

# A Case of Cerebral Tumor Embolism from Extracardiac Lung Cancer Treated by Mechanical Thrombectomy

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Cerebral tumor embolism is a rare cause of acute ischemic stroke, and extracardiac carcinoma is an extremely rare cause. A 34-year-old man who had been diagnosed with lung cancer developed right hemiparesis and aphasia, with the National Institutes of Health Stroke Scale (NIHSS) score of 17. Magnetic resonance imaging (MRI) showed early ischemic change in the insular cortex and frontotemporal lobe and left internal carotid artery (ICA) terminal occlusion was confirmed by magnetic resonance angiogram (MRA). Mechanical thrombectomy (MT) with contact aspiration by a Penumbra ACE 68, followed by combined technique with a stent retriever was performed, and a soft, fragile embolus was retrieved. Finally, good recanalization was achieved (Thrombolysis in Cerebral Infarction [TICI] scale 2b), and on the next day, the right hemiparesis and aphasia were improved. However, the patient's general condition gradually worsened, and 43 days after thrombectomy, he died from respiratory failure. The retrieved embolus was examined pathologically and diagnosed as mucoepidermoid carcinoma of the same type as his lung cancer. Chest computed tomography (CT) showed that tumor invaded the right pulmonary vein and left atrium; these findings suggested that a piece of the tumor in the left atrium flowed into the left ICA and caused the acute ischemic stroke.

**Keywords:** mechanical thrombectomy, endovascular treatment, tumor embolism, lung cancer, mucoepidermoid carcinoma

## Introduction

Mechanical thrombectomy (MT) is standard therapy for acute ischemic stroke with large vessel occlusion (LVO),<sup>1</sup> and tumor embolism is a rare cause. Cerebral tumor embolism is mostly caused by a primary cardiac tumor, with myxoma being the most common.<sup>2</sup> On the other hand, extracardiac carcinoma is a rare cause of cerebral embolism,

and only five cases treated with MT have been reported previously.<sup>3-7</sup> A case of acute ischemic stroke arising from tumor embolism of lung cancer that invaded the pulmonary vein and left atrium and was successfully recanalized with MT is presented.

## Case Report

A 34-year-old man who was diagnosed with lung cancer (pathological diagnosis was mucoepidermoid carcinoma) 6 months earlier underwent right lower lobectomy and chemoradiotherapy, but it was not effective. In the middle of the night, he suddenly developed a speech disturbance and right hemiparesis and was transferred to the emergency department of our hospital. The time from onset to the emergency department was 47 minutes. The National Institutes of Health Stroke Scale (NIHSS) score was 17, and the Glasgow Coma Scale (GCS) score was 13 (E4V3M6). He showed motor aphasia, right hemiparesis, and left conjugate deviation of the eyes. He had no history of heart failure or atrial fibrillation. His laboratory data showed an elevated white blood cell count of 12,700/ $\mu\text{L}$  (normal range: 4000–7800/ $\mu\text{L}$ ), and D-dimer was also elevated to 32.5  $\mu\text{g/mL}$  (normal range: <1  $\mu\text{g/mL}$ ). Head magnetic resonance imaging (MRI) diffusion-weighted imaging (DWI) showed early ischemic change in the frontal and temporal areas (Figs. 1A and 1B), and the Alberta Stroke Programme Early CT Score (ASPECTS) was 6. A head magnetic resonance angiogram (MRA) demonstrated complete occlusion of the left intracranial internal carotid artery (ICA) (Fig. 1C).

A diagnostic angiogram confirmed complete occlusion at the terminal end of the left ICA (Fig. 1D), so intravenous tissue plasminogen activator injection (IV t-PA) followed by MT was performed. A 9-Fr balloon guiding catheter, OPTIMO (Tokai Medical Products, Aichi, Japan), was introduced into the left ICA cervical portion, and a Penumbra ACE 68 (Penumbra Inc., Alameda, CA, USA) was easily navigated to the occlusion site (Fig. 1E). After the ACE 68 contacted the embolus, aspiration of the embolus was started with a MAX pump (Penumbra Inc.) for 90 seconds, the ACE 68 was withdrawn into the OPTIMO, and the left ICA was recanalized (Fig. 1F). However, occlusion remained at the middle cerebral artery (MCA) superior and inferior M2 trunks, so a Solitaire 4 mm  $\times$  20 mm (Medtronic, Minneapolis, MN, USA) was deployed from the ACE 68 placed in the MCA M1 portion (Figs. 2A and 2B), and the Solitaire was retrieved into the ACE 68 with distal aspiration. After three

