Online October 8, 2024
Journal of Neuroendovascular Therapy 2024; 18: 321–325
DOI: 10.5797/jnet.cr.2024-0068

Case Report

A Steerable Microcatheter Effectively Worked in Tumor Embolization

Ryuta Yasuda, Naoki Toma, Seiji Hatazaki, Fuki Goto, Shota Ito, Yotaro Kitano, Genshin Mouri, and Hidenori Suzuki

Objective: A Leonis Mova (LM; SB Kawasumi, Kanagawa, Japan), one of the steerable microcatheters, has a remote-controlled flexible catheter tip manipulated with a dial in the hand grip, which enables operators to overcome complicated branching in endovascular surgeries. We report a case of a pituitary tumor in which the LM worked effectively as a distal access catheter (DAC) in tumor embolization.

Case Presentation: A female patient in her 70s complained of bitemporal hemianopsia, and an MRI revealed a pituitary tumor that appeared hypervascular. The right internal carotid artery angiography demonstrated a prominent stain from a tumor vessel derived from the meningohypophyseal trunk (MHT). Tumor embolization was scheduled before its removal due to the hypervascularity. In the tumor embolization, the tip of the LM was bent toward the orifice of the right MHT, through which a 1.3F–1.8F 155 cm microcatheter along with a 0.010-inch 200 cm microguidewire was advanced. Locking the LM tip provided good support for the microcatheter and the microguidewire to proceed to the tumor vessel. Successful tumor embolization was achieved with an injection of 0.21 ml of 12.5% n-butyl-cyanoacrylate. Thanks to the tumor embolization, gross total removal of the pituitary tumor was transshenoidally accomplished with the least blood loss. Histopathological diagnosis of pituicytoma was made, and the intraoperative blood loss of 100 ml seemed small for this histology. The patient recovered from the bitemporal hemianopsia and was discharged without a blood transfusion.

Conclusion: This is the first report in which the LM was used and well worked in tumor embolization as a DAC.

Keywords ▶ steerable microcatheter, distal access catheter, tumor embolization

Introduction

Preoperative tumor embolization is helpful for the following tumor removal by minimizing blood loss and softening the tumor. Hypervascular sellar and parasellar tumors are often fed by dural branches of the internal carotid artery (ICA), including the meningohypophyseal trunk (MHT) and the inferolateral trunk (ILT).[1–3] These branches are usually hard to selectively catheterize due to the steep branching angle between the target vessels and the ICA, and the discrepancy of the vessel diameter between the target vessels (small) and the ICA (large).[2,3]

A Leonis Mova (LM; SB Kawasumi, Kanagawa, Japan) is one of the steerable microcatheters with a flexible catheter tip controlled by a dial in the handle grip, which enables operators to adjust the projection of the catheter tip manually and, therefore, to overcome complex branching in endovascular surgeries. In addition, the adjusted tip can be locked using the dial stopper to maintain the intended projection, which provides good support for devices in reaching the target position (**Fig. 1**).[4]

We report a case of a pituitary tumor in which the LM effectively worked as a distal access catheter (DAC) in tumor embolization.

Department of Neurosurgery, Mie University Graduate School of Medicine, Tsu, Mie, Japan

Received: July 11, 2024; Accepted: August 27, 2024
Corresponding author: Ryuta Yasuda. Department of Neurosurgery, Mie University Graduate School of Medicine, 2-174 Edobashi, Tsu, Mie 514-8507, Japan
Email: yasudar1@gmail.com

Fig. 1 Steerable microcatheter (LM). The LM has a steering dial at the proximal grip (white arrowhead), which enables operators to optimally adjust the projection of the catheter tip. The dial can be turned in 2 opposing directions (white and black arrows at the grip), and the catheter tip is correspondingly bent up to 180° in each direction (white and black arrows at the catheter tip). Once the catheter tip is adjusted to the optimal projection, the dial stopper (black arrowhead) can lock the dial so that the projection of the catheter tip can be secured. An original image in this figure is provided by SB Kawasumi with their approval in publishing this article. LM, Leonis Mova

Case Presentation

A female in her 70s was referred to our hospital to treat a pituitary tumor that was detected with an MRI obtained for temporal hemianopsia (**Fig. 2A** and **2B**). The blood test, including hormone and tumor marker, was negative. Because MRI findings suggested hypervascularity of the tumor (**Fig. 2C** and **2D**), cerebral angiography was performed. The right ICA angiography demonstrated that a prominent tumor vessel derived from the MHT supplied almost the entire body of the tumor (**Fig. 3A** and **3B**). To minimize blood loss during tumor resection, endovascular embolization of the tumor vessel was planned. Because it seemed hard to select the MHT from the ICA, the LM was employed as a DAC for selective catheterization to the MHT.

