Sudan University of Science and Technology

College of Graduate Studies

Evaluation of Brain Stroke by using Computed Tomography

تقييم السكتة الدماغية بإستخدام الاشعة المقطعية

A thesis Submitted for Partial Fulfillment of the Requirements of MSc Degree in Diagnostic Radiological Technology

By:

Esraa Salim Mohammed Salim

Supervisor:

Dr. Saida Abdelkreem Omer Mohamed

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الآية

بسم الله الرحمن الرحيم

قال تعالى :

﴿وَقُل رَّبِّ زِدْنِي عِلْمًا﴾

صدق الله العظيم

سورة طه (114)

Dedication

I dedicate this work to my family and my teachers.

Acknowledgement

Firstly, I would like to express my gratitude and appreciation to the Almighty Allah from whom I have power and aid.

I would also like to express my sincere gratitude to my supervisor **Dr. Saida Abdelkreem Omer Mohamed** for his suggestions, patience, guidance, encouragement, cooperation and supervision of this work.

Finally, I would like to thanks every person who helped me ingathering different information, collecting data and guiding me from time to time in making this study.

Abstract

The stroke is a medical emergency in which the blood supply to any portion of the brain is interrupted or reduced, alternative names: Cerebrovascular accident/ disease (CVA), cerebral infarction, cerebral hemorrhage.

The aim of this research to evaluate brain stroke using CT scanning in Sudanese patients, by identify its appearance, site, size and type.

This study was a descriptive study and had been conducted at Albogaa hospital in a period from January 2022 to April 2022 with sample which was consisted from 60 patients having brain stroke and had done CT brain images.

A total of 60 patients 32 (52.3 %) were males and 28 (46.7 %) were females, categorized in eight age groups which doubles every 10 years. The majority of age groups was between 60 to 70 years 19 (31.7 %). Study found that the clinical symptoms which associated with stroke was left and right side weakness with incidence (29; 47.5 % and 10; 16.4 %. respectively). Study also revealed that ischemic stroke was the most type in this study 55 (91.7 %) where as only 5 (8.3 %) of total patients has a hemorrhagic stroke.

Conclusion

The study concludes that CT scan is ideal in evaluation brain stroke and identifying whether the stroke is hemorrhagic or ischemic

المستخلص

السكتة الدماغية هي حالة طبية طارئة يتم فيها انقطاع أو نقص إمداد الدم إلى أي جزء من الدماغ ، وهناك أسماء بديلة: الحادث الدماغي الوعائي (CVA) ، احتشاء دماغي ، نزيف دماغي.

الهدف من هذا البحث هو تقييم السكتة الدماغية باستخدام الأشعة المقطعية للمرضى السودانيين ، من خلال تحديد مظهرها وموقعها وحجمها ونوعها.

كانت هذه الدراسة عبارة عن دراسة وصفية أجريت في مستشفى البقعة في الفترة من يناير 2022 إلى أبريل 2022 بعدد 60 مريضًا يعانون من سكتة دماغية وقاموا بعمل صور مقطعية للدماغ.

من إجمالي 60 مريضاً، 32 (52.3٪) من الذكور و 28 (46.7٪) من الإناث ، تم تصنيفهم في ثماني فئات عمرية تتضاعف كل 10 سنوات. تراوحت غالبية الفئات العمرية بين 60 إلى 70 سنة 19 (31.7٪). وجدت الدراسة أن الأعراض السريرية المصاحبة للسكتة الدماغية كانت ضعف في الجانب الأيسر والجانب الأيمن بنسبة (29 ؛ 47.5٪ و 10 ؛ 16.4٪ على التوالي). كشفت الدراسة أيضًا أن السكتة الدماغية الأفقارية كانت أكثر أنواع السكتات الدماغية في هذه الدراسة بنسبة 55 (91.7٪) ، بينما 5 (8.3٪) فقط من إجمالي المرضى كانوا يعانون من السكتة الدماغية النزفية.

استنتاج

خلصت الدراسة إلى أن التصوير بالأشعة المقطعية مثالي في تقييم السكتة الدماغية وتحديد ما إذا كانت السكتة الدماغية نزفية أم إفقارية.

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List of Abbreviations

ATP	Adenosine triphosphate
CNS	Central nervous system
CSF	Cerebrospinal fluid
CT	Computed tomography
CVA	Cerebrovascular accident
DM	Diabetes mellitus
DWI	Diffusion weighting imaging
ECG\EKG	Electrocardiogram
HTN	Hypertension
LOC	Loss of conscious
Lt	Left
MRI	Magnetic resonance imaging
RRIND	Reversible ischemic neurological deficit
Rt	Right
SAH	Subarachnoid hemorrhage
SPSS	Statistical package for the social sciences
TIA	Transient ischemic attack

Chapter One

Introduction

Chapter One

Introduction

1-1 Introduction:

A stroke occurs when blood flow to a part of the brain is interrupted as a result of a broken or blocked blood vessel. Stroke may be hemorrhagic or ischemic. A hemorrhagic stroke occurs when a blood vessel in the brain ruptures or breaks, allowing blood to leak into the brain. An ischemic stroke occurs when a blood vessel carrying blood to the brain is blocked or restricted by severely narrowed arteries or a blood clot. (Gaillard F, 2018.)

Because treatment depends on the type of stroke, doctor may use brain CT scan or MRI to help in diagnosing this condition. Other tests may include blood tests, electrocardiogram (ECG or EKG), carotid ultrasound, echocardiography or cerebral angiography. Immediate stroke treatment can help save lives and reduce disability by restoring blood flow for an ischemic stroke or controlling bleeding and reducing pressure on the brain in the case of a hemorrhagic stroke (Gaillard F, 2018.)

A short episode of stroke-like symptoms is called a transient ischemic attack (TIA) or mini-stroke. Most often, no permanent damage results from a TIA; however, a TIA is often a warning sign that a stroke will occur. Symptoms of a TIA may last from a few minutes to up to 24 hours. (Donnan GA et al, 2008).

The symptoms of stroke depend on which part of the brain is affected. In some cases, a person may not know that he or she has had a stroke. Symptoms, which usually develop suddenly and without warning, include: Severe headache with no known cause, Numbness or weakness of the face, arm or leg (especially on one side of the body) ,Confusion and trouble speaking or understanding, speech Trouble seeing in one or both eyes Dizziness , loss of balance or coordination (Donnan GA et al, 2008).

A Computed Tomography (CT) of the brain is a noninvasive diagnostic imaging procedure that uses special X-rays measurements to produce horizontal, or

axial, images (often called slices) of the brain. Brain CT scans can provide more detailed information about brain tissue and brain structures than standard X-rays of the head, thus providing more data related to injuries and/or diseases of the brain (.American College of Radiology ,Jun,22,2018)

During a brain CT, the X-ray beam moves in a circle around the body, allowing many different views of the brain. The X-ray information is sent to a computer that interprets the X-ray data and displays it in a two-dimensional (2D) form on a monitor (.American College of Radiology ,Jun,22,2018)

1-2 **Problem of study:**

Stroke is a life threatening condition that needs surgical intervention and diagnosis, so it's important to characterize the stroke to plan for treatment. Two types of stroke are common in all ages (ischemic and hemorrhagic).

CT scans are the most common image tests ordered by doctors to evaluate strokes since its available at most major hospitals at all hours of the day, and it's so popular because it provide the test images sooner.

1-3 Objectives

1-3-1 General objective:

To evaluate brain stroke by using computed tomography.

1-3-2 Specific objectives:

To identify: site, types, size of stroke

To correlate: age and gender of sample with brain stroke

To correlate clinical symptoms of sample with brain stroke

1-4 Study outline:

Chapter one: introduction

Chapter two: literature review

Chapter three: design of study

Chapter four: data analysis

Chapter five: conclusion and suggestion

Chapter Two

Literature review and previous studies

Chapter Two

Literature review and previous studies

2-1 Anatomy and Physiology of the brain:

The brain may be divided into the brainstem, the cerebellum and forebrain (fig 2-1). The brainstem, the oldest region of the brain, functions primarily in a variety of vegetative functions, such as the control of heartbeat, respiration, and digestion. The cerebellum functions in the coordination of motor activity. The forebrain consists of both the diencephalon (the thalamus and hypothalamus) and the cerebrum, which is most highly developed in human beings, where it constitutes ~ 8o% of brain volume. The thalamus is a critical relay station for all synaptic input, and hypothalamus functions primarily in homeostasis. The cerebrum is divided into the right and left hemispheres, each of which may be divided into an outer shell of gray matter and inner core of white matter, however, are numerous gray matter nuclei within the inner portions of the hemispheres. Gray matter consists of densely packed neurons and glial cells, and white matter is made up of myelinated fiber tracts connecting parts of the Central Nervous System (CNS). Because white matter contains more lipid than gray matter, it appears relatively dark compared with gray matter on CT images (the increased lipid in the form of myelin makes it less dense). And relatively bright compared with gray matter on T1-weighted MR images. (Richard, 2006) (Fig 2-1).

