Techniques for measuring perfusion during reconstructive surgery procedures - effects of adrenaline in local anesthetics

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Background
Non-invasive techniques for blood perfusion measurements has been developed lately, which enables better control of the effects of reconstructive surgery. We used modern laser based techniques to study the time from injection, Lidocaine and epinephrine, to maximum effect bleeding reduction during surgery. A subject recently on debate.

Methods
We have used laser Doppler velocimetry (LDV), laser speckle contrast imaging (LSCI) and diffuse reflectance spectroscopy (DRS), to study the change in perfusion after injection lidocaine and epinephrine in porcine skin and eyelids. We have developed a new instrument based on diffuse reflectance spectroscopy(DRS) with an extended wavelength spectrum, 350 to 1700 nm and studied tissue response.

Results
In study I: we measured blood flow, with LDV and LSCI, in the skin of pig flank. Maximum hypoperfusion was reached after injecting a concentration of 10 μg/ml epinephrine and the time from the injection maximum hypoperfusion was 120 seconds.

In study II: we measured blood flow and tissue response, with LDV, LSCI and DRS, in pig eyelid. We found that maximum hypoperfusion was reached after injecting a concentration of 10 μg/ml epinephrine and the time from the injection maximum hypoperfusion was 75 seconds.

Conclusion
When using lidocaine with epinephrine, we have showed that the time to maximum hypoperfusion is about 75-120 seconds in pig eyelid and flank. When comparing different techniques to measure the tissue response when injecting local anesthetics + epinephrine, we have found a good model for validation of new techniques for perfusion measurements. We now plan to implement new techniques to monitor blood flow in reconstructive surgery. We also plan to do further studies with DRS, RGB-camera analysis and photoacoustic imaging (PAI). With RGB-camera analysis of skin color, we hope to find a simple tool to monitor perfusion changes I superficial skin. With PAI we will study tissue response and oxygenation in high resolution and with high spatial precision in 3D-scanning. Our goal is to use our findings to optimize reconstructive surgery procedures.