THE ATLANTIC Journal of Medical Science and Research

Atlantic J Med Sci Res 2026;6(1):30-7
DOI: 10.5455/atjmed.2025.12.057

Original Article

Prognostic value of interhemispheric ADC difference in acute large vessel occlusion stroke treated with endovascular therapy

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Received: 28 December, 2025
Accepted: 22 February, 2026
Published: 10 March, 2026

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CITATION
Turkoglu S, Akdeniz H, Gunsoy E, Kurt F. Prognostic value of interhemispheric ADC difference in acute large vessel occlusion stroke treated with endovascular therapy. Atlantic J Med Sci Res. 2026;6(1):30-7. DOI:10.5455/atjmed.2025.12.057

Abstract

Aim: This study aimed to evaluate the prognostic value of absolute interhemispheric ADC differences (ΔADC) in patients with AIS due to large vessel occlusion (LVO) who underwent endovascular therapy (EVT).
Materials and Methods: In this retrospective observational study, 100 patients with acute LVO stroke who underwent endovascular treatment and pre-treatment diffusion-weighted MRI were included. A total of 100 patients (mean age:66.6 years, 95% CI:64.0–69.2; 46% male) with acute ischemic stroke due to large vessel occlusion were retrospectively analyzed. ADC values were measured from infarcted regions and their contralateral homologous areas to calculate ΔADC. Functional outcome at discharge was assessed using the modified Rankin Scale (mRS), and receiver operating characteristic (ROC) analysis was performed to evaluate the predictive performance of ΔADC for poor outcomes (mRS≥5).
Results: The mean ΔADC was 295.7±150.4×10^{-6} mm²/s. Patients with better functional outcomes (mRS 0–4) exhibited consistently higher mean ADC differences (e.g., mRS 4:374.2×10^{-6} mm²/s), whereas those with poor outcomes had notably lower values (mRS 5:211.0; mRS 6:42.0×10^{-6} mm²/s). A significant negative correlation was found between ΔADC and mRS score (r=–0.29, p=0.003). ROC analysis yielded an AUC of 0.75 (p<0.001), with an optimal ΔADC threshold of ≤318×10^{-6} mm²/s (sensitivity: 0.88, specificity: 0.57).
Conclusion: In patients undergoing EVT for acute large vessel occlusion, ΔADC is a simple, reproducible, and treatment-independent imaging biomarker that correlates with short-term functional outcomes. Its integration into clinical stroke imaging protocols may aid early risk stratification.

Keywords: Acute ischemic stroke, large vessel occlusion, endovascular thrombectomy, diffusion-weighted magnetic resonance imaging, apparent diffusion coefficient, interhemispheric asymmetry, stroke outcome prediction

INTRODUCTION

Acute ischemic stroke is a leading cause of death and disability worldwide. Accurate and rapid differentiation between irreversibly infarcted and salvageable brain tissue is critical to guide timely therapeutic interventions such as intravenous thrombolysis or mechanical thrombectomy. Diffusion-weighted magnetic resonance imaging (DWI) and the apparent diffusion coefficient (ADC) have become central to acute stroke imaging due to their sensitivity to early cytotoxic edema (1,2). ADC values decline rapidly within minutes of arterial occlusion, reach their nadir within 24 to 48 hours, and begin to pseudonormalize over the following one to two weeks as infarcted tissue evolves (3).

While visual DWI hyperintensity is commonly used to detect ischemic lesions, quantitative assessment using ADC maps offers more objective insight into the severity of injury. Comparing ADC values between the infarcted area and its contralateral homologous region—an approach known as interhemispheric analysis—provides internal normalization and minimizes inter-patient variability (4). The resulting ADC difference or ratio reflects the physiological impact of ischemia on brain tissue. Studies have shown that larger ADC differences are associated with more severe neurological deficits and worse short-term clinical outcomes (5,6), particularly when minimum ADC values fall below commonly proposed thresholds for infarct core (7).

Beyond acute assessment, interhemispheric ADC differences have been investigated for their prognostic value. Lower ADC

ratios in the acute phase have been correlated with poor functional outcomes at 3 months, as measured by the modified Rankin Scale (8). In some cases, ADC asymmetry has outperformed traditional measures such as infarct volume, particularly when focusing on functionally important regions like the internal capsule or corticospinal tract (9). These observations suggest that ADC-based metrics, especially interhemispheric ratios, may serve as practical and reproducible biomarkers for clinical outcome prediction.

