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Gadopiclenol Maintains Image Quality at a Reduced Gadolinium Dose for Intracranial Vessel and Aneurysm Wall MRI

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Abstract

Background

Intracranial vessel wall MRI (VW-MRI) relies on gadolinium-based contrast agents (GBCAs) to assess cerebrovascular pathologies. Gadopiclenol is a high-relaxivity GBCA that may provide comparable diagnostic performance at half the gadolinium dose of conventional agents. This study compares the contrast enhancement performance of gadopiclenol with standard-dose gadobutrol for intracranial VW-MRI.

Methods

In this retrospective single-center study, patients with cerebral aneurysms underwent VW-MRI using either gadopiclenol (0.05 mmol/kg) or gadobutrol (0.1 mmol/kg). Qualitative image quality was independently assessed using four-point Likert scales for overall image quality, subjective noise, border delineation, and vessel wall morphology. Quantitative analyses included enhancement percentage (EP), lesion-to-background ratio (LBR), aneurysm-to-noise ratio (ANR), and normalized signal intensity (SI). Group comparisons used Wilcoxon rank-sum tests with Bonferroni correction. Mixed-effects models accounted for repeated measures and scanner variability. Inter-reader agreement was assessed using ICC and weighted Cohen's κ.

Results

Baseline characteristics were comparable between groups for all 53 patients and no statistically significant differences were observed between gadopiclenol (n = 26) and gadobutrol (n = 27) groups for any qualitative or quantitative metric after Bonferroni correction. A trend toward improved border delineation with gadobutrol (adjusted $p = 0.094$) and higher LBR with gadopiclenol (adjusted $p = 0.073$) did not reach statistical significance. Mixed-effects models confirmed no significant contrast-agent effect on EP ($p = 0.71$) or normalized SI ($p = 0.34$). Inter-reader agreement was excellent for qualitative image assessment (κ = 0.601–0.947) and good to excellent for aneurysm-specific quantitative metrics (ICC = 0.673–0.805), while background-dependent metrics demonstrated lower reproducibility.

Conclusions

Half-dose gadopiclenol provided image quality and enhancement metrics comparable to standard-dose gadobutrol, supporting its use for intracranial vessel wall MRI while reducing gadolinium exposure.

1. INTRODUCTION

Intracranial vessel wall MRI (VW-MRI) is a versatile imaging technique with multiple applications, including the differentiation of intracranial atherosclerotic disease, vasculitis, reversible cerebral vasoconstriction syndrome, arterial dissection, and other causes of intracranial arterial narrowing, as well as the assessment of intracranial aneurysm instability and rupture risk [1]. Intracranial aneurysms are present in approximately 3% [2] of the population and represent a major cause of subarachnoid hemorrhage in cases of rupture [3]. In recent years, VW-MRI has gained increasing importance as a tool for evaluating aneurysm wall enhancement, which serves as an imaging biomarker of inflammatory activity, wall instability, and potential rupture risk [4]. Consequently, contrast-enhanced VW-MRI is now widely used for the assessment and longitudinal follow-up of patients with unruptured intracranial aneurysms. Given that these patients often require repeated imaging over time, reducing cumulative exposure to gadolinium-based contrast agents (GBCAs) has become an important clinical priority, particularly considering concerns regarding gadolinium retention in human tissues following repeated administration [5–8].

GBCAs play a central role in contrast-enhanced MRI by improving lesion detection and characterization through T1 shortening and increased signal intensity [9]. In VW-MRI, contrast enhancement is particularly important for evaluating aneurysm wall inflammation and instability, which are associated with increased rupture risk [4]. Among currently available GBCAs, macrocyclic agents are preferred due to their higher kinetic stability[10] and lower propensity for gadolinium release. Their higher relaxivity allows comparable diagnostic performance to be achieved with lower gadolinium doses while preserving image quality. These characteristics enable the use of half the standard gadolinium dose without compromising diagnostic efficacy [11–13].

Gadopiclenol is a novel macrocyclic GBCA characterized by high r1 relaxivity and strong thermodynamic and kinetic stability, allowing effective imaging at half the standard gadolinium dose (0.05 mmol/kg). Clinical trials in central nervous system and body MRI, including the PROMISE [14] and PICTURE [15] studies, have demonstrated that gadopiclenol is comparable to standard-dose gadobutrol in terms of lesion visualization while maintaining a favorable safety profile. Although these studies have examined a range of brain and body pathologies, evidence regarding intracranial aneurysm vessel wall imaging remains limited, particularly under routine clinical conditions. Therefore, it remains unclear whether reduced-dose gadopiclenol provides equivalent qualitative and quantitative aneurysm wall enhancement compared with standard-dose gadobutrol.

The purpose of this study was to compare the qualitative and quantitative performance of half-dose gadopiclenol (0.05 mmol/kg; Elucirem®, Guerbet) with standard-dose gadobutrol (0.1 mmol/kg; Gadovist®, Bayer Healthcare) for cerebral arterial and aneurysm wall MRI.

We hypothesized that half-dose gadopiclenol would provide image quality and vessel and aneurysm wall enhancement comparable to standard-dose gadobutrol, supporting gadolinium dose reduction for intracranial wall imaging in routine clinical practice.

2. METHODS

2.1. Study Design and Population

This retrospective single-center study was approved by the institutional review board (IRB) and the ethics committee (XX), and all patients provided informed consent.

