

NADPH Oxidase Effects on Skeletal Muscle Blood Flow and Lactate Following the Administration of a High Carbohydrate Meal in Older Individuals with Overweight/Obesity

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Background

ROS

- Reactive oxygen species (ROS) are highly reactive molecules produced by cellular metabolism.
- Chronically elevated levels of ROS have been shown to increase risk for cardiovascular disease.
- Consumption of high-carbohydrate (HC) or high-fat (HF) meals are known to increase concentrations of ROS.

NADPH Oxidase

- NADPH Oxidase (NOX) is a protein in the human vasculature that prior research has shown to be a potent producer of ROS. A drug called apocynin can eliminate ROS produced by NOX in a small area.

Purpose

- To determine if NOX-derived ROS impairs skeletal muscle microvascular blood flow at rest and in response to a HC meal.
- To determine if NOX-derived ROS affects lactate concentrations in the skeletal muscle.

Methods

Study Design

- Double blind crossover study design.

Participants

- Nine participants (6 females, 3 males, 67 ± 6 years, 30.9 ± 2.9 kg/m², 39 ± 7 % body fat percentage).

Microdialysis Procedures

- Microdialysis was used to monitor *in-vivo* ROS production, lactate concentration, and microvascular blood flow within skeletal muscle.

ROS measurements (Hydrogen Peroxide (H₂O₂) and Superoxide (O₂⁻))

- The control and apocynin microdialysis probes were perfused with Amplex UltraRed, horseradish peroxidase, and superoxide dismutase to determine levels of ROS. The apocynin probe was additionally perfused with apocynin.
- Because SOD converts H₂O₂ into O₂, ROS was analyzed as the combination of H₂O₂ and O₂ concentrations.

Skeletal muscle microvascular blood flow

- Microvascular blood flow was assessed by perfusing both microdialysis probes with ethanol. The ethanol outflow-to-inflow ratio is *inversely* related to blood flow.

Skeletal Muscle Lactate

- Skeletal muscle lactate concentrations were measured using the CMA 600 Microdialysis Analyzer.

