

Modified Magnetic Resonance Imaging (MRI) Brain Protocol for Diagnosing Cerebral Micro Bleeding Hemorrhage

Khalid Abd Elmoniem^{1*}, Dr. Hussain Ahmed Hassan², Dr Salah Ali¹, Musab Mergani Abd Alla Abdelmagid³, Ala M. A. Elgyoum³, Mogahid M A Zidan⁴, Waleed H. Mhammed²

¹Colleges of Medical Radiologic Science, Sudan University of Science and Technology P.O. Box 1908, Khartoum – Sudan

²College of Medical Radiologic sciences, Karary University, Khartoum, Sudan

³National Ribat University, Faculty of Radiological and Nuclear Medicine Science, Nile Street Burri, Postal Code 11111, Khartoum – Sudan

⁴Medical Imaging Technology Department, Al-Ghad International College for Applied Medical Science, Abha KSA

DOI: [10.36347/sjams.2019.v07i11.028](https://doi.org/10.36347/sjams.2019.v07i11.028)

| Received: 12.11.2019 | Accepted: 19.11.2019 | Published: 20.12.2019

*Corresponding author: Khalid Abd Elmoniem

Abstract

Review Article

MRI provides information that is useful for diagnosing ischemic stroke, selecting appropriate patients for thrombolytic therapy and predicting the prognosis of ischemic stroke. Although modern multi sequences stroke MRI protocols are an emerging imaging routine for the diagnostic assessment of cerebral micro bleeding. The objective of this study was to determine the yield of adding T2*-weighted gradient echo to a conventional magnetic resonance imaging (MRI) protocol for cerebral micro bleeding Hemorrhage. Sample size of 200 patients in both genders (male=94, female=106) was used. In the present study, patients had brain MRI after presentation on a 1.5 T Philips MRI scanner on MRI sequences in the following order (including axial T2*, DWI, T2-weighted and fluid attenuated inversion recovery (FLAIR) sequences). Mean patient age was 47.82 years, Std. D was 18.108. New MRI techniques provide critical information in detecting acute bleeding. As blood extravasates in the tissue, the hemoglobin molecule becomes deoxygenated. Deoxyhemoglobin thereby produces a non-uniform magnetic field that results in rapid dephasing of proton spins in T2- and more so in T2*-weighted images. Our results confirmed the useful of T2*-weighted gradient-echo sequence in detecting early cerebral hemorrhage as part of a multimodal stroke MRI protocol. The findings suggest that micro bleeds on T2*-weighted MRI are an indicator of advanced small artery disease of the brain with an increasing risk of bleeding. This result should be taken into consideration when treating patients with stroke and further studies are required. Gradient-echo T2*-weighted MRI is uniquely sensitive to detect silent, old hemosiderin deposits, but the clinical significance of such “micro bleeds” remains to be determined.

Keywords: hemorrhage, echo-planar imaging, hemorrhagic transformation, magnetic resonance imaging, micro bleeds, diffusion, weighted and stroke.

Copyright © 2019: This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

INTRODUCTION

Neuroimaging plays a central role in the evaluation of patients with acute ischemic stroke (AIS). With improved technology over the last decade, imaging now provides information beyond the mere presence or absence of intracranial hemorrhage including tissue viability, site of occlusion, and collateral status. While computed tomography (CT) is the most widely available and faster imaging modality, some comprehensive stroke centers favor streamlined MR protocols over CT in the acute stroke setting due to the higher specificity and superior tissue characterization afforded by MRI.

Approximately 20% to 40% of all stroke patients experience hemorrhagic transformation within

the first week after symptom onset [1]. Although cerebral bleeding (CB) is a common event that occurs independently of therapy, caution is required when thrombolysis or anticoagulants are administered. The identification of risk factors for CB might be helpful in improving the risk-to-benefit ratio of thrombolytic treatments [2]. Hypertension, embolic origin, use of anticoagulant therapy, increasing stroke severity, and duration and intensity of the cerebral blood flow reduction have been associated with a higher risk of CB [3] and less frequently in patients with ischemic stroke. These micro bleeds (MBs) are thought to be indicative of microangiopathy. MBs are also considered as a marker of amyloid angiopathy. The likelihood of early CB after ischemic stroke might be increased in patients who had the most vulnerable micro vascular system.

