Cerebral tumor embolism from thyroid cancer treated by mechanical thrombectomy: illustrative case

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BACKGROUND Development in mechanical thrombectomy is progressing dramatically. Tumor embolism has been rarely reported on the basis of pathological study of the retrieved thrombus. Herein, the authors report a case of cerebral tumor embolism from advanced thyroid cancer, which was successfully treated with mechanical thrombectomy.

OBSERVATIONS A 57-year-old man was diagnosed with thyroid cancer with multiple lung metastases and chemotherapy was planned. He experienced left hemiparesis and was brought to the emergency section of the authors’ hospital. Magnetic resonance angiography revealed right internal carotid artery occlusion and endovascular treatment was performed. Using a combination of aspiration catheter and stent retriever, white jelly-like embolus was retrieved. The pathological study demonstrated thyroid cancer embolism. Pulmonary vein invasion following lung metastasis of thyroid cancer was most presumably the cause of the tumor embolism.

LESSONS Lung metastasis invading the pulmonary vein may be a cause of tumor embolism. Mechanical thrombectomy using a combination of stent retriever and aspiration catheter is effective in removing the tumor embolus and the pathological examination of the embolus is essential.

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KEYWORDS cerebral tumor embolism; mechanical thrombectomy; thyroid cancer

Cancer activates blood coagulation and results in cancer-associated cerebral infarction. In addition, cancer may invade the blood vessels and induce tumor embolism. It is reported that the rate of cerebral tumor embolism with a malignant tumor is as high as 4.7%.1 Herein, we report a case of thyroid cancer embolism retrieved with mechanical thrombectomy and review the literature on tumor embolism recanalized with endovascular treatment.

Illustrative Case

A 57-year-old man was diagnosed with an advanced stage of thyroid cancer. Multiple lung metastases were found, and chemotherapy was planned. He experienced left hemiparesis when he woke up and was brought to our hospital’s emergency department. Neurological examination showed mild disturbance in consciousness and left hemiplegia. His National Institutes of Health Stroke Scale Score was 11 points. His pulse rate was regular. Blood test revealed d-dimer in the normal range (0.7 μg/dL). Brain computed tomography (CT) showed low-density area in the right internal capsule. Systemic CT revealed a large mass in the right neck and multiple masses in the bilateral lung field, indicating lung metastases of thyroid cancer. Brain diffusion-weighted magnetic resonance imaging showed high-intensity area in the right internal capsule and the Diffusion-Weighted Imaging–Alberta Stroke Program Early CT score was 9 (Fig. 1A). In the fluid-attenuated inverted recovery image the lesion appeared as a high-intensity area. The right internal carotid artery (ICA) was not visualized with magnetic resonance angiography. On the basis of the diagnosis of acute cerebral infarction by the right ICA occlusion, endovascular recanalization was performed. A recombinant tissue plasminogen activator (rt-PA) was not administered considering the risk of bleeding due to thyroid cancer and
multiple lung metastases. A 9-Fr Optimo balloon guiding catheter (Tokai Medical Products) was introduced into the right common carotid artery, and occlusion at the origin of the right ICA was confirmed by angiography (Fig. 1B). A REACT-71 aspiration catheter (Medtronic) was navigated to the occlusion site, and the embolus was aspirated. Several pieces of red thrombus were aspirated (Fig. 1C) and the proximal part was recanalized. Angiography revealed occlusion at the bifurcation of the right ICA. Thereafter, a Phenom-27 microcatheter (Medtronic) and aspiration catheter were guided to the middle cerebral artery (MCA) in a coaxial manner, and sandwich angiography showed a defect in contrast medium at the horizontal portion of the right MCA, indicating the existence of another embolus (Fig. 1D). A Solitaire stent retriever (6 × 40 mm; Medtronic) was deployed; however, flow restoration was not observed. The aspiration catheter was brought closer to the stent retriever, and both devices were retrieved by combined technique. A long string-form, white mucous embolus was removed (Fig. 1E), and the occlusion was recanalized completely (Fig. 1F). Pathological analysis of the embolus showed thyroid cancer under hematoxylin and eosin and vimentin staining (Fig. 2). Pulmonary invasion of the lung lesion was discovered on systemic contrast-enhanced CT, and it was suspected as the cause of the tumor embolism (Fig. 3). The carotid artery was dislocated due to primary thyroid cancer but not invaded.

