose and oxygen they need to function , ischemic stroke is a complex entity with multiple etiologies and variable clinical manifestations, approximately 45% of ischemic stroke are caused by small or large artery thrombus, 20% are embolic in origin, and others have an unknown cause (Wise RJ al 1999).

Acute ischemic stroke (AIS) is characterized by the sudden loss of blood circulation to an area of the brain, typically in a vascular territory, resulting in a corresponding loss of neurologic function, also previously called cerebrovascular accident (CVA) or stroke syndrome, stroke is a nonspecific state of brain injury with neuronal dysfunction that has several pathophysiologic causes. Stroke can be divided into 2 types: hemorrhagic or ischemic , acute ischemic stroke is caused by thrombotic or embolic occlusion of a cerebral artery , thrombosis can form in the extra cranial and intracranial arteries when the intima is roughened and plaque forms along the injured vessel , the endothelial injury (roughing) permits platelets to adhere and aggregate, then coagulation is activated and thrombus develops at site of plaque, blood flow through the extra cranial and intracranial systems decreases, and the collateral circulation maintains function. When the compensatory mechanism of collateral circulation fails, perfusion is compromised, leading to decreased perfusion and

cell death, during an embolic stroke, a clot travels from a distant source and lodges in cerebral vessels , micro emboli can break away from a sclerosed plaque in the carotid artery or from cardic sources such as atrial fibrillation, patent foramen ovale, or a hypokinetic left ventricle , emboli in the form of blood, fat, or air can occur during surgical procedures, most commonly during cardiac surgery, but also after long bone surgeries (Heros R 1994).

Less common causes of ischemic stroke include carotid dissection (Heros R et al 1994).

And the presence of coagulopathies, such as those resulting from antiphospholipid antibodies (Siesjo BK 1989), other causes include arterities,infection, and drug abuse, such as the use of cocaine (Siesjo BK 1981).

As a thrombosis or emboli cause a decrease in blood supply to the brain tissue, events occur at the cellular level, referred to as the ischemic cascade , neurons and support cells require a careful balance of variables such as temperature, PH, nutrition and waste removal in their environment to function optimally, intensive basic scientific research during the last two decades has given healthcare professionals an increased understanding of the ischemic cascade in the format of the precise environmental alterations involved in the pathophysiology of ischemic injury at the cellular level , understanding the ischemic cascade has led to the concept of a therapeutic time window for treatment possibilities, often, there is a core region of dead cells surrounded by an area of hypoperfused tissue , the hypoperfused area may be rescued; this area is referred to as the penumbra region (Fuster V. Stein B et al 1990). Neuroprotection is a broad term that refers to pharmacological and no pharmacological treatments used to halt the cellular events in the ischemic cascade, forming the theoretical basis for many of the acute stroke therapies under study (Zivin JA 1991), as well as the rationale for intervening within a therapeutic time window following ischemic stroke (Zivin JA 1991).

2.3.1Sings and Symptoms of Stroke:

Stroke occur quickly, and as such their symptoms often appear suddenly without warning like sudden numbness, confusion, trouble seeing and severe headache. The acronym FAST is a way to remember the sings of stroke, and can help toward identifying the onset of stroke in someone, F for Face drooping. Arm weakness speech difficulty time to look for help (Schwamm et al 2005).

2.3.2 Diagnose of Stroke:

There are several different types of diagnostic tests that can use in order to diagnose stroke including clinical examinations: checking patient's symptoms ,medical history, check blood pressure, listen to the carotid arteries in the neck and examine the blood vessels at the back of the eyes. Lap test is complete blood count (CBC) is a routine test to determine the number of red blood cells, white blood cells, and platelets in the body. Imaging modalities induce CT, MRI, carotid ultrasound and cerebral angiogram (Schwamm et al 2005).

2.3.3Treatment of Stroke:

As the two main different kinds of stroke, ischemic and hemorrhagic, are caused by different forms of treatment. Ischemic strokes are caused by arteries being blocked or narrowed and so treatment focuses on restoring an adequate flow of blood to the brain. Treatment can begin with drugs to break down clot and prevent further ones from forming. Aspirin can be given; injection of a tissue plasminogen activator. tPA is very effective at dissolving clots , but needs to be injected within (3-4.5) hours of stroke symptoms manifesting themselves (Keith 2001).

Hemorrhage stroke are caused by bleeding into the brain and so treatment focuses on controlling the bleeding and reducing the pressure on the brain that it is causing . Treatment can begin with drugs being given to reduce the pressure

in the brain, overall blood pressure, prevent seizures and prevent sudden constrictions of blood vessels (Keith 2001).

2.3.4 Complications of Stroke

Stroke leave complications vary according to their strength and size, may lead to a significant hemiplegia (paralysis) in half the body and sometimes disorders in swallowing, breathing and in the circulatory system and may cause death in the first few hours or after several few hours or after several hours if not treated. (Fonarow et al 2007).

2.3.5 Stroke Risk Factor

There are two types of risk factors controllable and uncontrollable, controllable factors are high blood pressure, atherosclerosis, heart disease, smoking, high cholesterol, diabetes, obesity and excessive alcohol intake. Uncontrollable factors are age, gender, race, family history, and artery abnormalities (Schwamm et al 2005).

2.3.5.1 Computerized Tomography CT

Since its introduction in the 1970s, CT has become an important tool in medical imaging to supplement X-rays and medical ultrasonography . A CT scan makes use of computer-processed combinations of many X-ray images taken from different angles to produce cross-sectional (tomographic) images (virtual 'slices') of specific areas of a scanned object, allowing the user to see inside the object without cutting. Digital geometry processing is used to generate a three-dimensional image of the inside of the object from a large series of two-dimensional radiographic images taken around a single axis of rotation. Medical imaging is the most common application of X-ray CT . Its cross-sectional images are used for diagnostic and therapeutic purposes in various medical disciplines (Srinivasan et al 2006).

