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Comparing Routine Protocol Versus Abbreviated Protocol in Reaching Radiological Diagnosis of Stroke Using Magnetic Resonance Imaging (MRI)

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ABSTRACT

Background: Magnetic Resonance Imaging provides information that's beneficial for diagnosing ischemic stroke, choosing proper patients for thrombolytic therapy, as well as predicting the prognosis of ischemic stroke. Objectives: To evaluate the efficacy of the routine protocol of MRI and Abbreviated term protocol. The goal is to compare both types of protocols in the developing sustainable and reliable medical imaging for an effective radiological diagnosis of the cerebrovascular strokes. Methodology: This is a retrospective study conducted at PSMMC hospital to compare abbreviated with routine protocol in radiological diagnosis of acute stroke using Magnetic Resonance Imaging. An overall 116 patient aged from 40 – 95 years data were gathered who had previously undergone diagnosis using a routine protocol. They were provided to the board-certified radiologist in all of our 10 radiologists with different years of experiences who have performed the process. Therefore, image acquisition was the standardized method that has been conducted following the national quality assurance. The data was analysed using a variety of descriptive and inferential statistical measures. SPSS 12.0 was used to analyse the information gathered. Results: The results expressed that the sensitivity measure of the abbreviated protocol concerning the routine protocol ensured that 87 patients were evaluated to be positively diagnosed with the presence of acute strokes, with the progress rate and average frequency of 95.6%, after the application of abbreviated protocol. On the other hand, the results also elaborated those 25 patients who were not diagnosed initially for the presence of stroke using the medium of routine protocol for MRI, expressed the similar results with the abbreviated protocol as well. These patients presented no significant signs of having the strokes and associated with the abbreviated protocol, presenting an average success rate of 100%. Conclusion: The study ensured that the MRI performed using the abbreviated protocol expressed similar diagnostic results as the routine protocol, confirm the presence of the acute strokes among the patients. The specificity and sensitivity test indicated that the sustainable and expressive dependability and reliability of both types of MRI protocols.

Keywords: Radiological Diagnosis, Stroke, Magnetic Resonance Imaging (MRI), Saudi Arabia.

BACKGROUND

The MRI abbreviated as the magnetic resonance imaging is referred as the most reliable method of imaging and screening used in the healthcare diagnosis of the diseases. This technique

utilises the magnetic field and radio waves to develop the image of the systems and organs that are at the risk of chronic diseases and problems (Kloska et al., 2010). Different types of MRI scan are used to evaluate the variety of conditions and assessing the problems. These imaging techniques are widely recommended by the clinicians if the patients is predicted to have tumors or such cerebrovascular diseases (Sibbitt Jr. et al., 2010). The assessment and reliable screening of the brain and spinal cord is preferably performed using the medium of MRI, as it provides relatively clear and expressive imaging of the internal conditions of organs. To observe the conditions of the patients and to clearly screen the regions of the body, different MRI sequences are submerged, which is termed as the MRI protocol for relative screening (Kloska et al., 2010). The protocols for the brain imaging generally include the tumour protocol, screen protocol, stereotaxis protocol and stroke protocols. However, the abbreviated term protocol is one of the standard MRI techniques with the term dynamic contrasted enhanced (DCE) series, which is single phased. In contrast, the screening protocols are also regarded as the normal or routine MRI protocols used for the imaging of different regions of the body, involving different sequencing according to the regions.

The abbreviated term protocol of MRI interpretation includes three sequences that are Diffusion-weighted imaging (DWI)Axial with an apparent diffusion coefficient (ADC) image, Fluid-attenuated inversion recovery (FLAIR) Axial, and SAGT1 fast-spin echo (FSE) (Öztoprak, Öztoprak & Yıldız, 2016). T1 can be used to assess for hemorrhage in the absence of Gradient echo sequence (GRE). The GRE are considerably used in place of the spin echo sequences of MRI. This is because the GRE productively utilises the gradient fields for the subsequent development of the transverse magnetization. The preference of GRE is promoted because this sequencing technique appears to be more adaptable and relatively reliable when compared with the spin echo sequence or inversion recovery sequences. The total duration of the abbreviated-term protocol, in developing the images and screening the organ or region is 17 minutes (Traboulsee et al., 2016). On the other hand, the Routine protocol for interpretation of MRI images includes three additional sequences apart from sequences considered under the abbreviated protocol. These three additional sequences are susceptibility-weighted imaging (SWI) Axial or Gradient echo (GRE), T2 (FSE) Axial, and Coronal T2 FAT SAT. The Routine examination through MRI takes requires the duration of 35-40 minutes. The difference in the time period consumed by the routine MRI reduces its efficacy when compared with the abbreviated term protocol of MRI (Traboulsee et al., 2016).

DWI Axial is beneficial for the characterization of tumors influencing cerebral ischemia. This method of MRI interpretation is beneficial for differentiating between acute and chronic stroke. On the other hand, Axial FLAIR is beneficial in identifying disruption of the central nervous system, and DWI/FLAIR mismatch can be used to estimate penumbra (Collard et al., 2019), which is the tissue at risk. Both T2 and T1 Axial are used to identify ischemic and hemorrhagic stroke (School of medicine, 2020). COR T2 FAT SAT sequence is used to observe fat and water molecules in MRI images. On the other hand, SWI Axial sequences help distinguish between calcifications and blood product MRI images and identify hemorrhage (Radiopaedia, 2020).

