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USE OF AUTOLOGOUS INTERPOSITION VEIN GRAFT IN MANAGEMENT OF LYMPHEDEMA: PRELIMINARY EXPERIMENTAL AND CLINICAL OBSERVATIONS

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ABSTRACT

We report preliminary experimental studies in rats and rabbits together with clinical observations in 39 patients with chronic lymphedema undergoing interposition autologous lymphatic-venous-lymphatic (LVL) anastomoses. This microsurgical operative technique is an alternative to other lymphatic shunting methods particularly where venous disease coexists in the same limb and where direct lymphatic-venous bypass is accordingly inappropriate. Preoperative diagnostic evaluation including lymphatic and venous isotopic scintigraphy, Doppler venous flow metrics and pressure manometry play an essential role in delineating the status of both the lymphatic and venous systems and in determining which microsurgical procedure, if any, is indicated. Our microsurgical method consists of inserting suitably large and lengthy autologous venous grafts between lymphatic collectors above and below the site of blockage to lymph flow.

The data demonstrate the feasibility of the LVL technique experimentally and in 39 patients with obstructive lymphedema (either arm or leg). Using LVL shunt, improvement was seen in both limb function and edema, and in some, edema regression was permanent for as long as 5 years.

Potentially, 40% of patients with chronic lymphedema may be managed by lymphatic shunts. Because these operations are associated with negligible morbidity and no mortality, renewed enthusiasm for their use has arisen using advanced microsurgical techniques. The initial approach to patients with persistent lymphedema includes physiotherapy, massage, form-fitting stockinettes, bandaging, and pneumatic compression. In those individuals with obliterative lymphangitis and hypoplasia with either advanced disease or poor response to the aforementioned non-operative methods, "debulking" operations are useful (1). In patients, however, with longstanding obstructive lymphedema unresponsive to "conservative" methods or in whom there are demonstrable patent regional lymphatics and suitable lymph nodes, lymph nodal-venous, lymph nodal capsule-venous, and multiple end-to-side lymphatic venous anastomoses are feasible (2,3). In these latter operations, the integrity of the ipsilateral peripheral venous circulation is indispensable to maintaining patency of the shunt which depends in turn on an intact lymphatic-venous pressure gradient. In this regard, it is essential preoperatively to assess both the peripheral lymphatic and venous systems and, if necessary, even the arterial circulation (4). Accordingly, the technique of conventional oil contrast lymphography, isotope lymphangioscintigraphy, Doppler flow metrics and manometry, and venous scintigraphy are commonly used. On the

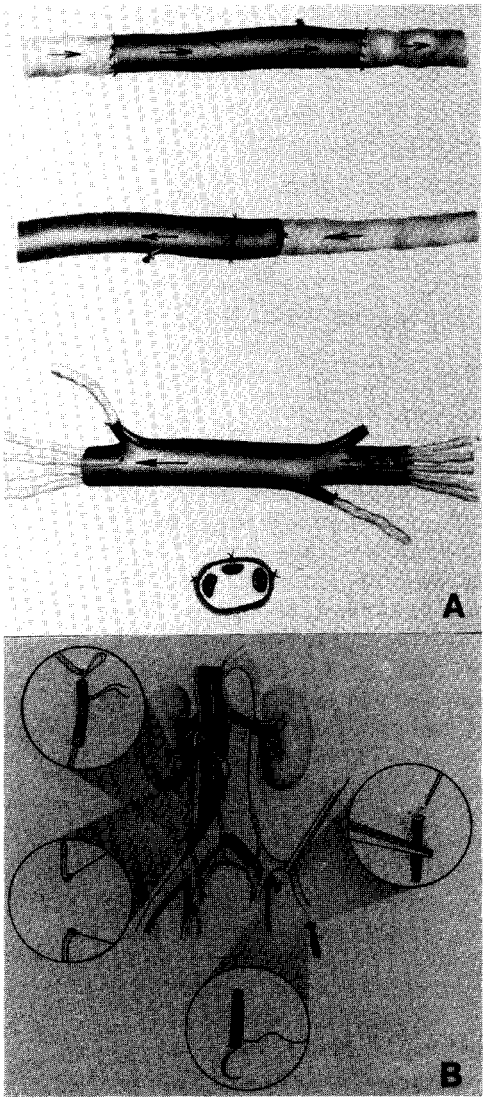

Fig. 1. Our technique (A) of lymphatic-venous-lymphatic angioplasty with its adaptation in rats (B) showing invagination (telescoping) of the lymphatic into the free autologous vein graft using a mattress U stitch.

