Repair and Replacement of Small Arteries, Microsuture Technique*

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Reconstructive procedures on small arteries have not been as extensive and as successful as those of the larger vessels. Progressive improvements have been made in this field in relation to large vessels since the concept of vascular reconstruction was introduced two centuries ago. However, the progress has been limited in arteries of small calibre.

At the present time the methods available for repair and replacement of small arteries are:

1. Gross suture technique;
2. Prosthetic technique;
3. Adhesive technique;7
4. Stapling technique; and
5. Microsuture technique.

Among these the microsuture technique is the most recent method of vascular repair and replacement. This was introduced by Jacobson and Suarez in 1960. Although it was felt that the microsuture technique would extend vascular surgery to many previously inaccessible areas, not much has been written on the subject.

The present study is similar to the one reported by Jacobson and Suarez; however, there are a few new observations and procedures in this report.

Method

The experiments were carried out on 55 cats. The animals were anaesthetized by intraperitoneal injection of pentobarbital sodium. The femoral or carotid arteries were exposed and their external diameter was measured directly under the microscope; this varied from 1 to 2 mm. The circulation was then arrested by Kerr clips8 or by another temporary clip made for small vessels.6 The procedures were carried out under 16 magnifications.

The arteries were repaired with 8-0 and occasionally with 7-0 monofilament nylon sutures. However, in two longitudinal incisions a fine stainless steel wire suture (one thousandth of an inch in diameter) was used. No local or systemic anticoagulants were used.

Five procedures were studied:

1. Repair of a Longitudinal Incision. In this type of repair the following observations and conclusions were made:

(a) A continuous suture was more satisfactory than time-consuming interrupted sutures.
(b) The bites should be small and superficial. A bite was just about right when the needle or the suture could be seen through the tissue.
(c) The suture should be just tight enough to approximate the edges of the incision.
(d) An average of 2 or 3 stitches per mm. were needed for a good closure.
(e) In some of the arteries with thicker walls, it was possible to exclude the intima from the suture.

2. Repair of a Transected Artery. In this type of repair it was thought that interrupted sutures were superior to continuous sutures, for two reasons:

(a) A continuous suture left an inflexible ring in the wall of the artery which would not allow the artery to dilate in the sutured area if the physiological need arose.
(b) When tying the two ends of a continuous suture, too much tension might cause a smaller ring and a narrow lumen. Conversely, if too loose, the longer length of suture could result in profuse haemorrhage.

This purely technical point will be more appreciated if we realize that a fraction of a millimetre of suture may produce a narrow lumen or profuse bleeding.

In the repair of a transected artery of 1 to

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2 mm., 8–12 stitches were necessary for a satisfactory closure. The first stitch was placed in the mid-posterior wall, the second and third in the mid-lateral wall, and the fourth in the mid-anterior wall. The additional 1 or 2 stitches were then placed between every 2 primary stitches.

Traction sutures were used in this procedure. They facilitated the technique and provided equal bites with almost an anatomical suture line.

3. Repair of a Partial Arterial Defect. Ovoid arterial defects measuring 5×1 mm. to 8×1.5 mm. were artificially produced with scissors. They were repaired with venous autografts. The patches were taken from the superficial saphenous vein in the following manner:

(a) The vein was exposed and the circulation was stopped by 2 clamps. It was cut half way across at both ends vertical to its long axis (Fig. 1).

(b) One suture was placed on each end of the future patch and held under slight traction.

(c) Using scissors, the patch was then freed by cutting along each side between the half cross sections (a).

(d) The venous patch was transferred to

FIG. 1. Repair of a partial defect. a, b and c show the technique used for preparing a venous patch, and d shows the patched artery.

FIG. 2. Segmental arterial replacement. a, b and c show the technique used for preparing a segment of vein, and d illustrates the graft to the artery.

FIG. 3. Factors important in segmental arterial replacement: a and b = immediate branches; AB = length of the segmental arterial defect; CD = transectional incision; EF = length of the artery between the branches; GH and IJ = length of the artery on either side of the segmental arterial defect before such a defect is produced. Arrows in the center of the artery show the direction of contraction.