Project On

Present instance of “Hydrocephalus” in a semi-urban area Ishwardi, Pabna.

Submitted To

Md Shajib Khan

The Department of Pharmacy,

Faculty of Allied Health Sciences

Daffodil International University

In the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy

Submitted By

Sumya Akter

Student ID: 181-29-096

Batch: 20th

Department of Pharmacy

Faculty of Allied Health Sciences

Daffodil International University

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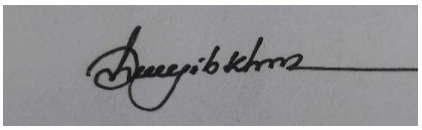
APPROVAL

This project, entitled "**Present instance of Hydrocephalus in a semi-urban area Ishwardi¸Pabna**: An online survey," was turned in to the pharmacy department at Daffodil International University. Its style and contents were approved, and it was accepted as partially satisfying the requirements for the degree of Bachelor of Pharmacy.

Supervised By



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Md Shajib Khan

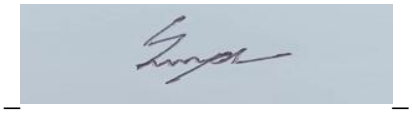
Lecturer

Department of Pharmacy

Faculty of Allied Health Sciences

Daffodil International University

Submitted By



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Sumya Akter

ID: 181-29-096

Department of Pharmacy

Faculty of Allied Health Sciences

Daffodil International University

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ABSTRACT

The abnormal expansion of the cerebral ventricles results from the common CSF physiology problem known as hydrocephalus. Infants commonly develop progressive macrocephaly, although signs of intracranial hypertension are more common in kids over the age of two. Models that include consider aberrant cerebral pulsations, brain compliance, and newly identified water-transport systems are replacing the conventional hypothesis of hydrocephalus, which attributes it to an obstruction of the CSF's bulk flow. The causes of hydrocephalus are numerous. Congenital hydrocephalus, which most often involves aqueduct stenosis, has been linked to genetic variables that regulate brain growth and development. The following are some typical research study objectives: Diagnosing illnesses and other health issues. Reduce the number of persons who get sick and stop sickness from developing or returning. Increase the number of persons who are cured or improve survival rates by treating the sickness. I created this project to raise

awareness of this illness. The majority of rural residents believe that hydrocephalus is a serious illness with no known cure. Many individuals will be concerned about the management and treatment of hydrocephalus as a result of my project. I conducted an online poll using a questionnaire, getting responses from roughly 100 people. I then compiled the data and created a pie chart to show the results. Some of the persons I spoke with had heard of hydrocephalus and had at least one encounter with a patient who had it.

However, they were unaware of how to cure this condition. I believe they learned some crucial information about this ailment from my survey.

INTRODUCTION

An excessive buildup of cerebrospinal fluid (CSF) in the brain cavities is known as hydrocephalus (Ventricles).

The ventricles produce CSF, which then travels through the brain and spinal cord before being reabsorbed from the brain's surface into circulation.

Back pressure builds up in the ventricles when this channel is obstructed for any reason, which causes hydrocephalus.

In addition to providing nutrition and a cushion-like layer of protection for the nervous system, CSF also removes waste.

A perfect balance between CSF secretion and absorption is achieved under normal circumstances through CSF circulation and absorption.

Adults' lying-down CSF pressure, also known as intracranial pressure (ICP), ranges from 80 to 200 mmH2O. (6 to 15 mmHg).

When you're standing up, the pressure is almost nothing or even negative.

However, if this balance is disturbed, hydrocephalus can result.

Only when the CSF's absorption or ability to exit the ventricle cavities is impaired does the problem become manifest.

The ventricles enlarge significantly as the extra CSF is kept there.

Any increase in the volume of fluid within the ventricles impacts the brain because the size of the cranium is fixed (except for children up to roughly 18 months of age, in whom the fontanelles are still open).

Depending on factors like brain compliance, this may result in the emergence of neurological symptoms caused by an increase in intracranial pressure (ICP).

OVERVIEW

Anyone can get hydrocephalus at any age, however, it most frequently affects young children and elderly people. Some of these situations may be linked to anomalies in the developing baby's brain and spinal cord. Communicating hydrocephalus and non-communicating hydrocephalus are the two main kinds of hydrocephalus. When the CSF flow is stopped after it leaves the ventricles, communicating hydrocephalus develops. This type is known as communicative because the ventricles' open passageways still allow CSF to flow between them. Building up of CSF in the ventricles and communicating hydrocephalus can also happen from decreased flow and absorption of CSF into specialized blood capillaries known as arachnoid villi.

When one or more of the tiny channels that link the ventricles are blocked, non-communicating hydrocephalus results.

Two further varieties of hydrocephalus are as follows:

Injuries or strokes can induce brain damage, which leads to hydrocephalus ex-vacuo.In these circumstances, the ventricles are larger than usual because the brain structures surrounding them shrink. In actuality, this illness is more of a "hydrocephalus look-alike" than a true hydrocephalus. Normal Pressure Hydrocephalus (NPH) can develop as a result of head trauma, infection, tumor, subarachnoid or intraventricular hemorrhage, or as a side effect of surgery. However, many people experience NPH even when none of these conditions exist. Since the increase in cerebrospinal fluid in NPH happens gradually, the tissues surrounding the ventricles can adjust, preventing an increase in the fluid pressure inside the skull.NPH results in difficulties walking, controlling one's urine, and thinking and reasoning. NPH can occasionally be confused with Alzheimer's disease.

MEANING & ORIGIN

The Greek words "hydro" and "cephalus," which both refer to the head, are the source of the English word "hydrocephalus."The phrase, which translates as "water on the brain," really describes the accumulation of cerebrospinal fluid, a clear organic liquid that covers the brain and spinal cord. The brain's ventricles are constantly circulating with CSF, which performs a variety of vital tasks. In addition to serving as a "shock absorber" for the brain and spinal cord, blood also transports nutrients and waste away from the brain and regulates pressure variations between the cranium and spine. CSF buildup can put dangerous stresses on the brain's tissues that are contained inside the skull.CSF builds up either because of an increase in production, a decrease in the rate of absorption, or because of a disease that prevents the fluid from flowing normally through the ventricular system. Although hydrocephalus can happen to anyone, it is most frequent in infants and those who are 60 years old or older. The National Institute

of Neurological Disorders and Stroke (NINDS) estimates that one to two of every 1,000 children born in the United States have hydrocephalus. Most of these situations are frequently identified before pregnancy, during delivery, or in the early stages of life.

TYPES

There are 4 types of “Hydrocephalus”

Communication-related hydrocephalus, non-communicating hydrocephalus, normal pressure hydrocephalus, and hydrocephalus ex-vacuo are the four basic kinds of hydrocephalus.