During the last twenty years, advances in care have significantly enhanced stroke patients' results with a decrease in more patients and deaths, ultimately achieving independence. Amongst several likely changes, three factors are mostly responsible for this particular improvement. It's believed that stroke can cost almost climate available £9 billion a year

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(Donkor, 2018). About 50% of this's advertised straight to the National Health Services. Also, 30% is designed for the price of casual care. In comparison, loss in efficiency is believed to account because of around 20%.

The majority of hemorrhagic and ischemic strokes are generally very different, but the secondary hemorrhagic transformation typically complicates ischemic strokes. The root cause of the perforating arteriolar illness is unknown though it's generally referred to as fibrinoid necrosis or lipohyalinosis; cardioembolism, and carotid stenosis, are infrequent reasons for lacunar stroke, though hypertension and diabetes are typical risk factors for both small-vessel and extensive- disease. Hypertension is additionally a significant risk element for hemorrhagic stroke, contained in approximately fifty % of cases (Sarnowski, and Schminke, 2015). In young adults or children, stroke is less prevalent. Still, it is almost sure to end up from arterial dissection to the neck (secondary to stress or maybe in the existence of a connective tissue condition, for example, Marfan's syndrome) (Garg, and Bathla, 2020) or perhaps in the existence of a clotting condition, illicit drug use or infection.

There is a number of the risk factors mentioned in the previous research studies that lead towards the incidence of stroke among people. The research study indicated that the major risk factors for the stroke can be alerted among the people according to the situation, conditions of the patient and the provided treatment (Smajlovic, 2015). One of the risk factors mentioned in the study that increased the risk of stroke among people was hypertension i.e high blood pressure. The blood pressure within the range of 140/90 or higher than this increased the stroke risk. Additionally, it was noticed that high blood pressure can damage the blood vessels named as arteries for the supply of blood to the brain.

In addition, the study provided information that cardiovascular issues may increase the risk of the development of strokes among people (Costa et al., 2014). Smoking enhanced the risk for people to be involved in a stroke. Mostly the people with ischemic stroke were found to be involved in smoking habits. Diabetes is a condition with high blood sugar levels that enhanced the risk for people to get involved in stroke issues. It was observed in the study that the enhancement of the number of red blood cells thickens the blood which decreases the blood flow within the body and further increased the risk of stroke among the people. Blood clotting was considered as one of the major issues that enhanced the chances of stroke among people (Conrad et al., 2013). It was also noticed that high cholesterol levels in the blood result in the thickening and hardening of the blood vessels such as arteries. This hardening of the blood vessels may be caused due to the formation of plague within the blood.

The main conditions of the stroke were due to the restriction of the blood supply to the blood due to the accumulation of fatty acids within the blood. Less physical work was also attributed to the increased risk of stroke. It will result in less flow of blood to the brain and other parts of the body result in the incidence of other diseases and stroke among the people. Obesity and high body mass index (BMI) of the people was among the factors that enhanced the risk of stroke among the people due to the less flow of blood. The excessive usage of alcohol also increased the risks of stroke among the people, because it was found to be related to the health issue of blood pressure (Bejot et al., 2006). The study indicated that the use of intravenous drugs increases the risk of cerebral embolisms. The most contributory cause of the cocaine was found to be associated with the enhanced risk of stroke among the people. The irregular

heartbeat was due to the risk of heart stroke and structural abnormalities of the heart which can cause acute and chronic damages of the heart.

Some of the risk factors identified for the stroke that cannot be altered, changed or modified and mentioned in the previous research studies includes the older age such as the age older than 55 years enhanced the risk of stroke (Knopman et al., 2011). It was noticed that race was also one of the contributory factors that enhanced the risk of stroke among people. For instance, it was observed that people with the race of African-American race had an increased risk of stroke in comparison with the other races. One of the research studies demonstrated that males had more risk of stroke in comparison with females. People with a previous history of stroke had more chances of another stroke. Family history and genetics were some of the contributory factors that increased the chances of stroke among people (Doubal et al., 2010).

Aim and Objectives

This research study aims to evaluate the efficacy of the routine protocol of MRI and Abbreviated term protocol. The goal is to compare both types of protocols in the developing sustainable and reliable medical imaging for an effective radiological diagnosis of the cerebrovascular strokes.

Research Hypothesis

H_0: There is no statistical and reliability differences existing between the abbreviated term protocol and routine protocol of MRI, in forming the images of brain during the terms of acute strokes.

H_1: There is an expressive statistical and reliability differences existing between the abbreviated term protocol and routine protocol of MRI, in forming the images of brain during the terms of acute strokes.

LITERATURE REVIEW

MRI diagnostic features used by the radiologists

MRI images are used by the radiologist for the prediction of the scanned images of the different parts of the body such as the brain, and other soft tissues. The images of the cerebral vessels can be produced by the radiologists by using MRI techniques (Tyan et al., 2014). This process is known as MRI angiography. In addition, the study showed that images of the blood flow can be produced by using the procedure of MR perfusion. The doctors and other specialists utilised the scanned images of the MRI for the monitoring of the brain and its internal parts. The anatomical and physiological processes can be observed for the diagnosis of the disease in the brain for example in the case of stroke issues.

The string magnetic field is employed in this case to produce the images of the internal parts of the body. The radiologist used the different diagnostic features and characteristics to produce the MRI of the internal parts of the body. They used the features which provide better visualisation of the brain stem and cerebellum. There were the features used by the radiologists that provided the contrasts between the white and grey matter (Schellinger et al., 2010). This feature makes the MRI the best technique for the examination of the central nervous system (CNS). The CNS can be better visualised and analysed for the diseases such as dementia, cerebrovascular disease, Alzheimer's disease, brain stork and epilepsy.

