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Original Article

Prevalence of Cerebral Microbleeds in Patients Undergoing MRI Brain for Suspicious Neurological Symptoms

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Abstract

Aim: The aim is to estimate the prevalence of cerebral microbleeds (CMBs) in patients undergoing magnetic resonance imaging (MRI) brain for suspicious neurological symptoms.

Materials and Methods: This was a cross-sectional observational study of 200 patients (≥50 years of age) undergoing MRI brain. MRI examinations were assessed for the presence of CMBs, ischemic cerebrovascular disease, and intracerebral hemorrhage. Patients with contraindications for MRI examination, head trauma, intracranial space occupying lesion, and central nervous system infection were excluded for the study.

Results: Mean age of the study subjects was 63 years. Overall, the prevalence of CMBs was found to be 26%. The prevalence of CMBs among males was 26.1% and the prevalence among females was 25.8%. The prevalence of CMBs in patients having suffered from intracerebral hemorrhage was 72.7% and the prevalence in patients with ischemic cerebrovascular disease was 35.5%. Deep and infratentorial microbleeds were found in 86.5% of the study subjects while as 13.5% had microbleeds in strictly lobar distribution.

Conclusion: CMBs are considered as markers of small vessel pathology. The frequency of CMBs varies by population. The prevalence of CMBs is lowest in healthy individuals, intermediate in patients with ischemic cerebrovascular disease, and highest in patients with intracerebral hemorrhage.

Key words: Cerebral microbleeds, MRI brain, Neurological symptoms, Prevalence

INTRODUCTION

Cerebral microbleeds (CMBs) are small hypointense focii with maximum size of up to 5 mm or even up to 10 mm detected using susceptibility weighted imaging (SWI) magnetic resonance imaging (MRI).[1-5] CMBs are tiny deposits of blood degradation products (mainly hemosiderin) contained within macrophages and lying in close spatial relationship with structurally abnormal vessels. Hemosiderin is a strong paramagnetic material allowing its detection when a magnetic field is applied.[6] This phenomenon is called susceptibility effect and is the basis of T2*-GRE imaging.[7] Most sensitive sequence to detect CMBs is SWI.[8] CMBs act as markers of small vessel disease. Specific topographic patterns of CMBs are thought to be representative of particular underlying vasculopathies mainly hypertensive vasculopathy and cerebral amyloid angiopathy. CMBs are also a common finding in other populations, even in healthy elderly individuals. In the differential diagnosis of CMBs, other causes of signal loss on GRE sequences have to be considered which include vascular flow voids, calcium or iron deposits in basal ganglia, cerebral cavernous malformations, and head trauma.

CMBs may be categorized into one of the three locations: lobar (cortical gray and subcortical or periventricular white matter), deep (deep gray matter matter: basal ganglia and thalamus and white matter of corpus callosum, and internal and external capsule), and infratentorial (brainstem cerebellum). CMBs are strongly predictive of mortality.

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Deep and infratentorial microbleeds are associated with cardiovascular mortality, while as lobar microbleeds are associated with stroke related mortality.[9] CMBs can also cause gait disturbances and cognitive impairment.[10]

MATERIALS AND METHODS

This was a cross-sectional study which was undertaken by the Department of Radiodiagnosis and Imaging, Government Medical College, Srinagar, with the aim to estimate the prevalence of CMBs in patients undergoing MRI brain for suspicious neurological symptoms (headache, dizziness, vertigo, numbness, syncope, and subjective memory impairment). The study was carried out over a period of 18 months (2020–2021). The study included 200 patients. The Ethics Committee approved this study and the study was carried out after explaining the study details and taking written informed consent from the patients. Patients aged ≥50 years were included in the study. Patients with contraindications for MRI, brain trauma, acute central nervous system infection, and intracranial space-occupying lesion were excluded for the study.

MRI examination was done on 3 Tesla equipment. For brain, following sequences and slice thickness were obtained: (i) T1-weighted axial sequence-3 mm, (ii) T2-weighted axial sequence-3 mm, (iii) fluid-attenuated inversion recovery axial sequence-4 mm, (iv) diffusion-weighted imaging (DWI) sequence-5 mm, and (v) SWI sequence.

The SWI sequence used in our study was a 3-dimensional, T2*-weighted, and gradient recalled echo sequence with a high resolution used for microbleed detection. The parameters of SWI were as follows: TR/TE 28/20 ms, flip angle 15®, matrix 448 × 364, number of excitations 1, field of view 18.68 × 23.0 cm, and slice thickness 2.0 mm.

On MRI brain, patients were assessed for the presence of CMBs. MRI examination was also evaluated for the presence of white matter hyperintensities, lacunar infarcts, large vessel infarcts, and intracerebral hemorrhage.

Statistical Analysis

The recorded data were compiled and entered in a spread sheet (Microsoft Excel) and then exported to data editor of SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean ± SD and categorical variables were summarised as frequencies and percentages.