Endovascular surgery

Under general anesthesia, an 8F 90 cm balloon guiding catheter (Optimo; Tokai Medical Products, Aichi, Japan) and a 6F 113 cm DAC (Cerulean DD6; Medikit, Tokyo; Japan) were placed on the right cervical ICA and the prepetrous ICA, respectively. The 2.9F 130 cm LM of high flow type was advanced to the proximity of the MHT, and its tip was bent and fixed toward the MHT orifice. Through the LM, a 1.3F–1.8F 155 cm microcatheter (Carnelian Marvel S 1.3; Tokai Medical Products) along with a 0.010-inch 200 cm microguidewire (CHIKAIx010; Asahi Intecc, Aichi, Japan) was introduced into the MHT. When the fixed tip of the LM was released before the microguidewire was advanced into the MHT far enough, the LM, the microcatheter, and the microguidewire were swept together distally (**Fig. 3C**). After the failure, the LM was secured near the orifice of the MHT (**Fig. 3D**) until the microguidewire advanced far enough distally in the tumor vessel. This provided good support for the microguidewire and the following microcatheter (**Fig. 3E**), which resulted in successful catheterization (**Fig. 3F**). Tumor embolization was completed with injection of 0.21 ml of 12.5% n-butyl-cyanoacrylate (NBCA). The NBCA cast represented satisfactory tumor embolization, which was also confirmed with the final right ICA angiography (**Fig. 3G** and **3H**).

Postoperative course

Transsphenoidal tumor removal was performed 6 days after the endovascular surgery. Because tumor bleeding was controllable all through the procedure, the intratumoral reduction was easily done, which facilitated efficient tumor resection. Gross total removal was achieved with intraoperative blood loss of 100 ml. A histopathological diagnosis of pituicytoma was made (**Fig. 4**), and the amount of blood loss seemed small for this histology.[5] The patient recovered from the bitemporal hemianopsia and was discharged without a blood transfusion.

Discussion

The LM was developed in 2014[4] and was officially approved in Japan for use in the head and neck region in November 2022.[6,7] Because of the ability to overcome complex branching with the steerable tip, they have been employed in various endovascular surgeries, including aneurysm treatment, mechanical thrombectomy, and embolization for shunting diseases and chronic subdural hematoma (**Table 1**).[6–11] In these previous procedures, they have mainly worked as a 0.035-inch guidewire, a stiff wire, or an obturator to navigate the subsequent guiding catheters, DACs, or aspiration catheters.[8] Otherwise, they have also been used as a microcatheter to deliver therapeutic devices or to be exchanged with other microcatheters suitable for treatment purposes.[6–11]