The images are taken in milliseconds that helped the radiologists and physicians to respond to the different stimuli. The structural and functional abnormalities can be visualised by using these features. The study indicated that patients with stroke are also diagnosed by doing the frequent and repeated scanning to identify the presence of the tumour and lesions inside the brain (Frisoni et al., 2010). The diagnosis is dependent on the monitoring and assessment of the features. MRI provides information among the stroke patients about the vascular and the parenchymal lesion. The main features observed were the narrowing of the carotid and vertebra; arteries caused due to the haemorrhage in the wall of the arteries. In the case of doubt in the process of diagnosis, intra-arterial diagnosis is also performed. MRI is a challenging and complicated technique that used different features and most radiologists can use it to do neuroimaging.

The specialist of the stroke and other neurologists helped to read the scanned images and will be able to distinguish the issue in the brain due to the haemorrhage and to identify the nature of the lesions that seems non-vascular. The identification and diagnosis of the early haemorrhage are considered significant for instance in the case of thrombolysis. It was noticed that the small spots found on the areas of the brain that represents the damage can be associated with the diagnosis of stroke. These spots indicated the damages that affect vision and speech. The researchers found that these damages can have adverse impacts on the memory of the affected person (Nael et al., 2014). The areas of the damage can be determined by the radiologist and neurologist by examining the abnormalities of the brain and blood vessels in the ischemic stroke and haemorrhage stroke.

Brain MRI Protocol

MRI process for stroke assessment is several MRI sequences put in concert to best address brain ischemia. Some institutions also use a fast MRI stroke process for code stroke individuals' assessment in the limited period window for thrombolytic treatment.

Note: This report is meant to outline a few basic concepts of protocol design. The particulars will change based on MRI hardware and software program, radiologist's, and referrer's inclination, institutional protocols, affected person elements (e.g., Allergy), and time constraints.

The different sequences of MRI helped in the generation of the images with the different radio frequencies of pulses as well as gradients that will produce the images with a special type of appearances. In the study, there was a broad categorisation of the MRI techniques explained such as T1 used to suppress the fats (Merino & Warach, 2010). It was observed that the T1 sequence was the component of almost all MRI protocols and produced the images with the close approximation of the tissue. In this sequence, the most visible tissues are the muscles, fats, fluids and brain. There was contrast-enhanced and fat suppression in the T1 images. The contrast was used to be injected by the means of intravenously by producing the scans in a short time after the administration. The tumours, areas of infections and inflammation were used to be examined by using the contrast of the images. The fat suppression was used to be applied in the T1 sequences for the suppression of the bright signals. In the T2 sequence, there was enhanced susceptibility with the suppression of fats and attenuation of fluids (Hurford et al., 2014) .

It was considered as part of almost all of the protocols of MRI. With this sequence, fats showed the high intensity of signals and the brain with the intermediate intensity of signals by using this sequence. The white matter of the brain displayed the hypo intensity in comparison with the grey matter. Another type of sequence used in the MRI was the susceptibility-sensitive type sequence. This type of sequence helped in the detection of the blood products and calcium levels that were significant in a number of pathological processes. In addition, the study found that this sequence was helpful in distinguishing the calcium levels from the blood .

The other type of sequence was the proton-based used ideally for the monitoring of the joints (Allen et al., 2012). The fluids can be observed with the high intensity and muscles with the intermediate level of intensity. The sequence diffusion-based was used to monitor the water molecules that flow around the tissues and provides information related to the tumours, swelling of the cells and edema. These different types of imaging techniques and types were used to determine the ischemic stroke and its age among the patients. The different types of image techniques such as FLAIR, T1, T2 and images of susceptibility based were helpful for the classification of the strokes and helped to provide comprehensive information about the intensity of the stroke to the medical team (Allen et al., 2012).

Abbreviated and Routine Brain Screening Protocols

There are two forms of brain screening protocols, including the standard routine protocol and a more abbreviated form. A brain screen protocol is an MRI protocol that consist of a series of MRI sequences (Cobben et al., 2009). The MRI sequence is a radiofrequency pulse that produces images. Multiple pulses, or sequences, are generated to create an image of the brain. An MRI protocol is a combination of those sequences, focused on a specific region of the body, that produce a final image. The goal of a protocol is to maximize the diagnostic usefulness of the image, produce a scan of high quality, and improve the efficiency of the radiological service that is delivered. A routine screening protocol may involve a number of sequences that look at various planes of the brain with different goals depending on the type of imaging being conducted. The abbreviated protocol reduces the number of sequences for more rapid completion.

Critical evaluation of the effectiveness of abbreviated protocol

Diffusion-weighted imaging (DWI) Axial with an apparent diffusion coefficient (**ADC**) image, Fluid-attenuated inversion recovery (FLAIR)Axial, and SAGITAL T1 sequences are considered for interpretation of MRI images under the abbreviated -protocol. As mentioned by Choi *et al*. (2018), ***DWI Axial*** sequence is encouraged the recognition of early ischemic modificationand purposeful imaging technique

That estimates physiological changes inside the brain by distinguishing changes in Brownian movement of water at intervalstissues. DWI is the main sequence to determine brain tissue at risk when resources are limited (Okorie *et al*., 2015).

