Early Reperfusion Renormalizes ADC Values in Acute Ischemic Stroke Patients with Endovascular Therapy Compared to IV Thrombolysis Alone

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BACKGROUND

Tissue with apparent diffusion coefficient (ADC)≤600μm^2/s on MRI frequently infarcts despite intravenous thrombolysis (IVT) and has been equated to the ischemic core. Discordantly, such lesions have been seen to reverse following early recanalization with endovascular therapy (EVT).

PURPOSE

We propose that ADC renormalization at 24hr is a potential marker of successful reperfusion, regardless of therapy.

METHODS

INCLUSION CRITERIA

EVT patients were included in this study if they:

1. Were admitted from January 2015 to July 2017
2. Consented to NINDS Natural History of Stroke Study
3. Had imaging evidence of anterior Large Vessel Occlusion (LVO)
4. Were treated with EVT with or without IVT
5. Had baseline MRI pre-EVT and 24hr MRI post-EVT

IVT patients were included in this study if they:

1. Matched to EVT patients based on age, sex, and admit NIHSS
2. Were admitted prior to January 2015
3. Consented to NINDS Natural History of Stroke Study
4. Had imaging evidence of anterior Large Vessel Occlusion (LVO)
5. Were treated with standard IVT only
6. Had baseline MRI pre-IVT and 24hr MRI post-IVT

ANALYSIS

- Early neurologic improvement (ENI) defined as a ≥8-point decrease or a 0-1 value at 24hr NIHSS
- ADC ratios (baseline, 24hr) calculated by dividing the signal intensity ADC values defined using the DWI lesion regions by the corresponding contralateral regions
- ADC renormalization defined as an ADC ratio ≥0.8 at 24hr
- Complete reperfusion defined at 24hr by resolution of ≥90% of baseline perfusion lesion on MRI
- Nonparametric tests and descriptor statistics performed using IBM SPSS Statistics v19