2.3.5.2 CT Brain Stroke Protocol

Non-contrast CT of the brain remains the mainstay of imaging in the setting on an acute stroke. It is fast, inexpensive and readily available. Its main limitation however is the limited sensitivity in the acute setting. Detection depends on the territory, the experience of the interpreting radiologist and of course the time of the scan from onset of symptoms (Srinivasan et al 2006).

The goals of CT in the acute setting are to exclude intracranial hemorrhage, which would preclude thrombolysis; look for any "early" features of infarction and exclude other intracranial pathologies that may mimic a stroke, such as tumor (Srinivasas et al 2006).

CT angiography and CT perfusion also can help diagnose and evaluate blood vessel disease or related conditions, such as aneurysms or blockages, they requires more time than non-contrast CT brain (Srinivasan et al 2006).

2.3.6 CT Finding in acute a stroke:

2.3.6.1 Immediate:

The earliest CT sign visible is a hyperdense segment of a vessel, representing direct visualization of the intravascular thrombus / embolus and as such is visible immediately . Although this can be seen in any vessel, its most often observed in the middle cerebral artery . (Pressman BD, et al 1987)

2.3.6.2 Early (1-3 hours) (also known as hyperacute phase)

Within the first few hours, a number of signs are visible depending on the site of occlusion and the presence of collateral flow. Early features include:

Loss of grey-white matter differentiation, and hypoattenuation of deep nuclei:

Lentiform nucleus changes seen as early as 1 hour

after occulusion, visible in 75% of patients at 3hours.(Nakano S, et al 2001).

Cortical hypodensity with associated parenchymal

swelling with resultant gyral effacement .

Cortex which has poor collateral supply (e.g insular ribbon) is more vulnerable. (Nakano S, et al 2001).

2.3.6.3 First week

With time the hypo-attenuation and swelling become more marked resulting in a significant mass effect. This is a major cause of secondary damage in large infarcts.

2.3.6.4 Second to third week

As time goes on the swelling starts to subside and small amounts of cortical petechial haemorrhages (not to be confused with haemorrhagic transformation) result in elevation of the attenuation of the cortex . This is known as the CT fogging phenomenon . Imaging a stroke at this time can be misleading as the affected cortex will appear near normal. (Becker H, et al 1979).

2.3.6.5 Months

Later still the residual swelling passes, and gliosis sets in eventually appearing as a region of low density with negative mass effect. Cortical mineralization can also sometimes be seen appearing hyperdense.

2.3.7 Previous studies:

In the study of (H. P. Adams Jr. et al 2007), show the risk of stroke rises significantly with age. After 55, it more than doubles with each passing decade. Each year, about 1 percent of people between ages 65 and 74 have a stroke and 5 to 8 percent of people in that age group who have had a TIA(Transient Ischemic Attack) go on stroke.

Another previous studies of (Kajstra J et al 1996), show the risk of stroke rises in males than females, among 1,110 patients, including 615 men and 505 women, a normal or near outcome at 90 days was found in 37.1% of men's vs 36.0% of women .

Another previous studies of (P. D. Schellinger 2010), on this study, including 403 ischemic strokes and 269 hemorrhagic strokes were documented,(>27 kg/m2) had significantly increased risk of ischemic stroke, with relative risks (RRs) of 1.75 (95% confidence interval {CL}, 1.17-2.59) for BMI (Body Mass Index) of 27 to 28.9kg/m2; 1.9(95%CL, 1.60-3.50) for BMI of 32kg/m2 or more (p for trend,<.001), as compared with those with a BMI of less than 21kg/m2.

Another previous studies of (Lancaster T, Stead L 2005), who saied smoking facilities atherosclerosis and appears to be a dependent risk factor for strokes that result from a clot. It also seems to be a risk for strokes that result from cerebral hemorrhage. Men in a community studied extensively for cardiovascular disease who smoked more than 40 cigarettes a day had twice the stroke risk of men who smoked fewer than 10. In large Harvard Medical School study of women, the number of cigarettes smoked was found to be directly related to stroke risk . Women smoking more than 25 cigarettes a day had a 2.7 times greater risk of stroke from a clot or embolus and a 9.8 times greater risk of a hemorrhagic stroke

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3.1 Materials

3.1.1 Patients (study sample):

This is a practical study carried out in a samples of 50 patients in different genders and age groups whom will be referred to the radiology department in Aljazeera injuries and orthopedic surgery center in wad Madani with suspected case of acute stroke, undergone CT examination, to evaluate each type of stroke according to their location and patient with brain tumor excluded from the study, the data collected and interpreted by radiologist reports.

3.1.2 Machine used:

Machine used in this study Toshiba CT scanner. Scans are taken parallel to the floor of the anterior fossa, the lowest section through the external auditory meatus and continuing to the top of the head. The gantry angled towards the feet. Slice thickness of 4mm was used for scanning posterior fossa, 7mm for remainder of the head.

3.1.3 Study area

Aljazeera injuries and orthopedic surgery center in wad Madani and Wad Madani Technical Hospital

3.1.4 Data collection

Data collected from findings which appear in different CT cuts and the data represented in tables and graphs.

The data included the general patients data (Age, gender and weight) and accompanied by the related to symptoms and clinical information such as clinical signs (A numb or weak feeling in the face, arm or leg, trouble speaking or understanding, unexplained dizziness, blurred or poor vision in one or both eyes, loss of balance or an unexplained fall, headache (usually severe or of abrupt onset) or unexplained change in the pattern of headaches, confusion) the risk factors and patients history (hypertension, diabetes mellitus).

3.1.5 Data analysis:

All data were entered and analyzed using Microsoft Excel . Statistical analysis included description statistic of frequency tables, graphs, cross tabulation.

3.2.5 Image interpretation:

All images were studied to differentiate causes of stroke, size and locations and radiologist reports considers.

Chapter Four
Results

Chapter Four

Results

In the present study, a total number of 50 patients with stroke were studied to evaluate the role of CT scanning in diagnosis stroke.

Table (4.1) illustrate the frequency of stroke patient's according to the gender.

