Sudan University of Science and Technology

College of Graduate Studies

The study of Hydrocephalus by using CT Scan in Sudanese population

دراسة مرض إستسقاء الرأس بإستخدام الأشعة المقطعية لدى السودانيين

A Thesis Submitted for Partial Fulfillment of the Requirements of The M.Sc. Degree in Diagnostic Radiologic Technology

By

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الاية الكريمة

(فَتَعالى اللهُ المَلِكُ الحَقُّ * وَلَا تَعْجَلْ بِالقُرآنِ مِنْ قَبْلِ أَنْ يُقْضَى إِلَيْكَ وَحْيُهُ * وَقُّلْ رَبِّ زِدْنِي عِلْمَا)

صدق الله العظيم

سورة طه الآية (114)

Dedication

_to my mother
_to my father
_to my sister
_ to my friends

Acknowledgement

Grateful thanks and grace to Allah, the Almighty for guiding and helping me to finish this research

I would like also to express sincere thanks and gratitude to my supervisor ***Dr. Salah A. Fadlalla*** *for his supervision, guidance and valuable comments and support from the idea of this research unital finishing*

Special thanks to Yastabshiroon Hospital and Police Central Hospital for grating me free access to use their facilities.

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CMV	cytomegalovirus
CNS	central nervous system
CSF	cerebrospinal fluid
CT	computed tomography
ETV	endoscopic third ventriculostomy
ICP	intracranial pressure
INPH	idiopathic normal pressure hydrocephalus
IVH	intraventricular hemorrhage
LP	lumboperitoneal
MRI	magnetic resonance imaging
MS	multiple sclerosis
NPH	normal pressure hydrocephalus
Pco2	partial pressure of carbon dioxide
RBCs	red blood cell
SAH	subarachnoid hemorrhage
US	ultra sound
VA	venriculo_artrial
VBR	ventriculo-brain ratio
VJ	ventriculo jugular
VP	ventriculopertoneal
WBCs	white blood cells

مستخلص الدراسة

يعتبر مرض استسقاء الرأس من الأمراض التي تصيب الصغار بصفة أساسية وأحياناً يصيب كبار السن وهنالك العديد من أنواع الفحوصات التي تستخدم لتشخيص ذلك المرض والهدف من هذا البحث هو دراسة قدرة الأشعة المقطعية في تشخيص المرض وتحديد أسبابه.

أجريت الدراسة في مستشفى يستبشرون ومستشفى الشرطة بالخرطوم خلال الفترة من أكتوبر 2016م حتى يناير 2017م وتم أخذ عينة من (50) مريضاً (21 ذكور، 29 إناث) من مختلف الأعمار وكان اختيار المرضى مبنياً على التقارير الطبية لصور الأشعة المقطعية الخاصة بالمرضى في كلاً من المستشفيين.

كشفت الدراسة دور الأشعة المقطعية في تشخيص مرض استسقاء الرأس من حيث الأسباب وتحديد الانغلاق البطيني في المخ من مختلف الأعمار.

أوضحت الدراسة أن السبب الأساسي لهذا المرض هو جيني ولادي وشكلت الأدوى (36%) من الأسباب بينما كانت هنالك أسباب غير معروفة.

أوضحت الدراسة أيضاً استسقاء الرأس غير التوصيلي قد شكل (60%) من العينة والتوصيلي (40%).

أوصت الدراسة من ضمن أشياء أخرى بالاستفادة من التصوير بالرنين المغنطيسي لتشخيص استسقاء الرأس ذي الأسباب غير المعروفة. كما أوصت باجراء دراسة مستقبلية على عينات أكبر وفي أماكن أخرى.

Abstract

Hydrocephalus is the common disease which effects pediatric and elderly people. many studies are usually used to detect this disease. This research aimed to study the hydrocephalus using the computed tomography (CT) modality.

The study was carried out at Yastabshiroon Hospital and Police Central Hospital in Khartoum, during the period from October 2016 to January 2017.A random sample of 50 patients (21 males and 29 females) with different ages was included in the study. The patients selection was based on the diagnostic reports at the CT departments of both hospitals.

The study revealed the significant of CT in the diagnosis of hydrocephalus, in term of the causes determination of the ventricular block among different ages the patients under study . was congenital genetic facto . Other causes include infection (36%) and unknown cause .

The result showed the non-communicating hydrocephalus constituted 60% and the communicating type constituted 40% of the study sample .

Finally, the study recommended among other things_ the utilization of MRI modality for the study of hydrocephalus of unknown cause , and conducting future study on greater sample on other places .

Chapter one

Introduction

Chapter one

Introduction

1.1 Hydrocephalus:

Hydrocephalus is buildup of too much cerebrospinal fluid (CSF) in the brain, normally, this fluid cushions the brain.

There are two kinds of hydrocephalus:

congenital hydrocephalus present at birth causes include genetic problems with how fetus develops, an unusually large head is the main sign of congenital hydrocephalus can occur at any age cause can include head injury, stroke infections, tumors and bleeding in the brain hydrocephalus can permanently damage the brain, causing problems with physical and mental development, if untreated, it is usually fatal. With treatment many people lead normal lives with few limitations. Treatment usually involves surgery to insert shunt, Medicine and rehabilitation can also help.

Hydrocephalus is result of imbalance between the formation and drainage of cerebrospinal fluid (CSF) Approximately 500- milliliters (about a pint) of CSF is formed within the brain. Each day by epidermal cell structure collectively called the choroid plexus.

There are three different type of hydrocephalus in the most common verity reduced absorption occur when are of more passage connecting the ventricles become blocked .this prevent the movement of CSF to it is drainage site in subarachnoid space just inside the skull .this type of hydrocephalus is called non communicating in a second type .a reduction in the absorption rate is caused by damage absorptive tissue.

This variety is called , communicating hydrocephalus both of these types lead to an elevation of the CSF pressure patches aside the soft tissue in the brain .this squeeze and distorts them .this process also result in damage of these tissue.

Hydrocephalus may be suggested by symptoms; however. Imaging studies of the brain are the mainstay of diagnosis. Computed tomography (ct) and magnetic resonance imaging (MRI) typically reveal enlarged ventricles and may indicate a specific cause. Abnormalities such as tumours and haemorrhage can also be detected. Small abnormalities that may not be detected using ct scan, such as cyst and abscess, are often seen with MRI. CT and MRI can also help the neurosurgeon differentiate between communicating and non commentating hydrocephalus . in cause of suspected normal pressure . A cisterngram elevates the dynamic of CSF flow in the brain and spinal cord.

Acquired hydrocephalus can occur at any age . the condition may cause CSF obstruction and subsequently acquired hydrocephalus can be presented in haemorrhage , brain trauma ,brain tumour , cyst , infection hemorrhage , traumatic barin injury , and infection are seen in some premature births: premature births may be a risk factor for hydrocephalus .

The symptoms of hydrocephalus are determined by factor such as age, degree of ventricular enlargement , rate of hydrocephalus development , type and underlying condition .

1.2 objectives of study:

1.2.1 General objective:

The aim of this study was to study the role of CT in classification and study conformation of underline cause of hydrocephalus

1.2.2 Specific objectives:

- To show the role of CT in investigation of hydrocephalus
- To correlate hydrocephalus with age .
- To measure size of ventricle of the brain
- To detect the clinical signs and symptoms of hydrocephalus .
- To classify types of the hydrocephalus .

1.3 Importance of study:

Computed tomography CT scan creates an image of the brain by using x-ray and special scanner .It is safe ,reliable,painless,and relatively quick (about 5 min). An x ray beam passes through the head , allowing a computer to make an image in the brain . A CT will show if the ventricles' is enlarged or blocked .

1.4 organization of the study:

- **Chapter one:** introduction.
- **Chapter tow:** literature review .
- **Chapter three:** materials and methods .
- **Chapter four:** results .
- **Chapter five:** discussion , conclusion and recommendation .
- References.
- Appendices

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Theoretical Background:

2.1.1 Anatomy of CSF and ventricles:

There are two lateral ventricles. The lateral ventricles are C shaped structure (with a tail) that is deep in the cerebral hemispheres. The part of the lateral ventricle include the anterior or frontal horn, the body , the trigone or atrium the posterior or occipital horn and the inferior or temporal horn . Each lateral ventricle communicates with thin single midline 3rd ventricle by their interventriculer foramen of monro . the 3rd ventricle connected to the 4th ventricle by the cerebral aqueduct of sylvius . the 4^{th} ventricle communicates with subarchnoid space by a medial aperture , the foramen of megendie and two lateral apertures, the foramen of luscchka. (Alfred aschoff et al,1999) .

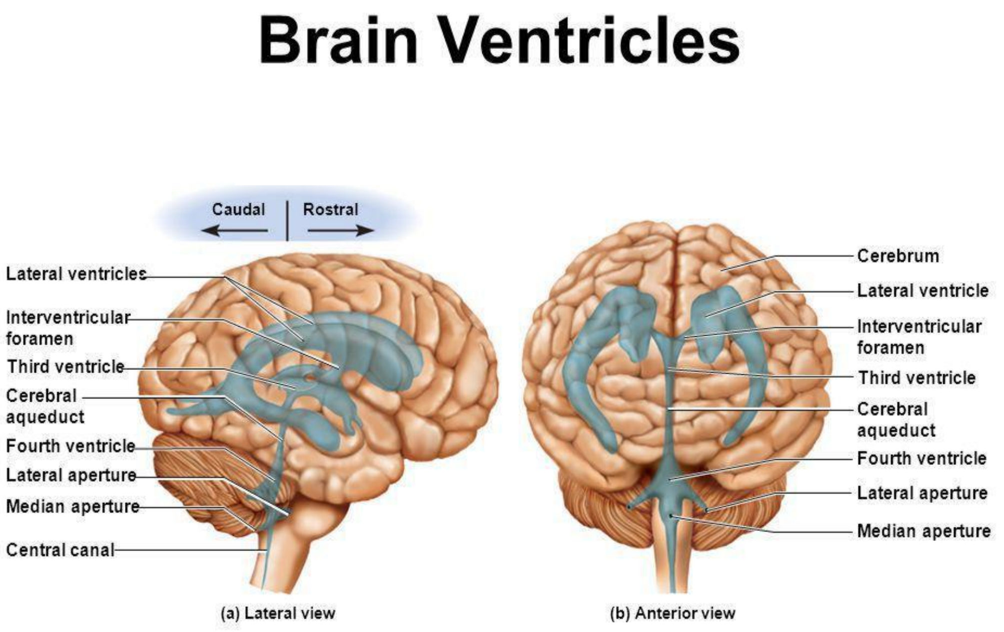


Fig (2.1) anterior and lateral views of brain ventricles

Most of CSF is formed by the choroid plexus. In the lateral ventricle, the choroid plexus is a continues structure that is found on the floor of the body and anterior trigone and the superior medial aspect of the temporal horns.

