Sudan University of Science and Technology

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Evaluation of Intracerebral HaemorrhageUsing Multidetector CT Scan

تقييم نزيف المخ الداخلي باستخدام الاشعة المقطعية متعددة الكواشف

A thesis Submitted in Partial Fulfillment for the Requirements ofM.Sc. Degree in Diagnostic Radiological Technology

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بسم الله الرحمن الرحيم

صدق الله العظيم

سورة هود الاية 88

DEDICATION

To the soul of my very missed “mother”

To the one who dedicated her life into not letting me ever feel the absence of her “my big sister”

To the best support and the one who have inspired me throughout the way in life “my father”

To whom I smile at and for “my beloved brothers and sisters”

To whom ever supported and encouraged me “my friends”

ACKNOWLEGMENT

In the present world of competition there is a race of existence in which those who are having will to come forward succeed. Project is like a bridge between theoretical and practical working. With this willing I joint this particular project; first of all, to thanks the ***Almighty Allah*** *the one who has always guided me to work on the right path of life. , whom I am indebted for bringing me up, inspiring and supporting me. Then I am feeling obliged in taking the opportunity to sincerely thanks* ***Dr. Asmaa Ibrahim Ahmed*** *for supervising this work to layout. I would like to express my greatest gratitude to* **Dr. MoaweyaBushraGameraddin***Who helped and guided me. Also Special thanks to my college and friend* **AbubakerElamin** *who helped me out throughout the way to this point. I have no value words to express my thanks, but my heart is still full of favors for any friend stood by and offered me his/her support. My thanks are extended to my family and friends for always being there for me.*

Abstract

Intracerebral hemorrhage (ICH) is when blood suddenly bursts into brain tissue, causing damage to the brain. It is most often caused by hypertension and is associated with increased intracranial pressure. ICH usually occurs in the basal ganglia, thalamus, pons and cerebral and cerebellar white matter. Cross-sectional descriptive population-based incidence study aimed to assess the intracerebral hemorrhage using CT scanning through identifying the site, size and intensity of the intracerebral hemorrhage, to identify the main causes and predisposing factors, and to test the correlation between those factors. Head CT have been taken from 63 patient (22 females, 41 males) who came to Al-Zaytouna and Ibrahim Malik HospitalsandYastabshiroon Medical Centers. The machine used are Toshiba model aquilion 64 instillation 2010 with detector type 64 rows and 4 rows. And GE model duel instillation 2001 with detector type 4 rows. The Data was analyzed by SPSS and excel. The data showed that the majority of the cases were suffering from hypertension 65%,the patients were checked for some predisposing factors that might have great correlation to the intracerebral hemorrhage. The majority of the patients were having hypertension 67% mostly among males. The data showed that most of which have had lobar intracerebral hemorrhage 61.9 %, to a lesser extend thalamic, cerebellar and basal ganglia intracerebral hemorrhage 14.3%, 12.7% and 1.6% respectively. The results showed that there is no significant correlation between the causes and size (P= 0.508) and there is no significant correlation between the site and size (P= 0. 669) but the data revealed that there is significant correlation between the causes and site (P= 0. 019). It is recommended further studies to compare between the CT and MRI in diagnosing the intracerebral hemorrhage. And to use more data sample size to test the incidence of all intracerebral hemorrhage causes and sites. It is also recommended further studies to assess ethnic group over the type and site of the intracerebral hemorrhage. And to conduct more studies to assess any predisposing factor that might have role in the intracerebral hemorrhage.

الخلاصــــة

النزيف المخي الداخلي يحدث عندما يكون هنالك تخلل مفاجئ للدم داخل أنسجة المخ مسبباً تلف لأنسجة الدماغ.وغالباً مايحدث النزيف بسبب ارتفاع ضغط الدم مصحوباً بارتفاع الضغط في التجويف الداخلي للجمجمة. النزيف المخي الداخلي عادةً مايحدث في منطقة الدماغ في الانوية القاعدية والمهاد للمخ، الجسر والمادة البيضاء للمخ والمخيخ.اجريت دراسة رقابيةوصفية ذاتالمقطعالمستعرض بغرض تقييم النزيف المخي الداخلي من خلال معرفة وقياس مكان وجهة النزيف، حجمه وشدته عن طريق استخدام الأشعة المقطعية للدماغ. وأيضاً لمعرفة الأسباب الرئيسية والمساعدة في حدوث النزيف واختبار العلاقة بينهم. اجريت الدراسة على ثلاث وستين حالة؛ احدى واربعين حالة من الذكور واثنتان وعشرين حالة من الإناث أخذت من مستشفى الزيتونة، مستشفى ابراهيم مالك ومركز يستبشرون الصحي. الاجهزة المستخدمة في التحليل كانت توشيبا موديل 2010 طراز 64 بمستقبل نوع 64 و 4 صفوف، وجهاز جي إي موديل 2001 ثنائي الأنوية ذو مستقبل 4 صفوف. تم تحليل العينات عن طريق برنامج التحليل الاحصائي SPSS وبرنامج EXCEL. أظهرت الدراسة وجود 65% من الحالات تعاني من ارتفاع ضغط الدم. تم أيضا فحص المرضى لأي عوامل قد تكون مساعدة أو مؤثرة في حدوث النزيف، ووجد أن نسبة كبيرة من المرضى الذكور يعانون من ارتفاع ضغط الدم 67%. اظهرت الدراسة ايضاً أن غالب حالات النزف الداخلي في منطقة فصوص الدماغ 61.9%، بحد أقل في المهاد 14.3%، المخيخ 12.7% والأنوية القاعدية للمخ 1.6%. اظهرت الدراسة أيضاً عدم وجود علاقة معنوية بين الحجم وسبب النزيف P= 0.508، كما اظهرت ايضاً عدم وجود علاقة معنوية بين مكان النزيف وحجمه P= 0.669، لكن أثبتت وجود علاقة معنوية بين مكان ومسبب النزيف P= 0.019.يوصى باجراء مزيداًمن الدراسات للمقارنة بين الأشعة المقطعية والرنين المغناطيسي في تقييم حالات النزيف المخي الداخلي، كما يوصى أيضاً باجراء أبحاث اضافية للمقارنة بين حجم ومكان النزيف مع مراعاة تغطية عدد اكبر من الحالات، المجموعات العرقية والعوامل التي يمكن أن يكون لها دور في النزيف المخي الداخلي.

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ICH	Intracerebral hemorrhage
CT	Computed tomography
RR	Relative risk
P	Value of null hypothesis
MDCT	Multi detector computed tomography
CSF	Cerebrospinal fluid
MRI	Magnetic resonance image
CVI	Cerebral venous infarction
SPSS	Statistical Package for the SocialSciences

Chapter One

Introduction

Chapter one

1.1 Introduction:

Intracerebral hemorrhage (ICH) is when blood suddenly bursts into brain tissue, causing damage to the(Pietrangelo, 2015).It is most often caused by hypertension and is associated with increased intracranial pressure.ICH usually occurs in the basal ganglia,thalamus,ponsand cerebral and cerebellar white matter(Mosby, 2009).Symptoms usually appear suddenly during ICH. They include headache, weakness, confusion, and paralysis, particularly on one side of the body.

The buildup of blood puts pressure on the brain and interferes with its oxygen supply(Drury et al., 1984). Drury *et al* (4) tested the incidence of the spontaneous intracerebral hemorrhage and found out that it accounts for about 10% of all strokes and is associated with high morbidity and mortality (Nadstawek et al., 1993). Others said that Intracerebral hemorrhage represents approximately 10% to 15% (10-30/100,000 population) of all strokes, and about 2 million of the 15 million strokes worldwide are intracerebral hemorrhages(Neurology, 2010). Men are more likely to suffer an intracerebral hemorrhage than women. Hemorrhage into the base of the brain structures and hemorrhage into the central fluid filled cavities of the brain (intraventricular hemorrhage). Patients with a Glasgow coma score of 8 (a quick measure of neurological status assessing eye opening, verbal response and best motor function, for which normal is 15), with hemorrhage size of 60 cubic centimeters, have an estimated 30-day mortality rate of 91%. Patients with a hemorrhage volume of 30 cc or more were severely disabled at 30 days. Hemorrhage into the lower brain region (i.e. pons) carries a grave prognosis, with 55% mortality and 24% dependency in survivors. Hemorrhage into other locations may have a much better prognosis for survival and independence (Neurology, 2010).

A CT scan has many uses, but is particularly well-suited to quickly examine people who may have internal injuries from car accidents or other types of trauma. A CT scan can be used to visualize nearly all parts of the body and is used to diagnose disease or injury as well as to plan medical, surgical or radiation treatment(Research, 2015).

The main advantages of CT over conventional radiography are in the elimination of superimposed structures, the ability to differentiate small differences in density of anatomic structures and abnormalities, and the superior quality of the images.

1.2Problem of the study:

The incidence of intracerebral hemorrhage was increased and causes severe morbidity and mortality. MDCT plays a great role to assess the ICH and this facilitate the management and treatment.

1.3Objective of the study:

1.3.1 General objective:

To assess the intracerebral hemorrhage using CT scanning.

1.3.2 Specific objective:

2. To identify the types and incidence of intracerebral hemorrhage.
3. To identify the site of the intracerebral hemorrhage among different group ages.
4. To identify the main causes of intracerebral hemorrhage
5. To identify the main predisposing factorswhich may play role in the intracerebral hemorrhage.
6. To test the correlation between the causes and site of the intracerebral hemorrhage.
7. To test the correlation between the site and size of the intracerebral hemorrhage.
8. To test the correlation between the causes and severity of the intracerebral hemorrhage.

1.4 Research Overview

Chapter One: Introduction & Literate review

Chapter Two: Anatomy and pathology of the brain

Chapter Three:Materials and Methods

Chapter Four:Results

Chapter Five:Discussion, Conclusion and Recommendations

References

Appendix

Chapter Two

Theoretical background

Chapter two

Theoretical background

2.1 Gross anatomy of the brain:

The brain is part of the nervous system. It lies within the cranial cavity and it is one-fiftieth of the body weight. It has the following parts; Cerebrum, cerebellum and brain stem (midbrain – pons – medulla oblongata)(Palastanga et al., 2002).

2.1.1 Cerebrum:

The cerebrum (Fig 2.1) is the largest part of the brain, situated in the anterior and middle cranial fossae of the skull and occupying the whole concavity of the vault of the skull. It may be divided into two parts: the diencephalon, which forms the central core, and the telencephalon, which forms the cerebral hemispheres(Snell, 2012).

The cerebrum is divided into left and right hemispheres and diencephalon in between, the hemispheres are separated by large cleft; the longitudinal fissure. The two hemispheres are connected by white Commissural fiber; the corpus callosum which lies deep within the longitudinal fissure(Palastanga et al., 2002).

Each hemisphere has a covering of gray matter, the cortex and internal masses of gray matter, the basal nuclei(Snell, 2012).

The surface grey matter of the cerebral cortex varies in thickness between 2-5 mm. It contains the cell bodies of the neurons responsible for the various functions of the cerebrum (Palastanga et al., 2002).

The term basal nuclei (basal ganglia) (Fig 2 & 6) is applied to a collection of masses of gray matter situated within each cerebral hemisphere. They are the corpus striatum, the amygdaloid nucleus, and the claustrum(Snell, 2012).

