Chapter one

1-1Introduction:

Corpus call sum (CC) is a wide, flat bundle of neural fibers about 10 cm long beneath the cortex in the brain at the longitudinal fissure, It connects the left and right cerebral hemisphere.(Gupta ,et al2008).The posterior portion of the corpus callosum is called the splenium, the anterior is called the genu between the two is the body of the corpus callosum, The part between the body and the splenium is the isthmus, The rostrum is the part of the corpus callosum that projects posterior and inferiorly from the anterior most genu, as can be seen on the sagittal image of the brain displayed on the right(William, et al 1989).This study using MRI scans to get inclusive data regarding (CC) in normal adult Sudanese population and to present the results of callosum anatomy and will give normative data on (CC) morphology in the population under study and thus establish reference values for studying age ,gender and racial differences.

1.2 Statement of The problems:

Agenesis of the corpus callosum (ACC) is a complete or partial absence of the corpus callosum. It occurs when the corpus callosum, the band of white matter connecting the two hemispheres in the brain, fails to develop normally, typically during pregnancy .the normal corpus callosum well demonstrated by magnetic resonance imaging (MRI) there for the measure should be know in order to void miss diagnosis.

1.3 Objective of the study:

1.3. 1General objectives.

Measurement of corpus callosum in Adult Using MRI.

1.3.2 Specific objectives:

- To measure the thick and length of the corpus callosum (genu, splenium and body).

- To correlate the measurement with age and gender.

CHAPTER TWO

Literature review

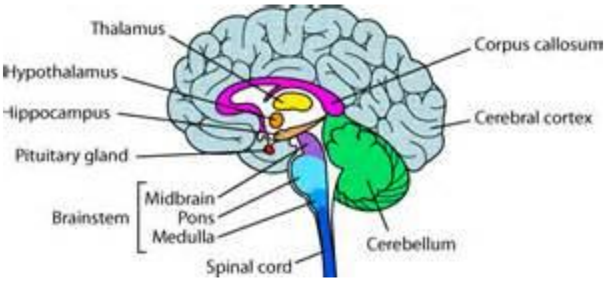
2-1 Anatomy of Corpus callosum:

The **corpus callosum** (Latin for "tough body"), also known as the callosum commeasure, is a wide, flat bundle of unreal fibers beneath the cortex in the ethereal brain at the longitudinal fissure. It connects the left and right cerebral hemispheres and facilitates interhemispheric communication. It is the largest white matter structure in the brain, consisting of200–250 million contra lateral axonal projections. (Gouliamos A, 2007).

Corpus callosum is a bundle of nerve fibers in the longitudinal fissure of the brain that enables corresponding regions of the left and right cerebral hemispheres to communicate. The axons and dendrites of the neurons in the corpus callosum synapse with cortical neurons on symmetrically related points of the hemispheres. Thus, electrical stimulation of a point on one hemisphere usually gives rise to a response on a symmetrically related point on the other by virtue of these callosum connections. The neurons in the corpus callosum also are insulated by a myelin sheath, which facilitates the rapid conduction of electrical impulses between the hemispheres. (Gouliamos A, 2007) .Diseases affecting the corpus callosum includes Marchiafava-Bignami disease, which is characterized by progressive demyelization of the neurons of the corpus callosum. In addition, agenesis (imperfect development) of the corpus callosum can cause intellectual disability and seizures. A reduced amount of tissue in the corpus callosum also has been associated with attention deficit/hyperactivity disorder (Warwick, R. 2009).

The corpus callosum has played an important role in the elucidation of functions specific to each of the cerebral hemispheres. For example, studies of individuals being treated for epilepsy in which the corpus callosum has been severed, allowing the two hemispheres to function largely independently, have revealed that the right hemisphere has more language competence than was thought.

Fig(2-14): Corpus callosum from above. (Anterior portion is at the top of the image.)https://en.wikipedia.org/wiki/corpus-collosum#/media /file:Gray733.png.. (GouliamosA,2007) .



Fig(2-15): Median sagittal section of brain (person faces to the left).Corpus callosum visible at center. https://en.wikipedia.org/wiki/corpuscollosum#/medile:Gray720ng.. (GouliamosA, 2007).

2-1-1 **Structure:**

The posterior (back) portion of the corpus callosum is called the selenium; the anterior (front) is called the genu (or "knee"); between the two is the trunks, or "body", of the corpus callosum. The part between the body and the splenium is often markedly narrowed and thus referred to as the "isthmus". The rostrum is the part of the corpus callosum that projects posterior and inferiorly from the anterior most genu, as can be seen on the sagittal image of the brain displayed on the right. (Gouliamos A, 2007) . On either side of the corpus callosum, the fibers radiate in the white matter and pass to the various parts of the cerebral cortex; those curving forward from the genu into the frontal lobe constitute the forceps anterior, and those curving backward into the occipital lobe, the forceps posterior. Between these two parts is the main body of the fibers which constitute the tapetum and extend laterally on either side into the temporal lobe, and cover in the central part of the lateral ventricle. Thinner axons in the genu connect the prefrontal cortex between the two halves of the brain; these fibers arise from a fork-like bundle of fibers from the tapetum, the forceps anterior. Thicker axons in the mid body, or trunk of the corpus callosum, interconnect areas of the motor cortex, with proportionately more of the corpus callosum dedicated to supplementary motor regions in cluding Boca's area. The posterior body of the corpus, known as the splenium, communicates tomato sensory information between the two halves of the parietal lobe and the visual cortex at the occipital lobe, these are the fibers of the forceps posterior.(Warwick, R. ,1989).

2-1-2 **Variation:**

Agenesis of the corpus callosum (ACC) is a rare congenital disorder that is one of the most common brain malformations observed in human beings, in which the corpus callosum is partially or completely absent. ACC is usually diagnosed within the first two years of life, and may manifest as a severe syndrome in infancy or childhood, as a milder condition in young adults, or as an asymptomatic incidental finding. Initial symptoms of ACC usually include seizures, which may be followed by feeding problems and delays in holding the head erect, sitting, standing, and walking. Other possible symptoms may include impairments in mental and physical development, hand-eye coordination, and visual and auditory memory.(Gouliamos A,2007)

Hydrocephaly may also occur. In mild cases, symptoms such as seizures, repetitive speech, or headaches may not appear foryears.ACC is usually not fatal. Treatment usually involves management of symptoms, such as hydrocephaly and seizures, if they occur. Although many children with the disorder lead normal lives and have average intelligence, careful neuropsychological testing reveals subtle differences in higher cortical function compared to individuals of the same age and education without ACC. Children with ACC accompanied by developmental delay and/or seizure disorders should be screened for metabolic disorders. Including too thin). Recent studies have also linked possible correlations between corpus call sum malformations.(Gupta, et al 2008).

