CORRESPONDENCE

Paradox Findings are Reality, Difficult is the Explanation

In their article "Lower limb deep vein diameters beneath medical compression stockings in the standing position", Rastel et al. concluded that in the standing position, deep vein diameter reduction is not caused by medical compression stockings (MCSs) but may be due to the isometric muscle contractions.[1] There is some doubt if this simple message is the full truth, as we would expect to see the effect regularly, even without any compression, which is not the case. Quite the opposite: the diameter of deep veins is usually larger without compression in the standing vs. recumbent position.[2] After applying the MCSs, a greater narrowing of deep than of superficial veins was occasionally demonstrated in the standing position, which was named the "compression paradox".[3] The same phenomenon was found in a considerable number of patients in the prone, but not the supine position,[4] which has nothing to do with active muscular activity.[2]

Our explanation for the paradox is governed by the relationship between intravenous and external pressures (in agreement with intramuscular pressure measurements performed in previous studies).[3,5]

Veins will collapse when the external pressure is higher than the intravenous pressure, as was impressively shown in the magnetic resonance imaging of a patient with a hugely dilated great saphenous vein.[2] In this case the massive refluxes in the superficial system were followed by an increased compartment pressure, which added to the 22 mmHg of MCSs. Ultimately, the pressure around the deep veins was higher than the intravenous pressure, which led to their collapse. This is not the case in the extrafascial varices, which can be compressed only by an external pressure higher than the intravenous pressure.

In conclusion, muscle contraction in the standing position certainly plays an important role in explaining the compression paradox of a stronger compression effect on deep than superficial veins, achieved by a light compression stocking. However, the reality is more complex, and the compartment pressure surrounding the deep veins has to be taken into account as well.

REFERENCES

1 Rastel D, Lun B. Lower limb deep vein diameters beneath medical compression stockings in the standing position. *Eur J Vasc Endovasc Surg* 2019;**57**:275–82.

2 Partsch H, Mosti G, Mosti F. Narrowing of leg veins under compression demonstrated by magnetic resonance imaging (MRI). *Int Angiol* 2010;**29**:408–10.

3 Uhl JF, Benigni JP, Cornu-Thenard A, Fournier J, Blin E. Relationship between medical compression and intramuscular pressure as an explanation of a compression paradox. *Phlebology* 2015;**30**:331–8.

4 Downie SP, Firmin DN, Wood NB, Thom SA, Hughes AD, Wolfe JN, et al. Role of MRI in investigating the effects of elastic compression stockings on the deformation of the superficial and deep veins in the lower leg. *J Magn Reson Imaging* 2007;**26**:80–5.

5 Murthy G, Ballard RE, Breit GA, Watenpaugh DE, Hargens AR. Intramuscular pressures beneath elastic and inelastic leggings. *Ann Vasc Surg* 1994;**8**:543–8.

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Response to "Re. Lower Limb Deep Vein Diameters Beneath Medical Compression Stockings in the Standing Position"

We are pleased to see that our work is a source of scientific debate around the effect of compression therapy in vascular disorders, and we agree that the mechanisms of such therapy should be considered as more complex than they appear. Initially, our work did not aim to oppose the paradox hypothesis.[1] We designed our experimental trial to document an assumption based, on the one hand, on impressive magnetic resonance imaging (MRI) images of a single selected case report, and, on the other, on limited numerical data.[2,3] Nevertheless, our results demonstrated not only that muscle contraction was predominantly responsible for reducing vein diameters in the standing position, but also that medical compression stockings did not add any significant synergistic effect.

We acknowledge that the muscle contraction effect on deep vein diameters has a wide range of results. This can be easily explained by the high variability in patient leg morphology and the legs' ability to contract. This assumption is supported by consistent results observed within an extended range of applied pressure on patients involved in this medical compression trial.

Moreover, as reported by Uhl,[4] the acquisition time during radiology imaging is long, and consequently patients in the standing position must contract their muscles more or less to maintain body balance, unless suspended which was not the case in Uhl's study. Consequently in compression therapy, when investigating the diameter of deep veins

of patients in the standing position, unless it is absolutely certain that the calf muscles are not at all contracted during MRI acquisition, the observed phenomena are not related to the external compression exerted by medical compression stockings.