other hand, in our registry approximately 30% of patients with lymphedema have coexistent venous disease precluding direct lymphatic or lymph nodal-venous shunts. Although segmental lymphatic autotransplants have been used successfully in these situations (5,6), this procedure is exceedingly tedious and may be

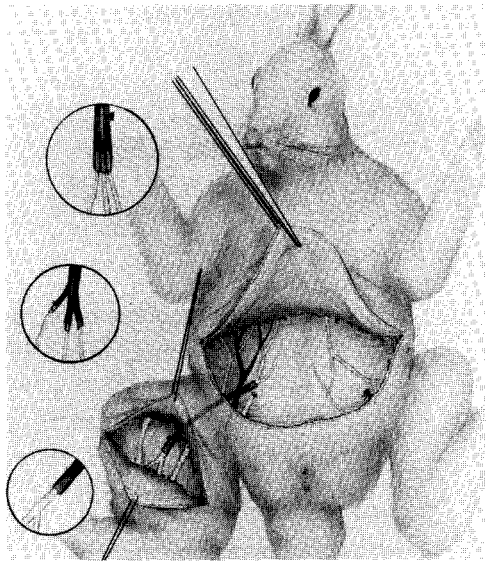

Fig. 2. Technique of lymphatic-venous-lymphatic anastomosis in rabbits with experimental unilateral paw lymphedema. Note the invagination of multiple lymphatic collectors into each end of the interposed vein graft.

associated with secondary lymphedema at the operative site (7). Alternatively, this group is amenable to autologous vein lymphatic-venous-lymphatic interposition shunt and this report describes our experimental and preliminary clinical experience with this approach.

MATERIALS AND METHODS

Experimental studies

Twenty outbred male adult rats were used. Under light general anesthesia using an invaginating technique as shown in *Fig. 1A*, segments of external iliac vein (caliber 1mm and length 0.5 to 1cm) were inserted between two severed ends of paracaval lymphatics using a telescopic anastomosing method with 10-0 nylon suture *(Fig. 1B)*. At operation, patency of the LVL graft was determined by patent blue V test. Ten, twenty, and thirty days after operation, the LVL shunt was examined initially under a dissecting microscope and then submitted to light and electron microscopy.

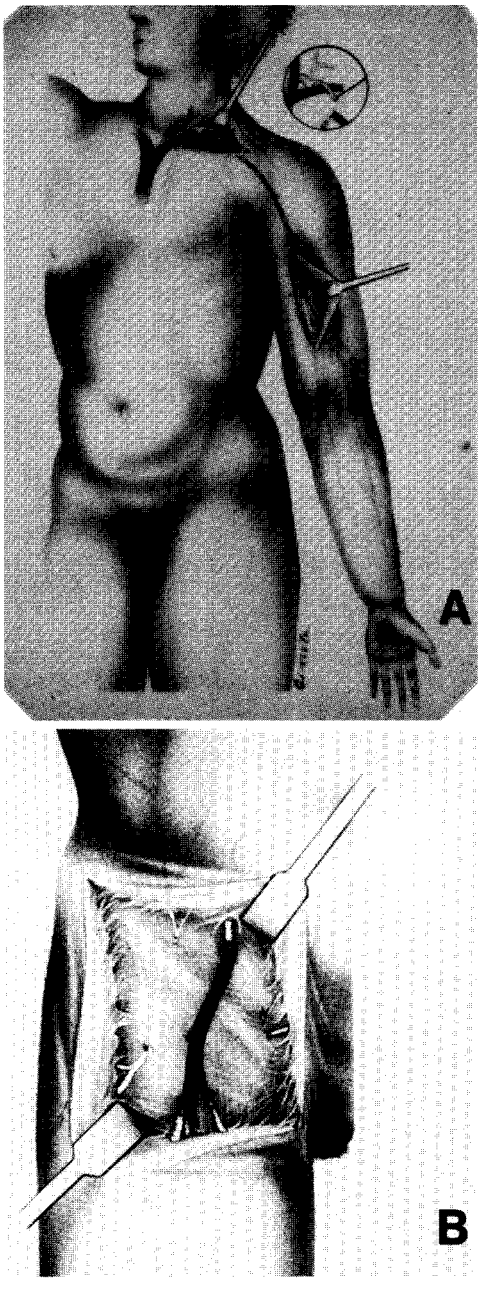

Fig. 3. Method of implantation of autologous vein graft between lymphatic collectors for management of lymphedema of the (A) arm and (B) leg.

