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RELATIONSHIPS BETWEEN MUSCLE SO_2, SKIN SO_2 AND PHYSIOLOGICAL VARIABLES

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1. INTRODUCTION

In 1995 we introduced the technique of lightguide spectrophotometry for the measurement of tissue oxygen saturation (SO_2) to predict healing viability of below-knee skin flaps in lower limb amputation for critical ischaemia[1]. This technique, using a Photal MCPD 1000 (Otsuka Electronics, Osaka) spectrophotometer, has been applied to the routine assessment of patients at the University Hospital of North Durham since 1999. Since then a healing rate of 94% has been achieved with a below knee to above knee amputation ratio of 9:2[2].

In a study to investigate the possible cause of the high infection rate in groin wounds following vascular bypass surgery Raza et al.[3] used the Erlangen microlightguide spectrophotometer[4] (EMPHO, BGT-Medizintechnik, Überlingen) to measure SO_2 in the groin skin medially and laterally to the incision sites in patients undergoing femoro-popliteal or femorodistal bypass operations prior to and at 2 and 7 days post-operatively. The equivalent contralateral sites were used as controls. The results showed a significant difference ($p < .01$) between the medial and lateral SO_2 values post operatively. On this basis, it was postulated that a disruption of blood supply may be responsible for the high incidence of infection in such surgical wounds.

The experience using lightguide spectrophotometry in the visible wavelength range to measure skin SO_2 (SSO_2) as a possible predictor of healing viability or infection of surgical wounds led to the study described elsewhere in this volume[5]. In addition, it was proposed that infrared spectroscopy should be used in the clinical study on the premise that muscle SO_2 may be a better predictor of wound infections emanating from deeper lying tissues than skin. The present study was therefore carried out in order to define the

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range of values to be found at the proposed measurement site in healthy volunteers. In addition it was intended to identify some of the physiological parameters that may influence skin and muscle SO_2 (MSO_2) at these sites.

2. AIM

The aims of this study are threefold:

1. To find out if physiological variables affect the oxygen saturation of the skin and muscle.
2. To find out whether oxygen saturations of skin (or muscle) are related at different sites.
3. To find out whether oxygen saturations of the skin and muscle are related at a specific site.

3. MATERIALS

The visible range lightguide spectrophotometer (LGS) used for the study was the Whitland RM200 instrument (Spectrum Medical, Cheltenham, UK). A comparison of the properties of this instrument with the MCPD 1000 has been reported recently[6].

Briefly, a white LED light source mounted in the probe transmits light into the skin. The light scattered back from the tissue passes through a single optical fibre to the integrated diffraction grating/photodiode array. The wavelength range analysed is 500-586nm with a resolution of 3nm. Correction algorithms are applied to the measured absorption spectra for the influences of scattering and melanin[7]. A further algorithm using the theory of Kubelka and Monk[8] makes use of two reference spectra (oxygenated haemoglobin, HbO_2 and deoxygenated haemoglobin, Hb) and a least squares fitting method to calculate the SO_2 from the measured spectrum. Figure 1 illustrates the principle of the least squares fitting method. In this case a proportion of 75% Hb and 25% HbO_2 produce the best fit to the measured spectrum (shown as particularly noisy in this illustration).