

## Review Of Cerebral Microbleeds using FAZEKA Classification

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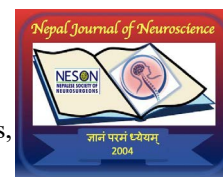
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### Abstract

**Introduction:** Cerebral microbleeds (CMBs), also known as cerebral microhemorrhages, are tiny hypointense foci discovered by susceptibility-weighted (SW) magnetic resonance imaging (MR). CMBs have been interpreted as asymptomatic lesions that may be identified by chance during a brain MRI. This study was done to understand the etiology and various imaging patterns of the cerebral microbleeds on MRI

**Materials & Methods:** This study was done with a sample size of 325 patients who underwent MRI Brain and diagnosed with CMB at our hospital. Detailed supportive history was taken and data was analysed.

**Results:** Present study shows strong correlation between CMB's and white matter changes. CMBs in parietal lobe found to have correlation with cognitive dysfunction. Lacunar infarct is the most common subtype associated with the CMB's

**Conclusion:** The markers of microangiopathy on MRI brain are CMBs and white matter changes. Correlation of lobar CMBs with periventricular white matter hyperintensities and deep, infratentorial CMBs with deep white matter hyperintensities were found.

**Keywords:** Microangiopathy, MRI, Cerebral microbleeds, cerebral small vessel disease.

### Introduction

Cerebral microbleeds (CMBs) are bleeding events associated with cerebral small vessel disease (SVD), occurring as small perivascular haemosiderin-deposits in the brain. 30-40 per 10,000 individuals are affected by symptomatic intracerebral haemorrhage and can have devastating clinical outcomes.<sup>1,2</sup> Cerebral microbleeds (CMBs), which occur with cerebrovascular illness, dementia, and ageing, are becoming more well recognised as neuroimaging findings. CMBs are linked to later ischemic and hemorrhagic stroke, as well as a higher risk of dementia and cognitive decline.<sup>2,3,4</sup>

They are defined as small, well-defined low signal lesions seen on SWI (susceptibility weighted imaging) MRI brain studies; the location of the CMBs may be an indication of the underlying aetiology. The different risk factors for the occurrence of microbleeds are numerous and it is still uncertain as to how they alter clinical evaluation and treatment protocol.<sup>5,6</sup>

### Material & Methods

325 patients who underwent MRI Brain and diagnosed with CMBs at tertiary care Hospital between December 2021 and June 2022 were analysed. Detailed clinical history including mode of presentation, co morbidities and laboratory parameters were collected for each patient. Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software.

### Results

Spearman's correlation found a statistically significant correlation between CMBs and white matter changes, with severity of white matter changes increasing linearly with increase in number of microbleeds.

Mixed distribution of CMBs have a propensity for deep white matter changes, while lobar distribution of CMBs show more of periventricular white matter changes.

Lobar microbleeds with parietal predominance were found to be associated with cognitive dysfunction.<sup>7</sup> The serum creatinine and mean blood pressure values were found to be significantly higher in the deep and infratentorial locations of CMBs.<sup>8</sup>

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Lacunar infarction is the most common stroke subtype associated with CMBs followed by intracerebral haemorrhage in our study.<sup>9</sup>

## Discussion

In our study of 325 patients the most common age group to be involved was 61 -70 years followed by 71 -80 years. There was slight male preponderance. (Table and Figure 1). Most common age group to be affected was from 61 to 70 years, followed by 71 to 80 years (Table 1 and Figure 1). The most common clinical presentation of the patients were altered sensorium followed by unilateral weakness, Headache , Decreased responsiveness & Giddiness.(Table 2). The associated comorbidities were hypertension, diabetes mellitus, alcoholism and smoking in respective order. The treatment history most commonly seen in our patient group was antihypertensive followed by anticoagulents and statins.(Table 3 and 4) . The most commonly affected location was mixed pattern followed by lobar bleeds. ( Table 5 & Figure 2). Grade III was seen most commonly followed by Grade I and then Grade II MARS: Microbleeds Anatomical Rating Scale among subjects. (Table 6 & Figure 3).Most of the patients in our study had normal memory and cognitive function, however 36.9% of the patients showed evidence of cognitive dysfunction. (Table 7).

