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ORIGINAL

A study of evaluation and proper diagnosis of stroke in CT scan and MRI

Un estudio sobre la evaluación y el diagnóstico adecuado del ictus en la TC y la RM

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Abstract

Objective: This project has taken to know why CT remains the primary imaging modality in stroke evaluation while is associated with high ionizing radiation, and to know when CT can be replaced by MRI as primary imaging.
Methodology: The study was carried out in different hospitals in Dhaka city using data collection from 120 patients suspected of stroke.
Results: the study showed that CT is the most common imaging modality used in stroke imaging mainly due to its practicality, speed, and availability in most clinical centers. An CT is more accessible in the emergency setting of stroke evaluation than MRI, thus is preferred in most centers as the primary imaging modality. CT has been proved to be very sensitive, especially in the detection of acute hemorrhage. However, its accuracy is decreasing with time from the symptom onset and this is a disadvantage, MRI has been proved much more accurate modality in both types of strokes, thus it can be used as a sole imaging modality for the evaluation of patients with suspected stroke. Theoretical and practical implications are discussed.
Conclusion: This study tried to find out if MRI becomes the primary imaging modality and can replace CT scan as primary imaging for stroke evaluation also this study presented compression between them, whether it is good to use MRI or CT furthermore, we presented the future study.

Key words: Ischemic stroke, intracerebral hemorrhage, transient ischemic attack, computed tomography, non-contrast computed tomography, magnetic resonance imaging, diffusion-weighted imaging, perfusion-weighted imaging.

Resumen

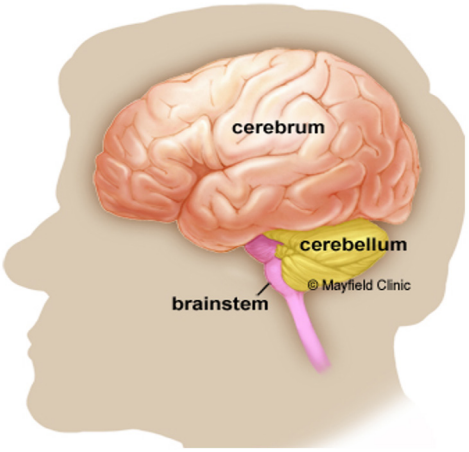
Objetivo: Este proyecto ha tenido como objetivo conocer por qué la Tomografía computarizada (TC) sigue siendo la modalidad de imagen primaria en la evaluación del ictus mientras se asocia a una alta radiación ionizante, y saber cuándo la TC puede ser sustituida por la (Resonancia Magnética (RM) como imagen primaria.
Metodología: El estudio se llevó a cabo en diferentes hospitales de la ciudad de Dhaka mediante la recogida de datos de 120 pacientes con sospecha de ictus.
Resultados: el estudio demostró que la TC es la modalidad de imagen más utilizada en el diagnóstico por imagen de los accidentes cerebrovasculares debido principalmente a su practicidad, rapidez y disponibilidad en la mayoría de los centros clínicos. La TC es más accesible en el entorno de emergencia de la evaluación del ictus que la RM, por lo que se prefiere en la mayoría de los centros como modalidad de imagen primaria. La TC ha demostrado ser muy sensible, especialmente en la detección de hemorragias agudas. Sin embargo, su precisión disminuye con el tiempo desde el inicio de los síntomas y esto es una desventaja, la RM ha demostrado ser una modalidad mucho más precisa en ambos tipos de accidentes cerebrovasculares, por lo que puede utilizarse como única modalidad de imagen para la evaluación de pacientes con sospecha de accidente cerebrovascular. Se discuten las implicaciones teóricas y prácticas.
Conclusiones: Este estudio intentó averiguar si la RM se convierte en la modalidad de imagen primaria y puede sustituir a la TC como imagen primaria para la evaluación del ictus también este estudio presentó la compresión entre ellos, si es bueno utilizar la RM o la TC además, presentamos el estudio futuro.

Palabras clave: accidente cerebrovascular isquémico, hemorragia intracerebral, ataque isquémico transitorio, tomografía computarizada, tomografía computarizada sin contraste, resonancia magnética, imágenes ponderadas por difusión, imágenes ponderadas por perfusión.

