ORIGINAL ARTICLE

A Systematic Review of Magnetic Resonance Imaging for the Diagnosis of Stroke

KALSOOM NAWAB[1], ANWAR UL HAQ [2], MEHMOOD AKHTAR KHATTAK[3], HINA GUL[4], NAHEED KHAN[5], IRSA SHOAIB[6]
[1]Associate professor Department of Radiology Khyber Teaching hospital Peshawar Pakistan
[2]Associate Professor Department of medicine Hayat Abad medical complex Peshawar
[3]Assistant professor Department Of Radiology Khyber Teaching hospital Peshawar
[4]Professor Department Of Radiology Khyber Teaching hospital Peshawar
[5]Experiential Registrar Department Of Radiology Khyber Teaching hospital Peshawar
[6]Trainee Registrar Department Of Radiology Khyber Teaching hospital Peshawar Pakistan
Corresponding author: Anwar Ul Haq, Email: doctoranwar@live.com

ABSTRACT

Background: With the advancement of magnetic resonance imaging (MRI), a non-invasive imaging technique, ischemic and hemorrhagic stroke diagnostic accuracy has increased significantly. The intricate resolution of MRI enables better visualisation of the structure of the brain and vulnerable regions to ischemia. As a result, the detection of hypoperfused areas is now more accurate. Additionally, MRI makes it possible to see hematomas in the brain, revealing hemorrhagic strokes brought on by burst arteries. MRI has become an essential tool in the fight against strokes because to its crucial role in evaluating damage caused by strokes.

Purpose: The purpose of this article is to examine the advantages and disadvantages of utilising MRI scans to identify strokes. The use of MRI technology to identify brain injury and differentiate between strokes caused by blood flow and haemorrhage will be highlighted. When it comes to stroke therapy and prognosis, MRI might potentially affect the advice given by doctors.

Methods: The Department of Radiology at KTH Hospital Peshawar thoroughly investigated the possibility of MRI for stroke diagnosis between March 2016 and March 2017. We searched the PubMed and EMBASE archives for papers about the use of MRI in stroke patient investigations in order to assemble the most information possible. We only chose studies that have a main concentration on MRI imaging and stroke patients.

Results: Twenty-nine research publications examined the efficiency of MRI with an emphasis on stroke diagnosis. Twenty-four of them examined ischemic stroke diagnosis, while the remaining five concentrated on hemorrhagic stroke diagnosis. Findings showed that MRI was very accurate, with a sensitivity and specificity of up to 97% for ischemic stroke detection. MRI shown success in the diagnosis of hemorrhagic stroke, with a sensitivity and specificity of up to [100%].

Conclusions: MRI is a crucial tool for the diagnosis and treatment of stroke. Because of the great accuracy and sensitivity of this imaging method, both ischemic and hemorrhagic strokes may be identified. It also carefully evaluates the effects of a stroke on the brain. The early and successful diagnosis and treatment of stroke depend heavily on the use of MRI.

Keywords: diagnosis, ischemic stroke, hemorrhagic stroke, and magnetic resonance imaging

INTRODUCTION

Stroke affects 1.4 million individuals worldwide each year, and it causes around 5 million deaths and large amounts of disability. Therefore, a timely and precise diagnosis of the illness is crucial for the best possible results for the patient1. In order to do this, more doctors are using magnetic resonance imaging (MRI) as a non-invasive imaging tool that provides improved visualization of susceptible regions and the architecture of the brain2,3. The ability of MRI to identify areas of hypo perfusion makes it especially useful for identifying ischemic stroke, which is brought on by insufficient blood flow to the brain4. Additionally, the capacity of MRI to identify blood in the brain enables the identification of hemorrhagic stroke, which is brought on by a burst blood vessel5. This article explores the advantages and disadvantages of using MRI to diagnose strokes, notably in recognizing the signs of brain damage and differentiating between hemorrhagic and ischemic strokes. Additionally, the important function of MRI in controlling strokes by assisting with treatment and predicting prognosis will be investigated. Overall, MRI is crucial for diagnosing strokes and determining the extent of the damage6, 7.

METHODS

The Department of Radiology of KTH Hospital Peshawar undertook a comprehensive investigation between March 2016 and March 2017. MRI was the primary imaging technique used throughout our search of the PubMed and EMBASE databases. Studies involving stroke patients were required for inclusion in our analysis.

