Herein, we describe hybrid vascular surgery for AVM at calf muscle (embolization of the feeding artery with subsequent immediate excision of the AVM).

CASE REPORT

A 38-year-old man was suffering from spontaneously developed painful calf mass on left lower leg from the past 2 months. The patient complained sharp, clumping pain and tingling sensation in the mass. Numeric rating scale for pain was checked as 4. The patient did not have any other medial disease or medication history. Apart from history of trauma at right lower extremity, there were no other surgical histories. The patient was a non-smoker, and non-alcoholic. Systolic pressure was 120 mmHg, and diastolic pressure was 70 mmHg. Pulse rate was 70/min. The physical characteristics like height, and weight were 170.6 cm, and 55.2 kg, respectively. Physical examination of patient revealed swelling, and presence of fixed soft tender palpable mass in left posterior medial calf area. There were no other signs of redness or heating. Pathological analysis revealed hemoglobin level as 14.1 g/dL, hematocrit value as 42.1%, and platelet count as 215,000/μL. The

Key Words: Arteriovenous malformations, Vascular surgical procedures, Therapeutic embolization
other laboratory tests, including blood chemistry, and coagulation profile were all within normal ranges. A simple radiograph showed no abnormal findings. Magnetic resonance imaging of lower extremity revealed a 1.6×1.6×2.7 cm sized round shaped T1 iso and T2 bright high signal intensity lesion in medial aspect of soleus muscle in left lower extremity. The lesion exhibited multiseptated appearance with heterogeneous enhancement. Certain engorged vascular structures were present around the lesion along with feeding and draining vessels. The mass was considered as a tumor of vascular origin (Fig. 1A∼D). Therefore, we decided to combine embolization and surgical excision of AVM, a sort of hybrid vascular surgery.

*Figure 1. Radiologic findings of arteriovenous malformation in the soleus muscle. (A, B) Axial and coronal T1-weighted magnetic resonance (MR) image shows iso-intense lesion in medial aspect of soleus muscle in left lower extremity. (C, D) T2-weighted MR image shows bright, highly intense, and round shaped lesion with dimensions of 1.6×1.6×2.7 cm. (E) Angiogram of left lower extremity arteries: digital subtraction angiography shows about 4 cm sized vascular malformation feed from left posterior tibial artery. (F) Post-embolization arteriogram: feeding artery was successfully embolized with gelfoam and microcoil.*

*Figure 2. Macro- and microscopic findings of arteriovenous malformation in the soleus muscle. (A) Arrow indicates embolized feeding artery which is arized from posterior tibial artery. (B) The cut section of resected specimen reveals mixed fibrofatty tissue and muscle containing several medium-sized blood vessels. (C) At the low power view, a mixture of varying sized vessels, fatty tissue, and muscular tissue is noted (H&E stain, ×12.5). (D) A thick walled vessel with embolization material is noted on the upper portion (arrow), and area of mixed fatty and muscular tissue is seen on the center (H&E stain, ×40). (E) Some vessel has fibrously thickened wall with osseous metaplasia (H&E stain, ×100). (F) Artery (arrow) and dilated vascular channel (asterisk) are connected within the muscle bundles. Factor-VIII highlights endothelial cells in both artery and vascular channel (Factor-VIII stain, ×100)*
To prevent any possible bleeding during mass excision, we decided to proceed with preoperative embolization. Because our hospital did not have hybrid operation room, the patient was first managed at the intervention room and moved to the operation room. In the intervention room, the patient was placed in the supine position on the fluoroscopy table. The inguinal area was cleaned and draped in standard sterile fashion. Under lidocaine 1% local anesthesia, a 6 Fr introducer sheath was placed in right common femoral artery. A 0.035-guide wire was advanced to left femoral artery through introducer sheath at right femoral artery. A Cobra catheter (Cook Medical, Bloomington, IN, USA) was inserted over the guidewire and directed towards left femoral artery. An angiogram with Cobra catheter showed about 4 cm sized vascular malformation feed from left posterior tibial artery (Fig. 1E). The feeding branch from posterior tibial artery was successfully embolized with gelform and microcoil (Cook Medical) (Fig. 1F). There was no acute complication after the embolization procedure.

