Sudan University of Sciences and Technology

College of Graduate Studies

Measurement of Normal Brain Lateral Ventricles by Using CT

قياس بطينات المخ الجانبية الطبيعية باستخدام الأشعة المقطعية

A Thesis Submitted, for a partial fulfillment of award of Master Degree in Diagnostic Radiological Technology

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بسم الله الرحمن الرحيم

(إِنَّمَا يَخْشَى اللَّهَ مِنْ عِبَادِهِ الْعُلَمَاءُ ۗ إِنَّ اللَّهَ

عَزِيزٌ غَفُورٌ)

صدق الله العظيم ،،،

فاطر 28

Dedication

To the soul of my father

To my mother

To my dear husband

To my son

To my brothers and sister

To my teachers

To my friends and colleagues

cknowledgment

First all thanks and praise are due to ALLAH .

I would like to express my grateful thanks to my supervisor ,A.Professor Mohamed Mohamed Omer for his valuable and continuous help and guidance.

My thanks extended to the staff of the Radiology Department in Khartoum Advance Diagnostic Center and AlrebatHospital , who helped me in collecting data.

Abstract

The main objective of the study is to measure the normal lateral ventricles in Sudanese patients using CT. This study was carried out using CT machines in Khartoum Advanced Diagnostic Centre and Alrebat University hospital , from August 2015 to November 2015. The researcher selected 51 patients (33)males 64.7% (18) females 35.3% the age group are ranged between (20-70) years who attending the department of CT brain scan. The patients were free from any brain disease that affect the measurement of lateral ventricles. The measured dependent variable included :Rt&Lt anterior horns, Rt&Lt posterior horns and Rt&Lt body of lateral ventricles, and also certain independent variable included : the patient's age , gender , weight and height. The result was obtained after collecting and analyzing the data collection sheet through using the computer program of Statistical Package for Social Sciences SPSS. The result showed that the mean length of anterior and posterior horns (2.4, 2.6)cms , (2.3, 2.4)cms and (3.8 , 3.9)cms , (3.7 , 3.8) in males and females respectively ,and mean length of body of lateral ventricles Rt and Lt (7.5 ,7.7)cms in males (7.2 ,7.3) cms in females respectively. Also the results showed the mean length of parts of lateral ventricles distribution in categories for both gender consider to their age, weight and height.

The correlation between anterior horns and age were insignificant giving the value 0.960 , but the correlation with, height and body weight were significant of values 0.000 and 0.001 respectively.

The correlation between posterior horns and age and body weight were significant of values 0.007 and 0.033 respectively, but the correlation with height was insignificant giving value 0.360.

The correlation between body of lateral ventricles and (age ,body weight) were insignificant giving values 0.143 and 0.096 respectively, but the correlation with height was significant giving value 0.022.

ملخص البحث

كان الهدف الأساسي من الدراسة هو قياس البطينات الجانبية بصورتها الطبيعية في المرضى السودانيين البالغين. تمت هذه الدراسة باستخدام أجهزة الأشعة المقطعية في مستشفى الرباط الوطني ومركز الخرطوم التشخيصي المتطور , خلال الفترة من أغسطس 2015 إلي نوفمبر 2015م. اختار الباحث(51)مريضا من البالغين (33) ذكر و(18), تتراوح أعمارهم بين (70-20) سنة وكانوا جميعا لا يعانون من أي أمراض من شأنها تؤثر علي قياس البطينات الجانبية.

شملت الدراسة قياس المتغيرات الآتية: طول البطينات الجانبية اليمنى واليسرى ومستوى جسم البطينات اليمنى واليسرى. كما شملت متغيرات أخرى مثل عمر , نوع ,وزن جسم وطول المريض.

وبعد جمع البيانات قام الباحث بتصنيفها وتحليلها بواسطة برنامج الحاسب الالي الاحصائي وأظهر نتائج هذه الدراسة أن متوسط الطول بالنسبة للبطينات اليمنى واليسرى بالإضافة لمستوى جسم البطينات كانت علي النحو الأتي:(2.4, 2.6)سم ,(3.8 +3.9)سم (7.5 +7.7.) سم عند الذكور ,(2.3 +2.4) سم ,(3.8+3.7)سم و (7.2 + 7.3) سم عند الإناث علي التوالي. كذلك اظهرت الدراسة متوسطات اطوال اجزاء البطين الطرفي في فئات لكل الجنسين علي حسب العمر والوز والطول.

كما اظهرت الدراسة الارتباط بين عمر المريض وطول البطينات الجانبية اليمنى واليسرى كان ذا دلالة إحصائية معطيا الارقام 0.960 و 0.007 علي التوالي , اما الارتباط مع جسم البطينات الجانبية اليمنى واليسرى كان ذا دلالة إحصائية 0.143 الارتباط بين وزن المريض وطول البطينات الجانبية اليمنى واليسرى كان ذا دلالة إحصائية معطيا الارقام :0.00, 0.033 علي التوالي , والارتباط مع جسم البطينات اليمنى واليسرى ذا دلالة إحصائيا معطيا الرقم 0.096 . كما أن الارتباط بين طول المريض وطول البطينات الجانبية اليمني واليسرى ذا دلالة إحصائية معطيا الارقام:

0.00 , 0.360 علي التوالي , والارتباط مع طول جسم البطينات الجانبية اليمنى واليسرى معطيا دلالة إحصائية معطيا الرقم 0.022 .

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List of Abbreviations

CT: Computed Tomography

MRI: Magnetic Resonance Imaging

CSF : Cerebrospinal Fluid

CNS : Central Nervous System

3D : Three Dimensions

SSPS : statistical Package for Social Sciences

EAM : External Auditory Meatus

Chapter One

1-Introduction

The brain is most fascinating and least under stood organ in human body. For centuries, scientists and philosophers have pondered the relationship between behavior, emotion, memory, thought, consciousness and physical body. In the middle age there was much controversy as to whether the soul was located in the brain or in the heart .As ideas developedhowever, it was suggested that mental processes were located in ventricles of the brain. According to this theory, common sense was located in the lateral ventricles, with imagination in its posterior part(Last, 1977).

The brain lies within the cranial cavity it consists of:

Fore brain: Tow cerebral hemisphere, which divided into lobes (frontal, 2parietal, 2 temporal and occipital lobe) this tow hemispheres divided by a deep cleft, the longitudinal fissure, each containing one of lateral ventricles that contain the choroid pluxes which produce cerebro- spinal fluid.Mid brain: cerebral peduncle

Hind brain:cerebellum,pons, medulla oblongata. The ventricular are fluid- fill spaces within the brain related to the development of nervous system as a tubular structure with a central canal, the ventricles are lined with ependymal ,which is invaginated by plexuses of blood vessels called the choroid plexus, these vessels produce CSF(www.clifsnotes.com).

Lateral ventricle come from Latin word (latus) meaning (side) and the Latin word (Venter) meaning belly (Last, 1977).

The lateral ventricles (first and second ventricle) are the largest cavities of the ventricular system and occupy large area of the cerebral hemispheres. Each lateral ventricle open through an interventricular foramen (foramen of mono) into third ventricle.

The third ventricle (3^{rd}) was the seat of reasoning judgment and thought, whilst memory was contained in fourth ventricle (4^{th}).

The third ventricle (a slit like cavity between the right and left halves of the diencephalons) is continuous posterio – inferiorly with the cerebral aqueduct (aqueduct of mid brain), a narrow channel in the mid brain connecting the third and fourthventricle lies behind the brain stem floored by Pons and medulla oblongata and in front of the cerebellum roofed by the superior and inferior medullary velli.It has rhomboid shape and extendsinfero-posterior. It's continuous with the central and to spinal cord. CSF drains from the fourth ventricle through a single median aperture (foramen of magendie) and paired lateral aperture (foramina of ilischka) into subarachnoid space. These apertures are the only means by which the CSF enter the subarachnoid space(www.cliflsnotes.com).

Virtual endoscopy (Computed Endoscopy) is new method of diagnosis using computer processing of 3D image data set (such as CT) to provide simulated visualization of patient specific organs similar or equivalent to those produced by standard endoscopic procedure . Conventional CT produce cross section (slice) of body that are viewed sequentially by Radiologist who can use reconstructed CT image to see what the actual three dimensional should be by using sophisticated logarithms and performance computing .

This cross section may be rendered as direct three dimension of human anatomy. Specific anatomic data appropriate for realistic endoscope simulations can be obtained from 3D acquired spiral CT data (Seruam).

1-2 Study Problem:

The size of the lateral ventricles considerably varied among individuals.

1-4 Objectives of thestudy:

1-4-1 General objectives:

To measure and assess the lateral ventricles length in order to have a Sudanese index value.

1-4-1 Specific objectives:

- To identify the capability of CT to measure the size of lateral ventricle
- To find correlation between the measurement of normal lateral ventricles and age, sex, height and body weight.
- To compare normal measurement of lateral ventricle in Sudanese with studies in other communities.
- To help the physician to differentiate between the normal and abnormal lateral ventricles size.

1-5 Significance of the study:

This study will profiled an index of brain lateral ventricles length in Sudanese.

1-6 OverviewOfthestudy

The study composed of five chapters:

Chapter one:dealwith general introduction which consisting of an introduction, problem of study, hypothesis, objectives, and significance of study and overview of the study.

Chapter two: it isdeal with literature review, which can beconsisting of following: anatomy, physiology and pathology of brain lateral ventricles, computed tomography (CT) and previous studies.

Chapter three:deal with material and methods.

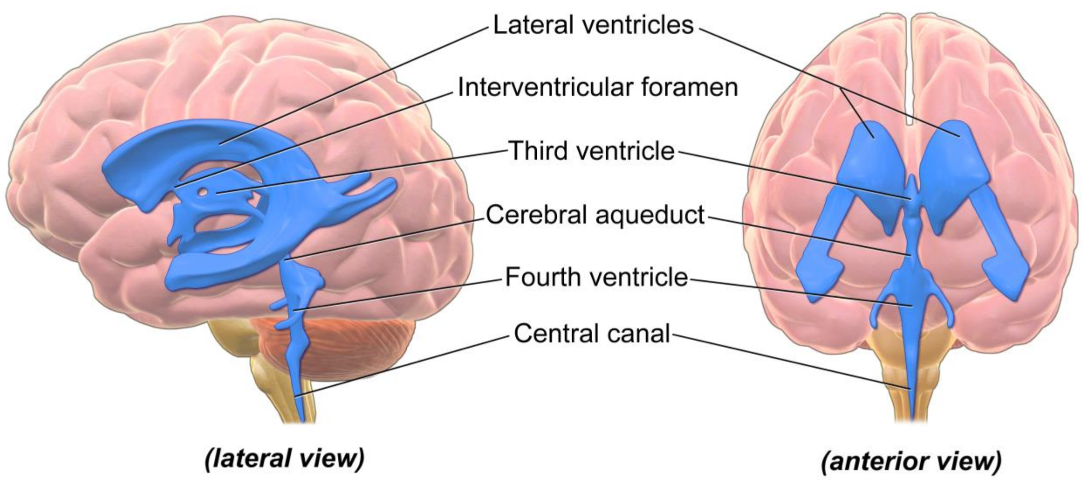
Chapter four:deal with including result presentation.

Chapter five: deal with discussion, conclusion and recommendation.

Chapter Tw0

The brain is large mass of soft nervous tissue made up of both neurons and supporting glial cells lying within the cranium of the skull. Brain is composed of: midbrain, pons, medulla oblongata. The diencephalon is consists of thalamus and hypothalamus. The cerebellum consists of two lateral hemispheres. The cerebrum includes cerebral hemispheres, separated by the cerebral falx, and it divided into four lobes for descriptive purposes: frontal, parietal , occipital and temporal lobe. There are four cavities in the cerebral hemisphere called the ventricular system, including the two lateral ventricles, the third ventricle and the fourth ventricle (Fix, 2002).

2-1Ventricular System:



.Figure2-1Shows the anatomy of ventricular system

Ventricular system is an internal cavity of the brain. It is divided into four cavities called ventricles, which connected by a series of holes called foramen and tubes(Vasan2010). The two largest ventricles (first and second)are the lateral ventricles in the cerebral hemispheres. They ach communicate with the third ventricles through the foramen of Munro. The third ventricle in the diencephalon of the forebrain between right and left thalamus, and the fourth ventricle is located at the back of the pons and upper half of the medulla oblongata of the hind brain. The third connects with the fourth through aqueduct of Sylvius(www.aanas.org.co). This ventricular system with normal brain, which provides a pathway for the circulation of cerebrospinal fluid (CSF) (Singh, 2010).

2-1-1 Lateral ventricle

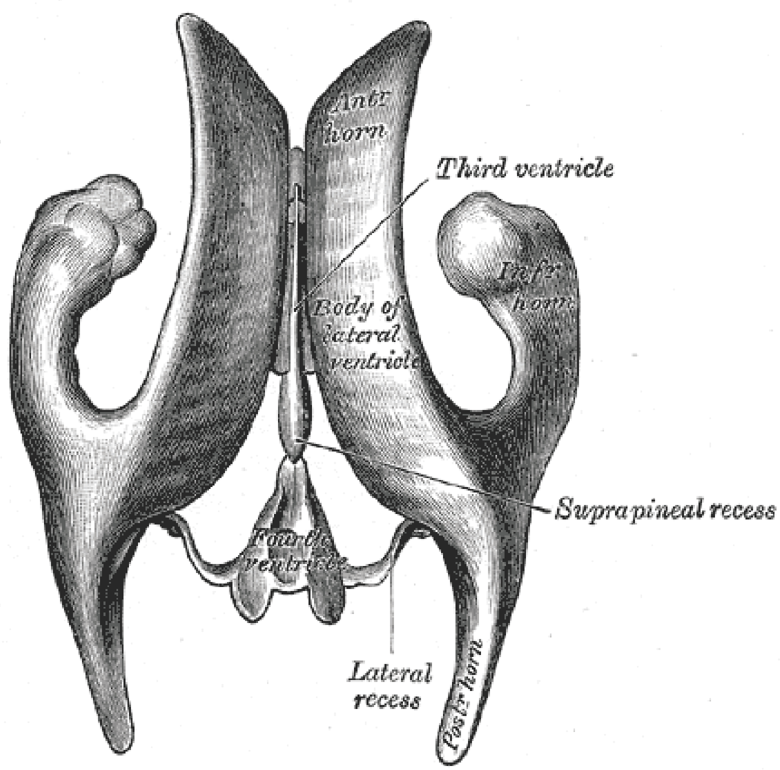


Figure 2-2: Shows anatomy of parts of lateral venricles

The lateral ventricles is a cavitylies 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 , septum pellucidum and not communicating directly . They communicate with third ventricle by interventricular foramina(Anne, 2006).

