COMPENSATION OF OXYGEN PARTIAL PRESSURE VARIATIONS DURING OPTICAL ENZYMATIC GLUCOSE SENSING IN ADIPOSE TISSUE

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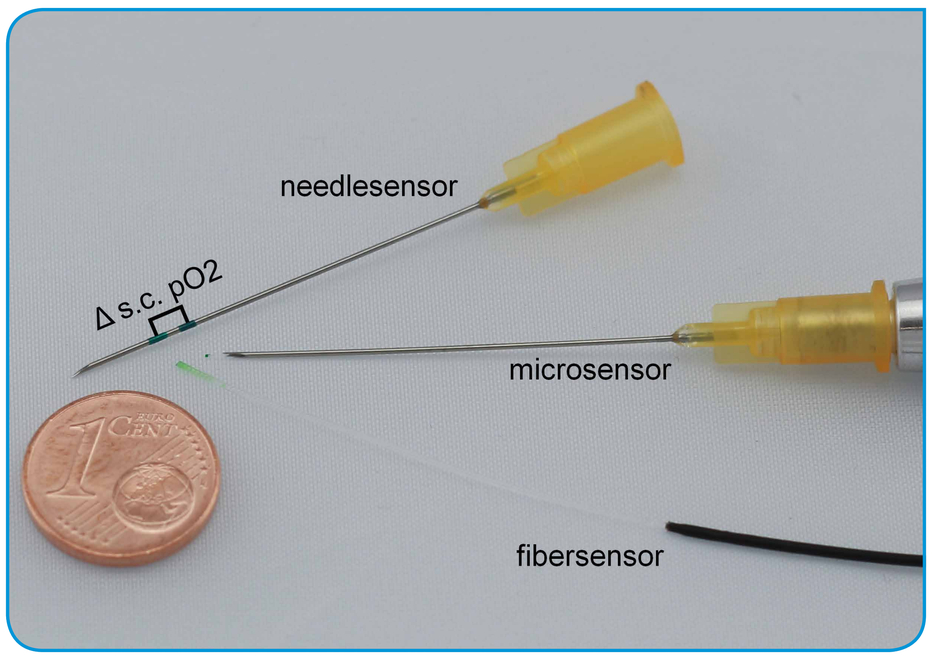
Background

This single-port concept combines an optical enzymatic glucose measurement and an insulin delivery system placed at the same position in subcutaneous adipose tissue (AT). Changes in oxygen partial pressure (pO2) in the AT influence the glucose measurement and thus require direct pO2 measurement in AT to mathematically correct the measured glucose values. The aim of this work was to assess the homogeneity of pO2 in AT and a possible mathematical correction of tissue pO2.