The choroid plexus of the lateral ventricles travel through the foramen of monro and is continuous with the choroid plexus found in the roof of 3rd ventricle. There is also choroid plexus in the roof of the 4th ventricle . (Alfred aschoff et all.1999)

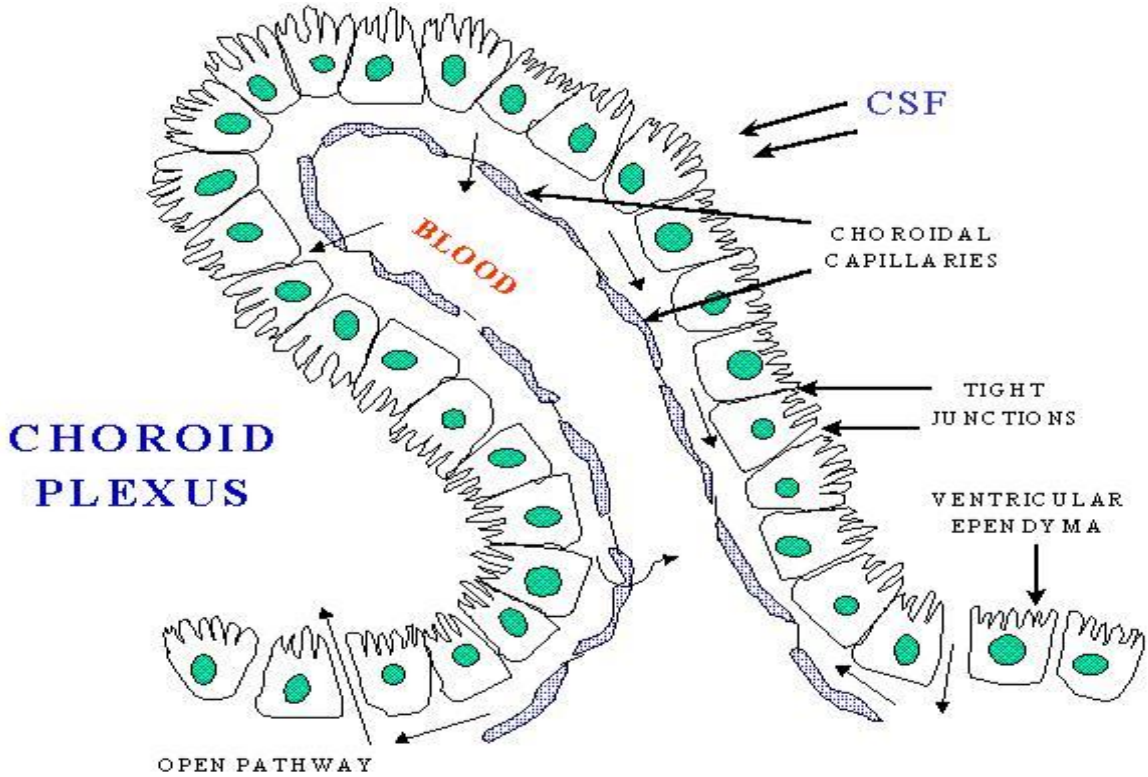


Fig.(2.2) Shows choroid plexus

Some of the CSF flows down around the spinal cord in the subarchnoid space . the spinal nerve roots traverse the CSF space and CSF surrounds the nerve roots as they exit through the dura. Some of CSF in absorbed trough archnoid villi that empty into ridicular veins . the conus medularies of the spinal cord is usually located at the inferior aspect of l1 vertebra body and the lumber and sacral spinal nerve roots from cuda equnia below this level

The CSF space around the cauda equnia is the lumber cistern .approxamilaty 30ml of CSF surrounds the spinal cord with the most of the volume located in the lumber cistern . (Alfred aschoff et al,1999).

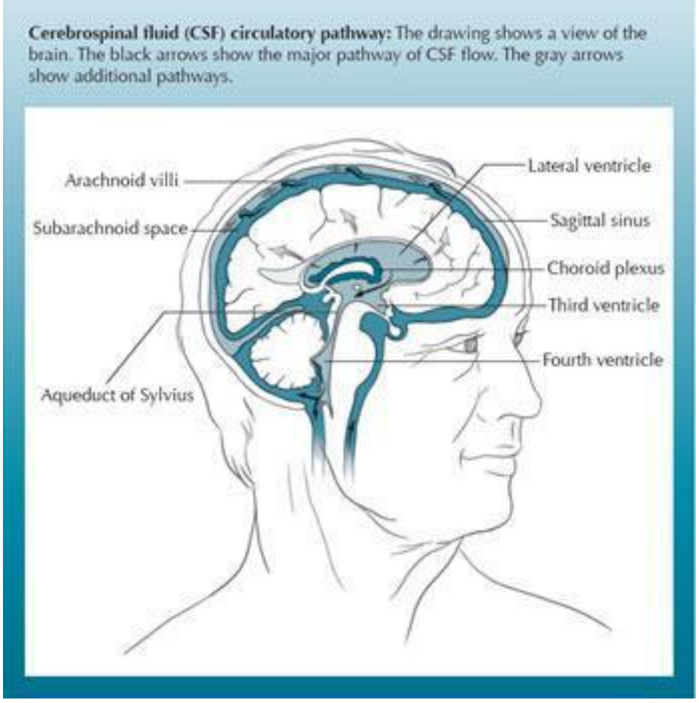


Fig (2.3) the pathway of cerebral spinal fluid (CSF)

Cisternal spaces are enlargement of the subarachnoid space and they contain 'pools' of CSF . total CSF volume for the adult brain approxamillty 150ml with 25 ml of the total in ventricles and 75 ml in cisterns(Alfred ashcoff et all 1999).

The ventricles are filled with cerebrospinal fluid (CSF) Which provides the following functions: absorbs physical shocks to the brain, distribution nutritive materials to and remove wastes from nervous tissue and provide chemically stable environment.(Alfred aschoff et all 1999).

The CSF circulates from the lateral ventricles (where the most CSF is produced) to the third and then fourth ventricles. From the forth ventricle. Most of CSF passes into the subarachnoid space . a space within lining (meninigs) ofthe CSF return to the blood through the subarchnoid villi located in the Dural sinuses of the meanings,(alberto j espay,2010).

There are four cerebral ventricles: the parried lateral ventricles and the midline third and fourth. The tow lateral ventricles , located within the cerebrum , are relatively large and C shaped , roughly wrapping around the dorsal aspects of te basal ganglia . it is in the lateral ventricles of the embryo that the successive generation of neurons gives rise to the 6-layered structure of the neocortex , constructed from the inside our during development (alberto j empasy, 2010)

Hydrocephalus (known colloquially as water in brain)is an extremely serious condition due to both the damage caused by the pressure as well as nature of whatever caused the block (e.g. a tumour or inflammatory swelling) the cavity of cerebral hemisphere are called lateral ventricles or 1&2 ventricles . these tow ventricles open commonly into 3 ventricles by a common opening called foramen of Monroe (alberto j empasy 2010).

2.1.2 Development of ventricles:

Neural The structures of the ventricular system are embryologically derived from the canal, the centre of the neural tube.

As the part of the primitive neural tube that will develop into the brainstem, the neural canal expands dorsally and laterally, creating the fourth ventricle, whereas the neural canal that does not expand and remains the same at the level of the midbrain superior to the fourth ventricle forms the cerebral aqueduct. The fourth ventricle narrows at the obex (in the caudal medulla), to become the central canal of the spinal cord. In more detail, around the third week of development, the embryo is a three-layered disc. The embryo is covered on the dorsal surface by a layer of cells called ectoderm. In the middle of the dorsal surface of the embryo is a linear structure called the notochord. As the ectoderm proliferates, the notochord is dragged into the middle of the developing embryo. The notochord becomes a canal within the embryo known as the neural canal.

As the brain develops, by the fourth week of embryological development several swellings have formed within the embryo around the canal, near where the head will develop. These swellings represent different components of the central nervous system, and are three in number: the prosencephalon, mesencephalon and rhombencephalon. These in turn divide into five sections. As these sections develop around the neural canal, the inner neural canal becomes known as *primitive* ventricles. These form the ventricular system of the brain The neural stem cells of the developing brain, principally radial glial cells, line the developing ventricular system in a transient zone called the ventricula zone]

The prosencephalon divides into the telencephalon, which forms the cortex of the developed brain, and the diencephalon. The ventricles contained within the telencephalon become the lateral ventricles, and the ventricles within the diencephalon become the third ventricle.

The rhombencephalon divides into a metencephalon and myelencephalon. The ventricles contained within the rhombencephalon become the fourth ventricle, and the ventricles contained within the mesencephalon become the aqueduct of Sylvius.

Separating the anterior horns of the lateral ventricles is the septum pellucidum: a thin, triangular, vertical membrane which runs as a sheet from the corpus callosum down to the fornix. During the third month of fetal development, a space forms between two septal laminae, known as the cave of septum pellucidum (CSP), which is a marker for fetal neural maldevelopment. During the fifth month of development, the laminae start to close and this closure completes from about three to six months after birth. Fusion of the septal laminae is attributed to rapid development of the alvei of the hippocampus, amygdala, septal nuclei, fornix, corpus callosum and other midline structures. Lack of such limbic development interrupts this posterior-to-anterior fusion, resulting in the continuation of the CSP into adulthood.

