Fibrin Adhesives in Intracranial Microvascular Surgery

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Abstract

Histological examinations after experimental microvascular surgery have shown that around sutures and other foreign substances considerable scar formation develops and results in constriction of the lumen if vessels have an average diameter of 1 mm.

Using tissue adhesive made of fibrin and mixed with thrombin for coagulation means that the number of sutures and the hazards of long-term stenotic changes in microvascular anastomoses can be greatly reduced. The adhesive substance does not have any neurotoxic effects and is therefore applicable in cerebrovascular aneurysms where clipping is hardly possible or not possible at all.

Introduction

In surgery, there have been frequent efforts to replace sutures by tissue adhesive systems. However, use of such adhesives has almost always resulted in problems of crosslinking immediately after applying the substances, which then developed into hard, irremovable material. In addition, almost all adhesives proved to be more or less neurotoxic. The introduction of fibrin adhesion systems was vital for neurosurgery since they do not have any neurotoxic effects and are well applicable.

Microvascular interventions may still present surgical problems because the operating area is difficult to localize or because the tissue of the operating site is vulnerable in the presence of edema or after stroke. As even high-level microsuturing did not always have the desired results, discussion was started on replacing it by fibrin adhesion systems for microvascular anastomoses and other microvascular surgery.

Experimental Research

End-to-end anastomosis of the common carotid artery was performed on 100 Wistar rats weighing on average 300 g. Various already described techniques of end-to-side anastomosis were used on 100 additional rats. Two animals of each series were killed at intervals of 24 h for histological and selective electron-optical examinations of anastomotic areas. After 50 days, a continuous survey of the healing process of the
microvascular anastomoses was carried out. Healing of microvascular anastomoses was observed to follow a standard course – also typical of any vascular anastomosis of an average 1 mm in diameter: After 48–72 h, extensive and inevitable necrosis occurs in the sutured area (Fig. 1). In the course of 3 more days a strong reaction of connective tissue sets in around necrotic material and foreign body giant cells appear (Fig. 2). In about 30% of all surgical cases this leads to narrowing of the lumen. During the last 3–4 weeks of the healing process new connective tissue is transformed into sometimes widespread and obstructing scar tissue (Fig. 3).

Fig. 1. Necrosis in the area of a microvascular suture (common carotid artery of rat 48 h after surgery)

Fig. 2. Granulation tissue with foreign-body giant cells (common carotid artery of rat 14 days after surgery)