RESULTS

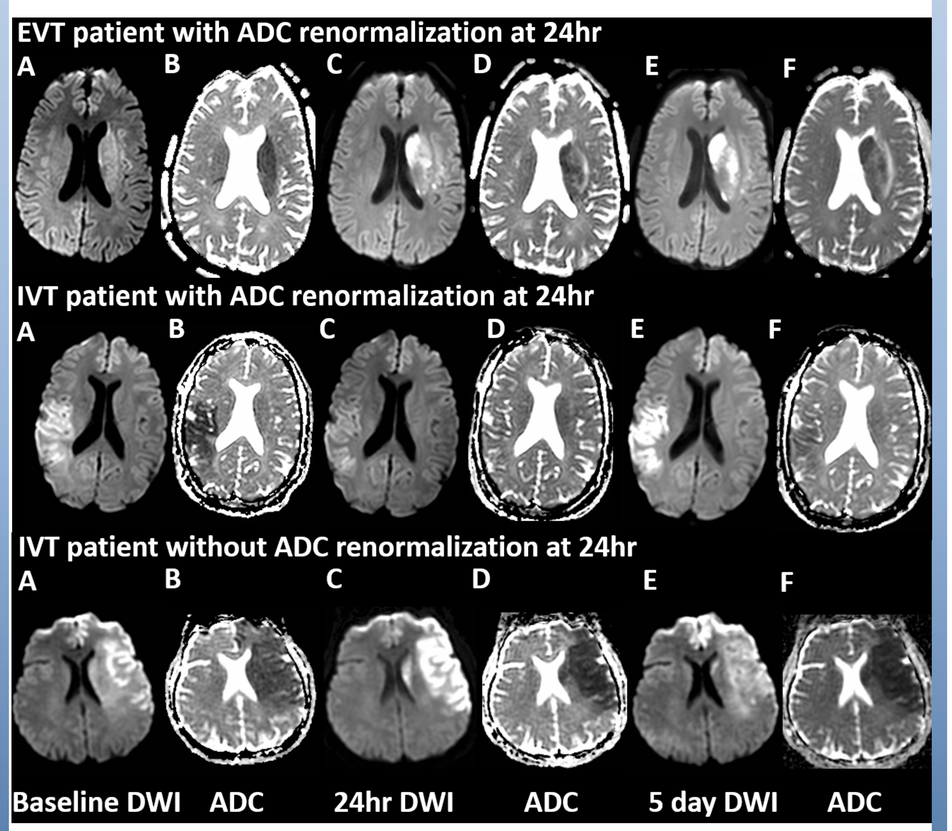

Figure 1. Top panel: EVT patient, 54-year-old male presenting 2 hours from onset, admit NIHSS 23, baseline DWI volume 26mL (A) and ADC positive (B), treated with IV tPA within 60 minutes from triage at outside hospital, transferred and received EVT within 90 minutes of triage at transfer hospital. TICI score of 3, complete reperfusion, renormalization of 24hr ADC (D), ENI with 24hr NIHSS of 8, and 24hr and 5 day DWI volumes 30mL (C) and 34mL (E) with 5 day ADC (F).
Middle panel: IVT patient, 45-year-old female presenting 2 hours from onset, admit NIHSS 17, baseline DWI volume 46mL (A) and ADC positive (B), treated with standard IV tPA 70 minutes from triage at the hub hospital, complete reperfusion at 24hr and renormalization of 24hr ADC (D), ENI with 24hr NIHSS 8, and 24hr and 5 day DWI volumes 28mL (C) and 44mL (E) with 5 day ADC (F).
Bottom panel: IVT patient, 59-year-old female presenting 39 minutes from onset, admit NIHSS 22, baseline DWI volume 143mL and ADC positive (B), treated with standard IV tPA 69 minutes from triage at the hub hospital, no reperfusion or renormalization of 24hr ADC (D), no ENI with 24hr NIHSS of 22, and 24hr and 5 day DWI volumes 135mL (C) and 111mL (E) with 5 day ADC (F).

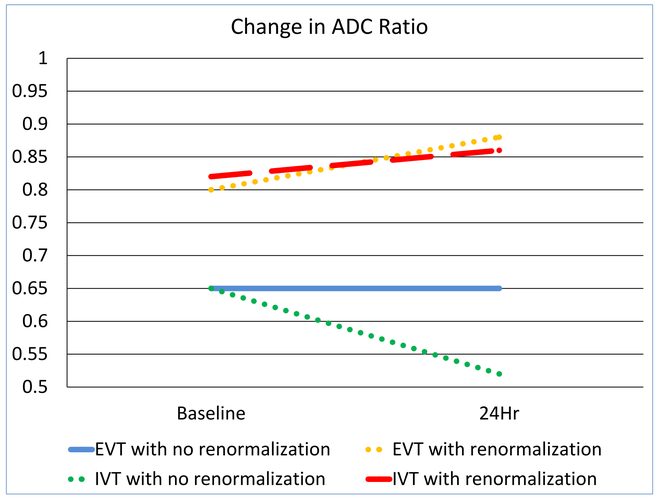

Figure 2. The change in ADC ratio from baseline to 24hr across four groups.

RESULTS

- There were no differences between the EVT and IVT patients (N=25 per group) in age (66 vs 65 yr, p=0.92), ethnicity (60% vs 52% Black\African American, p=0.57) or admit NIHSS (19 vs 17, p=0.67)
- Baseline median DWI volumes, 25mL vs 46mL (p=0.95), baseline ADC values, 639 vs 590 (p=0.37), and baseline ADC ratios, 0.76 vs 0.76 (p=0.84), were also comparable in the EVT vs IVT patients
- At 24hr MRI, 77% of EVT patients achieved complete reperfusion vs 38% of IVT patients (p=0.017) [Figure 1]
- At 24hr MRI, 63% of IVT patients with renormalization achieved complete reperfusion vs only 13% of IVT patients without renormalization (p=0.046) [Figure 1]
- Median ADC values at 24hr demonstrated significant renormalization in the EVT vs IVT patients, 703 vs 526 (p=0.013) [Figure 2]
- The 12 EVT patients with renormalization achieved ENI 67% of the time in comparison to 9 IVT patients with renormalization who achieved ENI 63% of the time (p=0.85)
- None (0%) of the IVT patients without renormalization achieved ENI (p=0.046)
- At 5 days, the infarct volumes were still significantly smaller in the 9 IVT patients with renormalization, 26mL vs 125mL (p=0.017) in the 16 patients without renormalization

CONCLUSIONS

- Renormalization of ADC values is seen more frequently in patients following EVT than IVT.
- Successful reperfusion was more prevalent in EVT patients with or without ADC renormalization compared to IVT patients.
- However, if ADC renormalization by 24hr was achieved in IVT patients, this significantly correlated with early neurological improvement and attenuated infarct growth.

ACKNOWLEDGEMENTS

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