1. Introduction

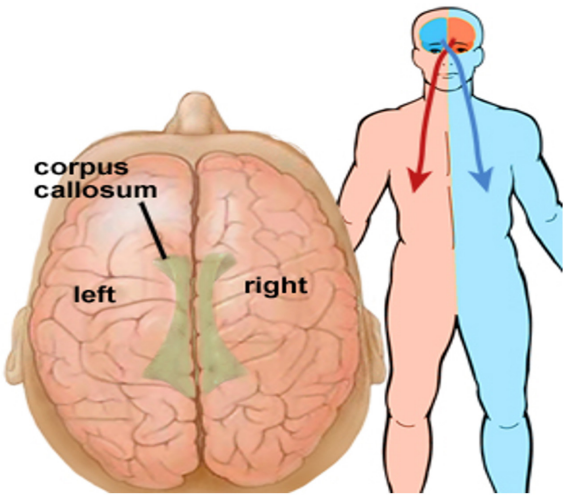
Stroke is the immediate or unexpected loss of brain function where there is decreased or cut off of the blood supply to the brain. It is one of the major healthcare problems as it is the third leading of death[1]. With the aging of population of the earth, the number of deaths caused by stroke is expected to increase in the near future[2]. the disturbance of blood supply to the brain which causes to a stroke event can be due to ischemia (thrombosis or embolism) or hemorrhage[3]. The term 'stroke' was coined and introduced to medicine by William Cole in the late 17th century[4] and has remained a generic definition since. The WHO describes stroke as a clinical syndrome typified by "rapidly developing clinical signs of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause apart that of vascular origin[5]. Normally we classified two main types, one is Ischemic stroke, is the most common type of stroke and it refers to the 80% of all cases[6]. Ischemic stroke occurs when an artery which provides blood to the brain is occluded due to thromboembolic events and the blood supply to the brain is greatly decreased or even cut off. The normal cerebral blood flow (CBF) is 50-80 ml/100g/min and when CBF is reduced into less than 8 ml/100g/min brain cells start to die and that causes an irreversible injured core within minutes. If the CBF is reduced to 20 ml/100g of tissue per minute to an area of the brain, this area represents an ischemic penumbra which is still viable and can be fully recovered if perfusion of the blood is restored in time[7]. The second is Hemorrhagic stroke is less frequent compared to ischemic (20% of all strokes) but much more fatal[8]. When the wall of a blood vessel becomes weak, it ruptures and bleeds into the surrounding brain, which causes buildup of pressure into the brain parenchyma, which distorts and injures brain tissue and this can cause death to the 40% to 50% of the patients[9]. There is another sub type of stroke which called Transient ischemic attack (TIA), is a subtype of the main types (Ischemic and Hemorrhage). TIA refers to a ''mini stroke" or to a ''warning stroke"[10]. TIA has similar symptoms to stroke, but with the difference that they last for few seconds to minutes without causing any infarction or severe problems to the brain[11]. The basic anatomy of the brain has three main parts first is the Cerebrum, which is the largest part of the brain and is composed of the right and left hemispheres. it performs higher functions like interpreting touch, vision, and hearing as well as speech, reasoning emotions, learning, and fine control of movement. The second Cerebellum- is located under the cerebrum. Its function is to coordinate muscle movements and maintain posture and balance. Thirdly Brainstem- acts as rarely center connecting the cerebrum and cerebellum to the spinal cord. It performs many autonomic functions such as breathing, heart rate, body temperature wake, sleep cycles, digestion, sneezing, coughing, vomiting, and swallowing.

Figure 1.1: three main brain components.



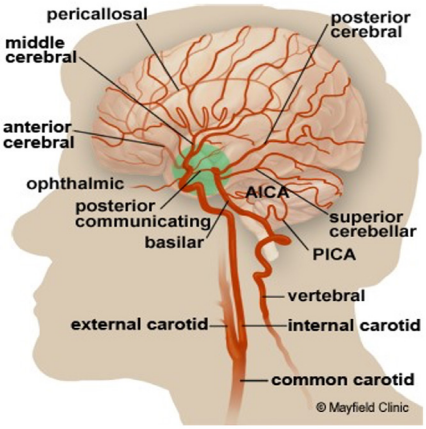
Moreover, the cerebrum is divided into two halves: the right and left hemispheres (**Figure 1.2**) they are joined by bundle of fibers called the corpus callosum that transmits messages from one side to the other. Each hemispheres controls the opposite side of the body. If the stroke occurs on the right side of the brain, your left arm or leg may be weak or paralyzed. Not all functions of the hemispheres are shared. In general, the left hemisphere controls speech, comprehension, arithmetic, and writing. The right hemisphere controls creativity, spatial ability, artistic, and musical skills. The left hemisphere is dominant in hand use and language in about 92% of people.

Figure 1.2: The cerebrum is divided into left and right hemispheres. The two sides are connected by the nerve fibers corpus callosum.



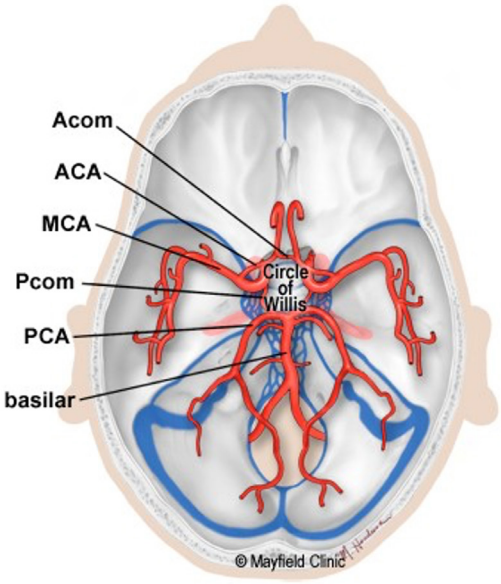
The also main important things we need to mention here is blood supply of the brain, Blood is carried to the brain by two paired arteries, the internal carotid arteries and the vertebral arteries (**Figure 1.3**). The internal carotid arteries supply most of the cerebrum.