2-1-3 Sexual dimorphism:

The corpus callosum and its relation to sex has been a subject of debate in the scientific and lay communities for over a century. Initial research in the early20th century claimed the corpus to be different in size between men and women. That research was in turn questioned, and ultimately gave way to more advanced imaging techniques that appeared to refute earlier correlations. However, advanced analytical techniques of computational neuro anatomy developed in the 1990s showed that sex differences were clear but confined to certain parts of the corpus callosum, and that they correlated with cognitive performance in certain tests. One recent study using magnetic resonance imaging (MRI) found that the midsagittal corpus callosum cross sectional areas, on average, proportionately larger in females.(GouliamosA,2007)

2-1-4 Physiologic imaging:

in one review. The ability to evaluate the form and function of the human mind has under gone almost exponential growth and a paradigm shift in recent years. Functional magnetic resonance imaging, for example, is now being used to analyze physiology, in addition to the traditional use of MRI for studying anatomy. Using diffusion tensor sequences on MRI machines, the rate at which molecules diffuse in and out of a specific area of tissue, anisotropy (directionality), and rates of metabolism can be measured. These sequences have found consistent sex differences in human corpus callosum morphology and micro structure. Morph metric analysis has also been used to study specific three-dimensional mathematical relationships with MRIs, and have found consistent and statistically significant differences across genders. Specific algorithms have found significant gender differences in over 70% of cases**.**(James E. 2007)**.**

2-1-5 Gender identity disorder:

Research has been done on the shape of the corpus callosum in those with gender identity disorder. Researchers were able to demonstrate that the shaped dimorphisms of the corpus callosum at birth in people assigned male at birth who self-identified as female was actually reversed, and that the same held true for people assigned female at birth that self-identified as male, however, the shape of the corpus callosum correlates better with the 'mental sex' of individuals rather than their 'physical sex'. The relationship between the corpus callosum and gender remains an active subject of debate in the scientific community. The front portion of the corpus callosum has been reported to be significantly larger in musicians than no musicians', and tobe0.75 cm2 or 11% larger in left handed and ambidextrous people than right-handed people. This differences evident in the anterior and posterior regions of the corpus callosum, but not in the splenium .Other magnetic resonance morph metric study showed corpus callosum size correlates positively with verbal memory capacity and semantic coding test performance. Children with dyslexia tend to have smaller and less developed corpus callosum than their no dyslexic counter parts. Musical training has shown to increase plasticity of the corpus callosum during sensitive period of time in development. The implications are an increased coordination of hands, differences in white matter structure.(Web MD. July 18, 2010)

Epilepsy: Electroencephalography is used to find the source of electrical activity causing a seizure as part of the surgical evaluation for a corpus colostomy. The symptoms of refractory epilepsy can be reduced by cutting the corpus callosum in an operation known as a corpus colostomy**.**(James E. 2007)**.**This is usually reserved for cases in which complex or grand mal seizures are produced by an epileptogenic focus on one side of the brain, causing an interhemispheric electrical storm.(Web MD. July 18, 2010)

2-1-6otherdisease:

Anterior corpus callosum lesions may result in akineticmutism or tactile anomie. Posterior corpus callosum (splenium) lesions may result in alexia (inability to read) without graphic. The cerebral cortex is divided into two hemispheres, connected by the corpus callosum. A procedure to help patients alleviate the severity of seizures is called split-brain procedure. As a result, a seizure that starts in one hemisphere is isolated in that hemisphere, since a connection to the other side no longer exists.

2-1-7 History:

The first study of the corpus with relation to gender was by R. B. Bean, a Philadelphia anatomist, who suggested in 1906 that "exceptional size of the corpus callosum may mean exceptional intellectual activity" and that there were measurable differences between men and women. Perhaps reflecting the political climate of the times, he went on to claim differences in the size of the callosum across different races. His research was ultimately refuted by Franklin Mall, the director of his own laboratory(Bishop, Katherine M.; Wellston ,Douglas (1997). Of more mainstream impact was a 1982 *Science* article by Holloway and Taming that suggested sex difference in human brain morphology, which related to differences in cognitive ability (DelacosteUtamsing, C; Holloway, R. 1982).More recent publications in the psychology literature have raised doubt as to whether the anatomic size of the corpus is actually different. A meta-analysis of49 studies since 1980 found that, contrary to de Lacoste-Utamsing and Holloway, nose difference could be found in the size of the corpus callosum ,whether or not account was taken of larger male brain size.[23]A study in 2006using thin slice MRI showed no difference in thickness of the corpus when accounting for the size of the subject. (Ladders, Eileen; Nar, KatherineL.;Zaidel, Iran; Thompson, Paul M.; Toga, Arthur W., 2006).

2-2 physiology:

2-2-1 Physiology of the corpus callosum:

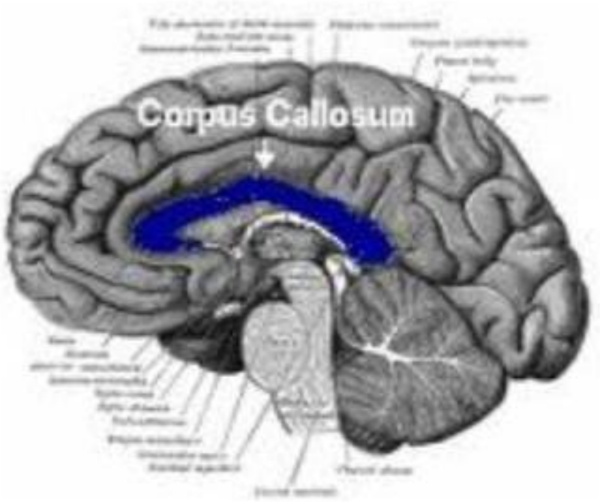


Fig (2-20) **Physiology of the corpus callosum**
o.tqn.com/d/biology/1/G/q/z/corpus-collosum.jpg

The **corpus callosum (CC)** links the cerebral cortex of the left and right cerebral hemispheres and is the largest fiber pathway in the brain. (Gouliamos A, 2007)

2-2-2**Gross anatomy:**

The corpus callosum is **~10cm** in length and is C-shaped, like most of the supra tutorial structures, in a gentle up warmly convex arch. It is divided into four parts (anterior to posterior):

Rostrum (continuous with the lamina terminals),genu, trunk/body and splenium.

