Percutaneous Direct Puncture Embolization for Superficial Craniofacial Arteriovenous Malformation

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Summary

Endovascular embolization for craniofacial arteriovenous malformation has been used as preoperative adjuvant devascularization or as definitive therapy. However, because the vascular network is complex, embolization via arterial access may be ineffective, risky, incomplete or technically difficult.

The purpose of this report is to describe our experience of percutaneous direct venous pouch puncture embolization. Four patients with craniofacial AVMs were treated with direct puncture embolization via injection of NBCA. After the selective transarterial angiogram, the lesions were directly punctured in the venous pouch under a road map angiogram. A glue mixture was injected, and post-embolization angiograms revealed that in all patients, the lesions had been completely obliterated without complication. Percutaneous direct puncture embolization is an effective, time saving and safe technique for the superficial craniofacial AVM with prominent venous pouch.

Introduction

Craniofacial arteriovenous malformation is an abnormal fistulous connection between arteries and veins, without intervening capillaries. The drainage veins are grossly dilated and tortuous, and may show variceal dilatation (ve-

nous pouch or cirroid aneurysm)^{1,2}. A progressive growing pulsatile mass, bruit, cosmetic deformity, ischemic ulceration and hemorrhage are the main complaints of the patients. Treatment of these lesions has been mainly surgical excision or ligation^{3,4}, but both of these procedures can sometimes be associated with significant blood loss, need for skin reconstruction or troublesome ligation due to complicated vasculatures. Due to recent development of endovascular techniques, better design of devices and improved embolization material, transarterial and venous embolization of superficial craniofacial AVM has been used as preoperative adjuvant devascularization or as definitive therapy^{4,5}. However, embolization via arterial access may be ineffective, incomplete or technically difficult due to the existence of a complex vascular network, and may be somewhat risky for important arterial compromise (e.g. ophthalmic artery branches), or may cause overlying skin ischemic necrosis^{2,6}.

Percutaneous direct puncture of the venous pouch is a more efficient method of access, and we used this technique because of the numerous advantages that it possesses in comparison to embolization. The purpose of this report is to describe our experience with superficial craniofacial AVM in four cases, and evaluate the outcome and benefits of percutaneous direct venous pouch puncture embolization of these lesions.

Table 1 Clinical characteristics, Angiographic findings and Embolization profiles.

No	Age/ Sex	Lesion location	Trauma history	Feeding artery	Drainage vein	Degree of embolization
1	53/F	Scalp	N	R't opthalmic artery R't superficial temporal artery	R't superior ophthalmic artery	Complete
2	30/M	Scalp	Y	Bil. opthalmic arteries R't superficial temporal artery	Bil. superior opthalmic vein R't angular vein	Complete
3	57/F	Nose ridge	Y	Bil. opthalmic arteries Bil. infraorbital arteries R't facial artery	Bil. angular vein Bil. superior opthalmic vein	Complete
4	66/M	Scalp		Bil. superficial temporal artery R't posterior auricular artery	Bil. superficial temporal vein	Complete

Cases reports

Four patients with craniofacial AVMs were treated with percutaneous direct puncture embolization via injection of n-butyl-2-cyanoacrylate (NBCA, Histoacryl Blue; Braun, Melsungen, Germany) mixed with iodized oil (Lipiodol; Laboratoire Guerbet, Roissy, France) under general anesthesia. Informed consent was obtained from each patient. Three patients presented with pulsatile masses and one had persistent tinnitus. three of the AVMs were thought to be traumatic in origin according to the medical history, with the fourth possibly being spontaneously formed. Bilateral internal and external carotid angiograms were carried out in all patients.

The periorbital lesions in two patients received their blood supply from the ophthalmic artery and superficial temporal artery, and drained through the superior ophthalmic vein alone or in combination with the angular vein. The medial canthal lesion was supplied bilaterally by the ophthalmic and infraorbital arteries and right facial artery, and drained through the superior ophthalmic vein and angular vein (Figure 1). Each pre-auricular temporal lesion had previously undergone an incomplete transarterial embolization and surgical resection and was reconstituted via distal branches of the right posterior auricular artery, transverse facial artery and contralateral superficial temporal artery, with drainage via the superficial temporal vein.

In every patient, a dilated venous pouch and multiple sites of arteriovenous communication were identified by angiogram. No intracranial component was identified. After the selective

transarterial angiogram, the lesions were directly punctured with a 19-gauge scalp vein set steel needle in the area of the dilated venous pouch, under an image-overlap road map angiogram. After direct angiographic confirmation of the anatomic details and dynamic status (drainage vein and flow), a 50-60% mixture of NBCA and Lipiodol were injected under direct fluoroscopy without temporary occlusion of feeding arteries or compression of drainage veins. The clinical characteristics and procedure-related information are summarized in Table 1. All four craniofacial AVM patients were treated with percutaneous direct puncture embolization using NBCA without experiencing gluing of the needle, puncture site bleeding or procedure-related complications. Post-embolization angiograms revealed that the lesions in all 4 patients had been completely eradicated after glue injection. No glue retrograde reflux into feeding arteries occurred, nor was any distal drainage vein migration noted. The patients experienced pain and swelling of the lesions after embolization due to the NBCA injection, and improved later.

The NBCA-casted superficial lesions in three patients were subsequently resected by surgery due to cosmetic consideration, and only minimal intraoperative bleeding was described in the operation notes.

Discussion

Percutaneous direct puncture embolization is an effective, time saving, simple and safe technique for the preoperative devascularization of superficial craniofacial AVM with

prominent venous pouch, compared with the transarterial route. It can decrease the possibility of incomplete embolization and result in a later recruit of new collateral feeders^{2,3}. The effect is dramatic and immediate in symptom relief and intraoperative bleeding control. For cosmetic consideration, there is no risk of skin necrosis and the lesion can be resected without the need for a skin graft. Although endovascular embolization is a definitive treatment, surgical resection may be needed in patients who do not want the protrusion of a superficial palpable glue cast. Although some articles suggest that temporary occlusion of venous outflow can be performed via manual compression or a compression device during glue injection^{6,7}, we concluded that compression may not be anatomically achievable for every lesion, and may not be so important when a 50-60% concentration of NBCA is used under appropriate injection force control. A high concentration of liquid acrylic surgical adhesive may also decrease the risk of NBCA retrograde reflux into feeding arteries. Additionally, we suggest slight

direct superficial venous pouch compression during the NBCA injection to decrease the volume of superficial glue cast bulging and to bring about more effective fistula tract obliteration. We used direct hand compression in our later cases, assuming the risk of radiation exposure because of early experiences using direct puncture embolization for craniofacial arteriovenous malformation. We plan to use an alternative radiolucent focal compression device in our future cases to improve the radiation protection for the operator. In addition, using a large caliber steel needle has the advantages of decreasing the risk of gluing of the needle and more directional control of the injection.

Conclusions

According to the advantages described above, we infer that the percutaneous direct puncture embolization technique can be used alone or in combination with surgical resection as an alternative approach for superficial craniofacial AVM with prominent venous pouch.

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