The lateral ventricle is composed of : (1) The anterior or frontal horn extend into the frontal lobe, (2) The posterior or occipital horn extend into occipital lobe, (3) The inferior or temporal horn extend into temporal lobe, (4) Body of lateral ventricle. The body is the central portion just posterior to frontal horn. The junction of the body anteriorly and temporal horn inferiorly and occipital horn posteriorly form the triangular area termed the trigone(atria). The cella media is a central part of lateral ventricle. Ependyma cover the inside of lateral ventricle and are epithelial cell. The lateral ventricles open downward into the third ventricle through the paired interventriclar foramen (foramen of monro)(Lorrie , 1997).

The lateral ventricles, similar to other part of ventricular system of the brain, developed from central canal of neural. Specifically the lateral ventricles originate from portion of the tube that is present in the developing prosencephalon ,and subsequently in the developing telencephalon (Vasan, 2010). During the first trimester of pregnancy the central canal expanded into lateral , third and fourth ventricles connected by thinner channel. In lateral ventricle specialized area (choroid pluxes) appear, which produce cerebrospinal fluid (CSF) (Calrson, 1999).

2-1-1-1 Parts of lateral ventricle:

2-1-1-1-1.Anterior (frontal) horn:-

The anterior horn lies anterior to the interventricular foramen and extends forward laterally and ventrally. It is triangular in coronal section. The posterior aspect of the genu of the corpus callosum and the rostrum borders the horn antriorly. The roof of the each ventricle is formed by the anterior part of callosal body while the rounded head of caudate nucleus forms most of the lateral wall and floor.

Medically the upper aspect of the rostrum forms part of the floor. The medical boundary of each lateral ventricle is spetumpellucidum , which contains the columns of forricesin it's posterior edge. The head of the caudate produces a characteristic bulge, which can be identified in ventriculogram and CT cuts. The posterior parts of anterior horn are separated by the septum pellucidum only, as where their tips diverge from each other (Ali,1993). This is how they appear in sections of brain specimen or in transverse cuts of computed tomography (CT).There is no choroid plexus in the anterior horn(Chan,1995).

2-1-1-1-2 Central part (Body) :

The central part extends back wards from the interventricular foramen to the atrium. The body of the corpus callosum roofs the central part of the ventricle. The medial wall which decrease in height as it is followed posteriorly, is formed by fornix and septum pellucidum anteriorly and by the fornix posteriorly (Corbett,1997).

The floor consists from lateral to medial by the following structures:-

-The caudate uncles ,which lies in the angle between the floor and the roof and narrows rapidly as it is traced posteriorly.

-The thalamostriate vein runs anteriorlly in the groove between thalamus and caudate nucleus and passes beneath the ependyma to join the internal cerebral vein just posterior to the interventricular foramen. A number of tributaries enterit from the center of the hemisphere by running across the caudate nucleus outside the ependyma of the ventricle.

-The striaterminalis runs with the thalamostriate vein and is aslender bundle of fibers which passes with the fibers of fornix to grey matter around the anterior commissure. It arise in theamygdaloid body deep to the uncus.

-Anarrowstrip of the dorsal surface of the thalamus.

-The choroid plexus.

-The fornix anteriorly this around bundle, but posteriorly it becomes progressively flattened and extends laterally into the floor of lateral ventricle (Williams,1995).

(The choroid plexus is attached to the lateral mangin of the fornix, and the torn ependyma (taeniafornices)).

In the higher transverse gross CT (MRI) slices of the brain the bodies appear symmetrical by the side of midline, but the atria diverge laterally (Chan,1995).

2-1-1-1-3 Posterior (occipital) Horns:

The posterior horn curved posteromedialy into the occipital lobe. It extends from the atrium to a variable distance in the occipital lobe, tapering to a point. The left is slightly longer than the right. The roof lateral wall, and floor formed by a sheet of fibers(tapetum) from splenium of the corpus callosum , which arches over it and passes inferiorly to the lower parts of occipital lobe. The medial wall is invaginated by two edges; The upper (bulb of posterior horn) is the formed by commissural fibers of the forceps major . The lower edge (calcaravis) is produced by calcarniesulcus , which extends deeply into the medial surface of the occipital lobe .There is no choroid plexus in the posterior horn (Corbett,1997).

There is often symmetry between the two posterior horns, and they are usually diamond shaped or square in outline(Williams,1995).

Varibility and asymmetry of posterior horn make it difficult to compare the radiological image of two sides. However ,familiarity with the configuration of each side helps in detecting abnormalities(Ali1993,Chan1995).

2-1-1-1-4 Inferior (Temporal) horns :

The inferior horn is the direct continuation of the ventricular cavity into the temporal lobe. It is inclined downwards and forwards from the atrium . Like the posterior horn, it varies in width and length. It curves around the posterior aspect of the thalamus(pulvinar)and at first passes downwards and posterolaterally before curving anteriorly to end with 25 mm of the temporal pole near uncus. It position on the surface of the hemisphere usually corresponds to the superior temporal sulcus. The roof of the temporal horn is formed mainly by the tapetum of the corpus callosum but the tail of the caudate nucleus and striaterminalies also extend forward in the roof to terminate in the mygdala at the anterior end of the ventricle . The roof of ventricle consist of collateral the eminence laterally and the hippocampus medially. The fimbria of hippocampus extends back on the superior medial surface of the hippocampus to become the alveus and then the crus of the fornix. Between the striaterminalis in the roof of the temporal horn and the fimmria, is inferior part of the choroid fissure and temporal extenuation of the choroid plexus filling the fissure and covering the outer surface of the hippocampus(Williams,1995).

In coronal sections, the temporal horns of lateral ventricle is flattened and when opened superiorly it can be seen that the collateral eminence form along swelling lateral and parallel to hippocampus and over lying the collateral sulcus. The eminence continues posteriorly into the flattened triangular collateral trigone forming the floor of the ventricle between its temporal and posterior horns(Corbett,1997).

2-1-1-2 Size of the lateral ventricles:

Most studies have demonstrated that brain weight is decreased among the elderly. Brain weight is probable maximal during the second and third decades of life at which time the brain from a normal man weighs about 1350 to 1400 grams. The brain from a normal woman of comparable age weighs about 100 grams less. With the passage of time there is progressive loss of weight averaging 7% to 8% of peak adult weight. The weight loss occurs predominantly after the age 55(Riggs,1998)

The volume of the lateral ventricles was determined by weighing the hemispheres with and without water in the lateral ventricles. The recorded variables were age, sex, body length and body weight. In normal brains there was a significant correlation between the size of the lateral ventricles and the weight of the cerebral hemispheres. Women had smaller brains than the men even when the difference in body length was taken into account. The difference was approximately 110- 115g for the whole brain after correction for other variables. Women had also smaller lateral ventricles than men, but this difference was in proportion with the smaller size of their hemispheres(Skullerud,1995).

The ventricular size changes with aging normally, there was considerable variation in size up to the seventh decade (Knudson,1958).Most studies of the aging brain have showing a slight increase in average size of the lateral ventricles up to seventh decadeand then a more rapid increase in size (Buhrenne1963,Engeset1958). The measurement of the cella media (the smallest transverse diameter of the body of lateral ventricles) gives best correlation with overall size of the lateral ventricles(Engeset,1958).

There was physiologic decline in brain weight and a widening of the lateral ventricles with increasing with age. The shrinkage properly started after the age of 55. There was a clear correlation between body lengthand brain weight. The estimated increase in brain weight was approximately 3g per cm body length(Skullerud,1995).

Sexual dimorphism of human brain an anatomy has not been well studied between 4 and 18 years of age, a time of emerging sex differences in behavior and sexually specific hormonal changes of adrenarche (the predominately androgenic augmentation of adrenal cortex function occurring at approximately age 8) and puberty. The lateral ventricles demonstrated a prominent sex difference in brain maturation with robust increase in size in males only. There was a significant change in the linear regression slope of the lateral ventricle volume in males after age 11years (Giedd,1997).

In spite of the apparent congruity, in size and proportion, of the right and left hemisphere, they are not (mirror images) .There is some evidence of anatomical asymmetry. The posterior part of the superior temporal gyrus is larger on the left in the majority of brains, and posterior horn of the lateral ventricle is said to be more prominent on the left than on the right side. The symmetry of the temporal lobe has been traced back to infancy suggesting a hereditary or genetic factor in the development of cerebral asymmetry. Agreement is not unanimous over the elements of morphological symmetry, but the search continues in order to establish a structural basis for well founded functional differences between the hemispheres(Wadaa,1975).

The left lateral ventricles were found to be larger than the right in both sexes, and both lateral ventricle were larger in male.There was a statistical significant increase of all cerebral parameters with age and the linear measurements at the lateral ventricles demonstrated positive correlation to cranial size (Gyldensted,1977). In object older than 60 years relative lateral ventricular area was larger in men than women, which showed marked relation to age . The age relation was more marked for the left hemisphereic structures(Agatz,1992).

2-2 Physiology (Cerebrospinal fluid CSF)

2-2-1 Physical characteristics and composition:

CSF is a clear, coloress fluid. It posses in solution , inorganic salts to those in the blood plasma. The glucose content is about half that of blood and there is only a trace of protein. Only afew cells are present and these are lymphocytes . The normal lymphocyte count is 0-3 cells/m13. In the lateral recumbent position the cerebrospinal fluid pressure, as measured by lumber puncturing is about 60-150mm of water. Straining , coughing or compressing of the internal jugular veins in the neck may easily raise this pressure. The total volume of CSF in the subarachnoid space and within the ventricles is about 130 ml (Snell,1997).figure (2-3).

2-2-2 Formation and Secretion:

The rate of production of CSF is about 0.35 ml per minute and its volume is completely renewed 3-4 times per day. Two third or more of this fluid originates as a secretion from the choroid plexus in four ventricles. Additional amounts of fluid are secreted by all the ependymal surfaces of the ventricles and the arachniodal membranes. The secretion of fluid by choroid plexus depends mainly on active transport of sodium ions through the epithelial cells that line outsides of the plexus(Guxton,1991).

2-2-3 Circulation and Absorption:

CSF leaves the lateral ventricles through interventricular foramina and enters the third ventricle, CSF passes from the 3rd ventricle to the 4th ventricle through its median and lateral apertures and enters the subarachnoid space, which is continuous around the spinal cord and posterosuperior over the cerebellum , however , part of the CSF flow into the interpeduncular and quadrigeminal cisterns, CSF from the various subarachnoid cisterns flows superiorly through the sulci and fissure on the medial and superolateral surface of the cerebral hemispheres, and also passes into extensions of the subarachnoid space system is through the arachnoid granulation specially the superior sagittal sinus and its lateral lacuae (Moore,1999).

2-2-4 Functions of Cerebrospinal fluid:

-The CNS (brain and spinal cord) is rendered buoyant by the CSF medium in which they are suspended. This provides the nervous system with support and protection against rapid movements and trauma.

-The CSF is believed to be nutritive for both neurons and glial cells.

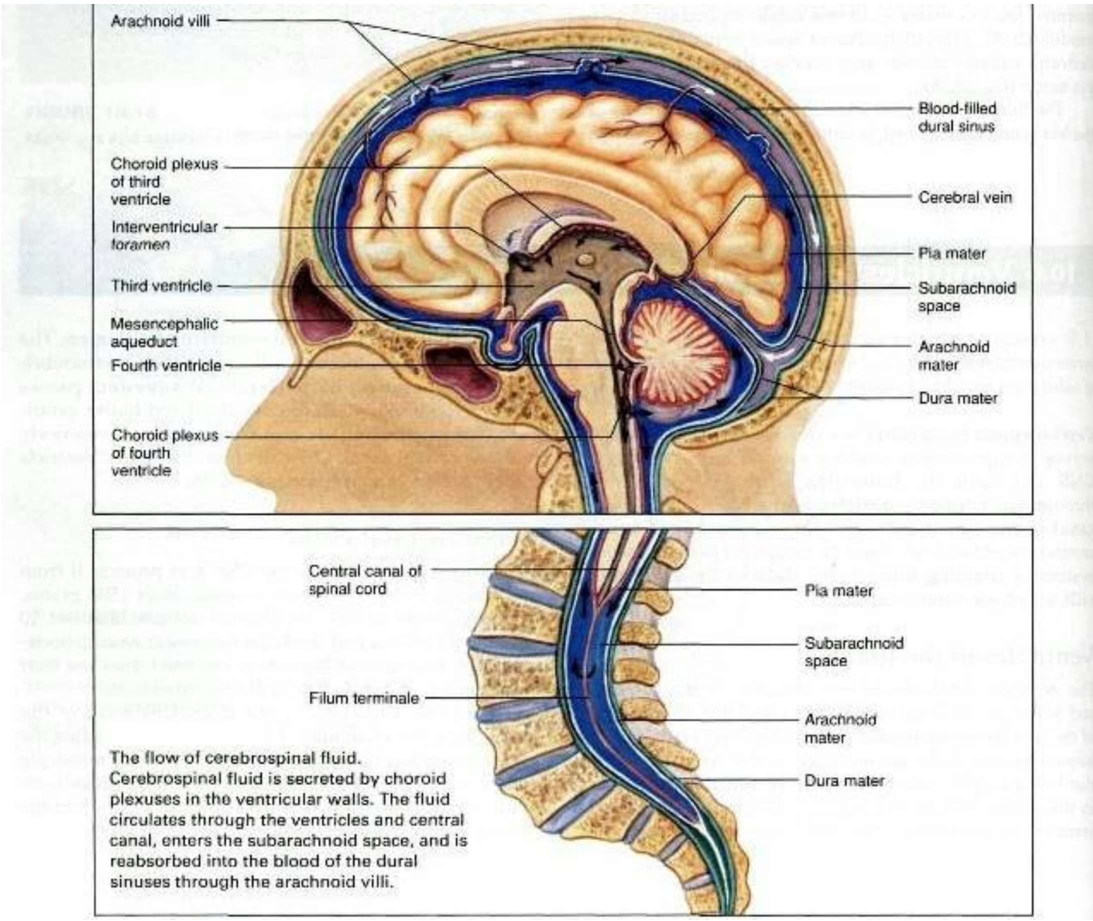
-The CSF provides a vehicle for removing waste products for cellular metabolism from nervous system. In this capacity , it functions like a lymphatic system.