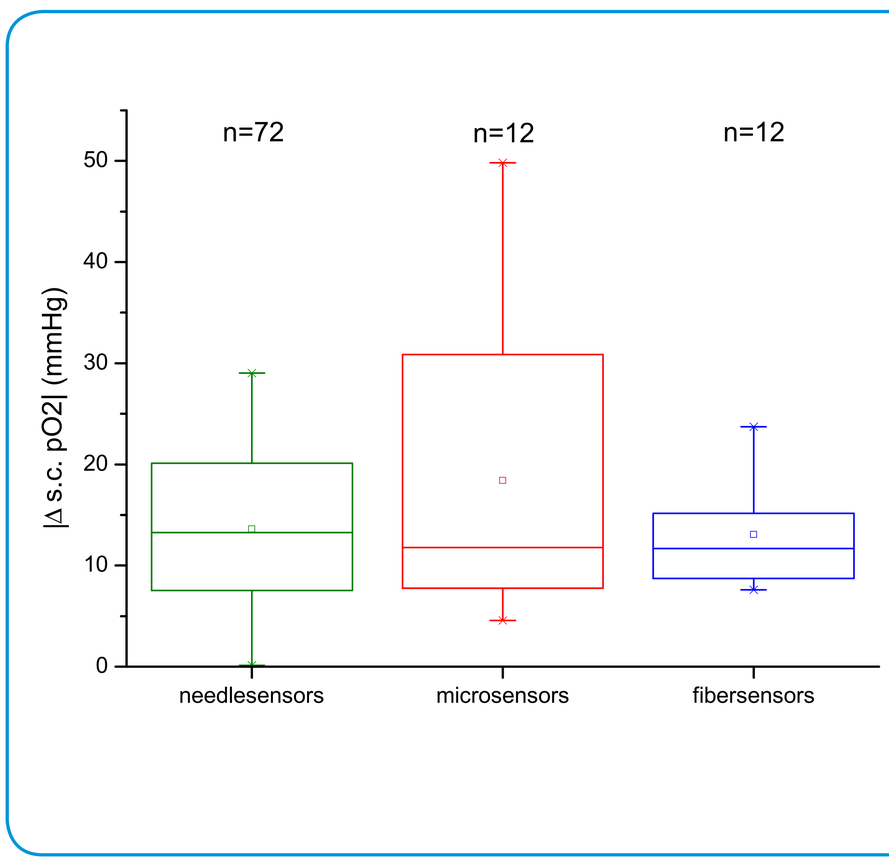
Methods

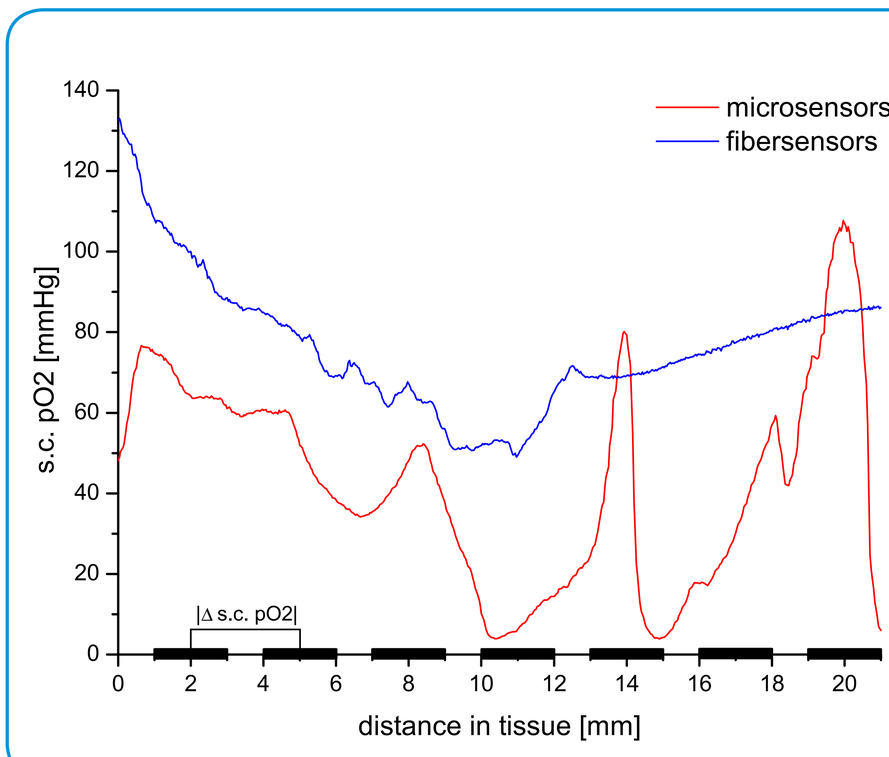
During in-vivo experiment in domestic pigs, the blood pO2 level During in-vivo experiments in domestic pigs, the blood pO2 level was modified to different steady state plateaus. During each plateau phase, three different sensor systems were used to measure tissue pO2. Fiber-sensors and micro-sensors continuously recorded tissue pO2 profiles over a distance of 21 mm. Six stationary needle-sensors, each with two 2 mm long sensor elements, were randomly placed across the abdominal area and recorded simultaneously the tissue pO2 for 30 min per steady state plateau. Fiber- and micro-sensors were read-out with light-guiding and needle-sensors were read-out transcutaneously by a phase fluorimeter.



Results

All measured tissue pO2 values were similar to values found in literature. Medians of the absolute differences of the pO2 values (|Δ s.c. pO2|) had a maximum intersystem deviation of 1.6 mmHg. The micro-sensors showed the largest interquartile range of all used sensor systems.





Conclusion

- We were able to show that tissue pO2 varies considerably along the distance of 21 mm (micro-sensors).
- An increased sensing area (such as fiber- and needle-sensors) can reduce these heterogeneities, so that
- a mathematical correction of the glucose measurement should be possible.

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