Pollicization After Radical Resection of Diffuse Arteriovenous Malformation of the Thumb

A Case Report

Takaaki Shinohara, M.D., Masahiro Tatebe, M.D., Shukuki Koh, M.D., Michiro Yamamoto, M.D., and Hitoshi Hirata, M.D.

Abstract

A case is presented of arteriovenous malformation of the thumb, requiring thumb amputation and free flap coverage for curative treatment. The thumb was reconstructed by pollicization of the index finger as a secondary operation. The patient remains free of recurrence after 2 years and uses the pollicized thumb for daily activities.

Arteriovenous malformation (AVM) of the hand is uncommon and represents one of the most challenging problems in the field of hand surgery. Well-localized forms may be eradicated by en bloc resection, but complete resection of diffuse malformations with high hemodynamic activity is difficult. Incomplete resection leads to early recurrence and the need for further treatment. In many cases, amputation is required as a result of a need for radical resection of a diffuse AVM. The case reported herein, of AVM of the thumb, was treated by thumb amputation and subsequent reconstruction with pollicization. The patient remains free of recurrence after 2 years and uses the pollicized thumb for daily activities.

Case History

The patient was a 41-year-old right-handed male with AVM of the right thumb. He first noticed, without pain, the abnormality of a blood vessel in his right thumb in early childhood. Right thumb pain and growth of the abnormal blood vessel was noted from the age of 21 years. Thumb pain and size of the abnormal vessel increased over the years.

Clinical examination revealed dilated vessels with thrills on the thenar eminence, extending to the whole thumb. Skin discoloration was noted on the thumb, and the patient showed local skin necrosis on the ulnar side of the thumb tip (Fig. 1). Magnetic resonance (MR) imaging revealed diffuse vascular lesions involving all tissues of the right thumb, thenar eminence, and thenar web (Fig. 2). Angiography also demonstrated diffuse abnormal vessels of the thumb, which were supplied by several small branches of the radial artery (Fig. 3).

Curative treatment was designed to manage severe pain and ischemic deficit of the thumb. The day before surgery, selective embolization of AVM was undertaken by a radiologist to decrease intraoperative blood loss, and radical resection was performed within 24 hours. Thumb amputation through the proximal third of the first ray was required to excise the lesion completely. The post-excisional skin defect was reconstructed concurrently, using a scapular free flap. Five months following radical resection, MR angiography showed no recurrence of AVM. Thumb reconstruction was performed, as thumb defect of the dominant hand was causing restrictions to activities of daily life. Pollicization of the index finger was selected for thumb reconstruction for three reasons. First, amputation was at the proximal third of the first metacarpal bone. Second, thumb intrinsic muscles were not spared by radical excision, and the thumb extrinsics did not work well because of tendon or muscle contracture. Third, the patient rejected sacrifice of the toe, as toe-to-thumb transfer including the metatarsophalangeal joint may have resulted in diminution of donor foot function. On follow-up 2 years after the first surgery, the patient showed no recurrence and was using the pollicized thumb for activities of daily living, such as writing and cooking, despite the presence
of first carpometacarpal (CM) joint contracture due to the initial surgery (Fig. 4).

**Discussion**

AVMs are present at birth and grow proportionately during childhood or adolescence. Common symptoms include disfigurements, such as venous varices, discoloration, thrills, bruits, and pain. Rapid expansion has been observed following local trauma, ligation, incomplete excision, pregnancy, or any hormonal modulation. This condition presents difficult therapeutic problems. In particular, diffuse malformations offer a dire prognosis. Hill and colleagues reviewed 15 cases of congenital vascular malformations of the upper limb and classified malformations into local and diffuse types on the basis of tissue involvement. Recurrence was encountered in 71% of diffuse-type lesions, despite the adoption of radical excision and emphasis on the difficulties of complete surgical removal of diffuse malformations. Upton and coworkers reported 270 patients with vascular malformations of the upper limb over a period of 28 years and subclassified their 33 patients with fast-flow arterial malformations into types A, B, and C. Type A and B patients showed localized malformations, whereas type C patients displayed diffuse arteriovenous anomalies involving all tissues. Nine of 10 patients with type C lesions required amputation after multiple
operations. In our case, the thumb was extensively involved. Thumb amputation and free flap coverage were thus required for curative treatment.

Embolization is not a definitive treatment for diffuse AVMs, but may be combined with surgery as a preoperative procedure to diminish intraoperative blood loss.\(^2,4^5\) The embolized AVM was also easier to remove because of its firm consistency.\(^6\) Likely complications include ischemia and ischemic pain after embolization, and recanalization of vessels.\(^6\) Jackson and associates\(^2\) stated that optimal treatment should include careful assessment and good embolization, followed by total resection within 48 hours, if feasible.

Options for thumb reconstruction are limited when amputations are at the proximal third of the first metacarpal bone. Only two good options are available: pollicization and toe-to-thumb transfer. Pollicization provides nearly normal sensation, stable hemodynamics, and good mobility.\(^7,8\) Moreover, pollicization of the index finger allows deepening of the first web space by means of excision of the second metacarpal.\(^8\) The disadvantage of pollicization is that the finger defect is not improved, whereas great toe-to-thumb transfer makes-up for thumb defect with good cosmesis. In cases of total or near-total thumb loss, toe-to-thumb transfers require the sacrifice of a greater part of the metatarsal. However, this may generate disorders of postoperative weightbearing mechanics and function of the donor foot. In the present case, the patient did not wish to sacrifice the toe. In addition, toe-to-thumb transfer might have been unsuitable for the indications, as the thumb intrinsics had not been left intact, and the thumb extrinsics did not work well due to the tendon or muscle contracture that had occurred over 5 months after the first surgery. At the time of the second operation, since we expected a stable basal joint of the thumb, pollicization with thumb CM joint preservation was performed, despite the presence of joint contracture. However, another option to achieve good basal joint range of motion may be pollicization in accordance with Buck-Gramcko’s method.\(^9\)

Disclosure Statement
None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

References

Figure 4 Appearance of the right hand after pollicization. A, No recurrence of the arteriovenous malformation was evident two years after radical resection. B, Patient used the pollicized thumb for activities of daily living such as writing, among others.