Recent work has also explored the relationship between ADC values and reperfusion success. Specific threshold values have been proposed to differentiate salvageable penumbra from nonviable core, and patients with preserved ADC in diffusion-restricted areas have demonstrated better outcomes after mechanical thrombectomy (10). Conversely, those with severely reduced ADC values may experience poor recovery despite successful recanalization, a phenomenon known as futile reperfusion (11). Integrating interhemispheric ADC differences into routine imaging protocols may enhance patient selection, support clinical decision-making, and ultimately improve individualized stroke management (12). Therefore, this study aimed to evaluate the prognostic value of absolute interhemispheric ADC differences in patients with acute ischemic stroke and to determine their association with short-term functional outcomes.

MATERIALS AND METHODS

Study Design and Setting

This was a retrospective observational study conducted at a tertiary academic stroke center between [2020-2025]. Ethical approval was obtained from the Health Sciences University Van Training and Research Hospital Ethics Committee on March 28, 2025, with approval number 2025.03.18, and the study was conducted in accordance with the principles of the Helsinki Declaration.

Participants

Patients diagnosed with acute ischemic stroke and who underwent diffusion-weighted magnetic resonance imaging (MRI) within the first 24 hours of symptom onset were retrospectively included in the study. A total of 100 consecutive patients meeting the inclusion criteria were selected through convenience sampling from the hospital database. Patients with missing imaging data, inadequate ADC map quality, or incomplete clinical outcome records were excluded.

Inclusion criteria were:(1) age≥18 years, (2) acute ischemic stroke due to anterior circulation large vessel occlusion, (3) baseline diffusion-weighted MRI performed prior to endovascular treatment, and (4) availability of modified Rankin Scale (mRS) score at discharge.

Exclusion criteria included:(1) prior stroke in the same vascular territory, (2) poor-quality MRI images precluding ADC analysis, (3) intracranial hemorrhage on baseline imaging, and (4) incomplete clinical or imaging data.

Data Collection and Variables

Demographic characteristics (age, sex), vascular risk factors (hypertension, diabetes mellitus, atrial fibrillation, coronary artery disease, congestive heart failure, prior stroke, chronic obstructive pulmonary disease), and smoking status were extracted from electronic medical records. Stroke severity at admission was assessed using the National Institutes of Health Stroke Scale (NIHSS), and functional outcome at discharge was recorded using the modified Rankin Scale (mRS). In addition, the type of interventional procedure performed (if any) and the modified Thrombolysis in Cerebral Infarction (mTICI) score were noted for patients who underwent endovascular treatment.

Diffusion MRI and ADC Measurements

All patients underwent diffusion-weighted MRI using a 1.5 Tesla scanner within the first 24 hours of symptom onset. (Siemens Healthineers, Erlangen, Germany). Diffusion-weighted imaging was acquired using b-values of 500 and 1000 s/mm². Apparent diffusion coefficient (ADC) maps were automatically generated by the system. For each patient, a circular region of interest (ROI) was manually placed on the infarct core identified on the ADC map, and a symmetrical ROI of the same size was placed in the corresponding contralateral hemisphere. ADC values from both ROIs were recorded, and the difference was calculated as:ADC difference=Contralateral ADC – Infarct ADC. All measurements were performed by a single radiologist who was blinded to the clinical outcomes (Figure 1).

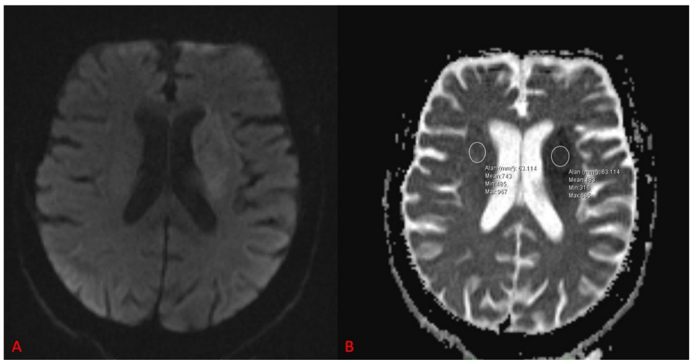

Figure 1. Representative diffusion-weighted magnetic resonance imaging (DWI) and corresponding apparent diffusion coefficient (ADC) map from a patient with acute ischemic stroke. A circular region of interest (ROI) was manually placed within the infarct core on the ADC map (left), and a symmetric ROI of identical size was placed in the contralateral hemisphere (right). These ROIs were used to calculate interhemispheric ADC differences. ADC values are expressed in $\times 10^{-6}$ mm²/s

