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Short Communication

"Growth Factor" Technique Using Expanded Polytetrafluoroethylene Monofilament for Arteriovenous Fistulae

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Abstract We employed the "growth factor" technique first described by Starzl et al. to construct 12 consecutive end-to-end arteriovenous wrist fistulas (AVWF) for chronic hemodialysis, using expanded polytetrafluoroethylene (ePTFE) monofilament (Gore-Tex) as the suture material. A complete migration of the "growth factor" loop through the vessel walls was observed and immediate patency of the AVWF was achieved in all patients. Although AVWF thrombosis developed in one patient, no other complications were observed in the early postoperative period. The 2-month AVWF patency rate was 90.9%. The ePTFE sutures demonstrated an adequate sliding property which make this monofilament a satisfactory material for vascular anastomosis constructed using this technique.

Key words Arteriovenous fistula · Hemodialysis · Expanded polytetrafluoroethylene

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The subcutaneous arteriovenous wrist fistula (AVWF), first described by Brescia at al.,[1] represents the vascular access of choice for chronic hemodialysis. A high incidence of early occlusion of up to 40% has been reported,[2,3] which is mainly caused by poor arterial inflow or inadequate venous runoff.[2,4,5] In view of this complication and after careful evaluation of ulnar artery patency, we prefer to utilize the end-to-end technique to construct AVWF. Because of the small size of the involved vessels, the radial artery diameter being about 2 mm, any narrowing of the anastomosis can jeopardize its function. To avoid this technical complication we have extended the use of the so-called growth factor technique,[6] first described by Starzl et al.,[7] to construct AVWF[8] since 1987.[9] This technique consists of a loop in the running suture which easily migrates through the vessel walls on revascularization, allowing a wide distension of the anastomosis. Our results using this approach are very satisfactory with an early patency rate of 94.5%, 3 months after surgery, and a secondary vascular access survival rate of 79.2% after a median follow-up time of 9.4 months. Until recently, we used polybutester or polypropylene monofilaments as the suture material; however, the availability of expanded polytetrafluoroethylene (ePTFE) monofilament has prompted us to evaluate the sliding properties of this suture material used in the construction of AVWF with this technique.

During the 22 months between May 1997 and February 1999, we performed 12 consecutive AVWF operations on 12 patients, being 5 women and 7 men, with end-stage renal failure requiring long-term hemodialysis. Two patients had a thrombosed AVWF that had been constructed elsewhere. In both instances the new anastomosis was performed utilizing the same vessels a few centimeters proximally. Under local anesthesia and 3.5× magnification loops, a 4–5-cm longitudinal incision was made, and both the radial artery and the antebrachial cephalic vein were dissected free and divided (Fig. 1). Two double-armed ePTFE 7-0 (Gore-Tex, Flagstaff, AZ, USA) monofilament sutures were placed at two opposite corners of the anastomotic walls for the end-to-end juxtaposition. Only one of these stay sutures was then tied, and the two ends were utilized to construct the anterior and posterior walls. Attention was paid to making the sutures not too tight during anastomosis. At the point where the ends met they were tied together. This knot was deliberately placed at a distance from the anastomotic wall about equal to the radius of the anastomosis (Fig. 2, left). On revascularization, the resulting loop of suture, being the so-called growth factor, easily migrated through the vessel walls allowing a wide distension of the anastomosis while the

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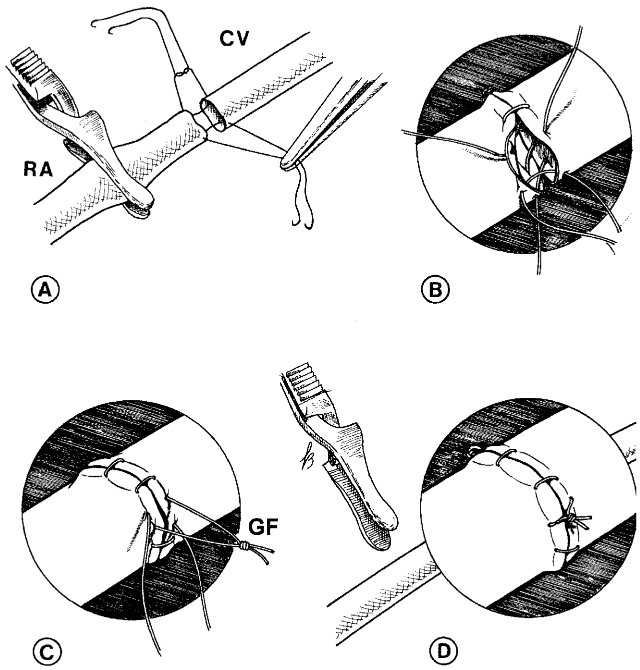