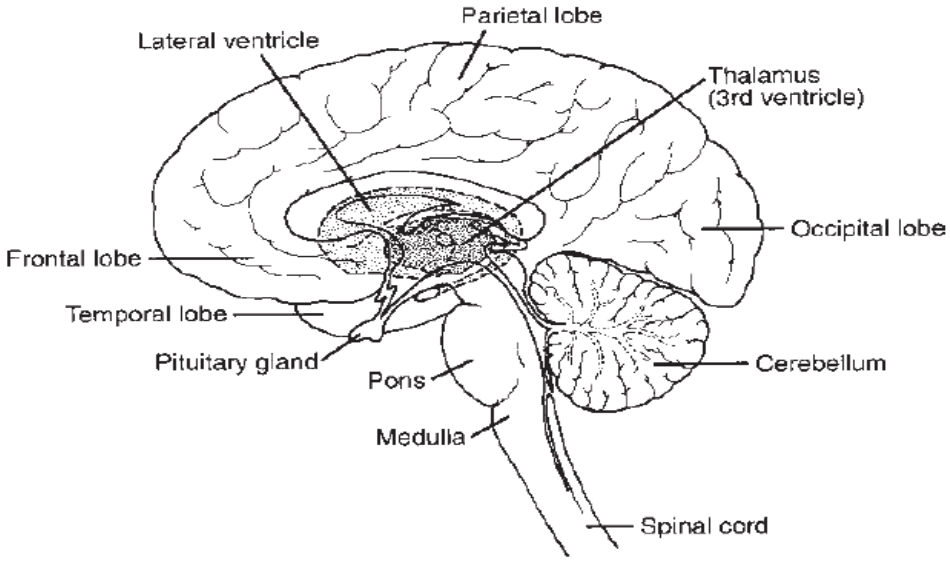

Fig 2-1: The basic anatomy of the brain as seen on a sagittal view of the midline (Richard, 2006).

The cerebrum may be divided into four lobes, broadly speaking; the occipital lobes are responsible for visual processing. The temporal lobes play important roles in hearing, motivation and emotion and memory. The parietal lobes functions in somatosensory and proprioceptive roles. And contain the somatosensory cortex, located immediately posterior to the central sulcus (which divides the frontal and parietal lobes).The frontal lobes contain the motor cortex (immediately anterior to the central sulcus), as well as regions responsible for speech and abstract thought. In addition, there is some division of labor between the two hemispheres, with right excelling in spatial, artistic, and musical functions, and the left in language and analytical tasks. Hence, a unilateral stroke that leaves a patient mute more likely affects the left hemisphere. Because both sensory and motor tracts generally cross to the contralateral side between the brain and spinal cord, the left half of the brain is connected to the right half of the body, and vice versa. (Richard, 2006).

The brain has several special protective structures. the brain is encased in the rigid cranium, although the cranium protects the relatively soft brain from mechanical trauma, it also poses special problems when intracranial pressure

rises from hydrocephalus, diffuse edema, or neoplasm, because the brain has no safe means decompressing itself. The meninges lie beneath the cranium and consist of the outer Dura mater, beneath which is the subdural space; the arachnoid mater, beneath which is the subarachnoid space , which is accessed during a spinal tap, and the pia mater which is attached to the brain and dips down into sulci (fig 2-2).(Richard,2006)

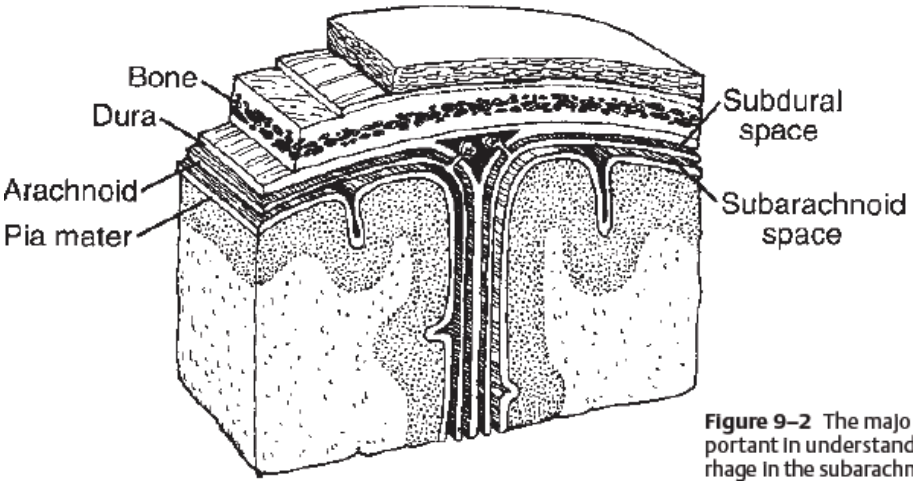

FIG 2-2 The major protective covering of the brain, which are important in understanding the appearance of processes such hemorrhage in the subarachnoid, subdural and epidural spaces.(Richard,2006).

The brain is cushioned both internally and externally by the cerebrospinal fluid (CSF), which is produced by the choroid plexus of the lateral, third, and fourth ventricles, and is absorbed by the arachnoids granulations in the region of the superior sagittal sinus. The brain's other protective structure is the microscopic blood brain barrier, which prevents most blood borne substance from leaving the CNS capillaries and entering surrounding tissues. The blood brain barrier is made up of glial cell foot processes and tight junctions between capillary endothelial cells, only simple sugars, oxygen, carbon dioxide, amino acids, and lipid-soluble substances such as anesthetic gases can pass through it. The brain is critically dependent on a constant blood supply. It receives ~ 15% of resting cardiac output and consumes 20% of the body's oxygen supply. Because it is

incapable of anaerobic metabolism, it requires oxygen to produce adenosine triphosphate (ATP). Moreover, the brain has no glucose stores, thus an interruption in the brain's oxygen supply for more than 5 minutes or its glucose supply for more than 15 minutes results in irreparable brain damage. The availability of oxygen can be reduced due to hypoxia (as in asphyxiation) or ischemia (as in hypotension or vessel occlusion). The blood supply of the brain arrives by four principal arteries, the paired internal carotid arteries and the paired vertebral arteries (Fig 2-3).The internal carotid arteries arise at the carotid bifurcation in the neck and represent the primary supply of the anterior and middle cerebral arteries, the vertebral arteries represent the first branches of the subclavian arteries and constitute the primary supply of the posterior circulation. (Richard, 2006)

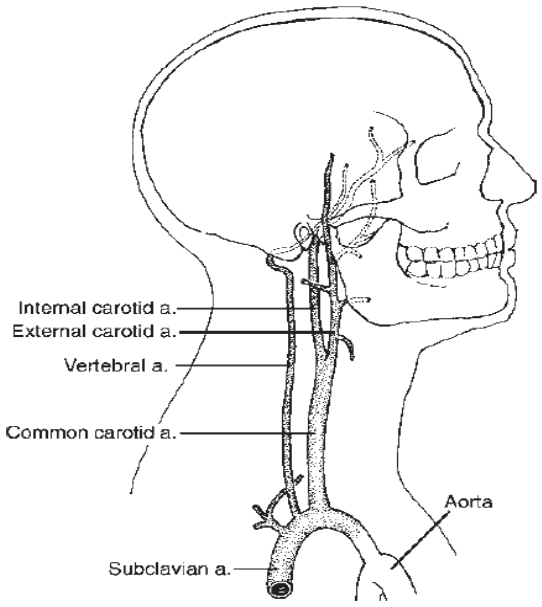

Fig 2-3 The course of the carotid and vertebral arteries in a lateral projection as they course toward the brain (Richard, 2006).

The circle of Willis provides a built –in backup system in the event –that one of these vessels should be compromised, with connections between the internal carotid arteries and the posterior circulation via the posterior communicating arteries (Fig 2-4) However, the circle is complete in only 25% patients. The

venous drainage of the brain is directed toward the occiput, eventually emptying into the internal jugular veins. (Richard, 2006)

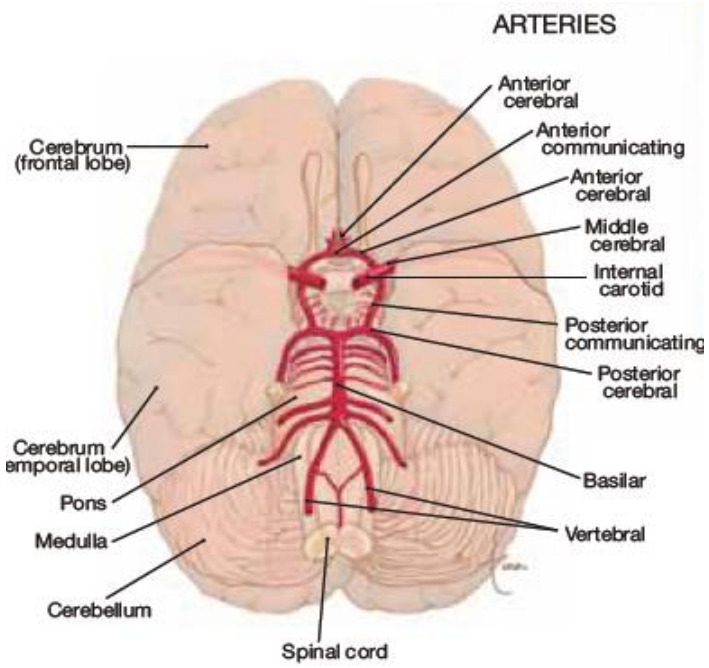

Fig 2-4**:** Major blood vessels and circle of Willis (Valerie and Sanders, 2007).

