



## Two Cases of Posterior Cerebral Artery P2 Segment Occlusion with Motor Weakness Improved by Acute Mechanical Thrombectomy

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### Key words

- Acute mechanical thrombectomy
- Motor weakness
- Posterior cerebral artery occlusion

### Abbreviations and Acronyms

**AIS:** Acute ischemic stroke  
**DWI:** Diffusion-weighted imaging  
**FLAIR:** Fluid-attenuated inversion recovery  
**IV tPA:** Intravenous tissue plasminogen activator  
**MRA:** Magnetic resonance angiography  
**MT:** Mechanical thrombectomy  
**NIHSS:** National Institutes of Health Stroke Scale  
**P2O:** P2 segment occlusion  
**PCA:** Posterior cerebral artery  
**SVS:** Susceptibility vessel sign  
**TGA:** Thalamogeniculate artery

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### INTRODUCTION

Acute ischemic stroke (AIS) due to posterior cerebral artery (PCA) occlusion is rare, accounting for 0.5% of all AIS cases.<sup>1</sup> Several randomized controlled trials published after 2015 proved the effectiveness of mechanical thrombectomy (MT) in AIS due to large vessel occlusion,<sup>2</sup> but the indications for and effectiveness of MT for PCA occlusion, including PCA P2 segment occlusion (P2O), have remained controversial. A case of P2O with severe motor deficit was reported,<sup>3</sup> but to our knowledge there have been no similar reports in which MT contributed to improvement of hemiplegia owing to P2O. We present 2 cases of P2O with hemiplegia that were improved by acute MT.

■ **BACKGROUND:** Clinical evidence to support the use of mechanical thrombectomy (MT) for posterior cerebral artery P2 segment occlusion (P2O) has not been established, and hemiplegia due to P2O improved by MT to our knowledge has not yet been reported. We report 2 cases of P2O with hemiplegia improved by MT.

■ **CASE DESCRIPTION:** In case 1, a 68-year-old man was admitted with right hemiplegia and dysesthesia (National Institutes of Health Stroke Scale score 14). Head magnetic resonance imaging showed acute ischemia in the left inferolateral thalamus and posterior limb of the internal capsule. Angiography showed left P2O, which was recanalized after MT. Hemiplegia improved immediately following recanalization, and modified Rankin Scale score at discharge was 0. In case 2, a 69-year-old man was admitted with left hemiplegia and dysesthesia (National Institutes of Health Stroke Scale score 8). Head magnetic resonance imaging showed acute ischemia in the right inferolateral thalamus and posterior limb of the internal capsule. Angiography showed right P2O, which was recanalized after MT, as in case 1. His symptoms resolved completely.