Interventional Procedures and Recanalization Assessment

Interventional procedures were performed based on clinical and radiological indications in accordance with current stroke management guidelines. Procedures included aspiration thrombectomy, combined aspiration and stent retriever use, or

intravenous tissue plasminogen activator (tPA) administration. Mechanical thrombectomy was performed using a Solitaire™ X stent retriever (Medtronic, USA) when indicated. The type of intervention was categorized as:0=unsuccessful, 1=aspiration only, 2=aspiration + stent retriever, and 3=tPA only. Recanalization success was evaluated using the modified Thrombolysis in Cerebral Infarction (mTICI) score, ranging from 0 (no perfusion) to 3 (complete perfusion), and documented by the interventional radiology team.

Outcome Measures

The primary clinical outcome was functional status at discharge, assessed using the modified Rankin Scale (mRS), which ranges from 0 (no symptoms) to 6 (death). For certain analyses, mRS scores were also dichotomized:an mRS score≥5 was considered an indicator of severe disability or death.

Statistical Analysis

All statistical analyses were performed using Jamovi version 2.6 and Python 3.10. Continuous variables were presented as mean±standard deviation or median with interquartile range, depending on distribution. Categorical variables were summarized as frequencies and percentages. Normality was assessed using visual histograms and the Shapiro–Wilk test.

Group comparisons of ADC differences according to arterial occlusion (e.g., MCAm1) were made using independent samples t-tests. ADC differences across multiple mRS categories were compared using the Kruskal–Wallis test. The diagnostic performance of ADC difference in predicting severe disability (mRS≥5) was evaluated using receiver operating characteristic (ROC) analysis. The optimal threshold for ROC analysis was identified using the Youden index, which maximizes the sum of sensitivity and specificity. The area under the curve (AUC), optimal cut-off values, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. A two-tailed p-value<0.05 was considered statistically significant.

RESULTS

Participant Characteristics

A total of 100 patients with acute ischemic stroke who underwent diffusion-weighted MRI within 24 hours of symptom onset were included. The mean age was 66.6 years, and 54.0% of the patients were female. The most common comorbidities were hypertension (49.0%), diabetes mellitus (31.0%), and atrial fibrillation (15.0%). Interventional procedures were performed in 29.0% of patients using aspiration alone, in 61.0% using combined aspiration and stent retriever, and in 5.0% using intravenous tPA. In 5.0% of cases, the intervention was unsuccessful. Complete recanalization (mTICI 3) was achieved in 65.0% of patients, while partial or no perfusion was observed in the remaining cases (mTICI 2B:15.0%, 2A:4.0%, 1:1.0%, 0:15.0%). The mean ADC value in infarcted areas was 453.7±121.5×10^{-6} mm²/s, compared to 749.4±136.3×10^{-6} mm²/s in the contralateral hemisphere. The mean ADC difference was 295.7±150.4×10^{-6} mm²/s (Table 1).

ADC differences did not significantly differ across treatment groups (aspiration alone, aspiration + stent, tPA, failed intervention; p=0.677). This suggests that the interhemispheric ADC difference reflects tissue injury independently of treatment modality. The mean ADC difference was 312.8±142.1×10^{-6} mm²/s in the mTICI 3 group (n=65) and 263.9±162.0×10^{-6} mm²/s in the mTICI <3 group (n=35)(p=0.121). This suggests that the interhemispheric ADC difference was independent of the degree of reperfusion achieved.