2-2 Pathophysiology:

The focal symptoms and signs that result from stroke correlate with the area of brain supplied by the affected blood vessel. Stroke may be classified into two major categories based on pathogenesis; ischemic stroke and hemorrhage (Fig 2-5). In ischemic stroke, vascular occlusion interrupts blood flow to a specific brain region, producing a fairly characteristic pattern of neurologic deficits resulting from loss of functions controlled by that region. The pattern of deficits resulting from hemorrhage is less predictable because it depends on the location of the bleed and also on factors that affect the function of brain regions distant from the hemorrhage (e.g., increased intracranial pressure, brain edema, compression of neighboring brain tissues and rupture of blood into ventricles or subarachnoid space)..(Stephen and Gary, 2009).

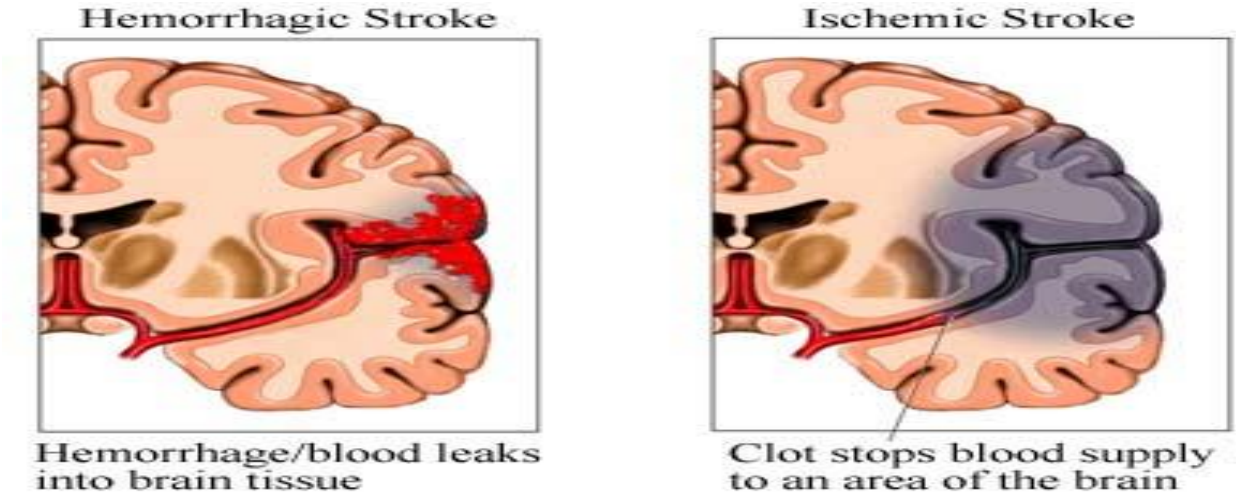

Fig 2-5 Ischemic and hemorrhage stroke(Stephen and Gary, 2009).

2-3 Stroke:

Stroke is a syndrome characterized by the acute onset of a neurologic deficit that persists for at least 24 hours, reflects focal involvement of the central nervous system, and as the result of disturbance of the cerebral circulation. The acute onset and subsequent duration of symptoms are documented by the history. The site of central nervous system involvement is suggested by the nature of the symptoms; it is delineated more precisely by the neurologic examination and confirmed by imaging studies (computed tomography {CT} scans or {MRI}). A vascular etiology may be inferred from the acute onset of symptoms and often from the patient's age, the presence of risk factors for stroke, and the occurrence of symptoms and signs referable to the territory of a particular cerebral blood vessel. When this is confirmed by imaging studies, further investigations can be undertaken to identify a specific cause (Fig 2-6). (Michael et al. 2005)

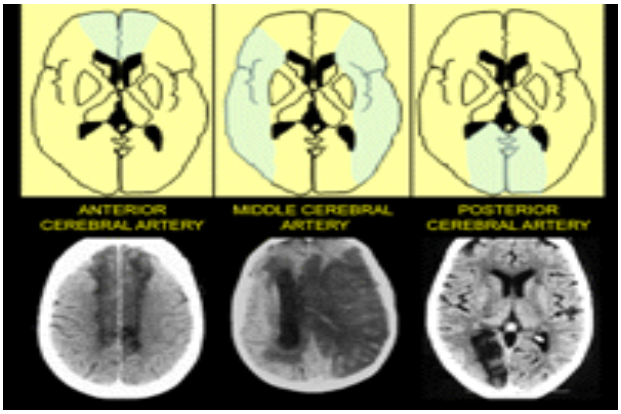

Fig 2-6 Drawing (top) illustrate the territories of anterior cerebral artery(ACA),middle cerebral artery(MCA),and posterior cerebral artery(PCA).CT scans (bottom) show established infarctions of these arteries.(Wardlaw et al,2004).

Strokes begin abruptly. Neurologic deficits may maximal at onset, as is common in embolic stroke, or may progress over seconds to hours (or occasionally days), which is characteristic of progressive arterial thrombosis or recurrent emboli. A stroke that is actively progressing as a direct consequence of the underlying vascular disorder (but not because of associated cerebral edema) or has done so in recent minutes is termed stroke in evolution or progressing stroke. Focal cerebral deficits that develop slowly(over weeks to months) are unlikely to be due to stroke and are more suggestive of tumor or inflammatory or degenerative disease. (Michael et al.2005)

Several terms have been used to classify strokes, often based on the duration and evolution of symptoms. By definition, stroke produces neurologic deficits that persist for at least 24 hours, when symptoms and signs resolve completely after briefer periods (usually within 30 minutes), the term transient ischemic attack (TIA) is used. Recurrent TIAs with identical clinical features are usually caused by thrombosis or embolism arising within the cerebral circulation. TIAs that differ in character from event to event suggest recurrent emboli from a cardiac source. Although TIAs do not themselves produce lasting neurologic dysfunction, they are important to recognize because about one- third of

patient's with TIAs will go to have a stroke within 5 years and because this risk may be reduced with treatment. (Michael et al.2005)

In some cases, deficits last for longer than 24 hours but resolve completely or almost completely within a few days the term reversibleischemic neurological deficit (RIND) or minor stroke is sometimes used to describe these events. As their names imply, TIAs and RINDs are uniquely associated with cerebral ischemia, as opposed to hemorrhage. (Michael et al.2005)

Progressing stroke (or stroke in evolution).This describes a stroke in which the focal neurological deficit worsens after the patient first presents. Such worsening may be due to increasing volume of infarction, hemorrhagic transformation or increasing edema. Completed stroke- this describes a stroke in which the focal deficit persists and is not progressing (Nicki R, et al.2005)

Stroke produces focal symptoms and signs that correlate with the area of the brain supplied by the affected blood vessel. In ischemic stroke, occlusion of a blood vessel interrupts the flow of blood to a specific region of the brain, interfering with neurologic functions dependent on that region and producing a more or less stereotyped pattern of deficits. Hemorrhage produces a less predictable pattern of blood involvement because; complications such as increased intracranial pressure, cerebral edema, compression of brain tissue and blood vessels, or dispersion of blood through the subarachnoid space or cerebral ventricles can impair brain function at sites remote from the hemorrhage. In most cases of stroke, the history and neurologic examination provide enough information to localize the lesion to one side of the brain (e.g. to the side opposite a hemi paresis or hemi sensory deficit or to the left side if an aphasia is present) and to the anterior or posterior cerebral circulation. The underlying pathologic process in stroke can be either ischemia or hemorrhage, usually from an arterial lesion. In recent series, ischemia accounted for about two-thirds and hemorrhage for about one-third of strokes. It may not be possible to distinguish

between ischemia and hemorrhage from the history and neurologic examination, but CT scan or MRI permits a definitive diagnosis (Michael et al. 2005)

Stroke is a common medical emergency with an annual incidence of between 180 and 300 per 100,000. The incidence rises steeply with ages, and in many developing countries, the incidence is rising because of the adoption of less healthy lifestyles. About one-fifth of patients with an acute stroke will die within a month of the event, and at least half of those who survive will be left physical disability (Nicki et al. 2005)

2-3-1 Ischemic Stroke:

