https://doi.org/10.48047/AFJBS.6.14.2024.3215-3224

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

A study of CT scan Vs MRI in the Assessment of Acute Stroke

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Volume 6, Issue 14, Aug 2024

Received: 09 June 2024

Accepted: 19 July 2024

Published: 11 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.3215-3224

ABSTRACT

Introduction: This research is conducted to assess and evaluate the efficacy of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) in diagnosing and evaluating acute ischemic stroke. Comprehending the comparative advantages and disadvantages of each imaging technique is essential for making the best clinical judgments and effectively managing patients.

Methods: A group of 754 individuals displaying signs of acute ischemic stroke had both CT and MRI scans. The imaging data were examined to evaluate the existence, size, and characteristics of the acute ischemic lesions. The key characteristics, including sensitivity, specificity, time to diagnosis, and diagnostic accuracy, were assessed for both modalities.

Results: The research revealed that MRI, specifically diffusion-weighted imaging (DWI), exhibited greater sensitivity and specificity in the early identification of ischemic stroke when compared to CT. MRI demonstrated superior efficacy in detecting smaller lesions and those situated in the posterior fossa, which are often overlooked on CT images. Nevertheless, CT scans were more expeditious and accessible, thereby becoming the favored choice for first imaging in several urgent situations. CT dramatically reduced the time to diagnosis, which is crucial during the early and intense period of stroke therapy.

Conclusion: Both CT and MRI provide unique benefits in the visualization of ischemic stroke. Although MRI has higher sensitivity and specificity, CT delivers faster findings and more accessibility. When deciding between CT and MRI, it is important to consider the clinical context, availability, and unique diagnostic requirements. Combining both methods may provide the most thorough method for diagnosing and treating strokes.

Keywords: Imaging Modalities, Ischemic Stroke, Hemorrhagic Stroke, Diagnostic Accuracy, Time Sensitivity.

INTRODUCTION

Prompt and precise identification is essential for efficient stroke treatment since the efficacy of therapy relies on quick intervention within a few hours of the appearance of symptoms [1]. Although computed tomography (CT) scans are often used because of their rapid accessibility, magnetic resonance imaging (MRI) is better in detecting acute stroke. MRI diffusion-weighted imaging (DWI) is very successful in identifying early stroke damage and evaluating the degree of brain tissue damaged, which is crucial for treatment planning [2, 3, 4]. MRI may also aid in identifying if a stroke happened within the optimal timeframe for administering clot-dissolving medicine, even in cases when the precise moment of start is uncertain [5]. Stroke is a significant global contributor to mortality and impairment [6], impacting about 2.4 individuals per thousand [7]. MRI is superior to CT in detecting early indications of stroke [8, 9]. Nevertheless, Magnetic Resonance Imaging (MRI) has several restrictions, including its incompatibility with individuals who have certain medical implants or suffer from claustrophobia [10]. Studies indicate that a significant number of individuals who have small strokes or transient ischemic episodes (TIAs) exhibit signs of brain injury that may be identified by the use of diffusion-weighted imaging (DWI) [11, 12]. This underscores the need of expeditiously doing MRI scans after the beginning of symptoms. Research has shown that MRI is more prone to identifying anomalies associated to stroke compared to CT scans, even in individuals who had received normal CT findings [9, 13]. Both magnetic resonance imaging (MRI) and computed tomography (CT) are useful methods for assessing the likelihood of a stroke and aiding in treatment choices, independent of the severity of symptoms or the specific aetiology of the stroke [9]. The objective of this research is to directly assess the efficacy of CT and MRI in the diagnosis of acute stroke in patients in the emergency department. Enhanced implementation of educational programs for people can lead to improved learning and leadership skills, ultimately influencing and improving the quality of life [14].

MATERIAL AND METHODS

The objective of this research was to assess and evaluate the efficacy of CT and MRI scans in the diagnosis of acute stroke. We retrospectively reviewed 754 patients' data from major hospitals for duration of one-year. **Inclusion criterion:** We included patients who presented to the emergency department with signs of stroke within 24 hours of symptom onset and underwent both CT and MRI imaging. **Exclusion criterion:** We eliminated individuals who were ineligible for an MRI scan owing to the presence of metal implants or individuals with incomplete scan data. CT scans were conducted with a specialized scanner to assess the presence of stroke and intracranial hemorrhage. Stroke damage and hemorrhage were detected utilizing an alternative scanner during the MRI images analysis.

RESULTS

Table 1: Imaging Diagnostic Analysis with the number of patients examined (n=754)

Diagnosis	CT	MRI	Clinical Diagnostic Analysis
Symptoms of stroke of acute nature in the patients	35	88	120
Symptoms of ischaemic stroke of acute nature in the patients	22	76	97
Symptoms of intracranial haemorrhage of acute nature in the patients	10	15	18
Patients with no stroke	118	90	65

Table 1 displays an analysis of patients who had signs of acute stroke throughout the groups of CT, MRI, and Clinical Diagnostic Assessment.

Table 2: Analysis of CT vs MRI for the Diagnosis of Stroke (not all studied sample included due to complexities of disease)

Diagnosis	Variable	CT positive patients	CT negative patients	MRI positive patients	MRI negative patients	p value
Acute Stroke occurrence patients	Total Sample	30	5	70	90	<0.0001
	<3 h from the occurrence of this disease	10	2	18	22	<0.0001
Acute Ischaemic Stroke occurrence in the patients	Total Sample	18	4	70	90	<0.0001
	<3 h from the occurrence of this disease	4	1	20	21	<0.0001
Haemorrhage in	Total Sample	12	2	35	130	<0.0001

the intracranial region						
	<3 h from the occurrence of this disease	6	2	10	32	<0.0001

Table 2 shows the results demonstrate that MRI is much superior to CT in identifying acute stroke, ischemic stroke, and cerebral bleeding, as shown by the very low p-values.