2-2-3**Relations:**

Immediately above the body of the CC, lies the interhemispheric fissure in which runs the flax cerebra, the anterior cerebral easels. The superior surface of the CC is covered by a thick layer of grey matter known as the in dusiumgresume. On either side, the body is separated from cingulated gyres by the callosum sulks. Attached to the concave undersurface of the CC is the septum pellucid interiorly, and the fornix and its commeasure posterior. Although the CC can be seen as a single large fiber bundle connecting the two hemispheres, a number of individual fiber tracts can be identified. These include:

Genu: forceps minor connect medial and lateral surfaces of the frontal lobes.

Rostrum: connecting the orbital surfaces of the frontal lobes Trunk (body):

Pass through the corona radiate to the surfaces of the hemispheres. Trunk and splenium: tapetum**;** extends along the lateral surface of the occipital and temporal horns of the lateral ventricle. Splenium: forceps major; connect the occipital lobes. These connections can also be divided into: Homotopi connections those that link similar regions on each side e.g. visual fields of motor/sensory areas of the trunk. Heterotypic connection those that link the corpus callosum (CC) has a rich blood supply, relatively constant and is uncommonly involved by infarcts. The majority of the CC is supplied by the per callosum arteries (the small branches and accompanying veins forming the pericallosal moustache) and the posterior pericallosal arteries, branches from the anterior and posterior cerebral respectively. In 80% of patients additional supply comes from the anterior communicating artery, via either sub callosum artery or median callosum artery hypothalamic branch, which in addition to hypothalamus also supplies the medial portions of the rostrum and genu median callosum artery (30% of patients) can be thought of as amore extended version of the subcallosal artery, in that it travels along the same course, supplies the same structures but additionally reaches the posterior pericallosal artery (also known as splenium artery)supplies variable portion of the splenium. Its origin is inconstant, arising from P3or branches thereof. After periods of disinterest, neurosurgeons' attention to the corpus callosum has-been reawakened for a variety of reasons. For centuries, the large size, central location, and widespread connections of the corpus callosum stimulated investigations, which were motivated herapeutic considerations. Callosum physiology has more recently been important to surgeons concerned primarily with other structures, including those neighboring the third ventricle, which can be approached through the corpus callosum. in the generation of seizure. At the end of the 19th century and on two other separate occasions in the 20th century, colostomy was considered as treatment for seizure disorders. Before1900, less obviously around 1940, and most clearly in the1960s, these therapeutic considerations were stimulated by animal experimentation. One theme of this chapter is the reciprocal interaction of surgical therapy and laboratory experimentation: in particular, the most recent therapeutic use of colostomy has been accompanied by widespread physiological and psychological interest in this conspicuous brain structure. In this chapter we consider first a brief history of studies of the corpus callosum. Then follows a chronological account of interest in colostomy as a treatment for epilepsy. (Henry Gray, et al, 1995).

2-2-4 Studies of Callosum Function:

Studies of the corpus callosum were first undertaken by the Humeral Anatomists. These were the writers of antiquity whose concepts of brain function emphasized the contents of the brain cavities and the flow of various fluids such as air, phlegm, cerebrospinal fluid, and blood. For them, the corpus callosum seemed largely a supporting structure. This view persisted for millennium. mechanical support, maintaining the integrity of the various cavities. In 1543, he wrote: There is a part [whose] external surface is gleaming white and harder than the substance on the remaining surface of the brain. It was for this reason that the ancient Greeks called this part "tyloeides" ["callous" in Latin] and, following their example, in my discourse I have always referred to this part as the corpus callosum. If you look at the right and left of the brain, and also if you compare the front and rear, the corpus callosum is observed to be in the middle of the brain; Indeed, it relates to the right side of the cerebrum more than the left; then it produces and supports the septum of the right and left ventricles; finally, through that septum it supports and props the [fornix] so that it support it, so as to not collapse and, to the great detriment (observe and control as well as integrate with the other side) of all the functions of the cerebrum, crush the cavity common to the two [lateral] ventricles of the cerebrum (Thomas Willis ,1621-1675)that anatomists began thinking more in terms of a traffic or communication between the more solid parts of the brain. who wrote in 1784: "It seems to me that the commissars are intended to establish sympathetic communications between different parts of the brain, Justas the nerves do between different organs and the brain itself. For over two centuries, beliefs about callosum function consisted almost solely of inferences from its central location, widespread connections, and large size(larger than all of those descending and ascending tracts, taken together, that connect the cerebrum with the outside world). **(**Willis,Françoisde la Personae ,1678-1747), and (Giovanni Lances' ,1654-1720) thought the corpus callosum a likely candidate for "the seat of the soul," or they used some other expression intended to cover that highest or ultimate liaison(communication) The observations of the early anatomists have often been supported by subsequent anatomical observations, including the large number of callosum fibers (at least 200 million of them).Because the callosum fibers interconnect so much of the cerebral cortex, especially that cortex considered associative, it has often been suggested that they serve some of the "highest," most educable, and characteristically human functions of the cerebrum. Inference of function from observable structure is time-honored and productive; however, such inference has its limitations. The physiological evidence has only partially sustained anatomical inference. We now know from various observations (notably the split brain) that the corpus callosum is indeed an important integrative structure; we also know that it is neither sufficient (D.W. Roberts, et al, 1995).That the corpus callosum is not the exclusive "seat of the soul "is evident from the apparent normality in social situations of patients who have had complete colostomies. That it is an important integrating mechanism is peculiarities of such patients. These include, among other things, a unilateral tactile anomie, a left hemi alexia. And unilateral paraxial. Is, for the right-hander with complete colostomy, there is an inability to name objects felt with the left hand, an inability to read aloud written material presented solely to the left half-field of vision, and an inability to execute with the left hand actions verbally named or described by the examiner. The paraxial usually recedes in a few months, whereas the hemi alexia and unilateral an omiapersist for years. In the closing decades of the 19th century, there emerged a group of neurologists whose discoveries and formulations are still at the core of current clinical knowledge. Among them were Carl (Warnock, 1848-1905), (HugoLiepmann, 1863-1925), (Jujubes Dejerine, 1849-1917), and (Kurt Goldstein, 1878-1965), who interpreted various neurological symptoms as resulting from disconnection, including interruption of information flow through the corpus callosum. The concept of paraxial was developed by Lipmann expressly to describe patient who could carry out commands with one of his hands but not with the other. In 1908, Lipmann and Maas *26* described a right-handed patient whose callosum lesion caused a left paraxial as well as a left-handed graphic (an inability to write) in the absence of aphasia. These disabilities have subsequently been observed many times. Unilateral paraxial and unilateral graphic are not always present, and they may subside when a stroke victim progressively recovers, but they remain among the cardinal signs of callosum interruption.