Cerebral infarction is mostly due to thromboembolic disease secondary to atherosclerosis in the major extra cranial arteries (carotid artery and aortic arch). About 20% of infarctions are due to embolism from the heart, and a further 20% are due to intrinsic disease of small perforating vessels (lenticulostriate arteries), producing so-called lacunar" infarctions. The risk factors for ischemic stroke reflect the risk factors for the underlying vascular disease. About 5% are due to rare causes, including vasculitis, endocarditis, and cerebral venous disease. Cerebral infarction is process which takes some hours to complete, even though the patient's deficit may be maximal close to the onset of the causative vascular occlusion. After the occlusion of cerebral artery, infarction may be forestalled by the opening of anastomotic channels from other arterial territories which restore perfusion to its territory; reduction in perfusion pressure leads to compensatory changes to maintain tissue oxygenation, these changes can sometimes present even occlusion of a carotid artery from having any clinically apparent effect. However, if and when these homeostatic mechanisms fail, the process of ischemia starts and ultimately leads to infarction unless vascular supply is restored. As the cerebral blood flow declines, different neuronal functions fail at various thresholds. Once blood flow falls below the threshold for the maintenance of electrical activity, neurological deficit appears. At this level of blood flow, the neurons are still viable: if the blood flow increases

again, function returns and the patient will have had a TIA, however, if the blood flow falls further, a level is reached at which the process of irreversible cell death starts, Hypoxia leads to an inadequate supply of adenosine triphosphate (ATP),which in turn leads to failure of membrane pumps, thereby allowing influx of sodium and water into the cell (cytotoxic edema) and the release of the excitatory neurotransmitter glutamate into the extracellular fluid. Glutamate opens membrane channels, allowing the influx of calcium and more sodium into the neurons, calcium entering the neurons, activates intracellular enzymes that complete the destructive process. The release of inflammatory mediators by microglia and astrocytes produces cell death of all cell types in the area of maximum ischemia. The infarction process is worsened by the anaerobic production of lactic acid and consequent fall in tissue ph. There have been attempts to develop neuroprotective drugs to slow down the processes leading to irreversible cell death but these have so for proved disappointing. The final result of the occlusion of cerebral blood vessels therefore depends upon the competence of the circulatory homeostatic mechanisms, the metabolic demand, and the severity and duration of the reduction in blood flow. Higher brain temperature, as might occur in fever, and higher blood sugar have both been associated with a greater volume of infarction for a given reduction in cerebral blood flow. Subsequent restoration of blood flow may cause hemorrhage into the infracted area (hemorrhagic transformation).This is particularly likely to occur in patients given antithrombotic or thrombolytic drugs, and in patients will larger infarcts (Fig 2-7) (Nicki et al, 2005).

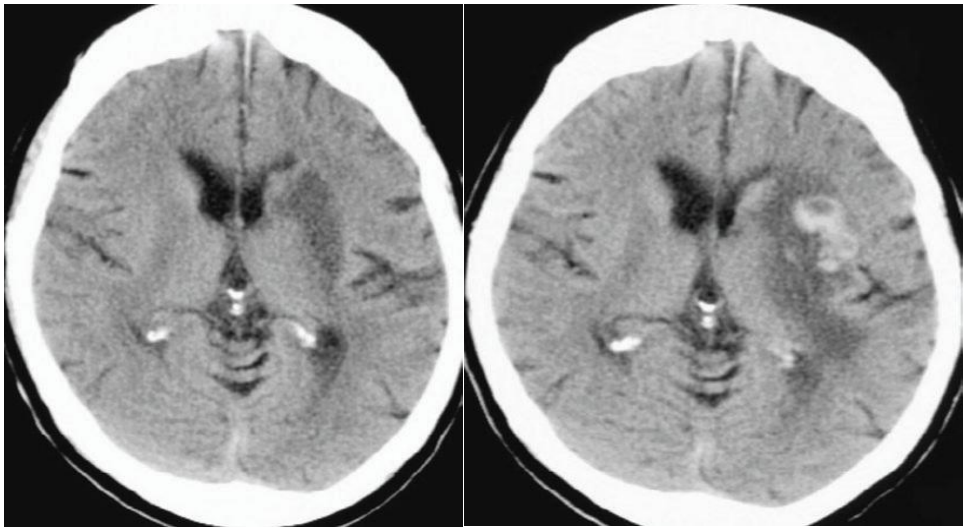

Figure 2-7 (A) This non contrast CT image demonstrates hypodensityin the left middle cerebral artery distribution, indicating an acute stroke.(B) The next day, after further deterioration in neurologic status, a follow-up CT demonstrates new high-density blood in the same area, indicatinghemorrhagic status, (Richard, 2006)

2-3-2 Hemorrhagic Stroke:

Hemorrhagic stroke occurs when a blood vessel in the brain suddenly ruptures with hemorrhage into the surrounding tissue. Stroke assessment reveals two types of hemorrhagic stroke, characterized by the location of the arterial rupture:

2-3-2-1 Intracerebral hemorrhagic stroke:

This usually results from rupture of a blood vessel within the brain parenchyma but may also occur in a patient with a subarachnoid hemorrhage, if the artery ruptures into the brain substance as well as into the subarachnoid space. Hemorrhage frequently occurs into an area of brain infarction, if the volume of hemorrhage is large, this may be difficult to distinguish from primary intracerebral hemorrhage both clinically and radiological. The explosive entry of blood into the brain parenchyma causes immediate cessation of function in that area as neurons are structurally disrupted and white matter fiber tracts are split apart. The hemorrhage itself may expand over the first minutes or hours, or

it may be associated with aim of cerebral edema, which along with the hemorrhage, acts like amass lesion to cause progression of the neurological deficit. If big enough, this can cause shift of the intracranial contents, producing transtentorial coning and sometimes rapid death. If the patient survives, the hematoma is gradually absorbed, leaving hemosiderin-lined slit in the brain parenchyma most common cause of intracerebral hemorrhage is chronic hypertension. Among the elderly, a myeloid angiopathy appears to play a major role in intracerebral hemorrhage. Fig 2-8 (Nicki et al, 2005).

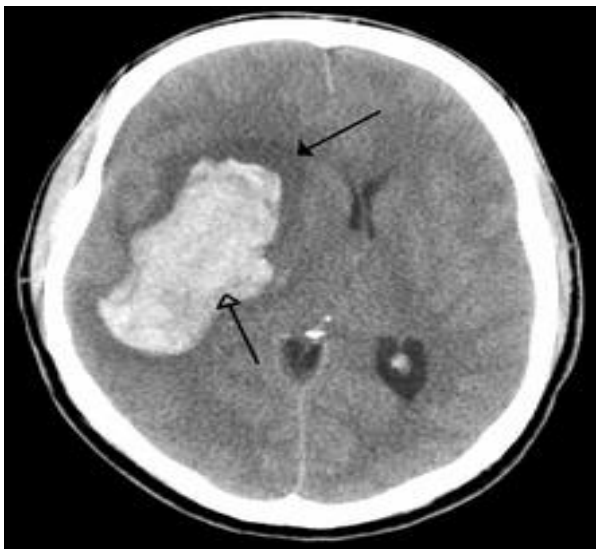

Fig 2-8 Non contrast axial CT brain show an intracerebral hemorrhage(bottom arrow)with surrounding edema(top arrow). (Nicki et al, 2005).

2-3-2-2 Subarachnoid hemorrhage:

Subarachnoid hemorrhage (SAH) is less common than other types of stroke and affects about 6/100,000 of the population. Women are affected more commonly than men and the condition usually presents before the age of 65. The immediate mortality of aneurismal subarachnoid hemorrhage is about 30% and survivors have a recurrence, or rebleed, rate of about 40% in the first 4 weeks and 3% annually thereafter. Eighty-five percent of SAH are caused by saccular or berry aneurysms arising from the bifurcation of cerebral arteries, particularly in the region of the circle of Willis. There is an increased risk in first-degree

relatives of those with secular aneurysms, and an increased risk of SAH in patients with polycystic kidney disease and congenital connective tissue defects such as Ehlers-Danlos syndrome. In about 10% of cases, SAH are non-aneurysmalhemorrhage (so called peri-mesencephalichemorrhages) which has a very characteristic appearance on CT and a benign outcome in terms of mortality and recurrence. Some 5% of SAH are due to arteriovenous malformation and vertebral artery dissection (Fig 2-9)(Nicki et al, 2005)

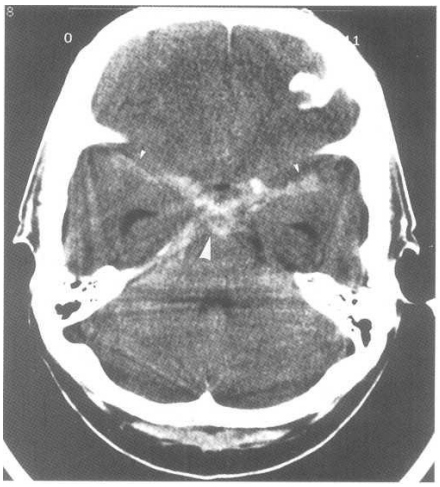

Fig.2-9: Subarachnoid hemorrhage. This non enhance axial CT brain image demonstrates bright blood in the suprasellar cistern(large arrowhead) and in the Sylvain fissures (a small arrowheads) (Hugue andPatrice, 2002).

