Percutaneous radiofrequency ablation: A novel treatment of facial venous malformation

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We performed radiofrequency ablation to treat a symptomatic facial venous malformation of a 24-year-old woman under ultrasound scan-guidance. The 20.25-cm sized original facial venous malformation in her right cheek markedly reduced without any scar formation and was grossly not visible after 1 month of the procedure. In the 3-month follow-up magnetic resonance imaging, original venous malformation reduced in volume to 5.40 cm. Radiofrequency ablation may provide an alternative treatment for facial venous malformations. (J Vasc Surg 2009; 50:424-7.)

CASE REPORT

A 24-year-old woman had a large palpable lesion in her right perimandibular area since her childhood. The lesion slowly increased in size as she grew older causing cosmetic problems. She complained of intermittent sensation of swelling but the lesion did not cause any pain. Physical examination revealed a large, easily compressible, swelling lesion which expanded in size during valsalva maneuver (Fig 1). The neck computed tomography (CT) she had performed initially showed a 4.1-cm sized delay enhancing well marginated venous malformation (VM) located inferior to the right parotid gland. For further evaluation, she underwent a neck magnetic resonance imaging (MRI) scan in 1 month which showed high signal intensity VM on T2 weighted image with no change in size and location as the previous neck CT (Fig 2). The final diagnosis was made as VM located lateral to the internal jugular vein and carotid artery in the right perimandibular area inferior to the parotid gland extending to the superficial neck. Sclerotherapy with ethanol or surgical excision was initially considered as treatment but the patient refused due to complications such as skin necrosis, neural toxicity, and scar formation. We had successful experiences in ablating benign thyroid nodules abutting the carotid artery and recurrent laryngeal nerve, therefore, we were able to plan radiofrequency ablation (RFA) of the VM located near the carotid artery and the cervical branch of facial nerve. Before the procedure, informed consent was obtained. RFA was performed percutaneously under real time ultrasound (US) scan-guidance on an outpatient basis. The patient was placed in supine position with the neck extended and tilted to the left. Two grounding pads were attached to both thighs. Under US scan examination, the operator determined the approach route for the electrode. Two percent lidocaine hydrochloride (KwangMyung, Seoul, Korea) was used for local anesthesia at the puncture site. The skin was not incised in order to prevent unnecessary scar formation. An electrode was inserted along the oblique axis of the VM. The RFA procedure was performed by one of the authors (H.K.K.). We used a 200 W radiofrequency (RF)-current (480-kHz) generator (CTRF-220; Valleylab, Boulder, Colo) and internally cooled electrode (Cool-tip RF system, Valleylab), a 17-gauge straight needle type with a 1-cm active tip. All US scan procedures were performed with the same transducer using the free-hand technique.[1] After inserting the electrode into the VM, we confirmed that the entire segment of the active tip of the electrode was completely included in the VM by measuring the length along the shaft of the electrode from its tip. We placed the electrode in the center of the VM. After the VM was conceptually compartmentalized, each compartment was ablated sequentially by moving the tip of the electrode to the left and the right or forwards and backwards. The extent of the ablated area was presumed by the echogenic change around the electrode. When the transient echogenic change appeared, application of RF energy stopped due to increased electric resistance and the electrode tip was moved to an untreated area after the generator was switched off. In this way, ablation was terminated when all units of the VM had changed to transient hyperechoic zones (Fig 3). The power output of RF energy was set maximally and moved from 50 W to 80 W in 1-cm active tip electrode under impedance control mode. With local anesthesia, the patient tolerated the pain well until the end of the procedure. The total ablation time was 20 minutes including time for lesion targeting. At the end of the procedure, the patient was discharged after 1 hour of close observation.

The patient followed-up with US scan in 1 month and an MRI in 3 months. Follow-up US scan showed remarkable size reduction of the VM from 4.1 cm to 1.5 cm. The volume of the VM was reduced from 20.25 cm to 5.4 cm on MRI by using an off-line workstation (AquariusNET, v 1.8.0.3; TeraRecon, San Mateo, Calif). Without any remaining scar, the protruded VM below the parotid gland grossly disappeared in 1 month follow-up after RFA (Fig 1).

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Competition of interest: none.

