

Utility of Visual MRI Rating Scales in Differentiating Vascular and Alzheimer's Dementia: Correlation with MoCA Scores

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Abstract

Background

Alzheimer's disease (AD) and vascular dementia (VaD) are the two most common causes of dementia. Differentiation between them is clinically important, especially in settings with a high cerebrovascular disease burden.

Objective

To assess the diagnostic utility of visual MRI rating scales—Medial Temporal Atrophy (MTA), Global Cortical Atrophy (GCA), and Small Vessel Disease (SVD)—in differentiating AD from VaD, and to examine their correlation with Montreal Cognitive Assessment (MoCA) scores.

Methods

A prospective case-control study was conducted at a tertiary care hospital between 2020 and 2022. Forty participants were included: VaD (n = 8), AD (n = 8), mixed dementia (n = 4), and controls (n = 20). MRI scans were evaluated using MTA, GCA, and SVD scales. MoCA scores were obtained for clinical correlation. Statistical analysis included ANOVA, Bonferroni post-hoc tests, Spearman correlation, and ROC curve analysis.

Results

MTA scores were significantly higher in AD and mixed dementia compared to controls ($p < 0.001$). SVD scores were significantly higher in VaD and mixed dementia compared to controls ($p < 0.001$). No significant differences were observed for GCA. MoCA correlated negatively with both MTA and SVD ($\rho = -0.4$, $p < 0.05$). ROC analysis demonstrated strong predictive performance of SVD in identifying VaD (AUC 0.85).

Conclusion

Visual MRI rating scales are simple, reproducible tools for dementia assessment. MTA is more useful for AD, whereas SVD strongly supports VaD. Their correlation with MoCA reinforces their role in clinical evaluation.

Introduction

Vascular dementia (VaD) is the second most common cause of dementia after Alzheimer's disease (AD), but in regions with high cerebrovascular disease burden, VaD may be the most frequent subtype [1]. Unlike AD, VaD is associated with modifiable risk factors, making accurate and early differentiation between the two clinically important [2].

MRI is the imaging modality of choice in dementia, but routine use often underutilizes structural findings due to lack of standardized assessment [3]. Visual rating scales (VRS) such as the Medial Temporal Atrophy (MTA) scale [9, 10], Global Cortical Atrophy (GCA) scale [8], and Small Vessel Disease (SVD) scale [11] provide a reproducible, clinically feasible framework. These scales can be applied to routine images without additional sequences or advanced post-processing.

The Montreal Cognitive Assessment (MoCA) is widely used to assess cognitive impairment, but its relationship with MRI-based severity scores has not been extensively studied in many populations [4, 5]. This study aimed to evaluate the role of MRI visual rating scales in distinguishing AD from VaD, and to assess their correlation with cognitive severity measured by MoCA.

Materials and Methods

This prospective case-control study was conducted in the Departments of Radiodiagnosis and Neurology at a tertiary university hospital between October 2020 and September 2022. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was secured from all participants. Patients were diagnosed using DSM-5, NINCDS-AIREN, and ICD-10 criteria, and classified into four groups: VaD (n = 8), AD (n = 8), mixed dementia (n = 4), and controls (n = 20) [7].

MRI scans were acquired on a 1.5 Tesla system (Magnetom Avanto, Siemens). Sequences included axial T1, T2, FLAIR, DWI with ADC maps, SWI, and MPRAGE. Visual rating scales were applied: MTA, 'Figure 2', GCA, and SVD 'Figure 3'. MoCA scores were obtained for all participants. Statistical analysis was performed using SPSS v29 (IBM). Between-group differences were assessed using one-way ANOVA with Bonferroni post-hoc testing. Correlation with MoCA was evaluated using Spearman's rho. ROC analysis was performed for SVD to assess predictive value for VaD.

Results

Of the 40 participants, 27 were male and 13 were female. The control group comprised 20 participants, while 8 were diagnosed with AD, 8 with VaD, and 4 with mixed dementia.

