

LETTER TO THE EDITOR

Response to the letter to the editor ‘Novel imaging methods reveal positive impact of topical negative pressure application on tissue perfusion in an in-vivo skin model’

Dear Editors,

We thank the authors for their valuable and interesting feedback on our study “Novel imaging methods reveal positive impact of topical negative pressure application on tissue perfusion in an in vivo skin model.”¹

They point out that the impact of topical negative pressure application (TNPA) on the local perfusion of tissue is still not fully understood and that this would result in an ongoing discussion if TNPA increases or decreases tissue perfusion. Questions of altering the skin circulation have been investigated for a long time and have been discussed controversially when controlled clinical tissue expansion, a then popular technique of providing donor tissue, showed to result in an increase in surface area of expanded skin.² Since tissue expanders exert pressure on the overlying tissue, one could expect that skin circulation would decrease. But the opposite effect occurs as is commonly known. Marks et al also showed that rapid expansion led to significant increases in capillary blood flow in expanded skin and to enhanced preservation of capillary flow.³

So there seems to be sufficient evidence that exerting pressure to skin and tissue—as definitely happens when TNPA is applied—is able to enhance capillary blood flow.

The interesting assumption by the author that the increase in both tissue oxygen saturation and skin temperature might be due to the reactive hyperaemia that occurred after the removal of the dressing may certainly play a role. However, if the repeatedly measured perfusion changes would only be due to reactive hyperaemia, one would rather expect a decrease in skin perfusion. This would result in a pallor of the skin. Moreover, a further increase in tissue oxygen saturation and skin temperature after removal of the dressing should occur in the very first phase. This is well known from reperfusion phenomena using arm tourniquets. Both tissue oxygen saturation and skin temperature showed an increase

directly after the removal of TNPA compared with the beginning, followed by a decrease ending in higher measured values compared with the initial level.

Also, one would expect a decrease of perfusion of the underlying tissue, accompanied by malperfusion when a TNPA dressing is not frequently changed. Nevertheless, dressing changes with a frequency up to 5 days are daily clinical routine, for example, in chronic wounds.⁴ Of course not exactly comparable to the principle of cupping, the collapsed dressing in TNPA presents a more or less stiff or rigid system. TNPA results in centripetal traction of the wound bed.⁵

In contrast to the previously described studies, where blood flow was measured using laser Doppler,^{6,7} our aim in this study was to present two devices—the near-infrared imaging and the thermal imaging—that have not yet been described in this context. These later techniques might help to shed more light on the physiological effects of TNPA. While the increase in blood flow might be influenced by a potential compression of the blood vessels by the TNPA itself—resulting in a reduced diameter of the vessels—there would not be an increase in tissue oxygen saturation. This presumption is supported by Sogorski et al who stated that a real increase in perfusion should result in higher tissue oxygen saturation, which is in accordance with the results of our study.⁸ Furthermore, we did not calculate blood flow, but instead we measured the skin temperature (with thermal imaging) and tissue oxygen saturation (with hyperspectral imaging) as indirect signs of perfusion. There are certainly more tools to be invented in the future to more precisely follow and explain the clinically observed perfusion changes under TNPA.

It is clear that despite several decades of clinically using TNPA, not all the underlying mechanisms are fully understood, and more details will hopefully be revealed concerning the underlying basic mechanisms. We hope to further stimulate this search for clearing the

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pathophysiology of TNPA and can confirm the usefulness of two novel imaging methods in the field of perfusion analysis. As Morykwas et al stated: “While much has been done, a great deal more needs to be done to elucidate the mechanisms of action responsible for the dramatic response seen clinically.”⁹

CONFLICT OF INTEREST

R.E.H. has received third party funding for scientific research on NPWT from KCI—an Acclity company in the past and has served as a member of a Scientific Advisory Board of KCI-Acelity in the past. R.E.H. and A.A. served as speakers on scientific symposia of KCI-Acelity in the past. The authors have no other relevant affiliations or financial involvement with any organisation or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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