Periventricular hyperintensities and deep white matter hyperintensities: 1 and 3 periventricular hyperintensities were seen in 33.85% patients each followed by 2 periventricular hyperintensities in 32.31% of patients. Similarly 1 and 2 deep white matter hyperintensities were seen in 43.08% of patients each followed by 9.33% of patients who have shown 3 deep white matter hyperintensities. Although 4.61% patients haven't shown any deep white matter hyperintensities. (Figure 4). Most commonly patients shown Fazek's scale 2 followed by Fazeka's 4 and Fazeka's 5.( Figure 5 & Table 8). In the study among subjects with MARS grade 1, majority had Fazekas Grade 2 (47.8%), among subjects with MARS grade 2, majority had Fazekas Grade 4 (72.7%) and among subjects with MARS Grade 3, majority of them had Fazekas Grade 5 (41.9%). There was significant association between MARS and Fazekas Grading (Table 9 & Table 10).

In an endeavour to understand the imaging pattern of cerebral microbleeds on MRI and various causes behind it and their clinical significance MRI Brain studies diagnosed with cerebral microbleeds at a Tertiary Care Hospital in North India over a period of 7 months were analysed.<sup>10</sup>

In a longitudinal study done by Nishikawa T et. al microbleeds were a predictor of future cerebrovascular events in both stroke patients and older people living in the community, according to longitudinal research.<sup>11</sup>

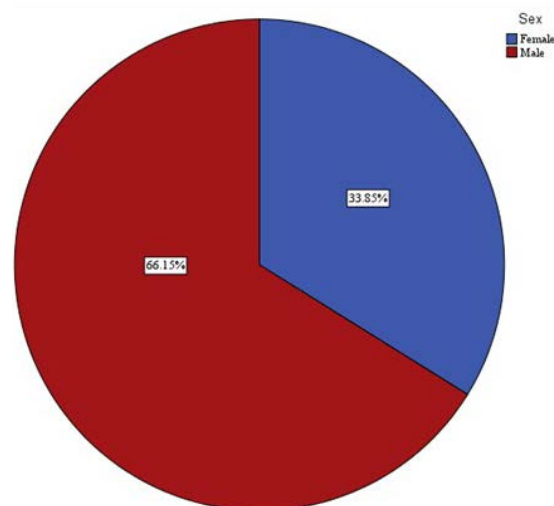
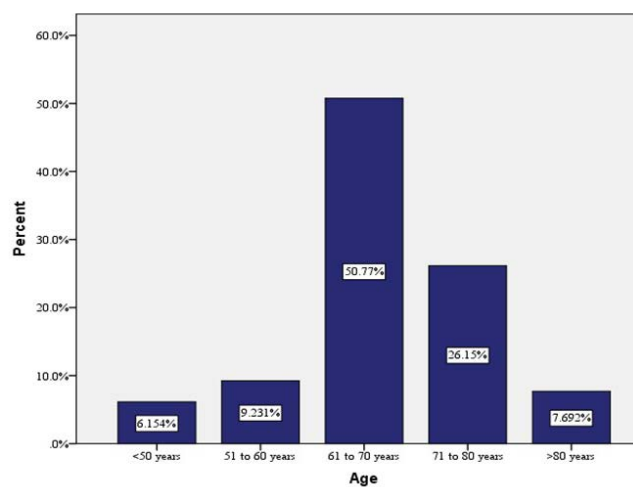
The different locations of CMBs have certain clinical correlations. A study by Liu W., et al. found systolic blood pressure variability as an independent risk factor for deep and infratentorial CMB progression.<sup>12</sup> Kim SH et al, found that renal dysfunction was significantly associated with the presence of CMB and the number of CMB lesions, independent of other known CMB risk factors in a neurologically healthy population without perceived chronic kidney disease or previous stroke

history.<sup>13</sup> In addition, the association was more evident for deep or infratentorial CMB than for the strictly lobar CMB. Cerebral amyloid angiopathy topographically preferentially affects cortical and leptomeningeal vessels, instead of vessels in the cerebellum, brainstem and basal ganglia, in a characteristic patchy manner; lobar microbleeds are more associated with cognitive dysfunction.<sup>14,15</sup>

