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CASE REPORT

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Increased intracranial blood flow velocity following mechanical thrombectomy in treatment of acute stroke precedes reocclusion

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Abstract

Rising numbers of mechanical thrombectomies in treatment of acute stroke emphasize the need for appropriate follow-up to identify potential complications in time. Recent findings suggest that abnormal hemodynamics post-recanalization are associated with worse outcomes. Here, we present the case of a patient who exhibited an increased blood flow velocity on transcranial color-coded duplex sonography (TCCD) following endovascular intervention shortly before suffering a reocclusion of the recanalized vessel. Our example shows that TCCD may serve as a valuable tool for detecting patients at risk for secondary vascular events after mechanical thrombectomy.

KEYWORDS
intracranial blood flow velocity, ischemic stroke, mechanical thrombectomy, neurosonography

1 | INTRODUCTION

The number of mechanical thrombectomies performed after acute stroke due to large vessel occlusion continues to increase. This circumstance emphasizes the importance of identifying potential complications in time.

Here we present the case of a male octogenarian who was admitted to our stroke center with an occlusion of the left middle cerebral artery (MCA). After the vessel had been successfully recanalized, transcranial color-coded duplex sonography (TCCD) showed a drastically increased blood flow velocity (BFV) along the former site of intervention. Shortly thereafter, the patient presented with new symptoms. Magnetic resonance (MR) angiography revealed a reoccluded left MCA, and another successful thrombectomy was performed. During follow-up, BFVs gradually returned to normal, and the patient was discharged with only mild residual deficits.

This case highlights the potential usefulness of TCCD as a readily available tool for the timely identification of complications after mechanical thrombectomy. Similar observations have been made by a handful of recent studies. However, more data is needed to establish a definite protocol for sonographic follow-up after endovascular recanalization.

2 | CASE DESCRIPTION

An 84-year-old man was initially admitted to another hospital with acute right-sided hemiparesis and non-fluent aphasia (NIHSS 15 points). CT angiography showed an occlusion of the left MCA in its M1 segment. Prior medication consisted of antihypertensive and lipid-lowering drugs as well as acetylsalicylic acid. After intravenous administration of 81 mg of recombinant tissue plasminogen activator for systemic thrombolysis, the patient was transferred to our stroke center for mechanical thrombectomy. Successful recanalization was achieved 5 h after onset of symptoms (thrombolysis in cerebral infarction scale = TICI 3) (Figure 1A).

The patient improved markedly (NIHSS 1 point). A subsequent MRI scan 3 days after intervention revealed a small number of dotted ischemic lesions in the territory of the left MCA (Figure 1B). In

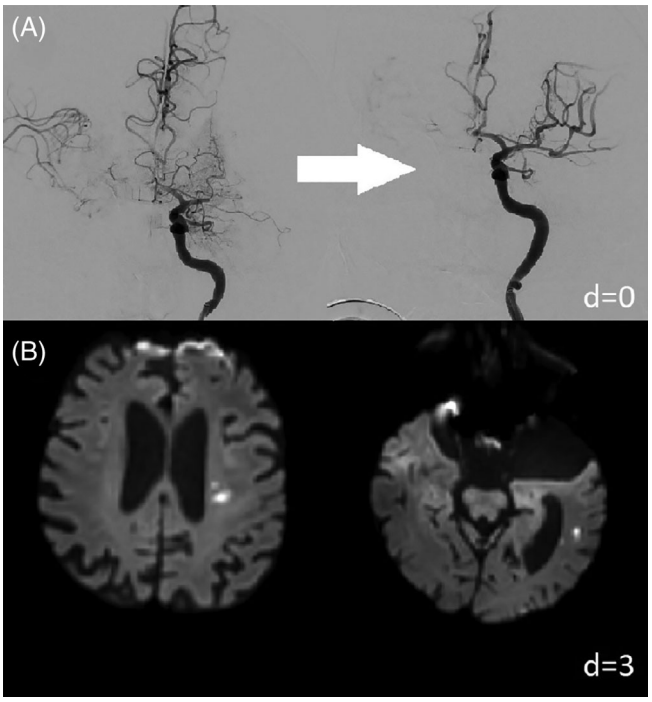

FIGURE 1 (A) Successful recanalization of the left middle cerebral artery (MCA) in its M1 segment 5 h after onset of symptoms (digital subtraction angiography [DSA] before and after intervention). (B) Diffusion-weighted imaging revealing small ischemic lesions in the territory of the left MCA