-The CSF plays a role in maintaining the constancy of the ionic composition of the local microenvironment of the cells of the nervous system. The extracellular space of the brain freely communicates with the CSF compartments and therefore the composition of the two fluid compartment is similar.

-The presence of a number of biologically active principles (releasing factors, hormones, neutrons, smatters and metabolites) within the CSF suggests that it may function as a transport system.

-The H^+ and Co_2 concentrations in the CSF (PH) may affect both pulmonary ventilation and cerebral blood flow.

-Since the CSF and brain extracellular space in continuity, analysis of the composition of the CSF provides diagnostic information about the normal and pathological state of the nervous system functions (www.umanitoba.ca).



Figure(2-3): Shows CSF within the choroid plexus.

2-3 Pathology OfLateral ventricles

Most pathology studies have shown progressive increase in ventricular size especially after 70 years of age. As the ventricular system enlarge ,the angles of the lateral ventricles become rounded the third and fourth ventricles become ballooned, and hippocampi don’t pill the temporal horn as fully as normal. More recently thesechange have been re investigated by CT and MRI scanning. Some of these radiologic studies have identified may elderly individuals who did not exhibit the expected degree of cortical atrophy or ventriclular enlargement. It was concluded from these findings that ventricular enlargement and cortical atrophy are not inevitable consequences of advancing age alone but may indicate abnormal aging(Riggs,1998).

When pneumoenphalogramorventriculogram is analyzed , the following are assessed:

Enlargement:(generalized, as in communication hydrocephalus or global as in cerebral atrophy, localized, due to local cerebral atrophy and involving one ventricle only due to focal atrophy or obstruction at the interventricular foramen and probably also hernition , as caused by a tumor),dislocation of the midline structures or of various portions of the system, filling defect and deformity(Grainger,1986).

2-3-1 Hydrocephalus:

Congenital hydrocephalus in infants and young children may be classified, like adult hydrocephalusas communicating and non-communicating. In the former there is free communication betweenthe ventricles and the basal cisterns, with obstruction to the flow of the CSF in the subarachnoid space or basal cistrens. This is due to meningeal irritation by hemorrhage, infection or trauma. All the ventricles are enlarged and basal cisterns may be prominent figure(2-4)(Sutton,1998).

2-3-2Cerebral atrophy:

Generalized atrophy of the brain is a routine concomitant of the aging process and is a normal finding in the elderly, increasing with age. The loss of natural tissue in the senile brain occurs in a cranium of unchanged size and is therefore compensated by an increase in the volume of CSF, which occupies the resulting enlarged ventricles, sulic and subarachnoid space figure (2-5)(Rewcastle,1999).

2-3-3Vascular disease:

Under normal circumstances, the brain receives 15% of the cardiac output and utilizes roughly 20% of the oxygen consumed by the body . Interruption of normal blood flow to the brain and spinal cord may produce irreversible parenchymal injury within a very brief time. Hence, the brain is exquisitely sensitive to changes in cerebral blood flow and is capable of regulating the flow of blood over a wide range of perfusion pressure, a process termed auto regulation. Although the incidence of cerebrovascular disease has decreased in recent decades, vascular insults remain the third most common cause of death in United State, exceeded only by heart disease and cancer figure (2-6)(Sutton,1998).

2-3-4 Trauma:

Cranial trauma is a major problem in accident and emergency departments and in one series study provided 10% of patients seen. It is not necessary for every patient who suffers a head injury undergo a CT scan. In the acute phase, the indications are deterioration of the patient's conscious level, with or without focal neurological sings figure (2-7)(Graham,1998).

2-3-5 Neoplasm:

Cerebral tumors account for 2% of death at all ages. The majority are metastasis tumors from malignancies outside the nervous system. Benign or malignant neoplasm of the central nervous tissue account for the remainder of cerebral tumors. Intracranial tumors are often associated with hydrocephalus and evidence of increased intracranial pressure, resulting with enlarged ventricles, sulci and subarachnoid space (2-8)(Chlivers,1991).

2-3-6 Schizophrenia:

In vivo, brain have demonstrated ventricular enlargement in brain of schizophrenia patients. Enlargement was shown in the studies of (lllowskyet;1998, Nasraallah, 1986). While others did not see any enlargement (Kemali,1989, Wood,1990). They related this discrepancy in finding to methodology differences between various studies. In lateral ventricular subdivision of male patients, the most substantial volume increase was in the left temporal horn, and volume increase were observed in the bilateral anterior horns and the right body. The females patients showed similar patterns with less statistical significant figure (2-9)(Dequardo,2003).

Figure 2-4: CT scan Shows hydrocephalus.

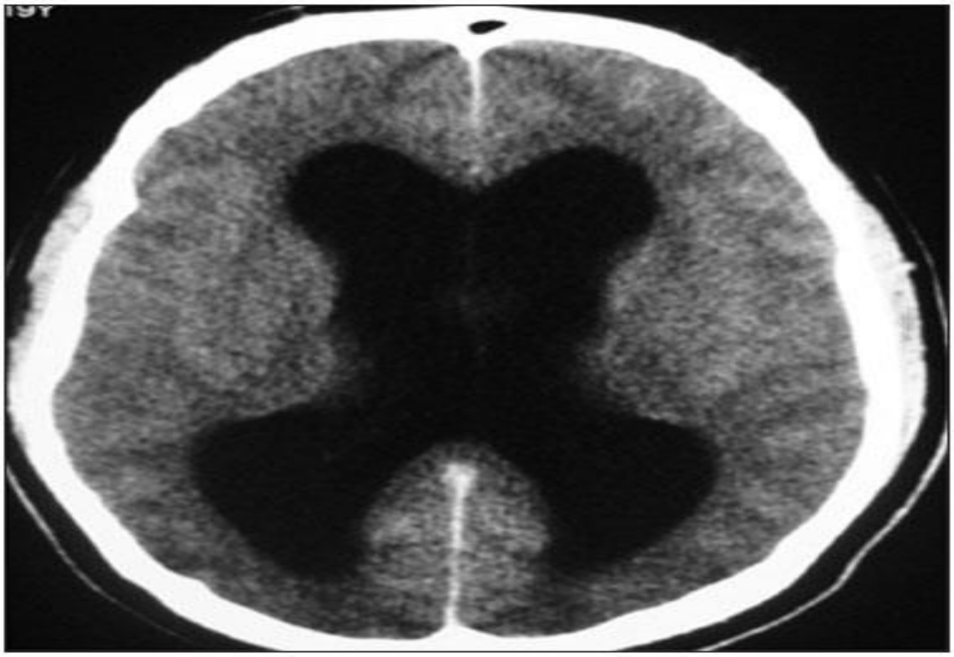


Figure 2-5: CT scan shows cerebral atrophy.

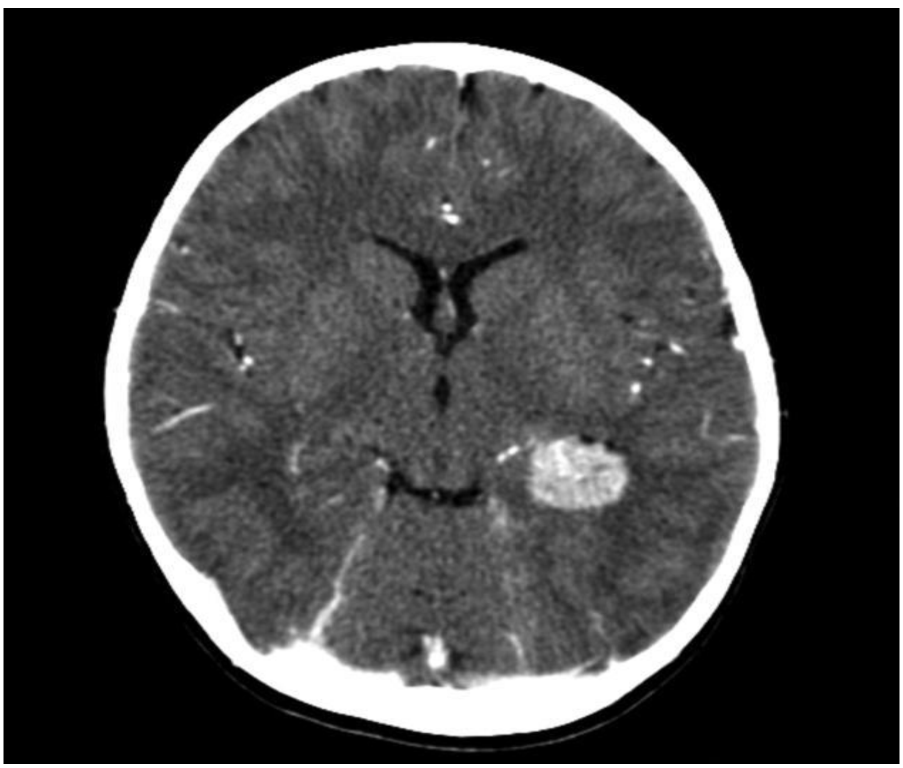


Figure 2-6: CT scan shows vascular disease.

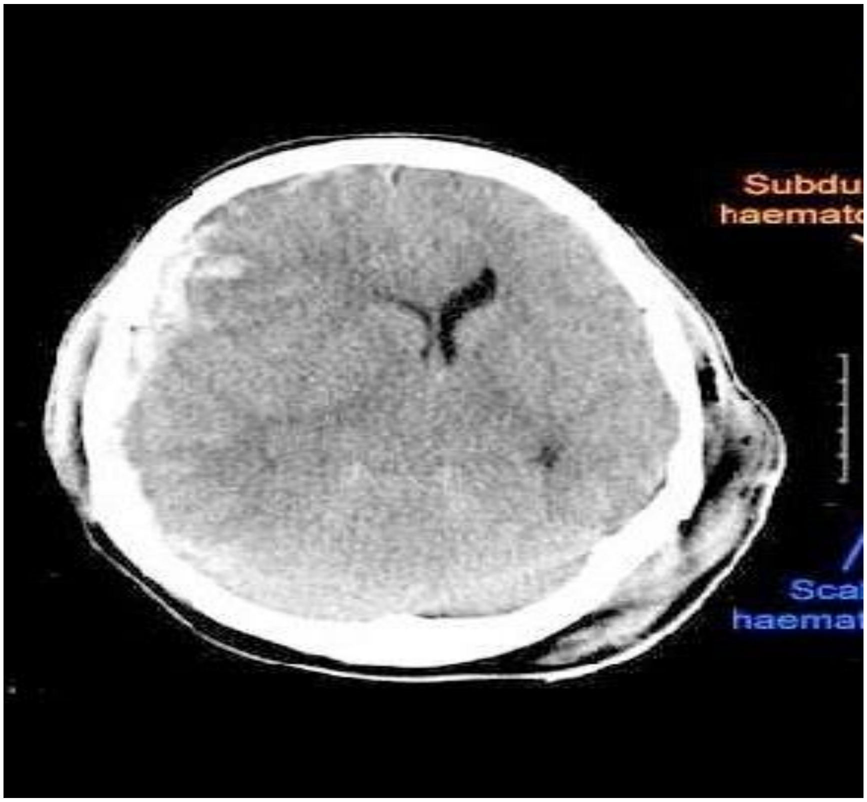


Figure 2-7: CT image shows the traumatic disorder causes subdural hematoma.

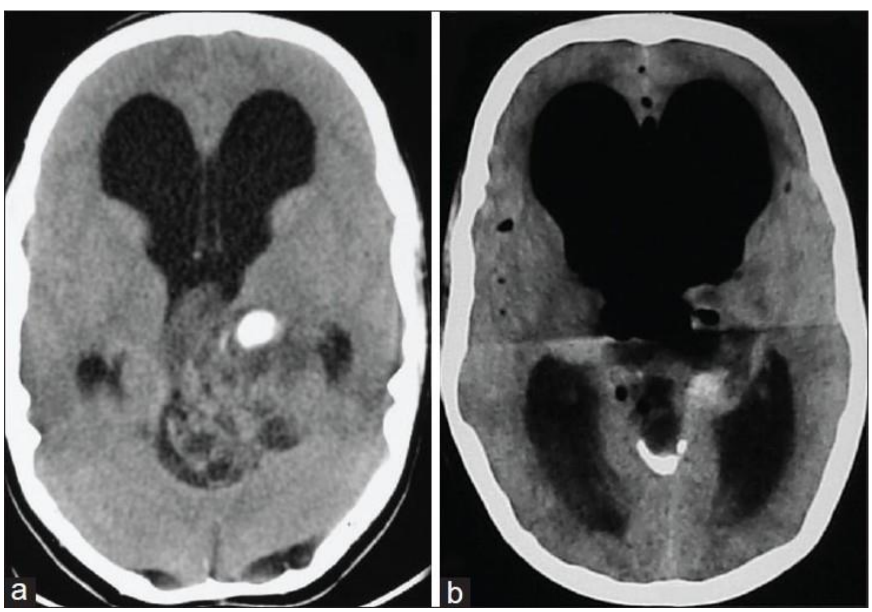


Figure 2-8: CT scan shows the neoplasm of brain.

2-4 Computed tomography (CT) investigation

2-4-1 Definition:

Computed tomograghy (CT) is a medical imaging method employing tomography and digital geometry processing, it use constant three –dimensional image of the inside of an object from a large series of two-dimensional x-ray images taken a round a single axis of rotation (Serum).

Physical Principle of CT scanning:

The primary purpose of CT is to produce a tow-dimensional representation of the linear x-ray attenuation coefficient distribution through a narrow planner cross section of the human body. The resultant image delineates various structures within the body , showing the relative anatomic relationship (Gasmo,1992).

2-4-2 Physical Principle of CT scanning:

The physical principle of the CT includes the three processes referred to as :

Data acquisition.