	Frequency	**Percentage%**
Male	34	68.0
Female	16	32.0
Total	50	100.0

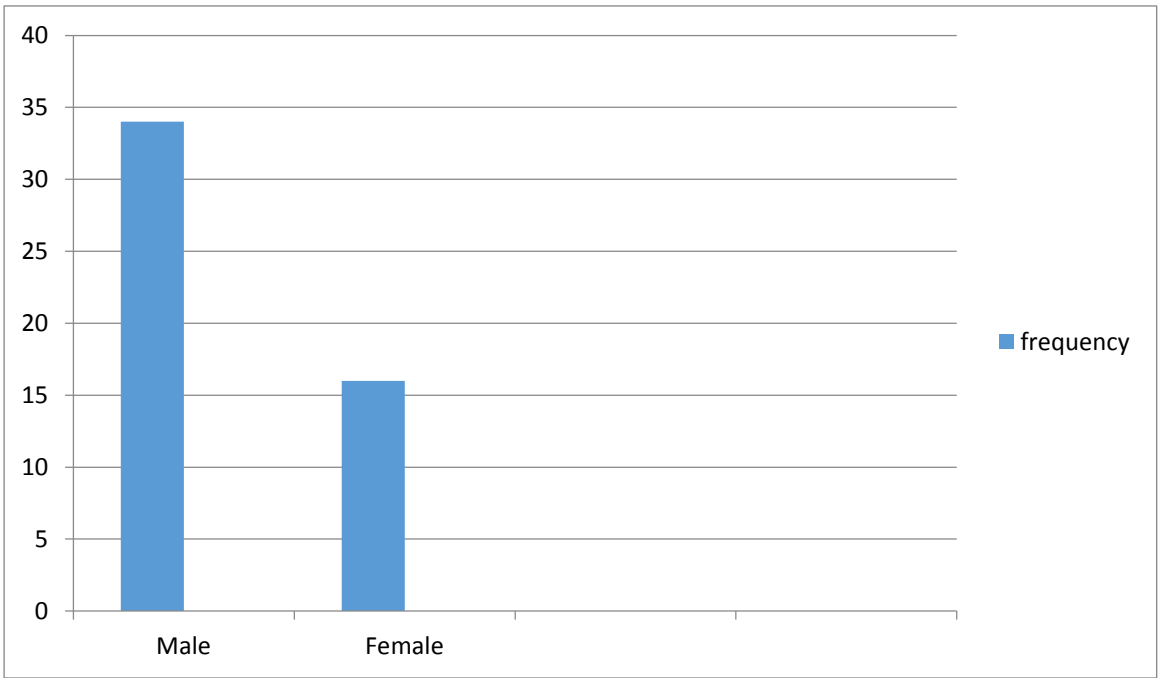
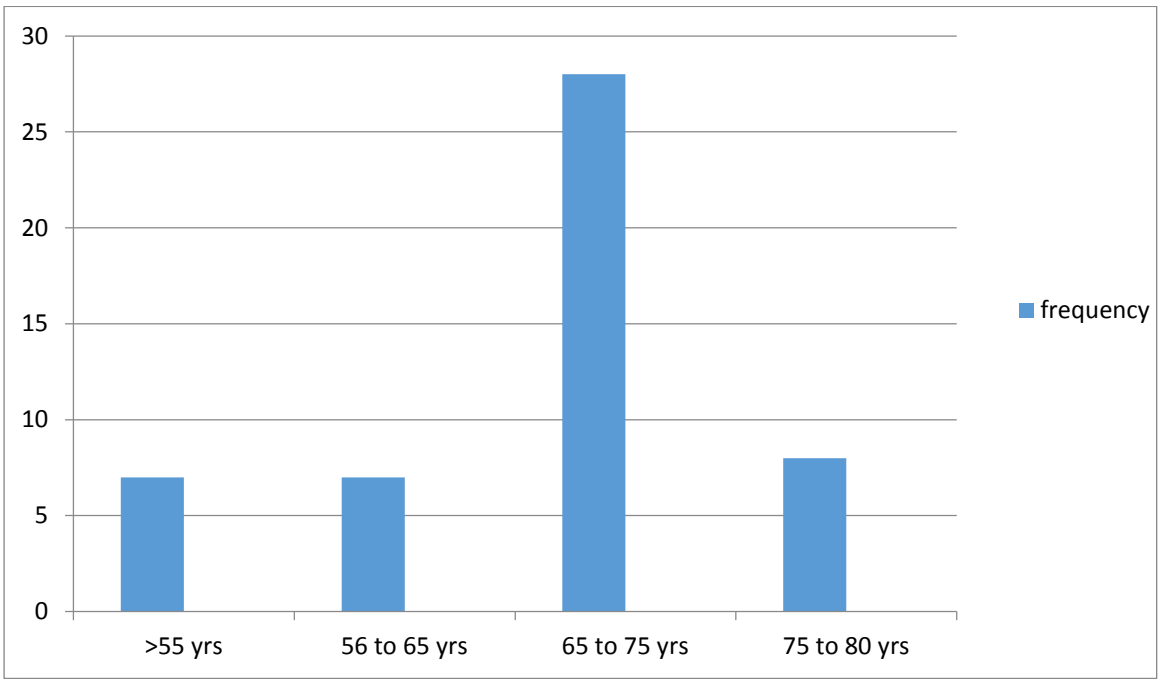


Figure (4.1) illustrate the frequency of stroke patient's according to the gender

Table(4.2) illustrate the frequency of stroke patient's according to the age.

Age	Frequency
>55 yrs	7
55 to 65 yrs	7
65 to 75 yrs	28
<75 yrs	8
Total	50



Figures (4.2) illustrate the frequency of stroke patient's according to the age.

Table (4.3) illustrates the frequency of stroke patient's according to the weight.