The corpus striatum is situated lateral to the thalamus. It is almost completely divided by a band of nerve fibers, the internal capsule, into the caudate nucleus and the lentiform nucleus. The caudate nucleus, a large C-shaped mass of gray matter that lies lateral to the thalamus. The lateral surface of the nucleus is separates from the lentiform nucleus by the internal capsule(Snell, 2012).

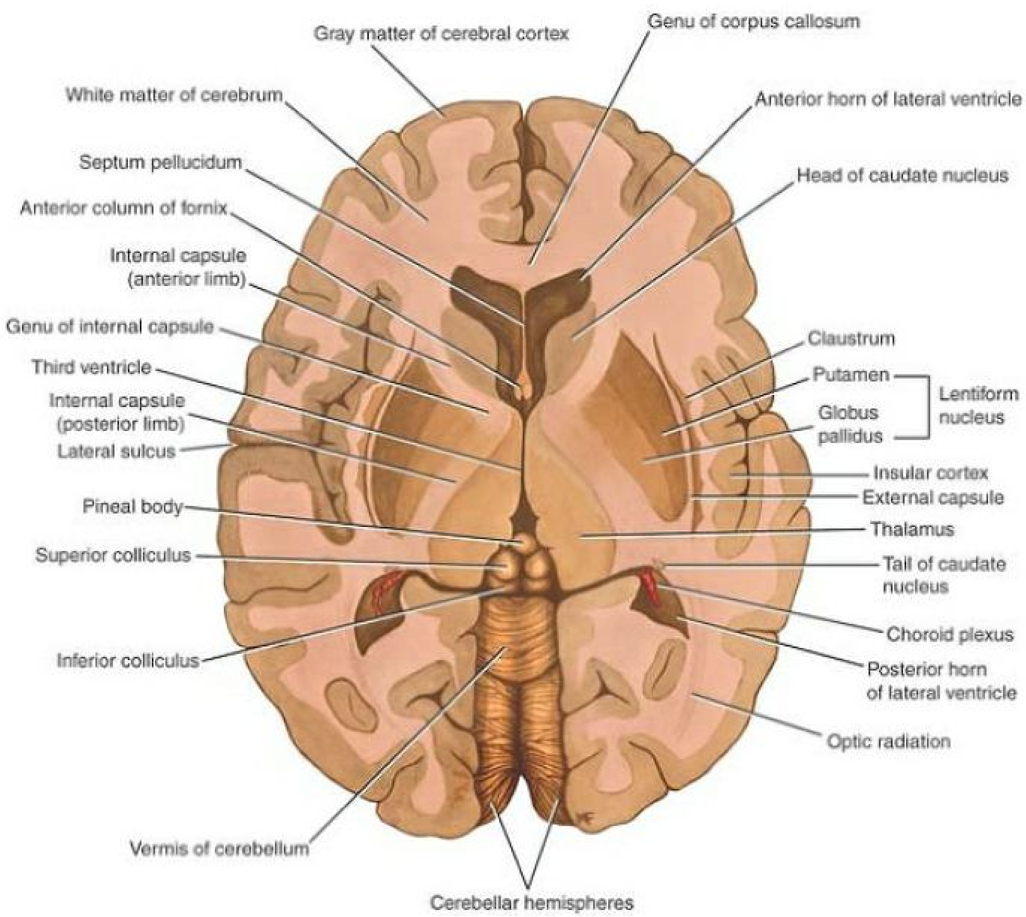

Fig 2.1 Cerebrum; coronal section – superior view(Snell, 2012)

The lentiform nucleus is related medially to the internal capsule, which separates it from the caudate nucleus and the thalamus. The lentiform nucleus is related laterally to the external capsule that separates it from the claustrum. The amygdaloid nucleus is situated in the temporal lobe at the end of the tail of the caudate nucleus(Snell, 2012).

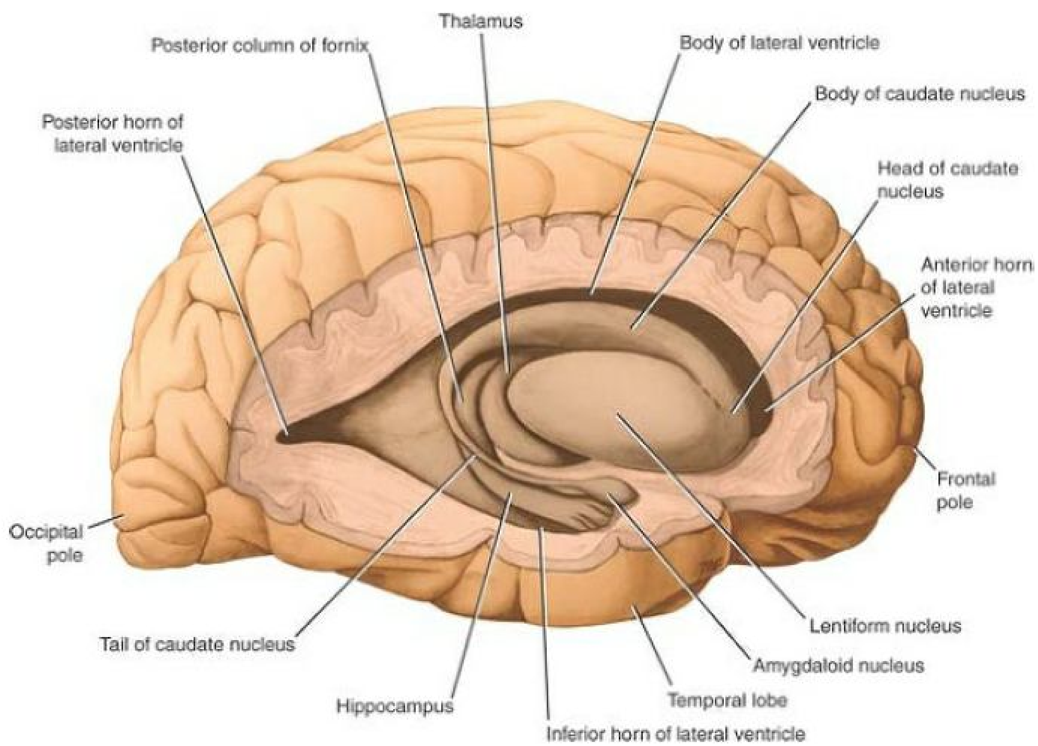

Fig 2.2Cerebrum; opened section in lateral view shows the basal ganglia(Snell, 2012)

2.1.2 The Diencephalon:

2.1.2.1 The thalamus: These paired, ovoid bodies of grey matter lie in the lateral walls of the third ventricle, from the interventricular foramenanteriorly to the brainstem posteriorly(Snell, 2012).

2.1.2.2 The hypothalamus: The hypothalamus forms the floor of the third ventricle. It includes the following, starting anteriorly:

Optic chiasm

Tuber cinereum - a sheet of grey matter between the optic chiasm and the mammillary bodies; Infundibular stalk - leading down to the posterior lobe of the pituitary gland

Mammillary bodies - small round masses in front of the posterior perforated substance in which the columns of the fornix (vide infra) end.

Posterior perforated substance - the interval between the diverging cruracerebri, which is pierced by central branches of the posterior cerebral artery.

The nuclei of the hypothalamus are connected by whitematter, the medial forebrain bundle, to each other, to thefrontal lobe anteriorly and to the midbrain posteriorly(Snell, 2012).

2.1.3 White matter of the cerebral hemispheres:

Deep to the cortex; the cerebral hemispheres are formed of a large mass of white matter that consists of the axons of the neurons in the cerebral cortex, together with axons that enter the cerebrum from the brain stem and diencephalons(Palastanga et al., 2002)these are:

Association (arcuate) fibers connect different parts of a cerebral hemisphere by extending from one gyrus to another.

Commissural fibers connect corresponding areas of thetwo cerebral hemispheres; the largest and most important commissure is the corpus callosum which lies within the depth of the great longitudinal fissure.

Projection fibers connect the cerebral cortex with greymatter of lower parts of the brain and with the spinal cord(Palastanga et al., 2002).

2.1.4 Lobar division:

Each cerebral hemisphere is divided by main three sulci into lobes that are named according to the outer covering bone of the skull. They are the frontal, parietal, temporal and occipital lobes(Palastanga et al., 2002).

This is the standard four lobes division but now it is widely accepted that the brain is subdivided into seven lobes. This new division states that each hemisphere includes in addition to the standard four lobes, the insular lobe, limbic lobeand central lobe (Standring, 2008).

2.1.5 Surfaces and main fissures:

On the superolateralsurface of each cerebral hemisphere there are two prominent fissures , the lateral (Sylvian) fissure and the central sulcus, are the main features that determine its surface divisions.The lateral fissure is a deep cleft on the lateral and inferiorsurfaces of the hemisphere. It separates the frontal and parietallobes above from the temporal lobe below.The central sulcus separates the frontal and parietal lobes. It starts in or near the superomedial border of the hemisphere, a little behind the midpoint between the frontal and occipital poles(Standring, 2008).

The parieto-occipital sulcus on the medial surface of thehemisphere(Fig. 2.3 &2.4) separates the parietal and occipital lobes. On thelateral surface of the hemispheres there is no complete sulcalseparation of the parietal, temporal and occipital lobes. The boundary between the parietal and temporal lobes lies on a line extended back from the lateral sulcus. Theboundary separating the parietal and temporal lobes from the occipital lobe is a line between the superior border of the parieto-occipital sulcus and the preoccipitalnotch(Ryan et al., 2004).

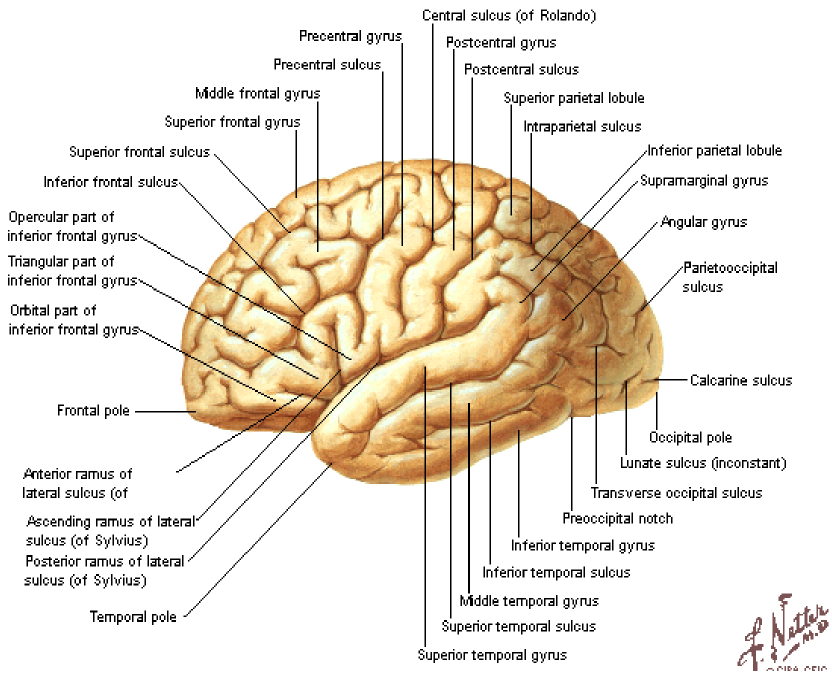

Fig 2.3: Cerebrum; Lateral View(Netter, 2006).