RESULTS AND DISCUSSION [TABLES 1-6 AND FIGURES 1-3]

This study included 200 patients undergoing MRI brain for suspicious neurological symptoms. Mean age of the study

Table 1: Prevalence of microbleeds in the study subjects

Microbleeds	Number	Prevalence (%)
Present	52	26
Absent	148	74
Total	200	100

Total number of study subjects=200. Number of subjects detected with CMBs=52. Overall prevalence of CMBs=26%

Table 2: Prevalence of microbleeds as per gender

Gender	Microbleeds		No Microbleeds		*P*-value
	No.	%age	No.	%age	
Male	29	26.1	82	73.9	0.964
Female	23	25.8	66	74.2	
Total	52	26.0	148	74.0	

Out of 200 study subjects, 111 were male and 89 were female. Prevalence of CMBs in males=26.1%. Prevalence of microbleeds in females=25.8%

Table 3: Prevalence of microbleeds in patients with ischemic cerebrovascular disease

Microbleeds	Number of patients with ischemic cerebrovascular disease	Prevalence (%)
Present	11	35.5
Absent	20	64.5
Total	31	100

Number of patients with ischemic cerebrovascular disease=31. Patients with ischemic cerebrovascular disease having CMBs=11. Prevalence of microbleeds among patients of ischemic cerebrovascular disease=35.5%

Table 4: Prevalence of microbleeds in patients with intracerebral hemorrhage

Microbleeds	Number of patients with intracerebral hemorrhage	Prevalence (%)
Present	8	72.7
Absent	3	27.3
Total	11	100

Number of patients with intracerebral hemorrhage among study subjects=11. Number of patients with intracerebral hemorrhage having CMBs=8. Prevalence of microbleeds among patients of intracerebral hemorrhage=72.7%

Table 5: Prevalence of microbleeds in healthy patients

Microbleeds	Number	Prevalence (%)
Present	33	20.9
Absent	125	79.1
Total	158	100

Prevalence of CMBs among healthy study subjects=20.9%

Table 6: Distribution/location of microbleeds

Location	Number	Percentage
Deep and infratentorial	45	86.5
Lobar	7	13.5
Total	52	100

Number of patients with deep and infratentorial microbleeds=45. Number of patients with strictly lobar microbleeds=7. Percentage of patients with deep and infratentorial microbleeds=86.5%. Percentage of patients with strictly lobar microbleeds=13.5%

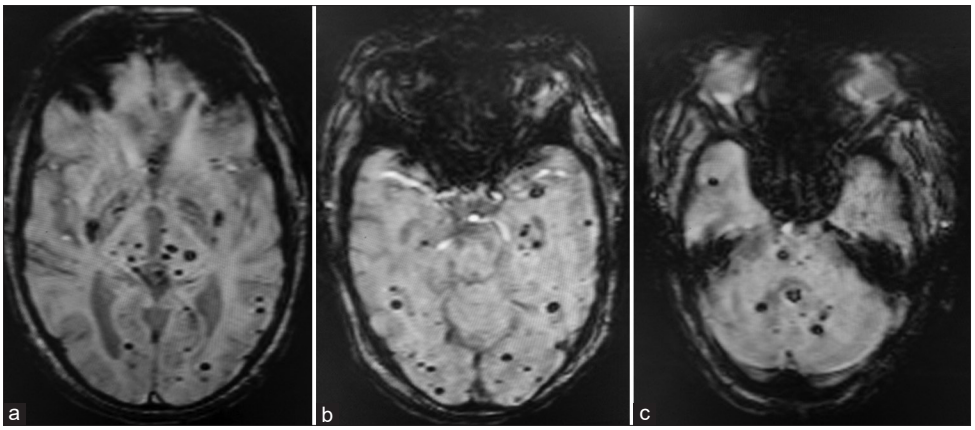

Figure 1: Multiple supratentorial and infratentorial microbleeds in a patient with chronic hypertension. (a) SWI showing multiple microbleeds in bilateral thalami and basal ganglia. (b) SWI showing microbleeds in bilateral occipital and temporal lobes. (c) SWI showing microbleeds in cerebellum