- Communication-related hydrocephalus: When the CSF flow is stopped after it leaves the ventricles, communicating hydrocephalus develops. This type is known as communicative because the ventricles' open passageways still allow CSF to flow between them.

- Non-communicating hydrocephalus: Obstructive hydrocephalus, also known as non-communicating hydrocephalus, develops when one or more of the tiny passageways that connect the ventricles are blocked from the CSF's flow.

- Normal pressure hydrocephalus: An abnormal buildup of cerebrospinal fluid (CSF) in the cavities or ventricles of the brain is known as normal pressure hydrocephalus (NPH). It happens if something prevents the CSF from moving normally through the brain and spinal cord.

- Hydrocephalus ex-vacuo: When the brain is injured due to a stroke, degenerative conditions like Alzheimer's disease or other dementias, or traumatic events, hydrocephalus ex-vacuo results. Brain tissue may contract in these situations.

COMPLICATIONS

There may be issues with the surgery used to cure hydrocephalus (excess fluid in the brain).

Shunt issues

A shunt is a fragile piece of machinery that is susceptible to failure, typically by being blocked or diseased.

Up to 4 out of 10 shunts are predicted to fail during the first year of implantation.

Sometimes a scan performed after surgery reveals the shunt is not in the ideal place, necessitating additional surgery to realign it.

If a shunt is implanted in a baby or child, it may become too tiny as the child develops and must be replaced.

There may be more than one replacement needed because most people require a shunt for the remainder of their lives.

When a shunt is placed, bleeding is occasionally possible. Nerve issues such as weakness down one side may result from this. After any kind of brain surgery, there is a very small chance of having fits.

Cerebrospinal fluid (CSF) can leak through the skin wound in newborns and younger children because the fluid can run alongside the shunt rather than down it.

To stop the leak, further sutures will be required.

Shunt obstruction

A shunt obstruction can be extremely dangerous because it can result in an accumulation of extra fluid in the brain, which can harm the brain.

This will result in hydrocephalus symptoms. The broken shunt will require emergency surgery to replace.

Shunt contamination

After shunt surgery, shunt infection is another very common consequence.

Infection risk in children might reach 1 in 5, but it is lower in adults.

The first few months following surgery are the time when infections are most prone to appear.

[Shunt infection symptoms could include the following:

neck stiffness, a high temperature, headache, and discomfort along the shunt's line.

Baby agitation or sleepiness if the shunt drains into their stomachs

If you or your child exhibits these signs, get in touch with your care team right once.

In some instances, surgery may be necessary to replace the shunt in addition to antibiotics to treat the infection.

Shunt alert cards

The hydrocephalus and spina bifida charity Shine has produced a series of shunt alert cards for adults and children. You carry the card with you if you've had a shunt fitted.

The card is useful in a medical emergency if you have symptoms of a blockage or infection.

The healthcare professionals treating you will be aware that you have a shunt fitted and will check whether this is causing your symptoms

SYMPTOMS

Depending on the age of the start, hydrocephalus symptoms and indicators can differ somewhat.

- Infants
- Typical baby hydrocephalus warning signs and symptoms include:
- shifts in the brain
- An abnormally huge head grows quickly or has a bulging or tight soft region (fontanel) on top of the head
- indications and symptoms in the body
- nausea and diarrhea
- drowsiness or lethargy (lethargy)
- Irritability
- bad eating
- Seizures

- fixated gaze downward (sunsetting of the eyes)
- issues with strength and tone in the muscles
- Young children and older kids

Signs and symptoms in toddlers and older kids may include:

- indications and symptoms in the body
- Headache
- double or blurry vision
- inconsistent eye motions
- abnormal head growth in children Drowsiness or sluggishness
- nausea or diarrhea
- unstable symmetry
- a lack of cooperation
- lack of appetite
- losing control of one's bladder or urinating a lot
- Behavioral and mental shifts
- Irritability
- alteration in personality
- reduction in academic performance
- delay or difficulty using previously learned abilities, such as walking or talking

- Adults in their twenties and forty

For this age group, typical symptoms and indications include:

- Headache
- Sluggishness
- loss of balance or coordination
- bladder control issues or a persistent urge to urinate
- vision issues
- the decline in memory, focus, and other cognitive abilities that could have an impact on job performance
- older people
- The more prevalent hydrocephalus indications and symptoms in people 60 years of age and older are:
- bladder control issues or a persistent urge to urinate
- No memory
- progressive loss of further reasoning or thinking abilities

- The walking difficulty, frequently described as a shuffling gait or the sensation that the feet are stuck
- Poor balance or coordination

Whenever to visit a doctor

For infants and young children, seek emergency medical attention if they exhibit these symptoms:

- an ear-piercing wail
- issues with feeding or sucking
- recurring, unexplained vomiting
- Seizures

Any age group should seek immediate medical assistance for any additional symptoms or indicators.

The issues related to hydrocephalus can be brought on by a variety of illnesses, therefore it's crucial to have prompt diagnosis and treatment.

DIAGNOSIS

Typically used to make a diagnosis of hydrocephalus include:

- Your responses to the doctor's queries regarding symptoms and signs
- generic medical examination
- neurological testing
- scans of the brain
- psychological test

Age will determine what kind of neurological examination is performed.

The neurologist may ask you questions and do quick tests in the clinic to assess your muscle tone, range of motion, general health, and sense of smell.

Brain x-rays

Imaging exams that can assist in determining the presence of hydrocephalus and the underlying reasons for its symptoms include:

Ultrasound.

Due to its simplicity and minimal danger, this test is frequently used as a preliminary evaluation for infants.

The soft region (fontanel) on top of a baby's head is covered by the ultrasound machine.

During standard prenatal exams, ultrasound may also identify hydrocephalus before delivery.

MRI.

A magnetic field and radio waves are used in this examination to provide precise photographs of the brain.

Although this examination is painless, it is noisy, and you must remain motionless.

For some MRI scans, children might require a little sedation.

However, certain medical facilities employ a quick variant of MRI that typically doesn't call for anesthesia.

CT scan

Cross-sectional images of the brain are produced using this specialist X-ray technology.

Scanning is rapid and painless.

A youngster typically receives a slight sedative for this test because it also demands lying still.

CT scanning exposes patients to a modest amount of radiation while producing less detailed images than MRI.

Hydrocephalus CT scans are typically reserved for urgent cases.

TREATMENT

Hydrocephalus can be treated surgically using one of two methods. Shunt mechanism Open a pop-up dialog box Shunt system

The surgical implantation of a drainage system, known as a shunt, is the most popular method of treating hydrocephalus. It comprises a long, flexible tube with a valve that ensures optimal direction and rate of brain fluid flow.

The tubing is typically inserted into one of the brain's ventricles at one end.

The extra fluid can then be more quickly absorbed by the belly, heart chamber, or another area of the body where the tubing is tunneled under the skin.