Figure 1.3: The common carotid artery courses up the neck and divides into the internal and external carotid arteries. The brain's anterior circulation is fed by the internal carotid arteries (ICA) and the posterior circulation is fed by the vertebral arteries (VA). The two systems connect at the Circle of Willis (green circle).



The vertebral arteries supply the cerebellum, brainstem, and the underside of the cerebrum. After passing through the skull, the right and left vertebral arteries join together to form the basilar artery. The basilar artery and the internal carotid arteries "communicate" with each other at the base of the brain called the Circle of Willis (**Figure 1.4**). The communication between the internal carotid and vertebral-basilar systems is an important safety feature of the brain. If one of the major vessels becomes blocked, it is possible for collateral blood flow to come across the Circle of Willis and prevent brain damage.

Figure 1.4: Top view of the Circle of Willis. The internal carotid and vertebral-basilar systems are joined by the anterior communicating (Acom) and posterior communicating (Pcom) arteries.



The venous circulation of the brain is very different from that of the rest of the body. Usually, arteries and veins run together as they supply and drain specific areas of the body. So, one would think there would be a pair of vertebral veins and internal carotid veins. However, this is not the case in the brain. The major vein collectors are integrated into the dura to form venous sinuses — not to be confused with the air sinuses in the face and nasal region. The venous sinuses collect the blood from the brain and pass it to the internal jugular veins. The superior and inferior sagittal sinuses drain the cerebrum, the cavernous sinuses drain the anterior skull base. All sinuses eventually drain to the sigmoid sinuses, which exit the skull and form the jugular veins. These two jugular veins are essentially the only drainage of the brain[12].

1.1 Justification of the study

- Clinical evidence might suggest stroke, only imaging modalities can provide enough information to identify acute stroke symptoms, either ischemic or hemorrhagic.
- On the hand CT ca detect accurately any intracranial hemorrhage.
- On the other hand, DWI is a sensitive technique for the detection of early ischemic changes and can visualize them within minutes after the symptom onset.
- Obviously, this is an advantage in stroke evaluation as 80% of all strokes are ischemic and treatment should be administered in the first 3 hours from the symptom onset.
- Furthermore, MRI has been proved to be as accurate as CT for the detection of acute intracerebral hemorrhage.
- New imaging techniques like Angiography and Perfusion with Diffusion imaging can provide all the vital information to the clinician to choose the correct treatment path
- With MRI and CT, enough information can be provided for the selection of patients eligible for thrombolysis, based not on clinical evidence and time from the stroke onset, but on pathophysiology of the brain.

1.2 Research question

Can MRI be a better imaging modality that can replace CT scan as primary imaging for diagnosis and evaluation of stroke?

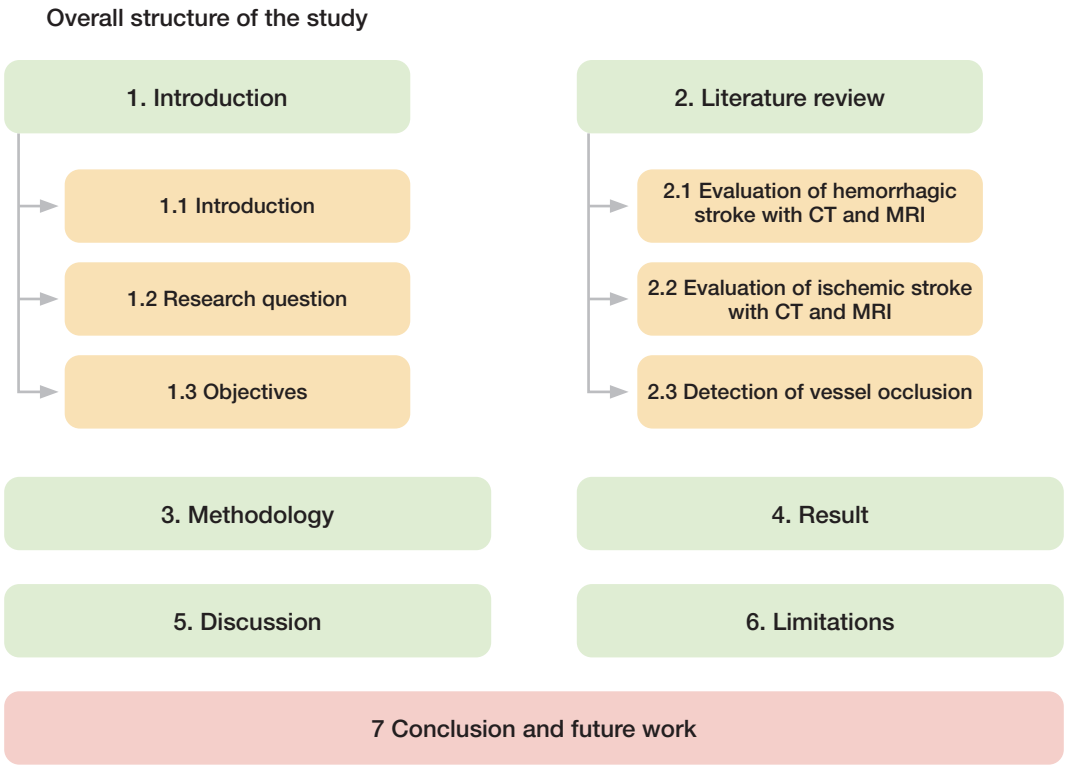
1.3 Objectives

The General objectives is to compare the diagnostic accuracy of diffusion-weighted MRI (DWI) and CT for acute ischemic stroke, and to estimate the diagnostic accuracy of MRI for acute hemorrhagic stroke. and the Specific objectives is to know why CT remains the primary imaging modality in stroke evaluation while is associated with high ionizing radiation? To know which gender is highly affected by the stroke, to compare CT and MRI for their detection and diagnosis of stroke.

