ROLE OF T2* GRE MRI SEQUENCE IN DETECTING CEREBRAL MICROBLEEDS IN HYPERTENSIVE PATIENTS PRESENTING WITH INTRACEREBRAL HEMORRHAGE

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ABSTRACT

OBJECTIVES

Examine the efficacy of T2 gradient echo in detecting Cerebral microbleeds (CMBs) among hypertensive patients, emphasizing its efficiency in acquisition time. Evaluate its potential as an alternative to susceptibility-weighted imaging (SWI) in routine assessments for hypertensive individuals.*

METHODOLOGY

A cross-sectional study from Sep 2021 to January 2023 was conducted at the Radiology Unit of Lady Reading Hospital Peshawar. Patients suspected of having a cerebrovascular accident (CVA) were referred from different units who had proven Intracerebral hemorrhage (ICH) on initial CT brain. The exclusion criteria were a history of recent trauma aneurysms/tumors on the present scan. The MRI examination included sequences like T1, T2, FLAIR, DWI/ADC, and T2. The CMB was defined as a hypointense focus of signal drops out, measuring 5-10mm, with blooming artefact on T2* images and no surrounding edema.*

RESULTS

62 patients were included in the study, with an equal proportion of males and females and age ranges between 46 to 78 years (62 ± 4.7). Forty-one cases had CMBs on T2 sequence in these 62 cases (66%), and 18 (44%) cases out of 41 were visible on T2WI. No significant correlation was seen between grades of CMBs and the location or size of the microbleed on Spearman's test.*

CONCLUSION

*T2*GRE weighting can effectively detect CMBs compared to SWI. Therefore, this sequence could be employed in hospitals with increased workloads due to short acquisition time instead of the longer time for SWI.*

KEYWORDS: *Intracerebral hemorrhage (ICH), Cerebral microbleeds (CMBs), Hypertension, T2*gradient echo MRI, Susceptibility weighted images (SWI).*

INTRODUCTION

Intracerebral hemorrhage (ICH) is a cause of significant morbidity, mortality, and severe long-term disability. It accounts for 10% to 15% of all strokes, with an incidence of 24.6 per 100,000 person-years,[1] and early-term mortality of about 30%-40%.[2] The commonest causes of ICH include cerebral amyloid angiopathy (CAA), tumors, hemorrhagic transformation of ischemic stroke, cerebral venous thrombosis, vasculitis, and vascular malformations such as cavernous malformations, arteriovenous malformations, and ruptured saccular aneurysms. Advanced age, deep location (basal ganglia, thalamus, or posterior fossa), or history of hypertension are often thought to indicate primary intracerebral hemorrhage. However, cerebral angiography studies reveal that these features are not reliable.[1] ICH is generally characterized into five stages: hyperacute (less than 24 hours), acute (1 to 3 days), early subacute (3 to 7 days), late subacute (7 days to 28days), and chronic (more than 1 month).[3] ICH, which accounts for 20-30% of strokes in Asian countries such as Korea and Japan, may be accompanied by Cerebral microbleeds (CMBs). Specialized MR sequences, i.e., can detect CMBs, T2*gradient echo MR sequence, or Susceptibility weighted images (SWI) by visualizing perivascular para magnetic hemosiderin deposits. There is a strong association with high blood pressure, high blood glucose levels, and smoking. Histopathologically, CMBs correspond to hemosiderin deposits as a result of cerebral small vessel disease (SVD) and are a risk factor for stroke, intracranial hemorrhage, and dementia.[4] The presence of CMBs, especially more than five in number, increases the risk and mortality of cerebral hemorrhage.[5] CMBs are detected in 34% (95% CI 31-36%) of patients with ischemic stroke and 60% (95% CI 57–64%) of patients with intracerebral hemorrhage (ICH).[6] The location of CMBs in the brain parenchyma, superficial vs deep and above or below the tentorium, is also an important indicator for the patient

prognosis in cerebral hemorrhages. Lobar CMBs are caused by hypertensive small vessel disease and CAA, while CMBs in the basal ganglia or below the tentorium are closely related to hypertensive vasculopathy.[7] Detecting CMBs can affect the prognosis of CVAs, the prediction of their functional outcomes, hemorrhagic complications, and the selection of appropriate medical therapies.[8] Both T2* and susceptibility-weighted (SW) sequences are used for CMB detection. SWI is a more sensitive but time-consuming sequence and also shows artifacts.[10] On the other hand, the role of T2*-weighted MRI in CMBs is controversial and has not been proven.[9] The purpose of this study is to explore the role of T2* gradient echo in detecting Cerebral microbleeds (CMB) among hypertensive patients, emphasizing its efficiency in terms of acquisition time and evaluating its potential as an alternative to susceptibility-weighted imaging (SWI) in routine assessments for hypertensive individuals.