Most hydrocephalus patients require a shunt system for the remainder of their lives. They must be checked on frequently. Third ventriculostomy by endoscopy

Some patients may benefit from a surgical procedure called an endoscopic third ventriculostomy. A tiny video camera is used by the surgeon to view the brain. To allow cerebrospinal fluid to exit the brain, your surgeon creates a hole in the bottom of one of the ventricles or the space between the ventricles.

risks associated with surgery Complications from both surgical techniques are possible.

Because of mechanical issues, blockages, or infections, shunt systems may fail to drain cerebrospinal fluid or may only regulate outflow ineffectively.

Ventriculostomy complications include bleeding and infections.

Any failure necessitates immediate intervention, whether it be medical, surgical, or other.

Make an appointment with your doctor if you have a fever or experience the initial hydrocephalus symptoms again.

Other therapies:

Depending on the severity of hydrocephalus' long-term effects, some patients, especially youngsters, may require extra therapy.

The following individuals might be on children's care teams:

Whoever is in charge of the medical care and treatment plan is a pediatrician or physiatrist. Pediatric neurologists are experts in identifying and treating neurological conditions in children.

occupational therapist, who focuses on therapy to improve daily living abilities

Your child will benefit from therapy from a developmental therapist who focuses on helping kids develop age-appropriate behaviors, social abilities, and interpersonal skills.

a specialist in mental health, such as a psychologist or psychiatrist

A social worker who helps the family obtain the assistance they need and make plans for care transitions

Special education teachers who address learning difficulties, assess educational requirements and locate necessary resources are likely to be needed for children who are enrolled in school.

Adults with more serious issues may also require the assistance of occupational therapists, social workers, dementia care specialists, or other medical professionals.

MEDICATION

Neonatal posthemorrhagic hydrocephalus is treated with acetazolamide (ACZ) and furosemide (FUR).

Both are diuretics that also seem to reduce CSF secretion at the choroid plexus level.

You can use ACZ by itself or in combination with FUR.

The combination increases the effectiveness of ACZ in reducing choroid plexus CSF secretion. The risk of nephrocalcinosis appears to be greatly reduced when ACZ is administered alone.It is debatable whether medication should be used to treat hydrocephalus.

In cases of posthemorrhagic hydrocephalus in newborns or when shunting is not an option, it should only be used temporarily.

AIMS OF THE STUDY

The main goal was to know how common is this disease & how many people know about this disease. Having the right health survey questions in a survey will allow you to collect valuable data about your respondents' health and well-being and adequately meet your research objectives.Other objectives of this research tool can be: to understand general health, the factors that affect a certain disease, the opinion about the medical services provided, and the risk factors associated with the individual's health, among others.Hence, the main principle of surveying is to work from the whole to the part..After doing this project,at least 100 people can know about this disease and treatment of the disease.

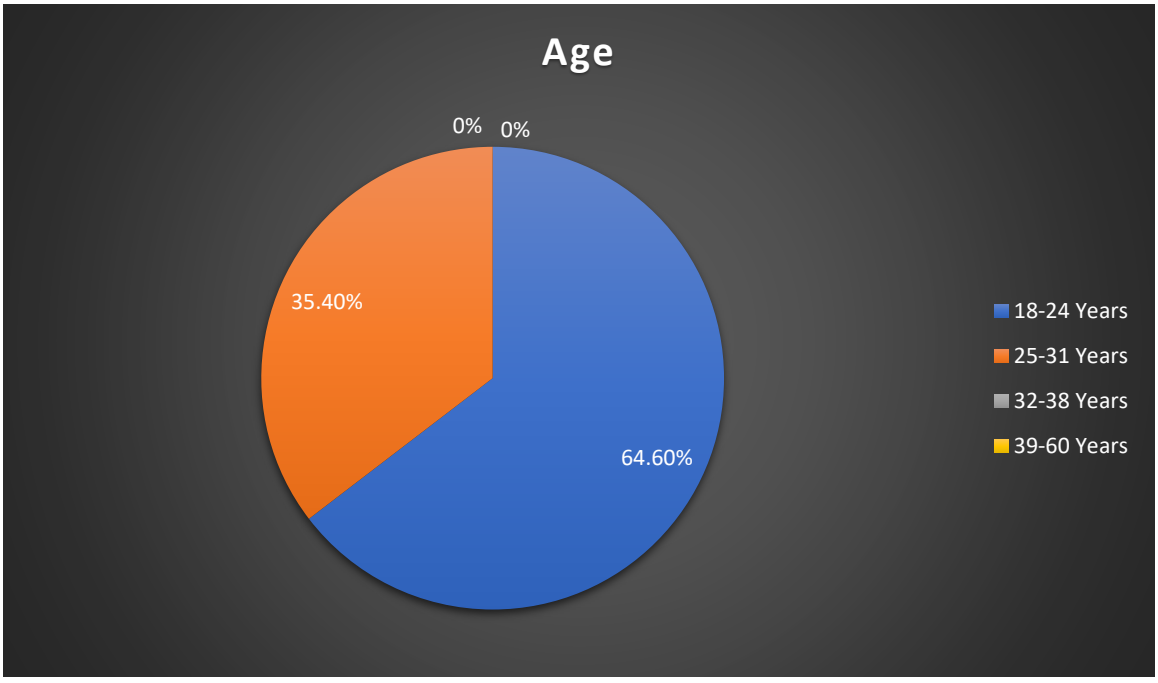
METHODOLOGY

Firstly I have selected my project topic as "Hydrocephalus" After that my instructor told me to read some articles on this disease. According to his instruction, I read some articles in Google Scholars. After that, I downloaded some articles and gain knowledge about this disease.Then I have selected my topic name.After selecting the topic name,I made 10 questions using google form and did an online survey among about 100 people. They responded to my questions and I collected the responses.Some people knew about the disease and some didn't know about the disease.But after my survey,they will be able to know some important facts about the disease and it's the main aim of my survey. I made a final result according to the responses.

