



The venous island flap: is it purely venous?

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SUMMARY. Histological study of the pedicles of long and short saphenous and cephalic venous flaps in fresh human cadavers and two clinical cases showed that one or two arterioles and multiple capillaries were present in the perivenous areolar tissue. This challenges the concept that these flaps are purely venous.

Several authors have described flaps based entirely on venous circulation both in experimental animals and humans. Based on experience with the "one-ended" venous flap, Thatte and Thatte¹ and Thatte and Patel² stressed the importance of preserving the loose areolar tissue around the vein. The experimental study of Noreldin *et al.*³ on the inferior epigastric venous flap of the rat confirmed the importance of the perivenous areolar tissue in perfusion of the skin island.

The contradictory reports on the survival of single ended venous flaps^{1,4-9} urged us to study the pedicles of these flaps histologically in two cadavers and two clinical cases. The long and short saphenous and cephalic venous pedicles were investigated.

Materials and methods

Proximally based venous island flaps based on the long saphenous⁴, short saphenous⁴ and cephalic⁴ veins of two cadavers were prepared.

The flaps were designed along and either side of the course of the corresponding vein. Each flap was cut distally, the distal end of the vein cut and marked, and the flap then raised as a fasciocutaneous island based on the pedicle vein proximally. The pedicle was raised off the deep fascia, leaving the vein with an intact flimsy fatty envelope. This tissue was retained to "protect" the vein as suggested by Thatte and Thatte.¹ In many cases scissor dissection on both sides of the vein was necessary to cut a layer of fascia which invested the vein.

In two clinical cases, proximally based saphenous venous flaps were used to repair contractures of the knees. The saphenous vein and perivenous areolar tissue at the distal ends of the flaps was sectioned for histology. The total number of biopsies was 6 and these were fixed and stained with haematoxylin and eosin (H & E), Mallory and Orcien stains. The slides were examined under light microscopy.

Results

One or more small arteries were demonstrated within the perivenous areolar tissue in each of the specimens examined.

Many minute vascular channels which were confirmed under high power to be thin walled capillaries were also present in this tissue.

The size of the arterioles was proportionally larger in specimens taken from the long saphenous and cephalic venous pedicles than that of the short saphenous pedicles. However, we have not measured the size of each arteriole and this was a gross comparison of the size on high power magnification ($\times 100$).

Figures 1-4 are microphotographs showing these findings.

Figure 3 illustrates the fascial envelope of the long saphenous vein and perivenous areolar tissue. This section was cut through the vein and fascia before raising it as a pedicle. During dissection of the pedicle we have preserved this envelope and its contents. The presence or absence of this envelope and its role in the pathogenesis of primary varicose vein will be the subject of another study of ours.

Discussion

Baek *et al.*⁴ first demonstrated the survival of the saphenous island venous flap in the dog on venous



Fig. 1

Figure 1—Photomicrograph of the long saphenous vein, showing two arterioles, plus multiple minute vessels within the perivenous areolar tissue (Mallory Stain $\times 100$) (ARL: arteriole, LSV: Long saphenous vein).