On the other hand, Siddiqui *et al.* (2011) mentioned that ***Axial FLAIR*** is an extremely efficient MRI sequence for identifying subarachnoid haemorrhage (SAH). In this context, Bradley *et al*. (1993) concluded that both **T1 and T2** sequences not only detect but gives the stage of bleeding. Low-resolution T2 information can be inferred from B0 map {DWI product with no added cost} (Joachim, 2020). These three sequences are beneficial for identifying blockage in

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an artery and identifying lesions in the brain. These three sequences are time-effective; thus,the abbreviated protocol is beneficial for early diagnosis of stroke; however, detailed information regarding stroke characteristics cannot be identified through this process.

Current understanding of the abbreviated protocol indicates that it is useful for identifying various brain issues quickly. However, whether it is more time-efficient or accurate remains unknown, leaving a gap in the existing literature. Consequently, it is necessary to understand better the advantages of the abbreviated protocol versus the long protocol to determine which is best recommended in any given set of circumstances. Concerning stroke specifically, if the abbreviated protocol is faster than the routine protocol at diagnosis while preserving accuracy, it may shorten the patient's time to receive needed care. Per Lacy et al. (2001), this may reduce the occurrence of permanent neurological damage.

Critical evaluation of the effectiveness of routine/long-protocol

Three additional sequences are considered in the routine protocol of MRI image interpretation, along with three abbreviated protocol sequences. These three sequences are susceptibility-weighted imaging (*SWI*)Axial or Gradient echo (GRE), T2 Axial, and Coronal T2 FAT SAT. Polan et al. (2015) stated that SWI and GRE Axial highlight the difference of magnetic susceptibility in deoxygenated blood cells and oxygenated tissues present in adjacent blood cells. This sequence highlights the drainage of blood in the brain's veins and is most sensitive for depictinghemorrhagic transformation (Allen *et al*., 2012). On the other hand, Liu *et al*. (2018) stated that **T2 Axial** sequences help avoid misclassification of stroke in DWI sequences. Thus, considering this sequence enhances the accuracy of stroke diagnosis. On the other hand, ***CORONAL T2 FAT SAT*** helps identify fat deposition in veins that help diagnose ischemic stroke, but it is time-consuming. This sequence of MRI image interpretation is beneficial for characteristic tissues and helps identify the presence of a large amount of lipid in brain arteries. Delays in detecting stroke can have severe negative consequences, including permanent neurological damage, mainly if detection takes more than six hours (Lacy et al., 2001).

The addition of **3D** time of flight angiography (**TOF)**sequences is quite common. This study is concerned with added clinical benefits in clinical management; it will not be considered in the routing protocol because of time constraints and data inhomogeneity.

After considering sequences of abbreviated-protocol further, these additional sequences of routine-protocol help to detailed stoke characterization; thus, it helps identify the accurate treatment method. Thus, the routing protocol may provide a more accurate diagnosis than abbreviated; however, it is not time efficient.

Routine vs. Abbreviated Protocols

There is no extensive body of literature regarding abbreviated MRI protocol usage regarding the brain over the past five years, and little research comparing the abbreviated vs. routine protocol. Recent research has indicated that the abbreviated protocol may provide at least comparable results to the standard protocol in breast cancer detection (Chen et al., 2017), stomach scans (Canellas et al., 2019), and scans of the liver (Lee et al., 2018; Khatri et al., 2020). The literature is far denser with the literature on the abbreviated protocol's performance in almost every other area but uses when performing scans of the brain. Consequently, to better

determine the abbreviate protocol's comparative effectiveness, it is necessary to conduct further research into its use in scans of the brain.

METHODS AND PROCEDURES

Study Design

This research assesses the feasibility of replacing the routine MRI stroke imaging protocol with an abbreviated version that we will call the abbreviated protocol. A quantitative research methodology has been selected for this study. According to Nassaji (2015), a quantitative research methodology is used when the researcher needs to assess the relationship between variables using numbers and statistics. In this study, the quantitative researcher methodology will assess the impact of replacing abbreviated stroke protocol with routine protocol in reaching the radiological diagnosis of stroke. Therefore, a quantitative research methodology will be suitable for assessing the research focus and purpose, which relates to establishing a statistical impact of replacing abbreviated stroke protocol with routine protocol in reaching the radiological diagnosis of acute stroke.

A descriptive research design has been selected to guide the study. Descriptive research design as a retrospective study is going to be considered. Nassaji (2015) stated that descriptive research design helps focus on accessing information related to focus groups. In this context, this research design can be beneficial for accessing information from reports of stroke patients. A descriptive research design will be used to critically gather detailed information that could be used to assess the impact of replacing abbreviated stroke protocol with routine protocol in reaching a radiological diagnosis of stroke.

Research Approach

This research for evaluating the effectiveness of the abbreviated protocol of interpretation of MRI for diagnosis of stroke deductive approach will be considered. As opined by Zalaghi & Khazaei (2016), the deductive approach is based on developing assumptions based on theories. The targeted audiences are the neuroradiologist who deals with the brain's diagnosis, a Neurologist who treats the brain's disease, and maybe a neurosurgeon specializing in the diagnosis and surgical treatment of the disorder in the brain.

Data collection method

During the years 2019 & 2020, we have retrospectively collected 116 completed MRI imaging studies of stroke patients from 40 – 95 years selected randomly. For the study about imaging, approximately eight consultants who have more than ten years of experience and three senior registrars who have more than five years of experience. so, basically, we used board certified radiologist in all of our 10 radiologists with different years of experiences who have performed the process. Therefore, image acquisition was the standardized method that has been conducted following the national quality assurance. Whereas the abbreviated version was established to proof that Abbreviated protocol is what the radiologist routinely checks for a quick diagnosis. Considering both the techniques and obtaining reading which will be reviewed by another radiologist who is not the part of the study to avoid biases. We didn't split the studies as it is technically complicated to provide only the abbreviated protocol, but that part of agreement to read only the abbreviated protocol. Furthermore, after conducting the data on abbreviated studies, the experiences of radiologist involved in the study were taken to record their experiences.