Segmental Arterial Occlusion and ADC Differences

When patients were grouped based on the presence of middle cerebral artery M1 (MCAm1) occlusion, those with occlusion (n=64) had significantly higher ADC differences compared to those without occlusion (n=36) (318.1 vs 255.9×10^{-6} mm²/s, p=0.043). The effect size for this difference was moderate (Cohen's d=0.42) (Table 2). No statistically significant differences were detected in the PCA, ACA A2, and ECA groups; however, interpretation is limited due to small sample sizes.

Functional Outcome and ADC Difference

The distribution of ADC differences across mRS categories is visualized in Figure 2. Patients with favorable functional outcomes (mRS 0–4) exhibited a wide range of ADC difference values, generally clustered above 300×10^{-6} mm²/s. In contrast, patients with poor outcomes (mRS 5–6) showed markedly lower and more compressed ADC differences. A significant negative correlation was found between ADC difference and 90-day mRS score (r=–0.29, p=0.003), indicating that lower interhemispheric ADC differences were associated with worse functional outcomes.

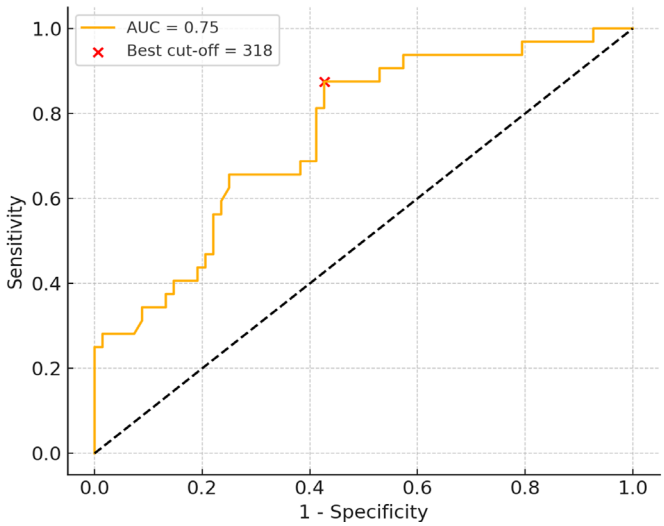

Figure 2. ADC Difference Across mRS Score Groups. Distribution of apparent diffusion coefficient (ADC) differences between the contralateral and infarcted hemispheres across modified Rankin Scale (mRS) categories. Box plots represent the median and interquartile ranges, while individual data points are displayed as scatter plots. A significant difference in ADC values was observed among mRS groups (Kruskal–Wallis H= 18.96, p= 0.004). ADC values are expressed in ×10^{-6} mm²/s. mRS: modified Rankin Scale

Table 1. Baseline demographic, clinical, and imaging characteristics of the study population (N= 100)

n=100	n (%) / mean±SD / median (IQR)	n (%) / mean±SD / median (IQR)
Age means (95% CI)	66.6	(64.0-69.2)
Sex, Female/Male (%)	54/46	(54.0)
NIHSS Score, Median (Q1–Q3)	12	(8-14)
Modified Rankin Scale (mRS), Median (Q1–Q3)	3	(1-5)
Chronic Comorbidities	**n**	**%**
Diabetes Mellitus (DM)	31	31
Hypertension (HT)	49	49
Coronary Artery Disease (CAD)	37	37
Heart Failure (HF)	4	4
Previous Stroke (CVA)	16	16
Coronary Angiography History (CAG)	5	5
Chronic Obstructive Pulmonary Disease (COPD)	4	4
Atrial Fibrillation (AF)	15	15
Current Smoker	4	4
At Least One Chronic Disease Present	77	77
Diffusion MRI Metrics	**Mean**	**SD**
ADC in Infarcted Region (10^{-6} mm²/s)	453.7	± 121.5
ADC in Contralateral Hemisphere	749.4	± 136.3
ADC Difference (Contra – Infarct)	295.7	± 150.4
Detailed mTICI Score Distribution	**n**	**%**
mTICI 0 (No perfusion)	15	15
mTICI 1 (Minimal perfusion)	1	1
mTICI 2A (Partial perfusion <50% of the territory)	4	4
mTICI 2B (Partial perfusion ≥50% of the territory)	15	15
mTICI 3 (Complete perfusion)	65	65
Interventional Procedure	**n**	**%**
Failed procedure	5	5
Aspiration only	29	29
Aspiration + stent retriever	61	61
Intravenous tPA only	5	5