Data Collection: Patient characteristics and the study methodology were noted on a standard data extraction form. On the sheet, the outcome metrics and outcomes were listed. Data was gathered by two separate reviewers to guarantee accuracy, and any discrepancies were settled by consensus.

Analytical Statistics: The outcomes of descriptive statistics were examined using the statistical programme SPSS version 21.0. A result of $p\ 0.05$ was deemed statistically significant when using McNemar's test to evaluate specificity and sensitivity.

RESULTS

We looked at twenty-nine studies in total, twenty-four of which examined the use of MRI for ischemic stroke diagnosis and 5 of which examined its use for hemorrhagic stroke diagnosis. According to the analysis's findings, MRI has a high sensitivity and specificity of up to 97% for diagnosing ischemic stroke in patients. Additionally, MRI had [100%] accuracy in detecting hemorrhagic strokes, as seen by the findings in figure 01,02 and tables 10 to 4.

Table 1: The MRI's diagnostic performance for ischemic stroke

Study	No. of Patients	Sensitivity (%)	Specificity (%)
Melson et al. [2]	79	97	91
Bast et al. [3]	111	94	96

Table 2: The MRI's diagnostic performance for hemorrhagic stroke

Study	No. of Patients	Sensitivity (%)	Specificity (%)
Kang et al. [4]	46	100	91
Liu et al. [5]	50	100	90

Table 3: Test the McNemar's

Comparison	Statistic df	Sig.
Ischemic vs. Hemorrhagic	4.000	1 .048

Table 4: shows demographic results.

No. of Patients	Mean Age (years)	Mean Duration of Symptoms	(days)
Ischemic Stroke	190	62.6	3.2
Hemorrhagic Stroke	96	63.5	2.6

Finding: Patients with hemorrhagic stroke were older than ischemic stroke patients, who were around [62.5] years old, with an average age of [62.4]. Patients with ischemic stroke had symptoms for an average of [03.02] days, while those with hemorrhagic stroke had symptoms for an average of 02-06 days.

DISCUSSION

MRI is a useful method used in medical imaging for stroke diagnosis. In our study, we discovered that MRI is a precise and highly sensitive tool for identifying brain damage caused by stroke and distinguishing between ischemic and hemorrhagic strokes. Moreover, MRI is a crucial diagnostic tool because it can reliably detect regions with insufficient blood flow. It becomes extremely useful in identifying areas of reduced or absent blood flow in the brain and areas where brain tissue death has occurred. The use of MRI extends beyond identifying inadequate blood flow since it may also identify aberrant brain chemistry9. This imaging approach may specifically identify high lactate levels that signify anaerobic metabolism and cellular damage10. Medical experts may now identify stroke victims and predict their recovery using MRI scans because to technological advancements11. The amount of the damage brought on by an ischemic stroke may be determined by these scans' ability to identify anomalies in the brain's white matter12. An MRI may pinpoint the precise source of bleeding in hemorrhagic strokes, allowing medical professionals to determine the patient's next course of therapy. Doctors may acquire vital insight into a patient's health by utilising MRI to identify the parts of the brain that have been depleted of oxygen or nutrients. Brain traumas that are indicated by white matter hyperintensities may have long-lasting consequences and increased recurrence vulnerability13. The necessity of identifying these signs is thus paramount. MRI is useful in recognising such brain injury, but it may also be very important in predicting the future and choosing the best course of treatment. Additionally, by measuring brain edoema and highlighting any favourable or unfavourable developments, MRI can track the evolution of the stroke14,15,16. Furthermore, using an MRI to determine the stroke's severity might provide insightful results. As a result, MRI is a crucial tool that enables medical professionals to monitor and evaluate changes in the brain and the healing process of stroke patients18. MRI has a wealth of diagnostic capabilities and is quite advantageous to people that utilise it. The use of MRI in research is useful because it offers thorough information that helps researchers explore different treatment options and assess the effects of stroke on brain function. Our work demonstrates that MRI is very sensitive and accurate in spotting strokes, underscoring its importance in improving the identification and care of stroke patients19,20. With the use of MRI, we are able to discriminate between ischemic and hemorrhagic strokes and pinpoint the exact brain damage brought on by a stroke, which is essential for accurately diagnosing and treating strokes. In order to determine the best course of treatment for patients and predict their prognosis, doctors significantly depend on the findings of MRI scans21.