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MATERIALS AND METHODS

The required sample size, which includes the MRI reports, will be calculated using G power software. According to Ryan (2018), GPower software is renowned software that researchers use to determine the adequate sample size for quantitative studies. Therefore, the adequate sample will be calculated using the following parameters: power analysis of 80% and 5%. By using such parameters, the adequate sample size for the study will be 116 MRI reports. Subsequently, 116 MRI reports will be considered for analysis, and the impact of the different protocols on the diagnosis process will be assessed as explained in detail below:

Table (1): The Routine MRI protocol which consists of 6 scanning sequences in period of (30-35) minutes without the localizer

Plane	Coil Phased Array	Pulse Sequence	Mode	Slice Thickness/Gap	FOV	Comments
3-Plane	Head coil with 20 channels	GRE	-	-	-	Localizer
AXIAL	Head coil with 20 channels	DWI	SE EPI	4mm/1mm	24cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.
AXIAL	Head coil with 20 channels	FLAIR T2	TSE 2D	4mm/1mm	23cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.
SAG	Head coil with 20 channels	T1	SE 2D	4mm/1mm	23cm	No angle & Scalp to Scalp.
AXIAL	Head coil with 20 channels	T2	TSE 2D	4mm/1mm	23cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.
CORONAL	Head coil with 20 channels	T2	TSE 2D	4mm/1mm	23cm	Parallel to the brainstem
AXIAL	Head coil with 20 channels	SWI or GRE	3D-2D	3mm	23cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.

Table (2): The Abbreviated MRI protocol which consists of 3 scanning sequences in period of (15-17) minutes without the localizer

Plane	**Coil Phased Array**	**Pulse sequence**	**Mode**	**Slice Thickness/Gap**	**FOV**	**COMMENTS**
3-Plane	Head coil with 20 channels	GRE	-	-	-	Localizer
AXIAL	Head coil with 20 channels	DWI	SE EPI	4mm/1mm	24cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.
AXIAL	Head coil with 20 channels	FLAIR T2	TSE 2D	4mm/1mm	23cm	Angle to corpus callosum & cover the whole brain from Skull Base to Vertex.
SAG	Head coil with 20 channels	T1	SE 2D	4mm/1mm	23cm	No angle & Scalp to Scalp.

Selection Criteria

Inclusion Criteria

(1) MRI report with suspicion of acute ischaemic stroke, which is determined by the National Institutes of Health Stroke Scale scores ≥3,

(2) It should have an interval between the onset of neurological deficits to MRI of <24 hours; and

(3) The absenteeism of contraindication to MRI.

(4) Safety measure has to be taken and followed by radiologist

In this context, radiologists with the abbreviated protocol will use DWI Axial with an apparent diffusion coefficient (ADC) image, Axial Flair, and SAG T1 to interpret MRI images. A radiologist with the routine protocol will follow DWI Axial with an apparent diffusion coefficient (ADC) image, Axial FLAIR, SAG T1, SWI Axial, T2 Axial, and COR T2 FAT SAT while unaware of one another diagnosis.

Exclusion Criteria

(1) MRI not reported acute ischaemic stroke according to the National Institute of Health Stroke Scale.

(2) The process does not show adequate interval in between the onset neurological deficits to MRI.

(3) Any contraindication to MRI were excluded.

Statistical Analysis

Statistical analysis will be performed using the SPSS software package, version 12. If there exists no difference in perception of acute stroke between the abbreviated and routine

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protocols", as this will (maybe) have implications on stroke protocols, in general, leading to a decrease in acquisition time. Linear regression will test the relationship between the abbreviated and routing protocols used to detect stroke among patients. The T-test will be used in this study to test the relationship between the abbreviated and routine protocols.

RESULTS AND DISCUSSION

Hypotheses Testing

The Pearson correlation test performed on the data obtained from the patients dealing with different degree of strokes helped in analysing that the Pearson correlation coefficient that expresses the association of the abbreviated and routine protocol, presented in the table 1.3 is 0.908. The correlation between both of these continuous variables is observably because the significant value is 0.01, which is less than 5% or *p=0.05.* These results and significance level expressed that the association among the variables is strongly positive. The significance was also observed at the 2 tailed levels because the significance value was expressed to be 0.000, which is also less than the thresholds of 5% or *p=0.05,* ensuring the aspects of positive and strong association. The Pearson correlation test efficiently predicted that there appears no change in the diagnostic efficacy of both type of MRI protocols and the abbreviated protocol can be widely used as a sustainable and effective supernumerary of the routine protocol for the screenings performed using the magnetic resonance imaging.

Thus, the null hypothesis is accepted and abbreviated protocol could replace a routine one and would give same findings for patient with acute stroke. This will make the diagnosis process faster and lead for better management actions.

Case processing summary

The case processing summary involves the evaluation and observation of the patients who were assessed and clinically examined using the abbreviated protocol and routine protocol for the MRI. The statistical analysis presented the summary expressed in table (3), elaborated that all the patients selected for the study including 116 sample were previously assessed using the routine protocols. The table obtained after the application of the statistical techniques ensures that there appeared no missing values in the patients' data. This summary provides the validity that the selection criteria was essentially focused on the inclusion of the patients who were previously examined using the source of routine protocol of MRI, with 100% expression of reliability of observations (See table 3).