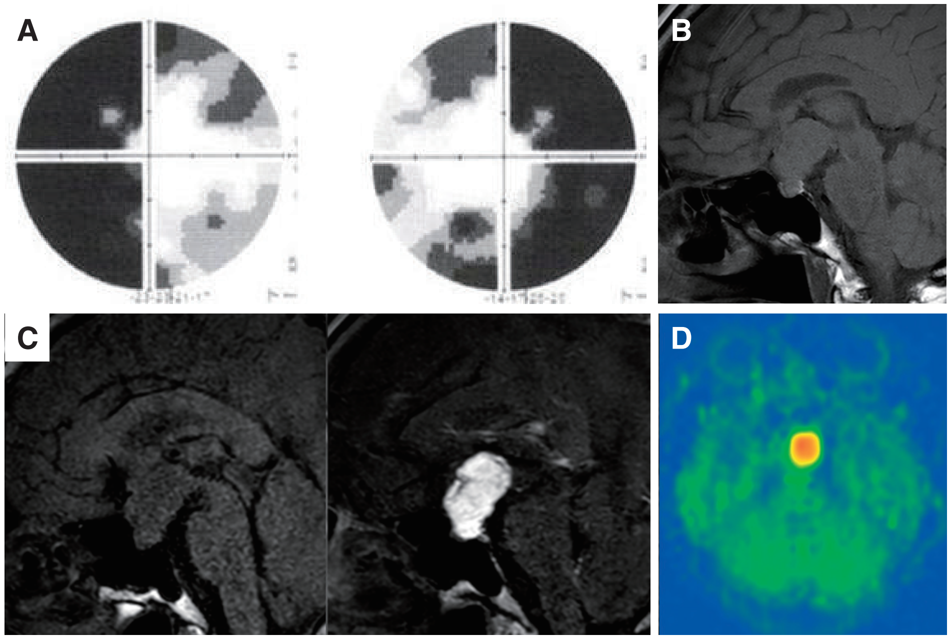

Fig. 2 (**A**) Visual field examination of the patient demonstrates bitemporal hemianopsia. (**B**) MRI T1-weighted imaging shows a pituitary tumor that extends to the suprasellar region compressing the chiasma. (**C**) Dynamic imaging obtained 0 second (left) and 10 seconds (right) after contrast injection. Almost simultaneously enhancement of the tumor compared with the normal pituitary gland is observed, which suggests the rich vascularity of the tumor. (**D**) Pseudo-continuous arterial spin labeling also suggests hypervascularity of the tumor.

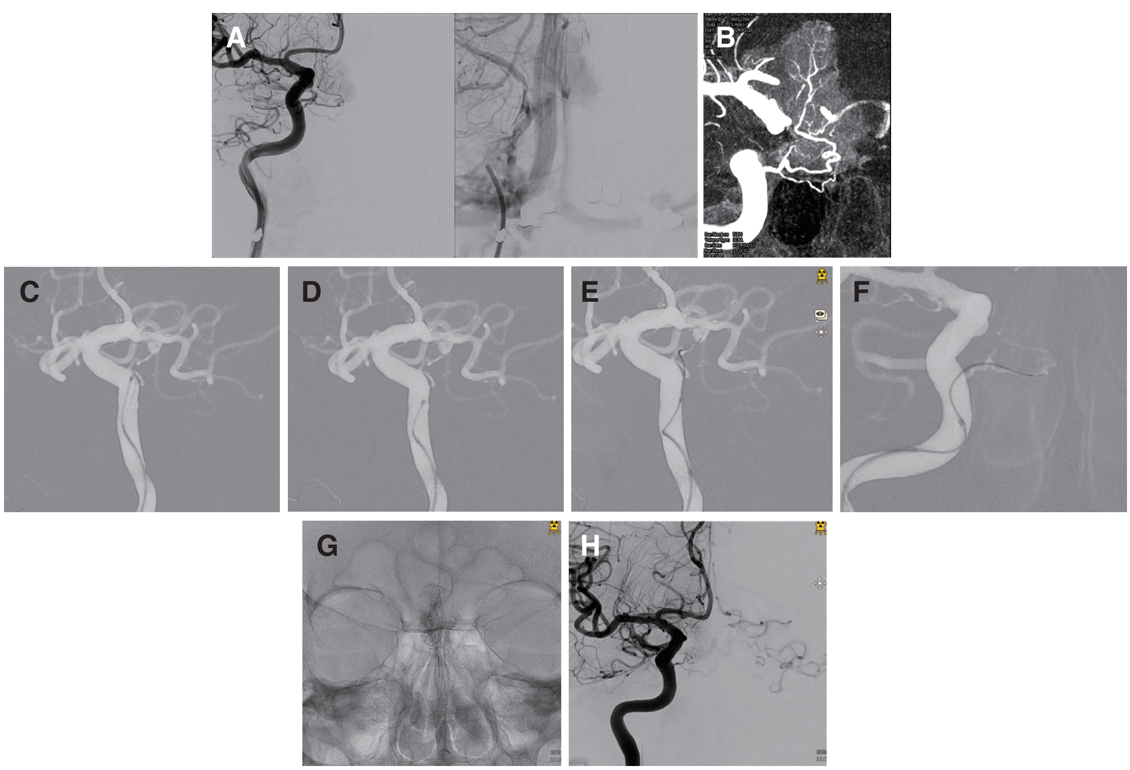

Fig. 3 Right ICA angiography demonstrates a conspicuous tumor stain remaining in the venous phase due to the rich vascularity (**A**). The tumor vessel is derived from the inferior hypophyseal artery, one of the branches of the meningophypophyseal trunk (**B**). In tumor embolization, the tip of an LM in the right ICA is bent toward the orifice of the meningohypophyseal trunk and fixed. However, premature release of the fixed LM tip results in the sweeping out of the LM, a microcatheter, and a microguidewire (**C**). Therefore, the LM tip has been secured (**D**) until the microguidewire and the following microcatheter advance distal enough (**E**), which results in successful catheterization (**F**). Note that while the secured LM is deflected, it still supports the advancement of the microguidewire and the microcatheter (**E**). Liquid embolic agent is well distributed in almost entire the tumor (**G**) and satisfactory tumor embolization is confirmed with the final right ICA angiography (**H**). ICA, internal carotid artery; LM, Leonis Mova