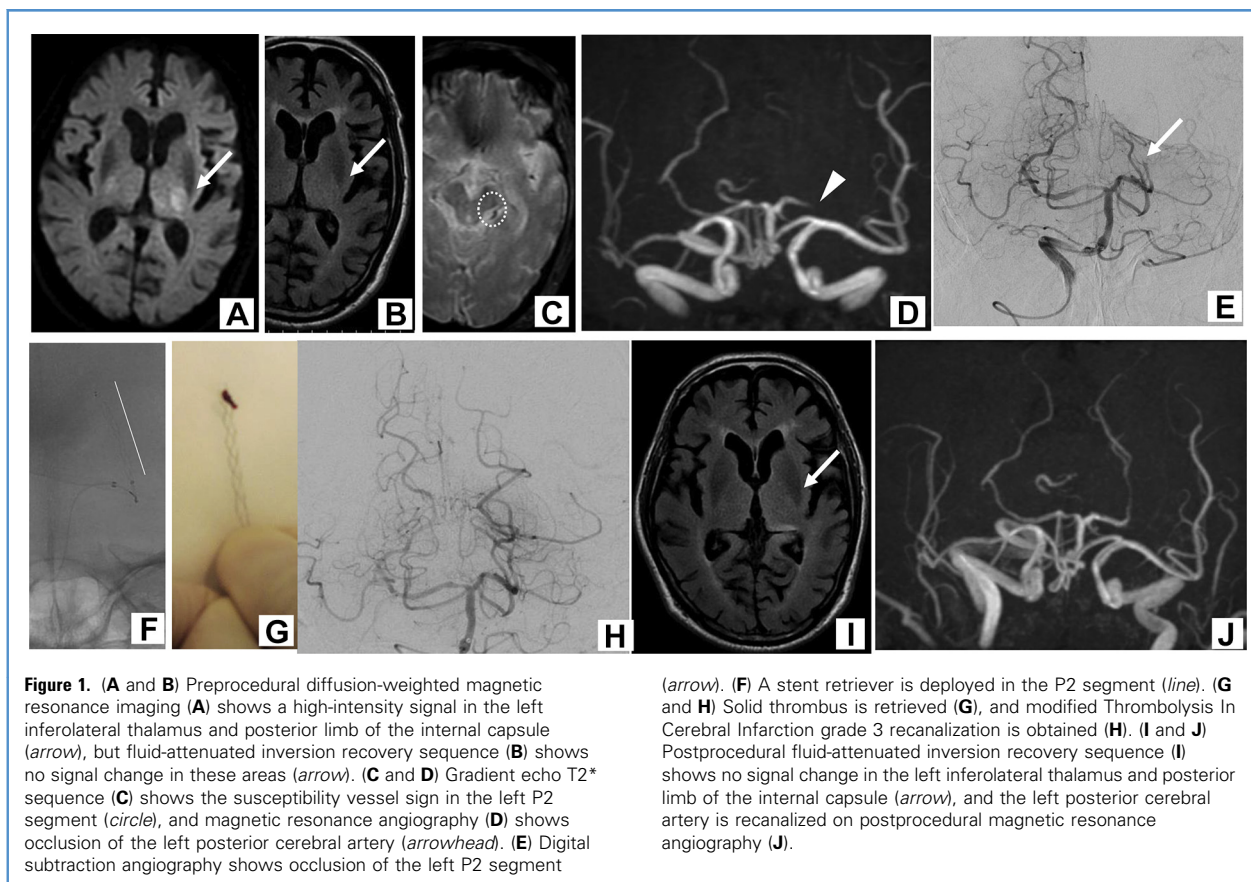
■ **CONCLUSIONS:** P2O may cause severe motor deficit. In such cases, MT may contribute to safely improving patients' deficits.

### CASE DESCRIPTION

#### Case 1

A 68-year-old man was emergently admitted to the hospital with right hemiplegia, right facial palsy, dysarthria, right limb ataxia, and dysesthesia (National Institutes of Health Stroke Scale [NIHSS] score 14; onset to door time, 131 minutes). Diffusion-weighted imaging (DWI) showed high-intensity signals in the left inferolateral thalamus and posterior limb of the internal capsule (Figure 1A), but fluid-attenuated inversion recovery (FLAIR) sequence showed no signal changes in these areas (Figure 1B). Magnetic resonance angiography (MRA) showed a signal defect in the left PCA (Figure 1D), and gradient echo T2\* imaging showed the susceptibility vessel sign (SVS) in the P2 segment of the left PCA (Figure 1C) with a length of 9.8 mm. An ischemic penumbra was suspected because of DWI-FLAIR mismatch on magnetic resonance imaging. MT was performed because the hemiplegia

remained despite administration of intravenous (IV) tissue plasminogen activator (tPA). Digital subtraction angiography showed occlusion of the left P2 segment (Figure 1E). A direct aspiration technique was attempted first, but a Penumbra 4MAX (Penumbra, Inc., Alameda, California, USA) catheter was not advanced to P2. Therefore, a stent retriever was selected to retrieve thrombus. A Trevo (Stryker Neurovascular, Fremont, California, USA) 3 × 20 mm device was deployed from the distal P1 to distal P2 segment (Figure 1F) and retrieved slowly. A solid thrombus was captured (Figure 1G), and modified Thrombolysis In Cerebral Infarction grade 3 recanalization was obtained (door to puncture time, 46 minutes; puncture to recanalization time, 50 minutes; onset to recanalization time, 227 minutes) (Figure 1H). Hemiplegia improved immediately after recanalization. Postprocedural FLAIR sequence still showed no signal change (Figure 1I), and the left PCA was reopened on



**Figure 1.** (A and B) Preprocedural diffusion-weighted magnetic resonance imaging (A) shows a high-intensity signal in the left inferolateral thalamus and posterior limb of the internal capsule (arrow), but fluid-attenuated inversion recovery sequence (B) shows no signal change in these areas (arrow). (C and D) Gradient echo T2\* sequence (C) shows the susceptibility vessel sign in the left P2 segment (circle), and magnetic resonance angiography (D) shows occlusion of the left posterior cerebral artery (arrowhead). (E) Digital subtraction angiography shows occlusion of the left P2 segment