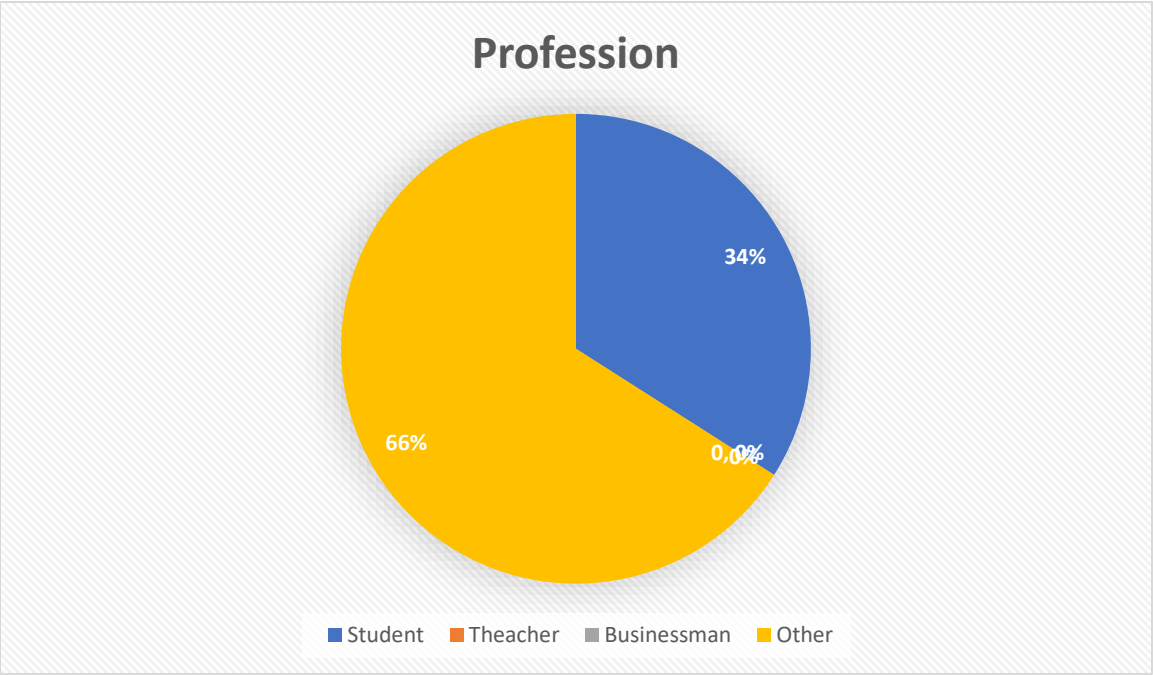
RESULT

Present instance of Hydrocephalus in a semiurban area Ishwardi, Pabna: An online survey