The study included consecutive patients with unruptured cerebral aneurysms, between June 2024 and May 2025, who received gadopiclenol (Elucirem, Guerbet) at 0.05 mmol/kg (0.5 mol solution, 0.1 mL/kg) for VW-MRI.

A control group matched for sample size was assembled within the same period from patients scanned for the same indication using gadobutrol (Gadovist/Gadavist, Bayer Healthcare) at 0.1 mmol/kg (1.0 mol solution, 0.1 mL/kg).

MRI acquisitions were performed on three scanners: two Siemens Magnetom Vida Fit systems ($\mathrm{n} = 32$, 60.4%) and one Philips 7700 system ($\mathrm{n} = 21$, 39.6%). The median age of the study population was 61 years [IQR: 49–70].

Inclusion criteria for the study were adult patients over 18 years old, both men and women, who were undergoing follow-up imaging for an untreated unruptured aneurysm without prior treatment.

Exclusion criteria included patients with allergies to contrast agents or renal insufficiency (estimated glomerular filtration rate < 30 mL/min/1.73 m2), pregnant patients, and individuals with prior aneurysm therapy.

2.2. MRI parameters and Image Assessment

All patients underwent imaging on 3 T scanners on Siemens Vida fit 3 T (Siemens Healthineers) and Philips 7700 3 T (Philips Healthcare).

Vessel wall imaging was performed on a 3-T Siemens MAGNETOM Vida Fit scanner2 using a 3D T1-weighted SPACE (Sampling Perfection with Application-optimized Contrasts using different flip-angle Evolutions) dark-blood sequence with the following parameters: TR/TE = 700/12 ms, variable flip-angle refocusing, voxel size = 0.4 × 0.4 × 0.8 mm³, field of view = 190 × 190 mm², matrix = 256 × 256, slice thickness = 0.8 mm, GRAPPA acceleration factor = 2, turbo factor = 38, bandwidth = 630 Hz/pixel, acquisition time = 12 min 22 s.

Vessel wall imaging was performed on a 3-T Philips MRI system using a 3D T1-weighted BrainVIEW black-blood sequence with the following parameters: TR/TE = 700/35 ms, flip angle = 80°, voxel size = 0.75 × 0.75 × 0.75 mm³, field of view = 240 × 240 × 180 mm³, 480 sagittal slices, turbo factor = 35, AI CS-SENSE acceleration factor = 6.4, SPIR fat suppression, receiver bandwidth = 550 Hz/pixel, and acquisition time = 2 min 50 s.

Signal intensity (SI) measurements were performed on native and post-contrast T1 MRI images for three structures: the intradural segment of the internal carotid artery (ICA), the V4 segment of the vertebral artery (VA), and the aneurysm wall. Two radiologists read the images independently: a board-certified neuroradiologist serving as principal reader (MM) whose measurements were used for all primary analyses, and a second reader, a general radiologist trained in neuroradiology (AA) whose measurements were used for inter-reader agreement assessment. The radiologists independently performed the readouts for all patients using the PACS system Dedalus DeepUnity Diagnost 2.0.2.2 (Dedalus Healthcare GmbH).

Quantitative imaging parameters were calculated from ROI-based measurements obtained on native and contrast-enhanced T1-weighted images, as follows: a circular ROI was placed on the enhancing portion of the target vessel or aneurysm wall on post-contrast T1-weighted images and copied to the corresponding pre-contrast image. A reference ROI was placed in normal-appearing contralateral white matter, and a background noise ROI was placed outside the head in an artifact-free region.

2.3. Qualitative Image Analysis

Two independent readers qualitatively assessed the post-contrast images using four image quality criteria: overall image quality, subjective image noise, border delineation, and vessel or aneurysm wall morphology. Each parameter was rated on a 4-point Likert scale (1 = poor, non-diagnostic image quality; 2 = fair, limited diagnostic quality; 3 = good image quality suitable for diagnostic interpretation; 4 = excellent image quality with optimal visualization). Higher scores reflected superior perceived image quality and visualization of anatomical details. Group differences between agents were assessed using Wilcoxon rank-sum tests. Bonferroni correction was applied across the four tests.

2.4. Quantitative Image Analysis

The following quantitative metrics were computed from signal intensity (SI) measurements:

Enhancement Percentage (EP): computed for ICA, VA, and aneurysm wall separately, and as a combined normal vessel average (VA + ICA).

$$\mathrm{EP} = \frac{\mathrm{SI}_{\mathrm{post}} - \mathrm{SI}_{\mathrm{pre}}}{\mathrm{SI}_{\mathrm{pre}}} \times 100$$

Lesion-to-Background Ratio (LBR):

$$\mathrm{LBR} = \frac{\text{Aneurysm } \mathrm{SI}_{\mathrm{post}}}{\text{Background } \mathrm{SI}_{\mathrm{post}}}$$

Aneurysm-to-Noise Ratio (ANR):

$$\mathrm{ANR} = \frac{\text{Aneurysm } \mathrm{SI}_{\mathrm{post}} - \text{Background } \mathrm{SI}_{\mathrm{post}}}{\text{Background SD}}$$

Normalized SI: computed for ICA, VA, and aneurysm wall to correct for inter-scanner variability.

$$\text{Norm SI} = \frac{\text{Structure SI}_{\text{post}}}{\text{WhiteMatter SI}_{\text{post}}}$$

2.5. Statistical analysis

All quantitative metrics were non-normally distributed (Shapiro-Wilk test, $p < 0.05$ in at least one group). Group comparisons were therefore performed using Wilcoxon rank-sum tests, with Bonferroni correction applied separately within three families of tests: EP metrics (3 tests), LBR/ANR metrics (2 tests), and combined normal vessel metrics (2 tests).