Table 3: Total number of observations and no missing values

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Abbreviated protocol result * Routine protocol result	116	100.0%	0	0.0%	116	100.0%

Sensitivity and Specificity tests

Proceeding with the analysis, the sensitivity and specificity of the abbreviated protocol was evaluated with reference to the routine protocol for MRI. The sensitivity test, in medical diagnosis is commonly known as the test of true positive rate, which is preferred by the health care professionals and the radiologists to investigate and confirm the clinical diagnosis or presence of the diseases. While, the specificity test also known as the test of true negative rate, is used to appropriately evaluate the absence of the disease within the patients (Trevethan, 2017). This test was performed on the data obtained from 116 participants from (40–95) years to confirm and accurately analyse the presence of acute stroke and associate hemorrhages. The results expressed in table 1.2 addressed that the sensitivity measure of the abbreviated protocol concerning the routine protocol ensured that 87 patients were evaluated to be positively diagnosed with the presence of acute strokes, with the progress rate and average frequency of 95.6%, after the application of abbreviated protocol. On the other hand, the results also elaborated those 25 patients who were not diagnosed initially for the presence of stroke using the medium of routine protocol for MRI, expressed the similar results with the abbreviated protocol as well. These patients presented no significant signs of having the strokes and associated with the abbreviated protocol, presenting an average success rate of 100%. The table dominantly expressed that specificity of 100% and the sensitivity of 95.6% of the abbreviated protocol in comparison with the routine protocol for the MRI screening (See table 4).

Table 4: sensitivity and specificity of the abbreviated protocol concerning the routine protocol

			Routine protocol result		
			Diagnosed with stroke	Not diagnosed with stroke	Total
Abbreviated protocol result	Diagnosed with stroke	Count	87	0	87
		% within Routine protocol result	95.6%	0.0%	75.0%
	Not diagnosed with stroke	Count	4	25	29
		% within Routine protocol result	4.4%	100.0%	25.0%
Total		Count	91	25	116
		% within Routine protocol result	100.0%	100.0%	100.0%

Correlation analysis

The correlation is the major statistical technique of the SPSS, which is potentially used by the researchers to analyse the frequency of association and the strengths of relationship between the focused variables (Bujang & Baharum, 2016). The value of correlation determines the extent of association and predict whether the relationship between the variables is strong or weak. If the value of correlation is high, the association appears to be strong, while the lower values ensures that the variables expresses relatively weaker associations (Hauke & Kossowski, 2011). For this respective analysis, the implication of Pearson correlation was effectively preferred to predict the extent of association between two continuous variables. The Pearson correlation is founded on the principles of covariance, hence regarded as the effective statistical technique which enables the researcher to evaluate the association of the continuous variables (Chok, 2010). The Pearson correlation test performed on the data obtained from the patients dealing with different degree of strokes helped in analysing that the Pearson correlation

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coefficient that expresses the association of the abbreviated and routine protocol, presented in the table (5) is 0.908. The correlation between both of these continuous variables is observably because the significant value is 0.01, which is less than 5% or *p=0.05.* These results and significance level expressed that the association among the variables is strongly positive. The significance was also observed at the 2 tailed levels because the significance value was expressed to be 0.000, which is also less than the thresholds of 5% or *p=0.05,* ensuring the aspects of positive and strong association. The Pearson correlation test efficiently predicted that there appear no change in the diagnostic efficacy of both type of MRI protocols and the abbreviated protocol can be widely used as a sustainable and effective supernumerary of the routine protocol for the screenings performed using the magnetic resonance imaging (See table 5).

Table (5): Pearson's Correlation Coefficient

		Abbreviated protocol result	Routine protocol result
Abbreviated protocol result	Pearson Correlation	1	.908**
	Sig. (2-tailed)		.000
	N	116	116
Routine protocol result	Pearson Correlation	.908**	1
	Sig. (2-tailed)	.000	
	N	116	116

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The leading cause of deaths and morbidity in the world is considered to be cerebrovascular diseases, it is a serious condition that should be managed in the emergency. Stroke is categorized on the bases of the aetiologies, Ischemic stroke caused by blockage of the artery and haemorrhagic stroke due to rupturing of the blood vessels.

The emergency radiology department and the radiologist on call have used significant amount of imaging to rule out acute stroke cases. In the imaging study, the tool used plays a significant role in depicting classic early signs of ischemia. The imaging investigations are selected with respect to stroke's category, ischemic and haemorrhagic stroke, in order to differentiate between these two diffuse weighted MRI is done on the first place and then non contrast CT scan to exclude haemorrhagic stroke (Allmendinger, 2012). Nearly 50% of stroke survivors fail to function independently and 20% of them after the start of stroke require 3 months of hospital care (World Health Organization, 2008).