Five rabbits with previously produced experimental lymphedema (8) of a posterior paw underwent a similar LVL anastomosis using a venous graft obtained from a superficial inferior epigastric vein *(Fig. 2)*. The gross appearance of the paw and patency of the anastomoses were determined beginning from the 5th-7th day after operation.

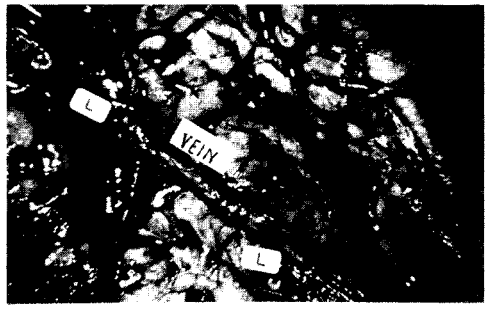

Fig. 4. Intraoperative photographs using our technique of lymphatic-venous-lymphatic interposition graft. Using microscopy, each anastomosis is done with 10-0 nylon.

Clinical studies

In 39 patients with chronic lymphedema, peripheral lymphatic-venous-lymphatic anastomoses were performed and in 32 were followed 3-5 years after operation. Each patient had initially undergone extensive nonoperative therapy without noteworthy benefit. Three patients had post-mastectomy arm lymphedema, 31 had secondary or acquired leg lymphedema, and 5 had primary or congenital lymphedema. Six patients had bilateral leg lymphedema, of which two were primary. The average age of these patients was 35 years (range 11-60 years) with females predominating (~1.5:1). Autologous venous valve grafts (length 7-25cm; caliber 1.5-5mm) were taken from the volar aspect of the forearm or from the ipsilateral great or lesser saphenous veins (or side tributaries) and interposed between lymphatics above and below the site of obstruction. Implantation of the vein graft was on the anterior surface of the arm between the midportion and the supraclavicular space *(Fig. 3A)* and in the leg either just above and below the inguinal *(Fig. 3B)* or popliteal space. Patent blue

Fig. 5. Lymphangioscintigraphy (^{99m}Tc-sulfur colloid) in a patient with secondary lymphedema of left lower leg before (A) and after (B) microsurgical LVL anastomosis. Note the "elongated" lymph collectors after the LVL anastomosis.

dye not only helped delineate lymphatics but verified patency at operation *(Fig. 4)*, which lymphangioscintigraphy confirmed post-operatively *(Fig. 5)*. In addition, clinical criteria to evaluate the patients included measuring limb circumference before and after LVL anastomosis, regression of edema and functional change. Of note, none of these patients had post-operative massage-physiotherapy or elastic compression so that the efficacy of the operation could be independently evaluated.

RESULTS

Experimental studies

Of 15 rats that survived operation, patency of the grafts at 10-20-30 days were established in 12 (80%) by direct examination and by scanning electron microscopy *(Fig. 6)*. Of the 5 rabbits with lymphedema undergoing LVL anastomosis, edema markedly regressed or disappeared in 4 after 5-7 days and one rabbit died 12 hours after operation. All grafts appeared patent.

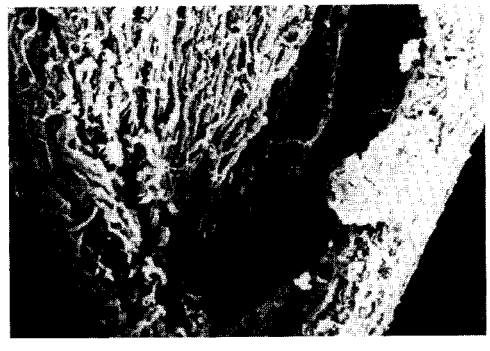

Fig. 6. Scanning electron microscopy of site of interposition lymphatic-venous-lymphatic anastomosis in rat demonstrating shunt patency 10 days after operation.