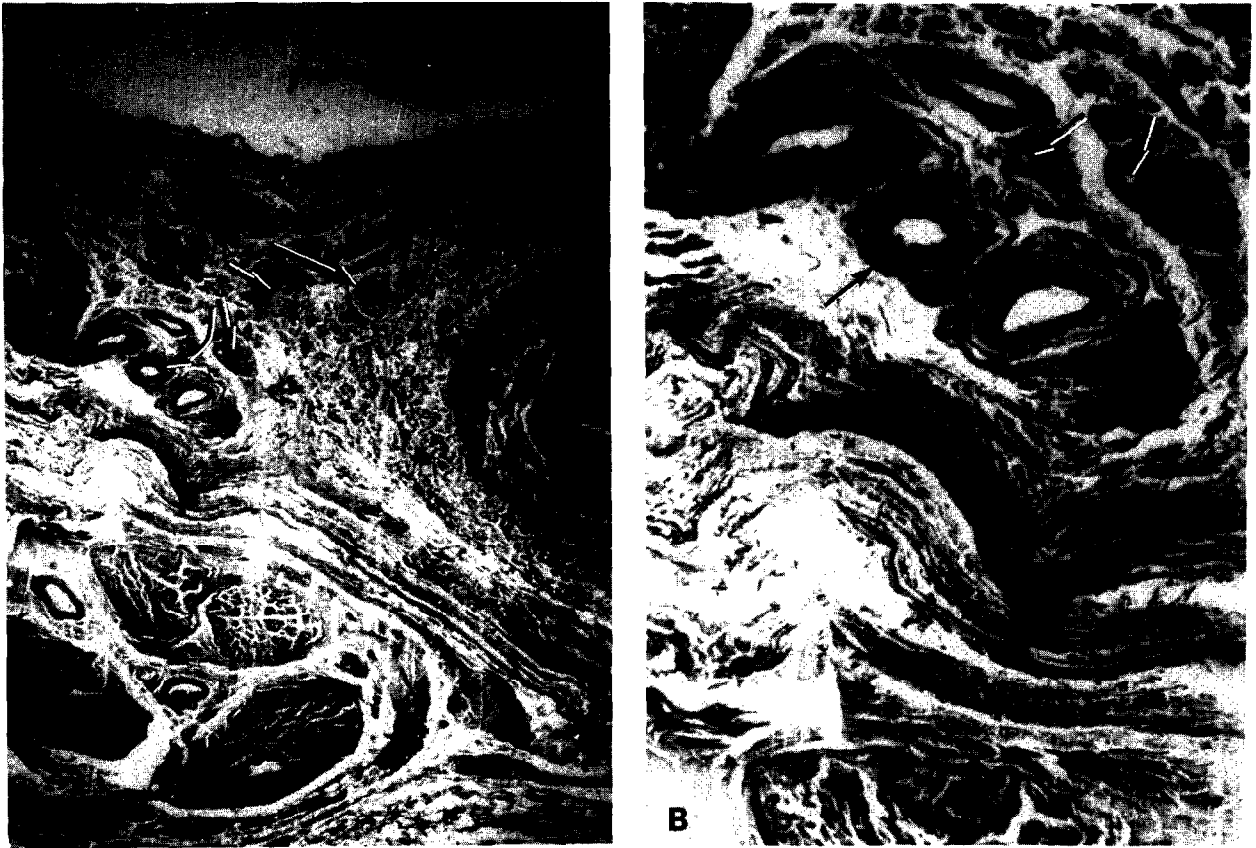


Fig. 2

Figure 2—Photomicrograph of the long saphenous vein, showing multiple arterioles (Orcien Stain 2A \times 40 2B \times 100). This section was taken across the saphenous vein below the knee joint (10 cm) with the vein *in situ* and includes the deep fascia. It shows that the deep fascia splits into superficial and deep layers to surround the vein and perivenous areolar tissue (F: fascia). 2B is a higher magnification of the area of arterioles.

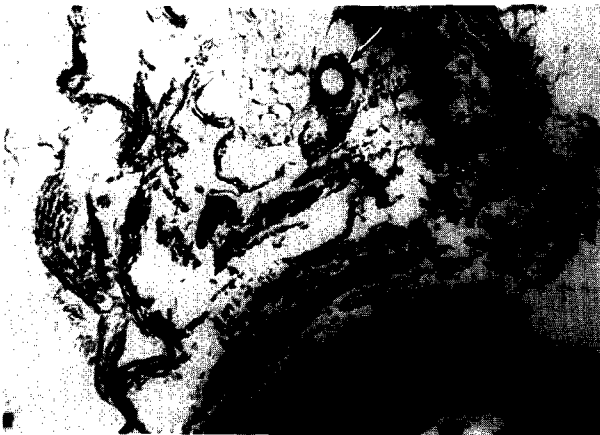


Fig. 3

Figure 3—Photomicrograph of the short saphenous vein with an arteriole within the perivenous areolar tissue (Mallory Stain \times 100, SSV: Short saphenous vein).

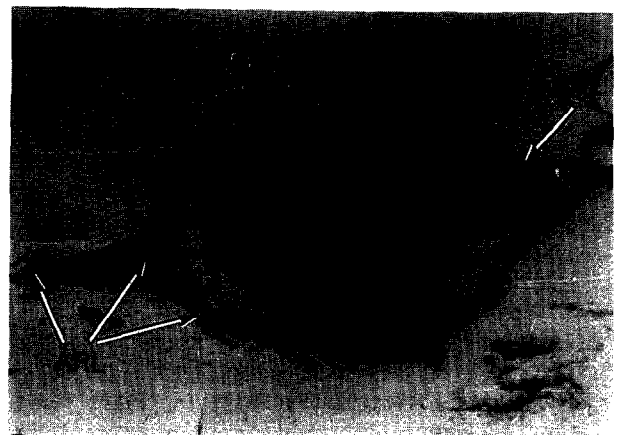


Fig. 4

Figure 4—Photomicrograph of the cephalic vein and perivenous areolar tissue with multiple arterioles (Mallory Stain \times 12, C: cephalic vein).

circulation alone but could not achieve survival on a single ended vein.