MRI demonstration of MBs could gain even more clinical significance if this finding could be used to identify patients at increased risk of early CB. Therefore, we assessed the impact of this abnormality on the occurrence of CB[4].

Recent studies have revealed that gradient-echo T2*-weighted MRI is extremely sensitive for detecting small areas of signal loss, which represent remnants of previous silent microbleeds [5]. This T2* effect occurs through the local magnetic field inhomogeneities caused by hemosiderin deposit. There is pathological confirmation that the micro bleeds on T2*-weighted MRI represent hemosiderin deposits [6]. The deposits may be a result of minor blood leakage through damaged blood vessels in addition to frank minor hemorrhage. Whatever the source, they may remain detectable for years. The micro bleeds are barely detectable with T2-weighted spin-echo MRI and are not visualized with other conventional scans. Of particular interest is that the microbleeds are frequently detected in patients with cerebral infarction as well as in patients with intracerebral hemorrhage and even in a small number of healthy individuals without stroke episodes. Recognizing bleeding prone microangiopathy in stroke patients is of extreme clinical significance when treating hypertensive patients with or without episodes of intracerebral hemorrhage. Furthermore, the risk of intracerebral hemorrhage after prophylactic treatment with oral anticoagulants is larger in patients with ischemic stroke than in patients with myocardial infarction, atrial fibrillation, or peripheral arterial disease.² However, the diagnostic and prognostic significance of the microbleeds on T2*-weighted MRI is still debated and remains to be determined. Therefore, to further clarify the significance of microbleeds in stroke patients, we compared the incidence and the number of microbleeds among different stroke subtypes and examined the association with the recurrence of ischemic and hemorrhagic stroke and the severity of white matter disease (leukoaraiosis) [7].

OBJECTIVE

The Objective of this study is to modify MRI protocol for diagnosing cerebral micro bleeding Hemorrhage.

We routinely examined our stroke patients with conventional MRI scans in addition to T2*-weighted MRI, during period from May 2016 to April 2019. The sample of 200 patients (94 males and 106 females). The Machine used in this study was MRI scanner PHILIPS (1.5tesla). The Whole brain was scanned with a slice thickness of 5 mm and a 1.5 mm inter slice gap, producing 19 axial images. The imaging protocol consisted of T2*-weighted gradient echo (repetition time [TR] echo time [TE] 800/26 ms, flip angle 30°), T1-weighted spin echo (TR/ TE_530/15 ms), T2-weighted fast-spin echo (TR/TE_5000/120). Fluid-attenuated inversion recovery (FLAIR) (TR/TE_9000/105 ms, inversion time 2500 ms) and diffusion-weighted imaging (TR/TE_5000/135 ms). The results data were collected from the results of MRI findings were supported the result by radiologist reports. The results were determined by signal intensity as hyper, hypo and iso compare to normal brain area by observation of affected area. All MRI images were studied for signal intensities in different weighted images and to differentiate size and locations of stroke, and radiologist reports were considered.

RESULTS & DISCUSSION

New MRI techniques provide critical information in detecting acute bleeding. As blood extravasates in the tissue, the hemoglobin molecule becomes deoxygenated. Deoxyhemoglobin thereby produces a non-uniform magnetic field that results in rapid dephasing of proton spins in T2- and more so in T2*-weighted images, our results confirm the useful of T2*-weighted gradient-echo sequence in detecting early hemorrhage transformation as part of a multimodal stroke MRI protocol (table 1).