This table summarizes the demographic features, comorbidities, clinical stroke severity scores, and diffusion MRI parameters of the study cohort. Apparent diffusion coefficient (ADC) values are presented as mean ± standard deviation ($\times 10^{-6}$ mm²/s). Stroke severity is represented by NIHSS and mRS scores (median, interquartile range). Interventional procedures and recanalization outcomes (mTICI scores) are reported with full categorical distributions

Table 2. Comparison of mean ADC differences between patients with and without occlusion in specific arterial segments

Occluded Arterial Segment	n	Mean ADC Diff.	SD	md	95% CI		p-value	Effect Size (Cohen's d)
					Lower	Upper		
MCAm1	64	318	152	62.2	0.92	123	0.047	0.420
MCAm3	2	380	183	85	-128	299	0.429	0.568
MCAm4	1	251	NaN	-45.1	-347	256	0.767	NaN
Basilar Artery	8	202	107	-102	-211	6.86	0.066	-0.685
ICAprox	29	279	119	-22.9	-88.8	43.1	0.493	-0.152
ICAtip	9	269	200	-29.3	-134	75.3	0.580	-0.194
ACAA1	3	264	63.5	-32.7	-208	143	0.713	-0.216
ACAA2	2	171	226	-128	-340	85	0.236	-0.851
ECA	2	394	144	100	-113	314	0.353	0.667
CCA	1	496	NaN	202	-96.4	501	0.182	NaN
PCA	1	220	NaN	-76.4	-378	225	0.616	NaN

This table presents the mean differences in apparent diffusion coefficient (ADC) values (contralateral – infarcted hemisphere) between patients with and without occlusion in each listed arterial segment. Data are shown as mean difference (md), standard deviation (SD), 95% confidence intervals (CI), p-values from independent samples t-tests, and effect sizes (Cohen's d). MCAm1 was the only segment showing a statistically significant difference (p= 0.047), indicating greater ADC change in patients with M1 occlusion. Segments with low sample sizes (e.g., MCAm4, ACAA2, PCA) yielded wide confidence intervals and non-significant p-values, limiting the interpretability of those comparisons

The comparison of ADC differences across mRS categories revealed statistically significant variation (Kruskal–Wallis H=18.96, p=0.004). Patients with better functional outcomes (mRS 0–4) exhibited consistently higher mean ADC differences (e.g., mRS 4:374.2×10^{-6} mm²/s), whereas those with poor outcomes (mRS 5–6) had notably lower values (mRS 5:211.0; mRS 6:42.0×10^{-6} mm²/s). These findings suggest that lower ADC difference is associated with worse functional prognosis (Table 3).

Diagnostic Performance of ADC Difference for Predicting Poor Outcome

Receiver operating characteristic (ROC) analysis was performed to evaluate the ability of ADC difference to predict severe functional outcome (mRS≥5). The area under the curve (AUC) was 0.75 (p<0.001), indicating moderate discriminative power. The optimal threshold was determined as ≤318×10^{-6} mm²/s, which yielded a sensitivity of 0.88 and specificity of 0.57. The positive predictive value (PPV) and negative predictive value (NPV) were 0.49 and 0.91, respectively (Figure 3).

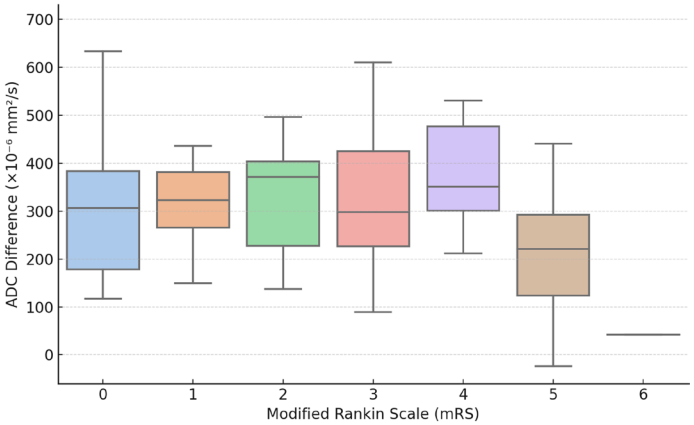

Figure 3. ROC Curve for ADC Difference Predicting Severe Disability or Death (mRS ≥ 5). ROC analysis evaluating the discriminative ability of ADC difference to predict poor functional outcome (mRS ≥ 5). The area under the curve (AUC) was 0.75. The optimal threshold was ≤ 318 ×10^{-6} mm²/s, yielding a sensitivity of 0.88, specificity of 0.57, positive predictive value (PPV) of 0.49, and negative predictive value (NPV) of 0.91. ADC: apparent diffusion coefficient; mRS: modified Rankin Scale