MTA scores were significantly higher in the AD and mixed dementia groups compared to controls (mean difference + 2.38, $p < 0.001$). 'Table 2'.

Table 2

Multiple Comparisons. Dependent Variable: MTA_SCALE					
Bonferroni					
disease_code	disease_code	Mean Difference	Std. Error	Sig.	95% Confidence Interval
					Lower Bound
alzheimer	control	2.388*	.240	< .001	1.72
	mixed	.875	.348	.100	– .10
	vascular	2.125*	.284	< .001	1.33
control	alzheimer	-2.388*	.240	< .001	-3.06
	mixed	-1.513*	.313	< .001	-2.39
	vascular	– .263	.240	1.000	– .93
mixed	alzheimer	– .875	.348	.100	-1.85
	control	1.513*	.313	< .001	.64
	vascular	1.250*	.348	.006	.28
vascular	alzheimer	-2.125*	.284	< .001	-2.92
	control	.263	.240	1.000	– .41
	mixed	-1.250*	.348	.006	-2.22

SVD scores were significantly higher in VaD and mixed dementia compared to controls mean difference + 5.73, $p < 0.001$) 'Table 3'.

Table 3

Multiple Comparisons. Dependent Variable: SVD_SCALE					
Bonferroni					
disease_code	disease_code	Mean Difference	Std. Error	Sig.	95% Confidence Interval
					Lower Bound
alzheimer	control	– .653	.469	1.000	-1.97
	mixed	-4.375*	.676	< .001	-6.27
	vascular	-5.375*	.552	< .001	-6.92
control	alzheimer	.653	.469	1.000	– .66
	mixed	-3.722*	.611	< .001	-5.43
	vascular	-4.722*	.469	< .001	-6.04
mixed	alzheimer	4.375*	.676	< .001	2.48
	control	3.722*	.611	< .001	2.01
	vascular	-1.000	.676	.891	-2.90
vascular	alzheimer	5.375*	.552	< .001	3.83
	control	4.722*	.469	< .001	3.41
	mixed	1.000	.676	.891	– .90

No significant differences were found for the GCA scale.

MoCA scores showed a significant negative correlation with both MTA and SVD (Spearman rho = – 0.4, $p < 0.05$) 'Table 1', 'Figure 1'.

Table 1

			MoCA
<i>Spearman's rho</i>	MTA SCALE	Correlation Coefficient	– .428**
		Sig. (2-tailed)	.006
		N	40
	GCA SCALE	Correlation Coefficient	– .279
		Sig. (2-tailed)	.081
		N	40
	SVD SCALE	Correlation Coefficient	– .490**
		Sig. (2-tailed)	.001
		N	40

ROC analysis showed that SVD scores strongly predicted VaD with an AUC of 0.85 (95% CI 0.81–0.89).

Discussion

This study demonstrates that MRI visual rating scales provide valuable diagnostic support in dementia subtyping. MTA scores were significantly elevated in AD, consistent with hippocampal atrophy as a hallmark of Alzheimer's pathology [9, 10, 13]. SVD scores were significantly higher in VaD, reflecting the contribution of small vessel ischemic disease, in line with findings from SCANS, RUN DMC, and ASPS studies [14–16]. MoCA correlated negatively with both MTA and SVD, indicating that these imaging markers also reflect clinical severity [17]. In contrast, the GCA scale did not provide discriminatory value, suggesting limited utility in clinical differentiation.

Compared with advanced neuroimaging techniques, visual rating scales are quick, reproducible, and easily applicable in routine radiology practice. They are particularly useful in settings where volumetric analysis or advanced post-processing is not feasible.

Conclusion

Visual MRI rating scales are reliable and clinically useful in dementia imaging. MTA strongly supports a diagnosis of AD, while SVD is more specific for VaD. Both scales correlate with MoCA, linking structural changes to clinical severity. Structured implementation of these scales in radiological reporting can improve diagnostic accuracy and clinical management of dementia patients.