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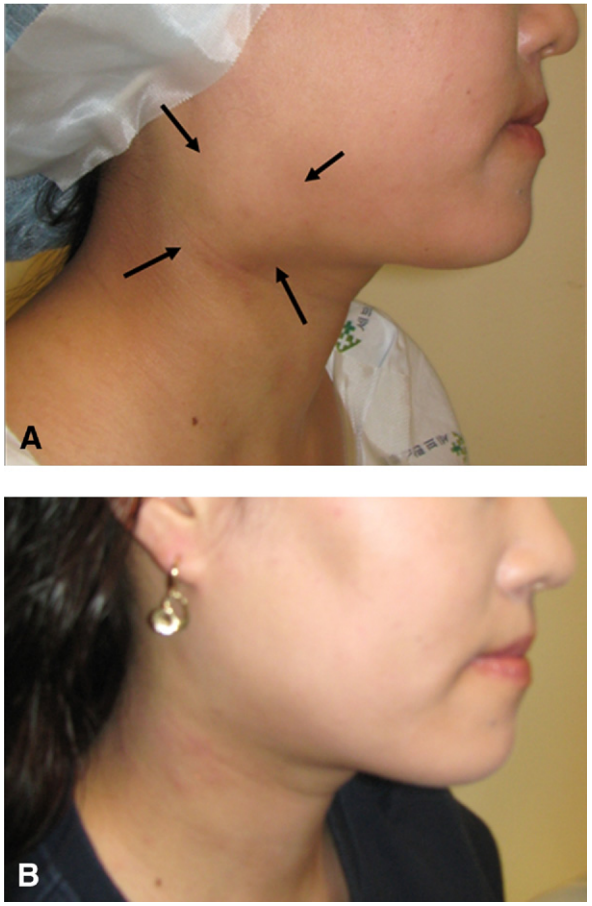

Fig 1. A photo of the venous malformation in the right check area before **(A)** and after **(B)** radiofrequency ablation (RFA). A large protruding mass (*arrows*) is prominently seen before RFA and disappears after RFA.

DISCUSSION

VM is defined as a simple malformation with slow flow and abnormal venous network. It is characterized by soft, compressible, non-pulsatile tissue mass. It tends to grow over time in proportion to the growth of the patient.[2] Forty percent of VMs in adults are found in the head and neck area.[2,3] Our patient had a VM in the perimandibular area, but additional related symptoms or dysfunctions were not found except esthetic disfiguration, which was her main complaint.

Treatment of VMs is indicated when they cause aesthetic problems, pain, or functional problems. Commonly known treatment options of VMs are sclerotherapy, laser therapy, and surgical resection. Sclerotherapy is the most widely used treatment option for VMs. It is performed by percutaneously inserting a needle into the nidus and injecting a sclerosing substance. However, several complications are reported due to the use of ethanol, including cutaneous necrosis and neural toxicity. Also, many patients feel pain after the procedure and several sessions are necessary for complete cure with a time delay of 1-3 months between each session.[4,5] Recently, foam sclerotherapy is used which has advantages over liquid sclerotherapy by using smaller amounts of sclerosing agents with higher therapeutic effects. However, complications such as pain, swelling, and skin necrosis still remains.[6] Laser therapy can be useful in very superficial forms of VMs. Satisfactory results with minimal scarring have been reported, but recurrences and repeated treatments are common.[2] The most definitive treatment of VM is by surgical excision, but only superficial small lesions can be considered. Attempts to excise large VMs usually cause significant morbidity and surgical resection always leaves a large scar.[2,7]

RFA is a minimally invasive, safe procedure. A needle electrode (14-17.5 gauge) with an insulated shaft and a non-insulated distal tip is inserted into the lesion under imaging guidance. In radiologic practice, it is used widely for the treatment of unresectable malignant tumors and several benign lesions.[1,8,9] Recently, RFA has been attempted as another alternative treatment for VMs. RFA for treatment of symptomatic low-flow VMs has been recently published by van der Linden et al.[10] In this report, a total of 3 patients (all reportedly diagnosed with capillary venous malformation, all in the lower extremities) were treated with RFA. The paper reported no complications. All patients were reported to be treated successfully, although 1 patient had symptomatic recurrence after a year. However, until now, to the best of our knowledge, there has been no reported study on RFA of VMs above the neck.