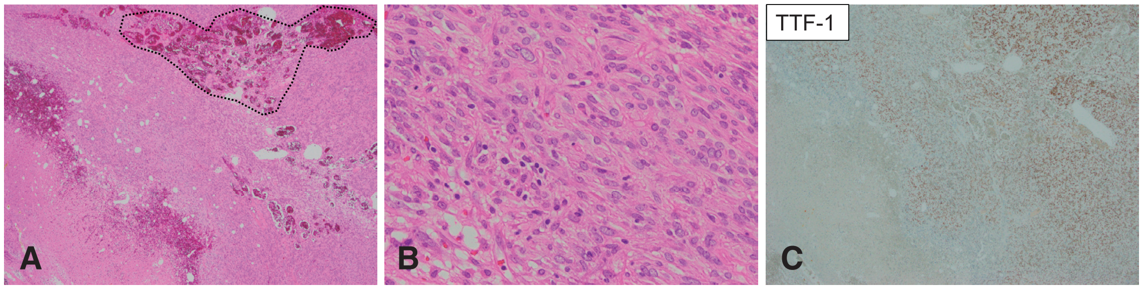

Fig. 4 (**A**) In H&E staining (40×), there are tumor cells in the middle, and necrosis is seen on the left side of the field. On the right side, embolic materials in the tumor vessels are seen (dotted area) beside tumor cells. (**B**) In H&E staining (100×), the tumor cells appear spindle shaped and have a quasi-circular nucleus with strong staining. Their fluent array implies a pituicytoma rather than a pituitary neuroendocrine tumor. (**C**) Tumor cells are positive for immunohistochemical staining for TTF-1. By contrast, they are negative for immunohistochemical staining for synaptophysin and chromogranin (not shown). H&E, hematoxylin and eosin

Table 1 The previous cases treated with endovascular surgery using steerable microcatheters

Author	Indication	Treatment	SM	Role of SM	N	Total
Qiao[8]	Aneurysm	Coil	Bandit 21	MC	2	21
Killer-Oberpfalzer,[9] Berenstein[10]		SAC	Bandit 21	MC	3	
Killer-Oberpfalzer[9]		Contour	Bandit 21	MC	6	
Killer-Oberpfalzer[9]		Contour + coil	Bandit 21	MC	1	
Qiao,[8] Inoue[6]		FD	Bandit 21, LM-SEL	MC	5	
Killer-Oberpfalzer,[9] Berenstein[10]		FD + coil	Bandit 21	MC	1	
Killer-Oberpfalzer[9]		FD + contour	Bandit 21	MC	1	
Qiao,[8] Devarajan[11]		WEB	Bandit, Bandit 21	MC	2	
Qiao[8]	AIS	Aspiration	Bandit 21	MC	1	4
Qiao[8]		Aspiration + SR	Bandit 21	MC	3	
Killer-Oberpfalzer[9]	AVM	TAE	Bandit 21	MC	2	2
Qiao[8]	CSDH	TAE	Bandit 21	MC	1	1
Tokuyama[7]	DAVF	TVE	LM-STD, LM-HF	MC, DAC	4	13
Tokuyama[7]		TAE + TVE	LM-HF	DAC	4	
Tokuyama[7]		TVE + TAE	LM-STD, LM-HF	MC, DAC	5	
Qiao,[8] Killer-Oberpfalzer[9]	Stenosis	Stent	Bandit 21	MC	2	2
Present case	Tumor	TAE	LM-HF	DAC	1	1

AIS, acute ischemic stroke; AVM, arteriovenous malformation; CSDH, chronic subdural hematoma; DAC, distal access catheter; DAVF, dural arteriovenous fistula; FD, flow diverter; HF, high flow type; LM, Leonis Mova; MC, microcatheter; N, the number of cases; SAC, stent-assisted coiling; SEL, selective type; SM, steerable microcatheter; SR, stent retriever; STD, standard type; TAE, transarterial embolization; TVE, transvenous embolization; WEB, Woven EndoBridge