Subsequently, the patient was moved to operating theater. Under spinal anesthesia, the patient was placed on supine position. Left lower extremity was prepared and draped in standard sterile fashion without tourniquet. The location of mass was confirmed and skin marking was done with Doppler ultrasound for exact skin incision. A 7 cm longitudinal skin incision was made above the mass. After dissection of subcutaneous tissue and soleus muscle, blood containing tortuous bunch (dark cherry-colored lesion) was located in soleus muscle. Meticulous dissection along the margin of mass revealed posterior tibial artery. Another meticulous dissection along the tibial artery revealed feeding artery into the hemangioendothelioma, which had been embolized previously (Fig. 2A). The feeding artery and the draining veins were carefully isolated and ligated. In the good field of vision, en bloc excision of the mass was done immediately, for complete removal of the AVM. After wound irrigation and complete hemostasis, a Penrose drain was placed. Prophylactic fasciotomy was not performed. The wound was closed layer by layer and there was no necessity for blood transfusion. The leg was not swell postoperatively. The penrose drain was removed with small amount of discharge 3 day after operation. Postoperative pathological examination revealed hemoglobin level as 13.5 g/dL, hematocrit value as 40.8%, and platelet count as 316,000/μL. The pathology revealed a thick walled vessel containing intraluminal embolization material, intermixed fatty component and skeletal muscle (Fig. 2B−D). Some area shows fibrous vessel wall with osseous metaplasia communicating with muscle bundles (Fig. 2E, F). The patient was discharged by postoperative sixth day without any complications.

DISCUSSION

Vascular malformations can be divided according to vascular channel type (capillary, lymphatic, venous, arterial, or combinations thereof) or blood flow (slow versus fast). Slow-flow vascular lesions include capillary malformations, lymphatic malformations, and venous malformations. Fast-flow lesions include arteriovenous fistulae and AVMs. According to Hamburg classification, AVMs are classified as truncular lesions and extratruncular lesions.9 The truncular lesions are divided into superficial lesions and deep lesions. The extratruncular lesions are divided into the infiltrating lesions and the limited lesions. In general, vascular malformations are treated with sclerotherapy, embolization, or surgical excision.10

In the present study, the patient had painful limited mass lesion at left calf muscle that was indicated en bloc resection of mass including a nidus of the AVM to prevent recurrence.11 However, AVMs have abnormal connections between feeding arteries and draining veins. Surgical treatment could induce massive bleeding during the operation due to high arterial blood flow. Nevertheless, preoperative embolization or sclerotherapy may decrease intraoperative blood loss and increase the likelihood of clinical success of operations. Such combined modalities with endovascular and conventional surgery, namely hybrid operation, have been developed in the field of vascular surgery with demonstrable improvements in surgical results.12 There are no clear indications of preoperative embolization. However, strict surgical approach is discouraged and today vascular malformations should be attended to and treated by multidisciplinary approach to improve the results.

Herein, we report a case of intramuscular AVM in the left soleus muscle, which was successfully treated with hybrid surgical approach. Magnetic resonance imaging revealed engorged vascular structures with the findings of feeding and draining vessels. Lower extremity angiography was performed to identify and embolize the feeding artery. The hybrid surgical approach was proven successful in removing AVMs with good field of vision. Minimal blood loss was noted in patients, though blood transfusion was not required. Moreover, hemoglobin level was also maintained. The patients showed no perioperative complications.13

There are a previous report mentioned about preoperative embolization for surgery of AVMs; however, there is no clear indication about time interval between embolization and excision.13 However, in case where the feeding artery is closed with embolization, a patient can be discharged by postoperative sixth day without any complications.
lization, the AVM including nidus should be removed as soon as possible. Because there was a possibility of fast growth of other collateral vessels and quiescent AVMs, AVMs could be bigger than before. In addition, if the feeding artery of the AVM is ligated without removal of nidus of AVM, further embolization will be impossible due to there will be no accessible route for interventional approach. However, one day interval between two procedures may be compatible to the patient. In the present case, 38 years old patient without comorbidity could undergo simultaneous two procedures.

In conclusion, we propose that focal AVMs can be excised with good results. The goal of the operation was complete excision to normal margins with removal of the nidus of the AVM. In terms of bloodless operation and improved results, AVM can be safely removed via combination of embolization and surgical excision, termed as hybrid operation.

REFERENCES