Data processing.

Image display (Gasmo,1992).

2-4-2-1 Data acquisition:

Refer to systemic collection of information from the patient to produce the CT image . The two method of data acquisition are slice-by-slice data acquisition and volume data acquisition (Gasmo,1992).

In conventional slice-by-slice data acquisition , data are collected through different beam geometries to scan the patient. Essentially , the x-ray tube rotates round the patient and collects data from the first slice. The tube stops and the patient moves into position to scan next slice. This process continues until all slices have been individually scanned(Gasmo,1992).

In volume data acquisition , special beam geometry referred to as spiral or helical geometry is used to scan a volume of tissue rather than one slice at a time. In spiral or helical CT , the x-ray tube rotates around the patient and traces a spiral/ helical path scan an entire volume tissue while the patient holds a single breath. This method generates a single slice per one revolution of the x-ray tube . More recently , multi-slice spiral / helical CT has become available for faster imaging patients. It generates multiple slices per one revolution of the x-ray tube (Gasmo,1992).

2-4-2-2 Data processing:

Essentially constitutes the mathematical principles involved in CT. Data processing is a three-step process. First , the raw data undergo some form of pre-processing, in which corrections are made and some reformatting of data occurs (Gasmo,1992).

This is necessary to facilitate the next step in data processing, image reconstruction. In this step , the scan data , which represent attenuation readings converted into a digital image characterized by CT number. The final step is image storage of the reconstructed digital image. This image is held in a disk memory is a short-term storage(Gasmo,1992).

Image display:

It is final process . After the CT image has been reconstructed, it exits the computer in digital form. The must be converted to a form that is suitable for viewing and meaningful to the observer. In CT the digital reconstructed image is converted into a gray scale image for interpretation by the radiologist. Because a diagnosis is made from this image, it is important to present this image in a way that facilitates diagnosis (Gasmo1992).

2-4-2-3 Display devise:

The gray scale image is display on a cathode ray tube (CRT), or television monitor, which is an essential componentbof the control or viewing console. In some scanner there are two monitors, one for text information and one for images(Gasmo,1992).

The instrumentation: a modern CT facility consists of :

A scanning gantry that includes the collimated x-ray source, the detectors, the computer for data acquisition, the image reconstruction system, Motorized patient – handling table and the CT viewing console.

The major technical difference between various commercial scanner lies in the gantry design and the number and type of x-ray detectors used(Gasmo,1992).

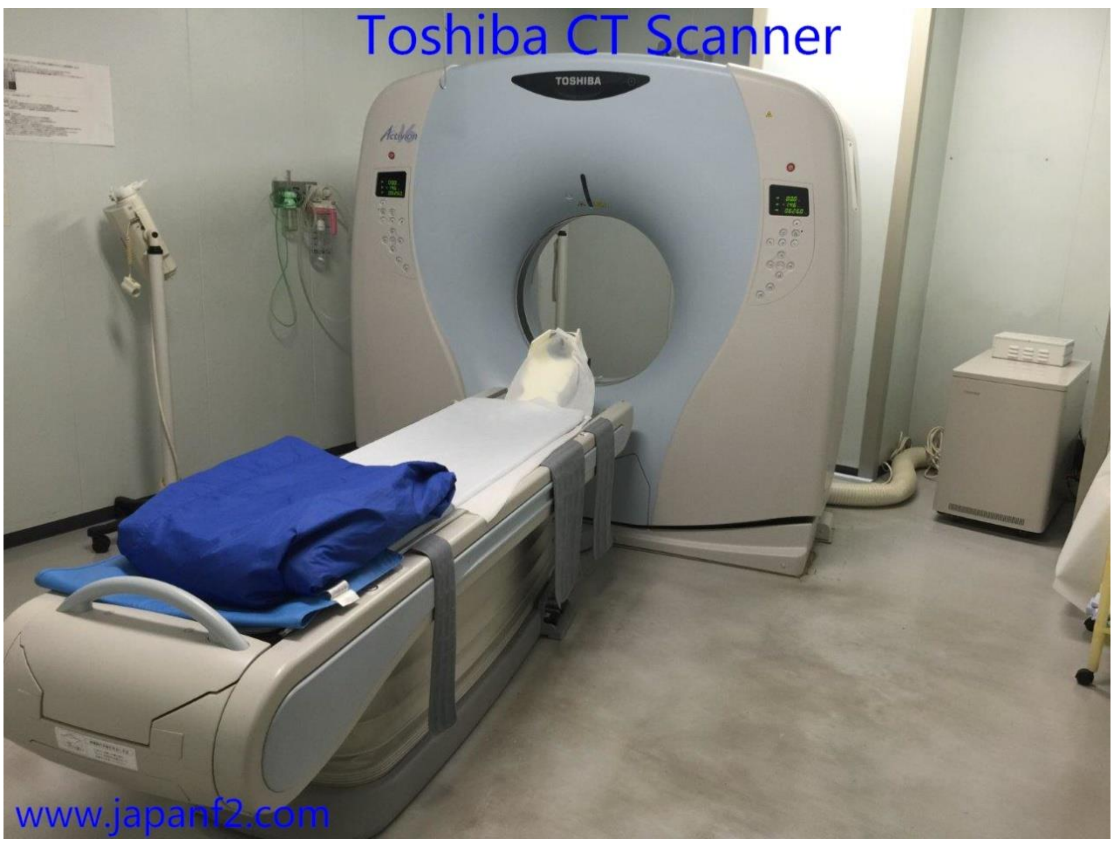


Figure 2-9 : shows CT scanner.

The Advantages of CT:

- CT has capacity to image material ranging from air to metal.
- CT is used as a guide in taking biopsy of the lesion demonstrated by other imaging technique.

CT images has high contrast resolution which can easily demonstrate the brain tissue and the ventricular system and any other brain lesion (Gasmo1992).

The disadvantages of CT:

- Long exposure time.
- The x-ray has serious effects in early pregnancy
- It is less available(Gasmo1992).

2-5 Measurement of lateral ventricles (Previous studies):

There are many studies has been dose in this case:

Gyldensted G.(1977) studied the measurements of the normal brain ventricular system and hemispheric sulci of 100 adults with CT. The left lateral ventricle was found larger than the right in both sexes and both lateral ventricles are larger in male. There are statistically significant increases of all cerebral parameters with age, and the cella media index showed a correspondingly small decrease with age. The linear measurements of lateral ventricles demonstrated positive correlation to cranial size, while the width of the third ventricle and hemispheric sulci were independent of the size of the skull(Gyldensted,1977).

Stephen A et al : (2005), wer studies the changes in the size of the normal lateral ventricles during aging determined by computerized tomography , one hundred thirty – five normal volunteers were examined and their ventricular size was measured by planimetry. A pattern of change in ventricular size from the first through the ninth decades was discerned and quantified. A gradually progressive increase in ventricular size from the first through sixth decades was followed by a dramatic increase in eighth and ninth . The range of normal ventricular size wasrelatively wider in the eighth and ninth decades than in the first seven; thus , abnormalities of ventricular size may be more easily identified in younger than older subjects. These data are more valuable than those from pneumocephalography or autopsy studies because CT is not subject to the artifact inherent in the procedures(Stephen2005).

Amani A. in (2003) reported that measurement of different part of the lateral ventricles in Sudanese were 26mm for anterior horn and 44mm in body in both (CT and MRI) the posterior horn was 44mm in CT imaging while it was 25mm in MRI imaging. Inferior horn was 31 mm in (MRI), also she found that the different parts of the lateral ventricles were found to be larger in males than females, the size of anterior horn and bodies of lateral ventricles significant correlation with age, body weight, and length, the size of posterior and inferior horns of lateral ventricles has so no significant variation in relation to age, body weight and length, horizontal CT scan such show cuts the full extensions of posterior horn in the occipital to better than horizontal MRI scan(Amani,2003).

D,Souza E et al (2007), studies on the ventricular system of brain by computerized tomography. 1000 pts were examined for the various morphmetric measurement of the ventricles of brain and it was observed that the anterioposterior extent of the lateral ventricles (inclusive of their frontal horns) on the right side was 6.96 +0.76cms males and 6.57 + 0,75 cms in females and on the left side was 7.09 +0 .78 cm in males and 6.73 + 0.77 cms in females; the anteroposterior extent of the frontal horns on the right side was 2.74 + 0.36 cms in males and 2.55 + 0.33 cms in females and on the left side 2.78 + 0.37 cms in males and 2.58 + 0.35 in females (Souza,2007).

M.Gameraddin et al (2014), Studies on the morphometric analysis of the brain ventricles in normal subjects , 152 pts were examined of fourth , third and lateral ventricles. It was observed that The anteroposterior extent of the body of the lateral ventricles on the right side was (74.89 + 9.86 mm) and (70.06 + 8.83 mm) in males and females , and on the left side (74.89 + 9.89 mm) and (69.56 +11.42 mm) in males and females respectively . It was also observed that mean length of the right frontal horns (28.53+ 3.88 mm) and (26.16 + 4.21mm) in males and females and on the left side (28.53 + 3.88 mm) and (26.17 + 4.237 mm)in males and females respectively(Gameraddin,2014).

Chapter Three

Materials and Methods

3-1 Study design and area:

This is a community based descriptive study. This study was took place in Khartoum state in different hospital and centers: Radiological Department/ Alrebat University Hospital and Khartoum Advanced Diagnostic centre (KADC).The study was conducted during the period from August 2015 up to November 2015.

3-2 Machine used :

CT spiral unit scan is used , Siemens (16 slices) and Toshiba (4 slices), type of scan: axial scan and spiral.

3-3 Study Population:

51Sudanese adult patients (33males,18 females), patient age range between 20 – 70 years, free from any brain disease that effect the measurement of lateral ventricles, underwent Computed Tomography (CT).

3-4 Conclusion and Exclusion Criteria:

This study include age between 20 – 70 years because in this range the lateral ventricles was complete the process of development , the study exclude the patient with hydrocephalus , neoplasm's , schizophrenia and any disease that effect to the lateral ventricles.

3-5 Study variables:

Radiological measurements of length lateral ventricle(Rt , Lt).

Finding normal measurements of parts of lateral ventricles(Rt, Lt) in a Sudanese sample.

Correlation of measurements with age, gender, height of individual and body weight.

Comparison of Sudanese measurement with other similar studies.

3-6 Method of data collection:

3-6-1CT examination:

From axial CT images measured the length of lateral ventricles (Rt, Lt anterior, posterior horns and RT, Lt bodies).

3-6-2 Interviewing patient:

Concerned with revision of their referral notes, measuring of body weight to nearest kilogram, patient height to the nearest centimeter and ask patient about age.

3-7 Method of measurement on CT image:

Standard CT examination of the head consists of a series of tomographic sections 10mm in thickness, at 10mm intervals from skull base to vertex. The orbitomeatal line is commonly used as the base line ,but sections may angled in either direction, views with increased extension may be preferred for examination of the posterior fossa since if the chin is extended, the beam will not pass through the orbit , thereby reducing radiation does to the eyes. The techniques used for measuring the head was the adopted by Grainger and Allison (Rewcaste199).Most adult's heads can be covered in 10 to 20 sections. The patient was placed on the CT table and the head was centralized and supported for correct alignment and to reduce blurring of images. A lateral image was taken to confirm correct position of patient. The lateral ventricles on CT are seen three or four contiguous slices; the highest tomogram to pass clearly through them contains the superior segments of the cellaemediae, with the corpus callosum in between; the superior segments of trigones and occipital horns may be also seen; the next descending contiguous tomogram incorporates the frontal horns anteriorly and occipital horns posteriorly whereas the temporal horns cannot be identified with certainty and their clear delineation implies that they are dilated.

3-8 Data collection techniques:

The data was collected on a master sheet design for that purpose. Different tables were used to tabulate the findings which were they statistically analyzed ,using Statistical Package for Social Sciences SPSS.

3-9 Routine Adult Brain:

3-9-1 Patient preparation-

The technician explained procedure to the patient briefly before examination .All metallic objects were removed from the area under examination, including such items as earrings, hair pins and necklaces.

If the patient was comfortable on the table, the result was less motion and therefore less degradation of image quality.

3-9-2 Patient Position:

• 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.

3-9-3Scan Range:

Top of C1 lamina through top of calvarium.

3-9-4 Scanning protocol:

Scanning protocol was established to include information such as pt position, pre-scan localization (scout view), scan range, slice thickness, spacing and MA values. This was intended to assist the technologist performed the CT examination and generally helped increase the efficiency of the examination.

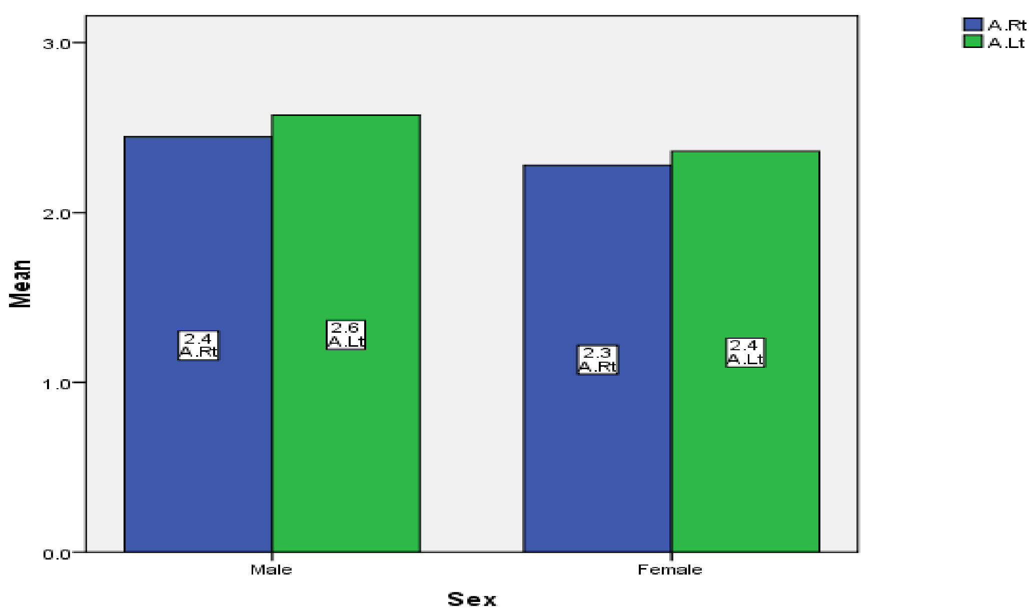
The axial plane used for brain imaging . The plane of the scans was based on the anthropologic baseline, which joins the infraorbital point anteriorly to the posterior border of the external auditory meatus (EAM), better cross-sectional images of the orbits, cellaturica temporal lobes, ventricular system and brain stem were obtained than a more steeply angled plane. Slice thickness of 10 mm was used , although often many site used 2-1 mm slice to improve spatial resolution.