Limitations

This study was limited by a small sample size, particularly within dementia subgroups. It was conducted at a single center using a 1.5T MRI system, which may reduce sensitivity compared to higher field strengths. The mixed dementia group could not be clearly separated using rating scales. Finally, the cross-sectional design did not allow longitudinal assessment of disease progression.

Declarations

Author Contribution

H.A.S. wrote main manuscript
A.N.D.D. reviewed figures and results
A.P. reviewed results
All authors reviewed the manuscript

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Figures

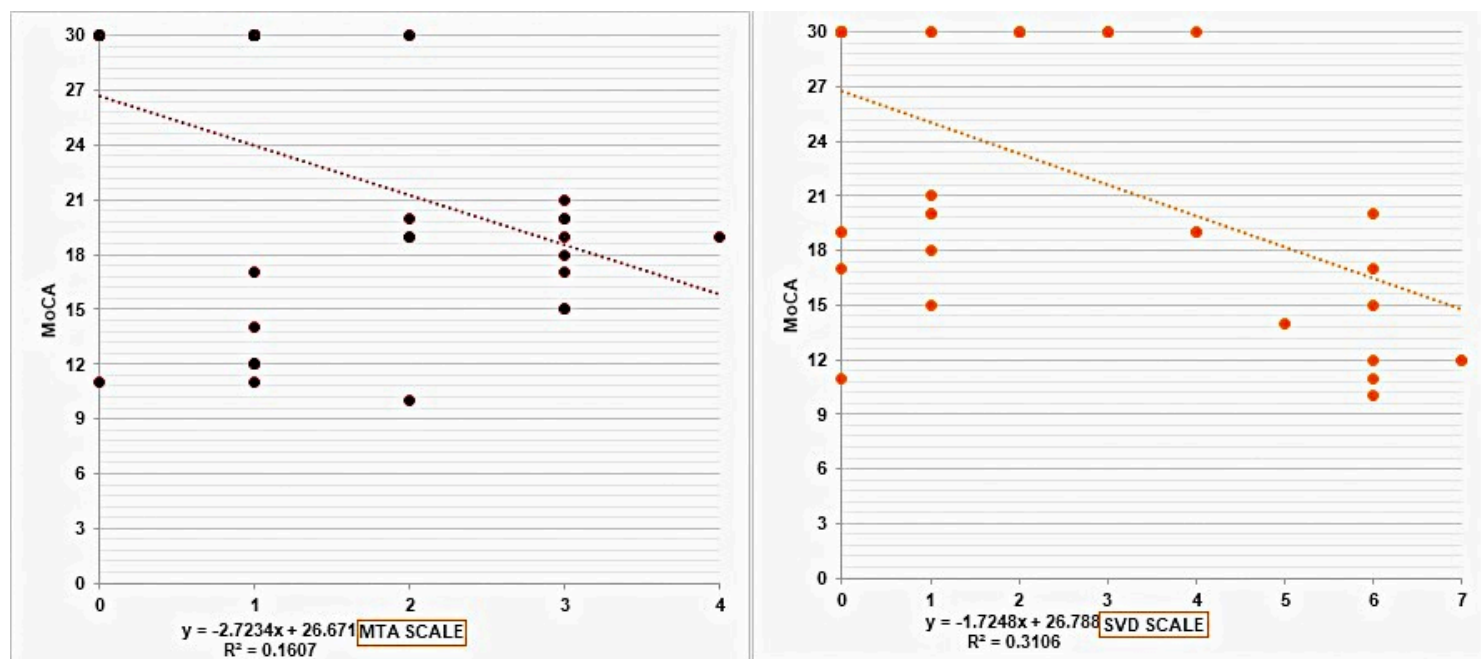


Figure 1

The scatter plots depict the correlation between the clinical score MoCA and the imaging scores MTA and SVD respectively. Individual points represent individual cases.