The imaging techniques should be easy and rapid ways to perform and analyse acute stroke furthermore it is important to order rapid imaging for patients with the risk of thrombosis the single therapy to treat ischemic stroke is administrating intravenous plasminogen activators. MRI is a non-invasive technique that uses waves and magnetic field to produce images of body organs and tissues, its faster protocols for the image interpretation is a necessity in diagnosis and managing stroke. The aim of the study is to point out and explain whether the routine

protocol be replaced by abbreviated in diagnosing stroke by radiological means. For this study quantitative analysis was used that was based on collecting the numerical data from the patients of acute stroke and establishing a statistical impacts on preferring abbreviated protocol over routine protocol in the radiological diagnosis of stroke. In the study of MRI imaging on 116 patients from 40 – 95 years with acute stroke were taken randomly. These MRI reports undergone to analysis and the impacts of diagnosis is assessed. After collecting data from abbreviated protocol the experiences from the radiologist were noted. G power software was used to calculate the required sample size. The study is based on quantitative and statistical analysis, where input variables are namely, patient number, abbreviated number, abbreviated radiologist result, routine radiologist number and expected radiologist result. This approach looks how abbreviated radiologist results are dependent to expected results. To support the effectiveness of abbreviated MRI correlation and regression analysis was used. Research study designed provides detailed analysis of data collected from the MRI imaging of patients with acute stroke. In the reference of the study objectives that is comparing the routine protocol with abbreviated protocol used in MRI.

An infarction on small scale usually in mild strokes might be hidden in the Ct and that is identified by MRI. Thrombolytic therapy is proven to be the ultimate treatment of ischemic stroke that is the leading cause of death and disability. The treatment of thrombolysis is observed to be effective in the time range of 3 to 4.5 hours and further studies aiming to widened the therapeutic prospective are in progress. However there is a concern of reperfusion injury and haemorrhage in thrombolytic therapy not only this it can causes the formation of hematomas and edemas. Thus choosing the accurate treatment for individual by evaluating and examining for any possible risks of thrombolysis is very essential for better results (Vilela, 2017).

The schematic protocol of MRI includes EPI gradient recalled echo (GRE), EPI fluid inversion recovery imaging (FLAIR), dynamic susceptibility contrast (DSC) and contrast enhanced MRA (CE-MRA) imaging. Image analysis requires MRA with projection of maximum intensity and data sources. The tissue distortions, delineation at structures like basal ganglia, posterior fossa, ventricles and thalami and the noise motions all these interfere with the image quality while using different MRI techniques. Using 3 scale system of scoring MRA images are classified into intracranial and extra cranial parts, the scoring is based on sufficient contrast opacification, motion artefact and visibility of arterial system. MRI sequences in the stroke MRI protocol is best used to diagnose and manage ischemic conditions. It produces images in the brain by using radiofrequency pulses the sequences includes:

T2 weighted has fast spin echo, an axial plane and has a purpose of detecting high signal infarcted tissues after the duration of 6 to 12 hours, T1 weighted has fast spin echo, sagittal plane and used for anatomical evaluation, Diffusion weighted imaging (DWI) with axial plane and purpose of early detection of stroke, has a good relation with ischemia and differentiates between chronic and acute strokes, FLAIR with axial plane and the purpose of early detection of ischemic stroke, MR angiography (MRA) with axial plane, illustrates occlusions and the diameter of lumen and Susceptibility weighted imaging (SWI) with axial plane (Nael, K., 2014) The study by image types a routine protocol for screening involves sequences to look at different planes of brain to complete various goals. In contrary the other type of MRI protocol called abbreviated protocol has reduced number sequences to complete the process rapidly.

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Alternative to routine protocol abbreviated MRI protocol is used. The benefit of using abbreviated protocol described by (Chan, 2019) is it eliminates the sequences not in the necessity and affects quality image, comfort of the patient, cost, time of the interpretation and table time of MRI negatively. . This protocol is used for stroke along with other diseases which illustrates that it doesn't compromise on the information in any way (It is important to develop the precise and efficient MRI protocol to meet patients demands and for easy accessibility not only this but to make the workflow efficient in comparison to the routine protocol. It is demonstrated by the investigator (Lee, 2020) that using abbreviation protocol reduces the time of image acquisition in comparison to standard protocol.

It is stated by (Bar, 2020) the more access and availability to the shorter MRI due to its less payment will have no negative effects on the revenue because of increased overall MRI equipment's capacity, more slots and appointment. Less time consuming with reduced artefacts of motion will lead to good quality of the images. It has the advantage of using three patients instead of one in the protocol with highly shortened time frame (Marshall, 2020).

Using abbreviated MRI protocol than routine protocol has others benefits like it shortens the hospital stay of the patients waiting for their delayed imaging results, decreases in the sequences improves the work activity because in this way there are less numbers or sequences to be interpreted and reviewed (Mango, 2015).

Abbreviation protocol represents FLAIR, SAGITALT1 and DWI for image interpretation. For valuable imaging technique and identification of early ischemia DWI axial is emphasized, in the cases with limited resources DWI is the important sequence used to detect and analyse brain ischemia. In contrary for subarachnoid haemorrhage to be identified Axial FLAIR sequence has greater importance. Currently in different clinical scenarios diffusion weighted MRI is used in abbreviated protocol as an alternative to T1 weighted MR with contrast enhanced. Abbreviated protocol must be used caution as it has the limitation of the data. It has the potential to eliminate the redundancies in these values the specific sequences. It is believed that in majority of the cases as the tool for screening abbreviated protocols will be used (Mango, 2015).

By proving the point that there isn't a difference between both these MRI protocols in the aspect of reliability (CHAN, 2019) stated that the standard MRI protocol should be used for comparing and to outline all the pre-existing lesions and this protocol can be used without any hesitation as per the need. It has said that the initial examination can be performed under the supervision during implementing abbreviated protocol by which any sequences required to be repeated or any changes in original protocol can be evaluated and done. T2 and T1 sequences is not restricted to detection of the ischemic areas but it also shows at what stage is the bleeding in the brain. T1, T2 and Axial FLAIR these abbreviated protocol sequences being time effective are used in the early stroke diagnosis with the identifications of lesions and recognizing blocked arteries (Vert, 2017).