Qiong Yang et al. found CMB incidence increased with age. Mixed CMB type displayed the highest incidence. The severity and number of CMBs at any location correlated with white matter changes (Fazekas) severity.<sup>16,17</sup>

In a study by Gao T, et al , both microbleeds (>grade 2) and white matter lesions in severity (>grade 2) were higher in the recurrent stroke group (14.5 and 48.4%) than those in the primary stroke group (3.8 and 7.7%).<sup>18</sup>

Table 1 & Figure 1: Age and sex distribution of subjects



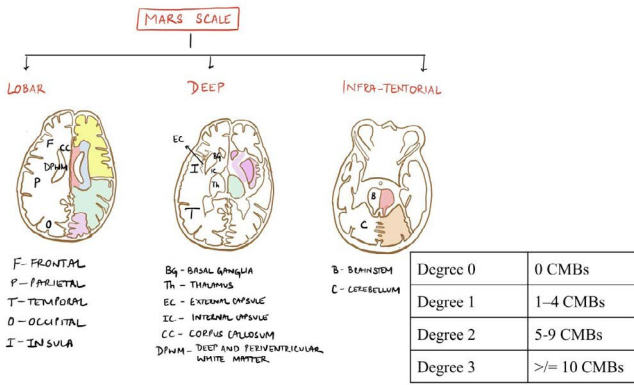


Image . 1: Microbleed anatomical rating scale (MARS) illustration

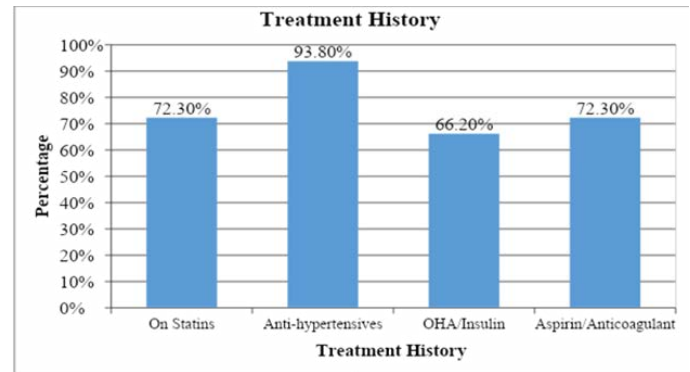
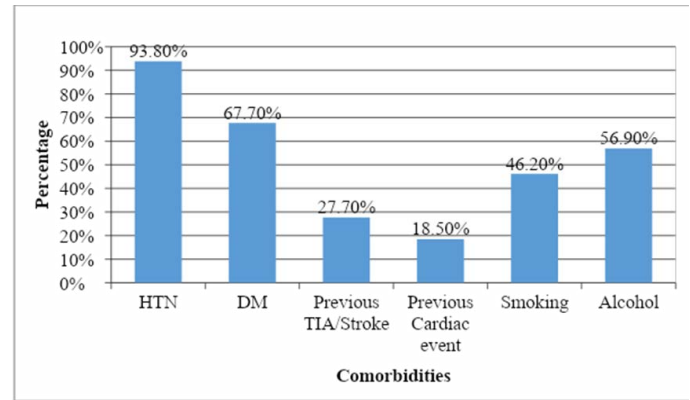
The most common clinical presentation of the patients were altered sensorium followed by unilateral weakness. (Table 2)

Table 2: Clinical presentation among subjects.

Clinical	Count	%
Altered Sensorium	110	33.8%
Confused	5	1.5%
Decreased responsiveness	15	4.6%
Difficulty talking	5	1.5%
Disoriented	5	1.5%
Disoriented, irrelevant talk	5	1.5%
Follow up of Multiple sclerosis, fatigue	5	1.5%
Gait instability, altered Sensorium	5	1.5%
Generalized weakness	10	3.1%
Giddiness	15	4.6%
Headache	20	6.2%
Irrelevant talking	5	1.5%
Left lower limb weakness	10	3.1%
Left sided weakness	40	12.3%
Left sided weakness, headache	5	1.5%
Left sided weakness, insomnia	10	3.1%
Loss of consciousness	5	1.5%
Previous CVA	5	1.5%
Right sided weakness	35	10.8%
Right sided weakness, accelerated hypertension, slurring of speech	5	1.5%
Weakness of right upper and lower limbs	5	1.5%
<b>Total</b>	<b>325</b>	<b>100.0%</b>