Patients with cerebral microbleeds on T2*-weighted MRI and the detection of microbleeds may be a potential tool to assess the disease progression. In any event, multiple microbleeds on T2*-weighted MRI may be a risk factor for intracerebral hemorrhage and its recurrence. This assumption may be supported by the findings on the location and frequency of microbleeds obtained in this study, which were quite similar to those of symptomatic hypertensive intracerebral hemorrhage.

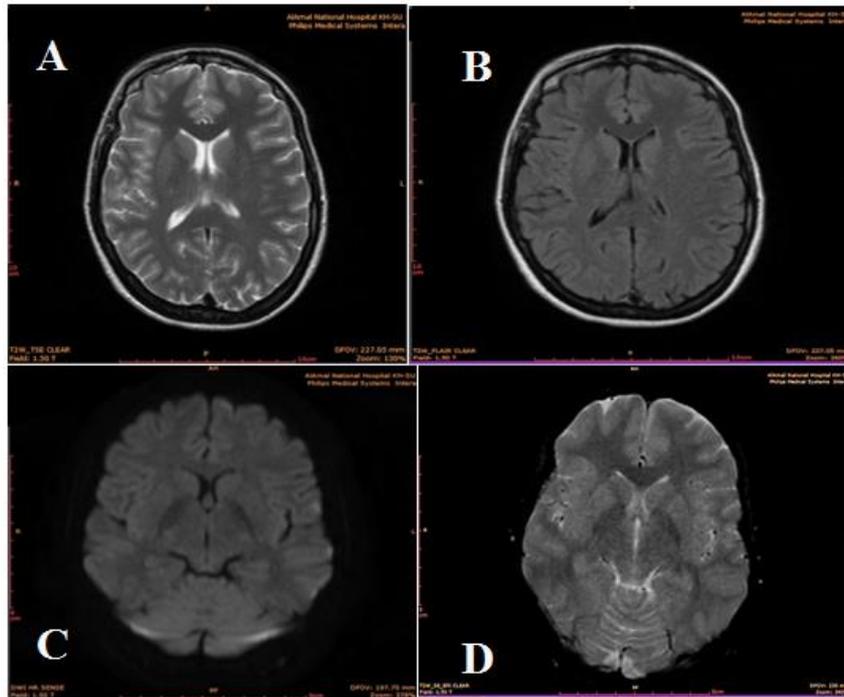


Fig-1: Axial images, T2-weighted fast-spin echo MRI(A) and, FLAIR (B),DWI (C) and T2*- Weighted gradient echo MRI (D) of a female of 27 years Old intracerebral hemorrhages were seen bilaterally, multiple small areas of signal loss (microbleeds) were observed on T2*- Weighted MRI The microbleeds were hardly visible on other sequences