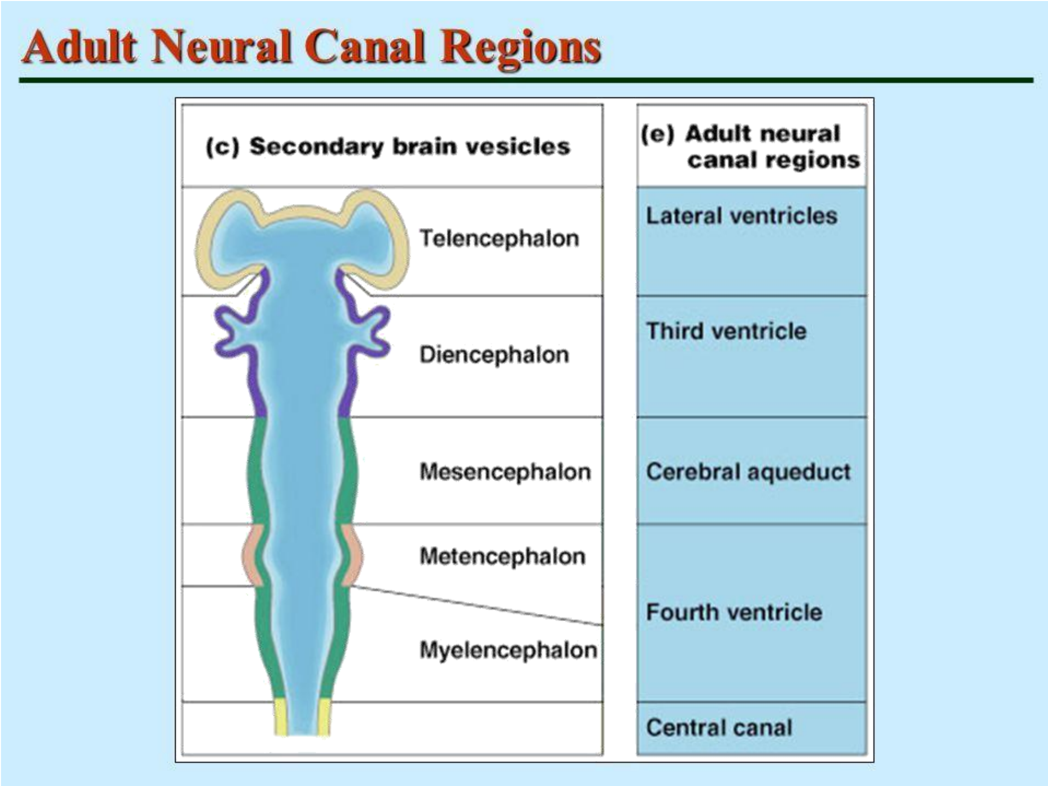


Fig (2.4) shows the devolpment of neural canal

2.1.3 Physiology of CSF and ventricles:

Cerebral spinal fluid (CSF) produced at a rate of 20ml per hour by the choroid plexus , CSF is located in all four ventricles . Fluid flows from the tow lateral ventricles via the foramen of monro into the third ventricle , then through the aqueduct of salvias into the forth ventricles . it ten exist via three small opening into the subarachnoid space where it circulates around the surface of the spinal cord and brain.

CSF is reabsorbed by the arachnoid villi in the subarachnoid apace into the cerebral venous system to maintain a constant volume and intracranial pressure within the brain csf function to clusion and support the brain . and it play an important role in the brain metabolism . approxamility 140ml of CSF is contained within the ventricles (relkin et al. 2005).

CSF volume is 150cc (25cc in ventricles) 450 cc is produced per day arachnoids granulations absorb if pressure is 3-6cmH2O above venous pressure . Normal pressure is 10-15cmH2O in children: 20-30 cmH2O when sitting . secretion increased by CO2 and volatile aesthetics secretion decreased by NE and carbonic anhydrase inhibitor . (relkin et all 2005).

Cerebrospinal fluid (CSF) is considered a part of the transcelluer fluids, it contained in the ventricles and subarachnoid space and bathes the brain and spinal cord . contained within meninges and acts as a cushion to protect the brain from injury with position or movement . it has been estimated that this ater bath effect gives the 1400g brain an effective net weigth of only 50g(relkin et all 2005). The total volume of CSF is 150mls . the daily production is 550mls/day so the volume of CSF turns over about 3 to 4 times per day. The CSF is formed by choroid plexus (50%) the wall of the ventricles (50%) CSF flows through the foramens of megendie & luschka into the subarchnoid space of the brain and spinal cord . it is absorbed by the archnoid villi (90%) and directly into cerebral venules (10%).

The normal intracranial pressure (icp) is 5 to 15 mmhg . the rate of formation of CSF is constanent and is not effected by ICP .. absorption of CSF increases linearly as pressure rises above about 7 cmsH2O pressure . at a pressure about 11cmsH2O , the rate of secretion & and absorbtion are equal

The CSF has a composition identical to that of the brain extra celluler fluid (ECF) but this is different from plasma . the major difference from plasma are: the partial pressure of carbon dioxide (Pco2) , reflects the amount of carbon dioxide gas dissolved in the blood . it higher (50 mmhg) resulting in a lower CSF ph (7.33) the protein content is normally very low (0.2g-l) resulting in alow buffering capacity , the glucose concentration is lower . the chloride concentration is higher and cholesterol content is very low .

There are no lymphatic channels in the brain and CSF fulfils the role of returning interstitial fluid and protein to circulation.

The CSF is seprated from blood by blood-brain barrier . only lipid soluble substance can easily cross this barrier and this is important in maintaining the compositional differences . (relkins et al. 2005).

Fluid CSF , liquor cerebrospinals , in a clear bodily fluid that occupies the subrarchnoid space and the entriculer system around and inside the brain amnd spinal cord . in essence , the brain 'floats' in it . the CSF occpices the space between archnoid mater (the middle layer of the brain cover meninges) and the pia mater(the layer of meninges closet to the brain)

It canstites the content of all intra-cerebral(inside the brain , cerebrum) ventricles , cisterns and sulci (singular sulcus) , as well as the central canal of the spinal cord . it acts as a cushion or buffer for the corytex, providing a basic mechanical and immunological protection to the brain inside the skull. It is produced in the choroid plexus .(Kenneth saladin 2007).

2.1.3.1 CSF function:

The actual mass of the human brain is about 1400grams however the net wiehght of te brain suspend in the CSF is equivelant to sa mass of 25grams . the brain therefore exists in neutral buoyancy . which allow the brain to maintain in density without being impaired by its own weight , which would cut off blood supply and kill neuron in the lower sections without CSF (Kenneth saladin .2007)

CSF protects the brain tissue from injury when jolated or hit . in certain situations such as auto accident or sport injuries , the CSF cannot protect the brain from forced contact with skull case , causing hemorhaging . brain damage , and sometimes death (Kenneth saladin 2007)

CSF flows throughout the inner ventricular system in the brain and is absorbed back into the bloodstream , rainsing the metabolic waste from the central nervous system through the blood brain barrier . this allows the homeostic regulation of the distribution of nuroendocrine factors , to which slightly change can cause problem or damage to the nervous system . for example , high glycine concentration disrupts tempreture and blooood pressure control and high csf ph causes dizziness and syncope .(Kenneth saladin ,2007) . the prevention of brain ischemia is made by decreasing the amount of CSF in the limited space inside the skull . this decrease total intracranial pressure and facilities blood prefusion .(Kenneth saladin,2007). When CSF pressure is elevated , cerebral blood flow may be constricted . when disorders of CSF flow occur , they may therefore effect not only csf movement but also craniospinal compliance annnd the cranial blood flow , with subsequent neuronal and glial vulnerabilities .

The venous system is also important in this equation . infnants and patients shunted as small children may have particularly unexpected relationships between pressure and ventricular size , possibly due in part to venous pressure dynamics. This may have significant treatment implication . but underlying pathophysiology need to be further explored (johuston m,2003)

CSF concentration wit the lymphatic system have been demonstrated in several mammalian system . prelimantry data suggest that these csf- lymph connection from around the time that the CSF secrtory capicaty of the choroid plexus is developing (in utero) . there may be some relationship between CSF disorders. Including hydrocephalus and impaired CSF lymphatic transport , CSF can be tested for diagnosis of variety of neurological disease . it is usually obtained by a procedure called lumber puncture . removal of CSF during lumber puncture can cause a severe headache after the fluid is removed , because the brain hungs on the vessels and nerve roots, and tranction on them stimulates pain fibers. The pain can be relived by intrathecal injection of strile isotonic saline . lumber puncture is performed in an attempt to account the cells in the fluid and to detect the levels of protein and glucose . these parameter alone my be exteremly beneficial in the diagnosis of subarachnoid haemorrhage and central nervous system infection (such as meningitis). Moreover , a CSF culture examination may yiled the microorganism that has caused the infection . by using more sophisticated methods , such as the detection of the oligoclanl bands , an ongoing inflamatory condition (for example . multiple sclerosis) can be recognized . a beta-2 tansferrin assay is highly specific and sensitive for the detection for e.g, CSF leakage .(jhomnston M2003).

Lumber puncture can also be performed to measure the intracranial pressure , which might be increased in certain types of hydrocephalus . however a lumber puncture should never be performed if increased intracranial pressure is suspected because it coulfd lead to brain hernation and ultimately death . this fluid has an importance in anaesthesiology . bracicity refers to the density of a substance compared to the density of human cerebral spinal fluid . baricity is used in anteshia to determine te manner in which a particular drug will spread in the intratheical space (Johnston M,2003) .

2.1.4 Pathology of CSF and ventricles:

Hydrocephalus is usually due to blockage of cerebrospinal fluid (CSF) outflow in ventricles or in the subarachnoid space over the brain . in a person without hydrocephalus , CSF contiously circulates through the brain . its ventricles and the spinal cord and is contionusly drained away into the circulatory system . alternatively , the condition may result from an overproduction of CSF fluid from a congenital malformation blocking normal drainage of the fluid , or from complication of head injuries or infections (cabot,Richard c,1919).

Compression of the brain by the accumulating fluid eventfully may cause convulsion and mental retardation. these sign occur sooner in adults . Whose skull no longer are able to expand to accommodate te increasing fluid volume within foetuses. infants and young children with hydrocephalus typically have an abnormally large head , excluding the face , because the pressure of the fluid causes the individual skull bones- which have yet to fuse-to bluge outward at their junction points. Another medical sign , in infnant s is characteristic fixed downward gaze with whites of the eye showing above iris . as through the infanant were trying to examine its own lower eyelids .(cabot Richard c,1919)

The elevated intracranial pressure may cause compression of the brain, leading to the brain damage and other complications . condition among effected individual vary widely . children who have bad hydrocephalus may have very small ventricles , and presented as the normal case.

If the foramina of the fourth ventricle or the cerebral aqudct are blocked cerebrospinal fluid (CSF) can accumulate within the ventricles . this ccondition is called internal hydrocephalus and it result in increased csf pressure . the production of csf continoues , even when the passages that normally allow it to exist the brain are blocked . consequently , fluid builds inside the brain causing pressure that compresses the nervous tissue and dilates the ventricles. Compression of the nervous tissue usually results in irreversible brain damage . if the skull bones are not compeletly ossified when the hydrocrcephalus occurs, the pressure may also serverly enlarge the head . the cerebral equeduct may be blocked at the time of birth or may become blocked later in life because of a tumor growing in the brain steam.