1.4 Ethical consideration

Ethical clearance to conduct the study was obtained from the Bangladesh University of Health Sciences (BUHS).

Figure 1.5: Overall organized of the paper process.



2. Literature review

2.1. Evaluation of hemorrhagic stroke with CT and MRI

The detection of intracerebral hemorrhage is the first step in stroke diagnosis, as its detection differentiates the ischemic from hemorrhagic stroke, and defines the treatment path. Computed tomography due to its high sensitivity in hemorrhage remains the primary modality for its detection, however according to published literature MRI using special sequences might prove to be an even more accurate method in the detection of any hemorrhage. This chapter will provide answers regarding the detection of intracranial hemorrhage with both methods in acute, and subacute and chronic hemorrhage, micro bleeds, plus hemorrhage after thrombolysis.

2.1.1. Detection of acute intracerebral hemorrhage

Non-enhance CT remains first step in stroke imaging because of its high accuracy in the detection of intracranial hemorrhage. Intracranial blood in CT appears as a hyper attenuated area 1.due to the different attenuation of the x rays, but when blood intermixes with Cerebral Blood Flow (CBF) or brain tissue might cause a hypo attenuation thus, the density of the hemorrhagic area will appear as the adjacent normal brain and this is more often in subarachnoid hemorrhage.

2.1.2. Detection of Subarachnoid Hemorrhage

Subarachnoid hemorrhage is most severe case of hemorrhagic stroke and refers to 1-7% of all strokes14. The most common imaging modality which is used for the detection of SAH is NCCT in which illustrates hyper intensity area filling the Cisterns and Sulci.

MRI uses a different philosophy in the detection of SAH, as it relies on the blood degradation, which produces DE oxyhemoglobin which can be detected by MR. Specifically, the sensitivity of MRI in the detection of hemorrhage increases with time[13].

Compared MRI sequences and NCCT to measure their sensitivity to SAH. His study included 41 patients and it was proved that T2* GRE and Fluid Attenuation Inversion Recovery (FLAIR) sequences had an overall sensitivity of 94% and 87% respectively and 95% for CT in the acute phase. Basic T1 and T2 sequences were less sensitive in the detection of acute SAH with percentages between 50-56%. In the subacute phase the sensitivity for T2*GRE and FLAIR sequences increased, reaching 100% for T2* GRE and 87% for FLAIR sequence and 90% for CT. However, the percentage for T1, T2 sequences was reduced to 33%, 47% and 33% respectively. Only one patient with SAH was not detected by MRI but with CT.

2.1.3. Detection of Chronic Hemorrhage

Computed Tomography might have an accuracy of almost 100% in the detection of acute intracranial hemorrhage however, its sensitivity on subacute and chronic hemorrhage cannot be compared with the sensitivity of MRI. Blood appears differently in diagnostic imaging at each phase (acute, subacute and chronic) and MRI has been found to be more accurate than CT in detection in the subacute and chronic setting[14].

Overall Result in the detection of any hemorrhage: MRI has been shown in this enquiry to be as accurate as CT in the detection of both intracranial and subarachnoid hemorrhage but more reliable and accurate in subacute and chronic hemorrhage.

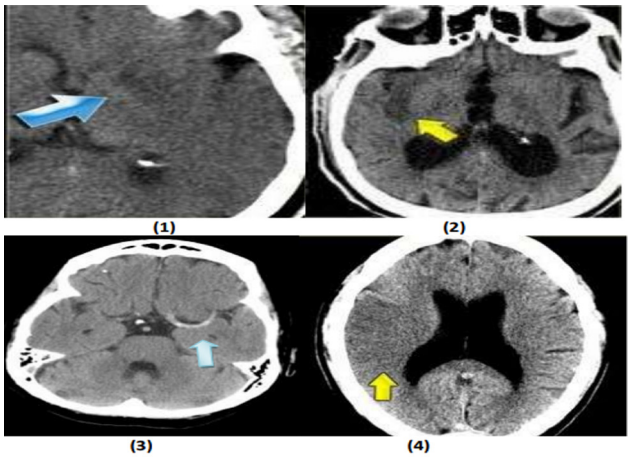
2.2. Evaluation of ischemic stroke with CT and MRI

Ischemic stroke is the most common type of stroke as it refers to the 80% of all cases. An ischemic stroke occurs when the blood supply to the brain is reduced significantly, most of the times due to clot. Ischemic penumbra is the area of the brain which is still viable and can be fully recovered if perfusion of the blood is fully restored in time. In the case where intracerebral hemorrhage is not detected, the next step in stroke evaluation is to check for early ischemic signs which can be found very frequently in a percentage of 92% and according to. Their detection is associated with a poor overall outcome.