Lipmann considered the corpus callosum instrumental in most left-hand responses to verbal command: the verbal instruction was comprehended only by the left hemisphere, and the left hand followed instructions delivered not by directly descending pathway (which we now call "ipsilateral control") but by arouse involving callosum interhemispheric transfer from left to right and then by right hemisphere control of the left hand (what we now call contra lateral control"). (D.W.Roberts, et al, 1995).Necessarily then, callosum interruption would result in an inability to follow verbal commands with the left hand, although there would be no loss of comprehension (as expected from a left hemisphere lesion) and no weakness or in coordination of the left hand (as could result from a right hemisphere lesion).This view was largely ignored or rejected (particularly in the English-speaking countries) for nearly half a century.(Norman Geschwind,1926-1984) suggested that there was a widest pared revulsion against attempts to link brain to behavior, associated with the rise of psychoanalysis (personal communication). He had another sociological explanation: Henry Head had been shrewd enough to point out that much of the great German growth of neurology had been related to their victory in the Franco Prussian war. He was not shrewd enough to apply this valuable historical less onto his own time and to realize that perhaps the decline of the vigor and influence of German neurology was strongly related to the defeat of Germany in World War I and the shift of the center of gravity of intellectual life to the English-speaking world, rather than necessarily to any defects in the ideas of German scholars. 19 As Harrington put it, 2l ways of thinking about the brain (i.e. laterality and duality) which seem natural enough now had "vanished from the working world view" for nearly 50 years. She has made available in scholarly detail the popularity of these ideas (laterality and duality) in the 19th century, and their eventual re-emergence in the 1960s. Chapter 9 of Harrington'sbook*2l*is devoted to the causes of this long eclipse. She was particularly critical of (Henry Head,1861-1940), whose highly selective reference to John Hugh ling Jackson, she wrote, "borders on intellectual dishonesty."Besides the sociological aspects, other factors were involved. There was widespread reluctance to consider callosum disconnection as the efficient cause of deficits such as unilateral paraxial or hemi alexia occurring in patients with lesions (e.g., tumors or infarctions) involving the corpus callosum. This reluctance developed in large part because surgical interruption of the corpus callosum had not been found to cause the same deficits. Walter (Dandy,1998-2001) went so far as to say in 1936: "The corpus callosum is sectioned longitudinally; no symptoms follow its division. This simple experiment puts amend to all of the extravagant hypotheses on the functions of the corpus callosum .Even more persuasive were the negative tests performed by (Andrew J.Akelaitis ,2004-2008)1 on patients who had callosum section. By the end of the1950s, Fissured summarized the view that was then generally accepted: "There Isa great deal of data showing [that] section of important associative white tracts such as the corpus callosum does not seem to affect mental performances. Other similar observations in man or animals are now accumulated in great number and variety. (D.W.Roberts, et al,2007).We no realize that most of the negative findings resulted from two sources:

1. When surgical section of the commeasures is incomplete, a remarkable capacity for maintaining cross-communication between the hemispheres may be retained with quite small commissural remnants, particularly when the part remaining is at the posterior end of the corpus callosum (in other words, the splenium). (D.W.Roberts, et al,2007).

2. Negative findings often result from the use of inappropriate or insensitive testing techniques. What one finds depends on what one looks for; although Dandy" said that callosum section produces no observable deficits, among his

own patients was one reported by Trencher and Ford to have hemi alexia. Essential to the resurrection of the callosum disconnection view was the ability to observe repeatedly and appropriately under controlled, prospective circumstances the results of colostomy in humans. This was facilitated by the use of complete colostomy as a treatment for epilepsy, which, in turn, had been made possible by cat and monkey experiments beginning in the 1950s.

Forty years of experimentation with laboratory animals and 30 years of experience with callosotomized humans have by now firmly established the principal features of callosum section and facilitated the more precise interpretation of deficits following naturally occurring lesions. (D.W.Roberts,et al,2007).

The impression is gained from this small number of observations that the type of case in which section of commissural fibers in the corpus callosum is most favorable is the one in which a large cortical or sub cortical scar exists.