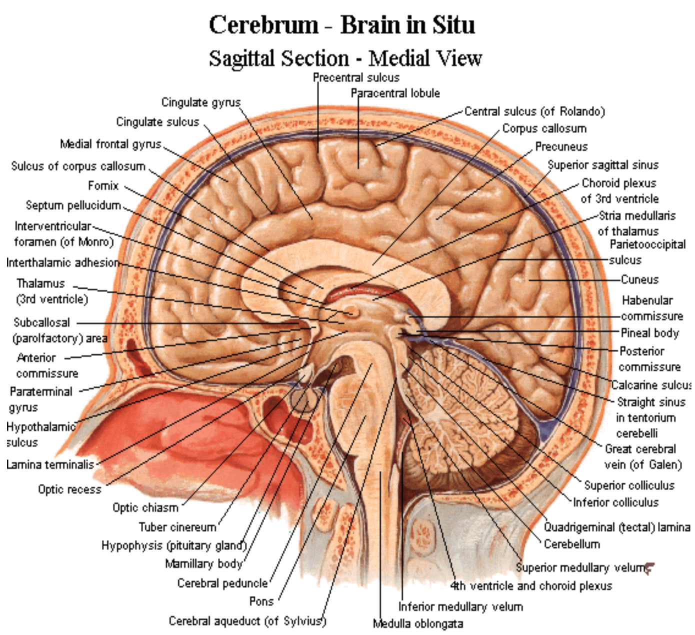

Fig 2.4 Cerebrum; Sagittal section – Medial view (Netter, 2006).

2.1.6 Functional areas of the cerebrum (Fig. 2.5):

2.1.6.1 Motor areas of the cerebrum(Waugh, 2014):

The precentral (motor) area: This lies in the frontal lobe immediately anterior to the central sulcus. They initiate the contraction of the contralateral skeletal muscles.

The premotor area: This lies in the frontal lobe immediately anterior to the motor area. It exerts a controlling influence over the motor area, ensuring an orderly series of movements. In the lower part of this area just above the lateral sulcus there is a group of nerve cells known as the motor speech (Broca's) area which controls the movements necessary for speech. It is dominant in the left hemisphere in right-handed people and vice versa.

The frontal area: This extends anteriorly from the premotorarea to include the reminder of the frontal lobe. It is thought that the communication between this and the other regions in the cerebrum are responsible for the behavior, character and emotional state of the individual**.**

2.1.6.2 Sensory areas of the cerebrum (Waugh, 2014):

The postcentral sensory area: This is the area behind the central sulcus. Here sensations of pain, temperature, pressure and touch, knowledge of muscular movement and the position of joints of the contralateral side of the body perceived.

The parietal area: This lies behind the post central area and includes the greater part of the parietal lobe. Its functions are associated with obtaining and retaining accurate knowledge of objects.

The sensory speech area: This situated in the lower part of the parietal lobe and extends into the temporal lobe in the dominant hemisphere. It is here the understanding of the spoken words.

The auditory (hearing) area: This lies immediately below the lateral sulcus within the temporal lobe.

The olfactory (smell) area: This lies deep within the temporal lobe.

The taste area: This is thought to lie just above the lateral sulcus in the deep layers of the sensory area.

The visual area: This lies behind the parietoccipital sulcus and includes the greater part of the occipital lobe.

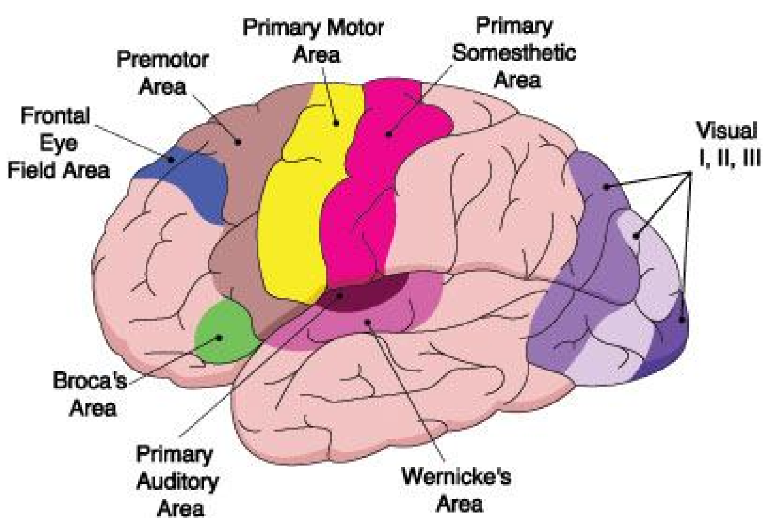

Fig 2.4 Functional areas of the cerebrum (Netter, 2006).

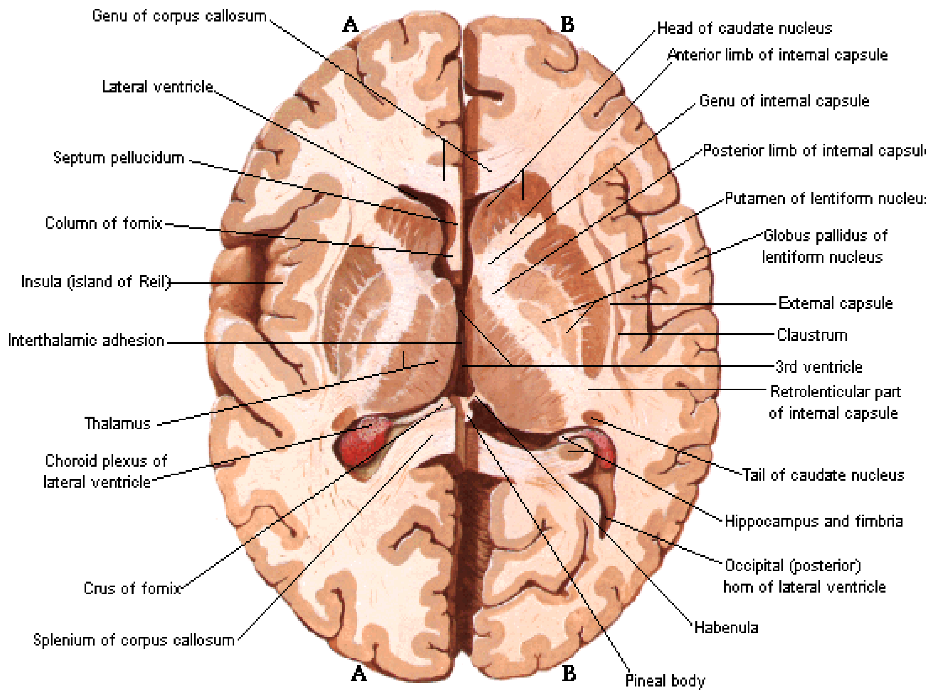

Fig 2.5 Horizontal section through cerebrum, showing the basal ganglia (Netter, 2006).

2.1.7 Ventricles of the brain (Fig. 2.7)(Waugh, 2014):

Within the brain there are four irregular-shaped cavities, or ventricles, containing cerebrospinal fluid (CSF). They are:

Right and left lateral ventricles.

Third ventricle.

Fourth ventricle.

2.1.7.1 The lateral ventricles: These cavities lie within the cerebral hemispheres**,** one on each side of the median plane just below the corpus callosum**.** They are separated from each other by a thin membrane, the septum plucidum**,** and are lined with ciliated epithelium**.** They communicate with the third ventricle by the interventricular foramina(foramina of Monro)(Waugh, 2014).

2.1.7.2 The third ventricle: It is situated below the lateral ventricle between the two thalami. It communicates with the fourth ventricle by a canal, the cerebral aqueduct or aqueduct of the midbrain(Waugh, 2014).

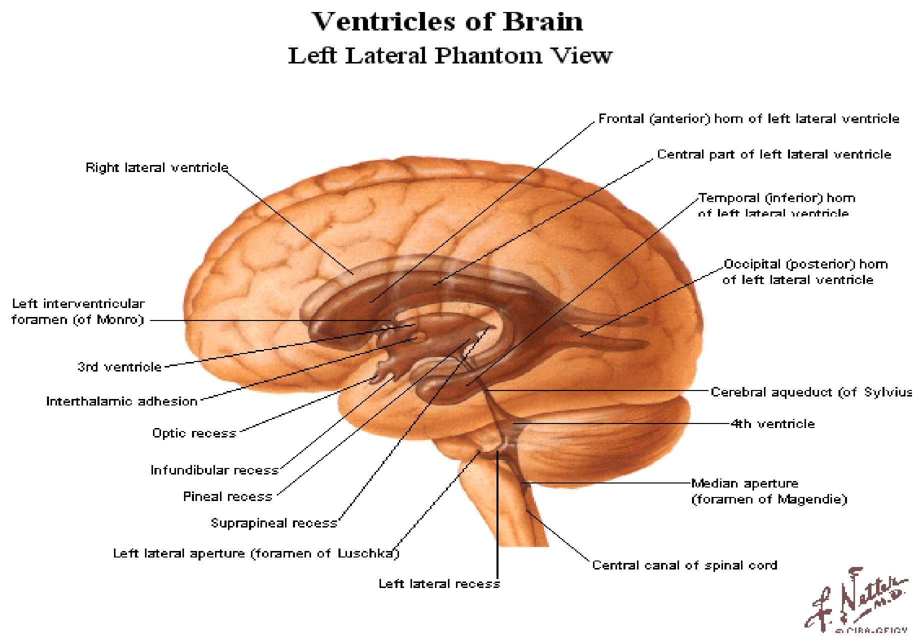

Fig 2.6 Ventricles of the brain; Lt Lateral phantom view (Quoted from Netter, 2006).

2.1.8 Membranes covering the brain (Fig. 2.8):

The brain is surrounded by three membranes, meninges, lying between the skull and the brain; Named from outside inwards.

They are:

Dura mater.

Arachnoid mater.

Pia mater.

The dura and arachnoid maters are separated by a potential space, the subdural space. The arachnoid and pia maters are separated by the subarachnoid space, containing cerebrospinal fluid(Waugh, 2014).

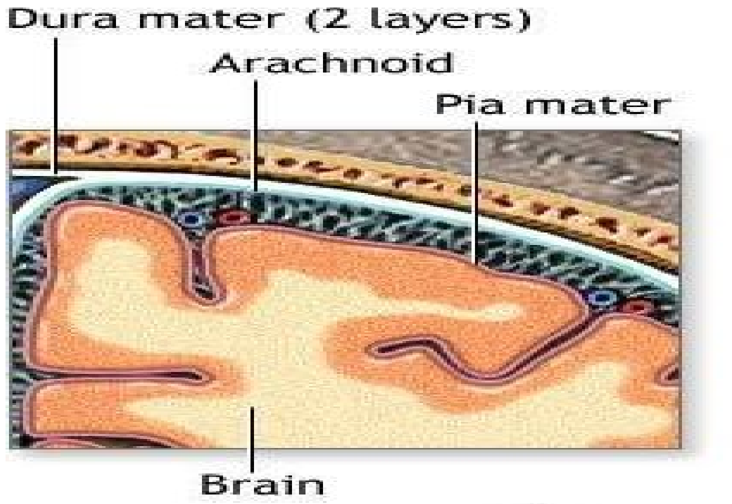

Fig 2.7 Meninges covering the brain (Netter, 2006).