Mixed-effects models were additionally fitted to jointly model EP and Normalized SI across the three structures simultaneously, accounting for repeated measurements per patient ($1|\text{patient}$) and scanner effects ($1|\text{scanner}$). Structure was included as a fixed effect.

Inter-reader agreement between MM and AA was assessed on 53 matched patients (matched by date of birth and contrast agent). One patient present in AA but absent from MM was excluded. For LBR and ANR, 12 patients with missing background measurements in AA were additionally excluded, leaving 41 patients for these metrics.

Intraclass correlation coefficients (ICC, two-way agreement, single measures) were computed for all quantitative metrics. Weighted Cohen's kappa was computed for the four qualitative Likert variables.

All analyses were performed in R (version 4.5.3). The key packages used were: lme4 and lmerTest for mixed-effects models, irr for ICC, psych for weighted Cohen's kappa, tableone for descriptive statistics, and ggrain for raincloud plot visualizations.

3. RESULTS

3.1. Baseline Characteristics

The study included 53 patients (26 receiving gadopiclenol, 27 receiving gadobutrol). Median age was 59.5 years [IQR: 48.3–69.8] in the gadopiclenol group and 63.0 years [IQR: 53.5–69.0] in the gadobutrol group. Scanner distribution was similar between groups (Siemens: 57.7% vs 63.0%; Philips: 42.3% vs 37.0%). Full baseline characteristics are presented in Table 1.

Table 1
Baseline characteristics of the study population.

n	Overall	Gadopiclenol	Gadobutrol
	53	**26**	**27**
Age (median [IQR])	61.00 [49.00, 70.00]	59.50 [48.25, 69.75]	63.00 [53.50, 69.00]
Siemens	32 (60.4)	15 (57.7)	17 (63.0)
Philips	21 (39.6)	11 (42.3)	10 (37.0)

3.2. Qualitative Analysis

No statistically significant differences were observed between gadopiclenol and gadobutrol for any of the four post-contrast image quality criteria after Bonferroni correction. Border delineation showed a trend toward higher scores with gadobutrol (median $3\ [2,\ 3.5]$ vs $2\ [2,\ 3]$; $\mathrm{p} = 0.023,\ \mathrm{p}_{\mathrm{adj}} = 0.094$) but did not reach significance after correction. Results are presented in Table 2.

Table 2
Qualitative analysis of post-contrast images. Results are presented as median [IQR]. P-values from Wilcoxon rank-sum test with Bonferroni correction.

Variable	Gadopiclenol	Gadobutrol	p-value	p-adj.
Overall Image Quality	3 [2, 3]	3 [3, 4]	0.069	0.27
Subjective Image Noise	2 [2, 2]	2 [1, 2]	0.79	1.00
Border Delineation	2 [2, 3]	3 [2, 3.5]	0.023	0.094
Vessel or aneurysm wall morphology	3 [2.25, 3]	3 [3, 3.5]	0.31	1.00

3.3. Quantitative Analysis

No statistically significant differences were observed between agents for any quantitative metric after Bonferroni correction. LBR showed a trend toward higher values with gadopiclenol (median $29.05\ [18.43,\ 44.53]$ vs $16.48\ [11.29,\ 28.96]$; $\mathrm{p} = 0.037,\ \mathrm{p}_{\mathrm{adj}} = 0.073$) but did not reach significance after correction. Results are presented in Table 3. Figure 1–3.

Table 3
Quantitative analysis. Results are presented as median [IQR]. P-values from Wilcoxon rank-sum test. Bonferroni correction applied separately within EP metrics (3 tests), LBR/ANR metrics (2 tests), and normal vessel metrics (2 tests).

Variable	Gadopiclenol	Gadobutrol	p-value	p-adj.
EP Carotis (%)	13.25 [-15.72, 44.79]	34 [-25.98, 80.12]	0.59	1.00
EP Vertebralis (%)	35.6 [-7.68, 85.7]	60.53 [21.7, 85.83]	0.34	1.00
EP Aneurysm (%)	29.6 [-13.53, 73.87]	23.81 [4.5, 82.16]	0.73	1.00
LBR	29.05 [18.43, 44.53]	16.48 [11.29, 28.96]	0.037	0.073
ANR	82.08 [51.99, 128.94]	70.52 [55.98, 119.05]	0.58	1.00
EP Normal Vessels (%)	25.11 [-20.11, 77.41]	41.06 [12.89, 74.67]	0.36	0.72
Norm SI Normal Vessels	0.57 [0.46, 0.67]	0.57 [0.42, 0.83]	0.78	1.00

Mixed-effects models confirmed the absence of a significant agent effect on EP ($\widehat{\beta} = 4.09$, $\mathrm{SE} = 11.09$, $\mathrm{p} = 0.71$) and Normalized SI ($\widehat{\beta} = 0.05$, $\mathrm{SE} = 0.06$, $\mathrm{p} = 0.34$). Normalized SI of the aneurysm wall was significantly higher than that of the carotid artery ($\widehat{\beta} = 0.211$, $\mathrm{p} < 0.001$), consistent with expected biological differences between pathological and normal vascular structures. Results are presented in Table 4.