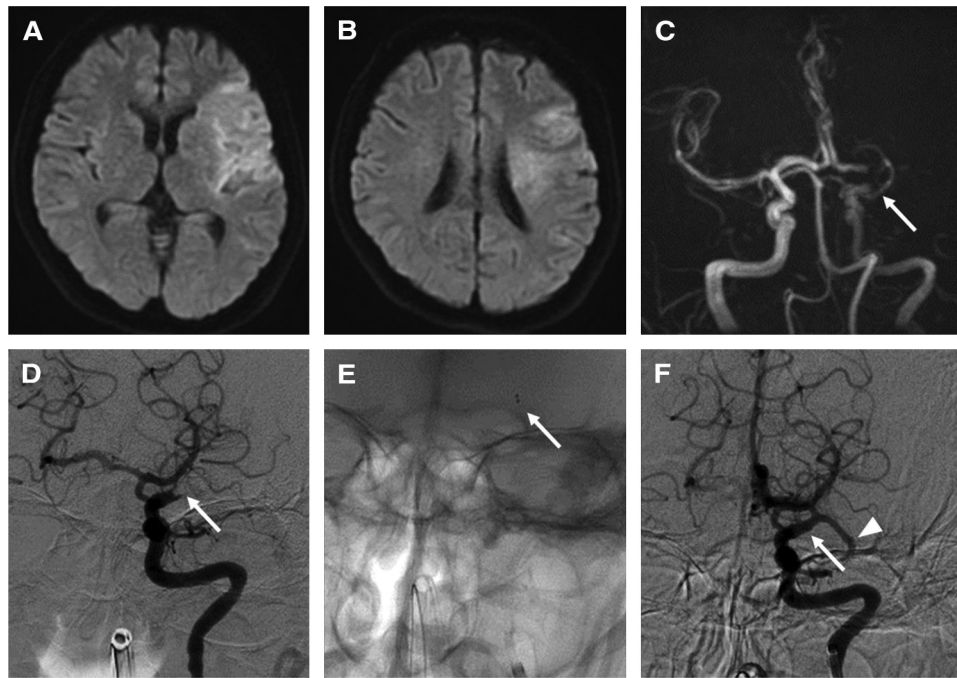
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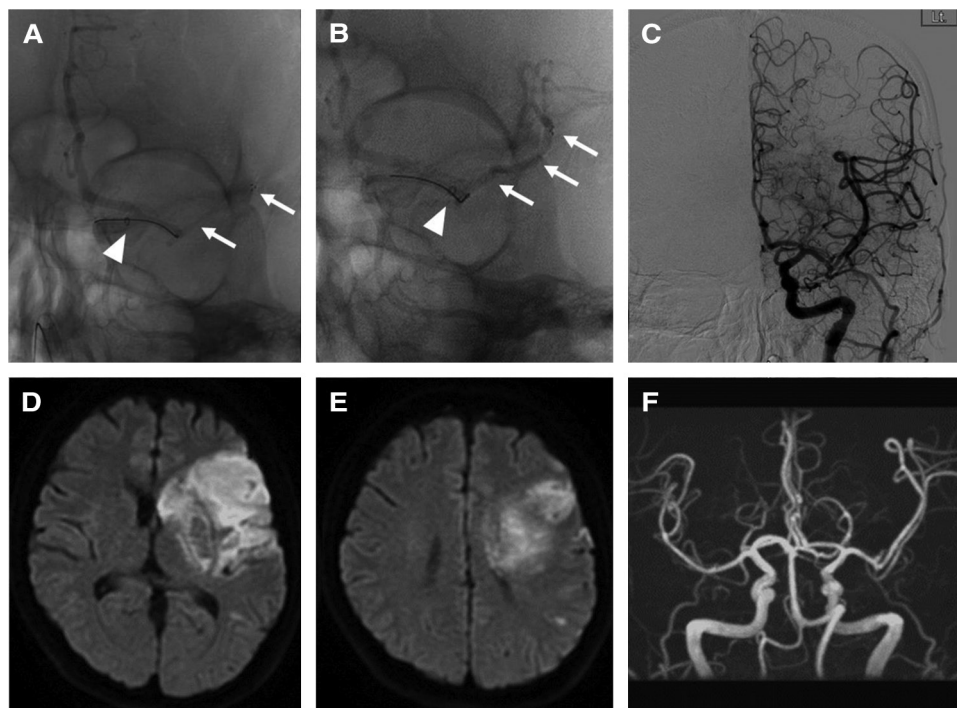
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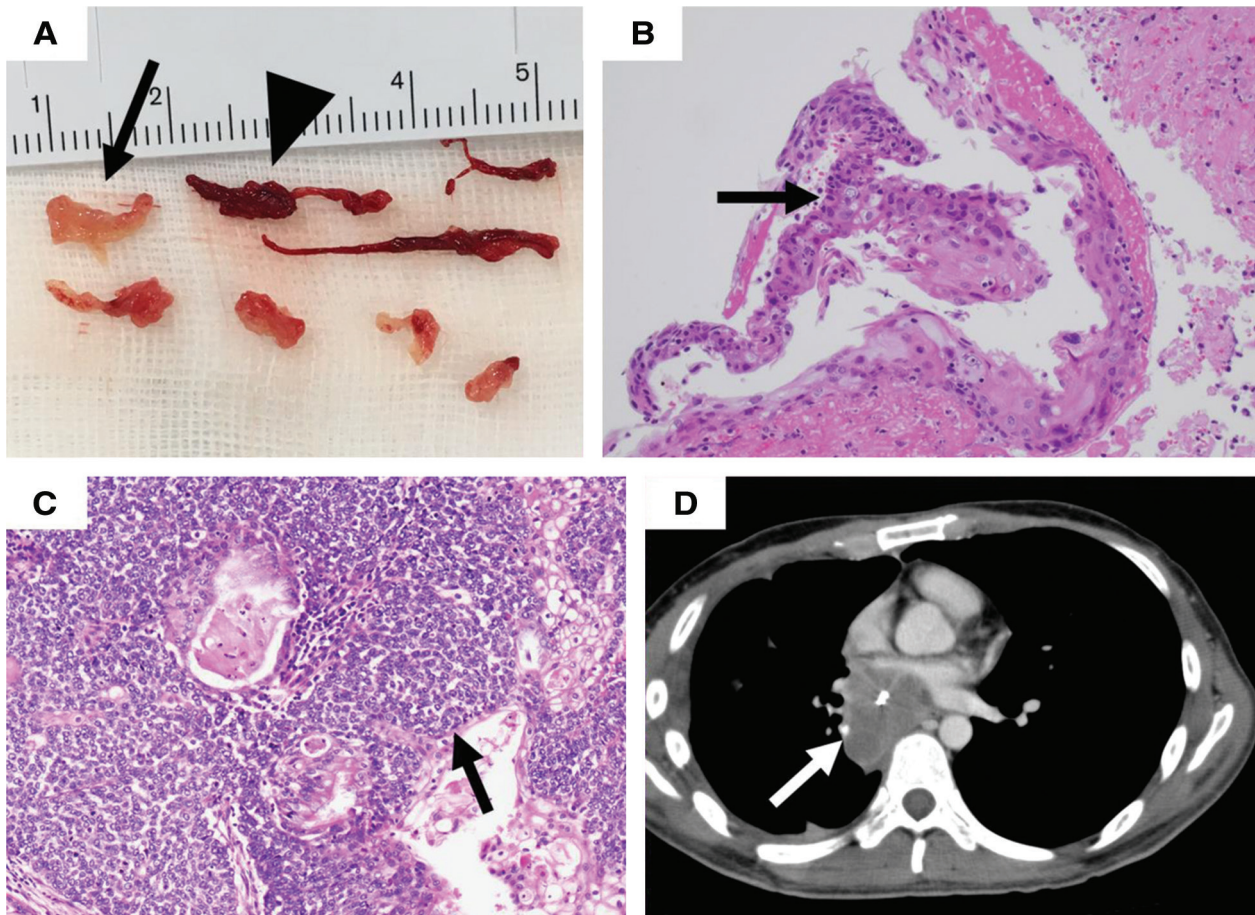
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**Fig. 1** (A and B) MRI-DWI shows early ischemic change in the insular cortex and frontal and temporal areas. (C) MRA shows occlusion of the intracranial left ICA (arrow). (D) DSA of the left ICA, AP view, shows complete occlusion of the terminal end of the left ICA (arrow). (E) The tip of the Penumbra ACE 68 is navigated to the occluded lesion (arrow). (F) Just after first contact aspiration, the ICA is recanalized (arrow), and both the M2 superior and inferior trunks are still occluded (arrowhead). DSA: digital subtraction angiogram, ICA: internal carotid artery, MRA: magnetic resonance angiogram, MRI-DWI: magnetic resonance imaging diffusion-weighted imaging.