Chapter Four

RESULTS

This study was performed to calculate the length of normal brain lateral ventricle in 51 patients (males & females) at age (20 – 70) years selected randomly when they attend to CT department for brain CT scan.

Table (4-1): distribution of gender for Anterior horns:							
		Anterior .Rt			**Anterior .Lt**		
		Mean	Frequency	Percent	Mean	Frequency	Percent
Gender	Male	2.4	33	64.7%	2.6	33	64.7%
	Female	2.3	18	35.3%	2.4	18	35.3%



Figure(4-1): distribution of gender for Anterior horns

Table (4-2): Correlation between gender and Anterior horn:

		Gender	Anterior .Rt	Anterior .Lt	Anterior horn
Gender	Pearson Correlation	1	-.417	-.456	-.453
	Sig. (2-tailed)		.002	.001	.001
	N	51	51	51	51

Table (4-3): distribution of gender for posterior horn:

		Posterior .Rt			Posterior .Lt		
		Mean	Frequency	Percent	Mean	Frequency	Percent
Gender	Male	3.8	33	64.7%	3.9	33	64.7%
	Female	3.7	18	35.3%	3.8	18	35.3%

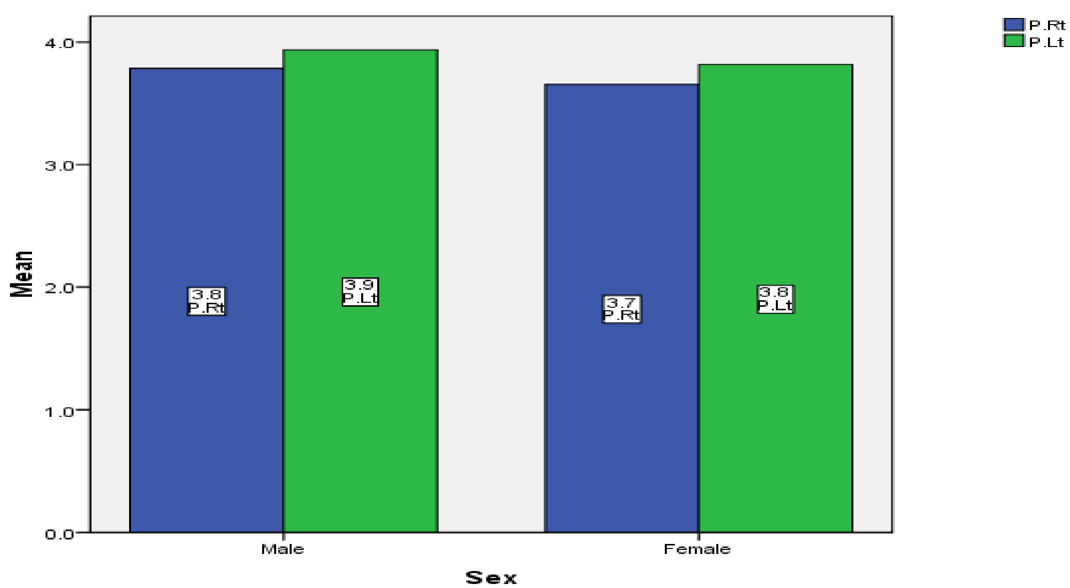


Figure (4-2): distribution of gender for posterior horn:

Table (4-4): Correlation between gender and Posterior horn:

		Gender	Posterior. Rt	Posterior .Lt	Posterior horns
Gender	Pearson Correlation	1	-.202	-.189	-.198
	Sig. (2-tailed)		.156	.184	.164
	N	51	51	51	51

Table (4-5): distribution of gender for Body lateral ventricles:

		Body .Rt			Body .Lt		
		Mean	Frequency	Percent	Mean	Frequency	Percent
Gender	Male	7.5	33	64.7%	7.7	33	64.7%
	Female	7.2	18	35.3%	7.3	18	35.3%

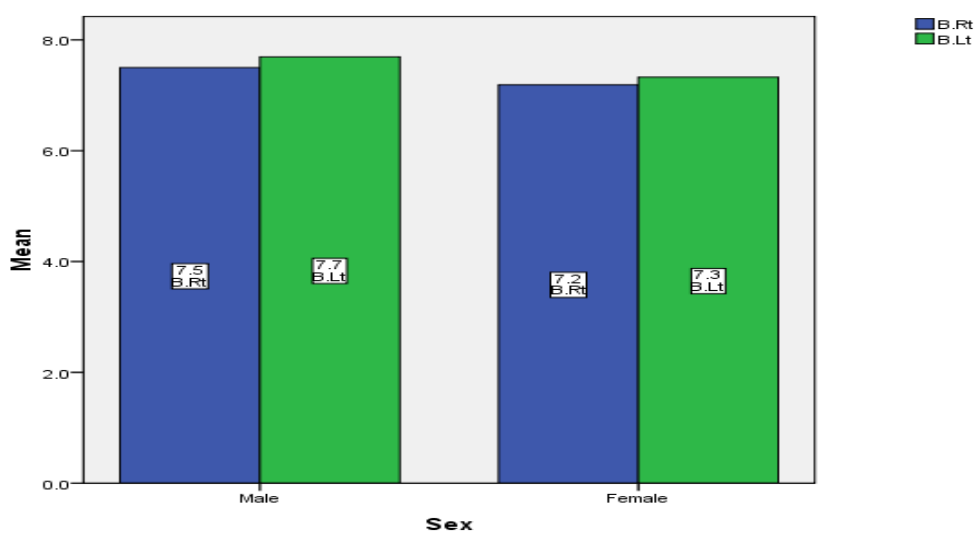


Figure (4-3): distribution of gender for Body lateral ventricles:

Table (4-6): Correlation between gender and Body lateral ventricles:

		Gender	Body .Rt	Body .Lt	Body lateral ventricle
Gender	Pearson Correlation	1	-.281	-.321	-.303
	Sig. (2-tailed)		.046	.021	.031
	N	51	51	51	51

Table (4-7): Distributions of Anterior horns for gender in each age category:

				Anterior .Rt	**Anterior .Lt**		
				Mean	Mean	Frequency	Percent
Age	Less than 30 years	gender	Male	2.5	2.6	10	62.5%
			Female	2.3	2.5	6	37.5%
	30-39 years	Gender	Male	2.4	2.5	7	63.6%
			Female	2.4	2.4	4	36.4%
	40-49 years	Gender	Male	2.2	2.4	5	62.5%
			Female	2.2	2.3	3	37.5%
	50-59 years	Gender	Male	2.5	2.6	7	100.0%
			Female	.	.	0	.0%
	60 years and more	Gender	Male	2.7	2.8	4	44.4%
			Female	2.2	2.3	5	55.6%

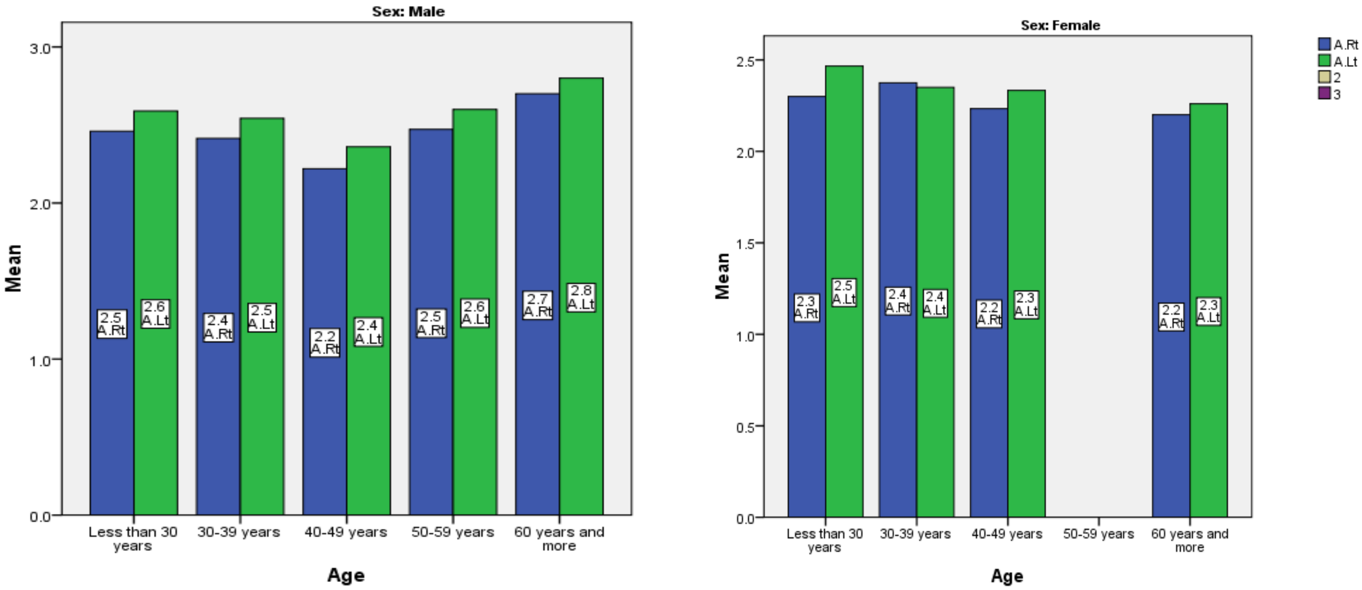


Figure (4-4): Distributions of Anterior horns for gender in each age category:

Table (4-8): Distributions of Posterior horns for gender in each age category:

				Posterior .Rt	**Posterior .Lt**		
				Mean	Mean	Frequency	Percent
Age	Less than 30 years	Gender	Male	3.6	3.7	10	62.5%
			Female	3.6	3.7	6	37.5%
	30-39 years	Gender	Male	3.8	3.9	7	63.6%
			Female	3.7	3.8	4	36.4%
	40-49 years	Gender	Male	4.0	4.2	5	62.5%
			Female	3.5	3.7	3	37.5%
	50-59 years	Gender	Male	3.9	4.1	7	100.0%
			Female	.	.	0	.0%
	60 years and more	Gender	Male	3.9	4.0	4	44.4%
			Female	3.8	4.0	5	55.6%

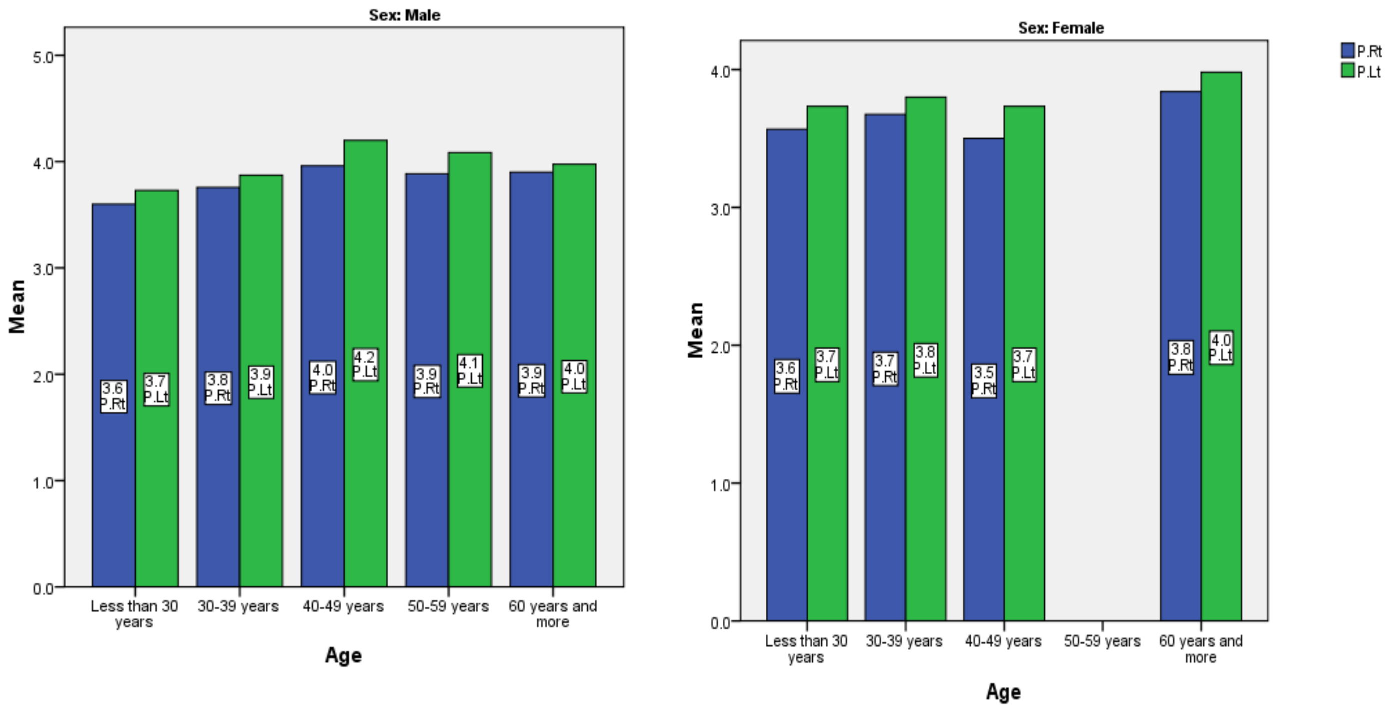


Figure (4-5): Distributions of Posterior horns for gender in each age category:

Table (4-9): Distributions of Body lateral ventricles for gender in each age category:

				Body .Rt	Body .Lt		
				Mean	Mean	Frequency	Percent
Age	Less than 30 years	Gender	Male	7.4	7.5	10	62.5%
			Female	7.2	7.3	6	37.5%
	30-39 years	Gender	Male	7.3	7.5	7	63.6%
			Female	7.5	7.7	4	36.4%
	40-49 years	Gender	Male	7.2	7.4	5	62.5%
			Female	7.1	7.2	3	37.5%
	50-59 years	Gender	Male	7.6	7.9	7	100.0%
			Female	.	.	0	.0%
	60 years and more	Gender	Male	8.3	8.4	4	44.4%
			Female	7.0	7.1	5	55.6%

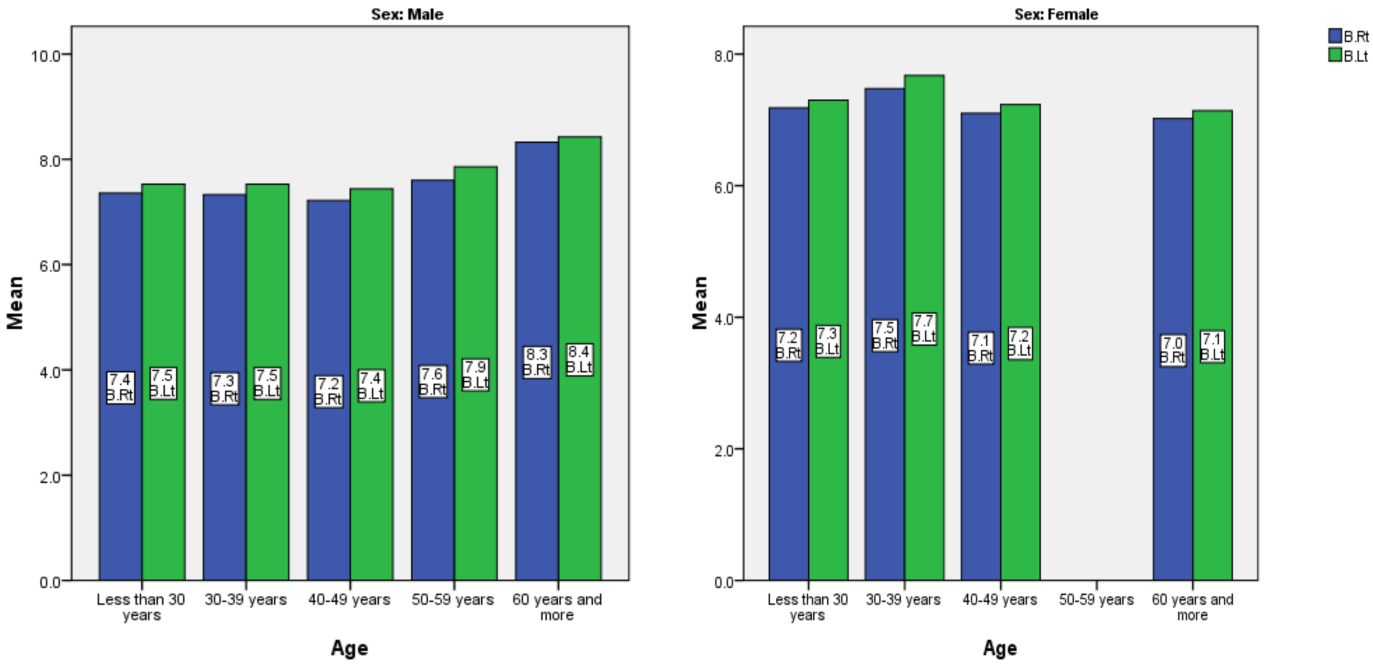


Figure (4-6): Distributions of Body lateral ventricles for sexes in each age category:

Table (4-10): Distributions of Anterior horns for sexes in each height category:

				A.Rt			A.Lt		
				Mean	frequency	parentage	Mean	frequency	parentage
Height category	Less than 150 cm	Gender	Male	.	0	.0%	.	0	.0%
			Female	2.4	1	100.0%	2.5	1	100.0%
	150-165 cm	Gender	Male	2.3	6	33.3%	2.4	6	33.3%
			Female	2.3	12	66.7%	2.4	12	66.7%
	166-175 cm	Gender	Male	2.4	15	78.9%	2.6	15	78.9%
			Female	2.2	4	21.1%	2.2	4	21.1%
	More than 175 cm	Gender	Male	2.5	12	92.3%	2.7	12	92.3%
			Female	2.4	1	7.7%	2.7	1	7.7%

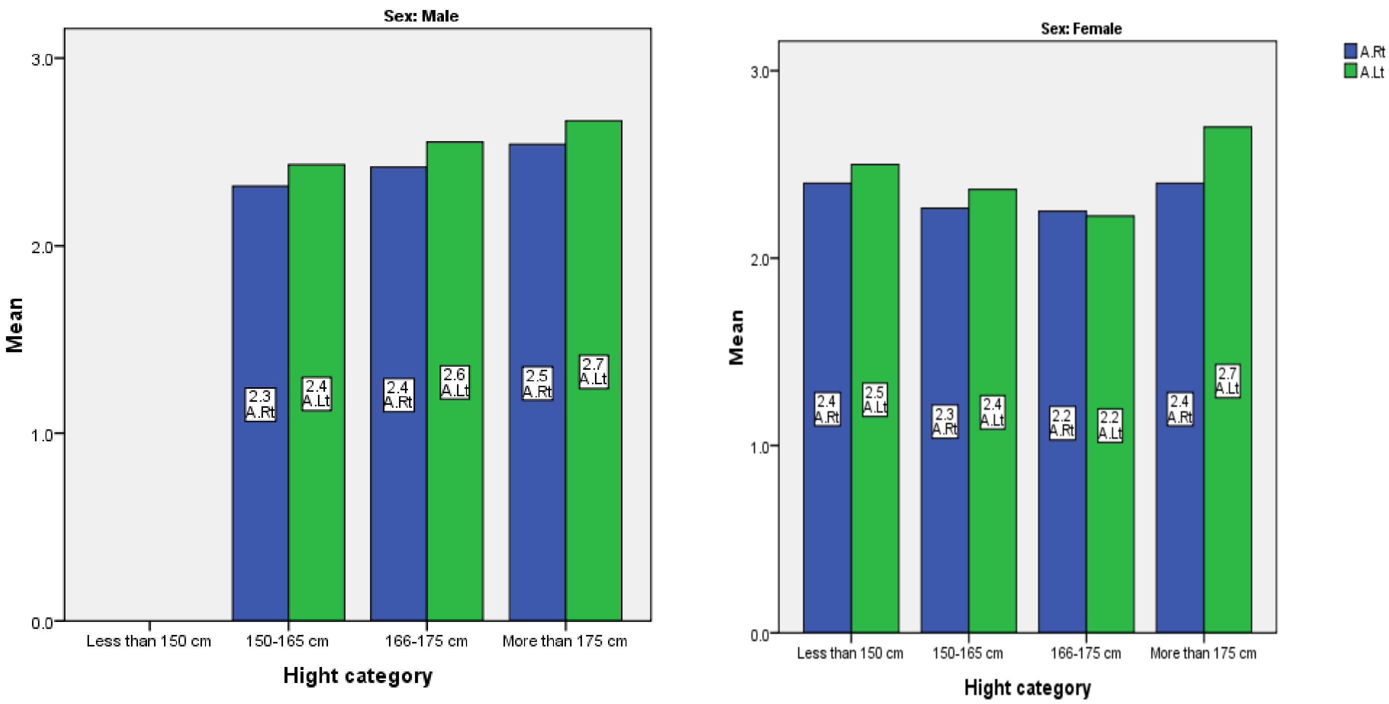


Figure (4-7): Distributions of Anterior horns for gender in each height category:

Table (4-11): Distributions of Posterior horns for gender in each height category:

				Posterior .Rt			Posterior .Lt		
				Mean	frequency	parentage	Mean	frequency	parentage
Height category	Less than 150 cm	Gender	Male	.	0	.0%	.	0	.0%
			Female	4.1	1	100.0%	4.3	1	100.0%
	150-165 cm	Gender	Male	3.8	6	33.3%	4.0	6	33.3%
			Female	3.7	12	66.7%	3.8	12	66.7%
	166-175 cm	Gender	Male	3.7	15	78.9%	3.9	15	78.9%
			Female	3.6	4	21.1%	3.7	4	21.1%
	More than 175 cm	Gender	Male	3.8	12	92.3%	4.0	12	92.3%
			Female	3.4	1	7.7%	3.7	1	7.7%

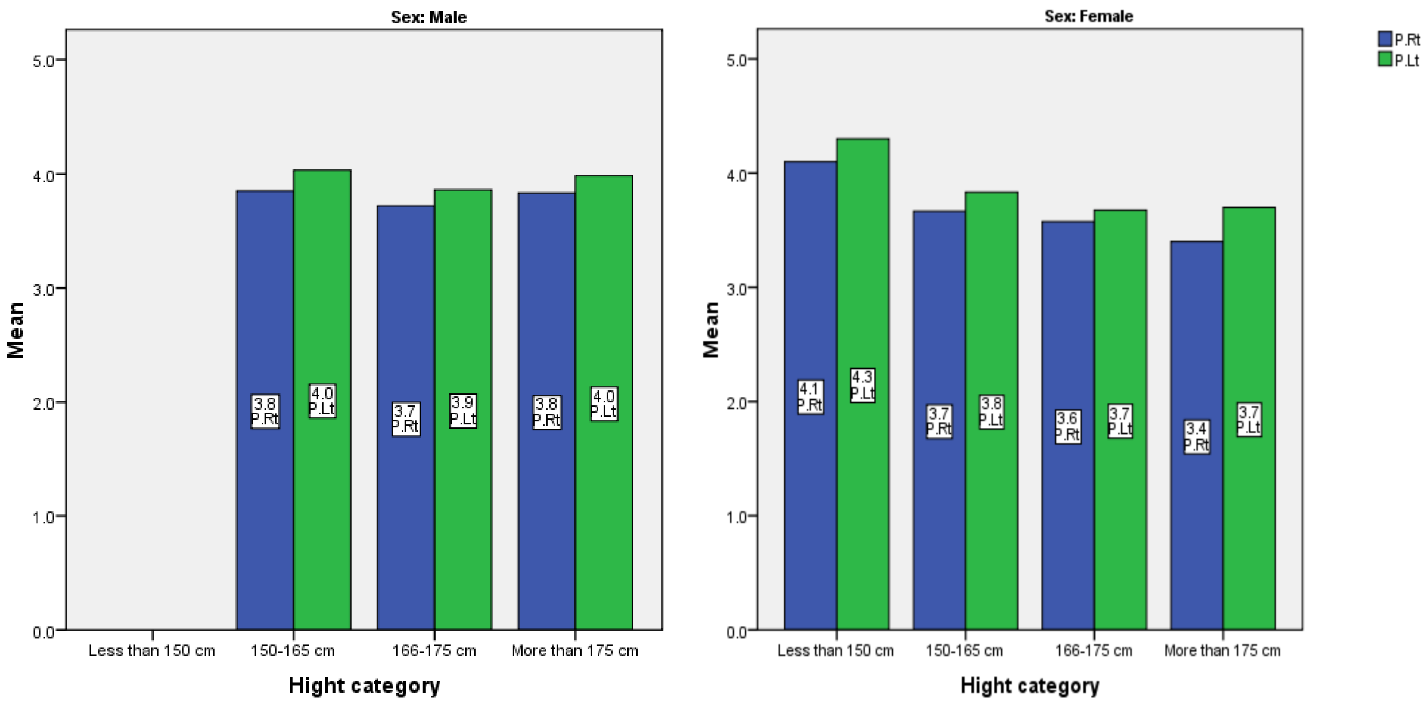


Figure (4-8): Distributions of Posterior horns for gender in each height category:

Table (4-12): Distributions of Body lateral ventricles for gender in each height category:

			Body .Rt			Body .Lt		
			Mean	frequency	parentage	Mean	frequency	parentage
Height category	Less than 150 cm	Gender Male	.	0	.0%	.	0	.0%
		Female	7.3	1	100.0%	7.4	1	100.0%
	150-165 cm	Gender Male	7.4	6	33.3%	7.6	6	33.3%
		Female	7.1	12	66.7%	7.3	12	66.7%
	166-175 cm	Gender Male	7.5	15	78.9%	7.7	15	78.9%
		Female	7.3	4	21.1%	7.4	4	21.1%
	More than 175 cm	Gender Male	7.6	12	92.3%	7.8	12	92.3%
		Female	7.4	1	7.7%	7.5	1	7.7%

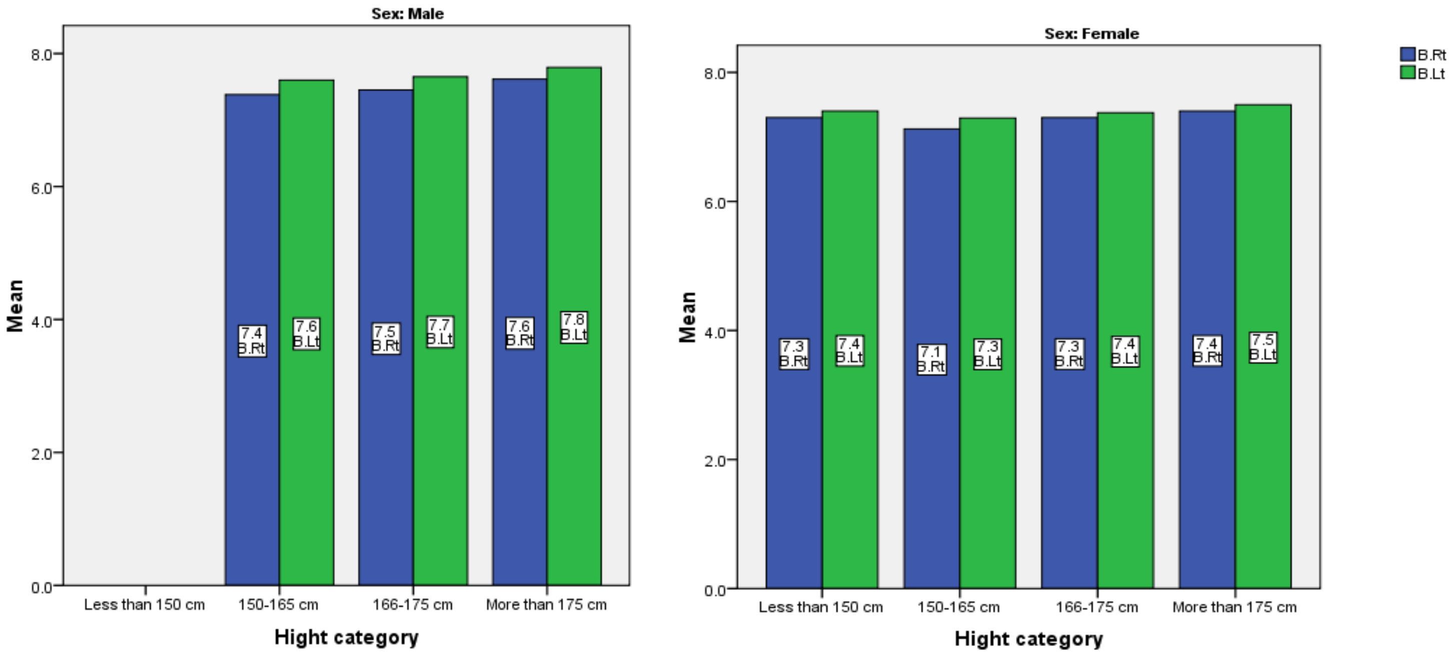


Figure (4-9): Distributions of Body lateral ventricles for gender in each height category:

Table (4-13): Distributions of Anterior horns for gender in each weight category:

				Anterior .Rt			Anterior .Lt		
				Mean	frequency	Parentage	Mean	frequency	parentage
Wight category	Less than 50 kg	Gender	Male	2.2	1	50.0%	2.3	1	50.0%
			Female	2.3	1	50.0%	2.4	1	50.0%
	50-65 kg	Gender	Male	2.4	13	56.5%	2.5	13	56.5%
			Female	2.2	10	43.5%	2.4	10	43.5%
	66-75 kg	Gender	Male	2.5	6	60.0%	2.6	6	60.0%
			Female	2.4	4	40.0%	2.3	4	40.0%
	More than 75 kg	Gender	Male	2.5	13	81.2%	2.7	13	81.2%
			Female	2.3	3	18.8%	2.4	3	18.8%

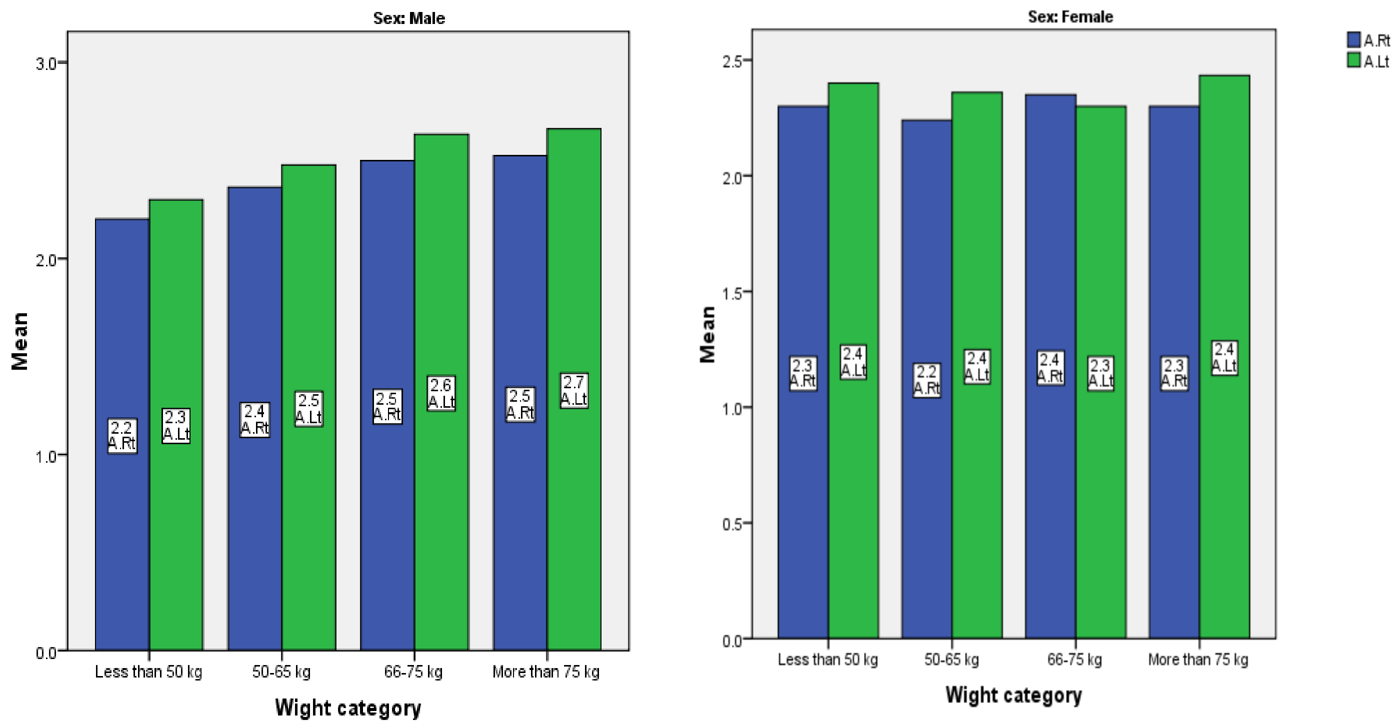


Figure (4-10): Distributions of Anterior horns for gender in each weight category:

Table (4-14): Distributions of Posterior horns for gender in each weight category:

				Posterior .Rt			Posterior .Lt		
				Mean	frequency	parentage	Mean	frequency	parentage
Weight category	Less than 50 kg	Gender	Male	4.1	1	50.0%	4.2	1	50.0%
			Female	3.8	1	50.0%	3.9	1	50.0%
	50-65 kg	Gender	Male	3.7	13	56.5%	3.8	13	56.5%
			Female	3.6	10	43.5%	3.8	10	43.5%
	66-75 kg	Gender	Male	3.7	6	60.0%	3.8	6	60.0%
			Female	3.5	4	40.0%	3.6	4	40.0%
	More than 75 kg	Gender	Male	3.9	13	81.2%	4.1	13	81.2%
			Female	4.0	3	18.8%	4.1	3	18.8%

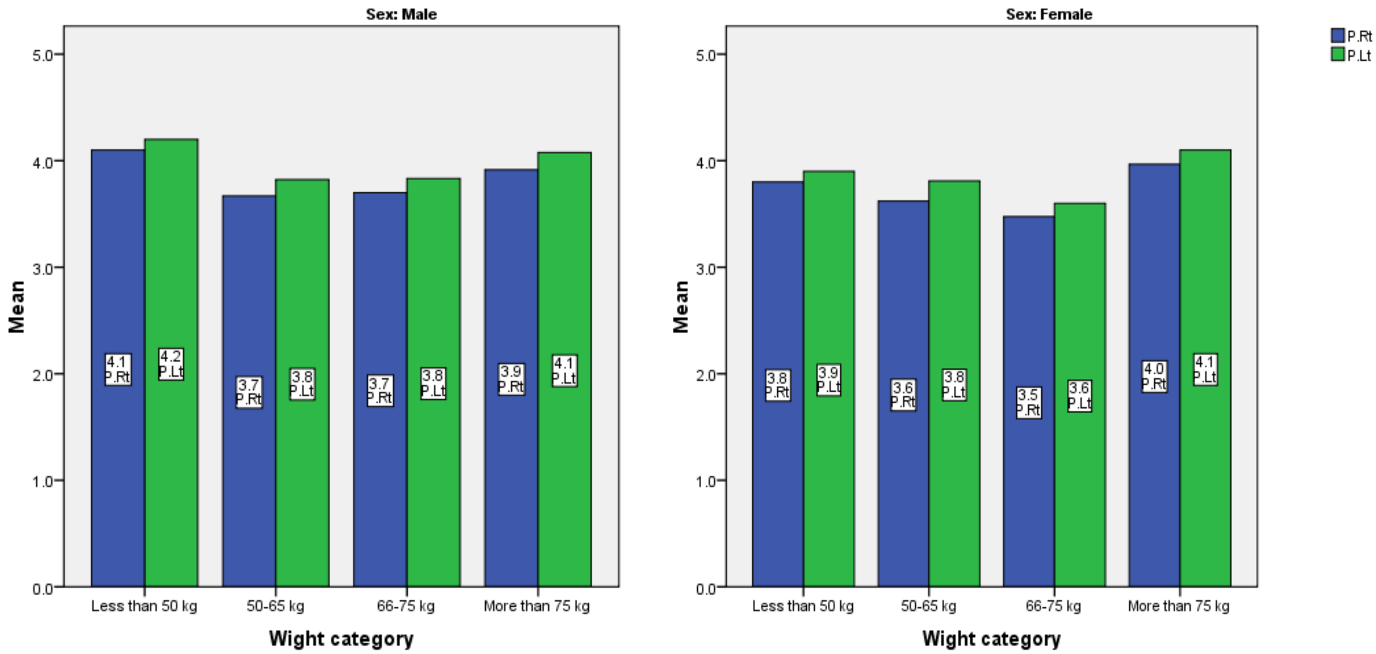


Figure (4-11): Distributions of Posterior horns for gender in each weight category:

Table (4-15): Distributions of Body lateral ventricle for gender in each weight category:

				Body .Rt			Body .Lt		
				Mean	frequency	parentage	Mean	frequency	parentage
Weight category	Less than 50 kg	Gender	Male	7.0	1	50.0%	7.2	1	50.0%
			Female	8.0	1	50.0%	8.2	1	50.0%
	50-65 kg	Gender	Male	7.5	13	56.5%	7.6	13	56.5%
			Female	7.0	10	43.5%	7.2	10	43.5%
	66-75 kg	Gender	Male	7.4	6	60.0%	7.6	6	60.0%
			Female	7.2	4	40.0%	7.3	4	40.0%
	More than 75 kg	Gender	Male	7.6	13	81.2%	7.8	13	81.2%
			Female	7.3	3	18.8%	7.5	3	18.8%

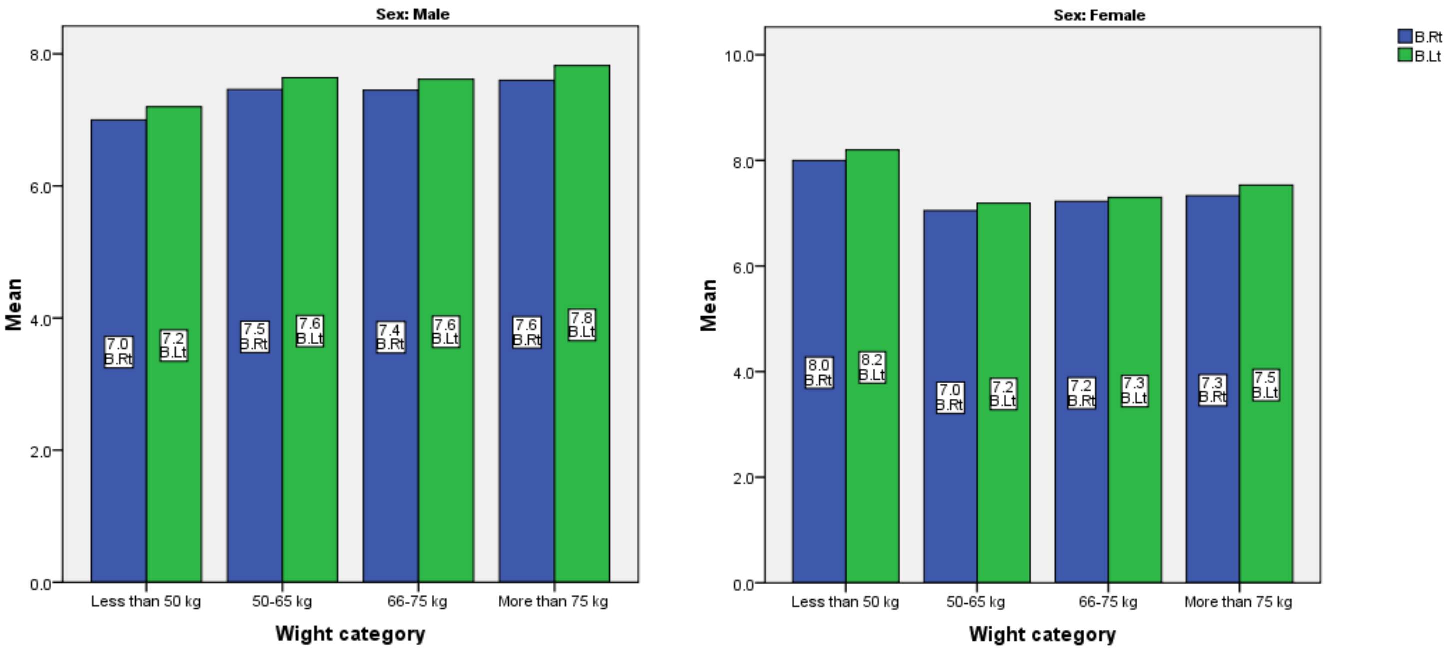


Figure (4-12): Distributions of Body lateral ventricles for gender in each weight category:

Table (4-16): Correlationbetween Age and Anterior horns:

		Age	Anterior .Rt	Anterior .Lt	Anterior horn
Age	Pearson Correlation	1	.045	-.026	.007
	Sig. (2-tailed)		.754	.856	.960
	N	51	51	51	51

Table (4-17): Correlationbetween Height and Anterior horns:

		Height	Anterior .Rt	Anterior .Lt	Anterior horns
Height	Pearson Correlation	1	.599	.565	.601
	Sig. (2-tailed)		.000	.000	.000
	N	51	51	51	51

Table (4-18): Correlationbetween Weight and Anterior horns:

		Weight	Anterior .Rt	Anterior .Lt	Anterior horns
Weight	Pearson Correlation	1	.474	.425	.464
	Sig. (2-tailed)		.000	.002	.001
	N	51	51	51	51

Table (4-19): Correlationbetween Age and Posterior horns:

		Age	Posterior .Rt	Posterior .Lt	Posterior horns
Age	Pearson Correlation	1	.359	.376	.372
	Sig. (2-tailed)		.010	.006	.007
	N	51	51	51	51

Table (4-20): Correlationbetween Height and Posterior horns:

		Height	Posterior .Rt	Posterior .Lt	Posterior horns
Height	Pearson Correlation	1	.155	.104	.131
	Sig. (2-tailed)		.278	.469	.360
	N	51	51	51	51

Table (4-21): Correlationbetween Weight and Posterior horns:

		Weight	Posterior .Rt	Posterior .Lt	Posterior horns
Weight	Pearson Correlation	1	.289	.303	.299
	Sig. (2-tailed)		.040	.030	.033
	N	51	51	51	51

Table (4-22): Correlationbetween Age and Body lateral ventricles:

		Age	Body .Rt	Body .Lt	Body lateral ventricles
Age	Pearson Correlation	1	.211	.204	.208
	Sig. (2-tailed)		.137	.152	.143
	N	51	51	51	51

Table (4-23): Correlationbetween Height and Body lateral ventricles:

		Height	Body .Rt	Body .Lt	Body lateral ventricles
Height	Pearson Correlation	1	.321	.316	.320
	Sig. (2-tailed)		.022	.024	.022
	N	51	51	51	51

Table (4-24): Correlationbetween Weight and Body lateral ventricles:

		Weight	Body .Rt	Body .Lt	Body lateral ventricles
Weight	Pearson Correlation	1	.220	.249	.236
	Sig. (2-tailed)		.121	.078	.096
	N	51	51	51	51

Chapter Five

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1Discussion:

The analysis in table and figure 4-1 show that, on average, male's **anterior horns** (2.4, 2.6) larger often than female's (2.3, 2.4). For both, males and females, the mean of left side larger than right,this agree with Gyldensted 1977 and Souza 2007.