Weight	Frequency
>76 kg	19
76 to 80 kg	31
Total	50

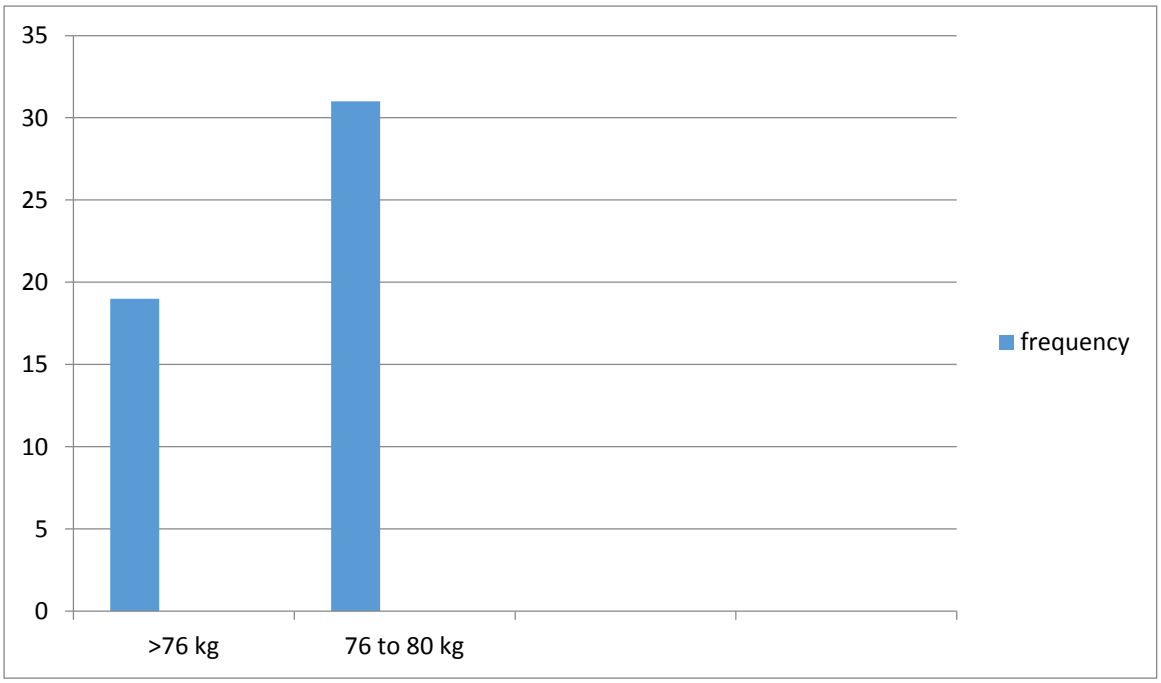


Figure (4.3) illustrate the frequency of stroke patient's according to the weight.

Table (4.4) illustrate the correlation between stroke patient's and their habits

Habits	Frequency	Percentage %
Smoker	32	64.0%
Non smoker	18	36.0%
Total	50	100.0%

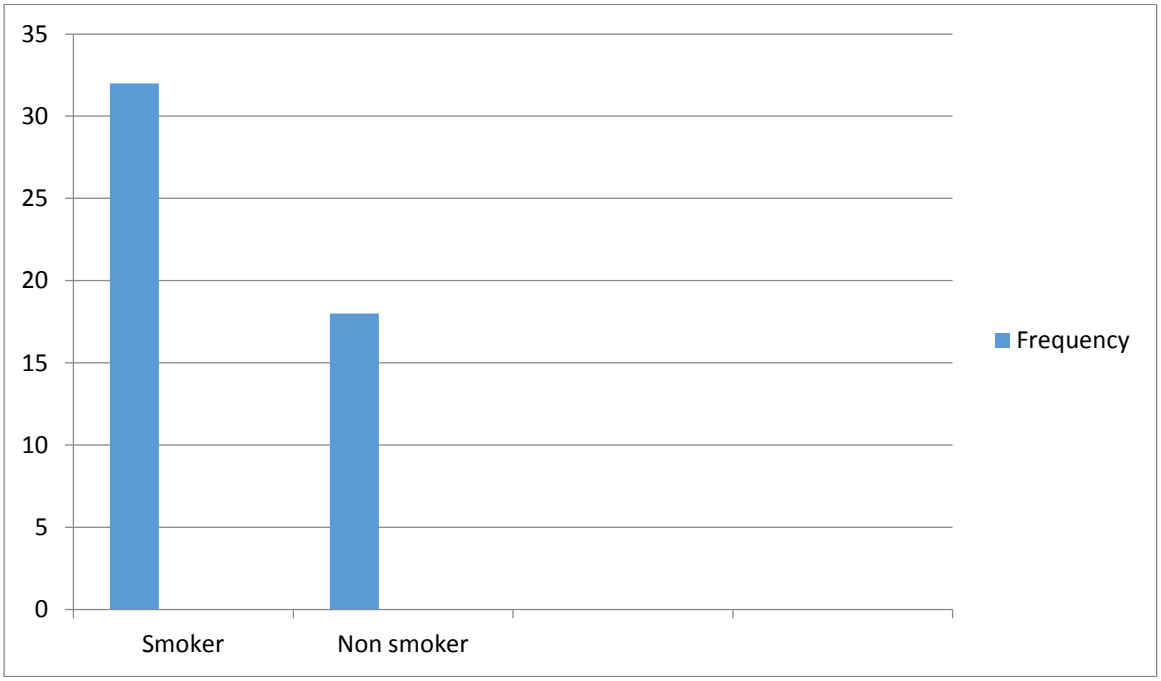


Figure (4.4) illustrate the correlation between stroke patient's and their habits.

Table (4.5) illustrate the percentage % of stroke patient's according to the final diagnosis.