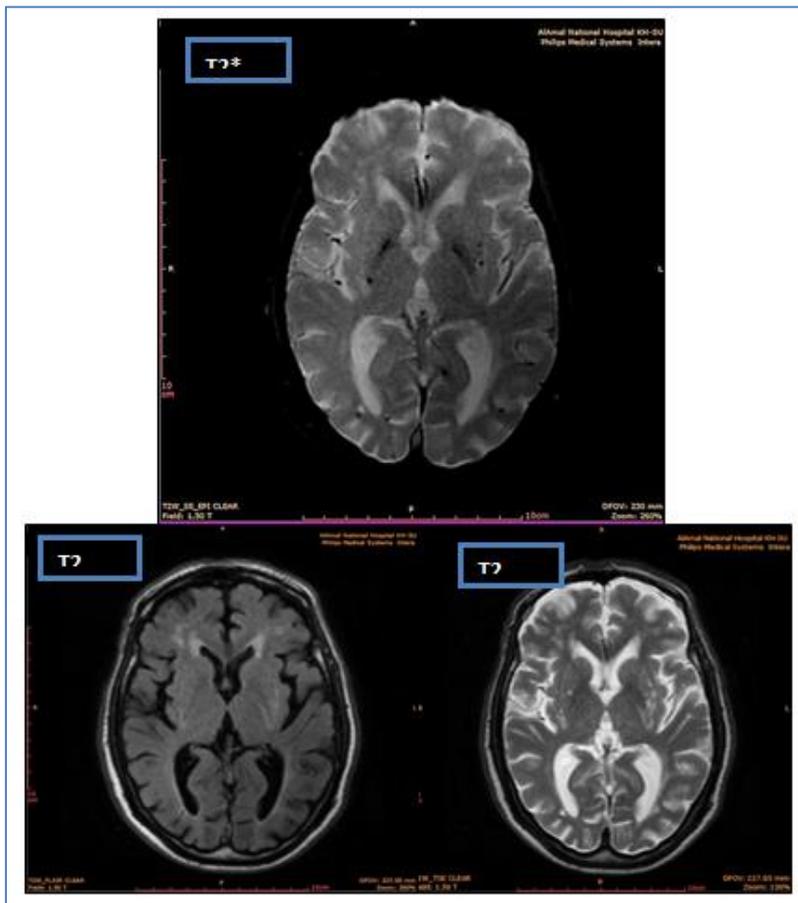


Fig-2: axial images, T2-weighted fast-spin echo MRI(A) and, FLAIR (B),DWI (C) and T2*- Weighted gradient echo MRI (D) of male of 72 years Old intracerebral hemorrhages were seen bilaterally, multiple small areas of signal loss (microbleeds) were observed on T2*- Weighted MRI The microbleeds were not visible on T2 TSE and T2 FLAIR sequences

Table-1: Shows the appearance of micro bleeding Hemorrhage on MRI brain protocol Sequences

Sequences	appearance of micro bleeding Hemorrhage	n
T1	no	200
T2	no	200
T2 FLAIR	no	200
DWI	no	200
T2*	yes	200

CONCLUSIONS

The findings suggest that microbleeds on T2*-weighted MRI are an indicator of advanced small artery disease of the brain with an increasing risk of bleeding. This result should be taken into consideration when treating patients with stroke, and further studies are required. Gradient-echo T2*-weighted MRI is uniquely sensitive to detect silent, old hemosiderin deposits, but the clinical significance of such “microbleeds” remains to be determined

REFERENCES

- Moulin T, Crepin Leblond T, Chopard JL, Bogousslavsky J. Hemorrhagic infarcts. *Eur Neurol.* 1993; 34:64–77.
- Meier DH, Hacke W. Acute stroke: usefulness of early CT findings before thrombolytic therapy. *Radiology.* 1997; 205: 327–333.
- Fazekas F, Kleinert R, Roob G, Kleinert G, Kapeller P, Schmidt R. Histopathological analysis of foci of signal loss on gradient-echo T2*-weighted MR images in patients with spontaneous intracerebral hemorrhage: evidence of microangiopathy-related microbleeds. *AJNR Am J Neuroradiol.* 1999;20:637–642.
- Nighoghossian N, Hermier M, Adeleine P, Blanc-Lasserre K, Derex L, Honnorat J, Philippeau F, Dugor JF, Froment JC, Trouillas P. Old microbleeds are a potential risk factor for cerebral bleeding after ischemic stroke: a gradient-echo T2*-weighted brain MRI study. *Stroke.* 2002 Mar 1;33(3):735-42.
- Chan S, Kartha K, Yoon SS, Desmond DW, Hilal SK. Multifocal hypointense cerebral lesions on gradient-echo MR are associated with chronic hypertension. *Am J Neuroradiol.* 1996; 17:1821–1827.
- Tanaka A, Ueno Y, Nakayama Y, Takano K, Takebayashi S. Small chronic hemorrhages and ischemic lesions in association with spontaneous intracerebral hematomas. *Stroke.* 1999; 30:1637–1642.
- Kato H, Izumiyama M, Izumiyama K, Takahashi A, Itoyama Y. Silent cerebral microbleeds on T2*-weighted MRI: correlation with stroke subtype, stroke recurrence, and leukoaraiosis. *Stroke.* 2002 Jun 1;33(6):1536-40.