Table 4
Mixed-effects model results. Estimate represents the effect of Gadobutrol vs Gadopiclenol (reference). Models include structure as fixed effect and random effects for patients and scanner.

Model	Estimate	SE	p-value
EP (Enhancement %)	4.089	11.088	0.71
Normalized SI	0.053	0.055	0.34

3.4. Inter-reader Agreement

3.4.1. Quantitative Metrics (ICC)

Inter-reader agreement was good to excellent for aneurysm-specific metrics: $\mathrm{ICC} = 0.673$ $[0.496;\ 0.797]$ for EP aneurysm and $\mathrm{ICC} = 0.805$ $[0.681;\ 0.883]$ for Normalized SI aneurysm. Agreement was poor for EP of the vertebral artery ($\mathrm{ICC} = -0.088$) and for LBR ($\mathrm{ICC} = 0.252$) and ANR ($\mathrm{ICC} = 0.086$), the latter two reflecting the difficulty of consistently measuring background signal intensity. Full ICC results are presented in Table 5.

Table 5
Intraclass Correlation Coefficients (ICC, two-way agreement, single measures) between readers. LBR and ANR based on 41 patients (12 excluded due to missing background measurements in AA).

Variable	ICC	CI95	p-value
EP Carotis (%)	0.441	[0.194; 0.635]	0.0005
EP Vertebralis (%)	-0.088	[-0.356; 0.189]	0.73
EP Aneurysm (%)	0.673	[0.496; 0.797]	< 0.0001
LBR	0.252	[-0.027; 0.504]	0.035
ANR	0.086	[-0.195; 0.366]	0.28
Norm SI Carotis	0.349	[0.100; 0.560]	0.003
Norm SI Vertebralis	0.594	[0.335; 0.759]	< 0.0001
Norm SI Aneurysm	0.805	[0.681; 0.883]	< 0.0001

3.4.2. Qualitative Metrics (Weighted Cohen's Kappa)

Inter-reader agreement for qualitative Likert scores was very good to excellent: border delineation ($\kappa = 0.947\ [0.893;\ 1.000]$), vessel or aneurysm wall morphology ($\kappa = 0.941\ [0.880;\ 1.000]$), and overall image quality ($\kappa = 0.881\ [0.808;\ 0.954]$). Subjective image noise showed moderate agreement ($\kappa = 0.601\ [0.431;\ 0.771]$). Results are presented in Table 6. Figure 4. **and** Fig. 5.

Table 6
Weighted Cohen's Kappa for qualitative post-contrast Likert variables between readers.

Variable	Kappa	CI95
Overall Image Quality	0.881	[0.808; 0.954]
Subjective Image Noise	0.601	[0.431; 0.771]
Border Delineation	0.947	[0.893; 1.000]
Vessel or aneurysm wall morphology	0.941	[0.880; 1.000]

4. DISCUSSION

This retrospective single-center study compared the performance of half-dose gadopiclenol (0.05 mmol/kg) with standard-dose gadobutrol (0.1 mmol/kg) for intracranial vessel wall MRI and aneurysm wall imaging. No statistically significant differences were observed between contrast agents for any qualitative image quality criterion or quantitative enhancement metric. Although trends toward improved border delineation with gadobutrol and higher lesion-to-background ratio with gadopiclenol were

observed, neither reached statistical significance. Overall, these findings show that half-dose gadopiclenol provides image quality and cerebral vessel wall enhancement comparable to standard-dose gadobutrol.

These findings are consistent with the pivotal PROMISE [14] and PICTURE [15] trials, which demonstrated that half-dose gadopiclenol shows comparable performance to standard-dose gadobutrol for contrast-enhanced body and central nervous system MRI. While these studies evaluated lesion visualization in highly standardized prospective settings, our results extend this evidence to intracranial vessel wall MRI, supporting the potential role of gadopiclenol for assessment of vessel wall enhancement. The comparable qualitative and quantitative performance observed in our cohort is likely attributable to the higher relaxivity of gadopiclenol, which compensates for the 50% reduction in administered gadolinium dose [16].

Patients with unruptured intracranial aneurysms undergo long term MRI follow-up, during which vessel wall MRI is increasingly used to monitor aneurysm wall enhancement and instability. Therefore, reducing cumulative gadolinium exposure while maintaining diagnostic performance is an important clinical objective. Our findings suggest that half-dose gadopiclenol may represent a suitable alternative to standard-dose gadobutrol for aneurysm surveillance, potentially reducing gadolinium exposure without compromising image quality. Furthermore, unlike the PROMISE [14] and PICTURE [15] trials, this study reflects routine clinical practice, as examinations were acquired retrospectively on two different 3-T MRI vendor platforms using standard clinical imaging protocols. The comparable performance observed across these heterogeneous acquisition conditions suggests that the benefits of gadopiclenol are applicable beyond tightly controlled research settings.