Besides these usages, the LM of high flow type can be used as a DAC because of the largest lumen among the LM series that is compatible with 0.025-inch guidewires. Tokuyama et al. reported that the LM of high flow type was employed in 12 of 16 procedures of selective transvenous embolization for dural arteriovenous fistulas to advance a 1.6F or 1.9F microcatheter more distally, emphasizing its usefulness over the LM of standard type.[7]

Our case was the first to employ the LM as a DAC for tumor embolization. Because it is generally hard to select branches with small diameters arising from a vessel with a relatively large diameter, the LMs inherent in an adjustable tip must be helpful for selective catheterization. We selected the coaxial system with the LM high flow type and a 1.3F-1.8F microcatheter rather than the LM standard type alone because the diameter of the tumor vessel appeared too small for the LMs to advance to the appropriate position. Note that the LM of high flow type is compatible with microcatheters whose thickness is 1.9F or less, and thus, Carnelian Marvel (Tokai Medical Products) S 1.3 (1.3F–1.8F), S (1.6F–1.8F), and Non-Taper (1.9F) can only meet the criteria in our country as of writing this paper. In addition to the adjustable tip, its ability to fix the bent tip of the LM also assists selective catheterization. In our case, the premature release of the fixed LM tip resulted in the sweeping out of all devices. Therefore, it is important to secure the tip of the LM to support a microguidewire and the following microcatheter until they advance distal enough.

Besides the MHT shown in our case, the ILT, another dural branch of the ICA, is also hard or even harder to selectively catheterize due to the same reasons described above. Hirohata et al. overcame these branches by modifying the tip of microcatheters into a J-shape and the tip of microguidewires into a C, S, or J-shape.[2,3] We believe that the LM is also useful in catheterizing the ILT.

Conclusion

This is the first case report in which an LM effectively worked in tumor embolization as a DAC.

Acknowledgments

An original image in **Fig. 1** was provided by SB Kawasumi with their approval in publishing this article.

Disclosure Statement

The authors have no conflict of interest to disclose when presenting this article.

References

1) Ogawa Y, Sato K, Matsumoto Y, et al. Evaluation of fine feeding system and angioarchitecture of giant pituitary adenoma—implications for establishment of surgical strategy. *World Neurosurg* 2016; 85: 244–251.
2) Hirohata M, Abe T, Fujimura N, et al. Preoperative embolization of brain tumor with pial artery or dural branch of internal carotid artery as feeding artery. *Interv Neuroradiol* 2006; 12(Suppl 1): 246–251.
3) Hirohata M, Abe T, Morimitsu H, et al. Preoperative selective internal carotid artery dural branch embolisation for petroclival meningiomas. *Neuroradiology* 2003; 45: 656–660.
4) Soyama T, Yoshida D, Sakuhara Y, et al. The steerable microcatheter: a new device for selective catheterisation. *Cardiovasc Intervent Radiol* 2017; 40: 947–952.
5) Guerrero-Pérez F, Marengo AP, Vidal N, et al. Primary tumors of the posterior pituitary: a systematic review. *Rev Endocr Metab Disord* 2019; 20: 219–238.
6) Inoue S, Fujita A, Kurihara E, et al. Steerable microcatheter for distal access of a giant cavernous carotid artery aneurysm during treatment with Pipeline Embolization Device: a case report and review of the literature. *Surg Neurol Int* 2024; 15: 40.
7) Tokuyama K, Kiyosue H, Hori Y, et al. Utility of a steerable microcatheter for the selective transvenous embolization of dural arteriovenous fistulas. *J Neuroendovasc Ther* 2023; 17: 153–158.
8) Qiao Y, Zhang YJ, Tsappidi S, et al. Initial clinical experience with the Bendit steerable articulating tip microcatheter for intracranial access and intervention. *Interv Neuroradiol* 2023; 15910199231193931. [Online ahead of print]
9) Killer-Oberpfalzer M, Chapot R, Orion D, et al. Clinical experience with the Bendit steerable microcatheter: a new paradigm for endovascular treatment. *J Neurointerv Surg* 2023; 15: 771–775.
10) Berenstein A, Chapot R, Orion D, et al. Clinical and simulated experiences with the bendit articulating/steerable microcatheter in endovascular treatment: 2-dimensional operative video. *Oper Neurosurg (Hagerstown)* 2023; 25: e36–e37.
11) Devarajan A, Al-Kawaz M, Giovanni B, et al. Placement of an intrasaccular flow diverter in an intracranial sidewall aneurysm using the Bendit articulating microcatheter. *J Neurointerv Surg* 2023; jnis-2023-020529. [Online ahead of print]