2.1.9 Blood supply of the brain:

The arterial supply of the brain is derived from the internal carotid and vertebral arteries(Ryan et al., 2004).

2.1.9.1 The internal carotid artery: It enters the skull through the carotid canal, and then traverses the foramen lacerum and cavernous sinus. It penetrates the dura and arachnoid matersmedial to the anterior clinoid process and enters the subarachnoid space over the ventral surface of the brain where it divides into its major branches: The anterior cerebral and middle cerebral arteries. Each anterior cerebral artery curves medially, crossing the optic nerve, to enter the longitudinal fissure. Before doing so, the two anterior cerebral arteries anastomose with each other's via the anterior communicating artery. The main trunk of the anterior cerebral artery follows the contour of the corpus callosum and distributes branches to the medial aspect of the cerebral hemisphere(Ryan et al., 2004).

The middle cerebral artery passes laterally to gain the floor of the lateral sulcus, and then runs backwards along it. Deep, penetrating branches arise from its proximal part and enter the cerebral hemisphere from below to supply the region of the basal ganglia. Superficial branches arise from the middle cerebral artery as it runs in the lateral sulcus supplying the lateral surface of the hemisphere except for the narrow strip supplied by the anterior cerebral artery, the occipital pole and the inferolateral surface of the hemisphere(Ryan et al., 2004).

2.1.9.2 The vertebral artery: The two arteries of both sides pierce the dural sac and enter the subarachnoid just above the first cervical vertebra. Each passes forwards and upwards through the foramen magnum to join in the midline in front of the medulla oblongata forming the basilar artery which runs upwards in front of the pons. Branches of the vertebral and basilar arteries pass laterally to supply the medulla oblongata, pons and cerebellum(Ryan et al., 2004).

The terminal branches of the basilar artery are the posterior cerebral arteries, each of which passes around the lateral surface of the midbrain to gain the inferior aspect of the temporal lobe of the cerebral hemisphere. It supplies the posterior parts of the hemisphere, notably the occipital lobe. Branches from the proximal part of the posterior cerebral artery supply the midbrain and thalamus.

2.1.9.3 The circle of Willis (Fig. 2.9):

On the ventral surface of the brain, each posterior cerebral artery anastomoses with the ipsilateral internal carotid artery through the posterior communicating artery. This allows the vertebrobasilar circulation to communicate with that of the internal carotid arteries. Similarly, the anterior communicating artery permits flow between the two internal carotid arteries. The ring of vessels formed by the anterior communicating artery, the anterior cerebral arteries, the internal carotid arteries, the posterior communicating arteries, posterior cerebral arteriesand the end of the basilar artery is known as the circle of Willis(Palastanga et al., 2002).

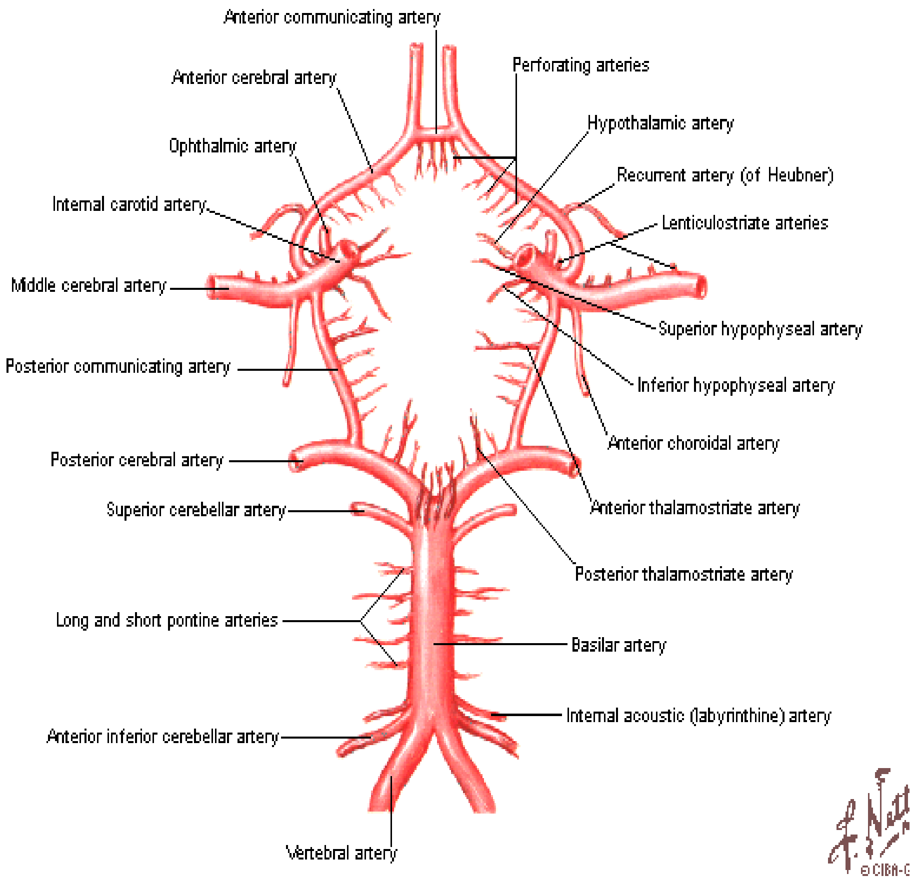

Fig 2.8 Circle of Willis; Vessels Dissected Out - Inferior view (Netter, 2006).

2.2 Pathology of intracerebral hemorrhage:

2.2.1 Introduction:

Intracerebral hemorrhage (ICH) is an acute and spontaneous extravasation of blood into the brain parenchyma. Bleeding may also extend into the ventricles or subarachnoid space.1 ICH is a subtype of stroke with high morbidity and mortality accounting for about 15% of all deaths from stroke.2 Depending on the underlying cause of bleeding, ICH is classified as either primary or secondary. Primary ICH, which accounts for 78-88% of cases, originates from the spontaneous rupture of small vessels damaged by chronic hypertension or amyloidangiopathy. Secondary ICH occurs in association with trauma, vascular abnormalities, tumors or impaired coagulation. 3 The focus of this article is mainly on the etiology, pathophysiology and pathology of primary ICH with brief comments on genetics and iatrogenic forms of ICH(Jones et al., 2016).

An intra-cerebral hemorrhage, or intra-parenchymal cerebral hemorrhage, is a subset of an intracranial hemorrhage. This can encompass a number of entities that share the acute accumulation of blood in the parenchyma of the brain. The etiology, demographics, treatment and prognosis vary widely depending on the type of hemorrhage, and as such these are discussed separately(Jones et al., 2016).

2.2.2 Types of intracerebral hemorrhage:

They can be conveniently divided according to their typical locations in order of frequency as following:

2.2.2.1 Hypertensive intracerebral hemorrhages:

Hypertensive intracerebral hemorrhages are common. It is the most common cause of intracerebral hemorrhages. Long standing poorly controlled hypertension leads to a variety of pathological changes in the vessels(Jones et al., 2016).

microaneurysms of perforating arteries (Charcot-Bouchard aneurysms)

small (0.3-0.9 mm) diameter

occur on small (0.1-0.3 mm) diameter arteries

distribution which matches incidence of hypertensive hemorrhages

80% lenticulostriate

10% pons

10% cerebellum

found in hypertensive patients

may thrombose, leak (see cerebral microhemorrhages) or rupture 2

accelerated atherosclerosis: affects larger vessels

hyaline arteriosclerosis

hyperplastic arteriosclerosis: seen in very elevated and protracted cases (Jones et al., 2016).

2.2.2.2 Basal ganglia hemorrhage (Fig 2.10, 2.11 and 2.12):

It is a common form of intracerebral hemorrhage, and usually as a result of poorly controlled long standing hypertension. The stigmata of chronic hypertensive encephalopathy are often present(Jones et al., 2016).

Radiographic features "*CT*"

Typically a region of hyperdensity is demonstrated centered on the basal ganglia or thalamus. Not infrequently there may be an extension into the ventricles, with occasionally the parenchymal component being very small or unapparent(Jones et al., 2016).

Fig2.10 Axial non contrast CT of the brain demonstrates an acute intracerebral hemorrhage centered in the basal ganglia of the left hemisphere(Jones et al., 2016).

Fig 2.9 Axial non contrast CT image demonstrates a hyperdense focus centered on the globus pallidus on the left with a faint rim of low attenuation(Jones et al., 2016).

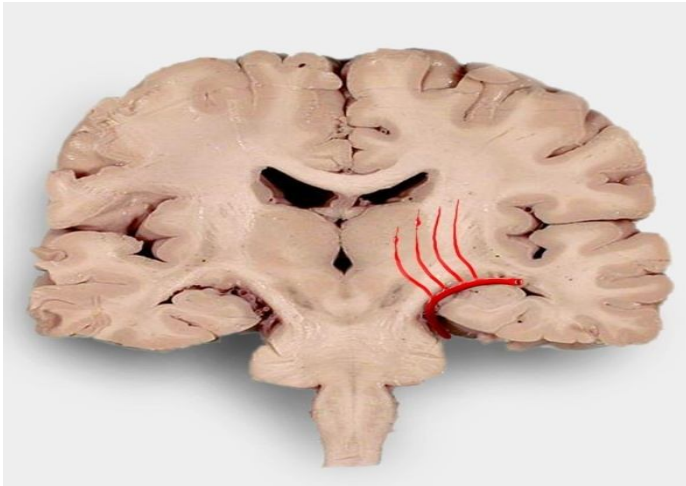

Fig 2.10Diagram depicts the Charcot Bouchard microaneurysms arising from perforating lenticulostriate arteries(Jones et al., 2016).

2.2.2.3 Thalamic hemorrhages or thalamic hemorrhagic strokes (Fig 2.13)

They are often the result of chronic hypertension. The thalamus transmits or prevents transmission of sensory signals from sensory areas of the cerebral cortex through internal capsule fibers and has a role in memory thus the clinical presentation reflects this one.

Radiographic features

Thalamic hemorrhage is easily recognizable on CT as hyperdensity within the thalamu(Jones et al., 2016).

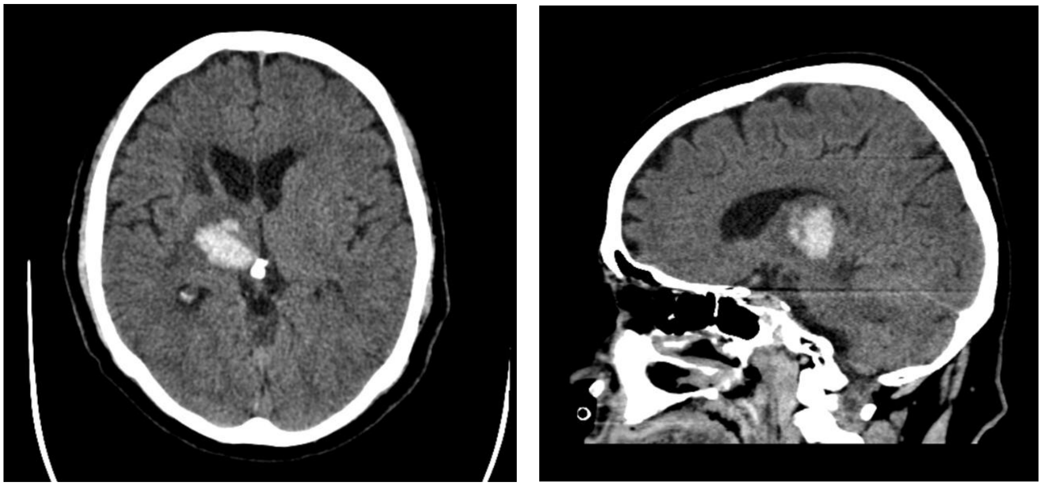

Fig2.13 Computed tomography demonstrates a round, hyperdense focus at right thalamic nucleus level, in keeping with a hematoma(Jones et al., 2016).