Final diagnosis	Percentage %
Ischemia	66.0%
hemorrhage	34.0%
Total	100.0%

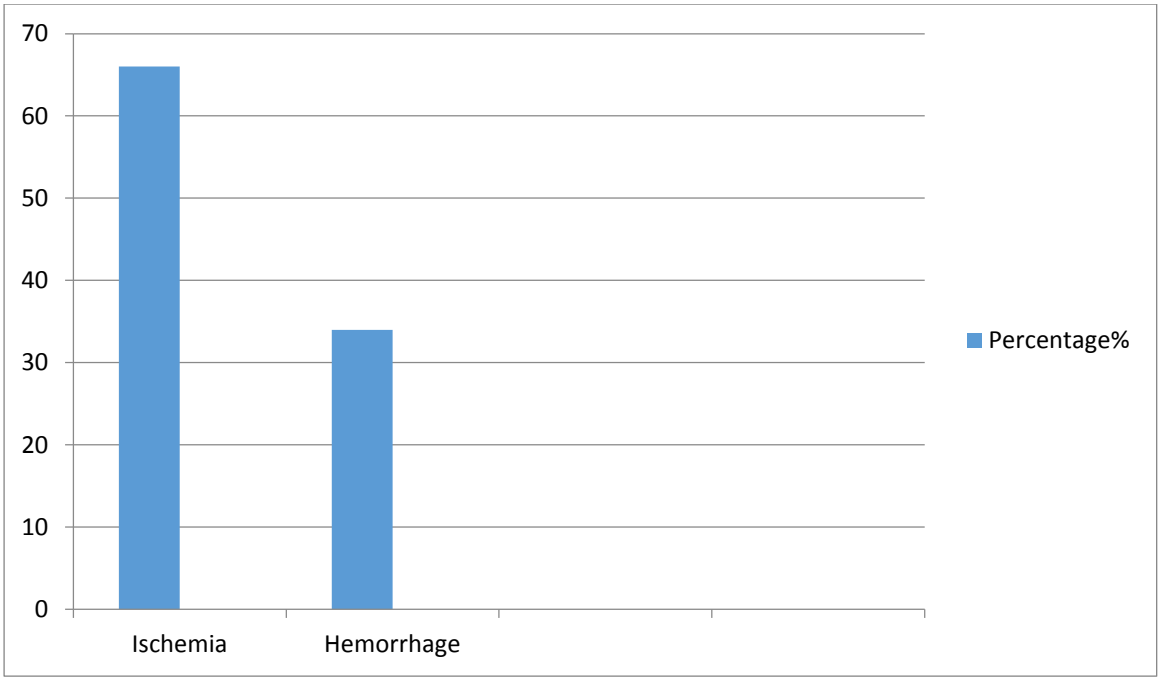


Figure (4.5) illustrate the percentage % of stroke patient's according to the final diagnosis.

Table (4.6) represents the frequency and percentage % of the common site of stroke.

Site of stroke	Frequency	Percentage%
RT anterior	4	8.0%
RT posterior	2	4.0%
LT anterior	6	12.0%
LT posterior	4	8.0%
Preiventricular	27	54.0%
LT anterior + preiventricular	4	8.0%
LT anterior + LT posterior	3	6.0%

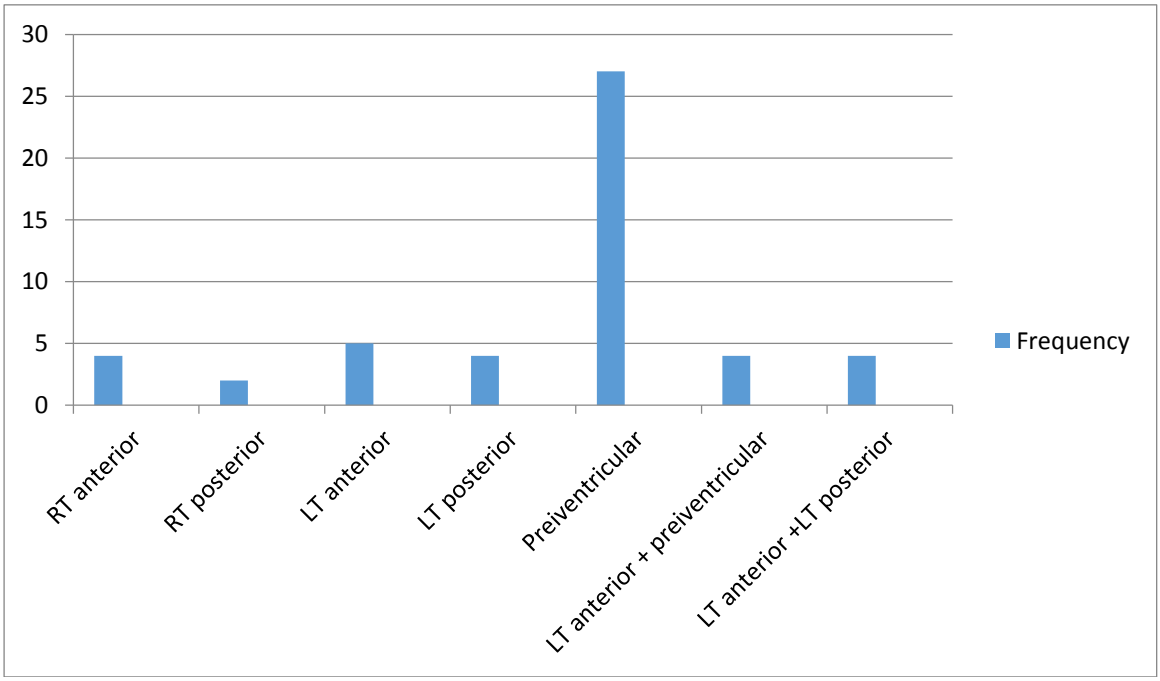


Figure (4.6) represents the frequency of the common site of stroke.