Internal hydrocephalus can be successfully treated by placing drainage tube (shunt) between the brain ventricles and abdominal cavity to eliminate the high internal pressure . there is some risk of infection being introduced into the brain through these shunts, however , and the shunts must be replaced as the person grows . a subarachnoid hemorrhage may block the return of CSF to the circulation . if CSF accumulates in the subarchnoid space , the condition is called external hydrocephalus . in this condition , pressure is applied to the brain externally hydrocephalus , compressing neural and causing brain damage . thus resulting in further damage of the brain tissue and leading to necrotization (yadav yr,et al 2007).

In spite of the fact that CSF pathway s are blocked csf is formed at a normal rate so the ventricles have to dilate at the expense of the white matter particularly but also the gray matter since the csf has no place to be reabsorbed. hydrocephalus evacuee in enlargement of the ventricles due to atrophy of brain substance , not increased intracranial pressure .(yadav yr,et al 2007)

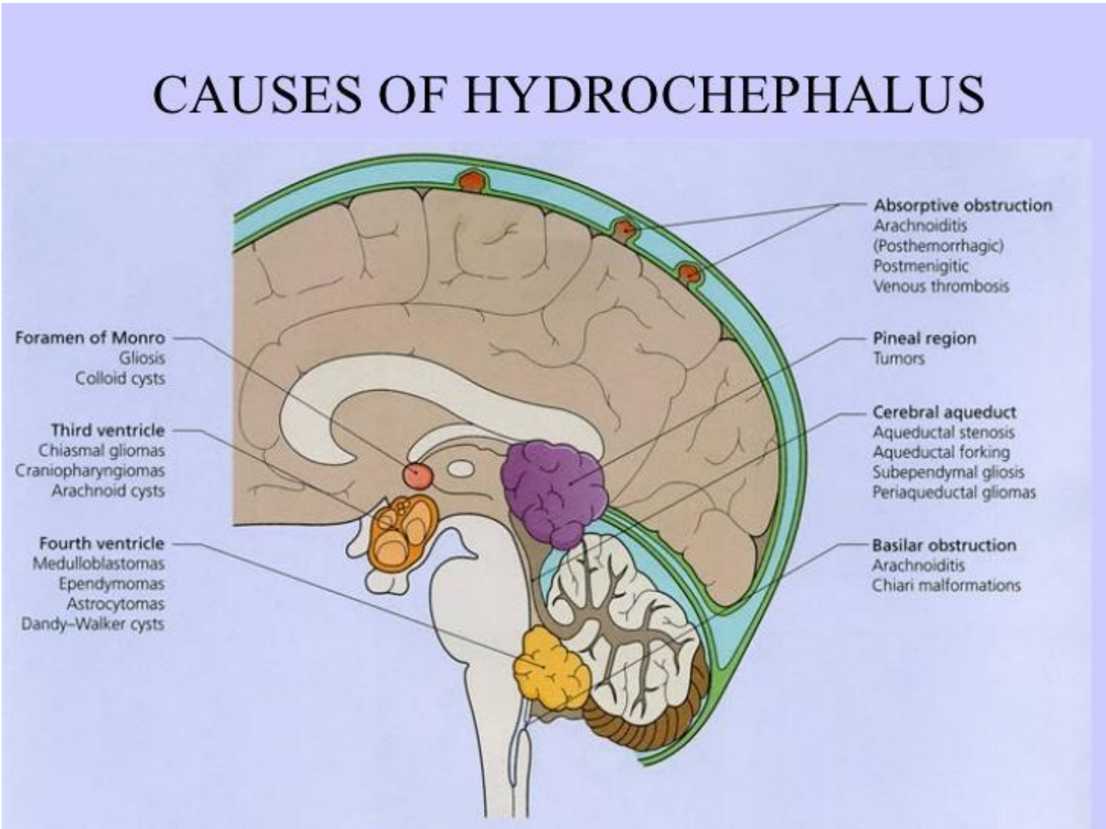
hydrocephalus is often an accompaniment of the meningomyelocele or arcold-chairi malformation . it can also be caused by isolated stenosis of the aqudect of sylvius due to in utero viral infection . meningitis can cause communicating hydrocephalus .

infanant have large head as well ventricles because of their flexable skull. Older children and adults develop headache and sign of increased intracranial pressure such as lethargy or a dilated pupil . treatment involves shunting the extra fluid from the ventricles to the protnieal cavity (yadav yr et al 2007).

2.1.4.1 Etiologty:

Congenital aqueduct stenosis . bdandy walker syndrome (small malformation cerebullem with large posterior fosse cyst in communication with 4th ventricle obsutructing flow of CSF to subarchnoid cisterns). Intracranial mass especially posterior fossa , third ventricular and pineal lesions). Subarchnoid inflammation – meningitis , hemorrhage , loss of parenchyma – infarcts , parineal insults .

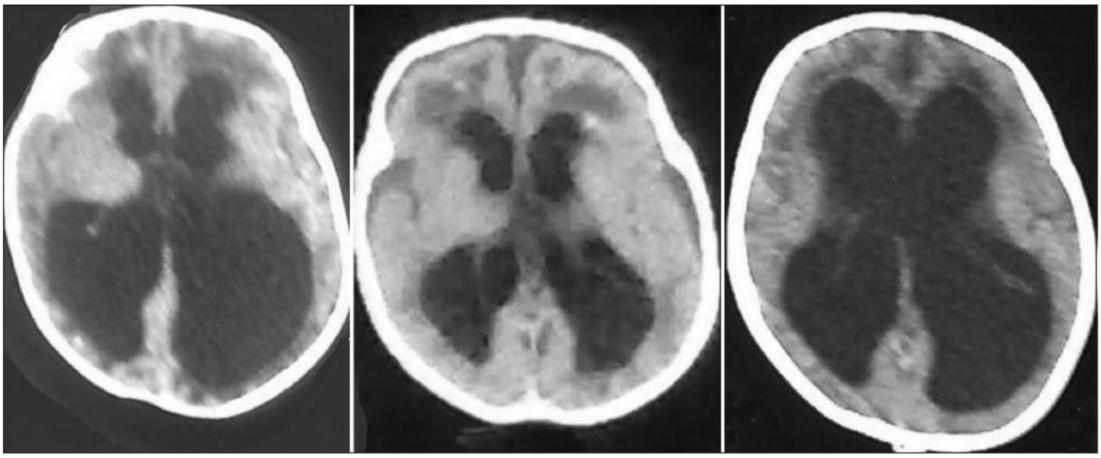
Intaventriculer hemorrhage (IVHH) is mosrt common cause of congenital hydrocephalus . hemmorhage in the preventriculer germinal matrix ruptures into ventricular system . ferquntly seen in premature infants . may proceed to cause non-obstructive hydrocephaphalus



Fig(2.5) shows the causes of hydrocephalus.

2.1.5 appearance of hydrocephalus:

CT would show an abnormally large carnial valut with increased soft tissue opacity within the cranial valut . an MRI would be able distinguish between the pathoglolgic fluid and the neural tissue remaining .



Fig(2.6) axial CT scan shows large ventricles with soft tissue damage

2.1.5.1 Grade of hydrocephalus

Grade I: isolated hemorrahge confined to the germinal matrices

Garde II: intaventriculer extension of germinal matrix hemorhage without hydrocephalus .

Grade III: intraventriculer extension of germinal matrix hemorhage with accompying venriculer enlargement .

Grade IV: intraparnchymal extension of hemorhage in adition to intraventriculer hemorrhage with hydrocephalus .

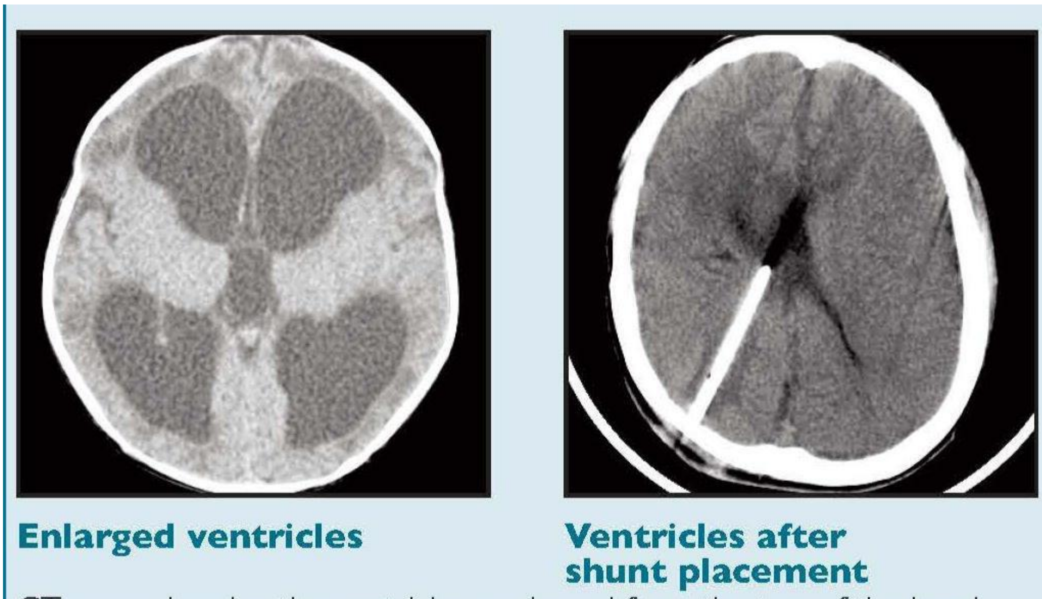
2.1.5.2 Diagnosis:

Diagnosis is needed by U/S or follow patients daily head circumference plotted on appropriate head growth chart . the most common inoitial diagnostivc test to determine hydrocephalus at any age in an image of the brain (CT scan &MRI) to identify the enlarged ventricles (spaces) within the brain that are typical or hydrocephalus . more test are often performed in adult .

2.1.5.3 Treatment: ventriculopertioneal (vp) shunt:

Infants-1500g generally are too small for shunting , so serial lumboperitoneal (lp) are done unital patient is lagre enough for shunting . if lumboprotineal (lp) unsuccessful , serial ventricular taps through the fontanelle can be performed or a temporary blind_ended ventricular cathter can be placed and serially tapped CSF shunting:

Venriculo-peritoneal (vp) – most common shunt used today . drains fluid from ventricles to protenium.ventriculo –artrial (va) ventriculo_jugular (vj); drains fluid from ventricles into venous system through the facial , jugular or subcalvian vein (lp); drains fluifd from the lumber theca to peritoneum . only used in communicating hydrocephalus (nph).subdural-peritoneal drains fluid from subdural space to prritoneum . used in chronic subdural hygroma/hematoma wich recur after external drainage .



CT scans showing the ventricles as viewed from the top of the head.