2.2.2.4 Pontine hemorrhage (Fig 2.14 &2.15):

A form of intracranial hemorrhage, is most commonly due to long standing poorly controlled chronic hypertension. It carries a very poor prognosis. As is the case with penetrating arteries into the basal ganglia, the penetrating arteries from the basilar artery extending into the pons are subject to lipohyalinosis as a result of poorly controlled hypertension 1. This renders the vessel wall prone to rupture. The larger paramedian perforators are more commonly the culprit vessels (Jones et al., 2016).

Hemorrhage into the pons can of course also be secondary to underlying lesions including:

Vascular malformations ,Cavernous malformations
,Arteriovenous malformations ,Tumors
,Neuroepithelial,(primary) brain tumors

Metastases

Downward herniation (duret hemorrhages)

Supratentorial surgery (remote hemorrhage)

2.2.2.4.1Radiographic features

CT of the brain is usually the first, and often the only, investigation obtained upon presentation. Features typical of an acute intraparenchymal hemorrhage are noted, usually located centrally within the pons (on account of the larger paramedian perforators usually being the site of bleeding).

The hematoma more frequently extends in a rostrocaudal direction along the traversing long tracts rather than laterally into the middle cerebellar peduncles. Usually the hematoma does not extend beyond the pontomedullary junction inferiorly and the inferior midbrain superiorly 1.These hematomas frequently rupture into the 4th ventricle 1. In patients who have small volume bleeds and who are thought to possibly have an underlying lesion, MRI may be of use (e.g. identification of a vascular malformation)(Jones et al., 2016).

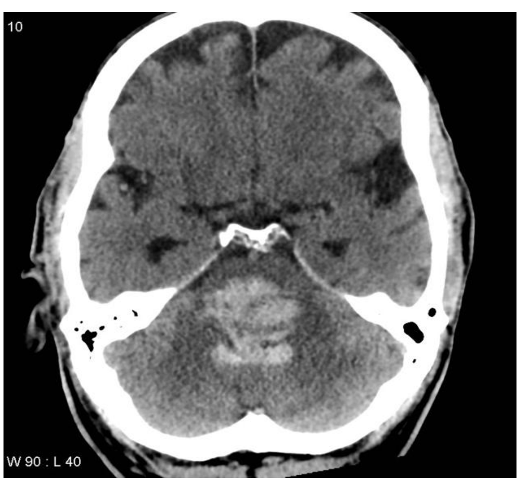

Fig2.14 Non-contrast CT demonstrates a large pontine hemorrhage with extension of blood into the fourth ventricle and up into the third ventricle(Jones et al., 2016).

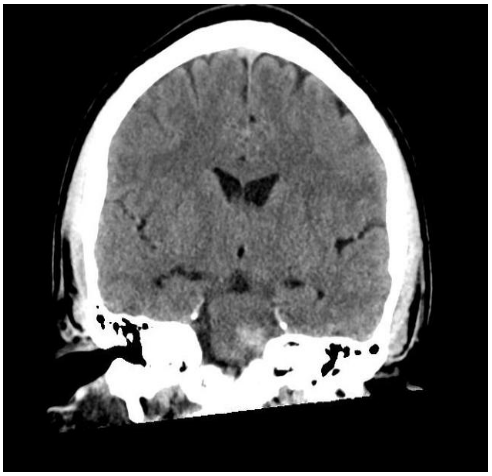

Fig 2.11 Acute left pontine hemorrhage. No mass effect at present. Grey-white differentiation is preserved(Jones et al., 2016).

2.2.2.5 Cerebellar hemorrhage (Fig 2.16 &2.17):

Itis a form of intracranial hemorrhage and is most frequently seen in the setting of poorly controlled hypertension, although this can of course also be secondary to an underlying lesion (e.g. tumor or vascular malformation) or due to supratentorial surgery (see remote cerebellar hemorrhage).

This article concerns itself with primary cerebellar hemorrhages. The demographics of affected patients reflect those of patients with long term poorly controlled hypertension, and as such patients are usually elderly.Cerebellar hemorrhages only account for approximately 10% of all intracerebral hemorrhages (Jones et al., 2016).

2.2.2.5.1Radiographic features

CT as with other hemorrhagic strokes, CT is usually the first, and often the only imaging investigation obtained.

As with other acute hemorrhages, cerebellar hemorrhages appear as regions of hyperdensity within the cerebellar hemispheres. Extension into the fourth ventricle or subarachnoid space is relatively common(Jones et al., 2016).

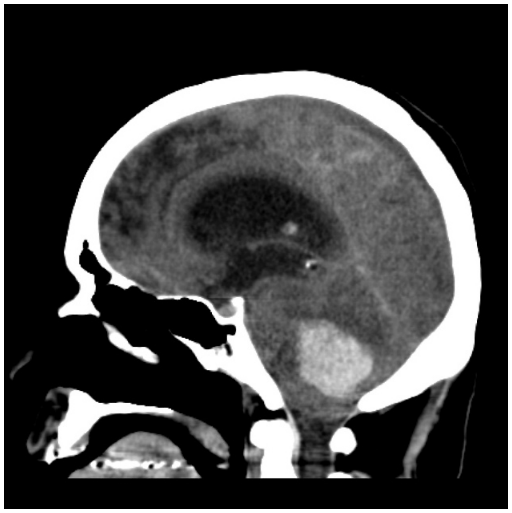

Fig2.16CT shows a large cerebellar hemorrhage with extension into the ventricles and sub-arachnoid space(Jones et al., 2016).

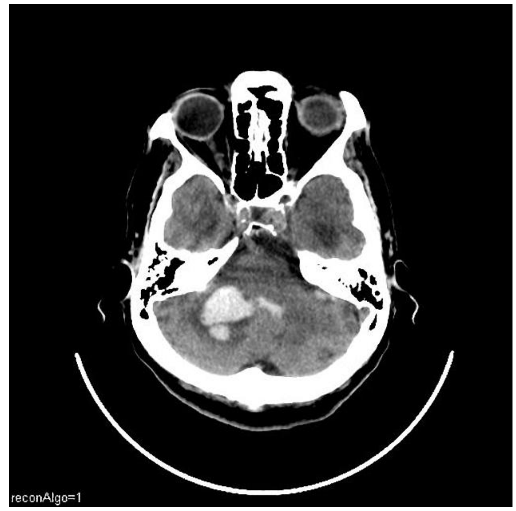

Fig 2.12 Cerebellar hemorrhage (about 3.8 x 2.4 cm) with extension into the ventricles(Jones et al., 2016).

2.2.2.6 Lobar hemorrhage (Fig 2.18 &2.19):

It is a subtype of intracranial hemorrhage, which generally carries a poor prognosis. Primary lobar hemorrhages (usually due to cerebral amyloid angiopathy) are typically seen in elderly. Younger patients may also develop lobar hemorrhages, but in such cases they usually have an underlying lesion (e.g. cerebral arteriovenous malformation) (Jones et al., 2016).

2.2.2.6.1Radiographic features

CT is usually the modality first obtained and demonstrates a hyperdense collection of blood, located superficially within the lobes of the brain (i.e., not in the basal ganglia). The hemorrhages vary widely in size from only a centimeter or so (often asymptomatic) to extremely large collections.Extension into the subdural or subarachnoid and even interventricular space (the latter is far more common in basal ganglia hemorrhages) may be seen(Jones et al., 2016).

Fig2.18 CT without contrast demonstrates a very large lobar hemorrhage occupying most of the frontal lobe and extending into the ventricles(Jones et al., 2016).

Fig 2.13 Hemorrhagic focus in the right frontal lobe, flanked by oedema of the adjacent parenchyma(Jones et al., 2016).

2.2.2.7 Cerebral venous infarction (CVI) (Fig 2.20 &2.21):

It is usually the sequelae of cerebral venous thrombosis, complicating both dural venous sinus thrombosis and deep cerebral venous thrombosis. Any other cause of venous occlusion can also lead to venous infarction, including trauma and surgical ligation.

As a result of the arterial supply to the infarcted tissue not being compromised, a hemorrhagic transformation is common, and is typically heterogeneous and gyriform(Jones et al., 2016).

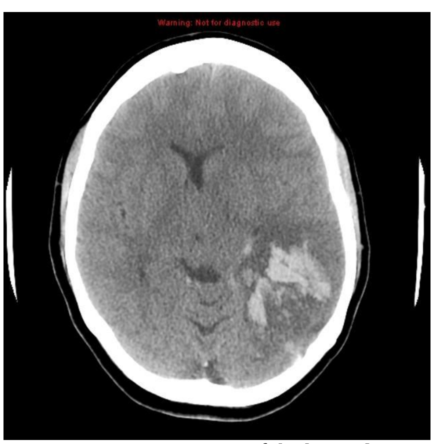

Fig2.20 Non-contrast CT of the brain demonstrates intracerebral hemorrhage involving the left parito-occipital region as well as superior temporal lobe, which is heterogeneous and gyriform(Jones et al.,

2016).Fig 2.14 Single image from a non-contrast CT demonstrates further evolution of the right sided venous hemorrhage(Jones et al., 2016)

2.2.2.8 Hemorrhagic transformation (Fig 2.22):

It is a complication of cerebral ischemic infarction and can significantly worsen prognosis. Petechial hemorrhagic transformation has traditionally been referred to by pathologists as "red softening" in contrast to the more common bland or anemic infarct(Jones et al., 2016).

It is believed that hemorrhagic transformation occurs as a result of preserved collateral perfusion (from adjacent vessels/territories) or from reperfusion of infarcted tissues which have weakened vessels (i.e. from extravasation or diapedesis). The former explains why hemorrhagic transformation is seen in patients with permanently occluded vessels. The latter accounts for the increased incidence in patients receiving therapies designed to increase re-perfusion rates.

Petechial hemorrhage typically is more pronounced in grey matter and results in increased attenuation. This sometimes mimics normal grey matter density and contributes to the phenomenon of fogging(Jones et al., 2016).

By the time secondary hematomas form, the underlying infarct should be easily seen and will appear as a region of low attenuation, involving both the white matter and the overlying cortex. Hemorrhage is often patchy, scattered throughout the infarcted tissue, and usually represents only a small component of the abnormal tissue (Jones et al., 2016).