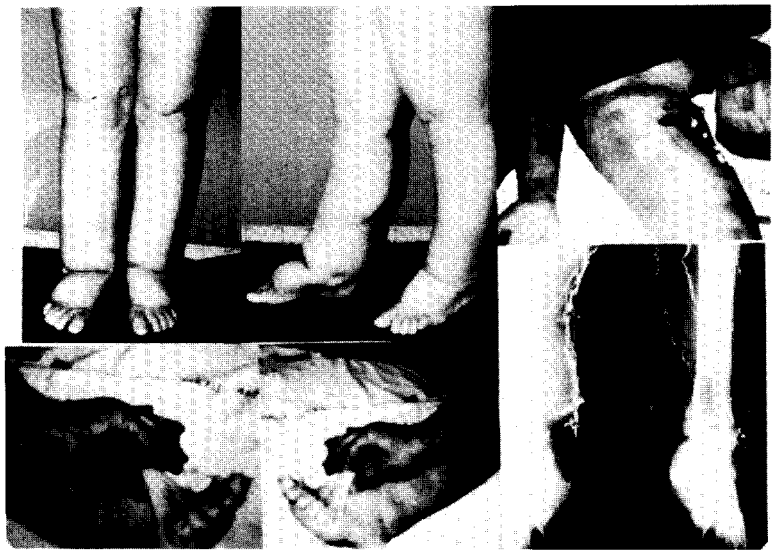

Fig. 7. Clinical appearance of lower extremities before and after lymphatic-venous-lymphatic angioplasty. On the upper right is the operative exposure. A portion of vein was excised from the volar surface of the forearm. The lower right demonstrates preoperative conventional (oil contrast) lymphography with numerous collateral lymphatic collectors. On the left is the patient before (upper) and after (lower) LVL interposition shunt demonstrating reduction of edema and greater forefoot laxity of the skin.

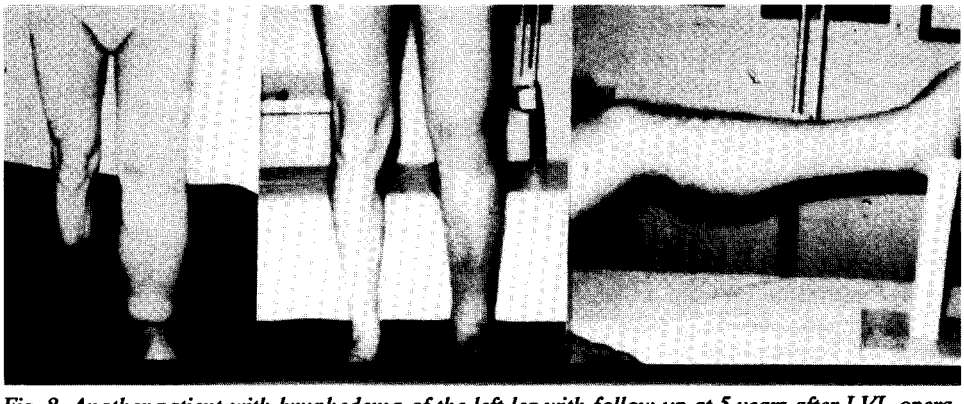

Fig. 8. Another patient with lymphedema of the left leg with follow-up at 5 years after LVL operation demonstrating considerable and persistent reduction in lymphedema. Note that in the far left photograph the patient is wearing a black stocking which obscures the normal right lower leg.

Clinical studies

Thirty two patients were followed up to 5 years and 7 more recent patients for a shorter time. In addition to intraoperative shunt patency (using blue dye) and occasional verification of postoperative patency using isotope lymphography *(Fig. 5)*, edema improved in all—marked edema regression (>75%) in 19 patients,

moderate reduction (50-75% decrease) in 9 patients, and mild reduction (25-50% decrease) in 4 patients *(Figs. 7,8)*.

COMMENT

Whereas this preliminary experience using intralymphatic interposition autologous venous graft in experimental animals and to manage highly selected patients with chronic lymphedema is encouraging, certain limitations exist. Thus, severe lymphatic and/or lymph nodal hypoplasia and aplasia or extensive obliteration of superficial and deep lymphatics represent a genuine contraindication to this and other lymphatic shunting operation and such patients must be managed nonoperatively or by debulking. Coexistent venous disease (with loss of lymph-venous pressure gradient) also precludes direct lymphatic-venous shunting and if operation is appropriate requires interposition lymphatic-venous-lymphatic bypass. The abundance and generally large caliber of venous tributaries as compared to lymphatic collectors allows several lymphatics to be invaginated for anastomosis into both ends of the venous graft. Moreover, the relatively short operative time (2-3 hours) and the ready adaptability of venous grafts to variant lymphatic anatomy also makes this operative approach attractable.

In conclusion, in patients with longstanding lymphedema in whom nonoperative treatment has failed and preoperative assessment discloses stagnant lymphedema, the presence of lymphatic collectors above and below the putative site of "obstruction" along with coexistent venous disease contraindicating direct lymphatic venous or lymph nodal-venous shunt, our technique of interposition lymphatic-venous-lymphatic shunt is a worthwhile consideration.

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