The associated comorbidities were hypertension, diabetes mellitus, alcoholism and smoking in respective order. The treatment history most commonly seen in our patient group was antihypertensive followed by anticoagulants and statins. (Table 3&4)

Table 3 & 4: Bar diagram showing co morbidities and treatment history among subjects.



The location of bleeds: The most commonly affected location was mixed pattern followed by lobar bleeds. ( Table 5 & Figure 2)

Table 5 & Figure 2: Location of cerebral microbleeds.

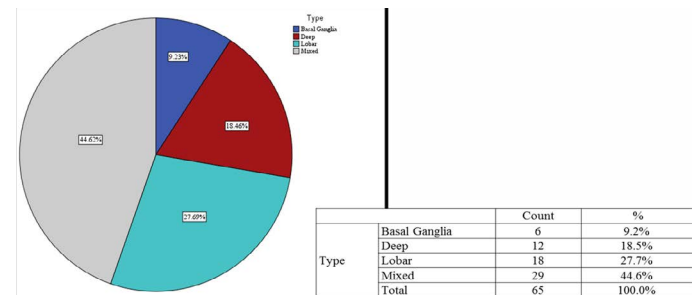
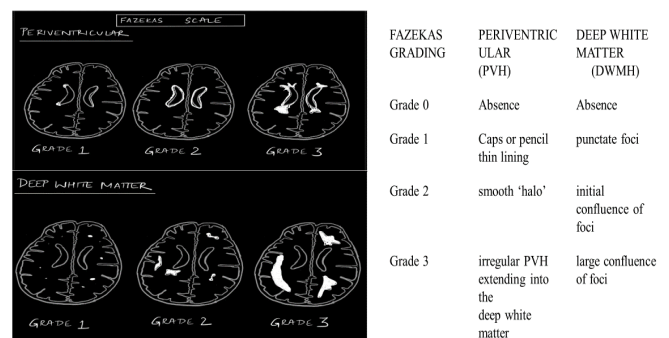
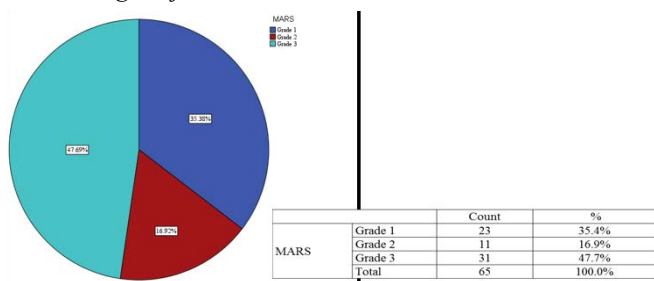


Image . 2: Fazekas scale illustration for white matter changes<sup>2</sup>



Grade III was seen most commonly followed by Grade I and then Grade II. ( Table 6 & Figure 3)

**Table 6 & Figure 3: MARS : Microbleeds Anatomical Rating Scale among subjects.**



Most of the patients in our study had normal memory and cognitive function, however 36.9% of the patients showed evidence of cognitive dysfunction. (Table 7)

**Table 7: Memory and Cognitive dysfunction among subjects**

		Count	%
Memory/ Cognitive function	Cognitive dysfunction	120	36.9
	Normal	205	63.1%
	Total	325	100.0%
<b>Cognitive dysfunction</b>			
Lobar	Deep	Infratentorial	Mixed
45	0	0	75

Total - 120

Periventricular hyperintensities and deep white matter hyperintensities: 1 and 3 periventricular hyperintensities were seen in 33.85% patients each followed by 2 periventricular hyperintensities in 32.31% of patients. Similarly 1 and 2 deep white matter hyperintensities were seen in 43.08% of patients each followed by 9.33% of patients who have shown 3 deep white matter hyperintensities. Although 4.61% patients haven't shown any deep white matter hyperintensities. (Figure 4)