(arrow). (F) A stent retriever is deployed in the P2 segment (line). (G and H) Solid thrombus is retrieved (G), and modified Thrombolysis In Cerebral Infarction grade 3 recanalization is obtained (H). (I and J) Postprocedural fluid-attenuated inversion recovery sequence (I) shows no signal change in the left inferolateral thalamus and posterior limb of the internal capsule (arrow), and the left posterior cerebral artery is recanalized on postprocedural magnetic resonance angiography (J).

postprocedural MRA (Figure 1J). Modified Rankin Scale score at discharge was 0.

## Case 2

A 69-year-old man with a history of subacute ischemic stroke in the right corona radiata and deep white matter (Figure 2B) 1 month earlier was emergently admitted to the hospital with left hemiplegia, left facial palsy, dysarthria, left limb ataxia, and dysesthesia (NIHSS score 8; onset to door time, 73 minutes). DWI showed a new high-intensity signal in the right inferolateral thalamus and posterior limb of the internal capsule (Figure 2A), but FLAIR sequence showed no signal change in these areas (Figure 2B). On MRA, a signal defect was seen in the right PCA (Figure 2D). Gradient echo T2\* showed SVS in the right P2 segment (Figure 2C) with a length of 7.8 mm. An ischemic penumbra was suspected in the right inferolateral thalamus and posterior limb of the internal capsule because of DWI-FLAIR mismatch on magnetic resonance imaging. MT was performed because

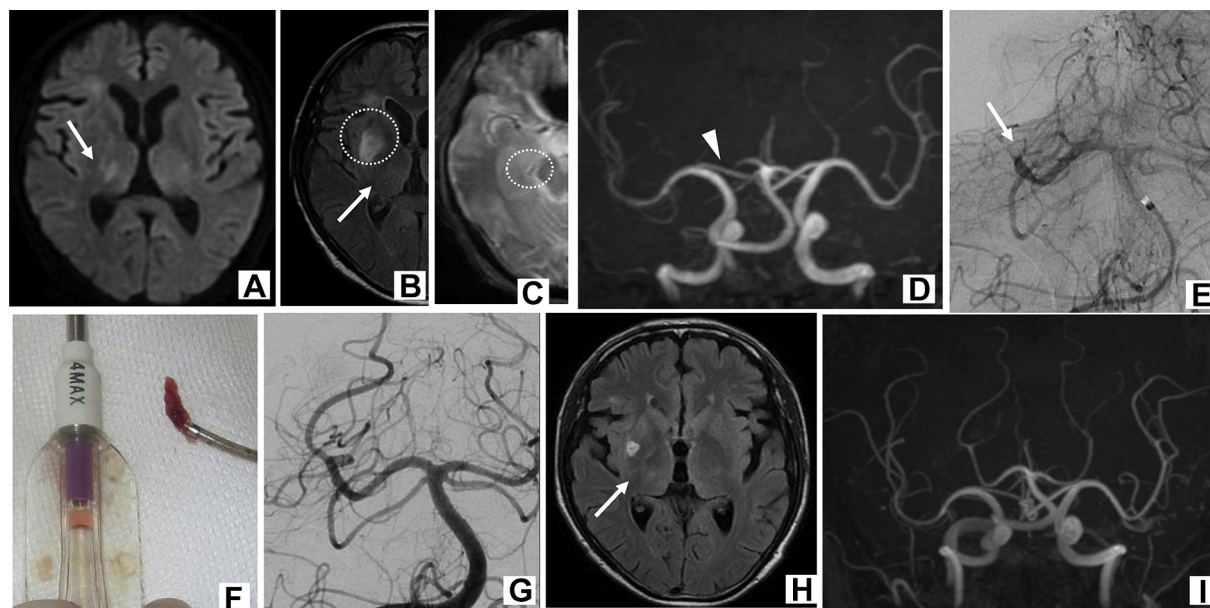
hemiplegia remained despite administration of IV tPA. Digital subtraction angiography demonstrated occlusion of the left P2 segment (Figure 2E). A Penumbra 4MAX catheter was advanced to the thrombus, and a direct aspiration technique was performed. A solid thrombus was retrieved (Figure 2F), and modified Thrombolysis In Cerebral Infarction grade 3 recanalization was obtained (door to puncture time, 29 minutes; puncture to recanalization time, 32 minutes; onset to recanalization time, 134 minutes) (Figure 2G). Hemiplegia improved immediately after recanalization. Postprocedural FLAIR sequence showed no signal change in the right inferolateral thalamus and posterior limb of the internal capsule (Figure 2H), and the right PCA was reopened on postprocedural MRA (Figure 2I). Modified Rankin Scale score at discharge was 0.

