

Technical note

“FlapApp” – contemporary microvascular free flap surveillance

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Accepted 29 August 2019

Available online 26 September 2019

Keywords: Flapapp; Microvascular Surgery; Reconstructive Surgery; Free Flap surveillance; Oncology

During microvascular surgery, regular surveillance is of paramount importance for early detection of compromise of the flap. Beside regular clinical control of the transplanted tissue, technical devices can augment the detection of potential vascular problems even before clinical signs become evident.

Laser doppler-devices for the superficial monitoring of blood flow, oxygen saturation, and venous drainage have been well described to show reliable, early detection of vascular occlusion. It is still necessary, however, for patients to make frequent visits to the healthcare professionals who can use these devices, make these measurements, and interpret the reported data.

We think that current advances in technology, along with the use of automated smart devices to stream the entire dataset could further improve the monitoring of such technically-demanding free flaps.

FlapApp

For the surveillance of microvascular free flaps, we used a laser Doppler device (Moor Instruments) that displayed the oxygen saturation and arterial influx (“flow”). The measurement probe was fixed on to the transplant (Fig. 1) with four



Fig. 1. The laser Doppler probe is fixed on the transplant with knots for continuous transmission of arterial influx (“flow”) and oxygen saturation.

knots (Vicryl, 4/0), and the continuous recordings of data were transmitted to a laptop (R540L, Asus).

The arterial flow and oxygen saturation were displayed as a graph on the laptop. A baseline of values was automatically set by calculating the flow and saturation during the first 30 minutes of recording (Fig. 2). If the values dropped below or raised above a 25% threshold to the baseline, an automatic alarm was triggered with a red flashing light and acoustic feedback.

These useful features, including the baseline and current perfusion values, were streamed live from the laptop to a smart device using the application, “Microsoft-Remotedesktop” (Microsoft). To protect the patients’ data, we used acronyms, and an in-house server (through an OpenVPN server) and a VPN tunnel (OpenVPN GUI; OpenVPN Inc).

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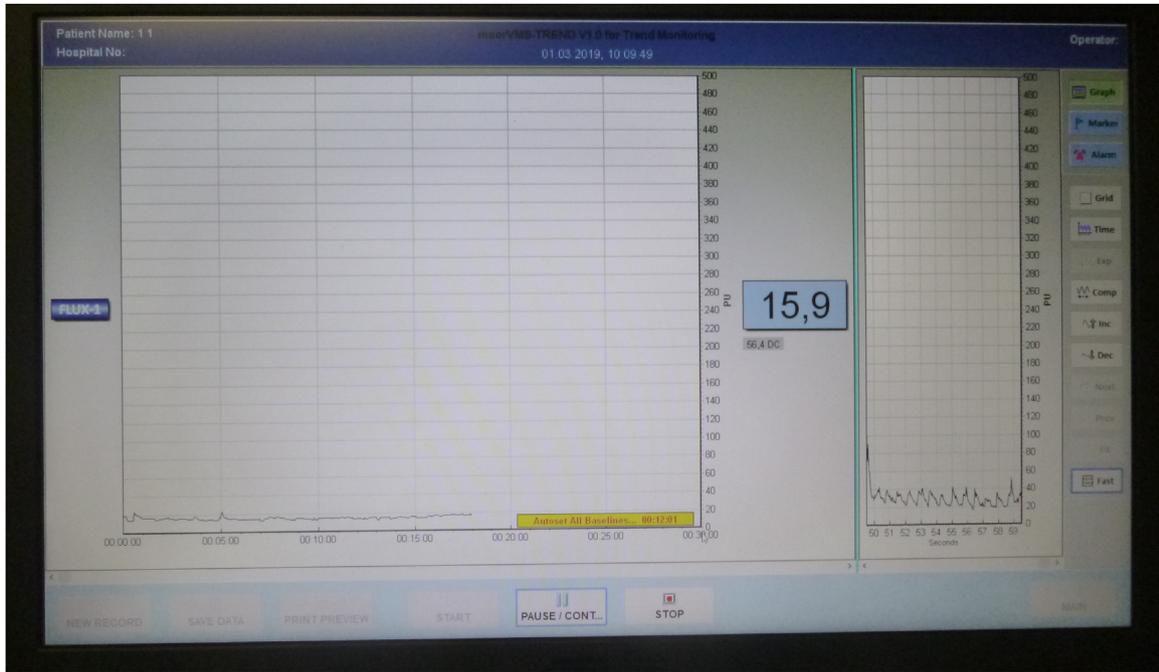


Fig. 2. The arterial influx is presented in the blue box in arbitrary units (15.9) and below it the oxygen saturation (56.4) is displayed. The yellow box at the lower right corner of the big graph shows the calculated baseline settings.



Fig. 3. The streamed display of the flap-surveillance measurements, as seen on an iPad mini.

Access to the data was created by the concurrent use of smart devices and applications (Fig. 3). We tried the iPad pro, iPad, iPad mini, and Apple Watch to access the live data (Apple).

In our experience, the iPad pro is suitable for use in an office-based environment because it has a wide screen and, consequently, good visibility. The iPad mini is a great option to carry with you, because it fits perfectly in the pocket of a white coat and allows good visibility of the streamed data, making it useful during the daily routine (such as work on the ward, or in the emergency department).

We did not find the regular iPad, iPhone or Apple Watch to be useful for efficient monitoring. The iPad is too large for the pocket and too small for the desk; the iPhone screen display is too small for the appropriate surveillance of data, and the Apple Watch has neither an appropriate display size nor a compatible application.

Funding

Funded by the Excellence Initiative of the RWTH Aachen University (RWTH Start Up).

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

Ethics approval number is EK 13717. Patients' permission was obtained.