Cerebral aneurysm wall enhancement (AWE) has been widely investigated as a potential imaging biomarker of aneurysm instability [17], supported by a growing body of evidence linking AWE to inflammatory activity and rupture-prone phenotypes. Multiple retrospective studies have reported a strong association between wall enhancement and aneurysm instability [18], including growth, symptomatic presentation, or rupture [19, 20], although definitions of “instability” have varied considerably across cohorts. For example, early case-control studies demonstrated significantly higher rates of enhancement in unstable compared with stable aneurysms, with meta-analytic data [21] suggesting a markedly increased likelihood of instability in enhancing aneurysms. More recent longitudinal [18] data further support this association, showing that enhancing aneurysms are more likely to exhibit growth over time, whereas non-enhancing aneurysms tend to remain stable. However, despite these consistent trends, the biological and imaging determinants of wall enhancement remain incompletely understood [22], and its predictive value requires further validation in larger prospective studies. In this context, reliable and reproducible vessel wall imaging is essential for the clinical translation of AWE as a biomarker. Our findings support the robustness of intracranial vessel wall MRI by demonstrating comparable qualitative and quantitative aneurysm wall enhancement between half-dose gadopiclenol and standard-dose gadobutrol, suggesting that reduced gadolinium dosing does not compromise the assessment of this potentially important imaging marker (Figure 6. A.).

The images were rated 4 points on the 4-point Likert scale used for qualitative image analysis.

Mixed-effects analyses accounting for repeated measurements within patients and scanner-specific variability confirmed the absence of a significant contrast-agent effect on enhancement percentage and normalized signal intensity. These findings indicate that scanner-related variability did not significantly influence the observed contrast-agent effect and strengthen the robustness of our conclusions. The significantly higher normalized signal intensity observed in aneurysm walls compared with normal intracranial arteries is consistent with the expected biological differences between pathological aneurysm tissue and normal vessel wall, supporting the biological validity of the quantitative measurements [23]. Inter-reader agreement was good to excellent for the qualitative image quality assessments and good to excellent for aneurysm-specific quantitative metrics, particularly enhancement percentage and normalized aneurysm signal intensity, supporting the reproducibility of these measurements. In contrast, lesion-to-background ratio and aneurysm-to-noise ratio demonstrated poor agreement between readers. Both metrics rely on accurate placement of background regions of interest, which can be challenging in intracranial vessel wall imaging because of adjacent cerebrospinal fluid and small anatomical structures [23], and image noise (Figure 6. B.). Consequently, normalized signal intensity and enhancement percentage may represent more robust quantitative biomarkers for future vessel wall MRI studies.

Several limitations should be acknowledged. First, this was a retrospective single-center study with a relatively small sample size, limiting statistical power and generalizability. The assessment of vessel wall enhancement was limited to the intradural internal carotid arteries and V4 segments of the vertebral arteries, where enhancement is predominantly attributed to vasa vasorum. While examinations were performed on two different MRI platforms that could have contributed to potential scanner-related variability, this potential limitation was addressed using mixed-effects modeling.

5. CONCLUSION

Half-dose gadopiclenol (0.05 mmol/kg) provided qualitative image quality and quantitative enhancement comparable to standard-dose gadobutrol (0.1 mmol/kg) for intracranial vessel wall and aneurysm wall MRI. These findings support the use of gadopiclenol as a reduced-dose alternative while maintaining diagnostic performance in terms of image quality and suggest its potential role in reducing cumulative gadolinium exposure in patients requiring serial vessel wall MRI.

Abbreviations

ANR	Aneurysm-to-Noise Ratio
AWE	Aneurysm wall enhancement
EP	Enhancement Percentage

GBCA	Gadolinium-Based Contrast Agent
ICA	Internal Carotid Artery
ICC	Intraclass Correlation Coefficient
IQR	Interquartile Range
LBR	Lesion-to-Background Ratio
MRI	Magnetic Resonance Imaging
SD	Standard Deviation
SI	Signal Intensity
VA	Vertebral Artery
VW-MRI	Vessel Wall Magnetic Resonance Imaging

Declarations

AUTHORSHIP CONTRIBUTION

Conceptualization: RAT, JV, NH, ZK

Data curation: RAT

Formal analysis: MM, AA, RAT, JV

Funding acquisition: do not apply.

Investigation, Methodology: RAT, JV, NH

Project administration: RAT, ZK

Resources: RAT, ZK

Supervision: RAT, NH, ZK

Writing - original draft: RAT, JV

Writing – RAT, JV, MM, AA, NH, ZK

The authors have no conflicts of interest to declare regarding this study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE MANUSCRIPT PREPARATION PROCESS.

Statement: During the preparation of this work the author(s) used ChatGPT to correct grammar and exclude redundant information in the discussions section. After using this tool,the author(s) reviewed and edited the content as needed and take (s) full responsibility for the content of the published article.

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Figures

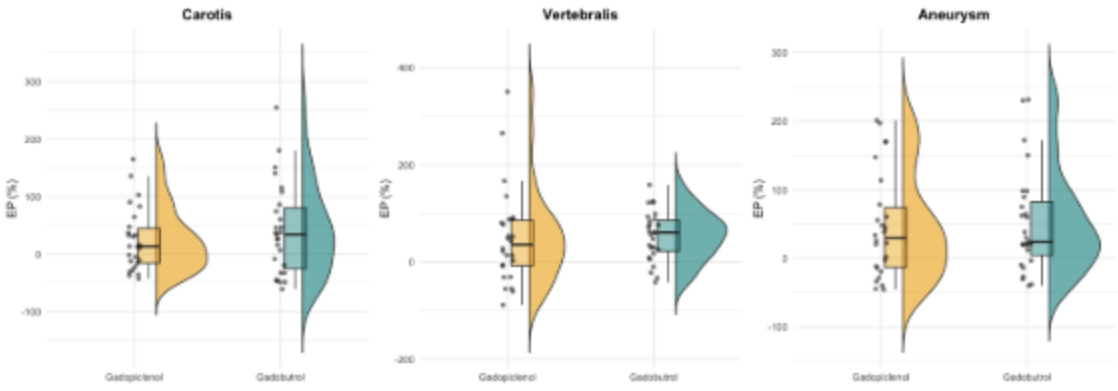


Figure 1

Raincloud plots of Enhancement Percentage (EP) by structure and agent. Yellow: Gadopiclenol; Teal: Gadobutrol.

