Abstract

In arteriovenous malformations (AVM), the tactics and techniques of combined treatment have been worked out adapting surgical and non-surgical methods. The most common combinations include surgery, catheter embolization and ethanol sclerotherapy. Strict indications should be followed when choosing the appropriate procedures and timing. The best long-term follow-up results are obtained with the combination of presurgery catheter embolization and surgery. Alcohol sclerotherapy has gained an important role in combined treatment. Experience has demonstrated that the indication for catheter embolization in the limbs when distally performed should take into consideration the danger of peripheral necrosis. Correct combination with surgery and/or ethanol sclerotherapy may avoid such a complication.

Introduction

The first documented treatment of cases with length discrepancy and arteriovenous (AV) malformations of the extremities occurred in 1853, but it is only recently that the true connection between these two entities has become obvious. The Hamburg Classification allowed the latest therapeutic concept in the modern era of vascular surgery to be developed: the combined treatment. This consists not only of operative occlusion of the vascular malformation with obstruction by sutures of its feeding arteries and, if possible, excision, but also of further surgical and non-surgical methods.

This treatment is the therapy of choice in predominantly AV congenital vascular defects. It is a logical improvement over the formerly recommended sole approach of skeletonization of the fistula feeding segment of the afferent artery. It makes it possible to treat even the smallest AV shunting vascular defects. This approach became feasible through the development of new catheter technologies and occlusive materials. Skeletonization of the afferent stem artery as sole treatment, or its application after embolization, is no longer recommended, because this removes any further opportunity for embolization of persisting AV fistulas with renewed hemodynamic activity. In fact, in some cases where skeletonization therapy had already been performed, it has been necessary to reattach the larger of the ligated arterial branches in order to allow embolization therapy to be performed.

The therapy consists of non-surgical and surgical treatment and is the therapy of choice in severe predominantly arteriovenous congenital vascular defects. It does not consist of alternative or competitive techniques; rather, the non-surgical and the surgical forms of treatment are complementary.

Non-Surgical Methods of Treatment

Non-surgical methods of treatment include laser-therapy, sclero-therapy and embolization-therapy.

The indications for non-surgical treatment are:
1. Laser-therapy: appropriate for all persisting capillary AV lesions, where no feeder artery for embolization treatment is present.
2. Sclero-therapy: the foam technique is a good alternative and/or adjunctive treatment for superficial malformed vessels; the ethanol technique is also indicated for deep AV malformations.
3. Embolization-therapy: appropriate for all hyper-vascular lesions with AV shunting (dependent on the morphological form and the site of the lesions).
Surgical Methods of Treatment

Surgical methods include operations to remove the vascular defect, where feasible; operations to reduce the hemodynamic activity of the vascular defect; and other, non-hemodynamic procedures.

Because the different morphological forms of AV defects most frequently appear in mixed combinations, many cases will require combined treatment, using multidisciplinary skills. In many cases severe enough to require treatment, surgery or embolization alone cannot succeed and may not be appropriate because of an inaccessible location of the defect or the impossibility of reaching the “nidus” by catheter. Thus, surgical treatment and embolization may have to be combined or completed with other non-surgical methods.

Surgery can be combined with embolization, performed preoperatively, intraoperatively or postoperatively.

Preoperative Embolization

Preoperative embolization is extended over several sessions and is the most effective approach. Ideally, it can be combined with surgical occlusion-sutures in persisting very small AV fistulas which cannot be reached by the catheter. This can be performed after the ischemic reactions and inflammatory signs of the embolized tissues have abated (Figs. 24.1–24.8).

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**Fig. 24.1.** Typical clinical aspect of a left lower arm with ulceration and swelling caused by an AVM. The patient complained of continuous pulsating pain and heat in his left arm

**Fig. 24.2.** Only a super selective arteriography is able to reveal AV fistulas originating mainly in the interosseal artery and its side branches

**Fig. 24.3.** After interventional embolization treatment of the interosseal artery the control arteriography demonstrates residual AV fistulas in the region of the ulnar artery

**Fig. 24.4.** The clinical aspect 2 weeks after embolization demonstrates the reduction of the ischemic ulceration of the lower arm and a superficial skin necrosis resulting from interventional embolization treatment