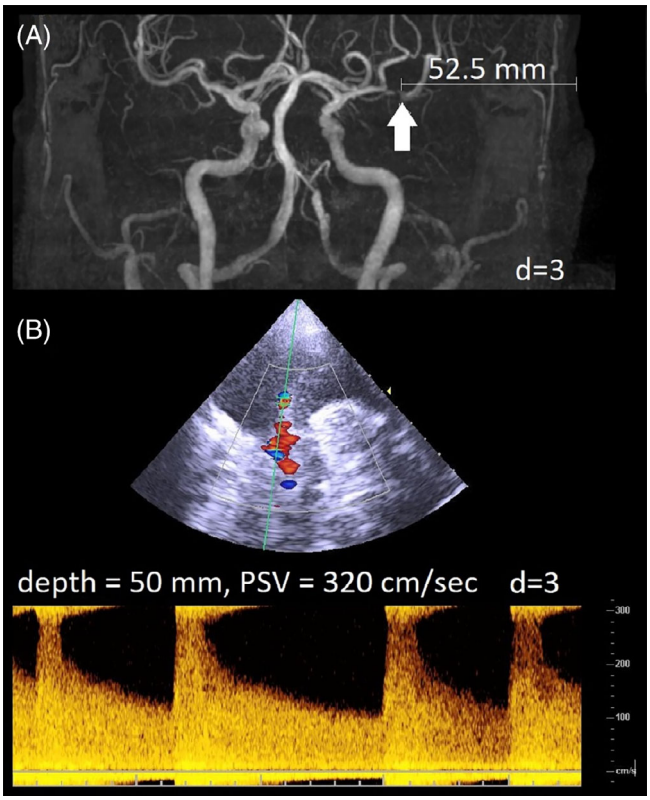

FIGURE 2 (A) Time-of-flight (TOF) magnetic resonance (MR) angiography showing vascular irregularities at the former recanalization site 3 days post-thrombectomy. (B) Increased blood flow velocity (BFV) in the left middle cerebral artery (MCA) was measured by transcranial color-coded duplex sonography (TCCD) 3 days after mechanical recanalization

addition to this, time-of-flight (TOF) MR angiography showed vascular irregularities at the former site of recanalization. However, no occlusion was observed (Figure 2A). A first control via TCCD the same day showed a peak systolic velocity (PSV) of more than 300 cm/s along the distal M1 segment of the left MCA (Figure 2B). The mean BFV index was ~3.2, which is defined as:

$$\text{Mean BFV index} = \frac{\text{Recanalized MCA mean BFV}}{\text{Contralateral MCA mean BFV}}$$

Based on the pathologic MRI and TCCD findings, prolonged monitoring in our stroke unit was indicated. During a follow-up TCCD the next day (i.e., 4 days post-thrombectomy), comparably increased BFVs were observed.

Shortly after the second sonographic examination, the patient again developed symptoms of global aphasia. Immediate cranial MRI with MR angiography revealed a reoccluded left MCA, this time at the M1/M2 transition (Figure 3A). Another thrombectomy was performed successfully (TICI 3) in conjunction with stenting of the vertical M2 segment (Figure 3B). The latter was necessitated by an immediate and drastic reduction of blood flow upon removal of the stent retriever. Clopidogrel was added to the anti-platelet therapy with acetylsalicylic acid. Again, the patient exhibited a complete remission of symptoms after endovascular intervention.