2.2.1. Detection of Early Ischemic Changes

The major disadvantage of CT in ischemic stroke is that it cannot detect any ischemic changes with accuracy in the acute setting. early ischemic changes might be detected and clarified correctly approximately 6 hours after the onset symptom if a CT scanner is used[15] but usually this cannot be fully justified and especially in the hyper acute setting (3 hours) where EIS (early ischemic) appear to be subtle and don't provide enough evidence which can lead to thrombolytic treatment (**Figure 2.1**).

Figure 2.1: Early Ischemic Changes and CT 1. Obscuration of the lentiform nucleus. 2. Insular ribbon sign. 3. Hyper attenuating media sign. 4. Hypo attenuation areas appear over time after the symptom onset.



Aside from specialized MR imaging techniques like DWI, conventional sequences are used as well in ischemic stroke evaluation. T2-Weighted imaging is well correlated with tissue prognosis as it can illustrate infracted tissue but, as on CT, definitive early ischemic changes can only be seen 6 hours from the symptom onset. With a T1-weighted sequence, an early infarction might be diagnosed by focal swelling and parenchymal hypo intensity because of the Cytoxan edema

Over all Result for the detection of Ischemic Changes: MRI is superior to CT in the detection of Early Ischemic Changes.

2.3. Detection of vessel occlusion

If an intracranial hemorrhage is not detected, and early ischemic changes might confirm an ischemic stroke then the next step to be performed in stroke imaging is to evaluate if a large vessel is occluded. Both CTA and MRA are noninvasive imaging techniques which can be used for the evaluation intracranial and cervical vessels for the detection of an arterial occlusion or stenosis in the circle of Wills and confirm the ischemic changes.

Overall Result for the detection of an occlusion: MRI might not be able to provide as accurate results and high-resolution images as CT, however it can lead to the same treatment decisions.

3. Methodology

The study design was a descriptive multidimensional and multiple sequence taken for the study.

And the study population was the patients of both outdoor and indoor patients, admitted different hospitals in Dhaka, who came in the Department of Radiology and Imaging for MRI or CT scan for diagnosis evaluation of stroke. The place of the study was carried out six different hospitals in Dhaka and the study period was carried out from 01/December/ 2020 to 31/march/ 2021. The sample size was determined purposively, 120 cases of suspected cases who developed sign and symptoms of stroke, has been diagnosed by MRI or CT scan, and uncooperative cases were excluded from the study. Moreover, we used sampling technique that was taken purposively, and the data collection tools was a semi structure questionnaire was prepared according to clinical symptoms, Risk factors, and the objectives of the study. The data collection procedure was taken from the Head of the Department of Radiology and Imaging in each hospital and verbal consent from Radiology & imaging Department In-charge. Prior to interview the purpose of the study was clearly elaborated to the patient and guidance of the patient and their verbal consent was taken before filling the questionnaire. I collected data by face-to-face interview. At first find the lists/prescription of stroke and collected

data by face-to-face interview, one by one, separately. Furthermore, Imaging and image analysis all patients referred to the Department of Radiology for MRI and CT of Brain underwent examinations as per protocols. MRI The routine protocol included was sagittal and axial T1- and T2-weighted images, diffuse weighted image (DWI), FLAIR and short tau inversion recovery (STIR) coronal images. All MRI examinations were performed on a 1.5 Tesla Siemens and Philips MRI scanner. CT- the routine protocol included was sagittal, axial and coronal images. All CT examinations were performed on a 128 slice and 64 slice Siemens and Philips respectively. All images were reviewed by radiologists, and a consensus diagnosis was given by different radiologists in controversial cases. Finally, data was analyzed after collection, also data was checked, verified, and processed to reduce error. Then it was analyzed by computer using SPSS software version 16.0.

4. Results

Table and Figure 4.1: Shows the age of the participants.

Age	Frequency	Percent
20-40	40	33.3%
41-60	44	36.7%
61-80	32	26.7%
above 80	4	3.3%
Total	**120**	**100.0%**

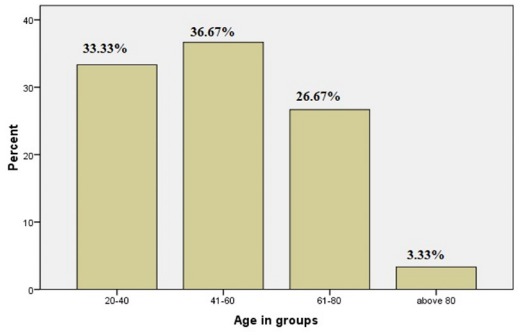


Table and Figure 4.2: Demonstrates the gender information.

Gender	Frequency	Percent
Male	62	51.7%
Female	58	48.3%
Total	**120**	**100.0%**

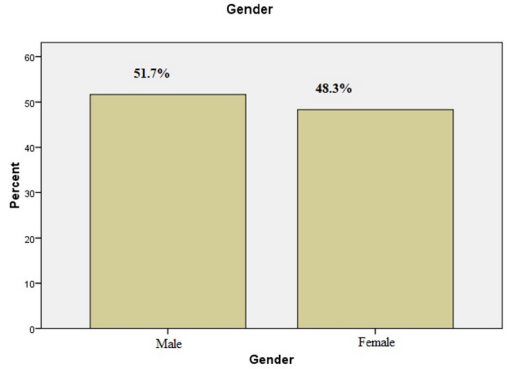


Table 4.3: Demonstrates the Educational status.