2-4 Clinical Features:

The clinical presentation of stroke depends upon which arterial territory is involved and the size of the lesion, both of which will have a bearing on management, such as suitability for carotid endarterectomy. The neurological deficit can be identified from the patient's history and, if the deficit is persistent, from the neurological examination. The presence of a unilateral motor deficit, a higher cerebral function deficit such as aphasia or neglect, or a visual field defect usually places the lesion in the cerebral hemisphere. Ataxia, diplopia, vertigo and/or bilateral weakness usually indicate a lesion in the brain stem or cerebellum. Different combinations of these deficits define several stroke

syndromes which reflect the site and size of the lesion and may provide clues to underlying pathology. (Nicki et al, 2005).

Reduced conscious level usually indicates a large-volume lesion in the cerebral hemisphere but may result from a lesion in the brain stem or complications such as obstructive hydrocephalus, hypoxia or sever systemic infection. (Nicki et al, 2005).

Clinical assessment of the patient with a stroke should also include a general examination (skin, eyes, cardiovascular system, respiratory system, abdomen, loco motor) since this may provide clues to the cause of the stroke, and identify important co morbidities and complications of the stroke. (Nicki et al, 2005).

Subarachnoid hemorrhage typically presents with a sudden, sever' thunderclap' headache (often occipital) which lasts for hours or even days, often accompanied by vomiting. Physical exertion, straining and sexual excitement are common antecedents. There may be loss of consciousness at the onset, so subarachnoid hemorrhage should be considered if a patient is found comatose. About 1 patient in 8 with a sudden severe headache has SAH. On examination the patient is usually distressed and initable with photophobia. There may be neck stiffness due to subarachnoid blood but this may take some hours to develop. Focal hemisphere signs such as hem paresis or aphasia may be present at onset if there is an associated intracerebral hemorrhage. A third nerve palsy may be present due to local pressure from an aneurysm of the posterior communicating artery, though this is rare. Fundoscopy may reveal a subhyaloid hemorrhage, which represents blood tracking along the subarachnoid space around the optic nerve (Nicki et al, 2005).

2-5 Investigations of stroke:

Investigations of a patient presenting with an acute stroke aims to confirm the vascular nature of the lesion distinguish cerebral infarction from hemorrhage and identify the underlying vascular disease and risk factors. (Nicki et al, 2005).

Initial investigation of all patients with stroke includes arrange of simple blood tests to detect common vascular risk factors and markers of rarer causes, an electrocardiogram(ECG) and brain imaging. Where there is uncertainty about the nature of the stroke, further investigations are usually indicated. This especially applies to younger patients who are less likely to have atherosclerotic disease (Nicki et al, 2005).

Brain imaging with either CT or MRI should be performed in all patients with acute stroke. Exceptions to this include patients in whom the results would not influence management, such as in the advanced stage of a terminal illness. (Nicki et al, 2005).

CT is the most practical and widely available method of imaging the brain. It will usually exclude non-stroke lesions, including subdural hematoma and brain tumors, and will demonstrate intracerebral hemorrhage within minutes of stroke onset. However, especially within the first few hours after symptoms onset, CT changes in cerebral infarction may be completely absent or only very subtle. Changes often develop over time, but small cerebral infarcts may never show up on CT scans. For most purpose, a CT scan performed within the first day or so is adequate for clinical care but there are certain circumstances in which an immediate CT scan is essential. Even in the absence of changes suggesting infarction, abnormal perfusion of brain tissue can be imaged with CT after injection of contrast media (i.e. perfusion scanning). This can be useful in guiding immediate treatment of ischemic stroke. MRI is not as a widely an available as CT, scanning times are longer, and it cannot be used in some individuals with contraindications. However, MRI diffusion weighted imaging (DWI) can detect ischemia earlier than CT, and other MRI sequences can also be used to demonstrate abnormal perfusion. MRI is more sensitive than CT in detecting strokes affecting the brain stem and cerebellum, and, unlike CT, can reliably distinguish hemorrhagic from ischemic stroke even several weeks after the onset. CT and MRI may reveal clues as to the nature of the arterial lesion,

For example, there may be a small, deep lacunar infarct indicating small-vessel disease, or a more peripheral infarct suggesting an extra cranial source of embolism. In hemorrhagic lesion, the location might indicate the presence of an underlying vascular malformation, saccular aneurysm or a myeloidantipathy (Nicki et al, 2005).

2-6 Risk Factor of stroke:

Hypertension (the number one risk factor of the ischemic stroke), carotid stenosis due to atherosclerosis, smoking, alcohol abuse, hypercholesterolemia, obesity, lifestyle, atrial fibrillation, sleep apnea and diabetes mellitus, (Kumar and Clark, 2006).

2 -7 Rare risk factors and other causes of stroke:

Thrombocythaemia and thrombophilia (protein C deficiency) are weakly associated with arterial stroke but predispose to cerebral venous thrombosis, Polycythemia in predisposes to stroke, Anticardiolipin and lupus anticoagulant antibodies (i.e. ant phospholipid syndrome causes arterial thrombotic stroke in young patients, Endocarditis –thromboembolic stroke may be the presenting feature, Low-dose estrogen –containing oral contraceptives do not increase stroke risk significantly in healthy women but probably do so with other risk factors, e g:uncontrolled hypertension or smoking, Migraine is a rare cause of cerebral infarction, Vacuities (polyarthritis nodes, giant cell arthritis, and granulomatous CNS agnates) are a rare cause of stroke, Hyperthomocysteinaemia predisposes to thrombotic strokes. Folic acid therapy does not reduce the incidence and Drugs –illicit drugs, e.g.: cocaine and over-the- counter 'cold' remedies containing vasoconstrictors. Chronic use of Cox II inhibitors is associated increased incidence of stroke. (Kumar and Clark, 2006).

2-8 Previous studies:

(Kehinde et al., 2006) in their study (validation study of the sir raj stroke score in African Nigerians: and evaluation of discriminate values of its parameters. CT scanning is important to identify stroke pathology and exclude mimics. Their study was a prospective multicenter study was carried out on patients that presented with stroke and had CT scan done within 14 days of onset. An interviewer structured questionnaire was administered and SSS computed. The stroke type was classified and compared with CT diagnosis. 1122 patients present with clinical features of stroke, of which only 101(9%) could afford the cost of CT scan. Of these, 90 had CT scan features consistent with a cute stroke, 5 had cortical atrophy and 1 was normal. Thus, 96 patients were analyzed, of which 68(71%) had cerebral ischemia and 28(29%) had intracerebral hemorrhage. The 6 patients with no visible infarct on CT were regarded as cerebral infarction. The correlation between SSS, headache, vomiting, and loss of consciousness and CT diagnosis achieved statistical significance, whereas atheroma markers and diastolic blood pressure did not. The SSS has an overall predictive accuracy of 80%.

(Mark et al., 2005) in their study (Intracranial hemorrhage complication, Acute stroke :How common is hemorrhagic stroke on initial head CT scan and How often is initial clinical Diagnosis of acute stroke eventually confirmed?,their study aimed to determine the frequency with which patients present clinical stroke and have intracranial hemorrhage on initial non contrast CT scan (NCCT). In addition they sought to determine the frequency with which initial clinical diagnosis acute stroke is confirmed in this group. Medical records of 691 consecutive patients with admitting diagnosis of acute stroke were evaluated respectively. Results of initial NCCT performed within 24 hours often presentation was assessed. All patients were examined before anticoagulation or thrombolysis. Twenty five patients (25/691{3, 6%}) had hemorrhage, twenty three patients (23/25{92%}) hadintraparenchymal hemorrhage only, one patient

(1/25{4%}) had a combination of intraparenchymal and subarachnoid hemorrhage, one patient (1/25{4%}) had subdural hemorrhage only. Twenty two NCCT scans (22/25{88%}) were performed within 6 hours of presentation. Seventeen NCCT scans (17/25{68%}) were performed within 3 hours of presentation.

(Sarah,2017) who found that most (72%) were ischemic stroke, while (28%) of them were hemorrhagic stroke and not agree with here non –significant difference between the mean hemorrhagic and ischemic stroke.

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3-1 Patients:

In this study there were 60patients, 32 of them were males and 28 were females, those patients had a variety of ages, ranging from 30 to 88 years with average age of (62) years that clinically diagnosed as having stroke. All of these patients underwent to CT scan. These patients were collected from department of radiology in Albogaa hospital. The data had been collected in the period from January 2022 to April 2022.

3-2 CT Machines used:

CT Machines which used in this study is general electric (16) slice

3-3 Techniques:

The technique applied for brain scan are flexible and should be adapted to suit the patient, so the exam start by place the patient supine and head is rest on the head holder and axial scan started from the base of the skull to the vertex and the route 5mm slice thickness, 5mm spacing for base of skull and posterior fossa and slice thickness 7 mm, spacing 7mm from sella turcica to the vertex, and field of view 25 cm and reconstruction algorithm, WW 50-100, and WL 30 -40

3-4 Image interpretation:

This is research study to determine the size, site, and type of brain stroke in CT scan. Clinical neurological abnormality is determined underwent CT scan for brain and all images of patients studied by radiologist and technologist.