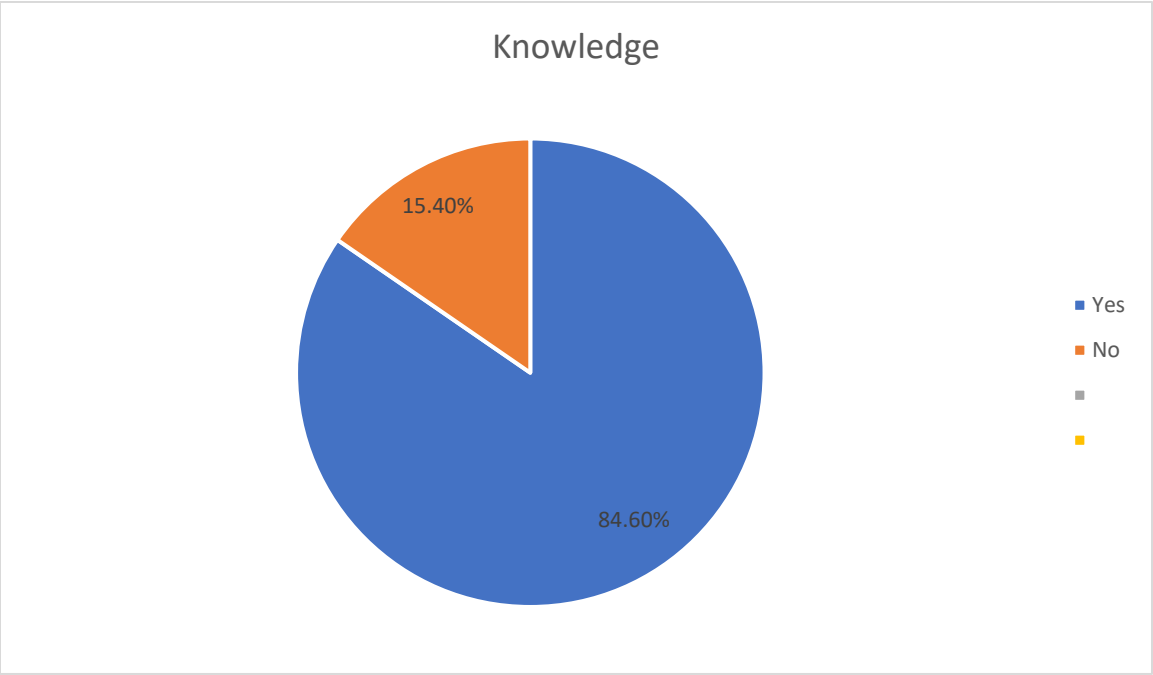
Age



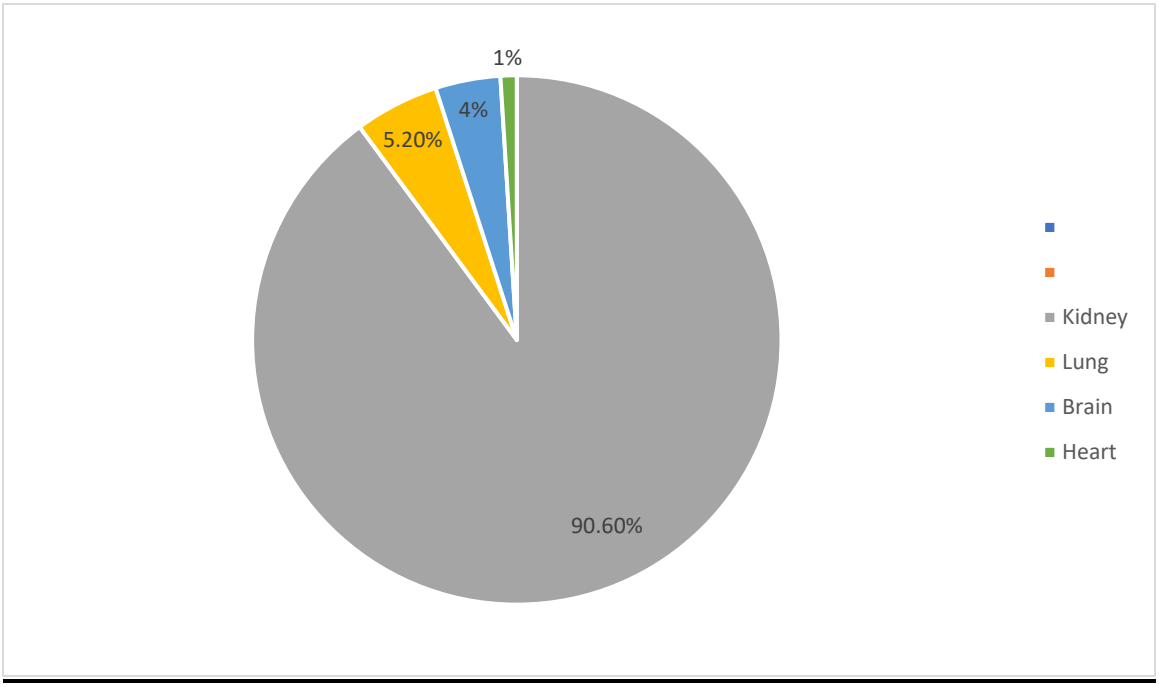
Profession



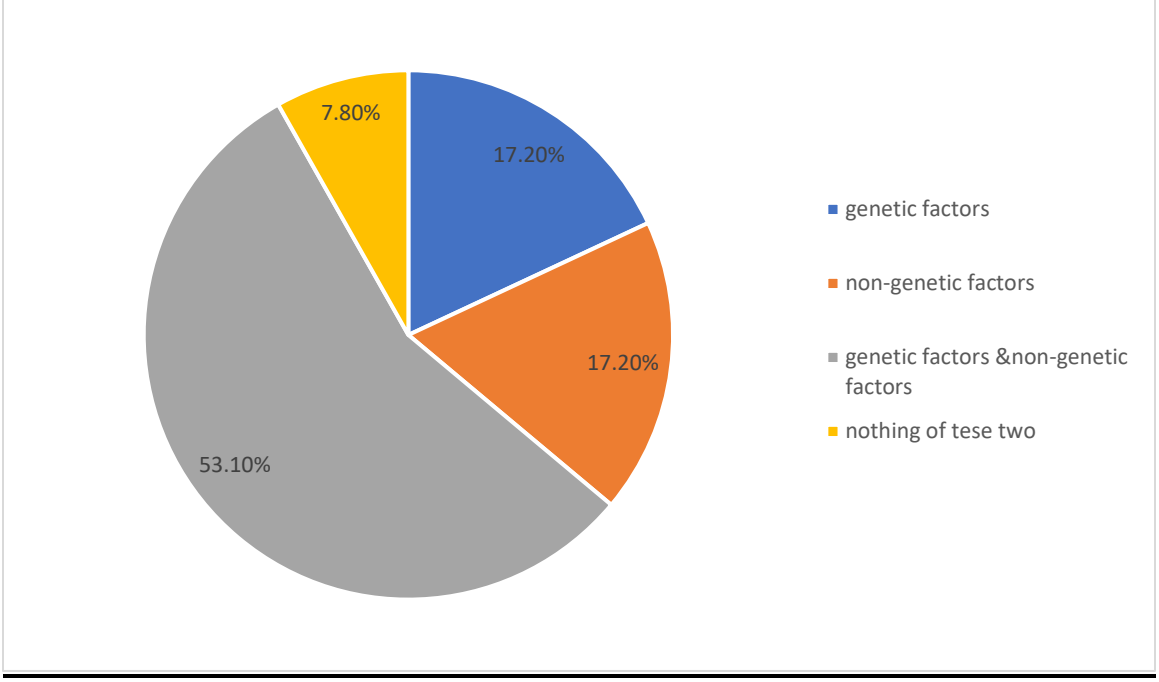
Knowledge



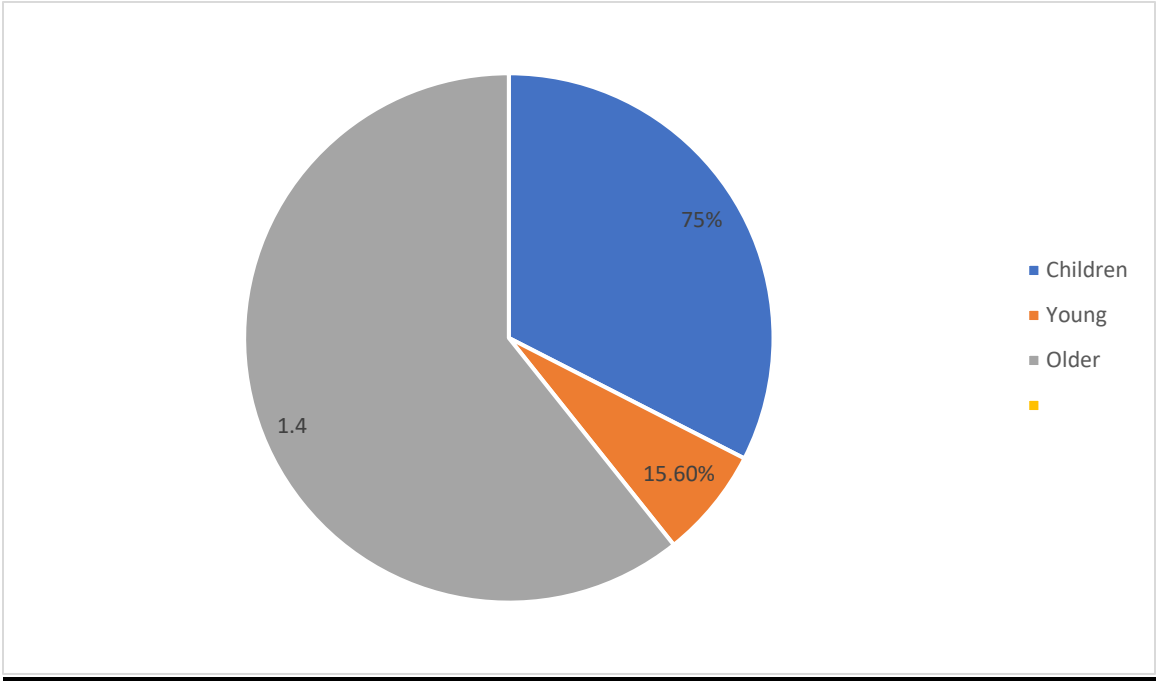
Understanding rate about the name of the organ affected by Hydrocephalus



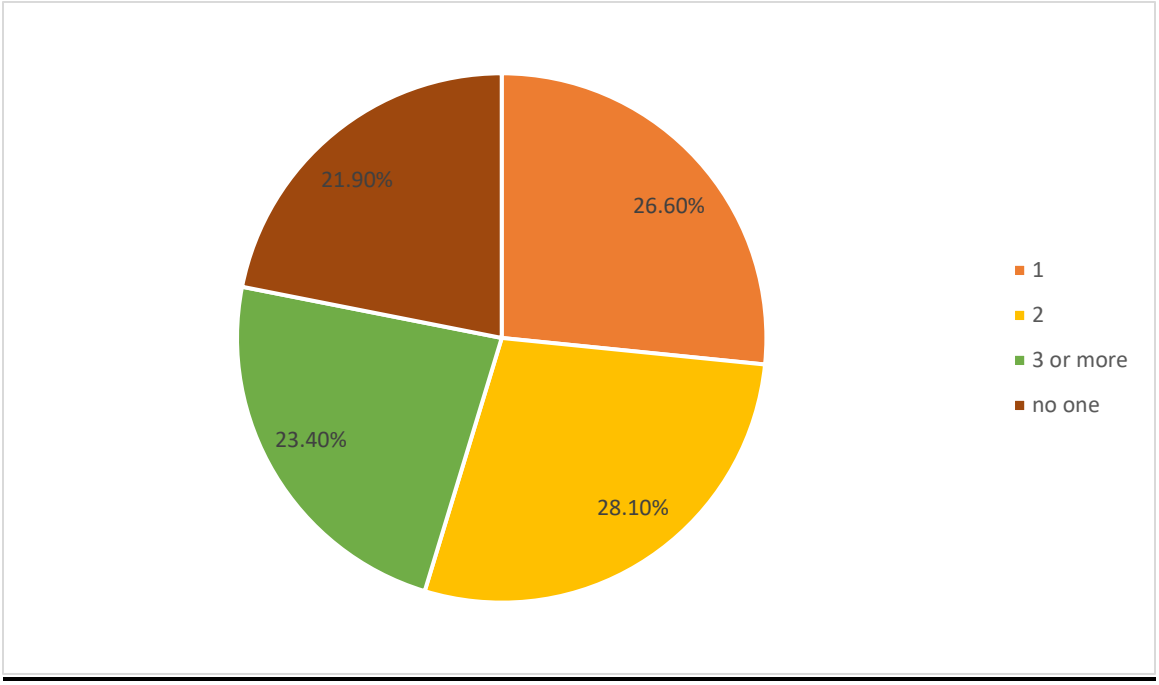
Understanding the rate of the causing factor of Hydrocephalus