Thatte and Thatte⁵ followed with experimental work on the saphenous venous flap in the dog, in which a single-ended proximally based venous flap survived.

Chavoïn *et al.*⁷ stated that these flaps could only be raised below the ankle and the wrist due to the unique nature of the vascular architecture of the skin in these

areas. They also felt that the volume of these flaps is limited.

However, Thatte and Thatte^{1,6} have shown that these flaps can be raised at and below the knee and elbow and have surface areas up to 90 cm².

Amarante *et al.*⁸ showed experimentally that the single ended proximally based venous flap is perfused and drains through its single pedicle vein. They also stated that a critical distance between the flap and the

first tributary of the cephalad vein pedicle is dependent on the vein radius and the pressure drop across the branch vein.

In the absence of firm evidence that the pedicles of these flaps includes only the vein, scepticism is bound to be voiced about them being purely venous flaps.¹ The perivenous tissue of the pedicle of the venous flap seems to be a crucial factor for flap survival. Thatte and Thatte,¹ Thatte and Patel² and Yuen and Leung¹⁰ have recommended preserving the perivenous areolar tissue as a safeguard for the pedicle vein. The importance of this soft tissue pedicle as a haemodynamic means for proper flap perfusion has been studied by Noreldin *et al.*³ in the rat inferior epigastric venous flap, who believe it to be of importance in the perfusion of skin flaps based on the inferior epigastric vein in the rat.

In this study, the presence of at least one small calibre artery in all the pedicles of the venous flaps studied, in addition to multiple capillaries in the perivenous areolar tissue shows that these flaps are not purely venous and that these small vessels could arterialise the flaps. These vessels are raised together with the pedicle vein and perivenous areolar tissue from the deep fascia, as the island flap is a fascio-cutaneous one.

References

1. Thatte RL, Thatte MR. The saphenous venous flap. *Br J Plast Surg* 1989; 42: 399-404.
2. Thatte RL, Patel J. Venous flaps. *Clinical Update* 1990; 4: 9.
3. Noreldin AA, Fukuta K, Jackson IT. Role of perivenous areolar tissue in the viability of venous flaps: an experimental study on the inferior epigastric venous flap of the rat. *Br J Plast Surg* 1992; 45: 18-22.
4. Back SM, Weinberg H, Song Y, Park CG, Biller HF. Experimental studies in the survival of venous island flaps without arterial inflow. *Plast Reconstr Surg* 1985; 75: 88-95.
5. Thatte RL, Thatte MR. A study of the saphenous venous island flap in the dog without arterial inflow using a non-biological conduit across a part of the length of the vein. *Br J Plast Surg* 1987; 40: 11-5.
6. Thatte RL, Thatte MR. Cephalic venous flap. *Br J Plast Surg* 1987; 40: 16-9.
7. Chavoin JP, Rouge D, Vachaud M, Boccalon H, Costagliola M. Island flaps with an exclusively venous pedicle. A report of eleven cases and a preliminary haemodynamic study. *Br J Plast Surg* 1987; 40: 149-54.
8. Amarante J, Costa H, Reis J, Soares R. Venous skin flaps: an experimental study and report of two clinical distal island flaps. *Br J Plast Surg* 1988; 41: 132-7.
9. Mamoun M, Zaki M, Kadry M, Atta A, Negm A. The use of venous flaps for reconstruction of digital defects. *Egyptian Journal of Plastic and Reconstructive Surgery* 1990; 14: 53.
10. Yuen QM, Leung PC. Some factors affecting the survival of venous flaps: an experimental study. *Microsurgery* 1991; 12: 60-4.
11. Thatte MR, Kamdar NB, Khakkar DV, Varade MA, Thatte RL. Static and dynamic computerised radioactive tracer studies, vital dye staining and theoretical mathematical calculations to ascertain the mode of survival of single cephalad channel venous island flaps. *Br J Plast Surg* 1989; 42: 405-13.

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