Level of education	Frequency	Percent
Below school level	27	22.5%
School level	47	39.2%
College level	34	28.3%
University level	12	10.0%
Total	**120**	**100.0%**

Table 4.4: Shows that occupational status off the study.

Services	Frequency	Percent
No service	26	21.7%
Service	94	78.3%
Total	**120**	**100.0%**

Table and Figure 4.5: Shows the clinical history of the participants.

Clinical history	Frequency	Percent
Right sided weakness	12	10.0%
Left sided weakness	20	16.7%
General weakness	32	26.7%
Headache	35	29.2%
memory loss	11	9.2%
Unconsciousness.	5	4.2%
Slow movement	5	4.2%
Total	**120**	**100.0%**

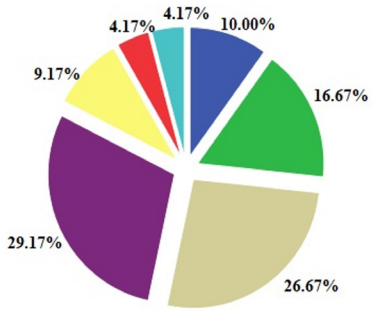


Table and Figure 4.6: Shows the risk factors of stroke.

Risk factors	Frequency	Percent
Diabetes and hypertension	35	29.2%
Hypertension and smoking	16	13.3%
Smoking	11	9.2%
Diabetes only	9	7.5%
Family history of stroke	7	5.8%
All of the above except family history	18	15.0%
All	7	5.8%
Hypertension only	17	14.2%
Total	**120**	**100.0%**

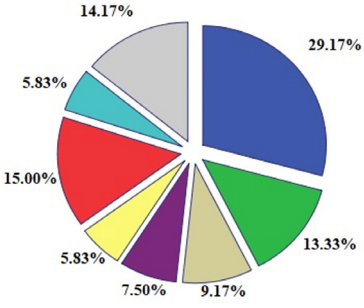


Table and Figure 4.7: Show the trauma history of the study participants.

Trauma	Frequency	Percent
No	109	90.8%
Yes	11	9.2%
Total	**120**	**100.0%**

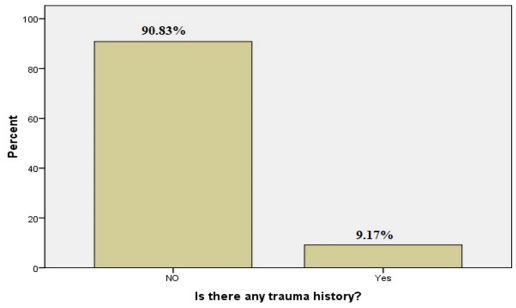


Table and Figure 4.8: Demonstrated which modalities is used?

Modality	Frequency	Percent
MRI	45	37.5%
CT scan	75	62.5%
Total	**120**	**100.0%**

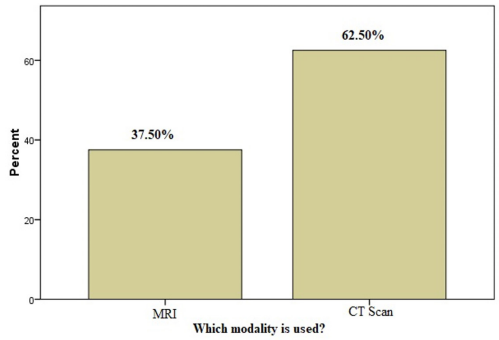


Table and Figure 4.9: Show the factors of influence the decision to use a CT scan or MRI as the primary imaging modality.

Factors	Frequency	percent
MRI takes longer than CT scan.	27	22.5%
Most centers offer CT scans, but MRIs are not	25	20.8%
MRIs are more expensive than CT scans.	11	9.2%
CT scans do not cause claustrophobia but MRIs do	12	10.0%
CT scans are less accurate than MRIs.	21	17.5%
No idea	24	20.0%
Total	**120**	**100.0%**

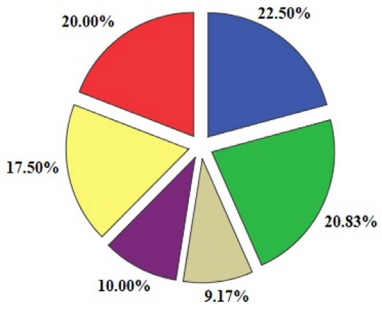
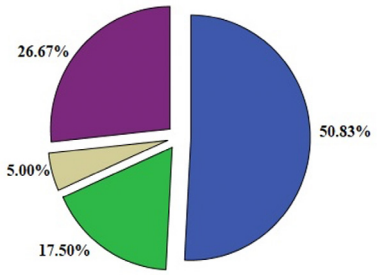


Table and Figure 4.10: Show the radiological findings of the study participants.