METHODOLOGY

The institutional ethics committee reviewed and approved this study vide 413 / LRH/MTI dated 21 June 2021. This was a cross-sectional study, and data was collected prospectively from Sep 2021 to January 2023 at the Radiology Unit of Lady Reading Hospital Peshawar. The included patients were referred from medical and neurology wards as well as from the emergency department who had proven ICH on initial CT brain or were suspected of having a CVA. Informed consent was obtained from the study participants. The exclusion criteria were a history of recent trauma and aneurysms/tumors on the present scan. All the patients underwent an MRI examination with a 1.5 tesla scanner (Toshiba vintage). The examination included sequences like T1, T2, FLAIR, DWI/ADC, and T2*. The MRI scan was interpreted by a consultant radiologist with more than 13 years of post-fellowship experience. The CMB was defined as a hypointense focus of signal drops out, measuring 5-10mm, with blooming artifact in T2* images and no surrounding edema, as shown in Figure 1. The CMBs were graded as Grade 0: no CMBs, Grade 1: 1-2 CMBs, Grade 2: 3-10 CMBs, and Grade 3: >10 CMBs.[5] Statistical software SPSS version 23 (IBM-SPSS.Version.23) was used for data analysis. The mean was calculated for continuous variables like patient age and hematoma size. Frequency tables were given for nominal parameters like the site of hematoma and grades of CMB. The correlation between site and size of intracranial hematoma with CMBs grade was analyzed using the Spearman test, taking a p-value of 0.05 as a significant

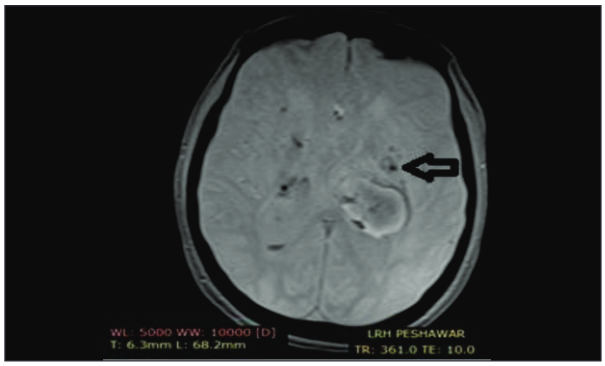

Figure 1: Multiple CMBs as hypointense signal foci on T2* GRE sequence. An arrow shows the one in the left basal ganglia

RESULTS

Sixty-two patients were included in the study, with an equal proportion of males and females, i.e., 31. The patient's age ranges between 46 to 78 years (62 ± 4.7). The size of the macro hemorrhage ranges from 1.3 - 8.7 cm (4.06±1.74). Most macro hemorrhages were early subacute hematoma (42, 68%) and late subacute (16, 26%). One case of hyperacute and chronic stage each, and two cases of acute hematoma were also detected. Central diffusion restriction was mostly observed in the late subacute stage of hematoma (15 out of 16, 94%), while no diffusion restriction was seen in the rest of the hematoma stages, except in two cases of the early subacute stage out of 42 cases (5%). The macro hematomas were mostly in superficial locations, i.e., 35 cases (56%), while 20 cases were in deep nuclei and 7 cases were in infratentorial regions. The details of hematoma location as compared to grades of CMBs are as given in Table 1.

Table 1: Location of Macrohemorrhage vs Grade of Microhaemorrhage

Location of Macrohemorrhage	Grade of Microhaemorrhage				Total
	Grade 0	Grade 1	Grade 2	Grade 3	
BG	05	08	03	01	17 (27.4%)
Temporal lobe	02	07	04	04	17 (27.4%)
Frontal lobe	06	01	02	02	11 (17.7%)
Parietal lobe	03	00	01	00	04 (6.5%)
Occipital lobe	02	00	00	00	02 (3.2%)
Cerebellum	02	00	02	02	06 (9.7%)
Brainstem	00	00	02	00	02 (3.2%)
Thalamus	01	00	01	01	03 (4.8%)
Total	21	16	15	10	62 (100%)

