Assessment of Skin Vasoconstriction using Tissue Viability Imaging

GE Nilsson [1,2], H Zhai [3], HP Chan [3], S Farahmand [3] S and HI Maibach [3]

[1] WheelsBridge AB, Lovsbergsv 13, 58937 Linkoping, Sweden
[2] Department of Biomedical Engineering, Linköping University, 58185 Linköping, Sweden
[3] Department of Dermatology, University of California, School of Medicine, San Francisco, California, USA

Introduction

Operator independent assessment of skin blanching is important in the development and evaluation of topically applied steroids. Spectroscopic instruments based on handheld probes, however, include elements of operator dependence such as difference in applied pressure and probe misalignment, while laser Doppler based methods are better suited for demonstration of skin vasodilatation than for vasoconstriction associated with skin blanching. The objective of this study was to demonstrate the potential of the emerging technology of Tissue Viability Imaging in the objective and operator-independent assessment of skin blanching.

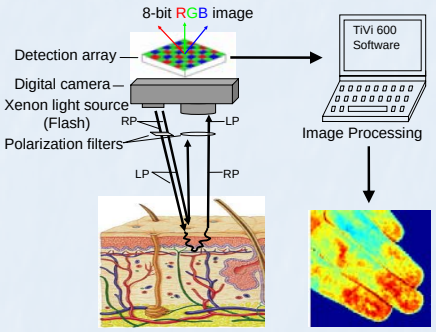

Figure 1. Schematic of TiVi (RP = Randomly Polarized, LP = Linearly Polarized)

Figure 2. The Tissue Viability Imager

Methods

Tissue Viability Imaging (TiVi) is a novel technology based on polarized light spectroscopy that can "see through" the top layer of the skin and collect information about the underlying microcirculation. The TiVi technology is primarily intended for quantitative mapping of human skin erythema (vasodilatation) and blanching (vasoconstriction). Images can be captured with a maximum lateral resolution of about 50 micrometers and an average measurement depth of about 500 micrometers. Detailed investigation of a particular skin site as well as whole body surface imaging is possible.

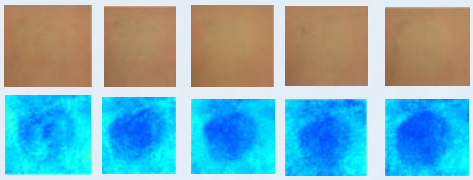

Figure 3. Photos (top) and TiVi images (bottom) recorded at 1, 10, 30, 60 and 120 minutes following the removal of occlusion cover.

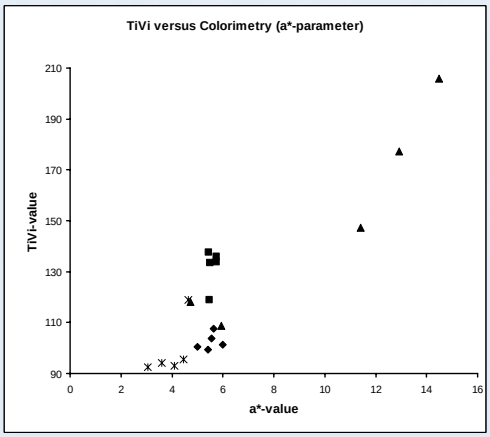

Figure 4. Average TiVi-values of circular ROIs positioned inside the patches versus Chromameter a parameter.*

Results

Following topical application of two corticosteroids (clobestal proprion and desoximetasone gel), the development of induced skin vasoconstriction was monitored over time. The relative uncertainty in the blanching estimate produced by TiVi was about 5% and similar to that of the Minolta Chromameter CR200 operated by a single user. The advantage of the TiVi technology is, however, that no physical contact has to be made with the skin, thereby effectively eliminating the influence of operator dependence. Furthermore, imaging as opposed to single point measurements, allows for detailed analysis of spatial variations in vasoconstriction patterns over an extensive skin area. By recording many images in rapid sequence, temporal information about alterations in skin red blood cells concentration can further be derived and displayed. In addition, The TiVi technology makes it possible to study also the initial phase of the blanching process and relate it to normal skin blood cell concentration by capturing images through a transparent cover during the occlusion phase. Time-compressed information about both temporal and spatial variations in skin red blood cell concentration can be displayed in terms of video-clips.

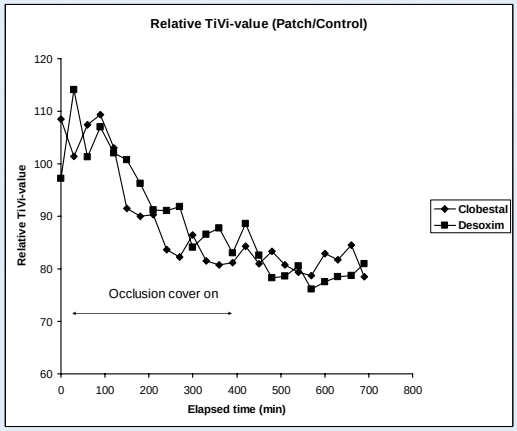

Figure 5. Demonstration of the dynamics of a blanching experiment using clobestal proprion solution and desoximetasone gel. The two curves represent average TiVi-values within a ROI positioned inside the patch normalized by the average TiVi-value in an adjacent skin site outside the patch but still under the occlusion cover.

Correspondence: WheelsBridge AB, info@wheelsbridge.se