Fig. 1A–D. Schematic representation of the end-to-end anastomosis performed using the "growth factor" technique. **A** Two double-armed sutures are placed at opposite corners and only one stay suture is tied. **B** The two ends are utilized to construct the posterior and anterior anastomotic walls. **C** At the point where these two ends meet, they are tied placing the knot at a distance from the vessels about equal to the radius of the anastomosis; the resulting loop of suture being called the "growth factor" (*GF*). **D** At revascularization, the GF migrates through the anastomotic walls allowing a wide distension of the anastomosis. *RA*, radial artery; *CV*, forearm cephalic vein

knot reached the anastomotic surface (Fig. 2, right). Complete migration of the "growth factor" loop was observed and immediate patency of the AVWF was achieved in all 12 procedures. Slight bleeding at the level of the "growth factor" corner was observed in 7 of the 12 patients, which was easily controlled by tying the second stay suture or by placing a further stitch in 2 patients. The corner suture was removed in the other 5 patients. No bleeding complications were observed in the postoperative period. All AVWFs but one (90.9%) were patent within the first 2 months postoperatively. In the one patient with a thrombosed AVWF, a proximal brachial artery AVF was performed. After 6 months of follow-up, the primary AVWF actuarial patency rate was 81.8%.

In our opinion, end-to-end AVWF has many theoretical advantages over end-to-side or side-to-side techniques. With the former procedure, the blood flow in the arterialized vein is satisfactory, and it is associated with a low distal venous pressure and an adequate peripheral hand perfusion via the ulnar artery.[10–13] The "growth factor" technique of performing end-to-end AVWF is indicated to avoid any narrowing of the anastomosis which, along with the operative arterial spasm,[14] can place the anastomosis at a higher risk of early occlusion. We prefer this particular type of continuous anastomosis to the interrupted suture technique because the latter approach is more time-consuming and cumbersome. Moreover, the continuous technique makes it is easier to juxtapose the wider cephalic vein to the radial artery. The utilized suture material must be a monofilament with good sliding properties. Over the last two decades we have utilized

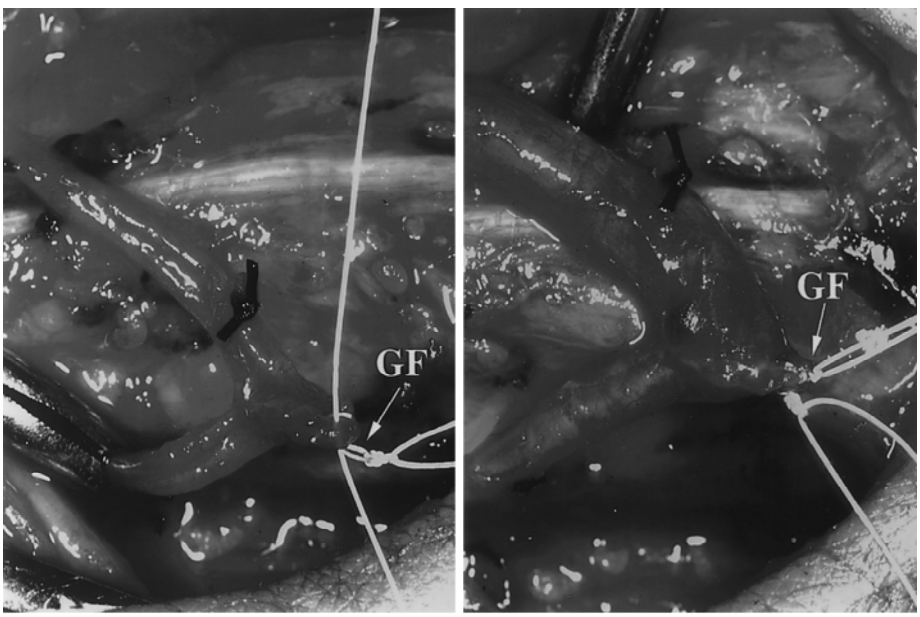

Fig. 2. Left End-to-end wrist arteriovenous fistula constructed with the ePTFE monofilament and "growth factor" technique. At the level of anastomosis, note the loop of growth factor (*GF*) and the untied second corner suture. **Right** After revascularization, the loop of growth factor migrated completely through the vessel walls, allowing distension of the anastomosis. In this case, the stay suture was tied after the anastomotic distension, to control slight bleeding from the corner

polypropylene or polybutester monofilaments,[6,9] but in the present series of patients we utilized an ePTFE monofilament. In all 12 patients the migration of the "growth factor" loop through the vessel walls was easy and complete. In our experience, the ePTFE sutures demonstrated an adequate sliding property and showed some advantages over other monofilaments such as polypropylene, which has memory, and polybutester, which has elastic properties under tension. These advantages resulted in better handling and easier tying, making ePTFE the monofilament of choice to construct vascular anastomosis using the "growth factor" technique.

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