Fig(2.7) shows treatment of hydrocephalus by insert shunt

2.1.5.4 Shunt hardware:

Rickham reservoir- hard non-comperessible plastic dome placed where ventricular cathter exist skull. Site of shunt tap with a Huber needle . some older shunt do not have this reservoir.

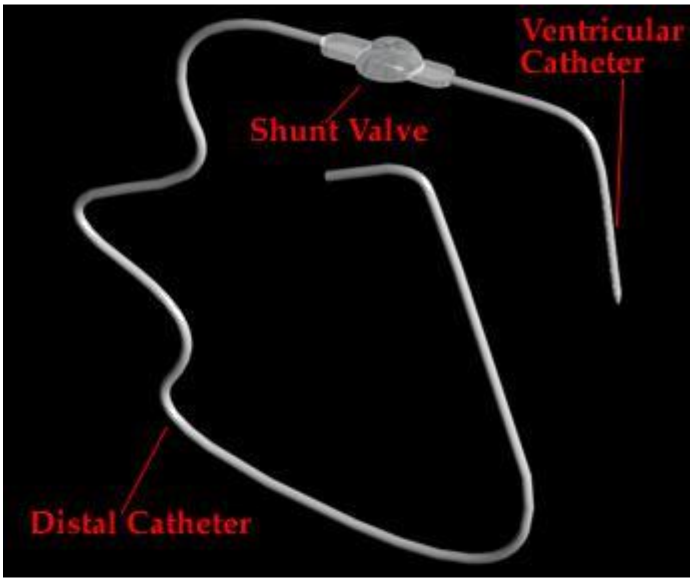
Valve regulates intracranial run-off pressure , are unidirectional allowing flow only distally , many different type ; holter – shaped like cylinder , ps medical single compressible dome , available in low , medium and high pressure , delta compined anti-syphone device and compreesble dome , must be placed at ear level , available in 2 pressure level disgnated 1 and 11, can be 'pumped' to assses function – should empty without resistance and refill rapidally .most are impregnated wit radiopaque arrow so that appropriate direction of flllow and pressure setting can be confirmed om plain x-ray , single dot: ps medical low pressure . delta11, triple dot: ps medical high pressure .

Distal A tubing travels subcutaneously to pretoneal cavity , needs to be lengthened when patient hits adolescent growth spurt and should be randomly colied within abdomen .

Straight metal connectors- used to connect above pieces and potential site of shunt disconnection .

On-off valve additional valve on-off switc to allow control of shunt patency and when central ball is depressed (dimpled), shunt is occluded 'Y' connector Y-shaped metal connector used to connect biventricular cathter to a single distal tubing.

Anti-syphon devise additional valve to prevent dranaige of csf and have slit ventricles . can also place a cathter into ventricle leading to blind reservoir for csf access for intrathecal chemotherapy (ommaya) , or into lumber cistern for intrathecal morphine (lead to lumber flushing reservoir on chest wall .(owler B,,2009).



Fig(2.8) shows the hardware component of shunt

2.1.5.5 Shunt dysfunction:

Multiple etiology can cause dysfunction of shunt proximal . most common source of dysfunction , plugged ventricular/lumber cather and disconnection from rickham reservoir, distal disconnection of tubing, broken valve , distal tubing no longer inside abdomen . classic presentation. headache , letagry , nausea , vomiting (owler b ,2009).

2.1.5.6 Evaluating shunt function:

Shunt series plain x-ray of entire system searching for disconnection , breaks , and tubing placement . skull films (ap,lat) cxr, kub,(and L/S spine film forLP) , all shunt components and radio-opaque except parts of some valves .

Uncontrasted head CT most useful when used in a compression to perior films when shunt was working, evaluate ventricular size for enlargement abdominal ultrasound /ct. Used to evaluate patient wit significant abdominal pain or distension .

Shunt tap placing Huber needle into rikham reservoir and checking for spontaneous CSF flow and distal run-off . only to be done under super vision of neurosurgery resident . never go to sleep without fixing a broken shunt (owler B, 2009) .

2.1.5.7 shunt infection:

Rarely occurs more than a few month after the last ,manipulation . in patient with fever , evaluate for other sources first unless there are clear meningeal signs . Ask about recent viral unless in family , check urine , lungs, ears , throat and send appropriate culture.(owler b ,2009) .

If a shunt is infected , it must be removed since it is a forign body which serves as a continoud nidus for infection . shunt dependent patient with infection are mainatiend with externalized ventricular cathters until infection clears and new shunt can be placed , intraventricular injection of antibiotics (either gent or vanco) is frequalntly used in addition to systemic antibiotic .(owler b,2009).

2.1.5.8 normal pressure hydrocephalus:

Symptomic hydrocephalus without elevated ICP Symptoms: classic traid- progressive dementia, urinary incontinence , and gait apraxia.

Etiology fibrosing arachnoiditis of unknown etiology . prior SAH, truma , prior surgery . meningitis . idiopathic from typically presented in the 6^{th} decade with no sex predominance diagnosis , uncontrasted head ct shows ventriculomegaly . nuclear medicine cisternogram shows delayed reabsorption of CSF .

Treatment:VP/LP shunt: dementia respond least to treatment .(owler B , 2009).

2.1.5.9 Pseudotumor cerebri (benign intracranial hypertension):

Elevated ICP witout hydrocephalus symptoms , headache , papilledema , and increased intracranial pressure in absence of CNS inflammatory disease , vanous occlusion , or a space occupaing mass . associated with obesity , pregnancy . and menstrual irregularties . present typically in women during adolescence or early adulthood . diagnosis: normal head CT (except decrease ventricular size). Increased ICP (measured by opening pressure on LP). (owler b,2009).

2.2 Previous studies:

In a study by (burwer et al , 2003) entitled can predict the level of CSF block in tuberculosis hydrocephalus showed that the only CT finding that correlated with the type of hydrocephalus was the shape of the third ventricle .

Significantly more children with non-commencating hydrocephalus had arounded third ventricle than those with commincating hydrocephalus .

In study done by (kouzo moritahea et al , 2007), ct was used in more than half of the cases . for diagnosis of fetal hydrocephalus . either U/S or MRI had become dominantly utilized and CT had gone out of use in (1996-2000).

In other study done by (relkin et al 2005), showed that idiopathic normal pressure hydrocephalus (INPH) typically occurs in a dults more than 60 years old and is a progressive , chronic disoreder without specific identifiable cause . the classic traid of symptoms- gait disturbance , cognitive dysfunction , and urinary incontinence_ genarelly responds to treatment if present for less than 2 years duration . gait and balance distribution are often the first most common symptoms of INPH and may develop over the course of mounth or years. INPH is a disorder of CSF circulation , probably related to decreased absorption at the arachnoid villi leading to venriculomegaly (kernich,2006) . in INPH,CSF accumulation occurs in ventricles , resulting in temporarily elevated ICP . the increase in ICP causes ventricular dilation , which allow the ICP to reset at higher pressure . this new sustained intracranial pressure , altrough within the normal range of 60_240mm H2O, is higher than pressure prior to the onset of INPH IN INPH , as CSF gradually increase in volume , dilating the cerebral ventricles , brain tissue is compressed , acting as a temporizing mechanism to maintain ICP within the normal range . however , ventricular dilatation exert pressure on brain tissue deforming the white matter motor tract and fibers directly adjacent to the lateral ventricles . gait abnormalities result from compression of these white matter motor tract and fibers ; it is described as a' glue footed' or 'shiffting' type of gait . cognitive disorders and urinary incontinence result from compression and deformation of adjacent motor tracts and fibers and white matter limbic structures .

Chapter three

Materials & Methods

Chapter three

Materials & Methods

3.1 Materials:

3.1.1 Machine used:

3.1.1.1 Toshiba ,64 slice with kvp/125, MA with medium (85MA), low (200MA), in yestbshroon medical center .

3.1.1.2 Siemens smoatomas, sensation 16 with KVP/120, MA with medium (63MA), low (45MA) in police central hospital .

3.1.2 Patients: A total sample of 50 patients with sign and symptoms of hydrocephalus, included in this study . All of the patients investigated by CT scan and had CT report. The average age ranging between (5 day_65), 29 of patient female and 21 males.

3.2 Methods:
3.2.1 Technique:

All axial scan obtain with slice thickness 3-5mm at base of skull 7-10mm above sella . axial images, without contrast obtain with 10-15 degree angle with radiographic base line . most of children underwent CT scan after sedation and slice thickness 10 mm with similar spacing and scan time 5 seconds .

3.2.2 Image interperation:

All axial images were studied by senior radiologist , to dignose the stages of hydrocephalus , types communicated and non communicated and underline causes

3.2.3 Methods of data collection:

References, websites, textbooks

3.2.4 Method of data analysis:

The all data analyzed through statistical method that includes frequency table percentage.

3.2.5 Area and duration of the study:

The study has been carried out during the period from November 2016 up to february 2017 in yestbshiroon medical centers and police central hospital.

Chapter four

Results

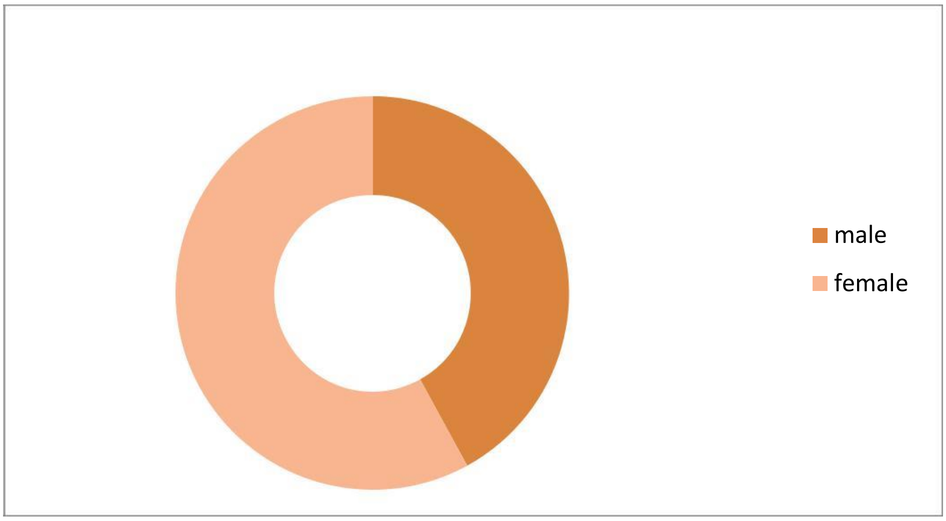
Chapter four

Results

Fifty patients in different ages, diagnosed by CT. The findings are read by senior radiologist and the following data were obtained from the radiologist reports. Type of hydrocephalus, degree and site of obstruction and underline cause. The results were presented in tables and graphs as follows:

Table (4.1): **Gender distribution of hydrocephalus patients**:

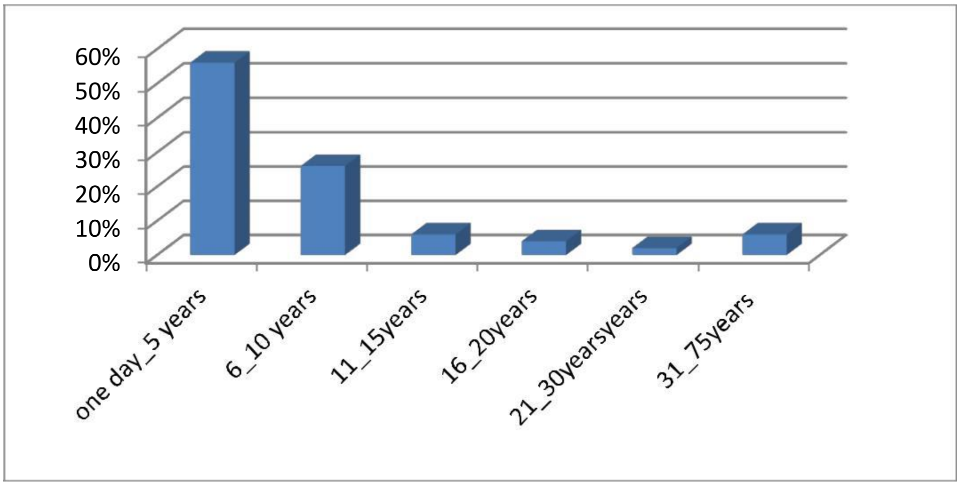
Gender	frequency	Percentage%
Male	21	42%
Female	29	58%
Total	50	100%



Fig(4.1)Pie shows gender distribution

Table (4.2) Age distribution for hydrocephalus patients:

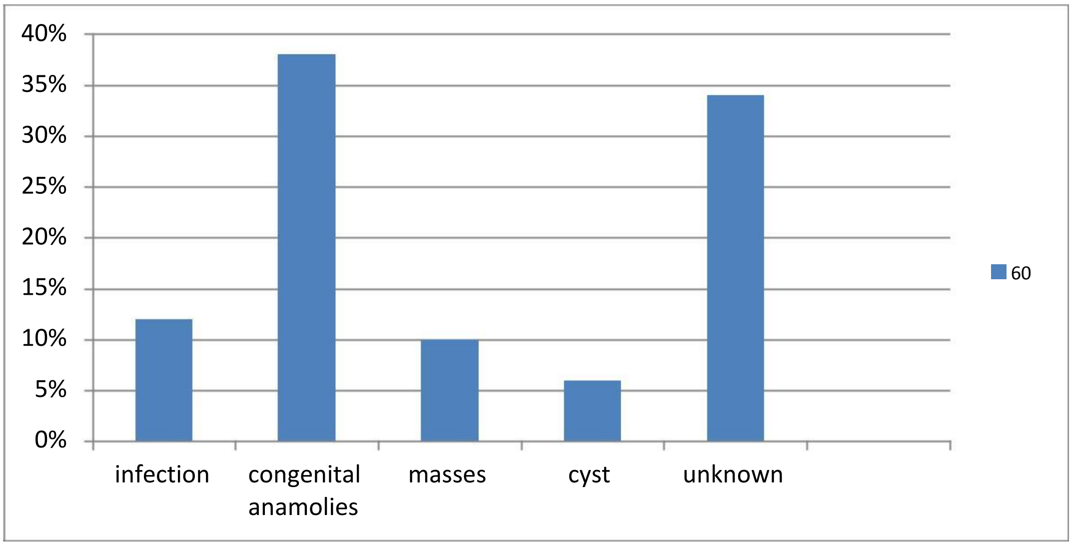
Age	Frequency	Percentage %
One day _ 5 years	28	56%
6_10 years	13	26%
11_15 years	3	6%
16_20 years	2	4%
21_30 years	1	2%
31_75 years	3	6%
Total	50	100%



Fig(4.2) Column shows age distribution

table(4.3) Frequency distribution of obstruction causes:

Factors	Frequency	Percentage %
Infection	6	12%
Congenital anomalies	19	38%
masses	5	10%
cyst	3	6%
unknown	17	34%
Total	50	100%



Fig(4.3) Column shows frequency distribution of obstruction causes

Table (4.4) Distribution of clinical signs and symptoms:

Sign/symptoms	Frequency	Percentage %
Headache	18	36%
Vision change	3	6%
Enlargement Of head	22	44%
Increased intracranial pressure	4	8%
Mental retardation	3	6%
other	50	100%

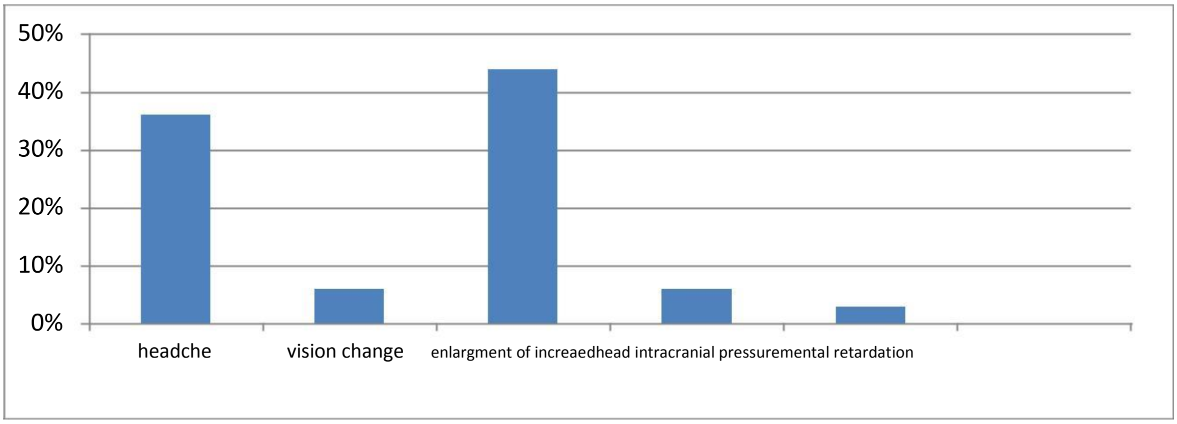
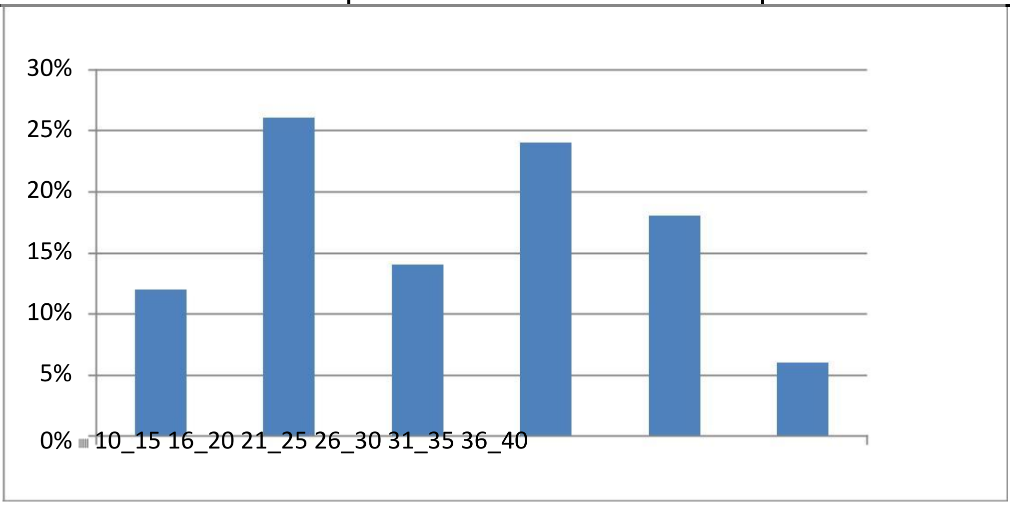


Fig (4.4) Column shows distribution of clinical signs and symptom

Table (4.5) Size of right lateral ventricle in (mm):

Size in (mm)	Frequency	Percentage %
10_15	6	12%
16_20	13	26%
21_25	7	14%
26_30	12	24%
31_35	9	18%
36_40	3	6%
Total	50	100%



Fig(4.5) Column Shows size of right lateral ventricles in (mm)

Table (4.6) Size of the left lateral ventricle in (mm):

Size in (mm)	Frequency	Percentage %
10_15	4	8%
16_20	10	20%
21_25	5	10%
26_30	6	12%
31_35	15	30%
36_40	10	20%
Total	50	100%