2-3 imaging of corpus callosum:

2-3-1 CT/ MRI of the corpus callosum:

The usual morphological MRI sequences include a sagittal $T1$ or $T2$ (fluid attenuated inversion recovery ((FLAIR)) weighted plane, as well as DTIreformatting images for an optimal study of the CC, were implemented.MRI is the modality of choice for the study of the CC. As a densely packed white matter structure, the CC is visualized with a high signal in $T1$ weighted imaging (WI) and a low signal in $T2$ images. Sagittal plane images provide an overview of the structural integrity and extent of development of the CC, whereas in coronal images we can better evaluate its relationship to the cerebral hemispheres. Complete assessment of CC pathologies is facilitated by the acquisition of the following sequences: $T1$ WI, fast spin-echo (FSE) $T2$ WI, as well as FLAIR sequences and volume acquisition sequences with high resolution. New techniques such as DTI have further expanded our capability to visualize the organization and orientation of the axonal pathways of the CC with tract graph and quantitatively with the use of anisotropic indices of diffusion such as fraction anisotropy (FA) maps, permitting a better compare and analysis The use of susceptibility-sensitive sequences (susceptibility-weighting imaging((SWI)) plays an important role in the assessment of traumatic injury and other pathologies of the brain resulting in the deposition of blood products or calcium, including pathologies affecting the CC. Vascular ((three-dimensional (3D) time of-flight (TOF)) sequences, on the other hand, are essential in cases of ischemic or hemorrhagic lesions. Images after contrast media enhancement are not necessary for the study of malformations or viral infection is suspected, the MRI study, including perfusion sequences, should be repeated within 48–72 h after the initial study in order to confirm the diagnosis. CT imaging is important for the diagnosis of CC lipomas and other pathologies with calcium deposition and can also be useful for the diagnosis of tumor, hemorrhage or infarction; CT angiography is essential for the diagnosis of aneurysms responsible for hematomas, more commonly situated in the anterior part of the CC. (Romans, et al, 2011).

2-4 Previous Studies:

Study (1):

Measurement of the corpus callosum using magnetic resonance imaging in the north of Iran. (Mohammadi MR1 et al 2011. Iran)

This study was done to measure the size of CC and to identify its gender- and age-related differences in the North of Iran The size of CC on midsagittal section was measured in 100 (45 males, 55females) normal subjects using magnetic resonance imaging (MRI) admitted to the Kowsar MRI center in Gorgas-Northern Iran. Longitudinal and vertical dimensions of the CC, longitudinal and vertical lengths of the brain and the length of genu and splenium were measured.

The anteroposterior length and vertical dimension of the CC, the length of genu and splenium were larger in males than in females, but these differences were not significant. The anteroposterior and vertical lengths of the brain were significantly larger in males than in females ($P < 0.05$). The length of CC increased with age and regression equations for predicting age were derived from the length of the CC. There was also a positive significant correlation between the anteroposterior length of the CC and the length of the brain and vertical dimension of the CC

Study (2)

Corpus callosum: normal imaging appearance, variants and pathologic conditions.

(Battle, et *al* 2010)Various types of lesions can occur within the corpus callosum (CC) which is a white matter tract communicating corresponding regions of the cerebral hemispheres. Magnetic resonance imaging is the modality of choice for the evaluation of the CC. In addition, diffusion weighted imaging and diffusion tensor imaging can provide additional information about the CC. The aim of this study is to illustrate the imaging features of the corpus callosum and its pathologies.

Study (3)

MR imaging of the corpus callosum: normal and pathologic findings and correlation with CT. By: (Reinarz et al -1988).

The MR appearance of the corpus callosum was investigated in 80 normal volunteers. Normal variations in appearance were recorded with regard to age, gender, and handedness. The MR studies of 47 patients with a wide spectrum of callosum disease were also reviewed. Abnormalities included trauma, neoplasia, congenital abnormalities, vascular lesions, and demyelinating and inflammatory conditions. The information provided by MR was compared with that obtained from other radiographic examinations, particularly CT and angiography. In all cases MR provided as much, and frequently more, information than was obtained by other imaging techniques. We believe that MR should be the primary imaging technique for the evaluation of corpus callosum disease.

Study (4)

Sex differences in corpus callosum size: relationship to age and intra cranial size.

(Sullivan, Margaret J et al 2001. USA)Report this study MRI to measure the body callosum in 51 healthy male. And41 female in good health, stretched from the age of 22 years old to 71years old, The results of the measurement of body size callosum in males larger than females.

CHAPTER THREE

Materials and Methods

3-1Materials:

This descriptive study ,about the corpus callosum ,the main objective were to obtain measurement of corpus callosum ,to know the normal measurement ,and used this information to diagnosis, the data were collected form radiology department of modern medical center and royal care international hospital, the study was carried out in the(Sudan Khartoum state) the study duration form january2016 to January 2017.

3-1-1 patients:

the patient population consist of 50 male and 50 female with age ranging from (20 to 70),normal patient full history taken from each patient. Patients with brain diseases and patient metallic prosthesis.

3-1-2 Machine used:

The machine used in this study GE (general electrical) GE medical system 2004 1.3Tesla. (Both close machine)

3-2 Method:

The data were collected from the patient refer to MRI scan , and before scan ,weight of PT and height were measured using measuring devised firstly all the patient were prepared remove from any metallic object and enter the room for scan.

3-2-1technique:

patient lying supine on the couch , The patients were positioned so that the longitudinal alignment light lies in the midline and the horizontal alignment light passes through the nasion, straps and foam pads are used for immobilization, door was closed to complete the scan ,the protocol was used form the computer system ,it differs according to hospital and radiographer worker.

3-2-2 image interpretation:

The corpus callosum was measured from sagittal T1weight image length and thickness(gnu ,splenium and body) the technical used to measure length from gnu to splenium and the thickness divided to gnu body and splenium ,this method similar to the method don by**. (**Mohammadi MR1 etal 2011. Iran) on his study about Measurement of the corpus callosum using magnetic resonance imaging in the north of Iran.**:**

Data collection according to work sheet (appendix1) and (appendix1) include figure to show way of measureme**nt.**

3—2-3 Data analyses:

Data collection according to work sheet (appendix1) and (appendix1) include figure to show way of measureme**nt.** Descriptive statistic using statistic package (spss).