3.5 Data analysis:

This data was analyzed by SPSS(Statistical Package for the Social Sciences).

Chapter Four

Results

Chapter four

Results

Table (4.1): Distribution of study sample according to gender (n=60):

Gender	Frequency	Percent %
Male	32	53.3 %
Female	28	46.7%

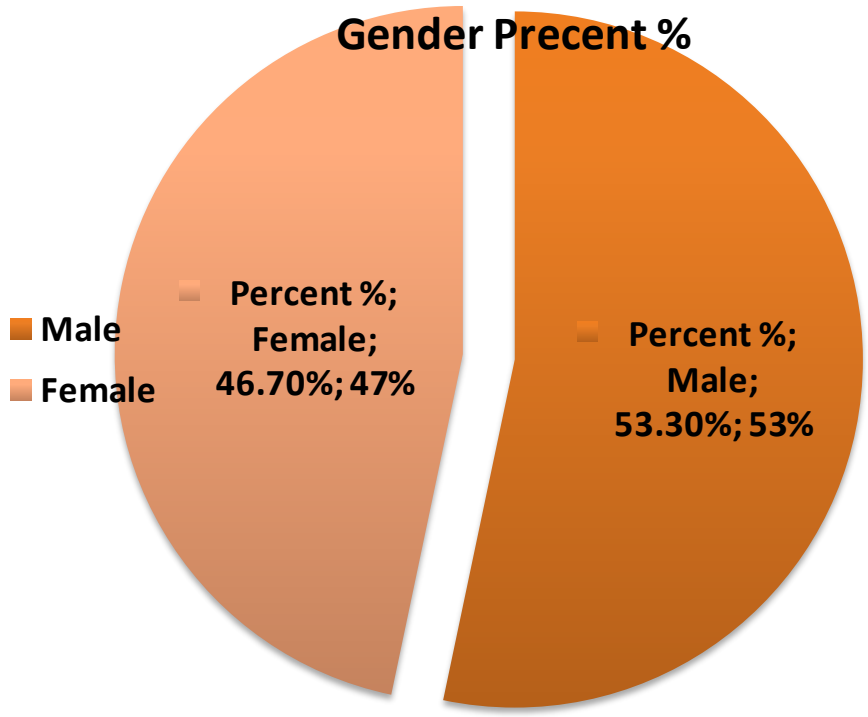

Figure (4.1):Distribution of study sample according to gender (n=60).

Table (4.2): Distribution of study sample according to age (n=60):

Age Groups	Frequency	Percent %
20 to 30 years	2	3.3%
31 to 40 years	4	6.7%
41 to 50 years	5	8.3%
51 to 60 years	8	13.3%
61 to 70 years	19	31.7%
71 to 80 years	8	13.3%
81 to 90 years	10	16.7%
More than 91 years	4	6.7%

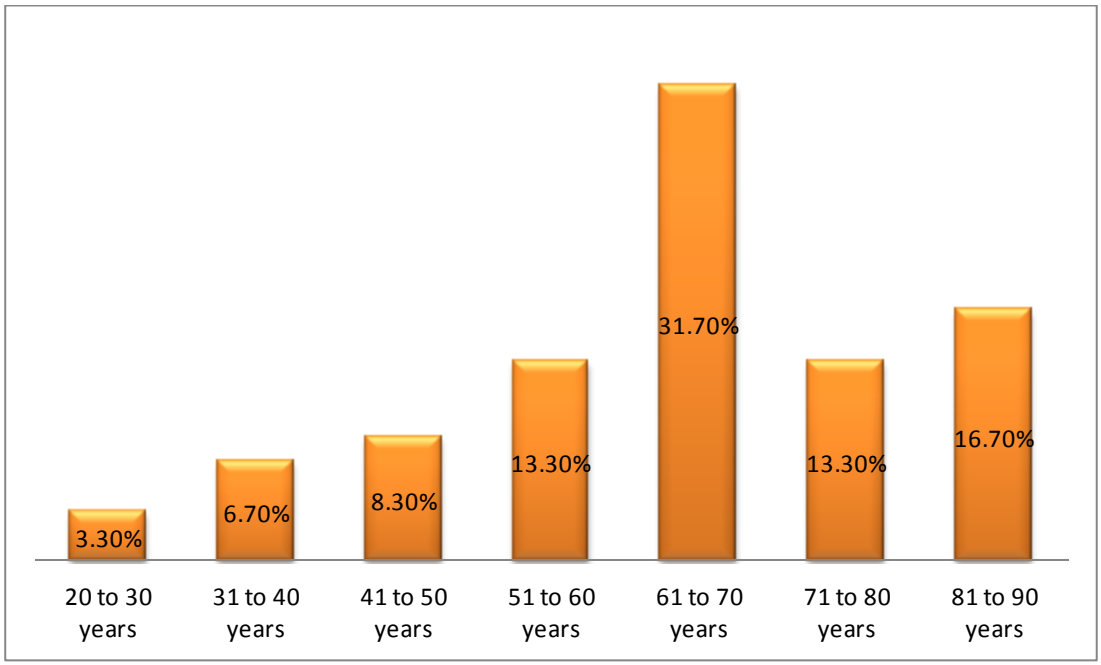

Figure (4.2): Distribution of study sample according to age (n=60).

Table (4.3): Distribution of study sample according toClinical Symptoms (n=60):

Clinical Symptoms	Frequency	Percent %
Lt Side Weakness 1	29	47.5 %
Rt Side Weakness 2	10	16.4 %
Convolution	6	9.8 %
Loss Of Consciousness	3	4.9 %
Trauma	2	3.3 %
Slurred Speech	2	3.3 %
LOC	1	1.6 %
Comma	1	1.6 %
DM	1	1.6 %
Rt Side Weakness/Aphasia	1	1.6 %
Lt Side Weakness/Aphasia	1	1.6 %
Lt Side Weakness/HTN	1	1.6 %
Rt Side Weakness/LOC	1	1.6 %
Convolution/DM	1	1.6 %

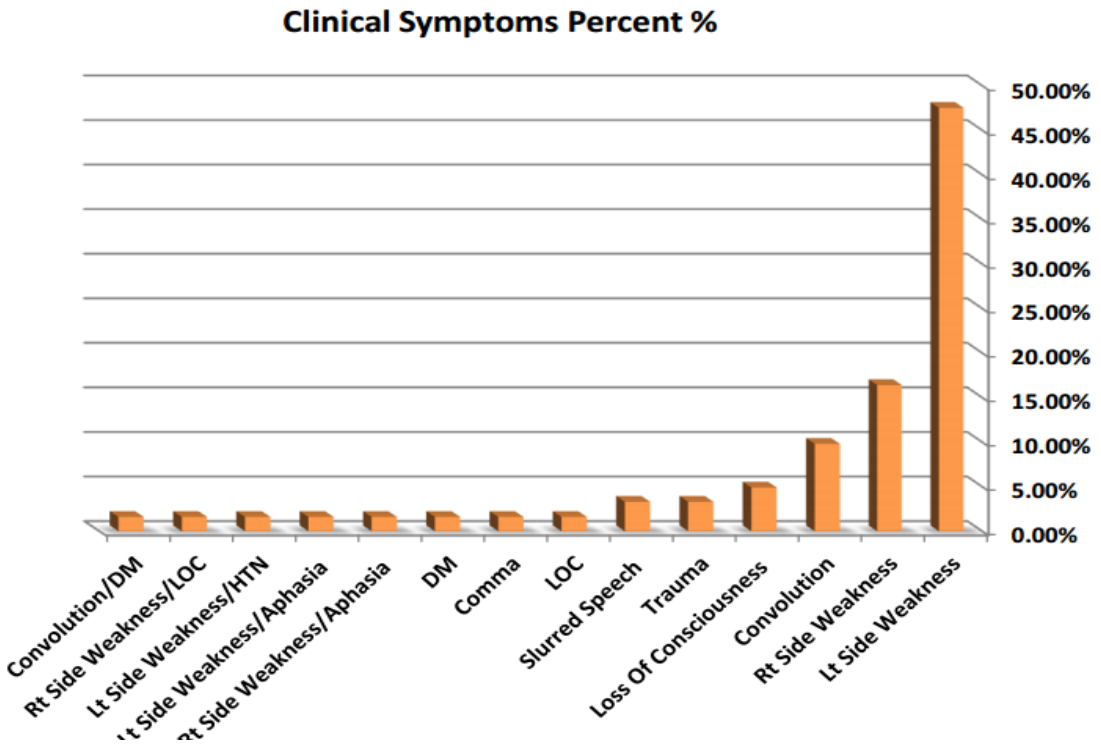

Figure (4.3): Distribution of study sample according to Clinical Symptoms (n=60).