As reported recently,[5] we support the statement recommending that "the compartment pressure surrounding the deep veins has to be taken into account" for future investigations.

REFERENCES

1 Rastel D, Lun B. Lower limb deep vein diameters beneath medical compression stockings in the standing position. *Eur J Vasc Endovasc Surg* 2019;**57**:276–82.
2 Partsch H, Mosti G, Mosti F. Narrowing of leg veins under compression demonstrated by magnetic resonance imaging (MRI). *Int Angiol* 2010;**29**:408–10.
3 Uhl JF, Benigni JP, Cornu-Thenard A, Fournier J, Blin E. Relationship between medical compression and intramuscular pressure as an explanation of a compression paradox. *Phlebology* 2015;**30**:331–8.
4 Uhl JF. 3D multislice CT to demonstrate the effects of compression therapy. *Int Angiol* 2010;**29**:411–5.
5 Frauziols F, Chassagne F, Badel P, Navarro L, Molimard J, Curt N, et al. In vivo identification of the passive mechanical properties of deep soft tissues in the human leg. *Strain* 2016;**52**:400–11.

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Re: "Editor's Choice – Cerebral Hyperperfusion Syndrome after Carotid Artery Stenting: A Systematic Review and Meta-analysis"

We have read the meta-analysis by Huibers et al.[1] regarding cerebral hyperperfusion syndrome (CHS) after carotid artery stenting, but some points should be addressed.

Firstly, the authors found that CHS is a frequent complication after carotid artery stenting (CAS) leading to a high stroke rate.[1] However, they provide no data on perioperative medication. The type/duration of antiplatelet and antihypertensive treatment should be evaluated for everyday clinical practice. Moreover, post-intervention monitoring protocols were not investigated, although guidelines strongly recommend a standardised monitoring protocol for the first 24 h.[2]

Secondly, no pooled disabling stroke/mortality and no intracranial haemorrhage (ICH) risks were reported. In a recent review of ours, ICH was significantly associated with a higher mortality in patients with CHS (pooled OR = 386.977).[3] Additionally, Abreu et al.[4] found a 38% ICH risk and an associated mortality of 51%, with ICH being more frequent after CAS than after endarterectomy. Therefore, such outcomes should also be reported in systematic reviews.

REFERENCES

1 Huibers AE, Westerink J, de Vries EE, Hoskam A, den Ruijter HM, Moll FL, et al. Editor's choice – cerebral hyperperfusion syndrome after carotid artery stenting: a systematic review and meta-analysis. *Eur J Vasc Endovasc Surg* 2018;**56**:322–33.
2 Naylor AR, Ricco JB, de Borst GJ, Debus S, de Haro J, Halliday A, et al. Editor's choice – management of atherosclerotic carotid and vertebral artery disease: 2017 clinical practice guidelines of the European Society for Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2018;**55**:3–81.
3 Galyfos G, Sianou A, Filis K. Cerebral hyperperfusion syndrome and intracranial hemorrhage after carotid endarterectomy or carotid stenting: a meta-analysis. *J Neurol Sci* 2017;**381**:74–82.
4 Abreu P, Nogueira J, Rodrigues FB, Nascimento A, Carvalho M, Marreiros A, et al. Intracerebral hemorrhage as a manifestation of cerebral hyperperfusion syndrome after carotid revascularization: systematic review and meta-analysis. *Acta Neurochir (Wien)* 2017;**159**:2089–97.

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The Many Faces of Frailty in Vascular Surgery

We read with great interest the systematic review and meta-analysis by Wang et al., on the impact of frailty on the outcome of elderly patients after major vascular surgery.[1] The authors present a nice detailed overview of current frailty papers. In their extensive analysis they evaluate multiple frailty tools, both single and multi-domain assessment tools, in major vascular surgery.

As described in the article, frailty is a syndrome defined as increased vulnerability because of a decline in reserve and