Chapter four

Results

Table (4-1): Distribution frequency and percentages according to Age

Age	*Frequency*	*Percent(%)*
10-20	25	25.0
20-30	20	20.0
30-40	15	15.0
40-50	10	10.0
50-60	10	10.0
60-70	20	20.0
Total	***100***	***100()***

Mean age = 37.89

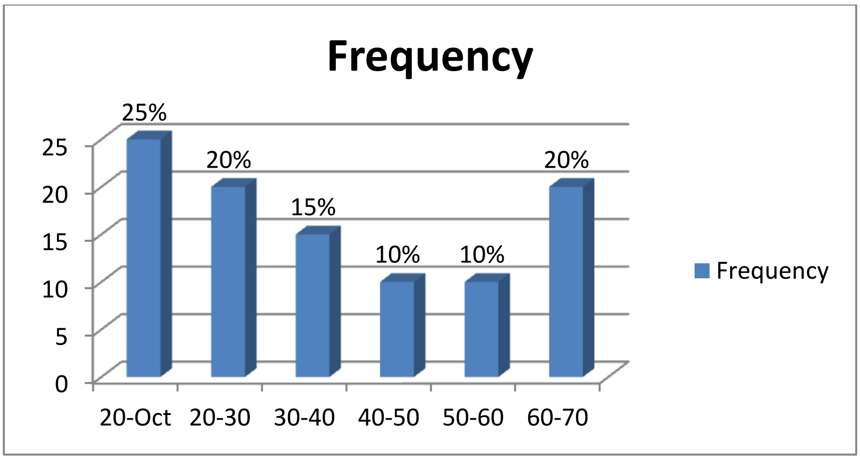


Fig (4-1) : Distribution frequency and percentages according to Age.

Table (4.2) Distribution of ages and CCI and thickness genu and thickness body and thickness splenium

	Age	Cc length	Thickness Aa	Thickness body Bb	Thickness splenium	Cci
Mean	37.89	75.7533	17.5447	6.8971	16.7647	.5334
Std. Deviation	20.6163	7.13869	2.13980	1.08507	2.45778	.08942

Table (4-3) Cc length, Thickness genu Aa, Thickness

Body Bb, Thickness splenium cc, CCI table for variables distribution according to age.

Descriptive							
		N	Mean	**Std. Deviation**	**Minimum**	**Maximum**	**P – value**
Cc length	10-20	25	62.3417	5.33209	55.38	67.95	.000
	20-30	20	76.4650	4.96783	66.99	86.27	
	30-40	15	72.8816	8.41926	46.90	82.77	
	40-50	10	75.3285	4.41351	68.46	82.93	
	50-60	10	80.7308	6.34523	74.71	93.74	
	60-70	20	78.5214	5.19045	68.06	89.73	
	Total	100	75.7533	7.13869	46.90	93.74	
Thickness genu Aa	10-20	25	15.0950	1.21535	13.18	16.17	.013
	20-30	20	17.3911	1.69320	14.64	19.74	
	30-40	15	18.2016	2.01853	15.10	21.52	
	40-50	10	18.4354	2.16693	15.06	21.77	
	50-60	10	18.0308	2.28717	14.60	21.19	

	60-70	20	17.0495	2.36910	12.95	22.45	
	Total	100	17.5447	2.13980	12.95	22.45	
Thickness body Bb	10-20	25	5.9500	.82808	4.89	6.83	.005
	20-30	20	6.6546	1.00530	4.24	7.81	
	30-40	15	7.4300	1.09337	5.16	9.69	
	40-50	10	7.2785	.74178	6.21	8.52	
	50-60	10	7.2975	1.09447	5.47	8.52	
	60-70	20	6.5600	1.10860	4.44	9.44	
	Total	100	6.8971	1.08507	4.24	9.69	
Thickness splenium cc	10-20	25	12.0967	4.02092	4.78	15.48	.000
	20-30	20	16.4471	1.64376	13.52	20.72	
	30-40	15	16.9089	2.44413	8.88	20.40	
	40-50	10	17.3400	1.50774	15.14	19.91	
	50-60	10	18.2442	2.82233	15.37	23.46	
	60-70	20	17.1705	1.59846	14.60	22.09	
	Total	100	16.7647	2.45778	4.78	23.46	
CCI	10-20	25	.5585	.03392	.51	59	.028
	20-30	20	.5312	.03544	.45	.59	
	30-40	15	.5707	.03455	.51	.64	
	40-50	10	.5709	.04779	.48	.63	
	50-60	10	.4939	.16392	.00	.64	
	60-70	20	.4964	.12151	.00	.62	
	Total	100	.5334	.08942	.00	.64	

Table (4-4) : Distribution frequency and percentages according to Gender

	Frequency	***Percent(%)***
Male	50	50.0
Female	50	50.0
Total	***100***	***100()***

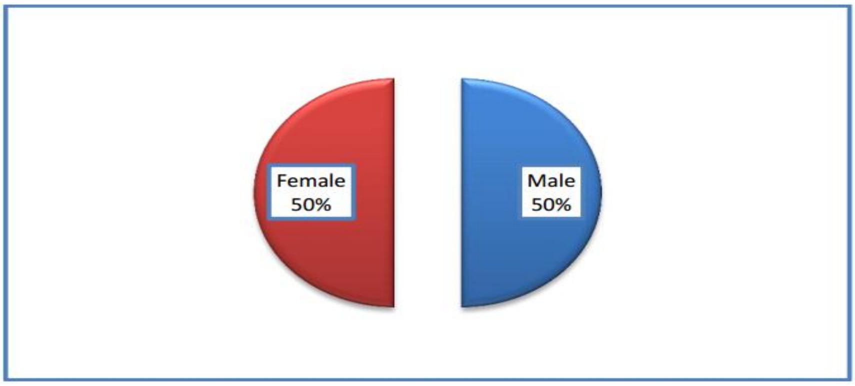


Figure (4-2) by graph show gender details

Table (4-6) display table for variables distribution according to gender

	Total	100	100.3041	8.18333	57.25	116.89	
Cc length	Male	50	74.2446	7.88008	46.90	89.73	.034
	Female	50	77.2620	6.01837	58.05	93.74	
	Total	100	75.7533	7.13869	46.90	93.74	
Thickness genu Aa	Male	50	17.4778	2.11141	13.18	22.45	.756
	Female	50	17.6116	2.18718	12.95	21.77	
	Total	100	17.5447	2.13980	12.95	22.45	
Thickness body Bb	Male	50	6.8532	1.00520	4.89	9.69	.688
	Female	50	6.9410	1.16808	4.24	8.53	
	Total	100	6.8971	1.08507	4.24	9.69	
Thickness splenium cc	Male	50	16.1350	2.47159	4.78	22.09	.010
	Female	50	17.3944	2.29928	8.88	23.46	
	Total	100	16.7647	2.45778	4.78	23.46	
CCI	Male	50	.5334	.08674	.00	.62	.995
	Female	50	.5333	.09291	.00	.64	
	Total	100	.5334	.08942	.00	.64	