Table (4.4): Distribution of study sample according to Stroke Type (n=60):

Stroke Type	Frequency	Percent %
Ischemic	55	91.7 %
Hemorrhage	5	8.3 %

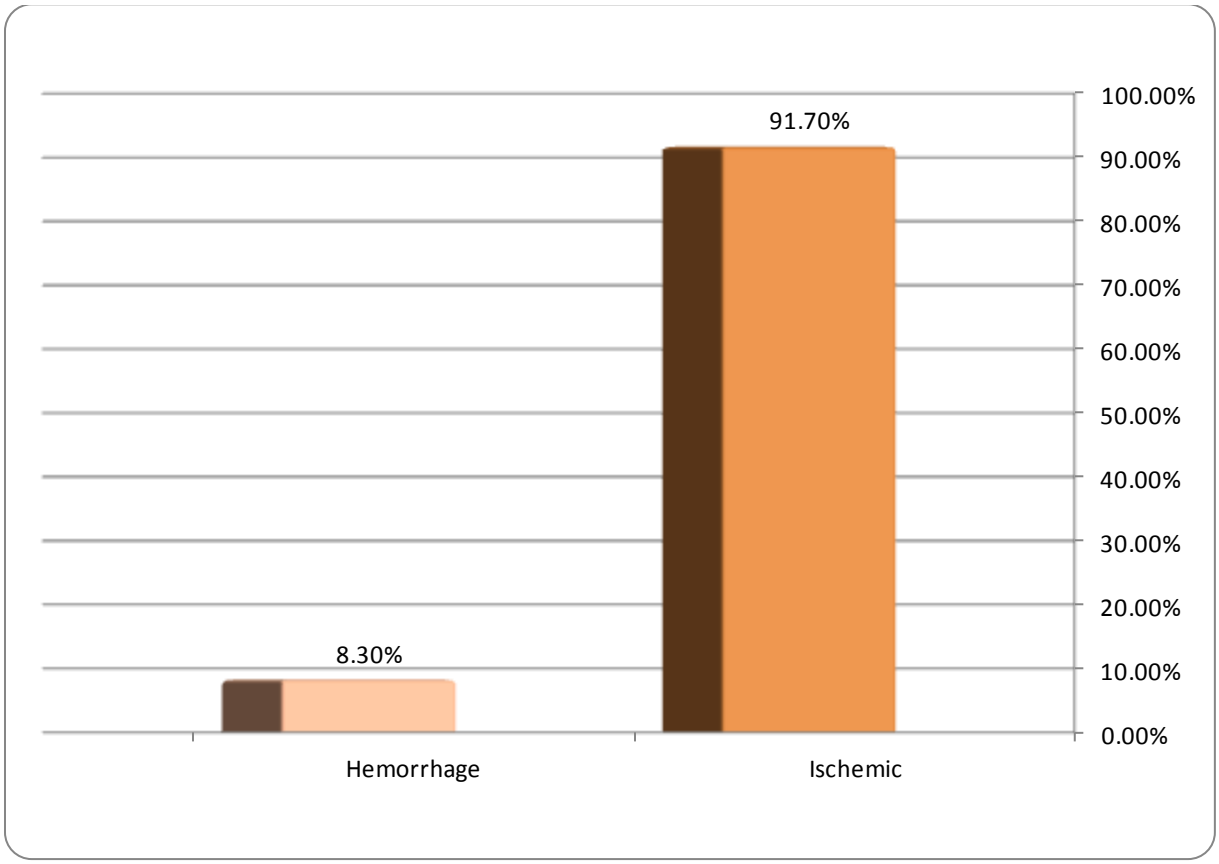

Figure (4.4): Distribution of study sample according to Stroke Type (n=60)

Table (4.5): Distribution of study sample according toStroke Site (n=60):

Stroke Site	Frequency	Percent %
Parietal	23	38.3 %
Temporal	17	28.3 %
Occipital	8	13.3 %
occipitoparital	5	8.3 %
temproparital	3	5.0 %
Paraoccipital	1	1.7 %
Frontal	1	1.7 %
Cerebral	1	1.7 %
paritoocipital	1	1.7 %
frontoparital	1	1.7 %

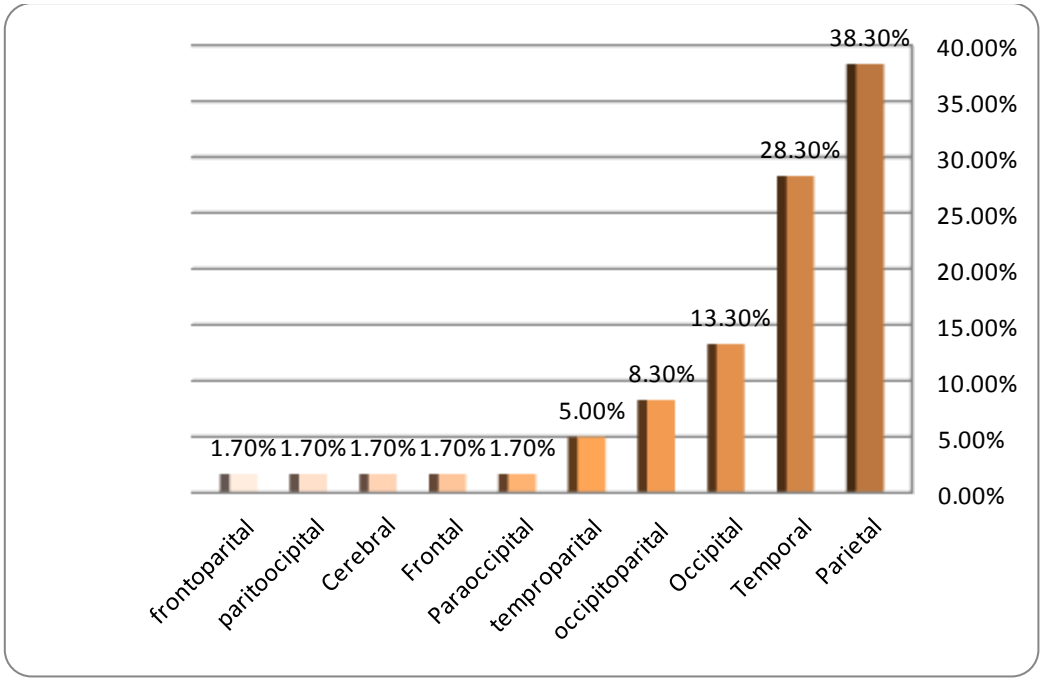

Figure (4.5): Distribution of study sample according to Stroke Site (n=60)

Table (4.6): Descriptive statics of study sample according to stroke size measurements (n=60):

Statics	Minimum	Maximum	Mean	Std. Deviation
Length	1	57	6.25	7.100
Width	1	21	2.93	2.542
Size	2.40	1197.00	34.1933	152.95943

Table (4.7): The correlation between stroke type and gender (n=60):

		Stroke Type		Total	P value
		Ischemic	Hemorrhage		
Gender	Male	28	4	32	0.212
	Female	27	1	28	
Total		55	5	60	

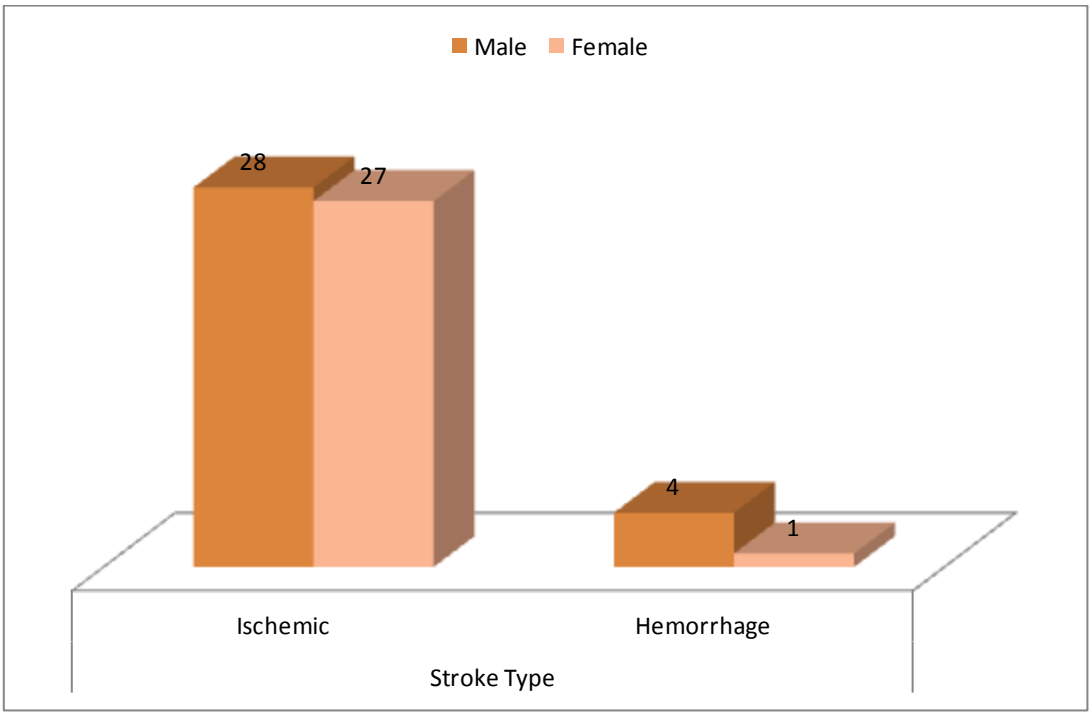

Figure (4.6): The correlation between stroke type and gender (n=60)