**Discussion**

**Observations**

Endovascular treatment for acute cerebral artery occlusion has been evolving dramatically with the development of new devices. Pathological study of the retrieved thrombus rarely reveals tumor
embolism. We reviewed cases of tumor embolism treated with endovascular methods that are listed in Table 1. Hoffmeier et al. reported that most cerebral tumor embolisms are caused by cardiac tumors. Among them, 70% were cardiac myxoma and 10% were cardiac metastasis. With regard to cardiovascular invasion, invasion to the pulmonary vein or left ventricle was reported and the majority of the primary lesions were lung or breast cancer. To the best of our knowledge, this is the first case of thyroid cancer embolism resulting in acute cerebral infarction and a long string-form embolus was removed. The primary lesion in this case was large; however, the carotid artery was intact. Contrast-enhanced CT showed pulmonary vein invasion of metastatic lung lesion, which seemed to have caused the tumor embolism. We finally diagnosed cerebral tumor embolism based on pathology. Therefore, it was important to examine the embolus pathologically.

With regard to recanalization therapy for the acute cerebral artery occlusion induced by tumor embolism, Ikeda et al. reported the effectiveness of intravenous rt-PA therapy for the thrombus component of the cardiac myxoma embolism; however, it was less effective for the tumor component. In this case, rt-PA was not administered considering a risk of

TABLE 1. Summary of case reports of tumor embolisms with mechanical thrombectomy

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Occlusion Site</th>
<th>Pre-NIHSS</th>
<th>Device</th>
<th>Post-TICI Score</th>
<th>Primary Lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhatia et al., 2010</td>
<td>62</td>
<td>F</td>
<td>Lt M1</td>
<td>19</td>
<td>Merci</td>
<td>2a</td>
<td>Lung metastasis of breast cancer</td>
</tr>
<tr>
<td>Tejada et al., 2014</td>
<td>64</td>
<td>F</td>
<td>Rt M1</td>
<td>16</td>
<td>Solitaire</td>
<td>3</td>
<td>Cardiac papillary fibroelastoma</td>
</tr>
<tr>
<td>Santos et al., 2014</td>
<td>34</td>
<td>M</td>
<td>Lt M1</td>
<td>17</td>
<td>N/A</td>
<td>2b</td>
<td>Cardiac papillary fibroelastoma</td>
</tr>
<tr>
<td>Baek et al., 2014</td>
<td>46</td>
<td>M</td>
<td>Lt ICA</td>
<td>N/A</td>
<td>Penumbra</td>
<td>3</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td>Garcia-Ptacek et al., 2014</td>
<td>45</td>
<td>N/A</td>
<td>Lt M1</td>
<td>27</td>
<td>Solitaire/Trevo/Wingspan</td>
<td>0</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td>Ryu et al., 2015</td>
<td>34</td>
<td>M</td>
<td>Rt M1</td>
<td>9</td>
<td>Solitaire</td>
<td>3</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td>Vega et al., 2015</td>
<td>11</td>
<td>M</td>
<td>Rt M1</td>
<td>16</td>
<td>Trevo/Penumbra</td>
<td>3</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td>Biraschi et al., 2016</td>
<td>75</td>
<td>M</td>
<td>Lt M1</td>
<td>18</td>
<td>Penumbra</td>
<td>3</td>
<td>Cardiac papillary fibroelastoma</td>
</tr>
<tr>
<td>Chung et al., 2016</td>
<td>4</td>
<td>M</td>
<td>Lt M1</td>
<td>16</td>
<td>Solitaire</td>
<td>3</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td>Zander et al., 2016</td>
<td>46</td>
<td>F</td>
<td>Lt M1</td>
<td>16</td>
<td>Solitaire</td>
<td>3</td>
<td>Cardiac myxoma</td>
</tr>
<tr>
<td></td>
<td>58</td>
<td>M</td>
<td>Lt M2</td>
<td>24</td>
<td>Solitaire</td>
<td>3</td>
<td>Pulmonary adenocarcinoma</td>
</tr>
<tr>
<td>Pop et al., 2018</td>
<td>56</td>
<td>M</td>
<td>BA/ICA</td>
<td>N/A</td>
<td>Solitaire</td>
<td>3BA/2bICA</td>
<td>Intrathoracic sarcoma</td>
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<tr>
<td>Abe et al., 2019</td>
<td>79</td>
<td>M</td>
<td>BA</td>
<td>40</td>
<td>Penumbra</td>
<td>3</td>
<td>Cardiac papillary fibroelastoma</td>
</tr>
<tr>
<td>Goddard et al., 2019</td>
<td>80</td>
<td>M</td>
<td>BA</td>
<td>19</td>
<td>Penumbra</td>
<td>2c</td>
<td>Pulmonary neuroendocrine cancer</td>
</tr>
<tr>
<td>Tsurusaki et al., 2019</td>
<td>72</td>
<td>M</td>
<td>Lt ICA</td>
<td>13</td>
<td>Solitaire/Trevo/Penumbra</td>
<td>3</td>
<td>Pulmonary squamous cell carcinoma</td>
</tr>
<tr>
<td>Oyama et al., 2019</td>
<td>34</td>
<td>M</td>
<td>Lt ICA</td>
<td>17</td>
<td>Solitaire/Penumbra</td>
<td>2b</td>
<td>Pulmonary mucoepidermoid carcinoma</td>
</tr>
<tr>
<td>Yoshikawa et al., 2020</td>
<td>66</td>
<td>M</td>
<td>Rt M1</td>
<td>14</td>
<td>Trevo</td>
<td>3</td>
<td>Pleomorphic pulmonary carcinoma</td>
</tr>
<tr>
<td>Moriyama et al., 2021</td>
<td>64</td>
<td>M</td>
<td>Rt M2</td>
<td>10</td>
<td>Trevo/Penumbra</td>
<td>2b</td>
<td>Pulmonary squamous cell carcinoma</td>
</tr>
<tr>
<td>Fujiwara et al., 2022</td>
<td>74</td>
<td>M</td>
<td>Lt M2</td>
<td>22</td>
<td>Trevo</td>
<td>2b</td>
<td>Pulmonary squamous cell carcinoma</td>
</tr>
<tr>
<td>Present case</td>
<td>57</td>
<td>M</td>
<td>Rt ICA M1</td>
<td>11</td>
<td>Solitaire/REACT</td>
<td>3</td>
<td>Thyroid carcinoma</td>
</tr>
</tbody>
</table>