Chapter five

5-1. DISCUSSION

This chapter discus the result in table (4-1), the study results were presented for the measurements related to age class's .The relations between the corpus callosum (CC) parameters and Index with age was found to be significant atp0.005. That means that the age has an impact on the (CCI).Age -related changes in (CC) morphology are controversial. Although many studies have concluded that age- related callosum thinning is modest (Johnosnetal 1994).Some studies have reported that it is statistically significant. (Weis, etal , 1993) reported statistically significant thinning of genu, body and splenium with age on MRI study of mid sagittal brain sections, our results were similar to these previous results. A knowledge of the normal (CC) morphology and the gender as well as age related changes, thus is likely to be helpful in providing baseline data for the diagnosis of presence of any pathological changes The goal of this work was to provide gender-specific reference data detailing the development of the corpus callosum on MRI of hundred healthy Sudanese subjects aged 37.89years.

table (4-4)about gender of normal subject ,result found that the frequency of male is 50 and 50 female is no deferent in CC this finding similar to .(Leonard , Takeda , et al 2003 ,2008) ,stating that no deference between males and females in CC, Ferraris et al have reported that effects are meaningful considering the age increase, while no meaning in respect to genders,(Ferrario , et al 1996) .This was consistent with our findings. there are groups stating that there are differences between male and female in respect to (CC) morphometry,(SeBellis et al , 2001) Knowledge of (CC) morphology and the gender as well as age-related changes, thus is likely to be helpful in providing baseline data for the diagnosis

of presence and progression of disease. Several studies have found significant sex differences in the length, shape and area of the corpus callosum of males and females; with females having larger relative splenium width. Which is similar to findings in Sudanese in table(4-6) . Justification for our study results was that the sexual dimorphism in (CC) might be due to greater bi-hemispherical representation of cognitive functions in females. (Sullivan, et al, 2001). (DeLacoste-Utamsing and Holloway, 1982)found the splenium to be larger in females. The previous studies results concerning differences in absolute measures have infrequently been replicated [19,20] Still the direction of non-significant absolute size differences in the(CC) is not consistent, with some studies showing larger measures in males[Witelsion, Demeter (1985,1988) others in females (Holloway, Deneberg, et al1986,1991).The sexual dimorphism of the human corpus callosum (CC) is currently controversial, possibly because of difficulties in morph metric analysis. (Clarke et al ,1989) The controversies may be due to differences in race of subjects under study or differences in the method of measurement.

5-2 CONCLUSION

This study about corpus callosum in normal Sudanese population using MRI T1 weighted multi section sagittal conventional to give better accurate estimate of normal measurement to used this information to diagnosis. As the result is no significant difference in corpus callosum between both male and female gender measurements -in CCI .there is a little difference in the size of the corpus callosum with age

5-3 RECOMMENDATION:

-To study the measurement in large group of patient

-Used the MRI machine for measurement compare with other modalities.

-measure meant of corpus callosum in pediatric compare with adult using MRI.

5-4 REFERENCES:

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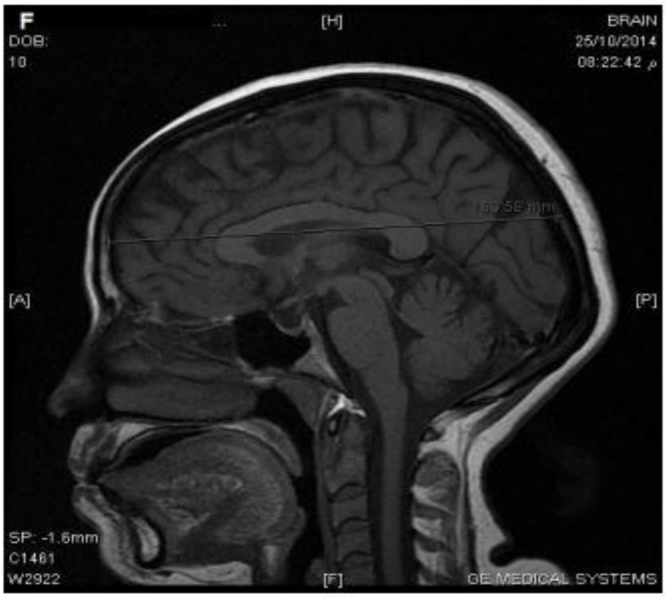
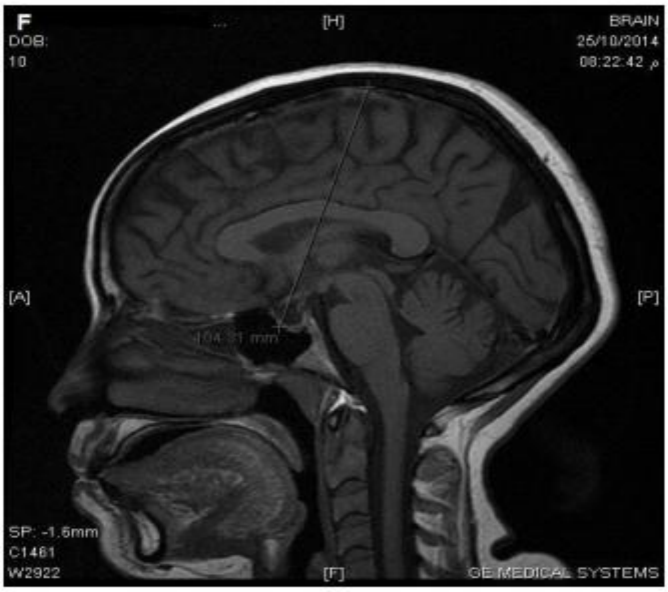
5-5 APPENDICES

Appending (1)



In figure (1)Female age 42 year old – sagittal T1 of CC
Measure was taken in italics passing through the body.(109.58mm).



In figure (2) Female age 42 years old Measurements was taken casual line going through Genu and splenium.(104.31mm).

In figure (3) Female The corpus callosum measure starting from Genu until splenium.(77.21mm).

In figure (4) Female Measurements was taken in italics began in Genu and ended with Rostrum.(17.71mm).

In figure (5) Female The body was taken to measure vertical line.(7.00mm).