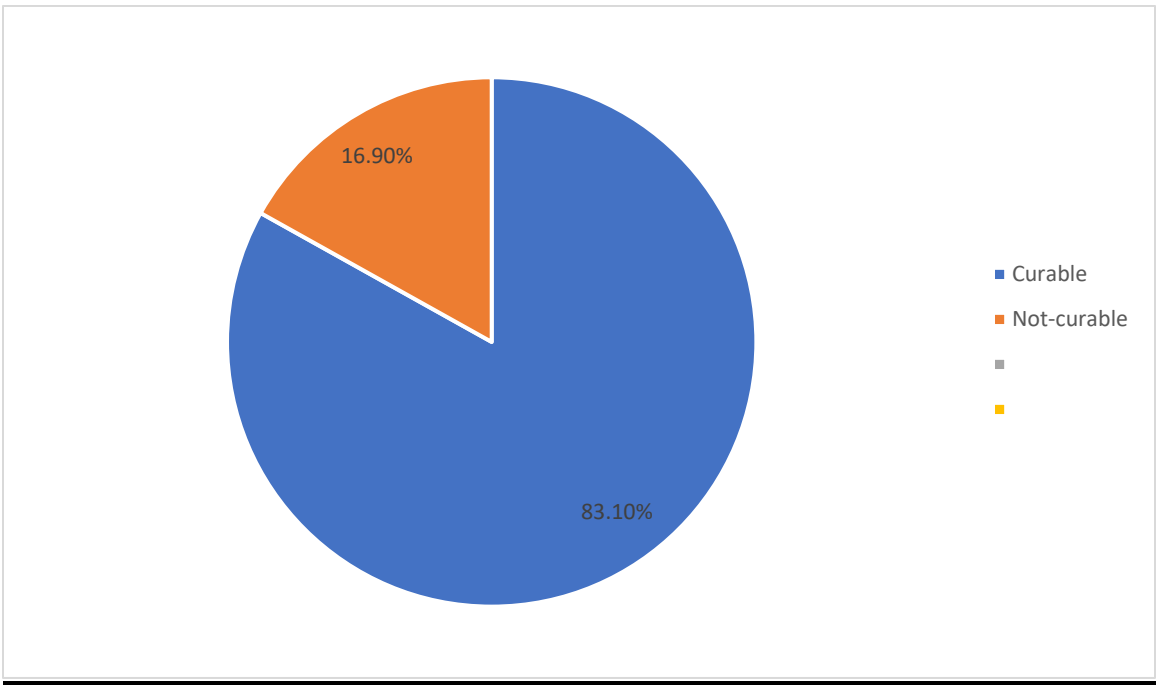
Thinking rate about who are the maximum victims of Hydrocephalus



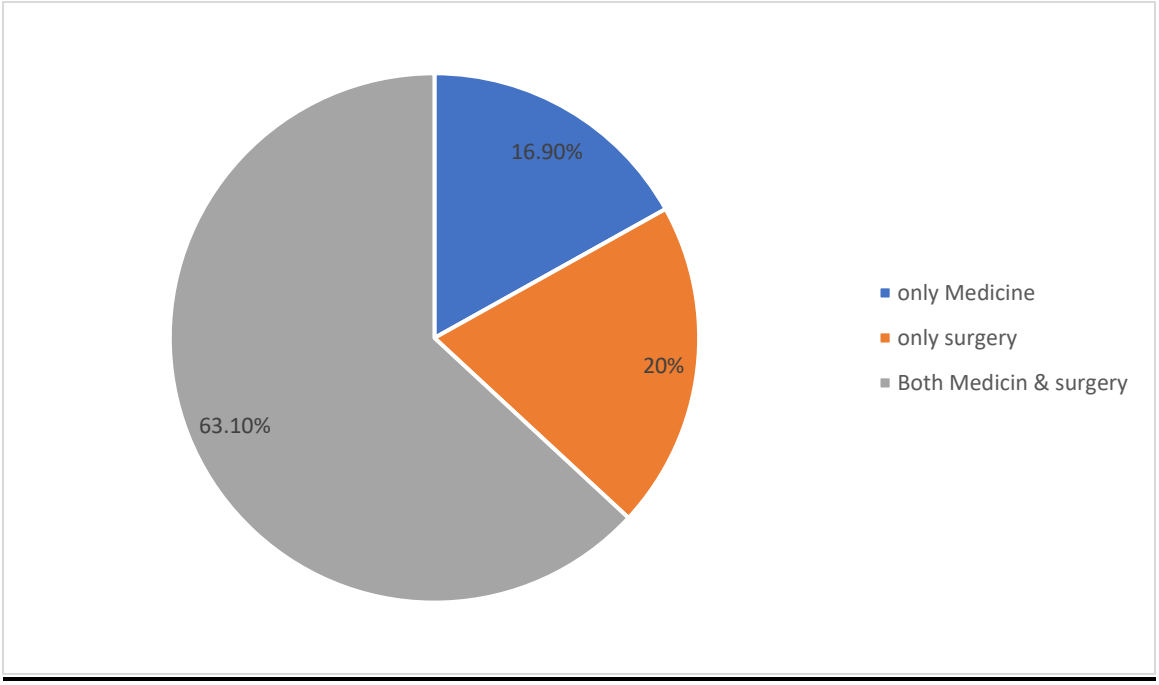
The rate of Hydrocephalus patients seen in life



