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Poster Communications

Methodological improvements in infrared thermography for the in vivo analysis of brown adipose tissue

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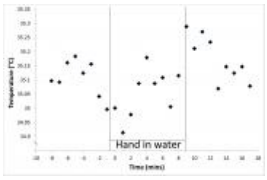
- 

Figure 1. Times series of BAT temperatures using an image capture rate of 1 per minute.

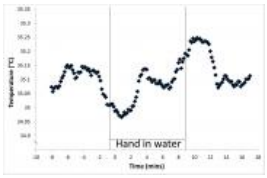
- 

Figure 2. Times series of BAT temperatures using an image capture rate of 6 per minute and applying a moving average of order 7.

Background - The emergence of brown adipose tissue (BAT) as a possible novel obesity prevention and treatment target has led to renewed interest in its physiology. The lack of an acceptable, safe, non-invasive method for repeated analysis is a significant barrier to in vivo human studies as the use of PET-CT in large prospective studies is limited by expense and ionising radiation exposure.We have developed a novel technique for measuring BAT activity using thermal imaging (TI)[1]. TI is a cheap, quick, non-invasive, valid and reproducible procedure acceptable to children as young as five years old[2]. We present here novel modifications to our original method.Method - As previously described[1,2] images centred on the anterior aspect of the neck were obtained using a thermal imaging camera (FLIR B425; FLIR Systems, Sweden) over a 25 minute period, at a rate of 6/minute. Following a period of acclimatisation, the participant's right hand was submerged in cold water (18°C±0.1°C), an effective stimulator of BAT activity[1]. After 10 minutes of stimulation with cold water, each participant removed their hand and imaging was continued for a further 8 minutes.Images were exported using ThermaCAM Researcher Pro 2.10 (FLIR systems) and analysed using a custom-designed code in MATLAB (Mathworks, USA). Key points on each image were identified to define the region of interest (ROI) within which upper temperature percentiles were calculated. Data were exported from MATLAB to Excel 2010 (Microsoft Corporation, USA). Moving averages of order 7 were calculated. A moving average replaces each point with an average of the point and the points on either side, thereby reducing the effect of random fluctuations.Results - Approximately 150 images per participant were captured. Time series were plotted using the original method (Fig 1) compared with the increased image frequency and moving averages (Fig 2).Conclusions - Previous data have shown an increase in the average temperature of the upper percentile of temperature in the region of interest (ROI) over the anterior aspect of the neck with cold water stimulation. Within this, there is a degree of natural variation in measurements. We show here that utilisation of a simple moving average substantially reduces point-to-point fluctuation revealing a clear trend line.By increasing the number of images taken per minute from 1-6, we are able to use higher order moving averages. Previously, the ROI had to be defined for each image using the irregular polygon tool within the ThermaCAM software, which is a time-intensive process. Our new semi-automated process allows larger numbers of images to be processed consistently and quickly. In summary, thermal imaging is an essential tool in the in vivo analysis of BAT, particularly in human participants and the methodological improvements outlined above further improve the method.

Where applicable, experiments conform with Society ethical requirements