## DISCUSSION

AIS due to PCA occlusion is rare,<sup>1</sup> and only a few cases of MT for PCA occlusion have

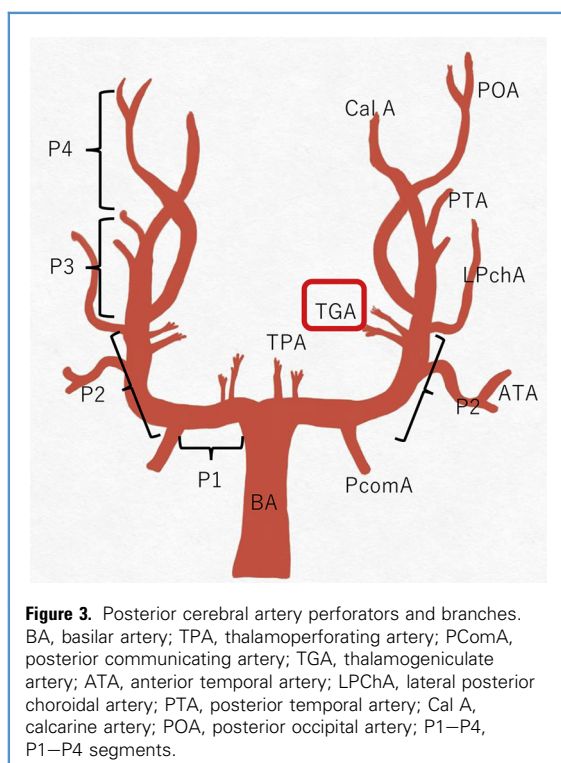
been reported<sup>4-6</sup>; therefore, the indications for and effectiveness of MT for P2O are not clear. The symptoms of P2O are generally mild, but a case of P2O with severe hemiplegia has been reported.<sup>3</sup> To our knowledge, however, no cases describing MT for P2O with hemiplegia improved after MT have been reported. The present 2 cases show the effectiveness of MT for hemiplegia caused by P2O.

Hemiplegia due to P2O might be caused by hypoperfusion of the thalamogeniculate artery (TGA).<sup>3</sup> The TGA generally branches from the P2 segment (Figure 3) and supplies the posterior limb of the internal capsule.<sup>7</sup> This is why hemiplegia is sometimes caused by P2O. Not all patients with P2O present with hemiplegia. The anatomic location of the pyramidal tract and the balance of the blood supply from the TGA or MCA branches to the posterior limb of the internal capsule differ among individuals. The indication for MT was acceptable in the present cases of P2O with hemiplegia



**Figure 2.** (A and B) This patient has a past history of subacute ischemic stroke in the right corona radiata and the deep white matter (circle in B). Preprocedural diffusion-weighted magnetic resonance imaging (A) shows a high-intensity signal in the right inferolateral thalamus and posterior limb of the internal capsule (arrow), but fluid-attenuated inversion recovery sequence (B) shows no signal change in these areas (arrow). (C and D) Gradient echo T2\* magnetic resonance imaging (C) shows the susceptibility vessel sign at the right P2 segment (circle), and magnetic resonance angiography (D) shows occlusion of the right posterior cerebral artery (arrowhead).

(E) Digital subtraction angiography demonstrates occlusion of the right P2 segment (arrow). (F and G) Solid thrombus is retrieved by a direct aspiration technique (F), and modified Thrombolysis In Cerebral Infarction grade 3 recanalization is obtained (G). (H and I) Postprocedural fluid-attenuated inversion recovery sequence (H) shows no signal change in the right inferolateral thalamus and posterior limb of the internal capsule (arrow), and the right posterior cerebral artery is recanalized on postprocedural magnetic resonance angiography (I).