**Fig. 2** (A) A Solitaire 4 mm × 20 mm is deployed in the left M2 superior trunk (arrow), and a Penumbra ACE 68 is placed in the distal M1 portion for distal local aspiration (arrowhead). (B) The Solitaire is deployed in the left M2 inferior trunk (arrow) with the Penumbra ACE 68 (arrowhead). (C) TIC1 2b recanalization is confirmed by DSA. (D and E) MRI-DWI shows the stroke core on the next day. (F) MRA shows recanalization of the left ICA on the next day. DSA: digital subtraction angiogram, ICA: internal carotid artery, MRA: magnetic resonance angiogram, MRI-DWI: magnetic resonance imaging diffusion-weighted imaging.



**Fig. 3** (A) White embolus (arrow) and red clots (arrowhead) retrieved by MT. (B) Hematoxylin-eosin stain of the retrieved white embolus specimen; the pathological diagnosis of the embolus is the same as the lung cancer. There are atypical squamous cells containing mucin (arrow). (C) Atypical squamous cell fragments with a few intracytoplasmic lumens (arrow) contain mucin in an operatively extracted specimen of lung cancer. The pathological diagnosis is mucoepidermoid carcinoma. (D) Chest CT shows tumor that has invaded the right pulmonary vein and left atrium (arrow). CT: computed tomography, MT: mechanical thrombectomy, TICI: Thrombolysis in Cerebral Infarction.

passes, good recanalization (Thrombolysis in Cerebral Infarction (TICI) scale 2b) was achieved (Fig. 2C). The time from onset to recanalization was 212 minutes. The patient's motor aphasia and right hemiparesis improved immediately after the procedure, and the GCS score also improved to 15 (E4V5M6). The NIHSS score decreased to 10 after 24 hours. MRI-DWI showed that the ischemic lesion had not spread compared with the initial early ischemic lesion (Figs. 2D and 2E), and MRA showed good recanalization of the left ICA (Fig. 2F).

In this procedure, a long and fragile white embolus and red clots were retrieved (Fig. 3A). The pathological diagnosis of the white embolus was mucoepidermoid carcinoma, the same as his lung cancer (Fig. 3B). Atypical squamous cell fragments with a few intracytoplasmic lumens contained mucin (Fig. 3C). Chest computed tomography (CT) that was taken 1 month before the ischemic stroke showed mass lesions in the lung and mediastinum, suggesting lung cancer that had invaded the right pulmonary vein and left atrium (Fig. 3D). Thus, it appeared that the lung cancer invaded the left atrium, and that the cancer itself might have flowed into the cerebral artery. Because his general condition gradually

worsened, he was transferred to a hospice on the 31st postoperative day to receive supportive care, and on the 43rd day, he died from respiratory failure.

### Discussion

MT is standard therapy for acute ischemic stroke with LVO,<sup>1)</sup> and one can observe the retrieved clots and perform pathological examination of the embolus after MT, unlike with medical therapy. However, most cerebral embolism cases are the result of thrombi from the left atrium due to atrial fibrillation, and several case reports of cerebral tumor emboli treated by MT were recently published.