The location of the VM in our patient was in the right perimandibular area where RFA is generally not considered as a treatment due to surrounding important structures such as the carotid artery and the facial nerve. To overcome this situation, we used an internally cooled electrode which has a 1-cm active tip. Ablation was performed by shifting the 1-cm active tip within the VM under real-time US scan-guidance. Because all the areas ablated turns echogenic on US scan, we could distinguish between the non-ablated and ablated areas and treatment of over 90% of the patient's facial VM was possible. Unlike ablating deep located organs such as the liver, real-time US scan-guidance is possible for superficially located lesions. We named this technique as the "moving tip technique". This technique has been reported to be safe and effective on benign thyroid nodules in close proximity to the carotid artery and the recurrent laryngeal nerve. When setting the generator on impedance mode, this technique induces hot bubbles above the cell-cidal temperature around the electrode and these hot bubbles are monitored throughout the whole procedure by real-time US scan. Therefore, although the target lesion is surrounded by important structures, RFA can be safely performed. The current of the generator is automatically blocked when the impedance of the surrounding structures increase due to induced hot bubbles. When this occurs, the electrode is re-inserted into a different site of the lesion and in this manner treatment

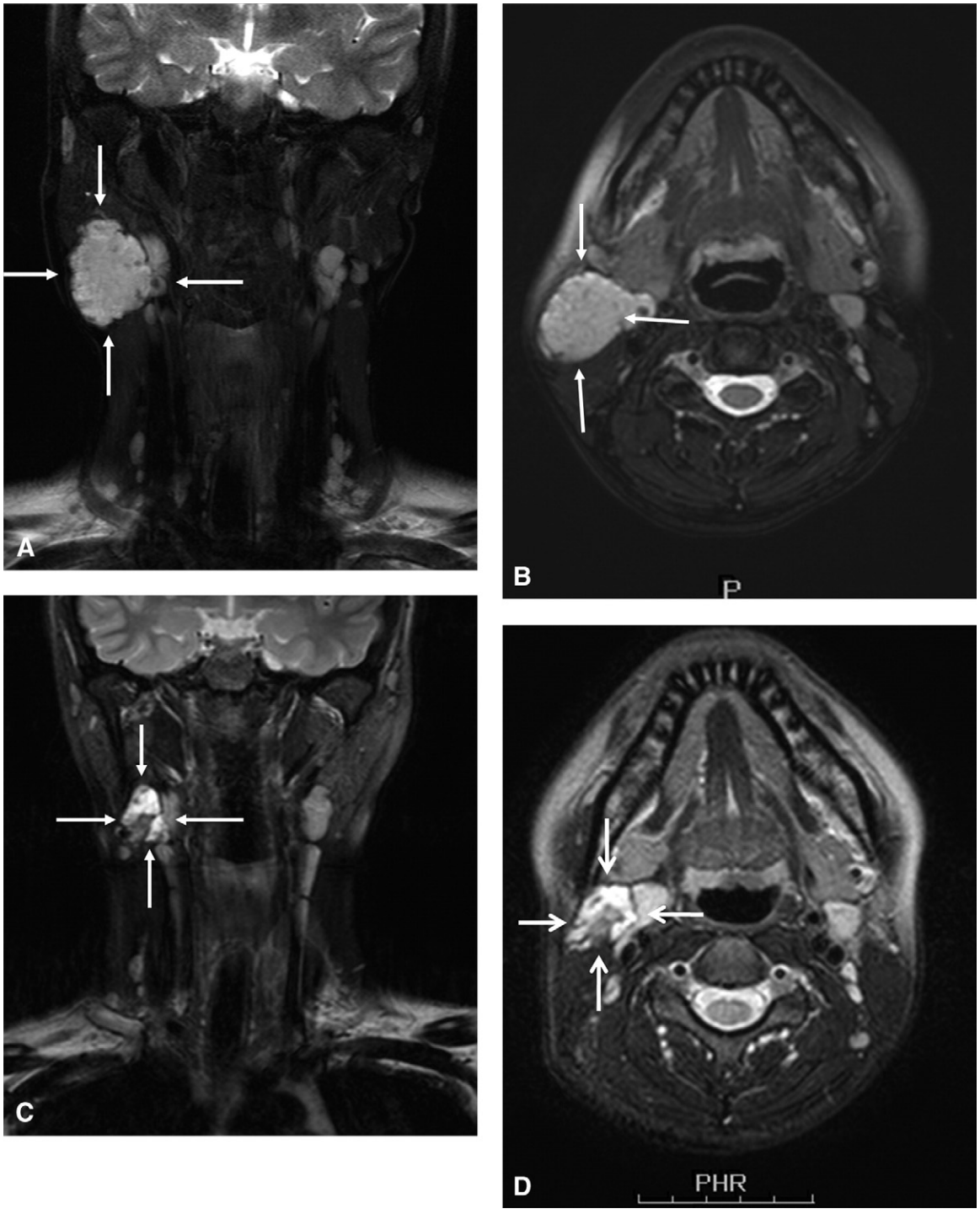

Fig 2. Axial and coronal magnetic resonance (MR) images **(A, B)** before RFA show a hyper-intense mass in the right cheek (*arrows*). Axial and coronal MR images **(C, D)** 3 months after RFA shows that the vascular mass has markedly shrunk with dark signal fibrous code in the center.