**Figure 3.** Posterior cerebral artery perforators and branches. BA, basilar artery; TPA, thalamoperforating artery; PComA, posterior communicating artery; TGA, thalamogeniculate artery; ATA, anterior temporal artery; LPChA, lateral posterior choroidal artery; PTA, posterior temporal artery; Cal A, calcarine artery; POA, posterior occipital artery; P1–P4, P1–P4 segments.

due to ischemic penumbra in the posterior limb of the internal capsule on DWI-FLAIR mismatch.

The effectiveness of IV tPA for distal cerebral artery occlusion has been reported,<sup>8</sup> but patients with initial NIHSS scores >7 had a much lower full recovery rate than patients with initial NIHSS scores ≤7 after administration of IV tPA at 48 hours (2.4% vs. 45.5%,  $P < 0.000005$ ).<sup>9</sup> In addition, a long SVS (7–10 mm) was related to failure of early recanalization with administration of IV tPA after 3 hours compared with an SVS ≤7 mm (adjusted odds ratio 4.6, 95% confidence interval 2.2–9.6).<sup>10</sup> In the present cases, it might have been difficult to improve hemiplegia with just IV tPA because both patients had NIHSS scores >7 and SVS >7 mm.

There is a technical problem with MT for distal cerebral artery occlusion because the occluded artery is small and tortuous; therefore, the risk of postprocedural subarachnoid hemorrhage caused by the stent

retriever has been reported to be higher.<sup>11</sup> The rate of postprocedural subarachnoid hemorrhage after MT might also be higher for P2O than for large vessel occlusion. To reduce the risk of procedure-related cerebral hemorrhage, the use of a proper stent retriever or aspiration catheter appropriate for the size of distal vessels should be considered. The effectiveness and safety of MT for P2O with severe motor deficit have been controversial, but the present cases suggest that MT for P2O with hemiplegia might safely contribute to improvement.

## CONCLUSIONS

A severe motor deficit might be caused by TGA occlusion due to P2O. MT in such a case could safely contribute to improvement.

## REFERENCES

- Rai AT, Seldon AE, Boo S, et al. A population-based incidence of acute large vessel occlusions and thrombectomy eligible patients indicates significant potential for growth of endovascular stroke therapy in the USA. *J Neurointerv Surg.* 2017;9:722-726.
- Saver JL, Goyal M, van der Lugt A, et al. Time to treatment with endovascular thrombectomy and outcomes from ischemic stroke: a meta-analysis. *JAMA.* 2016;316:1279-1288.
- Griffin AS, Mariano R, Hauck SK, et al. Inferolateral thalamic ischemia secondary to PCA P2 perforator occlusion mimics MCA stroke syndrome. *Neurosurg Rev.* 2020;43:339-342.
- Clarençon F, Baronnet F, Shotar E, et al. Should posterior cerebral artery occlusions be recanalized? Insights from the Trevo Registry. *Eur J Neurol.* 2020;5:787-792.
- Grossberg JA, Rebello LC, Haussen DC, et al. Beyond large vessel occlusion strokes: distal occlusion thrombectomy. *Stroke.* 2018;49:1662-1668.
- Yamamoto T, Ohshima T, Sato M, et al. A case of acute isolated posterior cerebral artery occlusion successfully treated with endovascular clot aspiration. *NMC Case Rep J.* 2017;4:55-58.
- Zeal AA, Rhoton AL Jr. Microsurgical anatomy of the posterior cerebral artery. *J Neurosurg.* 1978;48:534-559.
- Hirano T, Sasaki M, Mori E, et al. Residual vessel length on magnetic resonance angiography identifies poor responders to alteplase in acute middle cerebral artery occlusion patients: exploratory analysis of the Japan Alteplase Clinical Trial II. *Stroke.* 2010;41:2828-2833.
- DeGraba TJ, Hallenbeck JM, Pettigrew KD, et al. Progression in acute stroke: value of the initial NIH stroke scale score on patient stratification in future trials. *Stroke.* 1999;30:1208-1212.
- Seners P, Turc G, Naggara O, et al. Post-thrombolysis recanalization in stroke referrals for thrombectomy: incidence, predictors, and prediction scores. *Stroke.* 2018;49:2975-2982.
- Ng PP, Larson TC, Nichols CW, et al. Intra-procedural predictors of post-stent retriever thrombectomy subarachnoid hemorrhage in middle cerebral artery stroke. *J Neurointerv Surg.* 2019;11:127-132.

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