Cerebral tumor embolism is rare, and primary cardiac tumor, especially myxoma, is the most common cause.<sup>2)</sup> Hoffmeier et al.<sup>8)</sup> reviewed cardiac tumor and reported that myxoma was the most common (70%), with cardiac metastases in about 10%. Thus, cerebral tumor embolism from extracardiac metastatic tumor is particularly rare. Yagita et al.<sup>9)</sup> reported a case of cerebral embolism with lung cancer invading to the left ventricle, and Mitomi et al.<sup>10)</sup> also described a case of stroke due to tumor embolism caused by

**Table 1** Summary of cerebral tumor embolism from extracardiac carcinoma treated by mechanical thrombectomy

Author	Year	Age	Gender	Occlusion site	Pre-NIHSS	First-pass device	Post-TICI score	mRS at 90days	Primary lesion	Pathological diagnosis
Bhatia et al. <sup>3)</sup>	2010	62	Female	Left ICA	19	Merci retriever	2a	N.A.	Breast cancer	High-grade phylloides tumor
Zander et al. <sup>4)</sup>	2016	58	Male	Left M2	24	Stent retriever	3	6	Lung cancer	Non-small cell carcinoma
Pop et al. <sup>5)</sup>	2018	56	Male	BA left ICA	N.A.	Stent retriever Stent retriever	3 2b	6	Lung cancer	Sarcomatoid carcinoma
Goddard et al. <sup>6)</sup>	2019	80	Male	BA	19	Aspiration catheter	2c	6	Lung cancer	Large-cell, high-grade neuroendocrine cancer
Tsurusaki et al. <sup>7)</sup>	2019	72	Male	Left ICA	13	Stent retriever	3	0	Lung cancer	Squamous cell carcinoma
Present case	2019	34	Male	Left ICA	17	Aspiration catheter	2b	6	Lung cancer	Mucoepidermoid carcinoma

BA: basilar artery, ICA: internal carotid artery, M2: middle cerebral artery M2 portion, mRS: modified Rankin Scale, NIHSS: National Institutes of Health Stroke Scale, TICI: Thrombolysis in Cerebral Infarction.

metastatic cardiac liposarcoma that was confirmed by autopsy. Because these two cases were not treated by MT, a diagnosis of tumor embolism was not confirmed by examination of the embolus.

Five cases treated by MT and diagnosed as tumor embolism were recently published<sup>3-7)</sup> (Table 1). In all six cases including ours, the pathological diagnosis of the retrieved embolus was the same as the primary malignant tumor. The primary lesions were lung cancer and breast cancer, and these malignant tumors directly invaded the pulmonary vein or the left atrium or ventricle, and a piece of tumor flowed into the systemic circulation and occluded cerebral arteries. In three cases of previous five reports, chest CT revealed tumor mass invading the pulmonary vein and left atrium just like our case (Fig. 3D). Despite successful recanalization, four patients died within 90 days, and one patient received supportive therapy for 5 months; thus, these patients had extremely poor prognoses. Only one case died due to severe hemorrhagic infarction and brain swelling caused by large ischemic stroke. In another cases, the general conditions of the patients, especially respiratory function, were getting worse because of the progression of the cancer and they died shortly after successful MT.

It is considered that IV t-PA is effective only for thrombus and not for tumor itself. MT was successfully performed in the previous five cases with LVO. The Aster trial<sup>11)</sup> showed that there was no difference in the results between stent retriever and contact aspiration for LVO in the anterior circulation. However, tumor embolus is soft and fragile, and a stent retriever might fragment the soft embolus, and distal migration can occur. It has been suggested that contact aspiration with a large-bore catheter (Penumbra ACE 68) such as the ADAPT<sup>12)</sup> is more suitable for soft and fragile emboli. If using a stent retriever, to prevent migration of the fragmented embolus to distal or new territory, a balloon guiding catheter is a useful device to stop proximal blood flow, and distal local aspiration at just proximal of the embolus with a large-bore catheter<sup>13)</sup> is also effective to retrieve the soft and fragile embolus. In our case, a large-bore catheter (Penumbra ACE 68) was advanced to the level of the embolus and aspirated the fragile embolus successfully. It was a different method from another five cases that were reported previously.

**Conclusion**

MT was performed for cerebral embolism from lung cancer diagnosed by pathological examination of the retrieved embolus. Lung cancer directly invaded the pulmonary vein and left atrium, and a piece of tumor floated to the cerebral artery. A large-bore aspiration catheter was effective to achieve successful recanalization for this soft and fragile embolus.

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**Conflicts of Interest Disclosure**

All authors have no conflict of interest concerning this article.

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