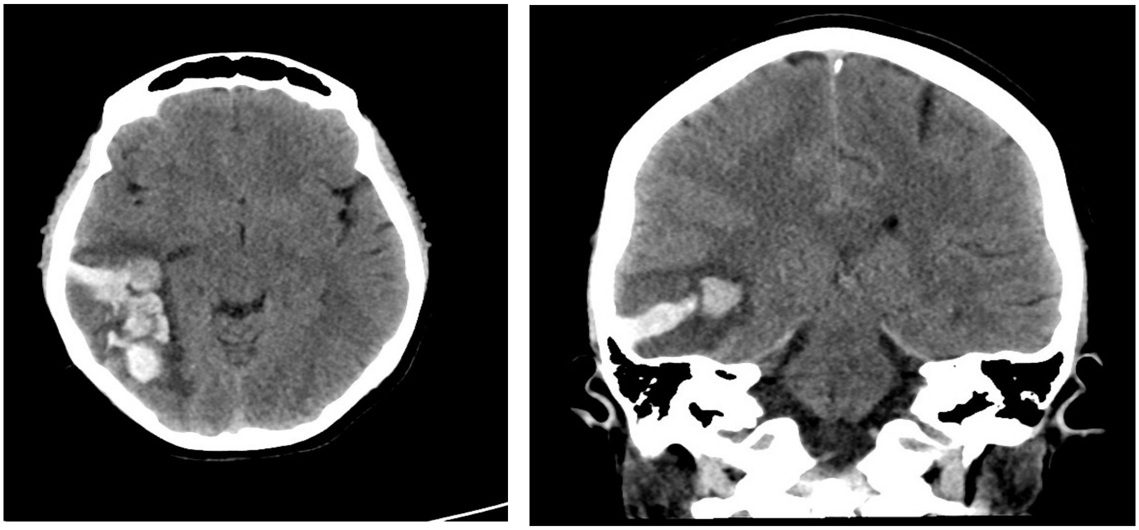

Fig2.22 A large region of wedge-shaped hypodensity blurring the grey-white matter differentiation in the right temporoparietal region contains a moderate volume of parenchymal hemorrhage, which measures 5.8 x 3.7 x 2.7 cm(Jones et al., 2016).

2.3 Principal of computed tomography(CT)

Conventional radiographs depict a three-dimensionalobject as a two-dimensional image. This results in overlying tissues being superimposed on the image, a majorlimitation of conventional radiography. Computed tomography(CT) overcomes this problem by scanning thin sectionsof the body with a narrow x-ray beam that rotatesaround the body, producing images of each cross section.

Another limitation of the conventional radiograph is itsinability to distinguish between two tissues with similardensities. The unique physics of CT allow for the differentiationbetween tissues of similar densities(Jones et al., 2016).

The main advantages of CT over conventional radiographyare in the elimination of superimposed structures,the ability to differentiate small differences in density ofanatomic structures and abnormalities, and the superiorquality of the images(Jones et al., 2016).

2.4 Helical (spiral) scanning

Many technical developments of the 1990s allowed forthe development of a continuous acquisition scanningmode most often called spiral or helical scanning. Keyamong the advances was the development of a systemthat eliminated the cables and thereby enabled continuousrotation of the gantry. This, in combination with otherimprovements, allowed for uninterrupted data acquisition that traces a helical path around the patient.

2.5 Multisection computed tomography (CT)

Multisection computed tomography (CT) was introduced in 1992 withthe advent of dual-section–capable scanners and was improved in 1998following the development of quad-section technology. With a recentincrease in gantry speed from one to two revolutions per second, multisectionCT scanners are now up to eight times faster than conventionalsingle-section helical CT scanners. The benefits of quad-section CTrelative to single-section helical CT are considerable. They include improvedtemporal resolution, improved spatial resolution in the z axis,increased concentration of intravascular contrast material, decreasedimage noise, efficient x-ray tube use, and longer anatomic coverage.These factors substantially increase the diagnostic accuracy of the examination.

The multisection CT technique has enabled faster and superiorevaluation of patients across a wide spectrum of clinical indications.These include isotropic viewing, musculoskeletal applications,use of multiplanar reformation in special situations, CT myelography,long coverage and multiphase studies, CT angiography, cardiac scoring,evaluation of brain perfusion, imaging of large patients, evaluationof acute chest pain or dyspnea, virtual endoscopy, and thin-sectionscanning with retrospective image fusing. Multisection CT is superiorto single-section helical CT for nearly all clinical applications.

2.6 Literature review:

Inagawa, T. diagnosed 267 patients in Izumo City, Japan, as having primary intracerebral hemorrhage (ICH) by computed tomography or magnetic resonance imaging. And he concluded that the crude incidence rate was 52/100,000 per year for all ages(Inagawa, 2002).

Tveiten, A., et al. haveadjusted to the standard European population the annual incidence rate. They reported that the incidence rates rose continuously with increasing age through all age groups in both sexes. And they added that men are at higher risk than women(Tveiten et al., 2012).

Labovitz, D. L., et al. conducted a population-based incidence study to directly compare the incidence of deep and lobar intracerebral hemorrhage in whites, blacks, and Hispanics. They found out that men had a higher risk of ICH than women (RR 1.5, 95% CI 1.2 to 1.8)(Labovitz et al., 2005). They concluded that the ICH is a heterogeneous disease with deep and lobar types and they added that the different patterns of these two groups in their race-ethnically diverse population lend credence to the notion that ICH should no longer be treated as a single entity(Labovitz et al., 2005).

Inagawa, T., et al. also tested the incidence rates and outcome in relation to the site of hemorrhage. They concluded that the most common site of ICH was the putamen (120 patients, 34%), followed by the thalamus (115, 33%), lobar areas (53, 15%), brainstem (30, 9%), cerebellum (25, 7%), and caudate nucleus (7, 2%)(Inagawa et al., 2003).

Koivunen, R. J., et al. examined the Incidence, risk factors, etiology, severity and short-term outcome of non-traumatic intracerebral hemorrhage in young adults. They found out that in the young patients, median age was 42 years and the most prevalent risk factors were hypertension (29.8%) and smoking (22.3%).Hematoma volumes were similar across all ages (P = 0.324) and independently predicted mortality in older patients but not in the young. They concluded that the Intracerebral hemorrhage (ICH) in the young appears less fatal and has a different spectrum of causes and factors associated with short-term mortality than for the elderly(Koivunen et al., 2015).

Qureshi, A. I., et al. correlated the relative risk (RR) of intracerebral hemorrhage (ICH) among African Americans and whites. They concludedthat African Americans have a twofold increased risk for ICH(Qureshi et al., 1999).

Zahuranec 1,256 cases were includedICH 171 (14%). Descriptive characteristics of the population overall, by 30-day mortality, and by stroke type are shown in table 1. Most patients (IS 68%, ICH 74%) arrived to medical attention within 24 h of symptom onset.(Zahuranec et al., 2012)

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3.1 Materials:

3.1.1 patients:

Images were obtained from 63 people who came to the emergency department suffering from intracerebral hemorrhage. The study group consisted of (63) samples (22 females, 41males).

3.1.2 CT Machine

Three CT machines were used to collect data during this study. This machines are installed in three radiological departments.

- **Al-zaytouna Hospital:**

  Manufacture: Toshiba
  Model: Aquilion 64
  Instillation: 2010
  Detector type: 64 Rows

- **Ibrahim MalikHospital:**

  Manufacture: Toshiba

  Model: Duel

  Instillation: 2001

  Detector type: 4 Rows

- **Yastabshiroon Medical Center:**

  Manufacture: GE
  Model: Duel
  Instillation: 2001
  Detector type: 4 Rows

3.8.2.3 Technique used:

- **Al-Zytouna hospital:**

  Scouts: lateral
  Scan type: Helical
  Start location: foramen magnum
  End location: vertex
  Reconstruction: Slice Thickness and Interval 5 mm/5 mm
  KVp: 120
  Mas: ≥150

- **Ibrahim Malik &Yastabshiroon Medical Center:**

  Scouts: lateral
  Scan type: Helical
  Start location: foramen magnum
  End location: vertex
  Reconstruction: Slice Thickness and Interval 5 mm/5 mm
  KVp: 120
  Mas: ≥100

3.1.3 Study Design:

Cross-sectional descriptive population-based incidence study, by brain CT were obtained from patients who had intracerebral hemorrhage,whomfit the study and the criteria, then I measured that site, size and severity of that hemorrhage.

3.1.4 Study area:

The data collected from various hospitals in Khartoum city. The data was gathered by random ways, the hospitals included are Al-zaytounaandIbrahimMalikHospitalsandYastabshiroon Medical Centers.

3.1.5 Inclusion criteria:

Sudanese maleor female.

From all ages.

Suffering from intracerebral hemorrhage.

3.1.6 Exclusion criteria:

Very bad quality radiographs.

3.6 Limitation of the study:

I was not able to investigate the difference between the variable Sudanese ethnic groups, because our study was performed in the center of Sudan.

3.2 Mathodes:

3.2.1 Data analysis:

Statistical analysis was performed by using programs SPSS and Excel.

3.2.2 Data Collection:

Head CT have been taken from intracerebral hemorrhage patients. Patients' reports data were collected in a separate data collection sheet.

3.2.3 Sample size:

A total of 63 Sudanese intracerebral hemorrhage patients calculated randomly.

3.2.4 Data collection tools and techniques:

Subject: This study intended to measure the site, size and severity of the intracerebral hemorrhage in Sudanese population. The data collected from September 2016 to January 2017.

patient positioning limitations, it is considered good practice to perform one or both of these maneuvers whenever possible.

Scan range: Top of C1 lamina through top of calvarium.

3.2.5Patient positioning:

Patient should be supine, head first into the gantry, with the head in the head-holder whenever possible.

Center the table height such that the external auditory meatus (EAM) is at the center of the gantry.

To reduce or avoid ocular lens exposure, the scan angle should be parallel to a line created by the supraorbital ridge and the inner table of the posterior margin of the foramen magnum. This may be accomplished by either tilting the patient’s chin toward the chest (“tucked” position) or tilting the gantry. While there may be some situations where this is not possible due to scanner or

Chapter Four

Result

Chapter Four

Result

Table 4.1: shows the percentage of causes among data patients

Causes	**Gender**			
	Male		**Female**	
Trauma	7	11.11%	2	3.17%
Vascular	`6	9.52%	5	7.94%
Hypertension	26	41.27%	15	23.81%
Tumor	2	3.17%	0	0.00%
Total	41	65.08%	22	34.92%

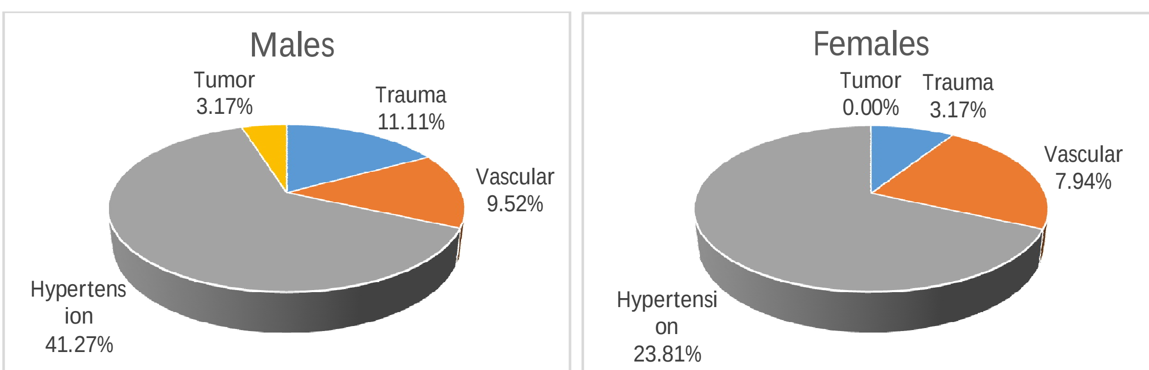

Figure 4.1: pie charts shows the incidence of the intracerebral hemorrhage among male and female patients