Table (4.7) show the effect of age on stroke patient's Final diagnosis * age cross tabulation

		>55 yrs	55 to 65 yrs	65 to 75 yrs	75 to 80 yrs
Final diagnosis	Ischemia	5	4	18	5
	Hemorrhage	2	3	10	3
Total	100				

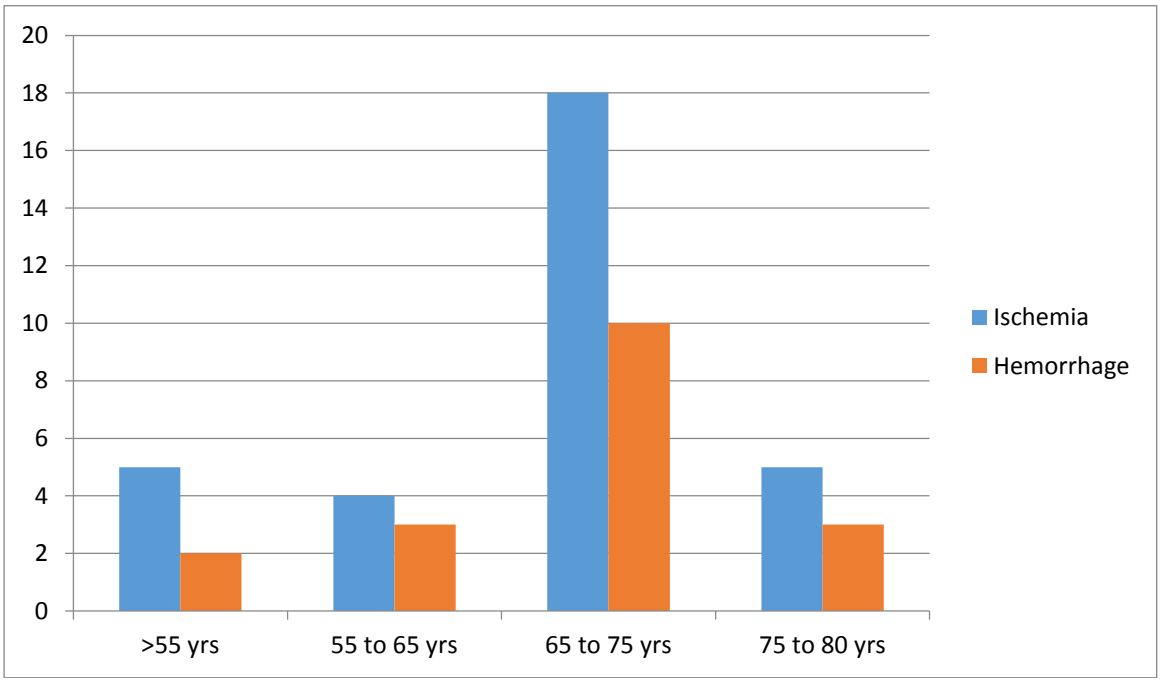


Figure (4.7) show the effect of age on stroke patient's

Table (4.8) show the cross tabulation between final diagnosis and gender.

		Final diagnosis		Total
Gender		Ischemia	Hemorrhage	
	Male	32	2	34
	Female	4	12	16
	Total	36	14	50

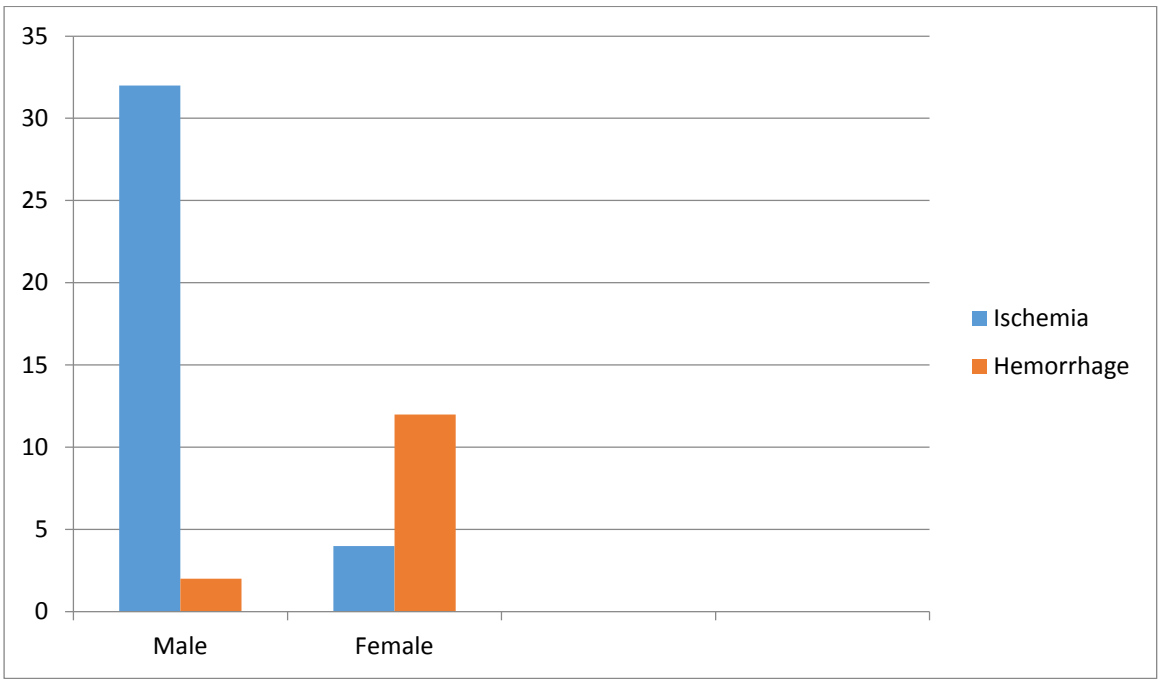


Figure (4.8) show the cross tabulation between final diagnosis and gender

Table (4.9) show the correlation between final diagnosis and underlining diseases

underlined disease		final diagnosis		Total
		Ischemia	Hemorrhage	
	Hypertension	6	4	10
	DM+HT	3	4	7
	DM	2	0	2
Total		11	8	19