.Table 4-2 shows that, the correlation between **gender** and **the two sides (right and left) of anterior horn** are -0.417 and -0.456 respectively by squaring them and then multiplying by 100, I can determine what percentage of the variability is shared. Rounding them to be -0.4 and -0.5, which when squared would be .0.16 and 0.25, multiplied by 100 would be 16% and 25%. Meaning that **gender** shares about 16% and 25% of its variability with **Sides of anterior horns .**While the correlation between **gender** and **anterior horns** is -0.453which meaning that **sex** shares about 16% of its variability with **anterior horns.**

Table 4-3 and figure 4-2 show that, on average, male's **Posterior horns** (3.8, 3.9) larger often than female's (3.7, 3.8). For both, males and females, the mean of left side larger than right.

Table 4-4 shows that , the correlation between **gender** and **the two sides (right and left) of posterior horn** are -0.202 and -0.189 respectively by squaring them and then multiplying by 100, we can determine what percentage of the variability is shared. Rounding them to be -0.2, which when squared would be 0.04, multiplied by 100 would be 4% for both. Meaning that **gender** shares only about 4% of its variability with both **Sides of posterior horns .**While the correlation between **gender** and **posterior horns** is -0.198which meaning that **gender** shares about 4% **posterior horns.**

Table 4-5 and figure 4-3 show that, on average, male's **body lateral ventricles** (7.5, 7.7) larger often than female's (7.2, 7.3). For both, males and females, the mean of left side larger than right.

Table 4-6 shows that, the correlation between **gender** and **the two sides (right and left) of body lateral ventricles** are -0.281 and -0.321 respectively by squaring them and then multiplying by 100, we can determine what percentage of the variability is shared. Rounding them to be -0.3, which when squared would be 0.09 and 0.4, multiplied by 100 would be 9% for both. Meaning that **gender** shares about 4% of its variability with both **Sides of body lateral ventricles .**While the correlation between **gender** and **body lateral ventricle** is -0.303which meaning that **gender** shares about 9% **body lateral ventricles.**

Table 4-7,and figure 4-4 show that, the frequency of **anterior horns** length in both sides, broken down into each permutation of gender and age. From this table, it appears that for both sexes, there is no obvious trend for the length of **anterior horn**s with age: on average, for less than 30 year-olds and 30-39 year olds larger than 40-49 year olds which is shorter than for 50-59 year olds and 60 year olds.

Table 4-8 and figure 4-5 show that, the frequency of **Posterior horns** length in both sides, broken down into each permutation of gender and age. From this table, it appears that for both sexes, there is no obvious trend for the length of **Posterior horn**s with age: on average, for less than 30 year-olds and 30-39 year olds shorter than 40-49 year olds which is larger than for 50-59 year olds and 60 year olds.

Table 4-9 and figure 4-6 show that, the frequency of **body lateral ventricles** length in both sides, broken down into each permutation of gender and age. From this table, it appears that for both gender, there is no obvious trend for the length of **body lateral ventricles** with age: on average, for less than 30 year-olds larger often as 30-39 years old in males and and shorter than in females, which is shorter than for 40-49 year olds which itself is shorter than for 50-59 year olds in both sex, but for 60 year olds is larger.

Table 4-10 and figure 4-7 show that, the distribution of **anterior horns** length in both sides, broken down into each permutation of gender and height. From the table and chart, it appears that for both gender, there is no obvious trend for the length of **anterior horns** consider to height: on average, for less than 150 cm and 150-165 cm larger as 166-175 cm which is shorter than for more than 175 cm.

Table 4-11 and figure 4-8 show that, the distribution of **Posterior horns** length in both sides, broken down into each permutation of sex and height. From the table and chart, it appears that for both gender, there is no obvious trend for the length of **Posterior horns** in males consider to height: on average, for 150-165 cm larger as 166-175 cm which is shorter than for More than 175 cm, while it decreases as height increase in females.

Table 4-12 and figure 4-9 show that, the distribution of **body lateral ventricle**s length in both sides, broken down into each permutation of gender and height. From the table and chart, it appears that for both gender, there is no obvious trend for the length of **body lateral ventricles** in females consider to height: on average, for less than 150 cm is larger as for 150-165 cm which is shorter than for 166-175 cm and more than 175 cm, while it increases as height increase in males.

Table 4-13 figure 4-10 show that, the distribution of **anterior horn** length in both sides, broken down into each permutation of sex and weight. From the table and chart, it appears that for both sexes, there is increase in the length of **anterior horns** consider to weight for males, while there is no obvious trend for females.

Table 4-14and figure 4-11 show that, the distribution of **Posterior horn** length in both sides, broken down into each permutation of gender and weight. From the table and chart, it appears that for both gender, there is no obvious trend for the length of **Posterior horn** consider to weight: on average, for less than 50 kg is larger as 50-65 kg and 66-75 kg which is shorter than for more than 75 kg.

Table 4-15 and figure 4-12 show that, the distribution of **body lateral ventricle** length in both sides, broken down into each permutation of gender and weight. From the table and chart, it appears that for both gender, there is no obvious trend for the length of **body lateral ventricles** consider to weight: on average, for less than 50 kg is larger as 50-65 kg in females and shorter than in males which is shorter than 66-75 kg and more than 75 kg in both gender.

Table 4-16 shows that, the correlation between **age** and **the two sides (right and left) of anterior horn** are0.045 and -0.026 respectively which meaning that there is a weak positive correlation(0.045)between**age** and **right side of anterior horn** and weak negative correlation (-0.026) between **age** and **the left side .**While the correlation between **age** and **anterior horn** is 0.007which meaning that approximately no correlation (0.007) between **age** and **anterior horns** with significance value (0.960) this disagree with Amina 2003 and Gyldensted 1977 studies.

Table 4-17 show that, the correlation between **height** and **the two sides (right and left) of anterior horn** are0.599 and 0.565 respectively which meaning that there is a mediate positive correlation between **height** and **both sides of anterior horn.** While the correlation between **height** and **anterior horns** is 0.601which meaning that there is correlation between **height** and **anterior horns** with statistically significant of value (0.000), this agree with Amina 2003 study.

Table 4-18 shows that, the correlation between **weight** and **the two sides (right and left) of anterior horn** are 0.474 and 0.425 respectively which meaning that there is a weak positive correlation between **weight** and **both sides of anterior horn.** While the correlation between **weight** and **anterior horns** is 0.464which meaning that there is medium correlation between **weight** and **anterior horns** with statistically significant of value (0.001), this agree with Amina 2003 study.

Table 4-19 shows that, the correlation between **age** and **the two sides (right and left) of posterior horn** are 0.359 and 0.376 respectively which meaning that there is a weak positive correlation between **age** and **both sides of posterior horn.** While the correlation between **age** and **posterior horns** is 0.372which meaning that there is a weak correlation between **age** and **posterior horns** with statistically significant of value (0.007), this disagree with Amina 2003 and Gyldensted 1977 studies.

Table 4-20 shows that , correlation between **height** and **the two sides (right and left) of posterior horn** are 0.155 and 0.104 respectively which meaning that there is a weak positive correlation between **height** and **both sides of posterior horn.** While the correlation between **height** and **posterior horns** is 0.131which meaning that approximately no correlation between **height** and **posterior horns** with significance value (0.360), this study disagree with Amin 2003 study.

Table 4-21 show that ,the correlation between **weight** and **the two sides (right and left) of posterior horn** are 0.289 and 0.303 respectively which meaning that there is a weak positive correlation between **weight** and **both sides of posterior horns.** While the correlation between **weight** and **posterior horns** is 0.299which meaning that there is a correlation between **weight** and **posterior horn**s with statistically significant of value (0.033), this disagree with Amina 2003.

Table 4-22 shows that, the correlation between **age** and **the two sides (right and left) of body lateral ventricles** are 0.211 and 0.204 respectively which meaning that there is a weak positive correlation between **age** and **both sides of body lateral ventricles.** While the correlation between **age** and **body lateral ventricles** is 0.208which meaning that approximately no correlation between **age** and **body lateral ventricles** with significance value (0.143), this disagree with Amina 2003 and Gyldensted 1977 studies.

Table 4-23 shows the correlation between **height** and **the two sides (right and left) of body lateral ventricles** are 0.321 and 0.316 respectively which meaning that there is a weak positive correlation between **height** and **both sides of body lateral ventricles.** While the correlation between **height** and **body lateral ventricles** is 0.320which meaning that there is a medium correlation between **height** and **body lateral ventricles** with statistically significant of value (0.022), this agree with Amina 2003 study.

Table 4-24 shows the correlation between **weight** and **the two sides (right and left) of body lateral ventricles** are 0.220 and 0.249 respectively which meaning that there is a weak positive correlation between **weight** and **both sides of body lateral ventricles.** While the correlation between **weight** and **body lateral ventricles** is 0.236which meaning that approximately no correlation between **weight** and **body lateral ventricles** with significance value (0.096) ,this agree with Amina 2003.

When compared between this study in Sudanese patients with other studies in the other community , was found the bodies of ventricles Rt&Lt in Sudanese (7.5 , 7.7) (7.2 , 7.3) cms in males and females respectively, and in Saudis Arabia(7.4, 7.4cms) (7.0 , 6.9) cmsin males and females respectively , that is means the Sudanese have larger brain lateral ventricles than the Saudis Arabian.

And also compared with other study in India by Souza 2007 was found the right and Left bodies of lateral ventricles (6.9 , 7.1) (6.5 , 6.7) cms in males and females respectively. Comparing with study the Sudanese have lager body of lateral ventricles than Hindus.

From this results of study observe that the CT has specific ability to measurement of brain lateral ventricles.

5.2Conclusion:

From the discussion of the groups involved in this study the analysis showed that the general mean length of Rt & Lt(anterior ,posterior horns and body) of lateral ventricles are9 2.4, 2.6 , 3.8 , 3.9) cms ,and(7.5 , 7.7) cms respectively in males and(2.3, 2.4 , 3.7, 3.8 and 7.2, 7,3)cms respectively in females.

These The "count" reassures us that SPSS used 33 (64.7% of the sample) males and 18 (35.3% of the sample) females in this study could be use as a Sudanese index value.

This result means the left sides of lateral ventricles larger than the right in both males and females, and also the lateral ventricles of the males larger than the females .

This study appears that for the both gender there is no obvious trend for the mean length of all parts of lateral ventricles consider to age, while the mean length of anterior horns increase consider to weight for males increase, but in females there is no obvious trend and other part of lateral ventricles (posterior and body) in both sex no obvious consider to weight.Also the mean length of posterior horns decrease as height increase in females, while in males there is no obvious trendconsider to height and the mean length of bodyof lateral ventricles increase as the height increase in male while it hasn't obvious trend consider to height females , for anterior horns for both gender there no obvious consider to height.

There is correlation between the age and anterior horns and bodies of lateral ventricle are so insignificance giving values 0.960, 0.143 respectively and correlation with posterior horns is so significant , giving the value , 0.007.

The correlation between height and anterior horns and bodies of lateral ventricles are so significant , giving the values, 0 .000, 0.0022 respectively,, and with posterior horns is significance value 0.360 .

The correlation between weight and anterior and posterior horns are so significant giving values 0.001, 0.033 respectively, and with body of lateral ventricles is so siginificance value 0.096 agree and disagree with Amin 2003 study.

The gender of patient effected in mean length of anterior horns and bodies of lateral ventricles greater than its effected in posterior horns.

5.3 Recommendation

CT device must be available in all hospital.

Reduce the cost of investigation.

Increase the efficiency of technologist by making course in CT investigation to increase the assurance.

for future research the researcher suggest doing the same study in normal lateral ventricles by using the MRI due to the fact that MRI is safe and more accurate.

Another research using large sample of patients is recommended for further assessment.

CT investigation should not be asked for routine investigation and should only be reserved the needed cases.

Follow up measurement of change of the lateral ventricles size with age from child hood could also be conducted

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Appendices

Appendix (1) : Shows

Figure 1: **Shows male age 18 years measured right body of lateral ventricle 7.6 cms and left 7.5 cms.**

Figure 2: Shows male age 18 years old measured posterior horns of lateral ventricles right 3.3 cms and left 2.9 cms .

Figure: **Shows male age 18 years old measured for anterior horns of lateral ventricles right 2.7 cms and left 2.9 cms.**

Appendix (2) : Shows

Data Collection Sheet

Date…………………

Patient name …………………..

Sex…...............   Age…………………

Height…………..   Weight……………

Measurement of parts of brain lateral ventricles:

Part of lateral ventricle	Rt	Lt
Anterior horn		
Body of lateral ventricles		
Posterior horn		