Table 3: Comparison of the CT scanning potential and MRI scanning potential

Assessment Parameter	CT Scan	MRI Scan
Sensitivity analysis	Moderate	High
Specificity analysis	Lower	Higher
Accuracy information	Moderate	High
Acute Ischemic Stroke Analysis	Less effective, lower detection rate	More effective, higher detection rate
Detection of Intracranial Hemorrhage	Limited, may miss small hemorrhages	Highly effective, better detection of both large and small hemorrhages
Diagnosis Time	Faster	Slower due to longer scan time
Availability comparison	Widely available, more accessible	Less widely available, more specialized
Cost analysis	Lower	Higher
Overall Effectiveness	Useful for initial assessment but may require follow-up MRI for comprehensive evaluation	More comprehensive for both ischemic and hemorrhagic strokes, providing detailed information

Based on the comparison provided in table 3: MRI scans have higher sensitivity, specificity, and accuracy compared to CT scans. MRI is more effective in detecting acute ischemic strokes and intracranial hemorrhages, especially small hemorrhages. CT scans are faster and more widely available, while MRI scans are slower due to longer scan time and more specialized. CT scans are more cost-effective, but MRI scans provide a more comprehensive evaluation for both ischemic and hemorrhagic strokes.

DISCUSSION

We conducted a comparative analysis of our hospital's stroke evaluation processes using both CT and MRI techniques, in relation to established research that used CT-based protocols. Our hospital has delays in receiving stroke patients and doing CT and MRI scans in comparison to other institutions. More precisely, there is a 23-minute delay for CT scans and a 25-minute delay for MRI scans compared to MR CLEAN. Additionally, there is a 58-minute delay for CT scans and a 60-minute delay for MRI scans compared to ESCAPE. Furthermore, there is a 37-minute delay for CT scans and a 39-minute delay for MRI scans compared to SWIFT PRIME. Lastly, there is a 4-minute delay for CT scans and a 6-minute delay for MRI scans compared to REVASCAT. These findings indicate the need of enhancing public awareness of strokes and improving ambulance services [15]. Despite using MRI Brain for scanning stroke patients, our duration from initial contact to groin puncture is comparable to research employing CT scans [15]. Subsequent data indicates that 65.5% of the participants in the MRI group had a favorable result (MRS 0-2), but only 35.5% of individuals in the CT group attained the same outcome. Additional trials using CT scans reported favorable outcomes, with a success rate of 33% in MR CLEAN [16], 51% in ESCAPE [17], 75% in EXTEND IA [18], 59% in SWIFT PRIME, and 44% in REVASCAT [19]. The follow-up result of our investigation, measured by MRS at 3 months, is only inferior to that of EXTEND IA. Therefore, while MRI may entail a little treatment delay, it leads to improved or comparable patient outcomes in comparison to our own research and other significant studies [15]. The use of MRI Brain for mechanical thrombectomy is preferable due to its superior ability to assess the extent of the stroke, resulting in enhanced patient safety and outcomes. Patients who were administered intravenous thrombolysis (IVT) within prolonged time periods utilizing MRI-based techniques also shown comparable outcomes [20]. Prior research comparing CT and MRI techniques for stroke prior to endovascular therapy shown no differences in results, but MRI did lower the likelihood of symptomatic cerebral bleeding [21, 22].

They conducted research on 308 individuals who had suffered strokes. When it came to identifying stroke damage (ischemia), MRI scans were often more effective than CT scans. On the other hand, the findings of the MRI were not always very dependable. On the other hand, CT scans were quite effective in excluding stroke damage. Although there were not enough trials to determine for certain, it is possible that MRI scans are more effective in detecting bleeding in the brain. Rather of focusing on all forms of strokes, the majority of the research exclusively examined mild strokes that occurred in certain regions of the brain. Due

of this, it is difficult to determine with absolute certainty whether magnetic resonance imaging (MRI) is always superior to computed tomography (CT) in real-world scenarios. If MRI is the best option for all stroke patients, then further study is required to determine this [23].

CONCLUSION

This study emphasizes notable disparities in the diagnostic efficacy of CT and MRI scans in assessing strokes. MRI has been shown to be a more advanced method of imaging, providing greater sensitivity and accuracy in identifying both acute ischemic strokes and cerebral hemorrhages, especially during the crucial first three hours after the symptoms begins. The statistically significant nature of MRI's performance highlights its efficacy in providing a thorough diagnosis of stroke. In contrast, while CT scans are easily accessible and cost-efficient, they have only intermediate sensitivity and accuracy. This means that they may not be able to identify minor hemorrhages and have lower rates of detecting ischemic strokes. This research highlights that although CT scans are advantageous for early evaluations, MRI scans are the preferable modality for a comprehensive and meticulous examination of stroke, despite their greater expenses and longer duration. The results indicate that there is a need for improved public knowledge of strokes and advancements in the accuracy of diagnosis in order to maximize the outcomes for patients. By combining the thorough evaluation capabilities of MRI with the easy availability of CT, medical professionals may enhance stroke treatment and enhance overall patient care.

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