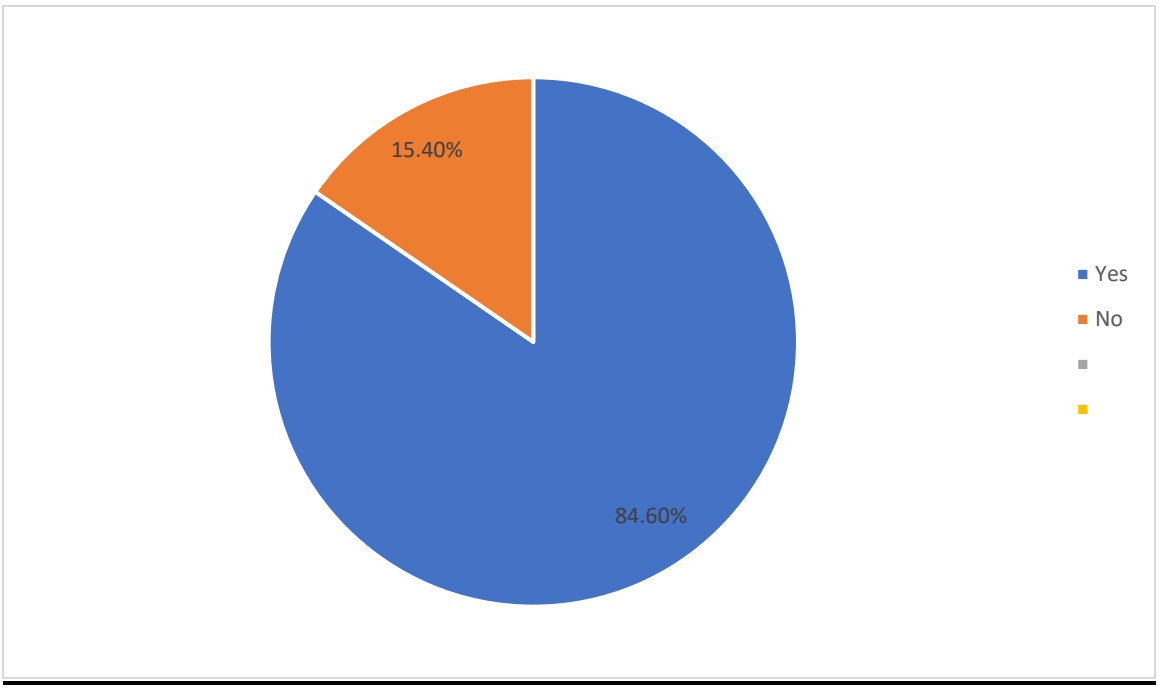
Rate of thinking about the curability of this disease



Understanding the treatment procedure



Understanding the rate of recovery from Hydrocephalus



DISCUSSION

The survey was an online survey that was done in a semi-urban area Ishwardi, Pabna, Bangladesh. I've taken 100 responses.

I've made 10 questions.

My first question was "Your age between_."Here I've found 65.7% of people between the ages of 18-24 years and 34.3% of people between 25-29 years. My second question was " Your profession is_"Here I've found 81.5% students & 18.5% others. Then my third question was "Do you know about Hydrocephalus?" Here I've found 84.6% of people who know about this disease & 15.4% responded "No".My fourth question was " Hydrocephalus is a disease of_"Here I've found 90.8% of people le who clicked the right answer & lung:5.2%,heart:4%. My fifth question was "Hydrocephalus is caused by_". In this question 53.8% of people tapped the right answer(Both genetic and non-genetic factors),16.9% clicked non-

genetic,16.9% clicked genetic factors, and 7.7% people tapped nothing of these two.

My sixth question was"Who is the maximum number of victims of Hydrocephalus?" In this question 75.4% of people clicked the 'Children' option,15.4% people clicked 'Young people and 9.2% response 'Older persons'.

My seventh question was "How many Hydrocephalus patients have you seen in life?"..28.1% of people clicked '2 ',26.6% of people clicked '1',23.4% of people clicked '3 or more,21.9% people clicked 'No one.

My eighth question was"The disease is_." The option was (a)Curable,(b)Not-curable. Here 83.1% of people clicked 'curable' and 16.9% of people clicked 'not-curable'.

My ninth question was"This disease can be treated with _"..63.1% of people answered rightly. They clicked 'Both medicine and surgery.20% of people clicked 'only surgery',16.9% of people clicked 'Only medicine'

The tenth question was "It is possible to become fully recovered from Hydrocephalus? ".84.6% of people clicked 'Yes', and 15.4% people clicked 'No'.

So it’s all about my online survey questions. Though it’s a semiurban area, people's understanding level of this disease is excellent. There are few hydrocephalus patients around us. I think my survey will be helpful to people to be aware of Hydrocephalus.

CONCLUSION

A change in the CSF's flow, absorption, or, less frequently, secretion causes an excessive buildup of CSF, which leads to hydrocephalus, an abnormal enlargement of the ventricles.

The choroid plexus in the ventricles primarily produces CSF at a rate of 0.4 ml per minute, or roughly 500 ml in 24 hours. The impact of hydrocephalus on public health is substantial.

In theory, there are three potential causes of the condition: restriction of the CSF route, excessive CSF secretion, and poor venous drainage.

It has been thoroughly investigated how ventricular enlargement affects the pathology.

Lack of prenatal care, multiple pregnancies, maternal diabetes, chronic hypertension in women, hypertension in women, and drug use during pregnancy were all recognized risk factors.

Either obstructive (non-communicating) or communicative hydrocephalus exists (non-obstructive).

In 85–90% of cases, it worsens open spina bifida, and it may not be diagnosed until the myelomeningocele has healed.

Numerous inflammatory or viral conditions can lead to hydrocephalus. Viral infections are far less likely to cause hydrocephalus than bacterial, parasitic, and granulomatous infections.

The normal flow of cerebrospinal fluid (CSF) being obstructed or being produced in excess is assumed to be the cause of the hydrocephalus. In a chronic form of hydrocephalus, ventricular enlargement continues but CSF pressure recovers to normal. The most typical symptoms and signs of hydrocephalus include an

enlarged head, vomiting, refusal to feed, a sunset-like appearance of the eye, convulsions, disturbed consciousness, abnormal fontanels (size, bulge, and pulsation), squint, decreased motor function, and the presence of other congenital anomalies.

MRI and CT brain scans can be used to investigate it.