**Figure 4: Periventricular and Deep white matter hyperintensities**

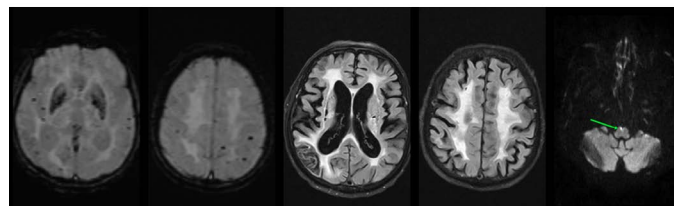
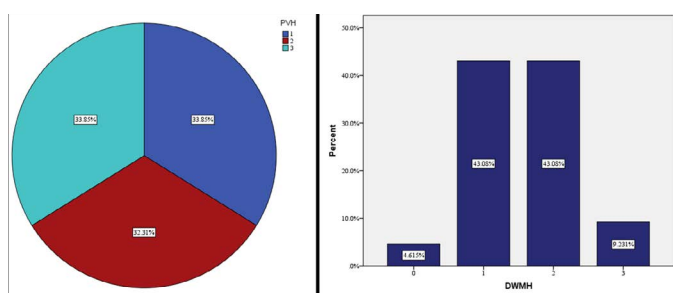
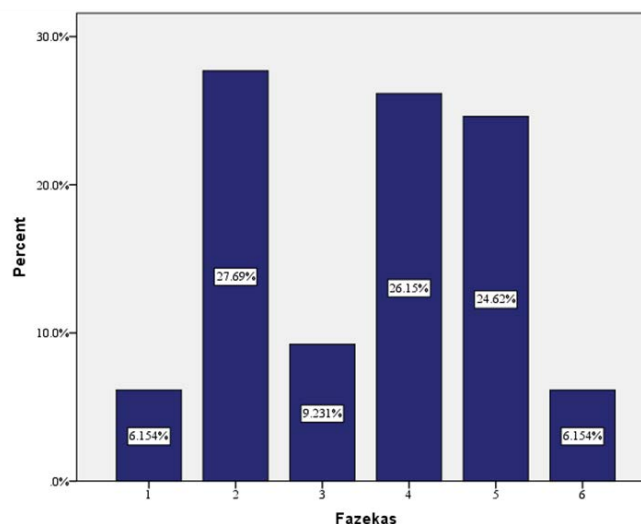


Image . 3: MARS correlation with Fazekas - Axial SWI, FLAIR and DWI sequences in a 76 year old chronic smoker and hypertensive male with cognitive dysfunction showing lobar only CMBs(MARS grade 3) correlating with high grade of periventricular and deep white matter hyperintensities(Fazekas: PVH - 3, DWMH - 3). Acute lacunar infarct noted in the right half of medulla on DWI.

**Figure 5 & Table 8: Fazeka scale distribution. Most commonly patients shown Fazek's scale 2 followed by Fazeka's 4 and Fazeka's 5.( Figure 5 & Table 8)**



Fazekas	Number Of Patients	%	
1	20	6.2%	
2	90	27.7%	
3	30	9.2%	
4	85	26.2%	
5	80	24.6%	
6	20	6.2%	
Total	325	100.0%	



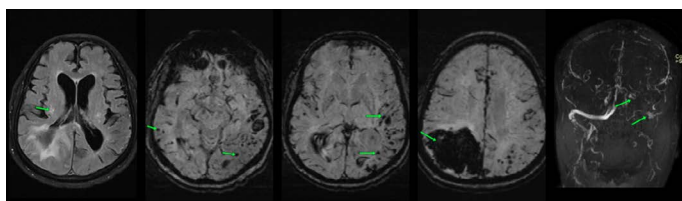


Image . 4: **Lobar CMBs**- Axial FLAIR and SWI sequences in a 68 year male with dementia showing disproportionate lobar only CMBs as compared to subtle WMCs. Right parietal haematoma with chronic superior sagittal, left transverse and sigmoid sinuses seen on the SWI and coronal MR venogram.