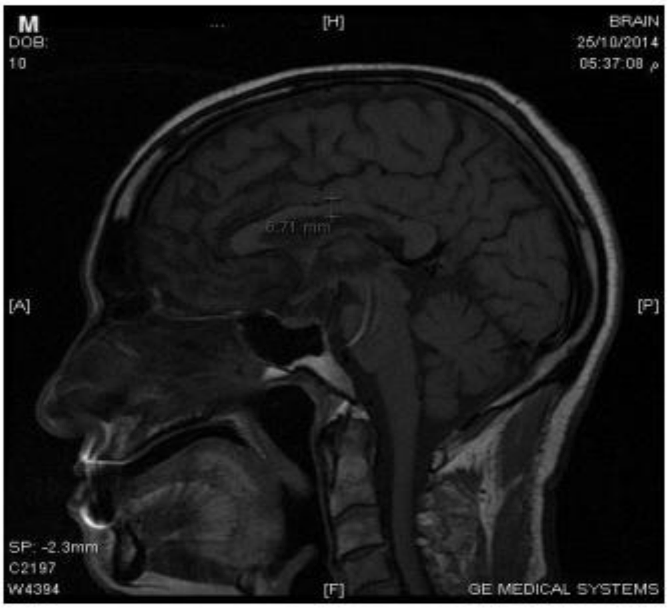
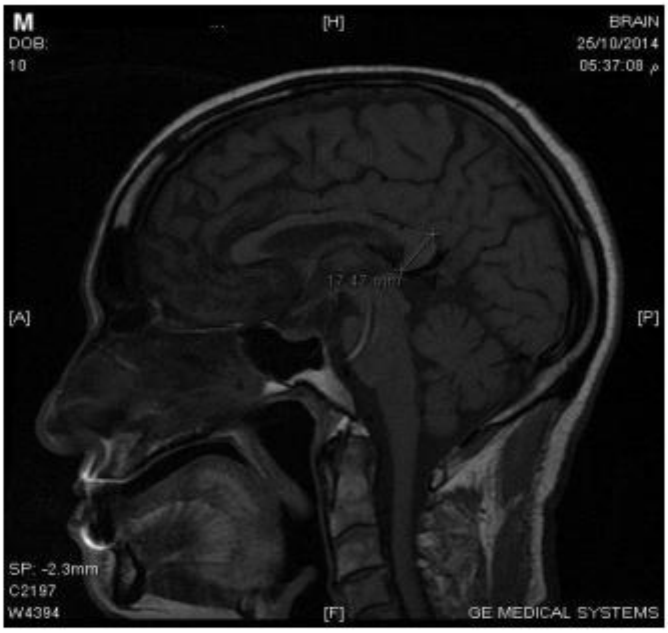


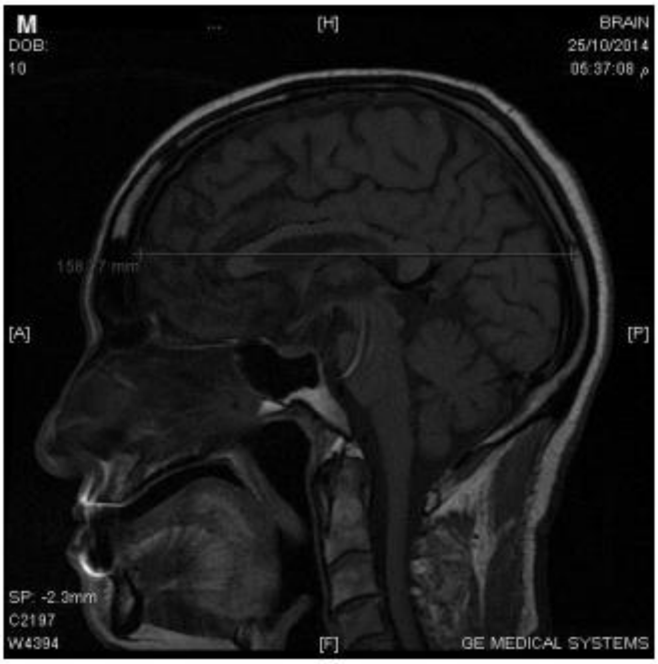
Figure (6) Female Splenium measure was taken in italics.(6.71mm).



In figure (9) Male Measurements was taken in italics began in Genu and ended with Rostrum.(17.47mm).

In figure (10) Male
Splenium measure was taken in italics.(6.71mm).

In figure (12)Male – age 47 years old Measure was taken in italics passing through The body.(107.09mm).



In figure (13)Male Measurements was taken casual line going through Genu and splenium.(158.27mm).

Figure (17) Magnetic resonance imaging in the user's machine samples.

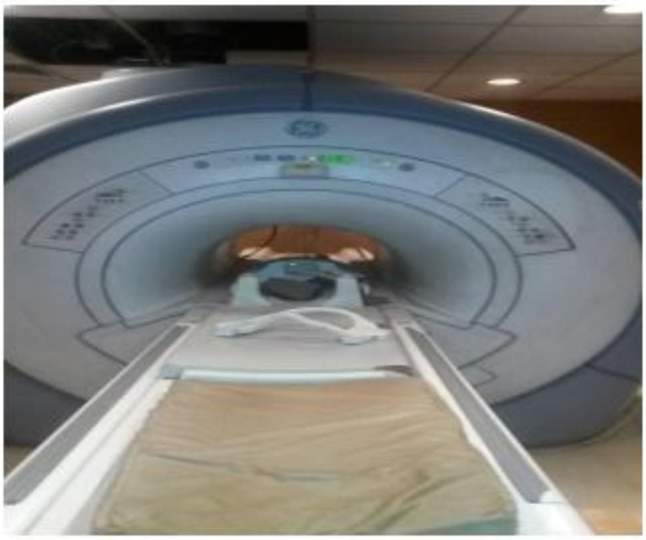


Figure (18) Magnetic resonance imaging in the user's machine samples.

Appendix (2)

Chart of data Collection as proposal to be filled

م		age	Cc length	Thickness genu Aa	Thickness body Bb	Thickness splenium cc	Cci Aa+ bb+ cc AP
م		age	Cc length	Thickness genu Aa	Thickness body Bb	Thickness splenium cc	Cci Aa+ bb+ cc AP