Primary hydrocephalus prevention involves avoiding risk factors, followed by secondary and tertiary prevention (early detection and appropriate care) (rehabilitation). Surgery to perform shunt operations (ventriculoperitoneal, ventricular-pleural, ventriculoatrial, and lumbar peritoneal) can be used to cure hydrocephalus, albeit this is unusual. This study was created with the intent of identifying risk factors connected to the pathogenesis of hydrocephalus, determining the epidemiological characteristics of hydrocephalus among infants attending Benha health insurance hospital and Benha children hospital, and determining the distribution, determinants, and dynamics of hydrocephalus to develop a thorough plan for the management and prevention of hydrocephalus

REFERENCE

[1]

Rekate HL, A contemporary definition and classification of hydrocephalus. Seminars in pediatric neurology. 2009 Mar; [PubMed PMID: 19410151]

[2]

Vinchon M, Rekate H, Kulkarni AV, Pediatric hydrocephalus outcomes: a review. Fluids and barriers of the CNS. 2012 Aug 27; [PubMed PMID: 22925451]

[3]

Chen S, Luo J, Reis C, Manaenko A, Zhang J, Hydrocephalus after Subarachnoid Hemorrhage: Pathophysiology, Diagnosis, and Treatment. BioMed research international. 2017 [PubMed PMID: 28373987]

[4]

Langner S,Fleck S,Baldauf J,Mensel B,Kühn JP,Kirsch M, Diagnosis and Differential Diagnosis of Hydrocephalus in Adults. RoFo : Fortschritte auf dem

Gebiete der Rontgenstrahlen und der Nuklearmedizin. 2017 Aug; [PubMed PMID: 28511266]

[5]

Tully HM, Dobyns WB, Infantile hydrocephalus: a review of epidemiology, classification, and causes. European journal of medical genetics. 2014 Aug; [PubMed PMID: 24932902]

[6]

Garne E, Loane M, Addor MC, Boyd PA, Barisic I, Dolk H, Congenital hydrocephalus--prevalence, prenatal diagnosis and outcome of pregnancy in four European regions. European journal of pediatric neurology : EJPN: official journal of the European Paediatric Neurology Society. 2010 Mar; [PubMed PMID: 19410489]

[7]

Isaacs AM, Riva-Cambrin J, Yavin D, Hockley A, Pringsheim TM, Jette N, Lethebe BC, Lowerison M, Dronyk J, Hamilton MG, Age-specific global epidemiology of hydrocephalus: Systematic review, metanalysis, and global birth surveillance. PloS one. 2018; [PubMed PMID: 30273390]

[8]

Munch TN, Rostgaard K, Rasmussen ML, Wohlfahrt J, Juhler M, Melbye M, Familial aggregation of congenital hydrocephalus in a nationwide cohort. Brain: a journal of neurology. 2012 Aug; [PubMed PMID: 22763745]

[9]

Damkier HH, Brown PD, Praetorius J, Cerebrospinal fluid secretion by the choroid plexus. Physiological reviews. 2013 Oct; [PubMed PMID: 24137023]

[10]

Preuss M, Hoffmann KT, Reiss-Zimmermann M, Hirsch W, Merkenschlager A, Meixensberger J, Dengl M, Updated physiology and pathophysiology of CSF circulation--the pulsatile vector theory. Child's nervous system: CNS: official journal of the International Society for Pediatric Neurosurgery. 2013 Oct; [PubMed PMID: 23832074]

[11]

Eymann R, [Clinical symptoms of hydrocephalus]. Der Radiologe. 2012 Sep; [PubMed PMID: 22940684]

[12]

Fink KR, Benjert JL, Imaging of Nontraumatic Neuroradiology Emergencies. Radiologic clinics of North America. 2015 Jul; [PubMed PMID: 26046515]

[13]

Kartal MG, Algin O, Evaluation of hydrocephalus and other cerebrospinal fluid disorders with MRI: An update. Insights into imaging. 2014 Aug; [PubMed PMID: 24903254]

[14]

Pini L, Pievani M, Bocchetta M, Altomare D, Bosco P, Cavedo E, Galluzzi S, Marizzoni M, Frisoni GB, Brain atrophy in Alzheimer's Disease and aging. Aging research reviews. 2016 Sep; [PubMed PMID: 26827786]

[15]

Kim H, Jeong EJ, Park DH, Czosnyka Z, Yoon BC, Kim K, Czosnyka M, Kim DJ, Finite element analysis of periventricular lucency in hydrocephalus: extravasation or transependymal CSF absorption? Journal of neurosurgery. 2016 Feb; [PubMed PMID: 26274984]

[16]

LeMay M, Hochberg FH, Ventricular differences between hydrostatic hydrocephalus and hydrocephalus ex vacuo by computed tomography. Neuroradiology. 1979 Apr 26; [PubMed PMID: 313025]

[17]

Ragan DK, Cerqua J, Nash T, McKinstry RC, Shimony JS, Jones BV, Mangano FT, Holland SK, Yuan W, Limbrick DD Jr, The accuracy of linear indices of ventricular volume in pediatric hydrocephalus: technical note. Journal of neurosurgery. Pediatrics. 2015 Jun; [PubMed PMID: 25745953]

[18]

Kahlon B, Annertz M, Ståhlberg F, Rehncrona S, Is aqueductal stroke volume, measured with cine phase-contrast magnetic resonance imaging scans useful in

predicting the outcome of shunt surgery in suspected normal pressure hydrocephalus? Neurosurgery. 2007 Jan; [PubMed PMID: 17228260]

[19]

Larsson A, Moonen M, Bergh AC, Lindberg S, Wikkelsö C, Predictive value of quantitative cisternography in normal pressure hydrocephalus. Acta neurologica Scandinavica. 1990 Apr; [PubMed PMID: 2193476]

[20]

Hamilton MG, Treatment of hydrocephalus in adults. Seminars in pediatric neurology. 2009 Mar; [PubMed PMID: 19410156]

[21]

Markey KA, Mollan SP, Jensen RH, Sinclair AJ, Understanding idiopathic intracranial hypertension: mechanisms, management, and future directions. The Lancet. Neurology. 2016 Jan; [PubMed PMID: 26700907]

[22]

Bidot S, Saindane AM, Peragallo JH, Bruce BB, Newman NJ, Biousse V, Brain Imaging in Idiopathic Intracranial Hypertension. Journal of neuro-ophthalmology: the official journal of the North American Neuro-Ophthalmology Society. 2015 Dec; [PubMed PMID: 26457687]

[23]

Bakkour A, Morris JC, Wolk DA, Dickerson BC, The effects of aging and Alzheimer's disease on cerebral cortical anatomy: specificity and differential relationships with cognition. NeuroImage. 2013 Aug 1; [PubMed PMID: 23507382]

[24]

Richards JE, Sanchez C, Phillips-Meek M, Xie W, A database of age-appropriate average MRI templates. NeuroImage. 2016 Jan 1; [PubMed PMID: 25941089]

[25]

Rojas R, Riascos R, Vargas D, Cuellar H, Borne J, Neuroimaging in drug and substance abuse part I: cocaine, cannabis, and ecstasy. Topics in magnetic resonance imaging: TMRI. 2005 Jun; [PubMed PMID: 16340647]

[26]

Holt JL, Kraft-Terry SD, Chang L, Neuroimaging studies of the aging HIV-1-infected brain. Journal of neurovirology. 2012 Aug; [PubMed PMID: 22653528]