Usefulness of Oily Iodine Contrast Medium for Embolization of Meningioma

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Objective: Focusing on the effect of oily contrast medium as an embolic agent, we performed embolization of meningioma. Its usefulness is reported.

Case Presentations: A flow guide catheter was advanced through the feeding blood vessel to the tumor as close as possible, and 1.0 mL–2.0 mL of undiluted oily contrast medium was injected. The contrast medium did not flow out, and it was retained in the tumor. The proximal portion was then embolized with 33%–40% N-butyl cyanoacrylate (NBCA). On pathological examination of the excised specimen, the embolized blood vessel and tumor necrosis were noted, showing time-course progression of necrosis and softening.

Conclusion: This method is superior in visibility and injection control because of the use of oily contrast medium. The flow guide microcatheter is easy to guide close to a tumor and insert into thin and tortuous blood vessels. So this is applicable for skull base tumors, showing its usefulness.

Keywords ▶ meningioma, embolization, iodized lipid

Introduction

Preoperative embolization is performed before excision of brain tumors including meningioma to reduce blood loss and shorten the surgery time. Particle embolic materials, such as microspheres and polyvinyl alcohol (PVA), liquid embolic agents, such as N-butyl cyanoacrylate (NBCA), and platinum coils are used as embolic materials. Focusing on the effect of iodized ethyl esters of poppy seed oil (lipiodol, TERUMO, Tokyo), which is an oily contrast medium used to dilute NBCA, we performed embolization in combination with proximal embolization using NBCA. We report the usefulness of this method with a literature review.

Case Presentation

Case 1: 48-year-old female

The patient visited the Department of Internal Medicine for a chief complaint of visual field defect, and she was referred to our department because a mass was observed in the frontal region. Higher brain dysfunction such as hypobulia and bitemporal hemianopia had appeared. On head MRI, a brain tumor arising from the anterior skull base accompanied by extensive edema around it was observed (Figs. 1A and 1B), and intense staining of the tumor fed by the bilateral posterior ethmoidal arteries was noted on angiography (Figs. 1C and 1D).

Embolization

A 5-Fr long sheath was inserted into the right femoral artery under local anesthesia. After intravenous injection of 2000 units of heparin, 5FrSlimGuide (Medikit, Tokyo) was placed in the left internal carotid artery with coaxial 125-cm 4FrOK2 (KATECS, Tokyo) and a 150-cm 0.035-inch guide. Using Marathon (Covidien Japan, Tokyo), Tenrou10 (Kaneka Medix, Osaka) was guided to the left ophthalmic artery. The guide wire was then changed to Chikai 0.008 inch (ASAHI INTECC, Aichi), the left posterior ethmoidal artery was selected, and it was guided to the tumor as close as possible. Under
angiography, 2.0 mL of lipiodol was slowly injected into the
tumor so as to prevent inflow into the central retinal artery
through reflux into the ophthalmic artery. Lipiodol was retained
in and filled the tumor (Figs. 1E and 1F). The root was then
embolized with 33% NBCA. NBCA did not reach the tumor
vascular bed, and it remained as embolization of the proximal
portion.

The right ophthalmic artery was not embolized because its
angle of branching from the internal carotid artery was very
sharp and selective insertion of Marathon was not applicable.

Course after embolization
On CT after embolization, the contrast-enhancing effect
remained mainly on the left side of the tumor (Fig. 1G).
Tumor excision by craniotomy was performed on the fol-
lowing day. The tumor attached to the bilateral anterior skull
bases, but blood loss during detachment and internal decom-
pression was small on the embolized left side, and surgery
could be easily performed. On pathological examination,
tumor cells were arranged in a whorl appearance on the right
non-embolized side. Although no dysplasia was present,
infiltration was noted in a part of the brain, based on which
invasive meningioma was diagnosed. On the embolized left
side, a dilated blood vessel containing no blood cell compo-

tent assumed to be occluded by lipiodol and surrounding
coagulation necrosis were observed (Fig. 1H).

Case 2: 84-year-old female
A mass in the posterior cranial fossa was pointed out 6 years
earlier, but she refused treatment because of her age, and
course observation was selected. She visited us for chief
complaints of dementia and gait disturbance progressing
over one month. Enlargement of the tumor and ventricular
dilatation were observed. The patient requested treatment
and was admitted. An intensely stained tumor with a maxi-


mum diameter of 50 mm was noted in the convexity of the
left posterior cranial fossa on head MRI and a tumor fed by
the left posterior meningeal artery was noted on cerebral
angiography (Figs. 2A and 2B).

Firstly, third ventriculostomy was performed to treat
hydrocephalus.

Embolization
A 6-Fr long sheath was inserted into the right femoral artery
under local anesthesia, and 6FrSlimguide was guided to the
left vertebral artery. Marathon was guided to the posterior
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Treatment of the above two patients was performed after obtaining informed consent.

Discussion

The objective of tumor embolization is to decrease blood loss during excision, make internal decompression and dissection easier, and shorten the operative time to safely excise the tumor. Borg et al. reported a study with 117 cases embolized with particles or glue, in which the blood transfusion volume significantly decreased in the group with complete resolution of the tumor shadow compared with that in the partially embolized group, and complication occurred in 4 (3.7%). In a review by Shah et al., the complication rate was 4.6% in 459 cases of embolization in 36 studies, but most complications were transient, and the possibility of reducing the risk of embolization by selecting appropriate cases and expansion of the indication were mentioned.

meningeal artery using Tenrou14 and to the distal region using Chikai 0.008 inch. After confirming the absence of a collateral circulation to the normal cerebral blood vessel, 1.0 mL of lipiodol was injected into the vertebral artery so as to prevent reflux (Fig. 2C). The proximal portion was then embolized with 40% NBCA, and the intense staining of the tumor mostly disappeared (Fig. 2D). On head CT after embolization, lipiodol accumulation in the tumor was observed (Fig. 2E), and contrast enhancement was lost in the most part of the tumor on contrast MRI after 5 days (Fig. 2F).