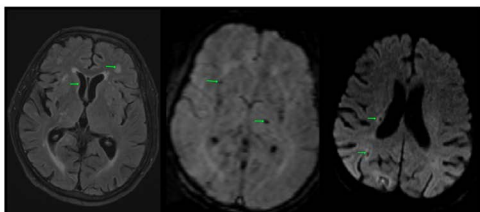


Image . 5: **Deep CMBs**- Axial FLAIR, SWI and DWI sequences in a hypertensive 73 year male showing periventricular and deep white matter hyperintensities(Fazekas PVH -2 and DWMH - 1) and predominantly deep CMBs. Chronic lacunar infarcts are seen in the right parietal white matter.

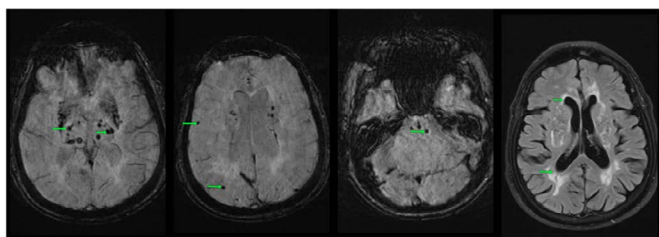


Image . 6: **Mixed CMBs** - Axial SWI and FLAIR sequences in a hypertensive 68 year male with mild cognitive impairment showing lobar, deep and infratentorial CMBs and predominantly deep WMCs.

Table 9: Correlation between MARS and Fazekas Scale.

			MARS	Fazekas
Spearman's rho	MARS	Correlation Coefficient	1.000	.439**
		Sig. (2-tailed)		.000
		N	65	65

\*\* . Correlation is significant at the 0.01 level (2-tailed).

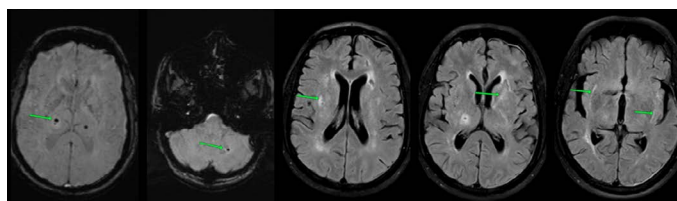
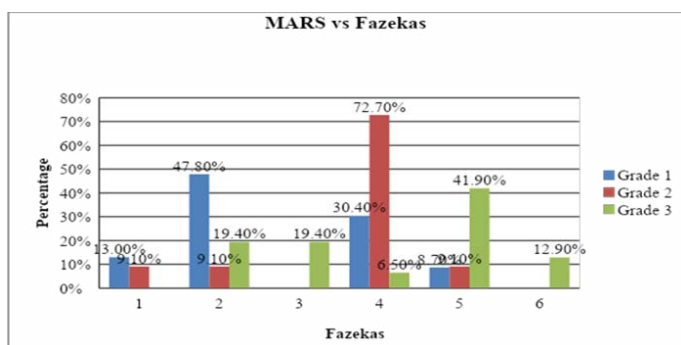


Image . 7: **Chronic kidney disease (CKD)**- Axial SWI and FLAIR sequences in a 52 year old male with CKD showing predominantly deep and infratentorial CMBs and few deep white matter hyperintensities. 'Lentiform fork sign' i.e bilateral basal ganglia hyperintensities are seen on FLAIR sequence.

In the study among subjects with MARS grade 1, majority had Fazekas Grade 2 (47.8%), among subjects with MARS grade 2, majority had Fazekas Grade 4 (72.7%) and among subjects with MARS Grade 3, majority of them had Fazekas Grade 5 (41.9%). There was significant association between

### Conclusion

The markers of microangiopathy on MRI brain are CMBs and white matter changes. Correlation of lobar CMBs with periventricular white matter hyperintensities and deep, infratentorial CMBs with deep white matter hyperintensities were found. Average serum creatinine and blood pressure values are greater for mixed, deep and infratentorial CMBs as compared to lobar distribution. Lacunar infarction which is again a small vessel ischemic marker is thereby most commonly associated with CMBs and white matter hyperintensities.

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