Table 4.2: shows the site of the intracerebral hemorrhage among the patients' age groups

Age group	Site of Hemorrhage				
	Lobar	**Thalamic**	**basal ganglia**	**Pontine**	**Cerebellar**
less than 50	6.35%	0.00%	0.00%	1.59%	3.17%
between 50 and 60	4.76%	0.00%	0.00%	0.00%	0.00%
between 60 and 70	9.52%	4.76%	3.17%	0.00%	6.35%
between 70 and 80	19.05%	4.76%	1.59%	0.00%	1.59%
over 80	22.22%	4.76%	4.76%	0.00%	1.59%
Total	**61.90%**	**14.29%**	**9.52%**	**1.59%**	**12.70%**

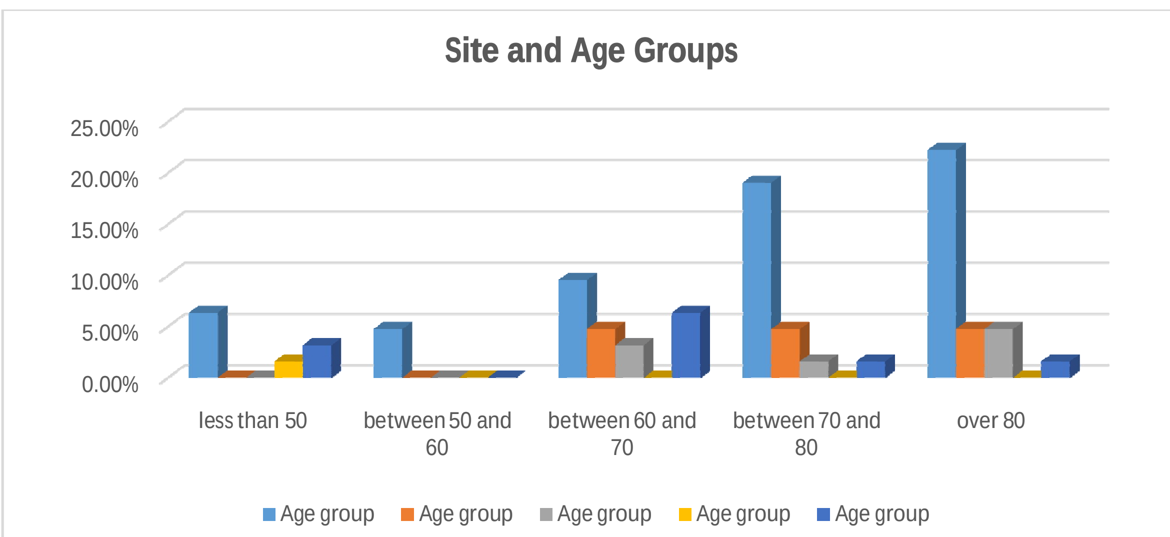

Figure 4.2: clustered bar chart shows the site of the intracerebral hemorrhage among different age groups

Table 4.3: shows the predisposing factors among males' and females' patients

Predisposing Factors	Gender			
	Male		Female	
Healthy	9	14.29%	4	6.35%
Hypertensive	8	12.70%	7	11.11%
Diabetic	2	3.17%	1	1.59%
Smoker	2	3.17%	1	1.59%
Hypertensive & Diabetic	9	14.29%	8	12.70%
Hypertensive &Smoker	5	7.94%	0	0.00%
Diabetic &Smoker	1	1.59%	1	1.59%
Hypertensive & diabetic & smoker	5	7.94%	0	0.00%
Total	**41**	**65.08%**	**22**	**34.92%**

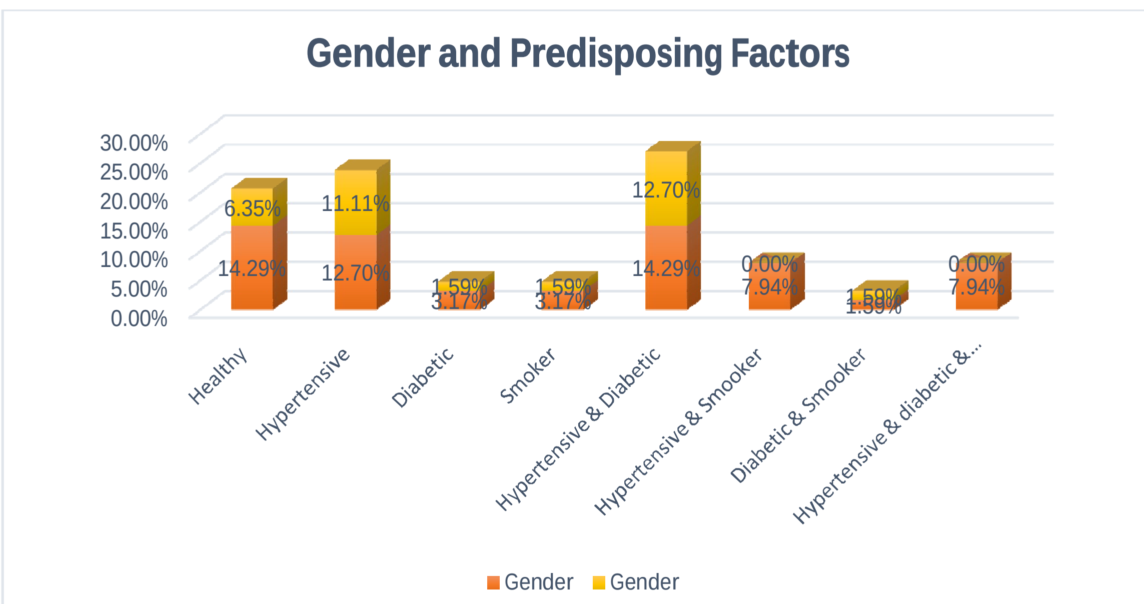

Figure 4.3: stacked bar chart shows the predisposing factors among the intracerebral hemorrhage patients

Table 4.4: Shows the percentage of the predisposing factors in relation to the site of the intracerebral hemorrhage

Predisposing Factors	**Site**									
	Lobar		Thalamic		basal ganglia		Pontine		Cerebellar	
Healthy	9	14.29%	2	3.17%	0	0.00%	1	1.59%	1	1.59%
Hypertensive	6	9.52%	1	1.59%	4	6.35%	0	0.00%	4	6.35%
Diabetic	3	4.76%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Smoker	3	4.76%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Hypertensive & Diabetic	9	14.29%	3	4.76%	2	3.17%	0	0.00%	3	4.76%
Hypertensive & Smoker	3	4.76%	2	3.17%	0	0.00%	0	0.00%	0	0.00%
Diabetic & Smoker	2	3.17%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Hypertensive & diabetic & smoker	4	6.35%	1	1.59%	0	0.00%	0	0.00%	0	0.00%
Total	**39**	**61.90%**	**9**	**14.29%**	**6**	**9.52%**	**1**	**1.59%**	**8**	**12.70%**

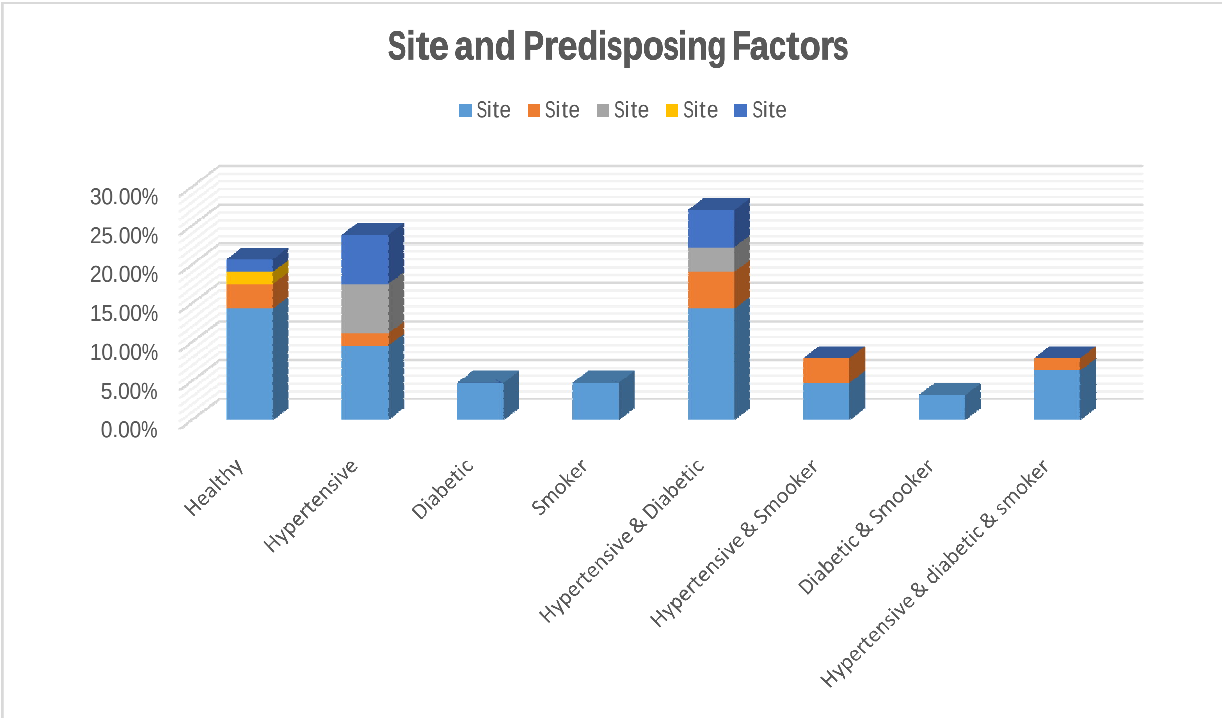

Figure 4.4: stacked bar chart shows the distribution of the site of the intracerebral hemorrhage and the predisposing factors

Table 4.5: shows the relation between the size and cause of the intracerebral hemorrhage

	Size					
Causes	**Mild**		**Moderate**		**Sever**	
Trauma	3	4.76%	4	6.35%	2	3.17%
Vascular	6	9.52%	1	1.59%	4	6.35%
Hypertension	12	19.05%	13	20.63%	16	25.40%
Tumor	1	1.59%	1	1.59%	0	0.00%
Total	**22**	**34.92%**	**19**	**30.16%**	**22**	**34.92%**

Table 4.6: shows the correlation between the causes and size of the intracerebral hemorrhage

	Chi-Square Tests		
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	7.272a	8	.508
Likelihood Ratio	8.531	8	.383
Pearson Chi-Square	7.272a	8	.508
N of Valid Cases	**63**		

a. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .60.

