FRI086

Burn imaging with a whole field laser Doppler perfusion imager based on a CMOS imaging array

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Rationale

Laser Doppler perfusion imaging (LDPI) has been proven to be a useful tool in predicting burn depth in an early stage. A major disadvantage of scanning beam LDPI devices is their slow scanning speed, leading to patient discomfort and imaging artefacts. Therefore, a whole field LDPI based on a CMOS* imaging array, the Twente Optical Perfusion Camera (TOPCam), was developed.

By illuminating the area under investigation and simultaneously taking images at high speed with the camera (fig. 1), it is possible to obtain a perfusion map of the area two orders of magnitude (~20x) faster than scanning beam LDPI systems.

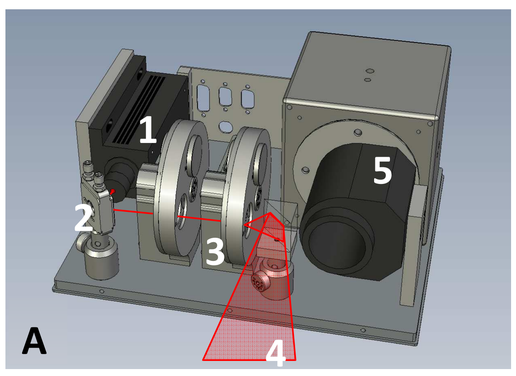


Figure 1: Schematic view of the TOPcam.

A: The light from the laser (1) is directed via a mirror (2) through the density filter and diffuser (3). Another mirror reflects the diffused light (4) to the sample. The system is equipped with a CMOS camera with zoom lens (5) for detection of the backscattered light.

B: Each pixel works as an individual detector, allowing fast measurements without the need for a scanning laser beam. The camera sends the data to a computer and after processing the system displays a two dimensional perfusion map on the computer screen.

** Complementary Metal Oxide Semiconductor*

Methods

The first prototype was evaluated in a dedicated Burn centre on a convenience sample of patients. Patients with psychiatric problems and children less than 18 years of age were excluded. The study was approved by the local Medical Ethics committee.

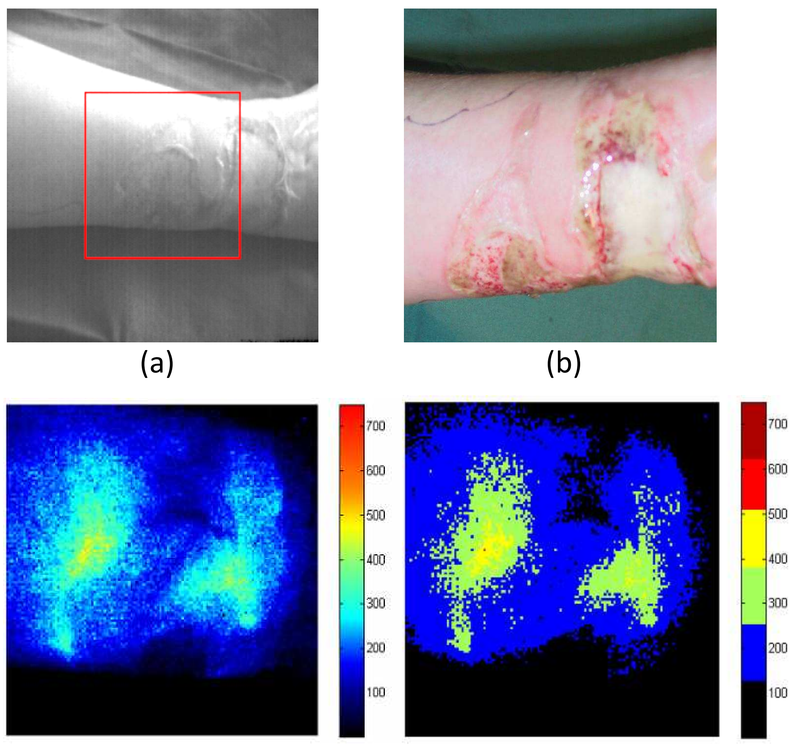
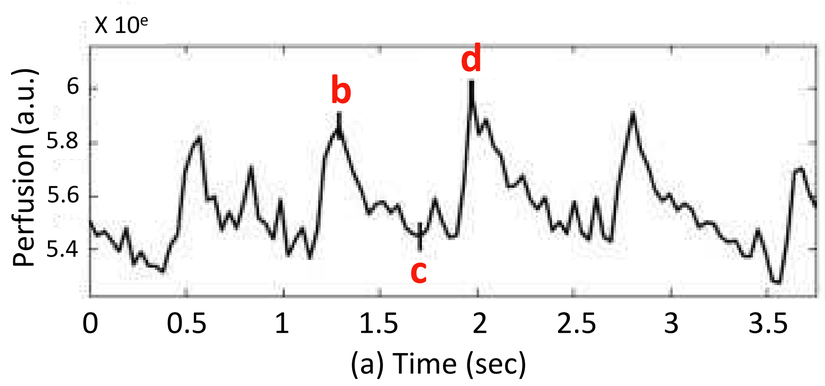


Fig. 2: Burn on the ventral side of the left forearm, 2 days postburn.
a: Photograph made by the TOPcam
b: Colour photograph made manually
c: TOPCam perfusion image displayed on its usual matlab scale with a fixed scale
d: PIM 2 perfusion scan displayed on the six colour scale with a fixed scale from



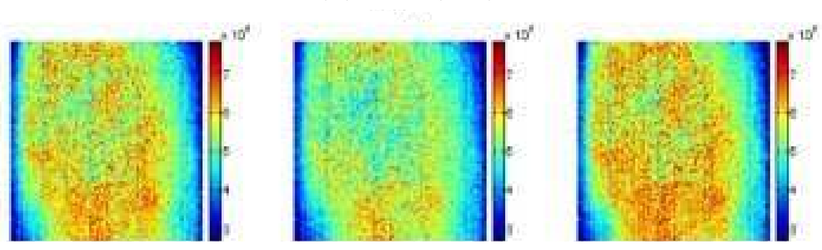


Fig. 3: Continuous recording of the blood circulation of the hand of a healthy test person. Graph (a) shows the average blood circulation, and *b* through *d* show the entire situation for the time period on the graph: the heart beat can be observed.

Results

From June - August 2007 in total 1015 images were made of 37 burns in 23 patients. All patients asked to participate agreed with enrolment.

The mean age of patients was 37.1 years (sd: 15.2; range: 16-66), mean TBSA 4.6% (sd: 4.2; range 0.25 – 16). Measurement series were done on average 5.0 days postburn (sd: 4.2; range: 1-21) in burns of various etiology and in a variety of locations (fig. 2).

The system does encounter problems caused by blisters, surface reflection and curvature in a manner similar to scanning beam imagers.

Conclusions

The TOPCam poses a clear advantage in terms of procedure time. Image quality i.e. dynamic range and resolution appears to be sufficient for burn diagnosis. Hence, an important step in overcoming the limitations of LDPI in burn diagnosis imposed by the measurement speed was taken

Addendum

After these earlier successful tests a number of significant improvements have been made; real-time images of variations in the blood circulation are now possible (fig. 3).

Literature

- Van Herpt HE et al. *Burn imaging with a whole field laser Doppler perfusion imager bosed on a CMOS imaging array.* Burns (accepted)
- Draijer M et al. *Twente Optical Perfusion Camera: system overview and performance for video rate laser Doppler perfusion imaging*. Opt Express 2009; 17: 3211-25

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