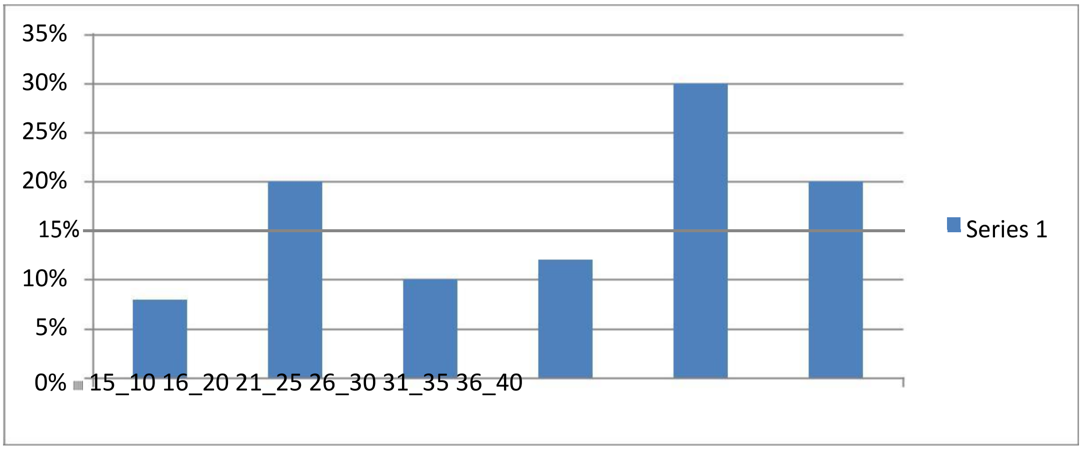
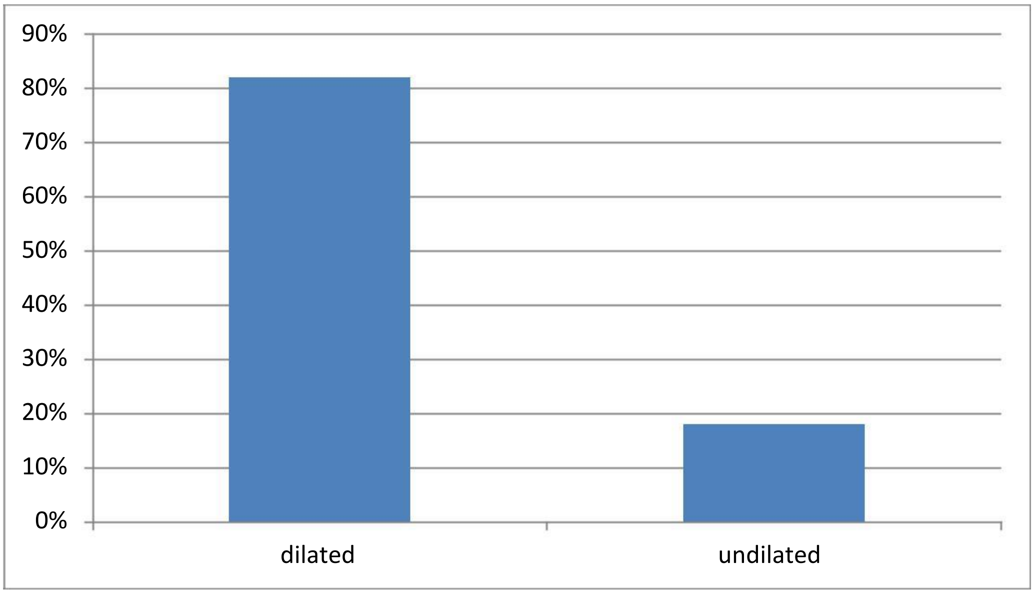


Fig (4.6) Column shows size of left lateral ventricles in (mm)

Table (4.7) Shows size of the third ventricle:

State	Frequency	Percentage %
Dilated	41	82%
Undilated	9	18%
Total	50	100%



Fig(4.7) Column shows size of third ventricle

Table (4.8) Shows size of fourth ventricles:

State	Frequency	Percentage %
Dilated	23	46%
Undilated	27	54%
Total	50	100%

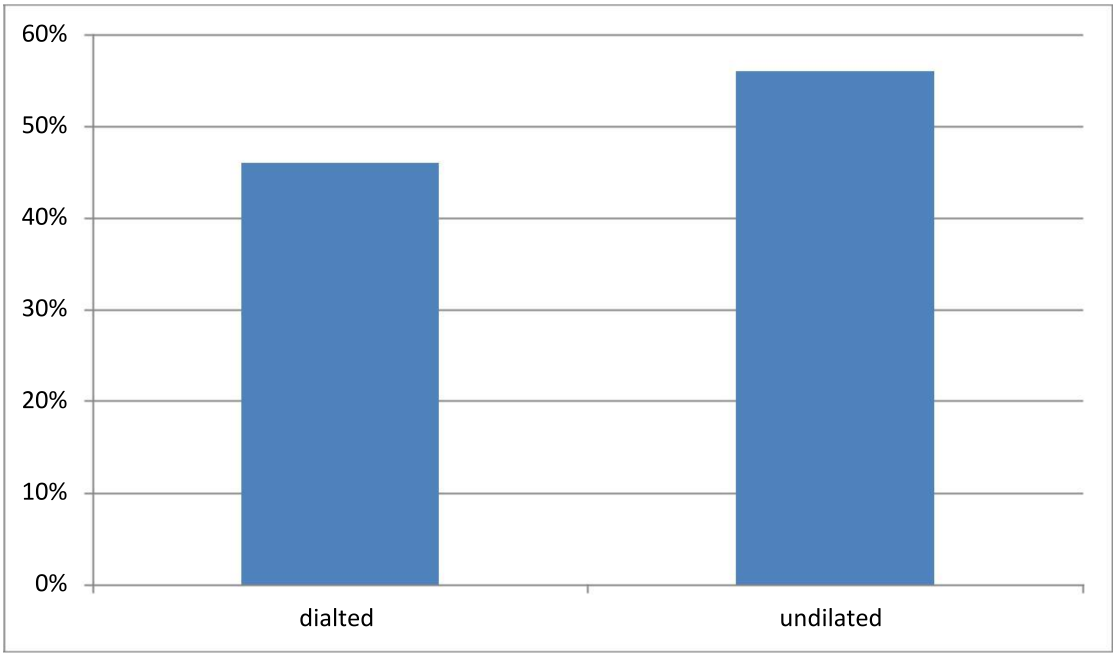


Fig (4.8) Column shows size of fourth ventricles

Table (4.9) Type of hydrocephalus distribution:

Type of hydrocephalus	Frequency	Percentage%
Communication	20	40%
Non communication	30	60%
Total	50	100%

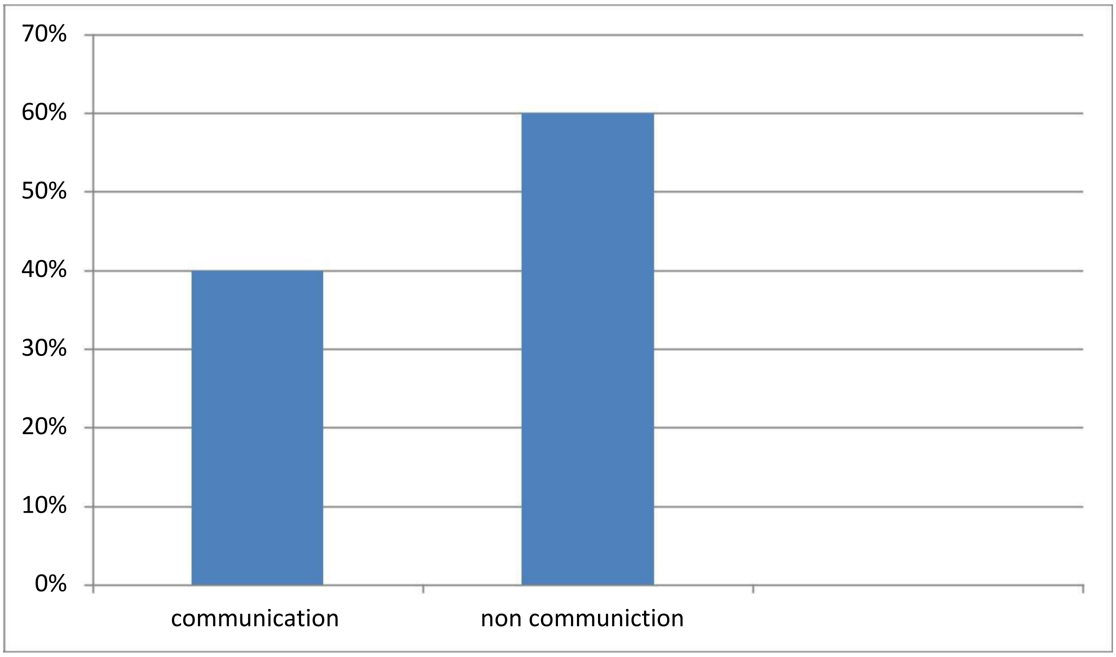


Fig (4.9) Column shows type of hydrocephalus distribution

Chapter five

Discussion, conclusion and recommendations

Chapter five

Discussion, conclusion and recommendations

5.1 Discussion

Table and fig. (4.1) showed that 21 of patients out of 50 (42%) are males while 29(58%) are females.

Table and fig. (4.2) showed that the ages of 28 patients(58%) out of 50 patients ranged between one-day to 5 years , 13 patients (26%) their ages ranged between 6 - 10 years , 3 patients (6%) their ages between 11 – 15 years , 2 patients (4%) their ages between 16 – 20 , 1 patient (2%) his age 25 while 3 patients (6%) their ages were more than 31 up to 75 years . These findings reflected that the clinical suspicion of hydrocephalus is high in children more than adult. This result agreed with Relkin et al, 2005 .

Table and fig.(4.3) showed the cause of obstruction , Out of 50 hydrocephalic patients there are 6 (12%)those cause was infection , 19 patients (38%) their cause was congenital anomalies , 5 patients (10%) their cause was mass , 2 patients(6%) their cause was cyst while there were 17 patients (34%)were unknown cause . These findings reflected that the congenital anomalies were the most common causes of hydrocephalus,and infection was the least cause

Table and fig.(4.4) showed that the clinical signs and symptoms of this disease were mostly represented by enlargement of head (44%) followed by headache (36%) , vision change and mental retardation (6%) and increase intracranial pressure (8%). These findings reflected that the head enlargement is the most common symptom due to no closed suture of the most of the study group. This result was congruent with the Konzo Mortiakea et al , 2007.

Table and fig.(4.5) and (4.6) showed that 50 patients (100%) were with dilated right and left lateral ventricle by different size in mm as this symptom is the main indication of hydrocephalus

Table and fig.(4.7) and (4.8) showed that the CT was informative in demonstrating the site of obstruction and this reflected that the third ventricle is the most common site of obstruction. This study result is congruent with Bruwer et al, 2003.

Table and fig. (4.9) showed there were 20 patients (40%) out of 50 patients with communicating hydrocephalus, the other 30 patients (60%) were with non-communicating hydrocephalus. These findings showed that the CT is informative in demonstrating the type of hydrocephalus.

According to these findings, the CT is important in the assessment of hydrocephalus. CT can deal with all age groups, and usually identify the level and the cause of obstruction.

CT is important to follow up patients with shunt to check its position and function , but it has a radiation hazard, especially to the lens of the eye, and its relative high cost.

5.2 Conclusion:

Hydrocephalus is a disease occurs in pediatric and it may occur in the elderly people.

The main objective of this study was to study the role of CT in the diagnosis of hydrocephalus. It is most commonly found in neonates and children who are below 5 years.

CT is important imaging technology for demonstrating hydrocephalus and its causes, but it has its own advantages delimitation. The main cause of hydrocephalus is congenital, as shown by the results CT is very informative in demonstrating the cause and the site of obstruction. Some cases of congenital hydrocephalus their causes remain unknown in this study.

5.3 Recommendations:

- For unknown cause of hydrocephalus there should be further imaging investigations such as MRI.
- All governmental hospitals should have a CT department.
- The government should encourage establishing CT clinics by giving more financial facilities, which should decrease the price of CT investigations.
- The training departments in to Ministry of Health should offer considerable chances for staff training in CT.
- Upcoming studies are recommended to focus on pediatric field.
- further future studies on greater sample and at other places may give more reliable results.