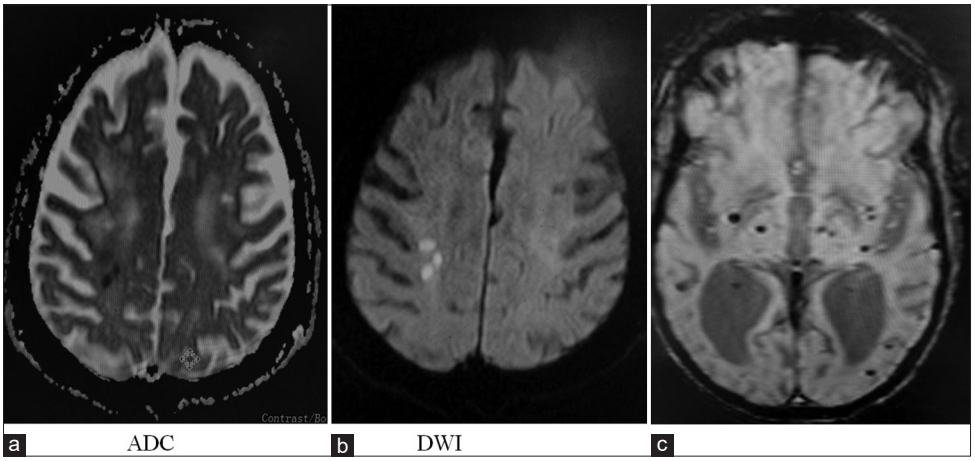

Figure 2: Microbleeds in a patient with acute lacunar infarct in right centrum semiovale. (a) Apparent diffusion coefficient – Area of diffusion restriction in right centrum semiovale. (b) Diffusion-weighted imaging - Area of diffusion restriction in right centrum semiovale. (c) SWI showing multiple microbleeds in bilateral basal ganglia and left occipital lobe

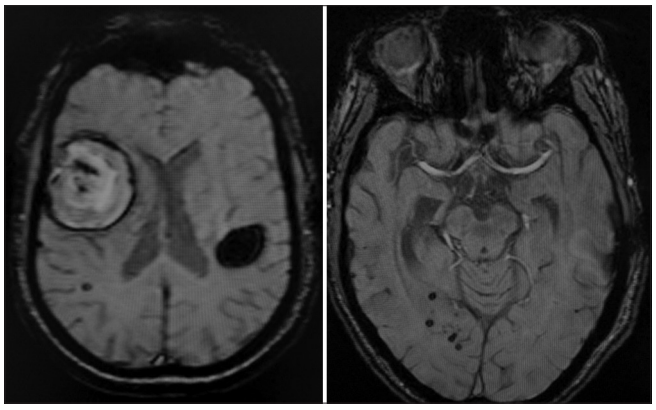

Figure 3: Lobar microbleeds in a patient with few lobar hemorrhages (probable CAA). Susceptibility weighted imaging showing blooming in lobar hemorrhages and microbleeds right parietal and occipital lobe

subjects was 63 years. Out of 200 study subjects, 111 were male, while as 89 were female. Out of 200 patients, 11 were detected with intracerebral hemorrhage, among which three patients had lobar hemorrhage and eight patients had hemorrhage in deep and infratentorial location (basal ganglia, thalami, brainstem, and cerebellum). One hundred and two patients had white matter hyperintensities. Out of 200 patients, 31 patients were detected with ischemic cerebrovascular disease (acute and chronic lacunar infarcts and large vessel infarcts). Out of 200 patients, microbleeds were detected in 52. Hence, the overall prevalence of CMBs in our study was found to be 26%. It has been found that frequency of CMBs varies enormously depending on the MRI study characteristics (such as field strength, sequence used for cerebral microbleed detection, and section thickness) and selection of study subjects. Several population based studies have reported on microbleed prevalence and according to Rotterdam scan study (performed using 1.5T MRI), the prevalence of CMBs in healthy older individuals can be as high as 23.5%.[11] The difference in the reported prevalence of CMBs can be attributed to higher field strength MRI (3T) used to perform the study apart from the differences in the study populations which may be present. This finding has also been seen by Stehling *et al*.[12]

who have reported that the detection rate and visibility of CMBs benefit from the higher field strength, resulting in a significantly improved depiction of iron-containing brain structures (CMBs) at 3.0T compared to that at 1.5T.

In our study, the prevalence of CMBs among males was found to be 26.1% and the prevalence among females was found to be 25.8%. No significant difference in cerebral microbleed prevalence between males and females was found. Similar findings were reported by Poels *et al*.[13] in the update of Rotterdam scan study.

In our study, the prevalence of CMBs in patients with ischemic cerebrovascular disease (acute and chronic lacunar infarcts and large vessel infarcts) was found to be 35.5%. Similar results were found by Naka *et al*.[14] and Tsushima *et al*.[15] The prevalence of microbleeds in patients having suffered from intracerebral hemorrhage (ICH) was found to be 72.7%. Similar finding was reported by Jeong *et al*.[16] They evaluated 102 patients with deep and lobar ICH and found that 70% had microhemorrhages and they were frequently multiple. A wide range in the prevalence of CMBs in different clinical conditions such as ischemic stroke and ICH has also been reported by Naka *et al*.,[14] Lee *et al*.[17] and Kato *et al*.[18]

Regarding the distribution of CMBs, deep and infratentorial microbleeds were found in 86.5% of the patients while as 13.5% of the subjects had microbleeds in strictly lobar distribution.

CONCLUSION

There is no significant gender-based difference in the prevalence of CMBs. The frequency of CMBs varies by population, its prevalence being lowest in healthy individuals, intermediate in patients with ischemic cerebrovascular disease, and highest in patients with intracerebral hemorrhage. CMBs can be considered as a sign of underlying small vessel pathology.

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