

Development of New Method to Follow-Up Tissue Flaps Using Surface Sensor Pulse Oximeter

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Background

Follow-up of free flaps is a constant problem in microvascular reconstructive surgery. Laser Doppler has been used, as well as oxygen tension, temperature monitoring, metabolite analysis and infrared photography. All these methods have their advantages and disadvantages, and it has been difficult to develop a system that is sensitive enough to venous stasis and gives real-time information. Our group developed a surface sensor for pulse oximeter and used it in clinical set-up to follow up microsurgical patients. The method was sensitive enough to give pulse wave and haemoglobin saturation but offered no information on venous outflow obstruction. No adverse events were observed during the clinical trial, clinically or by the oximeter.

Aim

The aim of this study was to evaluate the suitability of pulse oximeter for detecting venous obstruction.

Material and method

Detecting venous stasis remained a problem and therefore the following device was constructed: A laptop PC with appropriate software to give readings on red (R) and infrared (IR) light alternating current (RAC and IRAC) and direct current (RDC and IRDC) values as well as darkness levels. An amplifier unit was connected to the printer port of the PC, the unit controlling the brightness of the light emitting diodes (LEDs) and the amplification ratio of the received signal. The surface pulse oximeter sensor was attached to this amplifier and the information was fed to the PC through analogue/digital (A/D) –converter. We used pigs as experimental animals. In each of them, latissimus dorsi (LD) flap was raised and left attached to the axillary vessels via the pedicular vessels but no anastomosis was performed. The sensor was sutured to a spot where the pulse could be detected. The pedicular vein was thereafter obstructed with a venous vascular clamp and the oximeter readings were recorded with the software on the PC.

Results

A constant pattern was observed. The RDC values fell from the moment of closure at rapid rate and reached a plateau after some one or two minutes at which the values changed very little or not at all. Arterial pulsation slowly lost amplitude and disappeared during the same time. After opening the clamp the RDC values immediately started climbing back to almost

pre-closure levels and arterial pulsation was immediately seen. Almost forty observations were made. In arterial obstruction pulse wave was immediately abolished. It returned as the arterial clamp was released.

Conclusion

In this experiment surface sensor pulse oximeter could reliably detect venous obstruction in a pedicular flap.

Keywords

Biosensors, free flaps, microsurgery, pulse oximetry

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