

Haemodynamic Properties of a Distal Y-shaped Arterial Autograft Bypass-flap in a Porcine Model: Changes from Elastic to Viscoelastic Mechanical Behaviour?

P. Kolh

University Hospital of Liège, Cardiovascular Surgery Department, CHU B35 Sart Tilman, 4000 Liège, Belgium

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Tissue loss is a devastating consequence of critical limb ischaemia in which the lower extremity is threatened by major amputation when graft material, bone, or tendon is exposed. A surgical technique recently developed is the subscapular artery Y-shaped flow-through muscle flap, an arterial autograft bypass-muscle flap (AABF) with the advantages of the arterial autograft, an increased run-off due to the muscular flap, and the possibility of covering the tissue loss with the same anatomic unit.¹ Anatomically, the arterial autograft is composed of the subscapular artery extended by the thoracodorsal artery while the free flap is made of the serratus anterior muscle supplied by the distal branch of the thoracodorsal artery.

Malikov et al.² recently showed the clinical feasibility of this technique, particularly useful in patients with poor run-off and large ischaemic lesions. Among 20 patients, all candidates for major amputation, who were treated with this AABF technique between 2002 and 2007, seventeen had a patent graft, a viable muscle flap, wound healing, and a functional leg at a mean follow-up of 31 months.²

The most important interest of a bypass-flap is its haemodynamic characteristics, as the increased distal resistance is the most frequent cause of outflow degeneration and of bypass failure in patients with severe peripheral ischaemia. In this issue of the *Journal*, Malikov et al.³ assessed, in a porcine experimental model, the transplantation-induced changes in the subscapular Y-shaped combined AABF haemodynamic characteristics.

They³ observed that, in *in situ* AABF, pressure and flow waveforms simultaneously reached their extremities with little hysteresis in pressure-flow loops, while, in the superficial femoral artery (SFA), maximal flow preceded maximal pressure, and conversely for the minimal values, eliciting marked pressure-flow loops hysteresis. Immediately after transplantation, the flow increased in the proximal AABF and adopted the specific SFA pulsatile characteristics. Following distal graft clamping, the flow in the proximal segment decreased to the intrinsic pedicle flow, while resistance proportionally increased. Upon declamping, each flow component increased above baseline values in the distal artery, while there was no significant change in the pedicle haemodynamics. After clamping the pedicle, systolic flow was significantly reduced in the proximal and distal graft segments only, while declamping the pedicle inverted each component of the pedicle flow and of the distal graft flow. Ten days after transplantation, the AABF flow was unchanged in the distal segment, but remained elevated in the proximal and pedicle segments. Upon declamping the distal segment, the vasodilatation in the distal arterial network characterised the flow-dependence.

Malikov et al.³ concluded that the results evidenced that the arterial autograft adapts, after transplantation, to the new flow conditions, changing from an elastic mechanical to a viscoelastic mechanical behaviour. In such behaviour, the waves pulsatility is increased, augmenting the blood flow in the muscular arteries.

This is an elegant study, giving important insights into the adaptative haemodynamic properties of the subscapular arterial autograft bypass-muscle flap. However, two additional experimental investigations could further assess the possible benefits of this technique. Firstly, in advanced arterial disease with skin necrosis, peripheral resistances are usually very high and the transplantation of a large flap can induce a stealing phenomenon. This could easily be tested by narrowing the arterial lumen after the distal anastomosis. Secondly, the authors are encouraged to precisely analyse the changes in arterial compliance after transplantation, which can easily be calculated from the instantaneous pressure and flow waveforms, and to assess long-term mechanical and histopathologic adaptations of this combined arterial and muscle bypass. Only by providing such an analysis could they possibly prove the definite change from elastic to viscoelastic mechanical behaviour.

References

- 1 Malikov S, Casanova D, Champsaur P, Magnan PE, Branchereau A. The bypass flap: an innovative technique of distal revascularization - anatomical study and clinical application. *Ann Vasc Surg* 2004;18:535-43.
- 2 Malikov S, Magnan PE, Champsaur P, Casanova D, Branchereau A. Subscapular artery Y-shaped flow-through muscle flap: a novel one-stage limb salvage procedure. *J Vasc Surg* 2008;48:159-66.
- 3 Malikov S, Rolland PH, Magnan PE, Bartoli M, Champsaur P, Branchereau A. The haemodynamics of the distal arterial Y-shaped autograft bypass-flap in a porcine experimental model. *Eur J Vasc Endovasc Surg*; 2008.