During cardiac monitoring in our stroke unit, atrial fibrillation was newly diagnosed and deemed the most likely cause of the first ischemic event. We initiated oral anticoagulation with apixaban 8 days after the second ischemic event. Although the combination of two anti-platelet drugs and an oral anticoagulant can increase the risk of bleeding, the patient's CHA2DS2-VASc-Score of 6 necessitated this decision in our eyes. Antiarrhythmic agents were not given as no tachycardia was observed and the patient's cardiac output was adequate. To complete our diagnostic work-up, transthoracic echocardiography was performed, which showed low degree mitral and tricuspid insufficiency without any indication of relevant functional problems. The second occlusion of the left MCA was hypothesized to be a consequence of complicative intracranial dissection following mechanical thrombectomy. This was based on our MRI and sonographic as well as angiographic findings, where the vessel appeared irregular at the reocclusion site. A follow-up MRI scan 5 days after the second thrombectomy revealed two small new ischemic lesions in the flow territory of the left MCA. TCCD on day 1 and 2 after the second intervention both measured a PSV of around 250 cm/s in the left MCA with a mean BFV index of 2.5 (Figure 3C). These values decreased steadily over the following days with a PSV of 130 cm/s and a mean BFV index of 1.4 just before discharge. Medication with clopidogrel was terminated 7 months later when a stable vascular situation was observed on control TCCD.