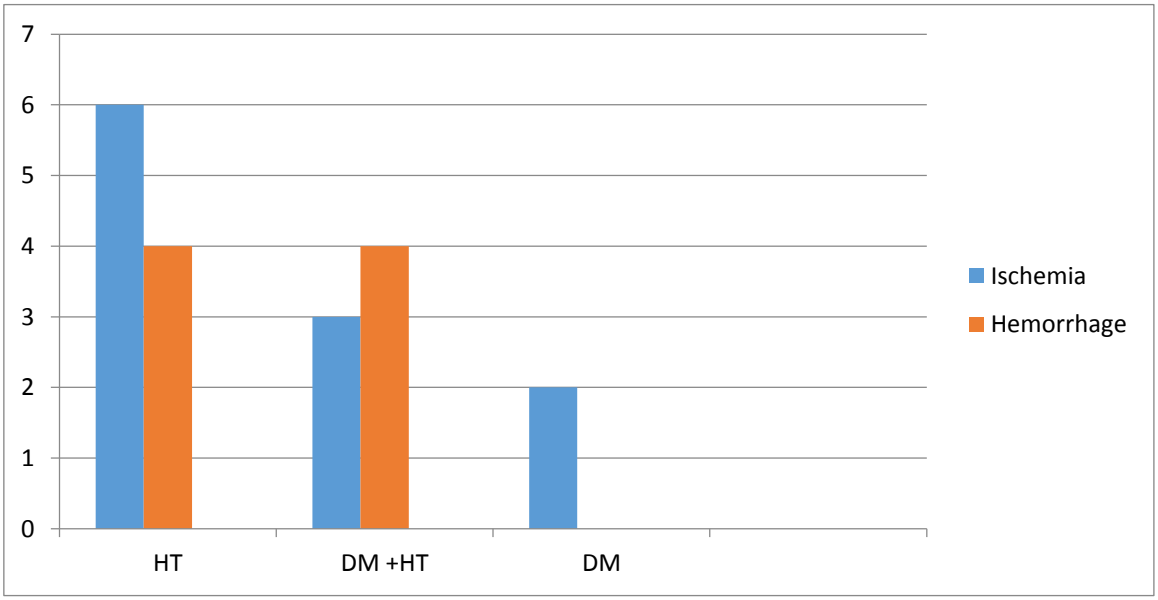


Figure (4.9) show the correlation between final diagnosis and under lining diseases

Table (4.10) show the cross tabulation between final diagnosis and weight

Final diagnosis	Weight		Total
	>76 kg	76 to 80 kg	
Ischemia	17	19	36
Hemorrhage	12	2	14
Total	29	21	50

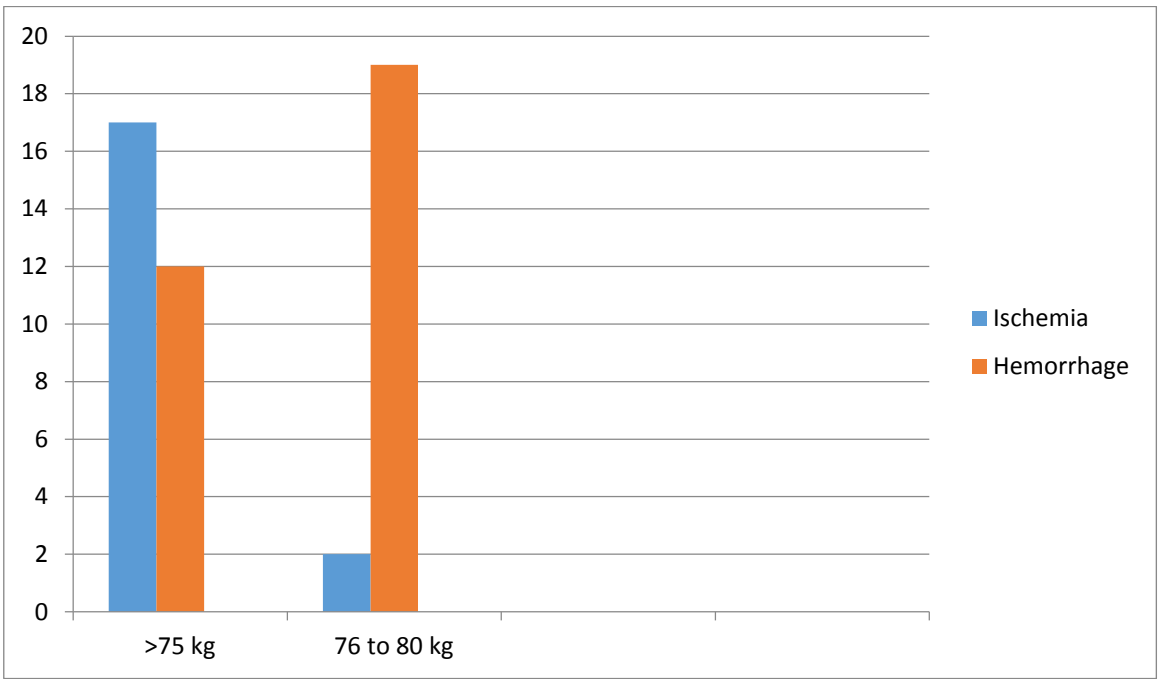


Figure (4.10) show the frequency of weight on stroke patient's

Chapter Five

Discussion, Conclusions, Recommendations

Chapter Five

5.1 Discussion:

The preliminary investigations obtained from this study revealed that the stroke patient's participated in this study, patients with old ages more affected than younger patient's , and this remarks are reported by (H. P. Adams Jr. et al 2007), who postulated that the stroke rises significantly with age. Each year, about 1 percent of people between ages 65 and 74 have a stroke and 5 to 8 percent of people in that age group who have had a transient ischemic attack go on to stroke. Although risk associated with advancing age cannot be changed, it is an important factor in assessing stroke risk and planning preventive therapies.

The preliminary investigations obtained from this study revealed that the patients participated in this study, men with being more affected than women in regards with stroke disease, as our study including 34 males and 16 females, and this remarks are reported by (Kajstra J et al 1996), who postulated that the stroke rises in males than females, among 1,110 patients, including 615 men and 505 women, a normal or near normal outcome at 90 days was found in 37.1% of men vs 36.0% of women. But disagree with (Dr David M. Kent 2011). Who Saied in his pooled analysis of acute ischemic stroke , stroke has a greater effect on women than men because women have more events and are less likely to recover .

In our study data indicate that both obesity and weight gain in males and females are important risk factors for ischemic but not hemorrhagic stroke. this result are in agreement with findings of (P. D. Schellinger 2010) , on his study , including 403 ischemic strokes and 269 hemorrhagic strokes were documented,(>27 kg/m2) had significantly increased risk of ischemic stroke, with relative risks (RRs) of 1.75 (95% confidence interval {CL}, 1.17-2.59) for BMI (Body Mass Index) of 27 to 28.9kg/m2; 1.9(95%CL, 1.60-3.50) for BMI

of 32kg/m2 or more (p for trend,<.001), as compared with those with a BMI of less than 21kg/m2.

