Survey of progress

Embolisation techniques in neuroradiology

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Summary. Embolisation is a definitive treatment for selected arteriovenous fistulas, aneurysms and both extra- and intra-axial angiomatous malformations. It is an effective emergency treatment for many cases of intractable epistaxis. It is useful prior to surgery to reduce blood loss from hypervascular tumours, including juvenile angiofibromas, paragangliomas and basal meningiomas, and from angiomas or soft tissue or of bone prior to excision, dental extraction or laminectomy. Embolisation is a satisfactory palliative treatment for angiomatous involving superficial tissues, in which the cosmetic effects of surgery are unlikely to be satisfactory, and of mucosal surfaces causing intractable bleeding. In inoperable tumours, embolisation can relieve pain, bleeding, pulsatile tinnitus or discomfort due to mass effect.

Key words: Interventional neuroradiology - Particulate embolisation - Detachable balloon embolisation - Isobutyl-2-cyanoacrylate

Introduction

Embolisation procedures are being applied increasingly in the treatment of arteriovenous fistulas, angiomatous malformations and hypervascular tumours supplied by systemic arteries. When these conditions are in the head, neck or spine, their blood may at least in part be derived from or be connected to arteries supplying the central nervous system, which must be protected from emboli. Embolisation is used: (1) preliminary to partial or total excision of tumours or angiomas, or to surgical approach through angiomatous tissue; (2) as a definitive treatment in angiomatous malformations of the soft tissues in sites where surgical could lead to disfiguring scars, and in the dura mater where adequate surgery may require excision of an indispensable venous sinus; (3) as palliation for bleeding from mucosa or skin, pain or discomfort from tissue swelling, or pulsatile tinnitus due to angiomatous malformations or inoperable tumours.

Closure of carotico-cavernous and vertebro-vertebral fistulas can be achieved by embolisation with preservation of arterial flow in the majority of cases, and embolisation has replaced surgery as the most appropriate treatment for these conditions. Some angiomatous malformations within the central nervous system are amenable to embolisation with acceptable risk, and the method should be given consideration, together with surgery and focused radiation therapy.

Prolonged occlusion of abnormal vessels can only be achieved by placing the embolic material within those vessels. The success rate and the risks of embolisation are largely determined by selection of the appropriate method to achieve this objective in the individual case, based on detailed demonstration of the angiographic anatomy and understanding of the pathophysiology. For example, if the same arteriovenous connection is filled from several arteries, it may be approached and obliterated through any one of them and the safest route for embolisation can be selected (Fig. 1). Multiple regions of shunting are commonly present within an angiomatous malformation, necessitating approach through several vessels and sometimes best treated by different methods of embolisation. In situations where only part of an angiomatous malformation can be safely embolised, circulation from inaccessible vessels may increase subsequently. When appropriate, this may be prevented by ligation, before or soon after an embolisation procedure, of systemic supply arising, for example, from the ophthalmic artery or cervical segments of the vertebral arteries.

This report deals briefly with the types of embolisation procedures in current use and their application.

Embolic material and delivery systems

Non-toxic, non-antigenic, easily sterilised, mostly synthetic substances capable of being delivered through a percutaneous catheter are currently used for embolisation. These materials replaced autologous blood clot, which was rapidly absorbed, and muscle and fat, which had to be obtained by surgical incision [3].

Embolic materials can be divided into solids and liquids, and the former subdivided into particles, coils and balloons.

Particles

Particulate microemboli are suitable for occlusion of vessels which form a precapillary barrier in which the particles will lodge [4]. Particles can be obtained of any size, from slightly less than the diameter of the largest practical catheter down to the dimensions of a large arteriole. Lack of penetration into distal normal arterioles is generally associated with retention of adequate blood flow in capillary beds in which arteries, other than those embolised at arteriolar level, contribute to anastomotic circulation. In these circumstances, necrosis of
normal tissues can usually be avoided, and for this reason particles are preferred for embolisation of systemic arteries when vessels supplying normal skin, mucosa or important cranial or peripheral nerves are liable to be occluded.

When examination of any vessel supplying the nervous system is indicated, this is first performed before using the catheter for embolisation. Particulate embolisation of abnormal vessels arising from systemic branches of the internal carotid