BA = basilar artery; N/A = not available; NIHSS = National Institutes of Health Stroke Scale Score; TICI = thrombolysis in cerebral infarction.
hemorrhagic complications. However, the embolus (Fig. 1C) was mainly a red thrombus, which was formed secondary to the tumor embolus (Fig. 4); hence, rt-PA could have been effective treatment.\textsuperscript{5} Instead, endovascular treatment was used emergently. The tumor embolism is usually soft and fragile. Therefore, retrieval with a stent retriever alone may fail complete removal. Oyama et al.\textsuperscript{6} recommended the use of an aspiration catheter to prevent distal migration of the embolus. On the contrary, Tsurusaki et al.\textsuperscript{7} reported that the push-and-flush technique using a Trevo Pro Vue Retriever (Stryker) was effective for a hard embolus. However, preoperatively, it is difficult to identify the cause of embolism as tumor embolus and the softness of the embolus. As shown in Table 1, a stent retriever was mainly used in the previous report and both stent retriever and aspiration catheter were effective for collecting tumor embolus. In this case, both origin and bifurcation of the right ICA were occluded, so-called "tandem lesion." The proximal part may have coagulated following blood stagnation and red thrombus was aspirated. The distal part was tumor embolus and retrieved successfully using a combination of stent retriever and aspiration catheter. The ASTER2 trial\textsuperscript{8} reported the superiority of a combined technique on first-pass effect and that it may be more effective in removing tumor embolus. Reviewing previous pathological studies of retrieved thrombi, Douglas et al.\textsuperscript{9} reported that patients with platelet-rich clots have poorer revascularization outcomes. The analysis of thrombus fragments retrieved in each pass revealed that the red blood cell contents of thrombus fragments retrieved in passes 1 and 2 were significantly higher than those retrieved in passes 3 to 6.\textsuperscript{10} Occasionally, a fragment of atheromatous plaque is identified in the occlusive thrombi retrieved from cerebral arteries, indicating an atherothrombotic etiology.\textsuperscript{11} The retrieved clot is not always sent for pathology but doing so facilitated a critical diagnosis.

Lessons
A case of cerebral tumor embolism of thyroid cancer is reported. Lung metastasis invading the pulmonary vein may have been the cause of tumor embolism. Mechanical thrombectomy using a combination of stent retriever and aspiration catheter is effective in the removal of tumor embolus, and pathological evaluation of the embolus is important.

References

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Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions
Conception and design: Fujiwara, Hayashi, Yamasaki, Uchimura, Kambara, Nagai. Acquisition of data: Fujiwara, Shibata, Yamasaki, Yamamoto, Uchimura, Nakagawa, Kambara, Nagai. Analysis and interpretation of data: Fujiwara, Yamasaki, Uchimura, Nakagawa. Drafting of the article: Fujiwara, Hayashi, Uchimura, Nagai. Critically revising the article: Fujiwara, Nagai. Reviewed submitted version of the manuscript: Uchimura. Approved the final version of the manuscript on behalf of all authors: Fujiwara. Administrative/technical/material support: Furuta, Uchimura, Nagai, Akiyama. Study supervision: Hayashi, Nagai, Akiyama.

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