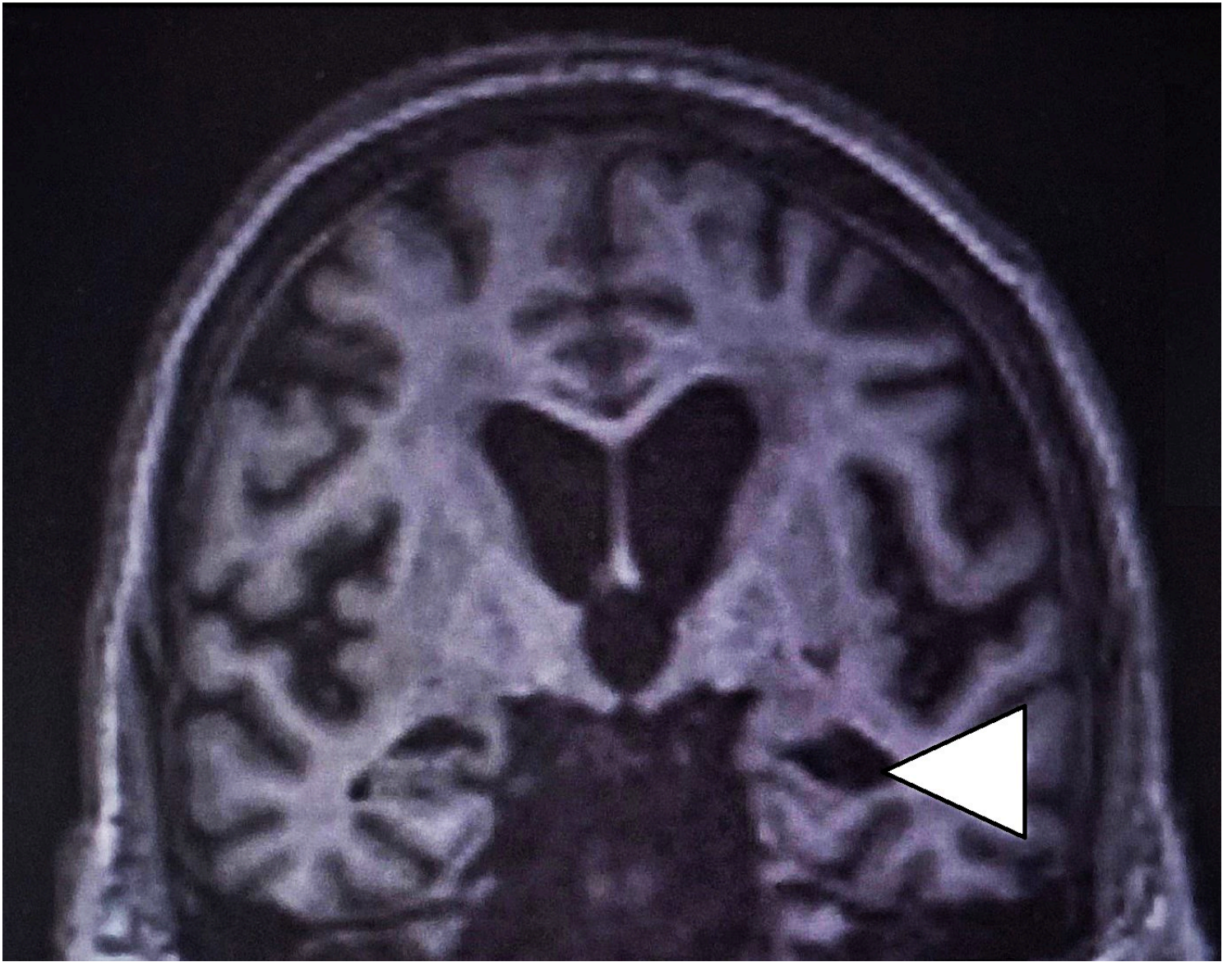


Figure 2

Coronal T1w MPRAGE shows hippocampal atrophy with widened temporal horn on left side.(white arrowhead)-- MTA 3.