can be completed when most of the lesion shows echogenic changes caused by the hot bubbles. There is no size limit when using this "moving tip technique" if real-time US scan is possible and we could ablate a VM of about 4.1 cm in size. As reported in previous RFA of thyroid nodules, the time taken for the generator to shut off is

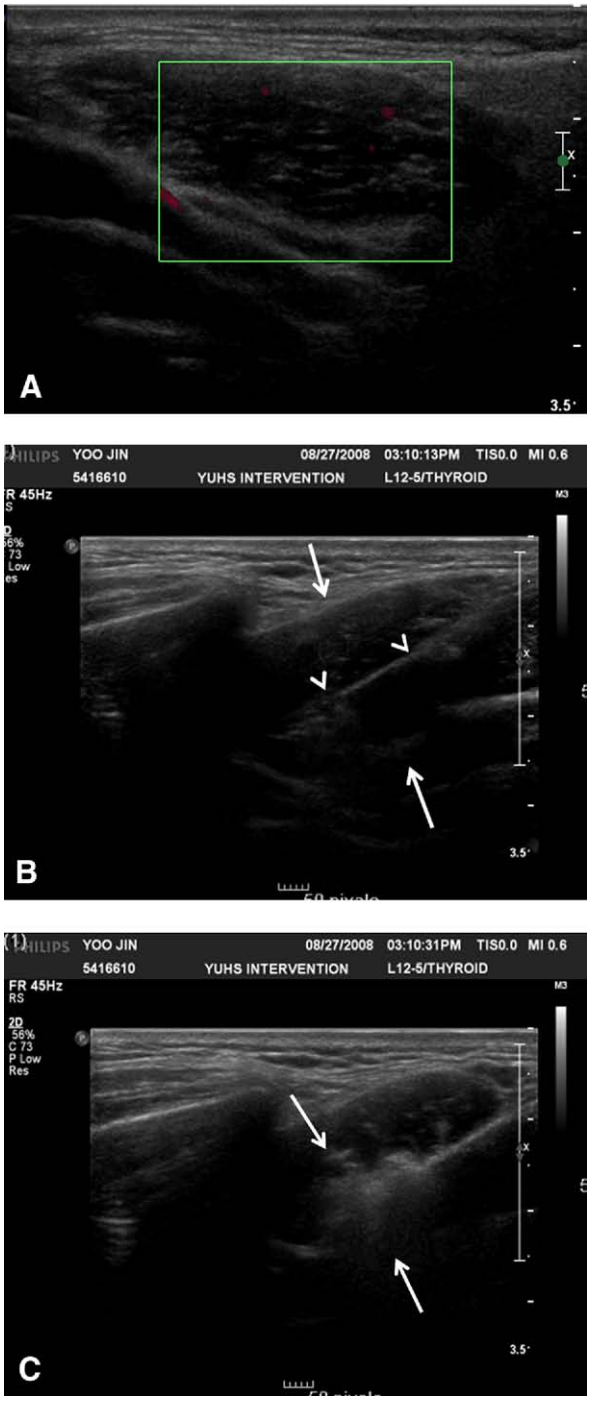

Fig 3. Ultrasound (US) scan image of the venous malformation (VM) (**A**) at the time of radiofrequency ablation (RFA) shows the radiofrequency (RF) electrode (*arrowheads*) in the center of the hypoechoic mass (**B**). During ablation, echogenic areas (*arrows*) around the electrode caused by hot microbubbles are well distinguished from the untreated lesion (**C**). In this way, most of the vascular mass could be ablated.

less than 3 seconds of ablation and the hot bubbles can be controlled to be within the VM by US scan. Therefore, the patient feels less pain during the procedure. The size of the mass was reduced immediately when high frequency heat was applied under US scan-guidance. We presume this immediate reduction in size is caused by shrinkage of the mass as the blood within the dilated vessels leaks out due to denaturation of proteins when heat is conducted through the vascular septa of the VM. The procedure took about 20 minutes including the time taken for targeting. Because a 17 gauge needle is inserted without surgical incision, there was no concern for post-procedure scar formations. She could continue her usual day to day life immediately after the procedure.

In summary, we report a case of a 4.1-cm sized cavernous malformation located above the neck which was successfully treated by RFA. In the near future, RFA with real-time US scan-guidance may provide an alternative treatment for low flow VMs with more advanced therapeutic effects and less morbidity.

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