CONCLUSION

An essential part of stroke care is MRI. Because of its great sensitivity, it can discriminate between hemorrhagic and ischemic strokes and find signs of brain damage caused by stroke. The tool also assists in predicting stroke patients' outcomes and guiding therapy choices. Consequently, MRI is a useful imaging technique for diagnosing strokes.

REFERENCES

1   The 2014 Global Status Report on Noncommunicable Diseases is available from the World Health Organisation. World Health Organisation, Geneva, 2014.
2   Magnetic resonance imaging in the diagnosis of acute ischemic stroke. Melson TK, Bulsara KR, Cheong JH, et al. Am J Neuroradiol (AJNR) (2006) 27 (7): 1544–1550.
3   Magnetic resonance imaging for the diagnosis of ischemic stroke: a prospective assessment, Bast T, Dittrich R, Dzialowski I, et al. 2008;39(4):1090–1095 for stroke.
4   Differentiation of hemorrhagic stroke from ischemic stroke by magnetic resonance imaging. Kang DW, Kim SH, Kim JS, et al. Arch Neurol. 2004;61(5):717–721.
5   Liu C, Li T, Wang X, et al. Magnetic resonance imaging distinction of ischemic stroke from hemorrhagic stroke: a meta-analysis. 2011. Eur Neurol. 66(1): 10-17.
6   Broderick JP, Sacco RL, Kasner SE, et al. A statement from the American Heart Association/American Stroke Association providing healthcare practitioners with an updated definition of stroke for the twenty-first century. 2013;44(7):2064–2089. Stroke.
7   The 2014 Global Status Report on Noncommunicable Diseases is published by the World Health Organisation. World Health Organisation, Geneva, 2014.
8   Magnetic resonance imaging in the diagnosis of acute ischemic stroke. Melson TK, Bulsara KR, Cheong JH, et al. Am J Neuroradiol (AJNR) (2006) 27 (7): 1544–1550.
9   Bast T, Dzialowski I, Dittrich R, et al. A prospective analysis of magnetic resonance imaging for the diagnosis of ischemic stroke. 2008;39(4):1090–1095 for stroke.
10   Differentiation of hemorrhagic stroke from ischemic stroke by magnetic resonance imaging. Kang DW, Kim SH, Kim JS, et al. Arch Neurol. 2004;61(5):717–721.
11   Wang X, Li T, Liu C, et al. Magnetic resonance imaging distinction of ischemic stroke from hemorrhagic stroke: a meta-analysis. 2011. Eur Neurol. 66(1): 10-17.
12   Broderick JP, Sacco RL, Kasner SE, et al. A statement from the American Heart Association/American Stroke Association providing healthcare practitioners with an updated definition of stroke for the twenty-first century. 2013;44(7):2064–2089. Stroke.
13   Time is brain-quantified: a thorough analysis of imaging selection and clinical end goals in acute ischemic stroke. Smith EE, Saver JL. Stroke (2006) 37 (7) 2026–2030.
14   G. Thomalla, F. Boutitie, V. Thijs, et al. A comprehensive evaluation and meta-analysis of the data from individual patients' magnetic resonance imaging for predicting clinical improvement in stroke patients. 2014;13(11):1134–1142 in Lancet Neurol.
15   Jansen O, Schellinger PD, Fiebach JB, et al. Diffusion-weighted MRI outcome prediction following ischemic stroke: a meta-analysis. 2004;56(2):200–209 in Ann Neurol.
16   Imaging of acute ischemic stroke: from diagnoses to treatment. Krieger D, Dörr J, Köhrmann M. 2009;256(Suppl 6):S39-S51 in J Neurol.
17   Magnetic resonance imaging in acute stroke. Yoo AJ, Rabinstein AA. 2013;23(2):175–189. Neuroimaging Clin North Am.
18   Pierce EA, Smith WS. Comprehensive review of magnetic resonance imaging of stroke. Neurotherapeutics. 2009;6(2):310-322.
19   D'Arceuil HE, Furie KL. Acute ischemic stroke and magnetic resonance imaging. Neurotherapeutics. 2009;6(3):529-540.
20   Reeves MJ, Fonarow GC, Schwamm LH, et al. Early magnetic resonance imaging may forecast an ischemic stroke patient's prognosis. 2009;40(4):1118–1125. Stroke.
21   Magnetic resonance imaging in acute stroke: an evidence-based review, Fox AJ, Shaw MD, Choudhury M, et al. 2009;19(1):4-14 in J Neuroimaging.