Radiological findings	Frequency	Percent
Ischemic stroke	61	50.8%
Hemorrhagic stroke	21	17.5%
Transient ischemic stroke (TIS)	6	5.0%
Normal	32	26.7%
Total	**120**	**100.0%**



5. Discussion

5.1. Sex participant of the study

Among 120 participant 51.67% (N=62) were male, were 48.33 %(N=58) were female. Stroke is more common among men, but women are more severely ill. According to[16]. 98 articles that contained relevant sex-specific information, including 59 incidence studies from 19 countries and 5 continents. The mean age at first-ever stroke was 68.6 years among men, and 72.9 years among women. Male stroke incidence rate was 33% higher and stroke prevalence was 41% higher than the female, with large variations between age bands and between populations. The incidence rates of brain infarction and intracerebral hemorrhage were higher among men, whereas the rate of subarachnoid hemorrhage was higher among women, although this difference was not statistically significant. Stroke tended to be more severe in women, with a 1-month case fatality of 24.7% compared with 19.7% for men.

5.2. Different age groups

Aging is the most robust non-modifiable risk factor for incident stroke, which doubles every 10 years after age 55 years. Approximately three-quarters of all strokes occur in persons aged ≥60 years. As the number of people aged ≥ 60 years is projected to grow, the number of incident strokes in older adults is expected to rise, presenting major challenges for clinicians and policy makers in the foreseeable future 44. According to national stroke association (NAS) The word “hemi” means “one side” and “paresis” means “weakness.” About 80% of people who have had a stroke have some degree of trouble moving one side, or suffer from weakness on one side of their bodies. This condition, called hemiparesis, is most often caused by stroke and cerebral palsy. But hemiparesis can also be caused by brain tumors, multiple sclerosis, and other diseases of the brain or nervous system. People with hemiparesis

may have trouble moving their arms and legs, difficulty walking and may also experience a loss of balance. As a result, doing simple everyday activities can be difficult. This includes grabbing objects, dressing, eating and problems using the bathroom. The loss of abilities that follow a stroke depend on the area of the brain that has been damaged from stroke. Right-sided hemiparesis involves injury to the left side of the brain, which controls language and speaking. People who have this type of hemiparesis may also have problems talking and/or understanding what people say. They also may have trouble determining left from right. Left-sided hemiparesis involves injury to the right side of the brain, which controls the process of how we learn, non-verbal communication, hear, touch, be aware of your own body and certain types of behavior. Damage to this area of the brain can also cause people to talk excessively, have memory problems and short attention spans. Damage to the lower part of the brain can affect the body's ability to coordinate movement. This is called ataxia and can lead to problems with posture, walking and balance.

5.3. Modifiable risk factors for stroke

Diabetes and hypertension are the most common modifiable risk factors for stroke. Major modifiable risk factors for stroke include hypertension, diabetes, and smoking. Diabetes is a well-established risk factor for stroke. It can cause pathologic changes in blood vessels at various locations and can lead to stroke if cerebral vessels are directly affected. Risk for stroke is actually higher in the young population with diabetes. According to data from the Greater Cincinnati/Northern Kentucky stroke study, diabetes increases ischemic stroke incidence in all age groups, but this risk is most striking before the age of 55 years in African Americans and before the age of 65 years in Whites[17]. Individuals with diabetes are more likely to suffer from hypertension, myocardial infarction (MI) and high cholesterol than individuals without diabetes. Even prediabetes (defined as impaired glucose tolerance or a combination of impaired fasting glucose plus impaired glucose tolerance) has been linked to a greater risk of stroke[18]. Uncontrolled diabetes puts subjects at risk for both ischemic and hemorrhagic strokes. There are specific clinical patterns of ischemic stroke in individuals with diabetes. For example, individuals with diabetes are more likely to have limb weakness and dysarthria as signs of lacunar cerebral infarction when compared with those without diabetes. In the Lausanne Stroke Registry between 1983 and 2002, patients with diabetes had higher relative prevalence of subcortical infarction and lower relative prevalence of intracerebral hemorrhage (ICH)[19]. In another study, significant differences were observed in patients with ischemic stroke along with diabetes in comparison with nondiabetics with higher frequency of lacunar infarct and hypertension[20].

5.4. Comparison between CT and MRI in stroke.

CT is the most common imaging modality used in stroke imaging mainly due to its practicality, speed and availability in most clinical centers. A NCCT is more accessible in the emergency setting of stroke evaluation than MRI, thus is preferred in most of the centers as the primary imaging modality. However, is it able to provide the same information like MRI? NCCT has been proved to be very sensitive especially in the detection of acute hemorrhage. However, its accuracy is decreasing with time from the symptom onset and this is a disadvantage. Furthermore, subacute and especially chronic hemorrhage cannot be detected accurately with CT due to its physical principles in the attenuation of x rays. The advantage of MRI in the detection of hemorrhage compared to CT is that its sensitivity is increasing with time and it can be very accurate apart from the acute setting, in subacute and chronic stage as well whereas CT cannot. Furthermore, MRI is more accurate in the detection of micro bleeds which can be missed by CT in most of the cases. The detection of micro bleeds is very important because is a contraindication for the administration of any thrombolytic treatment. MRI and CT use Perfusion imaging technique to evaluate the ischemic penumbra. CT perfusion appears to be more practical generally and offers advantages over MR. Scanning time takes less than two minutes, and the technique provides good quality images even if the patient cannot remain perfectly still. The only disadvantage of Perfusion CT at the moment is that it cannot cover the whole brain, even with modern multi slice scanners. Thus, this technique is performed in specific areas (most likely affected by ischemia) of just few centimeters. On the other hand, MRI can perform Perfusion imaging and cover all the brain area, and this is the major advantage of MRI in Perfusion technique. How large is the irreversible injured core? The identification of the irreversibly injured core is a predominant advantage of MRI. It is well established that MRI using Diffusion Weighted Imaging can identify infarct core in the very acute setting. This technique can detect early ischemic changes and irreversibly injured core within minutes from the symptom onset whereas CT can detect them accurately within 6 hours as findings of NCCT in ischemic stroke appear to be normal in the acute setting. Apparently, this is an important disadvantage for CT because in the case of ischemic stroke, as soon the treatment is administered the better the results are.