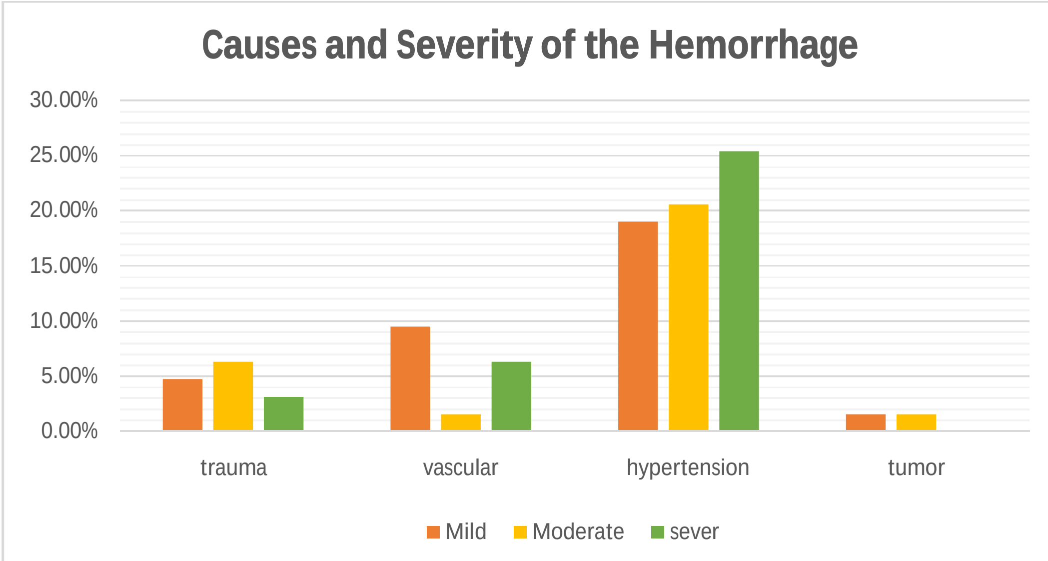

Figure 4.5: clustered bar chart shows the causes and severity of the intracerebral hemorrhage

Table 4.7: Shows the relation between the site and size of the intracerebral hemorrhage

Site	**Size**					
	Mild		**Moderate**		**Sever**	
Lobar	13	20.63%	12	19.05%	14	22.22%
Thalamic	2	3.17%	3	4.76%	4	6.35%
Basal Ganglia	4	6.35%	1	1.59%	1	1.59%
Pontine	0	0.00%	1	1.59%	0	0.00%
Cerebellar	3	4.76%	2	3.17%	3	4.76%
Total	**22**	**34.92%**	**19**	**30.16%**	**22**	**34.92%**

Table 4.8: shows the correlation between the site and size of the intracerebral hemorrhage

	Chi-Square Tests		
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	5.806a	8	.669
Likelihood Ratio	5.775	8	.672
Pearson Chi-Square	.188	1	.665
N of Valid Cases	**63**		

a. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .30.

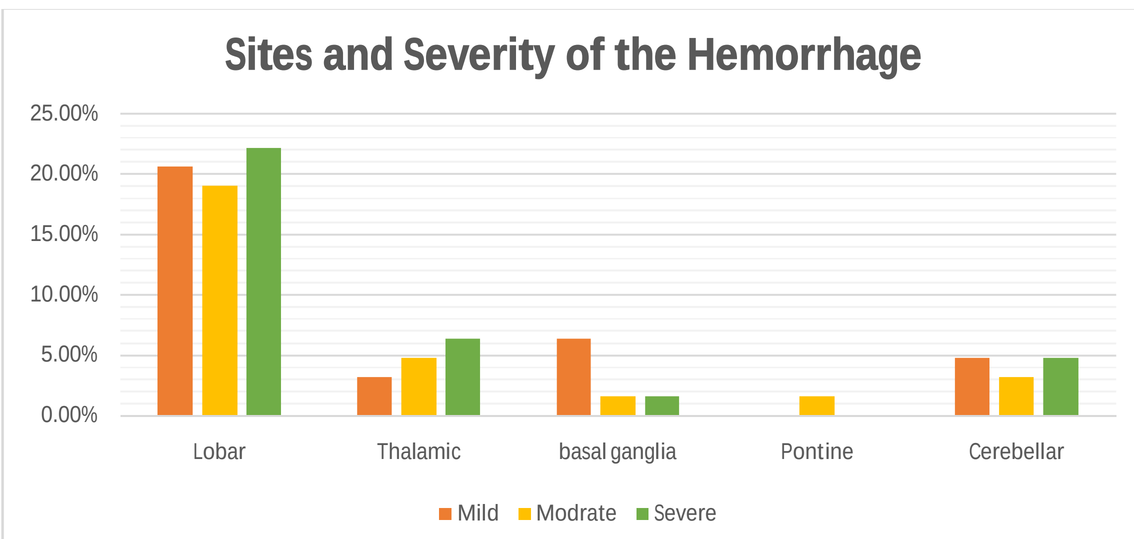

Figure 4.6: clustered bar chart shows the site and severity of the intracerebral hemorrhage

Table 4.9: shows the percentage of the site in relation to the cause of the intracerebral hemorrhage

Site	Causes							
	trauma		vascular		hypertension		tumor	
Lobar	7	11.11 %	6	9.52%	24	38.10%	2	3.17%
Thalamic	0	0.00%	0	0.00%	9	14.29%	0	0.00%
Basal Ganglia	0	0.00%	0	0.00%	6	9.52%	0	0.00%
Pontine	1	1.59%	0	0.00%	0	0.00%	0	0.00%
Cerebellar	1	1.59%	5	7.94%	2	3.17%	0	0.00%
Total	**9**	**14.29 %**	**11**	**17.46 %**	**41**	**65.08 %**	**2**	**3.17%**

Table 4.10: shows the correlation between the causes and site of the intracerebral hemorrhage

	Chi-Square Tests		
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	29.827[a]	16	.019
Likelihood Ratio	28.179	16	.030
Pearson Chi-Square	2.973	1	.085
N of Valid Cases	**63**		

a. 21 cells (84.0%) have expected count less than 5. The minimum expected count is .03.

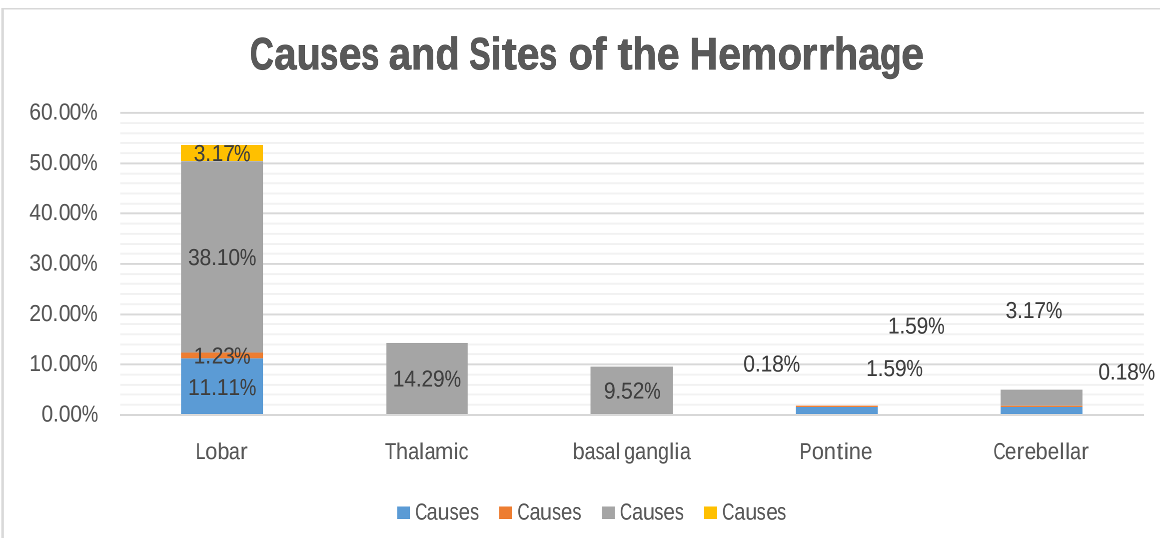

Figure 4.7: stacked bar chart shows the causes and site of intracerebral hemorrhage

Chapter Five

Discussion, Conclusion, Recommendations

Chapter Five

Discussion, Conclusion, Recommendations

5.1Discussion:

The study was conducted over 63 patients; 65% males and 35% female at age ranged between 10 and 90-year-old, whom have come to the ER at Al-Zaytouna and Ibrahim MalikHospitalsandYastabshiroon Medical Centers. the data showed that the majority of the cases were suffering from hypertension 65%, 14.2 % had trauma, few with vascular disorders 17.5% and only around 3% have come with brain tumor table (4.1) and figure (4.1). The patients were checked for some predisposing factors that might have great correlation to the intracerebral hemorrhage. The data showed that only around 20.5% of the total cases were healthy most of which have had lobar intracerebral hemorrhage. The majority of the patients were having hypertension 67% mostly among males, 43% were diabetic patients and only 23.8% were smokers table (4.3& 4.4) and figure (4.3 & 4.4) this has been proven by (Tveiten et al., 2012, Koivunen et al., 2015) and (Labovitz et al., 2005). Also as Hier, D. B., et al. concluded that the hypertension was the most prevalent risk factor for hemorrhage, he mentioned also that there are many other risk factors for hemorrhage including anticoagulants, platelet antiaggregating drugs, aneurysms, arteriovenous malformations, pregnancy, alcohol use, amyloid angiopathy, thrombocytopenia, renal and liver failure, and cocaine use(Hier et al., 1993).

The data revealed that most of the patients have come with lobar intracerebral hemorrhage 61.9 %, to a lesser extend thalamic, cerebellar and basal ganglia intracerebral hemorrhage 14.3%, 12.7% and 1.6% respectively Table (4.2) figure (4.2),Inagawaet al. analysis proven otherwise that the basal ganglia type had the highest percentage followed by thalamus, lobar, brainstem then cerebellum (Inagawa et al., 2003). And the severity of the lesions wereaverage between mild, moderate and sever in relation to the site and causes of the hemorrhage table (4.5&4.6) figure (4.5). The data were tested for association between causes and size of the intracerebral hemorrhage and the results showed that there is no significant correlation between the causes and size P= 0.508 table (4.6). The data was also tested for association between site and size of the hemorrhage and the results also showed that there is no significant correlation between the site and size P= 0.669 table (4.8). The data was also tested for association between the causes and the site of the intracerebral hemorrhage and the results also showed that there is significant correlation between the causes and site P= 0.019 table (4.10).

5.2 Conclusion:

The majority of the intracerebral hemorrhage are hypertension mostly among male elder patients which may have had a correlation to the life style and habits. The probability of intracerebral hemorrhage increases in hypertension patients. The most prevalent type of hemorrhage is the lobar intracerebral hemorrhage. The severity of the lesions is related to the cause but with no significant correlation. There is significant correlation between the causes and site (P= 0.019), but there are no association neither between causes and size of the intracerebral hemorrhage (P= 0.508) nor the site and size of the hemorrhage (P= 0.669).

5.3 Recommendation:

Further studies to compare between the CT and MRI in diagnosing the intracerebral hemorrhage.

Use more data sample size to test the incidence of all intracerebral hemorrhage causes and sites.

Further studies to assess ethnic group over the type and site of the intracerebral hemorrhage.

Further studies to assess any disposing factor that might have role in the intracerebral hemorrhage.

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Appendix

CT brain Axial section show intracerebral hemorrhage (M70y) , 5mm

No	Age	Gender	diabetes	hypertension	type of intracerebral hemorrhage					causes					final CT diagn
					Basal ganglia	thalamic	pontine	cerebellar	lobar	Trauma	vascular		others		
											aneurysm	arteriovenous malformation	tumours related hemorrhage	hypertensive hemorrhage	
1															
2															
3															
4															
5															
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Data sheet