The preliminary investigations obtained from this study revealed that the stroke patient's participated in this study , smoker patient's are more affected than non smoker patient's, and this remarks reported by (Lancaster T, Stead L 2005), who Saied smoking facilities atherosclerosis and appears to be a dependent risk factor for strokes that result from a clot. It also seems to be a risk for strokes that result from cerebral hemorrhage.

Data from both the Framingham Heart Study and the Honolulu Heart Study indicate that one can significantly reduce stroke risk by stopping smoking. Five years after they stop, smokers have a stroke risk equal to that of non-smokers (National Institute for Health and Clinical Excellence 2011).

In this study the result of final diagnosis in stroke patient’s, revealed that the percentage of ischemia is more frequently than hemorrhage in the sample of study, where the ischemia was 72% and hemorrhage was 28%. This result agree with Schellinger et al 2010 when found ischemic stroke increase than hemorrhagic.

One of the most interesting observations obtained from this study is to identify the common site of stroke, the result show that the percentage of stroke in preiventricular was 56% from total number of study sample.

5.2 Conclusion:

This study shows most positive finding of stroke in older age more affected than younger patient`s.

This study shows men with being more affected than women.

This study data indicate that both obesity and weight gain in males and females are important risk factors for stroke.

This study shows smoker patients are more affected than non smokers.

In this study the result of final diagnosis in stroke patients revealed that the percentage of ischemia is more frequently than hemorrhage.

CT scanning is the gold standard technique for diagnosis of acute stroke as the rational management of stroke depends on accurate diagnosis and should be ideally done in all cases . Since risk factors such as hypertension, diabetes and previous episodes of stroke play major role in the evolution of cerebrovascular accidents, thorough analysis by CT scan , other investigations and treatment in these patients will decrease the incidence of fresh episodes of CVA .

CT by itself cannot supply all the information needed to make accurate predictions, and ideal prognostic models should consist of a combination of clinical and imaging data.

5.3 Recommendations

CT scanning should be the first line of investigation for diagnosis of acute stroke as it is widely available than MRI . In addition CT is fast and easily performed in severely ill patients who are dependent on support and monitoring devices.

CT scanning should be done in patients with sudden onset of neurological deficit or unexplained headache for the possibility of stroke.

CT scanning is pivotal in determining which course of treatment is called for treatment for ischemic stroke is thrombolytic. Treatment of hemorrhagic stroke aims to relieve pressure on the brain , including with surgery or medication. And CT scanning is also helpful for Follow up studies to look for the resolution of the intracerebral hemorrhage and the effectiveness of the given treatment.

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Appendices

Appendices

Sudan University of Science and Technology College of Graduate Studies

Evaluation the role of CT examination in diagnosis of acute stroke

تقييم بروتوكول التصوير بالأشعة المقطعية للدماغ في تشخيص مرض السكتة الدماغية الحادة

Appendix (1)

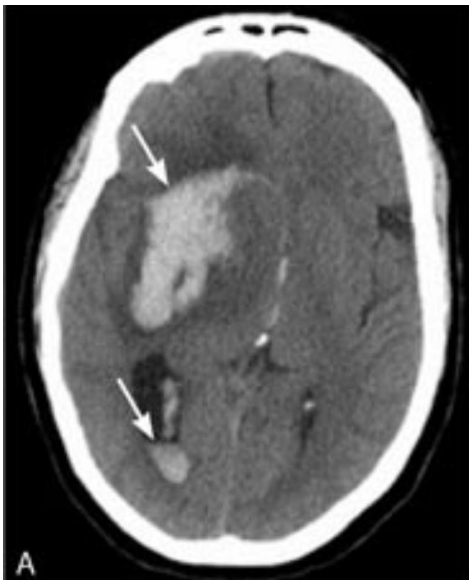
Name		
Age		
Gender		
Weight		
Habits	**Smoker**	**Non-smoker**

Examination Regard:

Underlining Diseases	DM	Hypertensive	Heart diseases
Type of stroke	Acute	Sub acute	Chronic
CT Finding			
Final diagnosis			
Site of stroke			

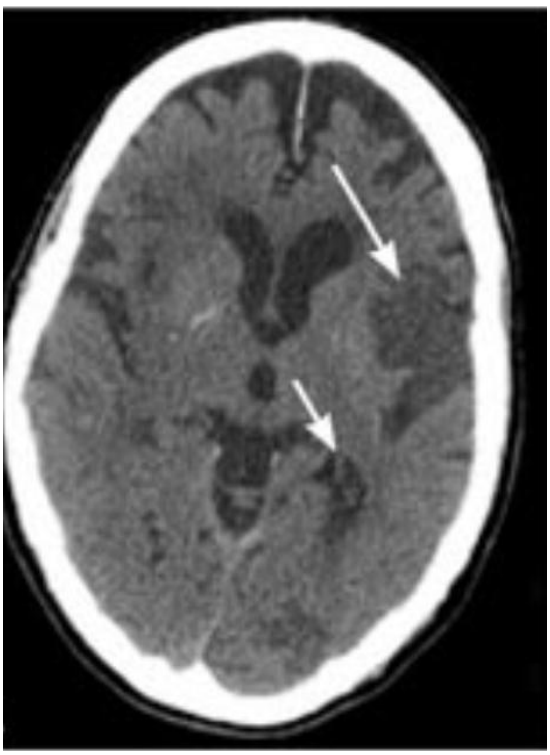
Appendix (2)

(CT) image (1)



Head computed tomography (CT) scans showing intracerabral hemorrhages (arrows)

(CT) image (2)



Noncontrast computed tomography (CT) scan showing two hypodense regions indicating old infarctions in the distribution of the left-middle cerbebral (long arrow) and posterior cerebral arteries (short arrow).