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Appendices

Appendix (A)

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

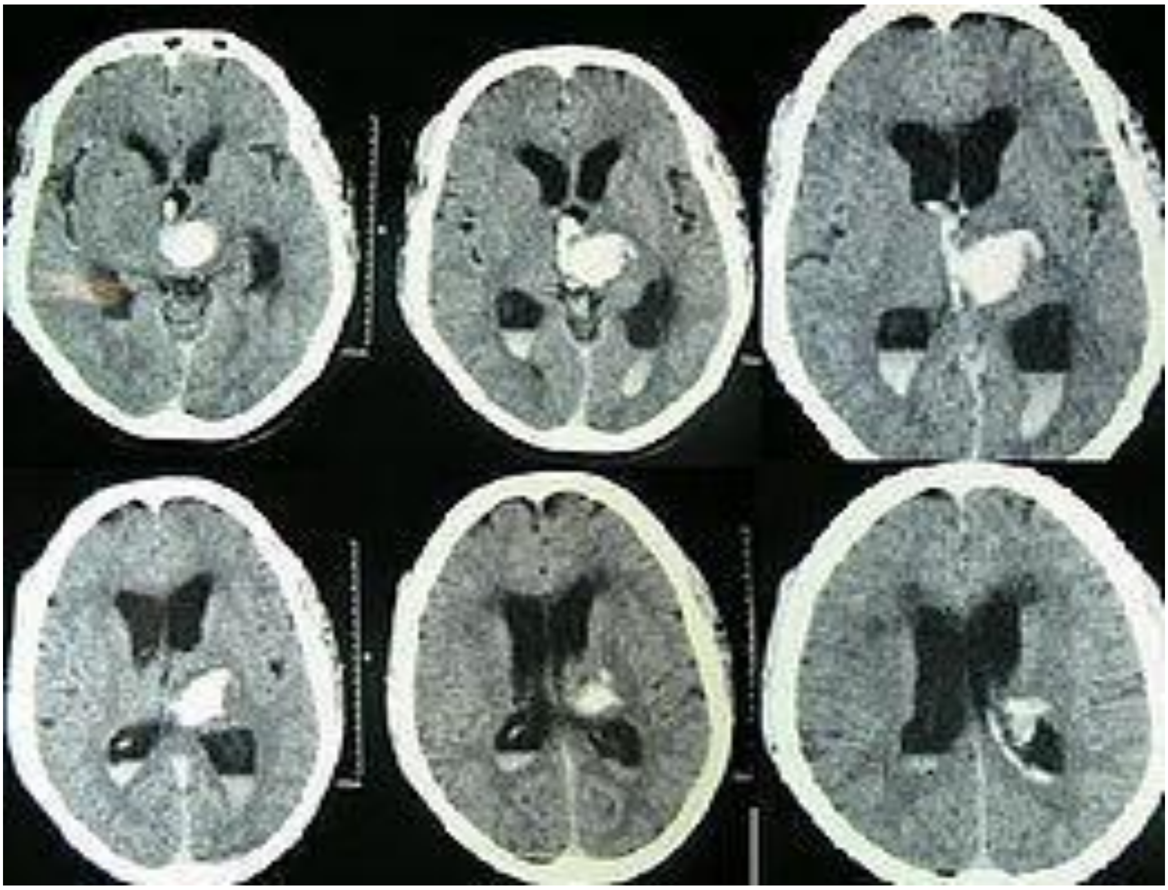
DATA COLLECTION FORM

Pt gender:
Pt age
Date of examination:
Clinical signs and symptoms:
Clinical diagnosis:

Appearance:

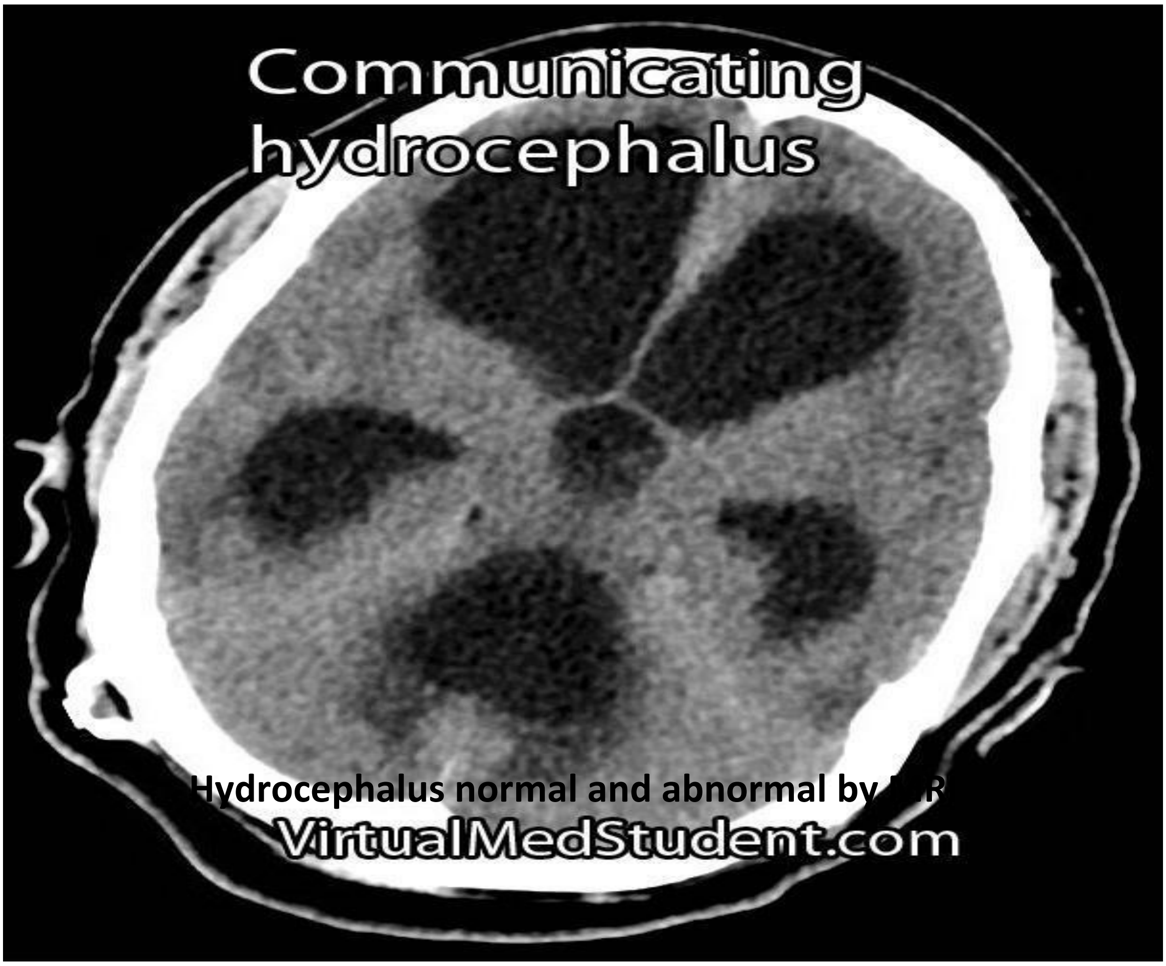
Ventricles:
Rt lateral ventricle:.......... mm left lateral ventricle..........
Third ventricle: dilated:...... undilated:.........
Fourth ventricle: dilated:........ undilated:.........
Type of hydrocephalus:
Communicating:....... noncommunicating:........

Appendix (B)



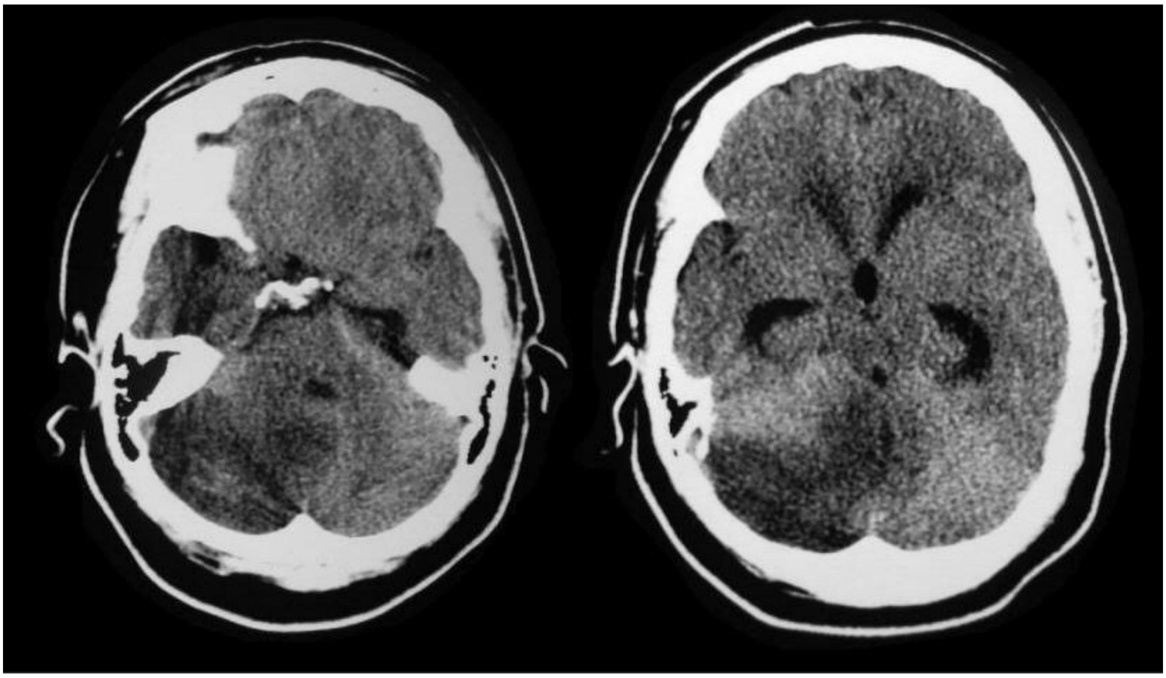
CT axial image shows Spontaneous intracerbral and intraventricular hemorhage with hydrocephalus

Appendix(C)



Axial CT scan how communicating hydrocephalus

Appendix(D)



Axial ct scan show non-communicating hydrocephalus .note the hypodensity in the right cerebellum . with sub acute stroke .

Appendix (E)

Two children of tow type of hydrocephalus

Appendix (F)

Another type of child hydrocephalus

Appendix(G)

Child with hydrocephalus , before and after treatment