5.5. Findings

Study of 120 participants, out of 120, 32 participants are seen normal, whereas others find out different types of strokes as illustrated in the (**Figure 4.10**) most common frequent of the study findings was the ischemic stroke, Ischemic stroke is the most common type of stroke and it refers to the 80% of all cases[6]. Ischemic stroke occurs when an artery which provides blood to the brain is occluded due to thromboembolic events and the blood supply to the brain is greatly decreased or even cut off. The normal cerebral blood flow (CBF) is 50-80 ml/100g/min and when CBF is reduced into less than 8 ml/100g/min brain cells start to die and that causes an irreversible

injured core within minutes. If the CBF is reduced to 20 ml/100g of tissue per minute to an area of the brain, this area represents an ischemic penumbra which is still viable and can be fully recovered if perfusion of the blood is restored in time[7].

Hemorrhagic stroke is less frequent compared to ischemic (20% of all strokes) but much more fatal When the wall of a blood vessel becomes weak, it ruptures and bleeds into the surrounding brain, which causes buildup of pressure into the brain parenchyma, which distorts and injures brain tissue and this can cause death to the 40% to 50% of the patients[9].

Intracranial hemorrhage is divided into two main categories: Intracerebral Hemorrhage (ICH): An artery within the brain ruptures and releases blood within the brain tissue because of brain trauma or a hemorrhagic stroke[21]. ICH comprises the 20% of all cerebrovascular diseases in the US, behind cerebral thrombosis (40%) and cerebral embolism (30%)[22]. Subarachnoid Hemorrhage (SAH): An artery on the surface of the brain ruptures and causes a release of blood into the subarachnoid space outside of the brain due to a ruptured cerebral aneurysm or head trauma. Subarachnoid hemorrhage is a dangerous and refers to 1-7% of all strokes[23].

6. Limitations

With a successive completion of this project, there are some limitations.

Related to the study. Some of them are pointed out below:

- This study will not be representative one, because it is hospital-based study.
- The sample was purposively, so it may reflect the actual situation.
- The cost is high; therefore, some patients cannot afford.
- For Both imaging modalities there are contraindications which will prevent patient to undergo examination. Generally, MRI appears to have more contraindication than CT and this one of the major disadvantages in diagnostic imaging. MRI uses magnetic field to produce images, metallic objects or electric device within the patients which might interact with these magnetic fields cannot be entered into the room., On the other hand CT uses high doses of radiation, but since the patients with acute stroke, in whom life may depend on time-rigid therapeutic window benefits definitely outweigh risk of radiation exposure.
- Claustrophobia and disorientated patients are difficult to have MRI.
- During my data collection, Due to this pandemic it was a very difficult to stay a long time in a hospital, for my safety and others as well.
- Due to MRI time consumption, unconsciousness patients cannot be done.

7. Conclusion and future work

This study tried to find out if MRI become primary imaging modality and can replace in CT scan as primary imaging for stroke evaluation. MRI has been finding to be accurate in the detection of both types of strokes, hemorrhagic and ischemic and it can be used as a primary imaging technique for the evaluation of a stroke patient. Acute, subacute and chronic stroke can be identified accurately with the special techniques of MRI whereas the information provided by CT remains subtle. MRI (DWI) is superior rather than CT for the detection of early ischemic changes within the hyper acute setting, whereas CT can identify EIS with accuracy 6 hours from symptom onset. Subacute, chronic hemorrhage and bleeding can be detected more accurate by MRI, whereas CT cannot even illustrate this type of hemorrhage. CT might have the advantage of speed, accessibility and widespread availability but it cannot provide all necessary information for the accurate evaluation of stroke and more specifically in the case of ischemic stroke. Stroke. MRI has been proved much more accurate modality in both types of strokes, thus it can be used as a solo imaging modality for the evaluation of patients with suspected Although CT is granted as ideal choice for imaging stroke, many studies has shown that MRI has many advantages compared to CT, even though the contraindications of MRI is more than CT.it could be the primary imaging modality. In the future studies we would provide further insight into CT scan determination of stroke. It needs further study to identify any relationship between educational status and incident stroke. and also, the penumbra may be seen with both CT and MRI; however, this concept may be over is not clear.

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Conflict of interest

There is no conflicts of interest to publish the present work.

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