Table 2: Location of Macrohemorrhage vs Location of Microhemorrhage

	Location of Micro hemorrhage							
	BG	**Temporal**	**Frontal**	**Parietal**	**Occipital**	**Cerebellum**	**Multilobar**	**None**
BG	08	02	00	00	02	00	00	05
Temporal Lobe	03	05	00	03	00	01	03	02
Frontal lobe	00	00	02	01	01	01	00	06
Parietal lobe	00	00	01	00	00	00	00	03
Occipital lobe	00	00	00	00	00	00	00	02
Cerebellum	02	02	00	00	00	00	00	02
Brainstem	00	01	00	00	00	01	00	00
Thalamus	02	00	00	00	00	00	00	01
Total	15	10	03	04	03	03	03	21

Table 3: CMBs on T* vs T2WI

CMBs on T2*		**CMBs on T2WI**		**Total**
		Yes	No	
	Yes	18	23	41
	No	00	21	21
Total		18	44	62

The visualization of CMB on T2* and T2WI is shown in Table 3. The visualization on T2WI did not show an association with a grade of micro hemorrhage with equal distribution (6 in grade 1, 7 in grade 2, and 5 in grade 3), while only 4 (9%) microhemorrhages were detected on T1WI (3 in grade 2 and 1 in grade 3). Spearman's test was applied regarding the correlation of the grades of CMBs with the location of macro hemorrhage, but there was no significant correlation [(rs) [62] =0.284, p .138]. The correlation of the grade of micro hemorrhage with the size of micro hemorrhage gives a non-significant value of {(rs) [62] = 0.439, p 0.100}.

DISCUSSION

The development of Cerebral microbleeds increases with age,[11] most likely due to the association of age with CMB risk factors such as small vessel disease, CAA, and hypertension.[12] CMB is not detected on conventional spin-echo MRI sequences and requires special sequences.[13] SWI MRI is sensitive to visualizing CMBs due to paramagnetic artifacts, with T2*GRE MRI as an alternative sequence.[14] A recent study has questioned the clinical relevance and sensitivity of SWI with false positive results due to motion artifacts from increased scan time, thus increasing the value of GRE sequence.[15] Shen J et al. stated the location of hypertension-related Macrohemorrhage as lobar (51, 24.4%), non-lobar (143, 68.4%), and mixed (15, 7.2%), respectively.[16] Our study showed 34 cases (55%) in cortical and subcortical locations, while 20 cases (32%) were of deep nuclei. The brain stem was the least common location of macro hemorrhage, with one case in the pons. A recent study by Reddy et al. shows a 60% prevalence of CMBs in hypertensive patients while using SWI.[17] Our study picked a nearly similar prevalence of 66% using T2*GRE. The high incidence in our study is likely due to the inclusion of cases with already cerebral hemorrhages in addition to hypertension. Lyu et al. stated 54.3% CMB in cortical and subcortical locations while 19.6% in basal ganglia and 6.7% in the thalamus.[5] Our study shows a nearly identical percentage in the cortical and subcortical locations, i.e., 60 %, while CMB differs in the basal ganglia (36 %) with no CMB in the thalamus. The location of microhemorrhages was mostly in the basal ganglia (36%) and temporal lobes (24%), and these two locations also show some association between macro and micro hemorrhage in the same location. The occipital lobe macro hemorrhage was without any associated micro hemorrhage. A study by Nikseresht et al. [18] shows a significant correlation between CMB and microinfarct in basal ganglia, while the frontal lobe ones were associated with amyloid angiopathy and atherosclerosis. The Spearman test reveals no statistical correlation between CMB grade and macro hemorrhage's location and size. In addition, the sensitivity of T2WI is 56%, as 44% of the cases show abnormal foci when observed retrospectively in the specific location of CMBs picked by GRE.

LIMITATIONS

We have not recorded the Grades and duration of hypertension. No other risk factors like Diabetes and advanced age were included in the study.

CONCLUSIONS

The pattern of choosing specialities slightly varies according to different areas and states of the country. The study revealed that students lack awareness about new specialities. No student opts for haematology, community medicine, pathology, fetal medicine, rheumatology, neurology, or emergency medicine. In contrast, less than 1% of students opted for fields like neurosurgery, urology, and endocrinology. Most of the students are satisfied with the medical profession. Despite significantly good academic abilities, females preferred to work inland, while many males planned residency abroad.

CONFLICT OF INTEREST: None

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