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CORRESPONDENCE

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Monitoring the microcirculation in the critically ill patient: reflectance spectroscopy

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Dear Editor,
I read with great interest and pleasure the excellent overview of the most common methods currently used to monitor the microcirculation by De Backer and colleagues [1]. The expertise of this group of authors with most of the methods described in their review of innumerable original publications was clearly evident. However, the section on reflectance spectroscopy is rather short, suggesting that they may lack in-depth practical experience with that specific method. In particular, the last sentence on recent developments in the technique is incorrect and needs to be explained more specifically.

The first device using reflectance spectroscopy (EMPHO) was limited to perpendicular probes for mucosa measurements and was based on spectrophotometry only. Nevertheless, it has been used in numerous experimental and clinical studies performed by our group for assessing the effects of various factors and agents, such as positive airway pressure, intraabdominal pressure, hypercapnia, cardiopulmonary bypass, vasoactive drugs and anaesthetics, on the splanchnic microcirculation [for references, see the Electronic Supplementary Material (ESM)].

The latest development using reflectance spectroscopy is incorporated in the O2C (oxygen to see) device (Lea, Giessen, Germany). The technology of the O2C device is based on two physical principles: reflection spectroscopy and the laser Doppler technique. Compared to the EMPHO device, the O2C instrument integrates both techniques in a much smaller device because the rotating filter wheel has been replaced by a CCD-spectrometer and the xenon high-pressure lamp by a small light source optimised for fibre optics.

Specific probes are used to introduce white light (wavelengths 500–800 nm) and laser light (wavelength 830 nm) simultaneously into the tissue. A part of the light spectrum is absorbed when the white light interacts with the erythrocytes, and this absorbed portion assumes the colour of the haemoglobin as a measure of its oxygen saturation. The laser light experiences a frequency displacement due to the moving erythrocytes (the so-called Doppler Shift), and this displacement is a measure of their velocity. The sum of all erythrocytes and their velocity is a measure of blood flow (volume flow) in the complex network of capillaries.

With this device the following parameters can be measured simultaneously in tissue:

- the oxygen saturation of haemoglobin (μHbO_2) at the venous end of the capillaries (the so-called "last meadow");
- the regional amount of haemoglobin (rHb) in the micro-blood vessels as a measure of its blood volume and for capillary density;
- the velocity of the blood in microcirculation;
- the flow of blood in the microcirculation.

The main advantage of this technology when assessing microvascular blood flow is that this combination of parameters allows the determination of regional oxygen consumption (rVO_2) in the tissue as a direct measure of tissue viability. The metabolism may be a more important parameter than the heterogeneity of perfusion, which is considered to be a key to monitor sepsis (for details, see ESM).

The method has been used clinically to assess the microvascular response in patients with septic shock [2], to monitor the effects of extreme anaemia [3] or flap viability [4] and to predict wound healing in burn injury [5].

In conclusion, the combination of reflection spectroscopy and laser Doppler (O2C) may offer a useful enlargement of the diagnostic tools available to the clinician for assessing microvascular blood flow and tissue oxygen consumption.

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