It is suggested that there is a possibly that the time consumed in both the protocols can have relative effects on radiological diagnosis. In the treatment and better prognosis of stroke MRI sequencing plays a significant role in determining the mechanisms of stroke. In evaluating the effects of thrombolysis MRI also provides the picture of lesions of haemorrhage or hematoma in the brain tissues (Prakkamakul, 2016).

It is shown by (OZEK, 2020) that for increasing the patients' comfort, elevating efficiency and reducing cost and time acquisition abbreviated MRI approach is best considered, using this protocol not only signifies to this but also avoids performing examinations repeatedly in this way the patient is satisfied with imaging in less time and less effort. Furthermore, abbreviated MRI protocol used has a benefit of less exposing patients to contrast material like gadolinium, repeatedly using this agents can harm kidneys or lead to other life threatening emergencies.

Advancing the radiological interventions for safe usage and successful outcomes can be done by either using non ionising modalities or imaging techniques with lower or no use of radiation, radiation has harmful and serious impacts on individuals (Tan, 2019). This advancement in the field of radiology is presented by abbreviated MRI protocol. Usually routine protocols are time consuming and patients prefer things to be done in shorter period of time but with good outcomes. In the emergency departments these days radiologist are using abbreviated approach in assessing serious conditions like stroke or other brain injuries(Khurana. 2012). When implementing imaging of susceptibility weighted and gradient recall echo abbreviated protocol and CT of head become comparative in depicting intracranial injuries.

Implementation of abbreviated brain MRI in the clinical practice like mostly utilized in emergency departments because of rapid results has three phases namely first the development of the project secondly the designing of the protocol and lastly its implementation in the emergency department, these implementations are done for conditions like stroke, brain injuries either due to trauma or life activities. Skull fractures, bleeding or signs of axonal injuries are detected by non-contrast abbreviated brain MRI protocol, it comprises of different sequences, focal areas in the brain in acute conditions detected as non-haemorrhagic injuries of axon are detected by the sequence diffusion weighted imaging used another sequence named arterial spin detects perfusion in the brain and the changes associated due to any haemorrhage or contusions (Jaimes, 2020).

In summary, the quantitative and statistical comparison made helps in the assessing the accuracy, reliability and sustainability of the types of MRI protocol in diagnosis and screening stroke by radiologist, the sample of 116 individuals previously assessed using routine protocols were then evaluated by using abbreviated approach and it is highly expected that routine protocol will be replaced by abbreviated protocol due to its significance and better, quicker results.

IMPLICATIONS AND CONCLUSION

Based on the focused research question of evaluating the efficiency of the abbreviated protocol in comparison with the routine protocol for the purpose of examining and screening the presence of strokes using MRI technique, among the patients, it can be concluded that the abbreviated protocol can be effectively and sustainably used as potential ancillary or substitute of routine protocol. The literature findings presented in the study, ensured that the acute strokes, also termed as the ischemic strokes are the major cause of cerebrovascular damage and haemorrhage. The appropriate and timely examination of the cerebrovascular strokes and associated symptoms is viably necessary, in order to maintain the quality of life of the individual and reduce the rate of mortality among the individuals. The results and literature review of this study supported the understanding that the Magnetic resonance imaging is immensely

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considered by the health care professionals and the radiologists, as provides an elaborated, clear and focused image of the internal structures and effected regions of the body.

The findings obtained from the application of quantitative analysis on the primary data supported the hypothesis that there appears no significant differences in the reliability and efficiencies of the abbreviated protocol of MRI, when compared with the screening capability and imaging strength of the routine protocol. The results of the study predicted that the diagnostic potentials of both types of imaging techniques are relatively similar. These findings were concluding after performing the MRI scan on the selected patients who were primarily examined using the routine protocols of MRI. The results ensured that the MRI performed using the abbreviated protocols expressed similar diagnostic results, confirm the presence of the acute strokes among the patients. The specificity and sensitivity test indicated that the sustainable and expressive dependability and reliability of both types of MRI protocols. The Pearson correlation statistical test applied on the variables, presented their continuous nature. Upon analysis it was highly observed that the abbreviated protocol expresses high correlation coefficient values, with positive significance and strong association with the routine protocol measures. The results also helped in concluding and evidencing the hypothesis that the time acquired in the MRI, with respect to the differences in the protocols is relatively unalike, but does not effects the process and reliability of their imaging. In comparison with the routine protocols, the MRI performed using the abbreviated protocols consumes less time interval, with the presentation of similar and authentic results. In supported to this evaluation, it was sufficiently observed that the health care professionals and radiologist are excessively considering the use of abbreviated protocols of MRI for the purpose of screening the patients with ischemic and acute stroke.

This prospect regarding the abbreviated protocol is considered because it proportionally contributes in reducing the exposure of the patients and the radiologist or lab technicians with the high radioactive rays and electron emission during the process of screening the patient. Moreover, the reduced time period of performing the MRI, using the abbreviated protocols, serves in reducing the rate of frustrations and side effects among the patients. Additionally, it supports the health care workers to process proficiently and examine the patients with cerebrovascular strokes in an immediate form. The results also predicted that this innate activity of the MRI scanning through the abbreviated protocols helps in catering the patients, with a subsequent reduction in the growth and adversity of symptoms involving the facial or thoracic paralysis, reduction in the nerve responses and increase in the neuronal damages. This research study also promoted the findings that the abbreviated protocols helps the radiologist and professionals to identify the brain injuries, haemorrhages and functionality of CNS in a more systematic and distinctive manner.

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