Table 3. Comparison of ADC values across modified rankin scale (mRS) categories

mRS	n	Infarcted Region			Contralateral Hemisphere			Difference		
		Mean	SD	p-value	Mean	SD	p-value	Mean	SD	p-value
0	14	435	116		755	118		320	169	
1	12	475	121		830	107		355	155	
2	19	455	103		784	87		329	111	
3	12	415	104	0.286	738	168	0.009	323	162	0.004
4	11	436	87		810	109		374	110	
5	31	481	147		692	133		211	134	
6	1	267	NaN		NAN	NaN		42	NaN	

Apparent diffusion coefficient (ADC) values in infarcted and contralateral hemispheres, as well as their differences, are presented for each mRS score group. A statistically significant difference in ADC difference was found across mRS categories (Kruskal–Wallis H= 18.96, p= 0.004). ADC values are expressed in $\times 10^{-6}$ mm²/s. SD: standard deviation; mRS: modified Rankin Scale

In multivariable logistic regression analysis adjusting for age and baseline NIHSS score, the interhemispheric ADC difference (ΔADC) remained independently associated with poor functional outcome at discharge (mRS≥5). Specifically, higher ΔADC values were associated with a lower likelihood of severe disability or death. For each 100×10^{-6} mm²/s increase in ΔADC, the odds of poor outcome decreased significantly (adjusted OR 0.54, 95% CI 0.34–0.86; p=0.011). Baseline NIHSS score was also independently associated with outcome, whereas age was not (Table 4).

Table 4. Multivariable logistic regression analysis for poor functional outcome (mRS ≥5 at Discharge)

Variable	Adjusted OR	95% CI	p-value
Age (per year)	1.02	0.99–1.05	0.134
Baseline NIHSS (per point)	1.12	1.02–1.24	0.015
ΔADC (per 100 $\times10^{-6}$ mm²/s increase)	0.54	0.34–0.86	0.011

DISCUSSION

The present study demonstrates that the interhemispheric ADC difference, derived from routine diffusion-weighted MRI, is a significant prognostic biomarker in patients with acute ischemic stroke due to large vessel occlusion. Unlike previous studies focusing solely on infarct-side ADC values, our approach incorporates contralateral hemispheric measurements, providing a normalized and patient-specific metric that may better reflect tissue injury severity. Interhemispheric asymmetry in the apparent diffusion coefficient (ADC) has gained increasing attention as a quantitative imaging biomarker in the evaluation of acute ischemic stroke (AIS). ADC reflects water diffusivity and is highly sensitive to early ischemic changes due to cytotoxic edema. After arterial occlusion, ADC decreases rapidly, reaching its minimum within 24–48 hours before gradually pseudonormalizing over time (2,3). Comparing ADC values between the infarct core and the anatomically homologous region in the contralateral hemisphere allows internal normalization that mitigates inter-individual variability in baseline diffusion values. This principle, first described by van Everdingen et al., showed that normalized lesion ADC values correlated significantly with outcome (4). In our study, we evaluated the absolute interhemispheric ADC difference (ΔADC) as a simple and reproducible parameter derived from a single time point. This approach is feasible with routine diffusion-weighted MRI and does not require complex modeling or post-processing. Our results support the clinical utility of ΔADC in characterizing ischemic injury severity and predicting functional prognosis.