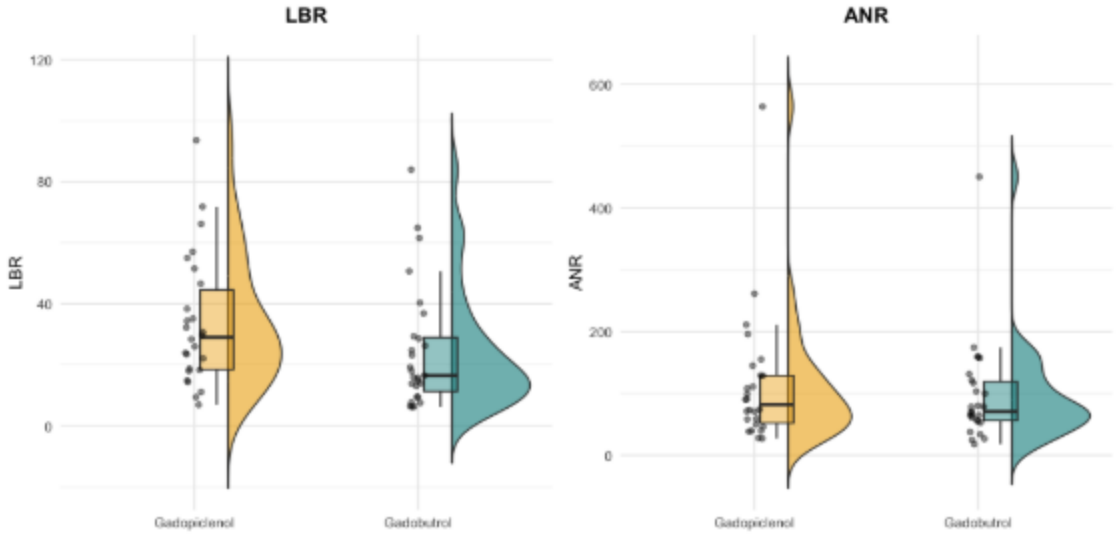


Figure 2

Raincloud plots of Lesion-to-Background Ratio (LBR) and Aneurysm-to-Noise Ratio (ANR) by agent.

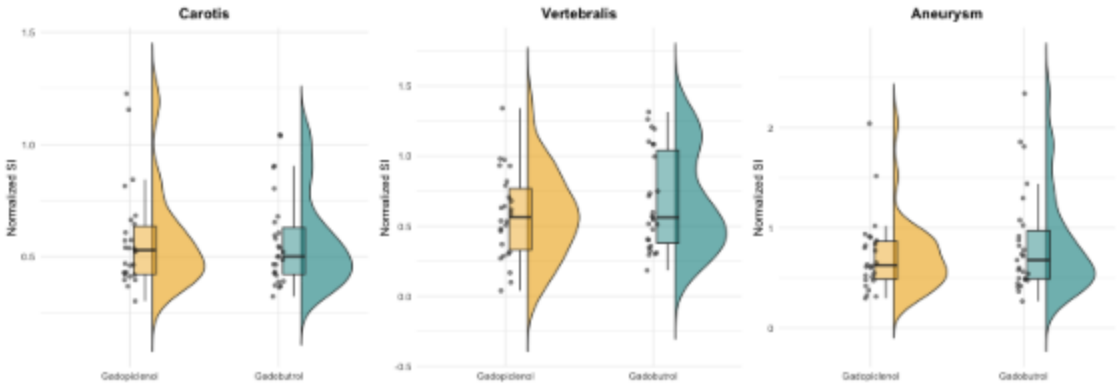


Figure 3

Raincloud plots of Normalized SI by structure and agent.