Table (4.8): The correlation between stroke type and age (n=60):

		Stroke Type		Total	P value
		Ischemic	Hemorrhage		
Age Group	20 to 30 years	2	0	2	0.140
	31 to 40 years	2	1	3	
	41 to 50 years	4	1	5	
	51 to 60 years	7	1	8	
	61 to 70 years	19	0	19	
	71 to 80 years	8	0	8	
	81 to 90 years	8	2	10	
	20 to 30 years	5	0	5	
Total		55	5	60	

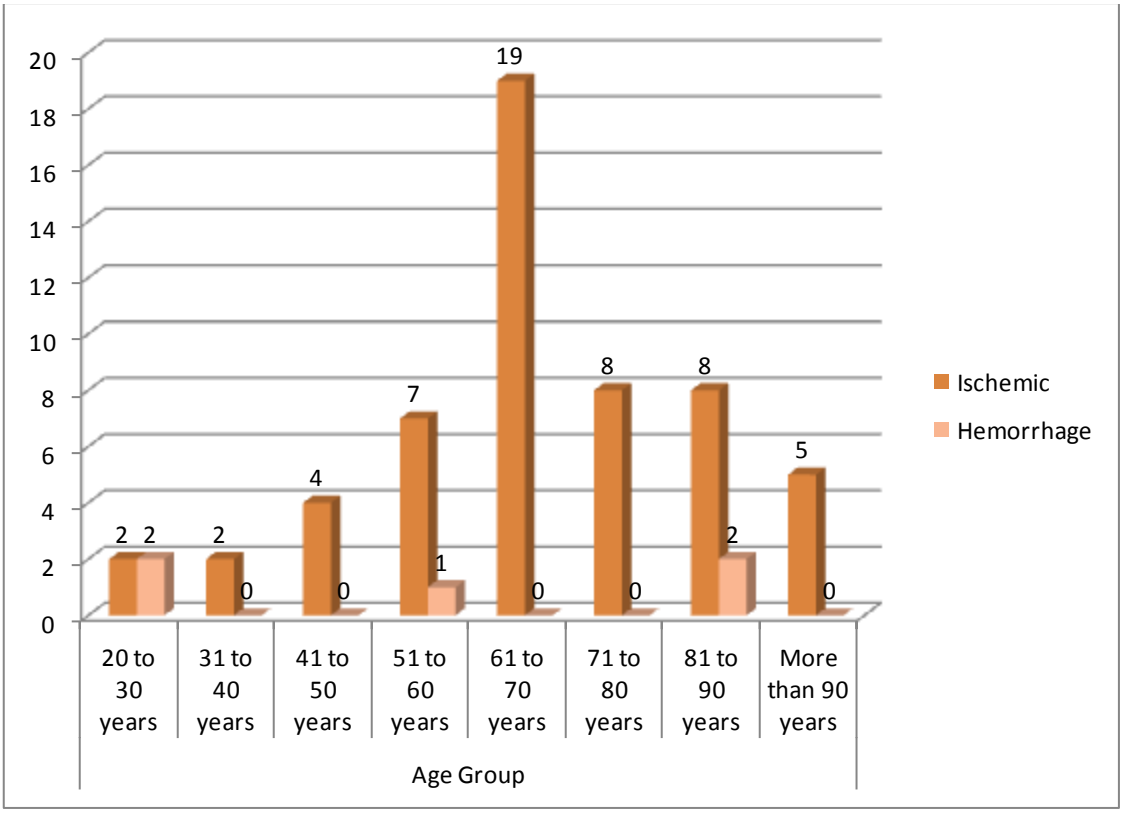

Figure (4.7): The correlation between stroke type and age(n=60).

Table (4.9): The correlation between stroke type and Clinical Symptoms (n=60)

		Stroke Type		Total	P value
		Ischemic	Hemorrhage		
Clinical Symptoms	Lt Side Weakness	28	1	29	0.005
	Rt Side Weakness	10	0	10	
	Convolution	5	1	6	
	Loss Of Consciousness	3	0	3	
	Trauma	1	1	2	
	Slurred Speech	2	0	2	
	LOC	0	1	1	
	Comma	1	0	1	
	DM	0	1	1	
	Rt Side Weakness/Aphasia	1	0	1	
	Lt Side Weakness/Aphasia	1	0	1	
	Lt Side Weakness/HTN	1	0	1	
	Rt Side Weakness/LOC	1	0	1	
	Convolution/DM	1	0	1	
Total		55	5	60	

Chapter Five

Discussion, Conclusions and Recommendations

Chapter Five

Discussion, Conclusions and Recommendations

5.1 Discussion:

The study aimed evaluatethe brain stroke who comforted by using computed tomography among Sudanese patients. In Khartoum state, 2022.

A total of 60 patients 32 (52.3 %) were males and 28 (46.7 %) were females, as shown in table and figure (4.1). Categorized in eight age groups which doubles every 10 years. Where the majority of age groups was between 60 to 70 years 19 (31.7 %) and then age between 80 and 90 years 10 (16.7 %). Other frequencies of age groups shown in table (4.2). Study found that the clinical symptoms which associated with stroke patients who included in this study, left and right side weakness were the common with incidence (29; 47.5 % and 10; 16.4 %. Respectively). Other not common clinical symptoms were shown in table (4.3). Study also revealed that ischemic stroke was the most incidence in this study 55 (91.7 %) whereas only 5 (8.3 %) of total patients have a hemorrhagic stroke.. As shown and illustrated in table and figure (4.4). These findings consistent with previous study done by **(Mark et al.)** who found that Twenty five patients (25/691{3, 6%}) had hemorrhage. And other study done by **(Sarah Mohamed. 2017)**who found that most (72%) were ischemic stroke, while (28%) of them were hemorrhagic stroke and not agree with here non – significant difference between the mean hemorrhagic and ischemic stroke.Study found that the parietal lobe was the common site for infected with stroke 23 (38.3 %) and then temporal lobe with 17 (28.3 %). Other site locations shown in table (4.5). Descriptive statistics of study sample according to stroke size measurements shown that the means and standard deviations of length, width and size as follows: (6.25±7.1, 2.93±2.54 and 34.19±152.95. respectively) as shown in descriptive statics table (4.6).

When making the correlation between the stroke type and gender using cross tabulation statics: 32 males of total of 60 patients were the most infected with

stroke, 28 of them having ischemic whereas 4 have hemorrhagic stroke and then 28 femaleswhere 27 of them having ischemic and only one female had a hemorrhagic stroke as shown in table (4.7) and figure (4.6). These results in the same line with previous study that done by **(Assar Adam, et al. 2017).** Who revealed that the patients participated in her study, men with being more affected than women in regards with stroke disease?These remarksalso are reported by **(Kajstra J et al 1996),** who postulated that the stroke raises 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.

Study found that 19 of total of 60 patients who have the age group between 60 and 70 years was the most infected group with ischemic stroke. Where 8 patients having an ischemic stroke, whereas the younger age groups were less infect with stroke as shown in table (4.8) and figure (4.7). So 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. Study stated that there is a significant correlation between the stroke type and Clinical Symptoms ($p= 0.005 < 0.05$). Where the left and right weakness the most clinical symptoms either wit ischemic or hemorrhagic stroke as shown in table (4.9).

5-2 Conclusion:

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.

In this study CT scans can was showed the size, site, and type of brain stroke.

The study showed that the incidence of ischemic stroke was higher than hemorrhagic stroke.

The ischemic stroke were higher incidence in male than female whereas in age between 60 to 70 years.

In this study the neurological deficit in the partial lobe was more than other lobes.

5.3 Recommendations:

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, and it is also helpful for Follow up studies to look for the resolution of the intracerebral hemorrhage and the effectiveness of the given treatment.

The best way to help prevent a stroke is to eat a healthy diet, exercise regularly, and avoid smoking and drinking too much alcohol.

.The institute sponsors of National Institute of Neurological Disorders and Stroke (NINDS) a wide range of basic and clinical research aimed at finding better ways to prevent, diagnose, and treat stroke, and to restore functions lost due to stroke.

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Appendices

Appendix [1]

Data sheet

No	Age	Gender	Clinical symptom	Type	Site	Size
1.						
2.						
3.						
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Appendix [2]

CT Images

Image 1: Shows 70 years male patient with ischemic stroke

Image 2: Shows 80 years male patient with hemorrhage stroke