Although both our study and that of Bevers et al. examined interhemispheric diffusion asymmetry in acute ischemic stroke, the methodologies and clinical endpoints differed significantly. While we focused on the absolute difference in ADC values (ΔADC) between hemispheres and its association with short-term functional outcome (measured by the modified Rankin Scale), Bevers et al. investigated changes in ADC signal intensity ratio over time to predict cerebral edema following reperfusion

therapy (8). Their findings showed that patients with lower initial ADC ratios had larger subsequent edema volumes, suggesting that early diffusion restriction correlates with secondary injury processes. However, they did not directly assess clinical disability. In contrast, our results showed that ΔADC values were significantly lower in patients with poor outcomes; yet, this reduction did not always indicate milder infarction. Specifically, in patients with mRS scores of 5–6, ADC values in the infarcted region were comparable to those with mRS 1–4, while ADC values in the contralateral hemisphere were markedly lower. This suggests that a low ΔADC in these cases may not reflect preserved tissue, but rather bilateral injury, pseudonormalization, or underlying white matter pathology. These findings underscore the importance of contextual interpretation of diffusion metrics and support the clinical applicability of ΔADC as a simple, single-time-point prognostic marker.

Our ROC analysis identified an optimal ΔADC threshold of $\leq 318\times10^{-6}$ mm²/s for predicting poor short-term functional outcome (mRS≥5), with an AUC of 0.75. Patients whose ΔADC values fell below this threshold were significantly more likely to experience severe disability or death. Prior studies have proposed various absolute ADC cut-off values to define ischemic core or predict tissue viability—such as 620×10^{-6} mm²/s [10] and 520×10^{-6} mm²/s [12]—but these metrics rely on single-region measurements rather than interhemispheric comparison. While our estimated lesion-side ADC values fall within similar ranges described in the literature, infarct-side ADC alone was not significantly associated with outcome in our cohort. Instead, only ΔADC—reflecting the asymmetry between hemispheres—demonstrated a significant correlation with prognosis. This supports the added value of using interhemispheric difference as a normalized, individualized imaging biomarker.

An important strength of our study is that all MRI scans were obtained prior to the initiation of treatment. Thus, the measured ΔADC values reflect baseline tissue status before any reperfusion intervention. In our cohort, ΔADC did not significantly differ across patients who subsequently received intravenous thrombolysis, stent retriever thrombectomy, aspiration therapy, or conservative management. This indicates that interhemispheric ADC asymmetry is a marker of the inherent severity of ischemic injury, independent of the therapeutic modality applied. Similar findings have been reported in prior studies, where baseline diffusion metrics retained prognostic significance regardless of recanalization status (8). While treatment may alter infarct evolution, ΔADC measured before therapy offers valuable insight into the initial ischemic burden and may serve as a robust tool for early risk stratification.

Limitations

This study has several limitations. First, it was conducted retrospectively at a single center with a relatively small sample size, which may limit the generalizability of the findings. Second, although ΔADC provides a normalized metric, variations in MRI protocols, scanner strength, and post-processing techniques across institutions may affect reproducibility. Third, clinical outcomes were assessed at discharge using the modified Rankin Scale, and longer-term functional status (e.g., at 90 days) was not evaluated. Additionally, our measurements were based on single time-point imaging before treatment; serial ADC assessments could offer deeper insight into lesion evolution and treatment response. ADC measurements were performed by a single radiologist, and interobserver reliability analysis could not be performed. This may limit the reproducibility of the measurements and should be considered when interpreting the results. Finally, while we observed a significant association between ΔADC and short-term outcome, causal inferences cannot be drawn due to the observational design. Prospective, multicenter studies with standardized imaging protocols are needed to validate our findings.

CONCLUSION

In summary, ΔADC represents a practical and individualized imaging biomarker that reflects early ischemic injury severity and correlates with short-term functional outcomes in acute ischemic stroke. By normalizing lesion ADC to the contralateral hemisphere, this metric enhances comparability across patients and reduces variability caused by scanner or anatomical differences. Our identification of a threshold value (318×10^{-6} mm²/s) supports its potential role in clinical risk stratification. Incorporating ΔADC into radiology reports and automated analysis tools could assist in prognosis estimation and therapeutic decision-making. Given its simplicity, reproducibility, and alignment with physiologic asymmetry, ΔADC deserves further validation and consideration in prospective, multi-center stroke trials.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that there is no financial support.

Ethical Approval
The study protocol received approval from the Ethics Committee of Van Training and Research Hospital, Health Sciences University, on (28.03.2025), with approval number (2025.03.18).

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