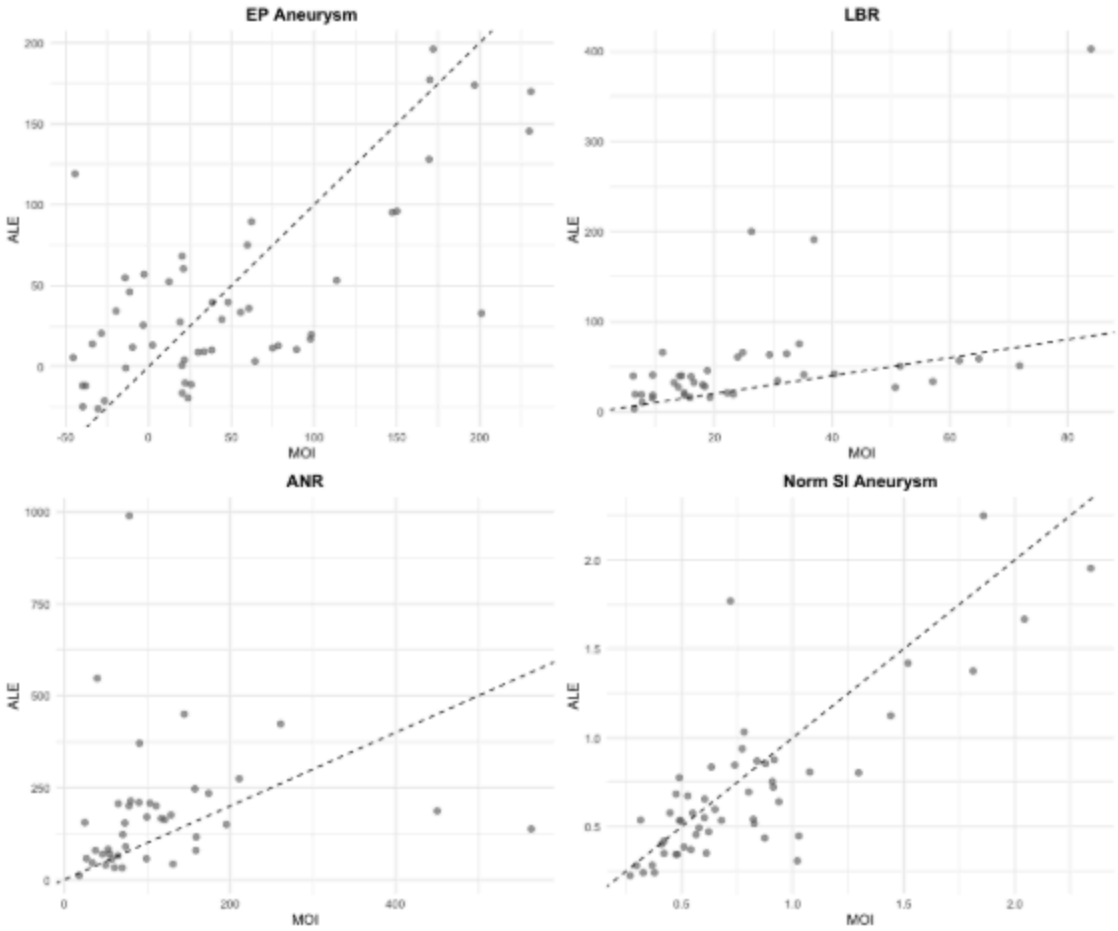


Figure 4

Inter-reader agreement scatter plots for aneurysm metrics. Dashed line: identity line (perfect agreement).

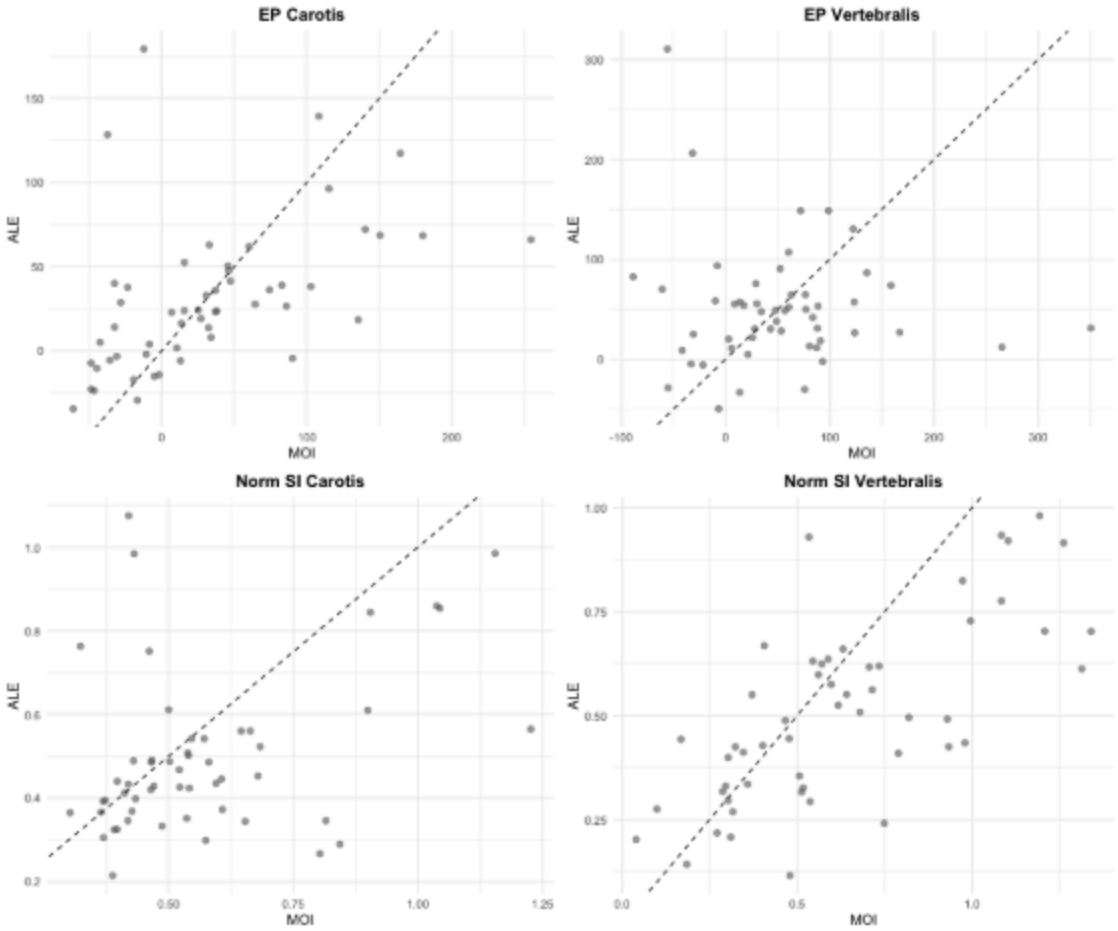


Figure 5

Inter-reader agreement scatter plots for normal vessel metrics. Dashed line: identity line (perfect agreement).