Course after embolization

Tumor excision by craniotomy was performed after 6 days. The tumor was exposed to outside the dura during craniotomy, but hemorrhage could be easily controlled. The tumor had been softened when it was excised, and internal decompression by suction was possible. The macroscopic specimen is shown in Fig. 2G. On pathological examination, hemorrhage was partially noted, but degeneration and hyalinization were noted, showing softening of the tumor (Fig. 2H). The nucleus was lost and the cell body showed advanced necrosis in most tumor cells, and infiltration by foamy cells was observed (Fig. 2I).
Particle embolic materials, liquid embolic agents, and platinum coils are used for tumor embolization. Platinum coils alone remain proximal to the tumor blood vessel, and it reduces blood loss during craniotomy, but it is not very effective to reduce blood loss during internal decompression and tumor dissection. When the middle meningeal artery is embolized in the proximal portion, blood flow from the opposite meningeal artery and pial artery increases and may interfere with operation.

Particle embolic materials include microspheres, PVA, Spongell, and Gelpart. To use these, an inner diameter of 0.018 inch or larger is necessary to avoid obstruction of the inner lumen of the microcatheter, and it is difficult to apply to a thin feeding blood vessel or guide a microcatheter close to a tumor by passing through bending and tortuous regions. Injection of an embolic agent from a distant proximal portion from the tumor increases the possibility of cranial neuropathy by ischemia of the nerve-feeding branch and aberration of the embolic agent through dangerous anastomosis, and it may be inapplicable for a tumor arising from the skull base surrounded by many important normal thin blood vessels. There is also a risk of tumor hemorrhage caused by obstruction of the outflow vein. Carli et al. reported that complications developed in 11 of 198 cases embolized with PVA, and the complication was hemorrhage in 10 cases, showing that the use of small-diameter particles is a risk factor. Sluzewski et al. reported that no hemorrhagic or ischemic complications occurred in 55 cases embolized with microspheres, but the target blood vessel was the middle meningeal artery or the occipital artery.

A liquid embolic agent, NBCA, can be guided to a small blood vessel and a distal site using a thin microcatheter. However, due to adhesiveness of NBCA and viscosity of lipiodol, tumor vascular bed cannot be embolized and embolization remains in the proximal portion in a tumor-feeding blood vessel with a slow flow rate in many cases. Kominami et al. reported safety of embolization mainly with NBCA compared with embolization with particles, although embolization remained in the proximal portion in some cases. Fukuda et al. reported the usefulness of low concentration NBCA diluted warmed lipiodol, which enabled embolization of the tumor vascular bed, but it makes the preparation complex. Aggravation of cerebral edema and intratumor hemorrhage due to obstruction of the outflow vein in cases with an arteriovenous shunt has been reported. It is desirable to select an embolic agent after confirming the presence or absence of a shunt by superselective angiography through a microcatheter.

Lipiodol was developed as a contrast medium for the lymphatic system and it is used for lymphangiography and salpingography. The viscosity is 27–54 mm²/s at 20°C and this is more than 10 times higher than that of non-ionic contrast medium used for cerebral angiography. In a study on liver cancer therapy, lipiodol was mixed with anticancer drugs and injected into the hepatic artery, utilizing the property of stagnating in tumor blood vessels and sinusoids, which resulted in sustained release of the anticancer drug for hepatocellular carcinoma and the 5-year survival rate of advanced liver cancer patients was improved. Improvement of the outcomes by the addition of embolization with a particle embolic material has been reported, suggesting that the addition of proximal embolization prolonged sustained release of drugs and stagnation of lipiodol.

When lipiodol is slowly injected to avoid reflux, it stagnated in the tumor and intense staining remained. Since it is contrast medium and used undiluted, its visibility while being injected into tumors is superior. Since it stagnates in tumors, it is easy to identify the grade of embolization. It slowly stagnates in the tumor compared with the rate immediately after initiation of injection, showing a reduction of the flow rate. Since its viscosity is high, it may remain in the tumor in a tumor blood vessel with a slow flow rate. Lipiodol alone may flow out with time and the tumor blood circulation may re-open, but the addition of proximal embolization with NBCA eliminates blood flow in the target feeding blood vessel and exhibits a tumor blood vessel-embolizing effect. On pathological examination, although lipiodol was lost during the sample fixation process, a dilated thin tumor blood vessel containing no blood cell component and surrounding coagulation necrosis indicate that the tumor vascular bed was embolized and tumor cells were necrotized by ischemia.

Since it is possible that blood flow in normal blood vessels is disturbed and cells are impaired by the alcohol component contained in the agent, attention should be paid to flow out into nerve-feeding blood vessels and aberration into the internal carotid and vertebral artery systems through dangerous anastomosis, similar to the use of other embolic agents.

Regarding the time to craniotomy after embolization, Nania et al. reported that the blood transfusion volume decreased when excision was performed 7 days after embolization and thereafter. In our patients, progression of necrosis and degenerative findings were observed when excision was performed after 6 days compared with those in cases in which excision was performed on the following day, showing that it is desirable to set an interval between embolization and excision, but detailed investigation involving increased cases is necessary to set the optimum time.

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Conclusion

A method of embolization of meningioma using lipiodol as an embolic agent was reported. This method is superior in visibility and injection control because oily contrast medium is used. In addition, guiding it into thin and tortuous blood vessels is easy because a thin microcatheter is used, and the method is applicable to skull base tumor.

Disclosure Statement

The first author and all the co-authors have no conflict of interest.

References