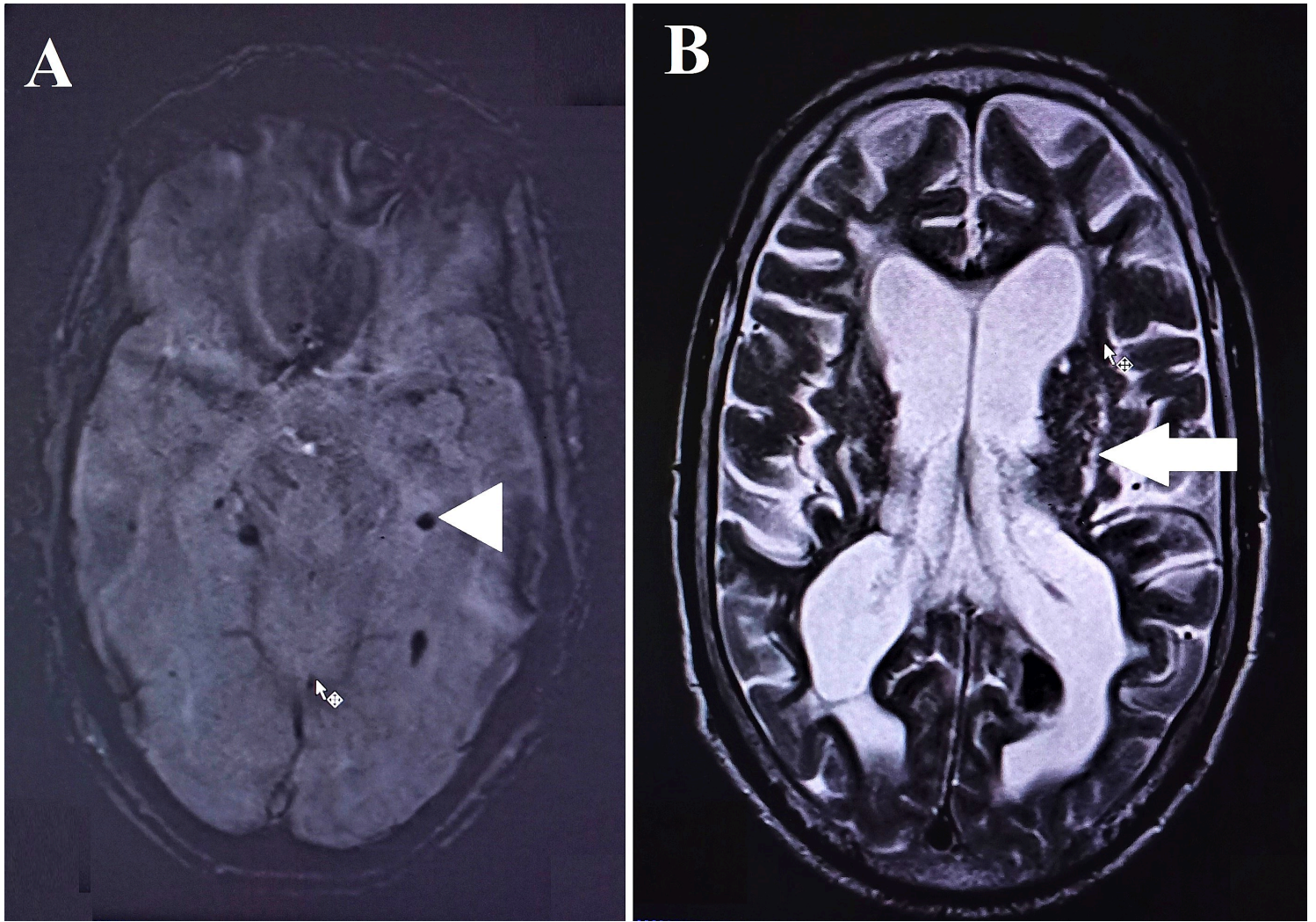


Figure 3

Image A-Axial SWI image shows multiple micro bleeds(*white arrowhead*). Image B-T2w image shows WMH and multiple lacunes(*white solid arrow*).