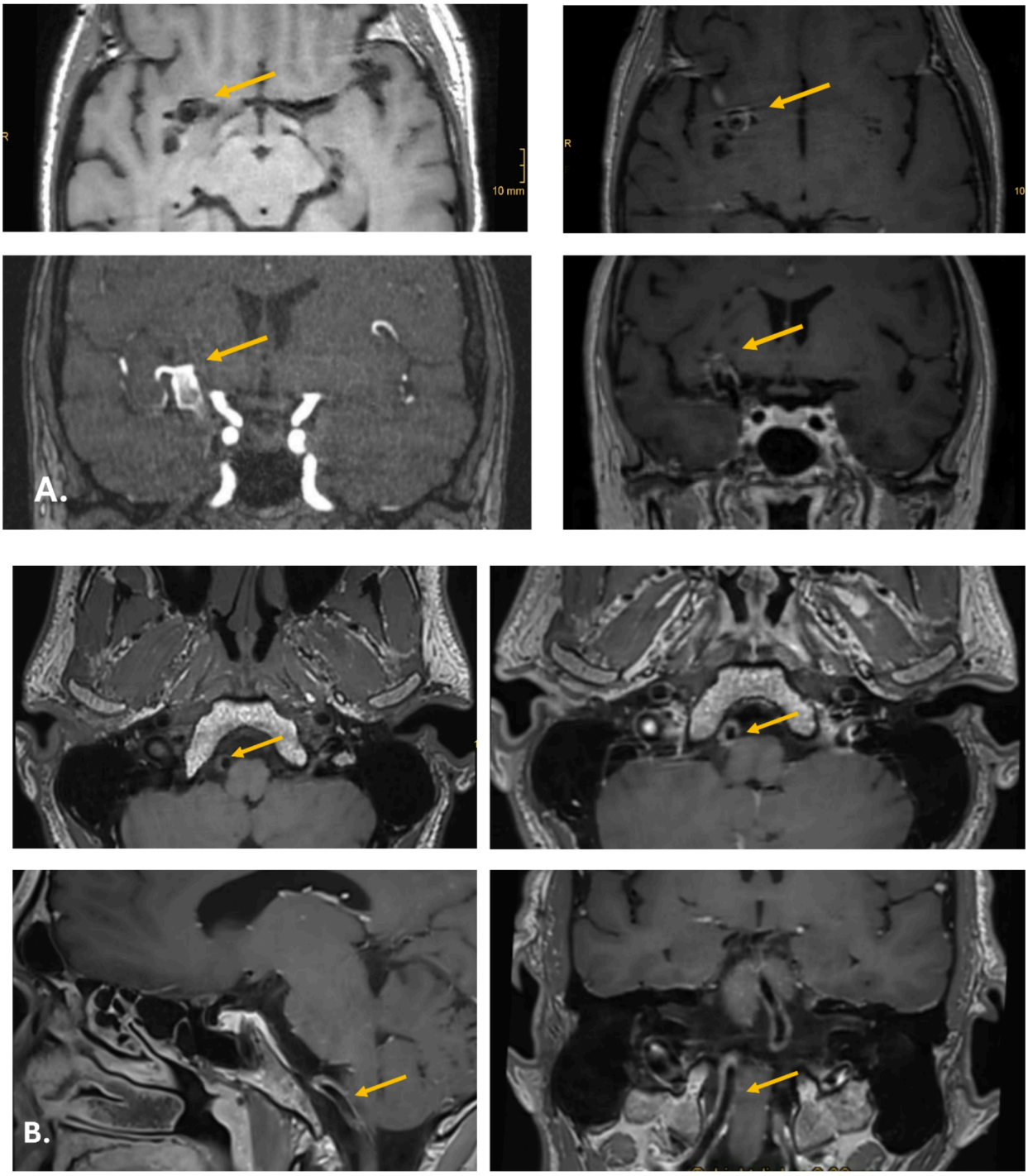


Figure 6

Representative pre- and post-contrast intracranial vessel wall MRI findings obtained at 3 T on a Siemens MAGNETOM Vida Fit scanner using a 3D T1-weighted SPACE black-blood sequence.

A. Right middle cerebral artery aneurysm imaged before contrast administration (upper left), after administration of gadopiclenol at 0.05 mmol/kg (upper right), and with time-of-flight MR angiography

(lower left). The post-contrast image demonstrates aneurysm wall enhancement, a potential imaging marker of aneurysm wall instability.

B. V4 segment of the vertebral artery imaged before contrast administration (upper left) and after administration of gadobutrol at 0.1 mmol/kg (upper right and lower row). Post-contrast enhancement of the vertebral artery wall is compatible with enhancement related to the vasa vasorum.

The images were rated 4 points on the 4-point Likert scale used for qualitative image analysis.