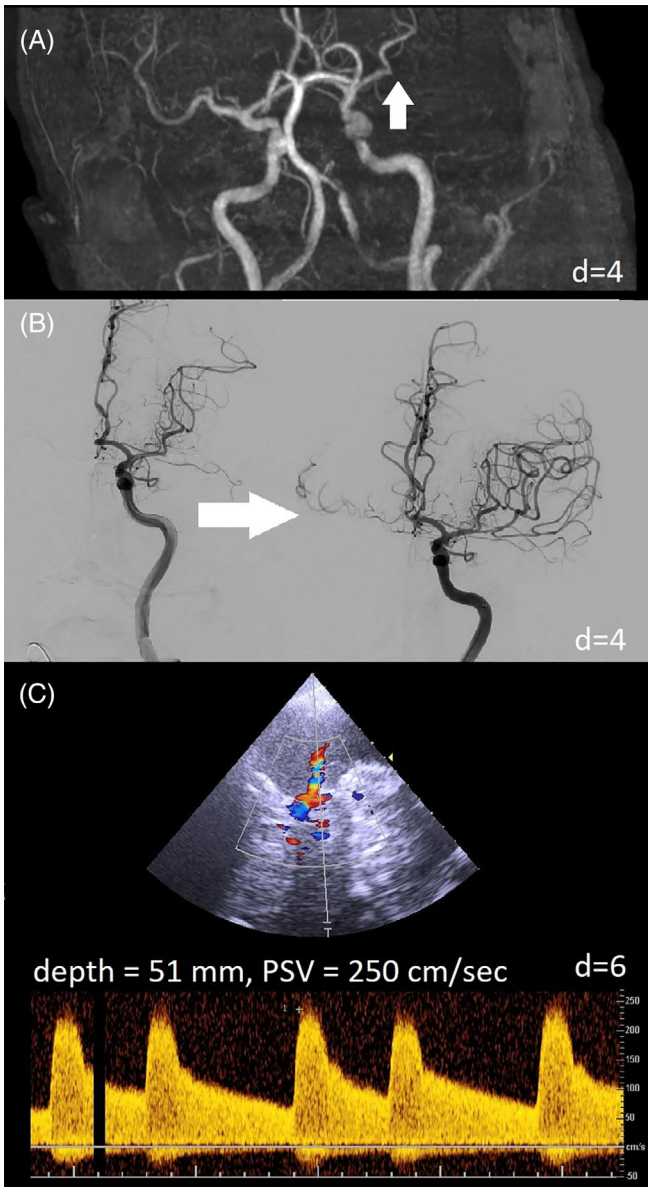

FIGURE 3 (A) Reocclusion of the left middle cerebral artery (MCA) (at the M1/M2 transition) was revealed by time-of-flight (TOF) magnetic resonance (MR) angiography with the patient developing symptoms of global aphasia 4 days after the initial thrombectomy. (B) A second successful mechanical thrombectomy (in conjunction with stenting) was performed (digital subtraction angiography [DSA] before and after intervention). (C) Transcranial color-coded duplex sonography (TCCD) 2 days after the second thrombectomy (and 6 days after initial onset of symptoms) showing increased blood flow velocity (BFV) along the left MCA

3 | DISCUSSION

In this case of a patient with a secondary ischemic event following mechanical thrombectomy, intracranial dissection was assumed as the underlying pathology of this second event based on a combination of digital subtraction angiography (DSA), MR angiography and TCCD findings after the initial recanalization procedure. Bolstering these assumptions, recent studies have identified intracranial intimal lesions after thrombectomy as a potential cause of recurrent large vessel occlusion.[1]

The combination of angiographic and, above all, TCCD findings after recanalization led to a change in the usual protocol with intensified monitoring in our stroke unit. This departure from standard procedure allowed for the earlier detection of a reocclusion in the recanalized vessel and consequently facilitated appropriate treatment.

With increasing numbers of recanalizing therapy in the treatment of acute stroke, the value of follow-up TCCD examinations is being investigated in multiple studies. The velocity ratio between the recanalized and the contralateral arterial segment emerged as an independent predictor of clinical outcome after mechanical thrombectomy, with abnormal hemodynamics indicating a worse prognosis.[2,3] Similarly, increased BFV in the recanalized vessel was associated with a higher risk of intracranial hemorrhage.[4] De novo stenosis after endovascular intervention, in itself a comparatively rare event, was associated with increased PSV in the recanalized vessel and could be detected with TCCD post-thrombectomy and during follow-up.[5]

While the studies mentioned were in general agreement about the benefit of routine TCCD following mechanical thrombectomy in identifying potential complications via increased BFV, the actual velocities measured differed quite markedly. One explanation for this fact might be the respective time points at which TCCD after thrombectomy was performed.[6] So far, there is insufficient data to establish a definite protocol for sonographic follow-up after endovascular recanalization. However, our case report and literature review emphasize that routine TCCD after thrombectomy may facilitate early identification of potential complications. Given the widespread and rapid availability of TCCD, its routine use following mechanical thrombectomy is a topic well worth further investigation in future studies.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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REFERENCES

1. Ikenberg B, Rösler J, Seifert CL, et al. Etiology of recurrent large vessel occlusions treated with repeated thrombectomy. *Interv Neuroradiol*. 2020;26:195-204.
2. Kneihsl M, Niederkorn K, Deutschmann H, et al. Abnormal blood flow on transcranial duplex sonography predicts poor outcome after stroke thrombectomy. *Stroke*. 2018;49:2780-2782.

3. Baracchini C, Farina F, Palmieri A, et al. Early hemodynamic predictors of good outcome and reperfusion injury after endovascular treatment. *Neurology*. 2019;92:2774-2783.
4. Kneihsl M, Niederkorn K, Deutschmann H, et al. Increased middle cerebral artery mean blood flow velocity index after stroke thrombectomy indicates increased risk for intracranial hemorrhage. *J Neurointerv Surg*. 2018;10:882-887.
5. Ikenberg B, Scharsich B, Mönch S, et al. Neurosonography after mechanical thrombectomy for acute stroke treatment. *J Neuroimaging*. 2019;29:364-370.
6. Gattringer T, Niederkorn K, Ikenberg B, Enzinger C, Kneihsl M. Reader response: early hemodynamic predictors of good outcome and reperfusion injury after endovascular treatment. *Neurology*. 2020;94:801-802.

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