Methods Continued

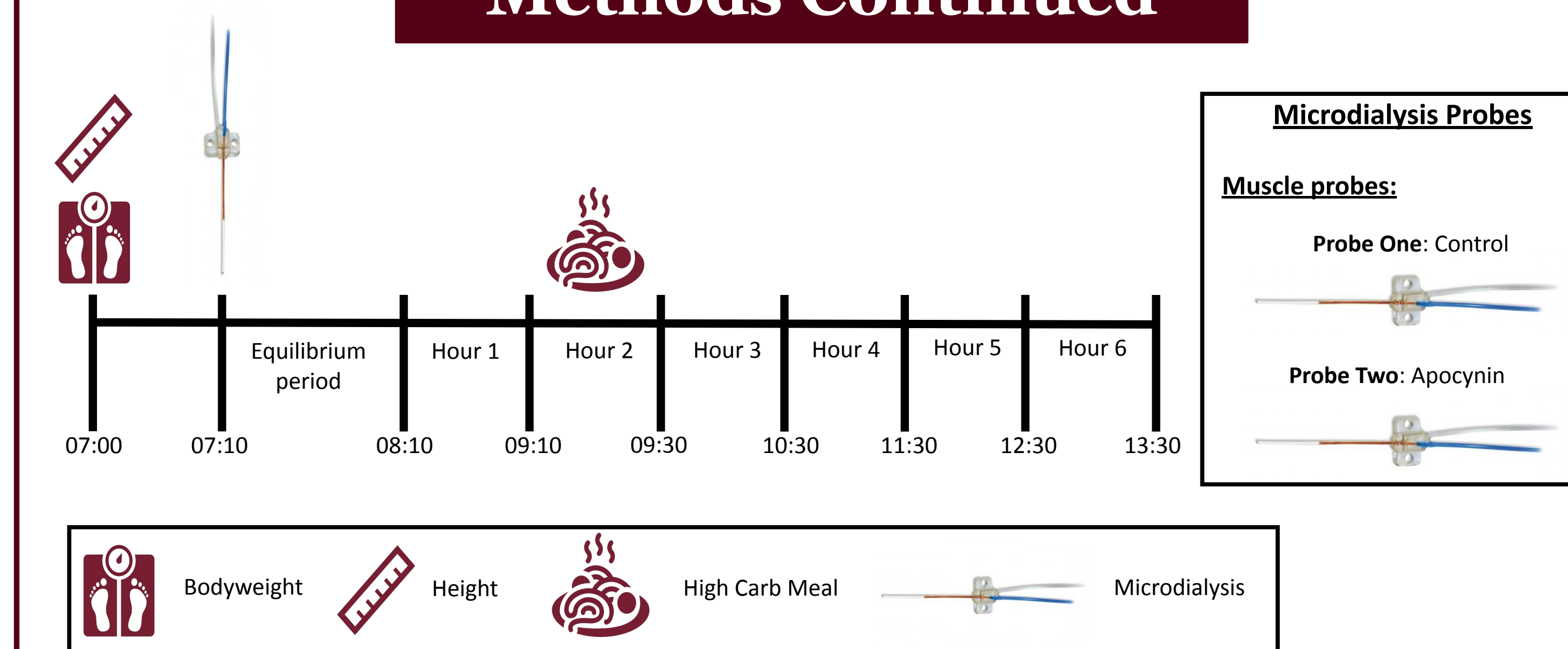
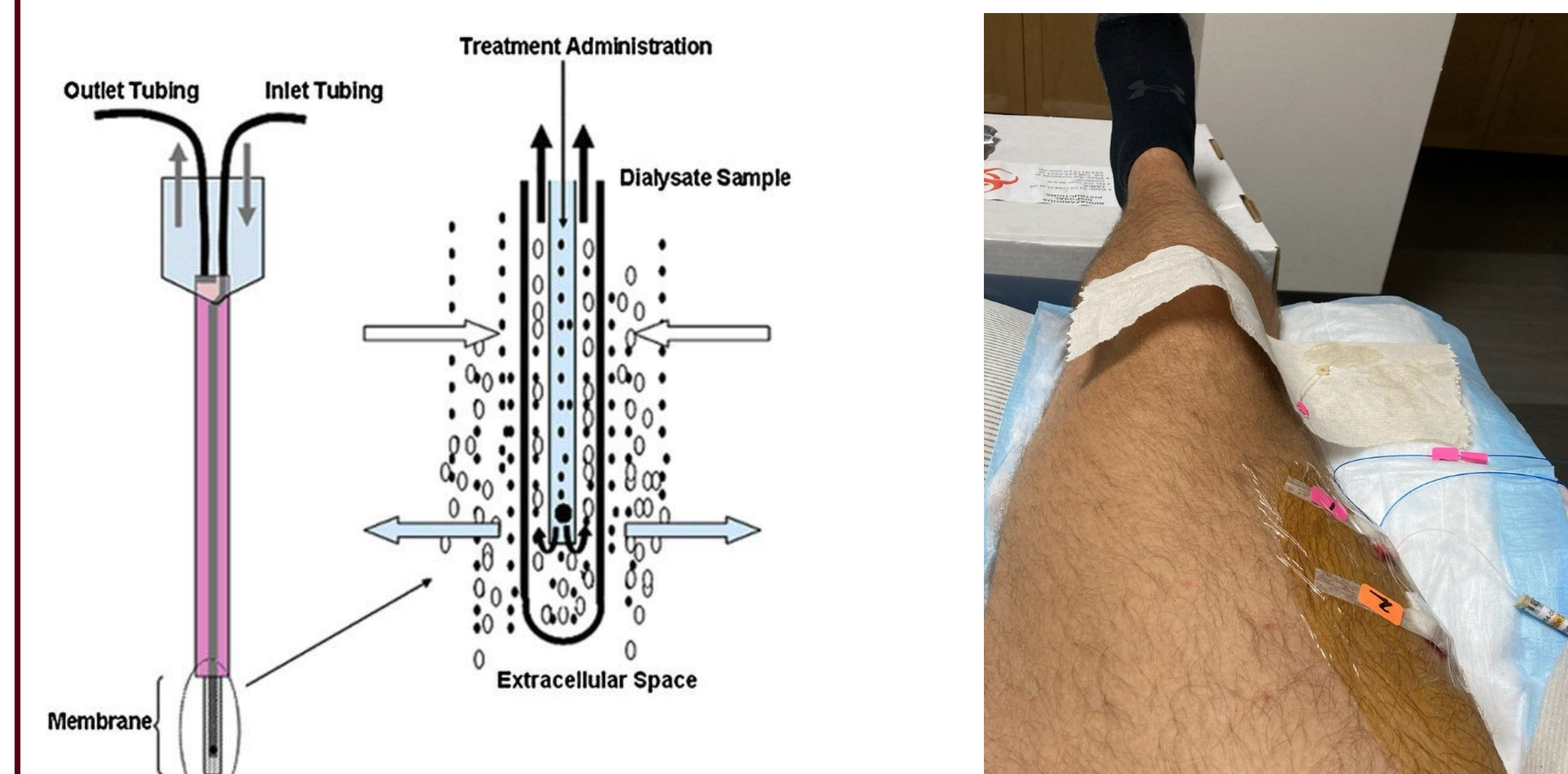
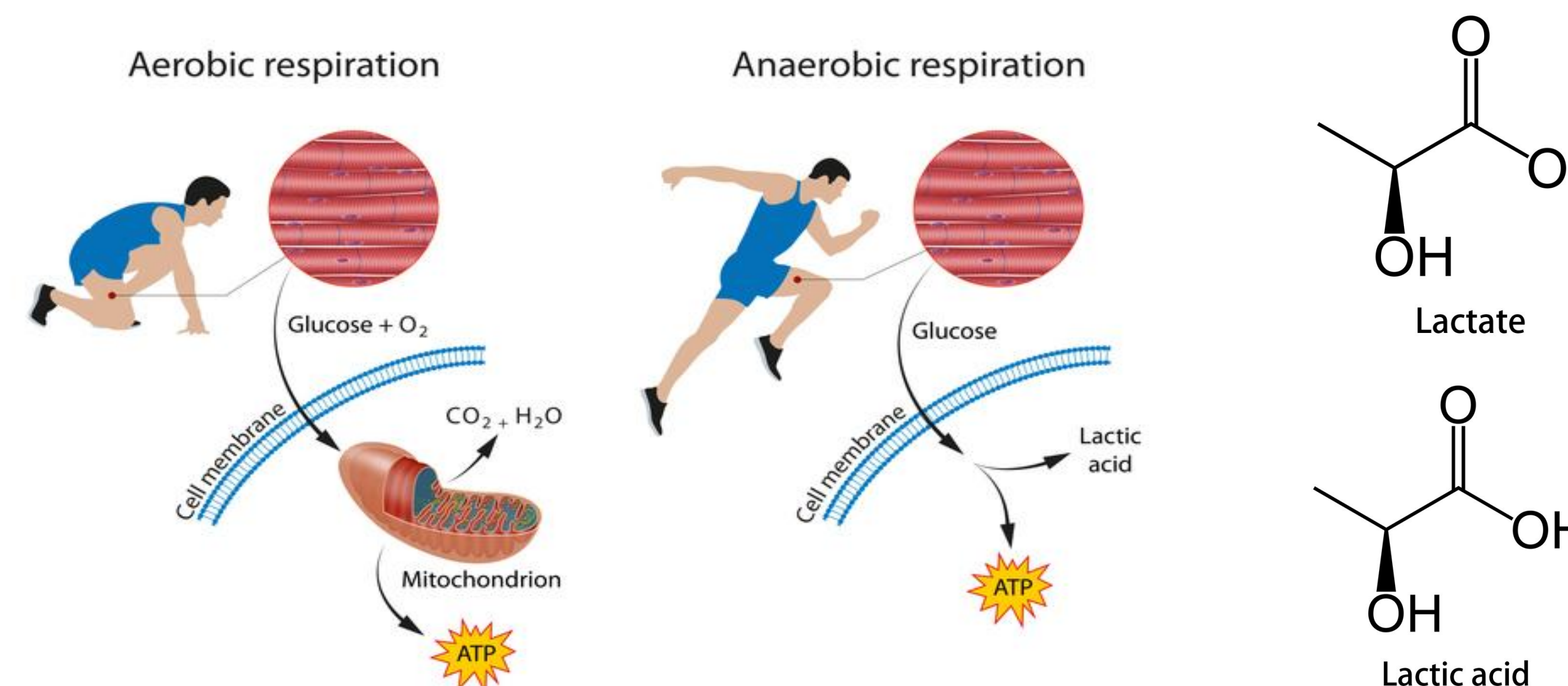


Image shows the testing visit in which microdialysis probes were inserted. Microdialysis and cardiovascular measures were taken at rest and continued for four hours after consuming a high-carbohydrate meal.

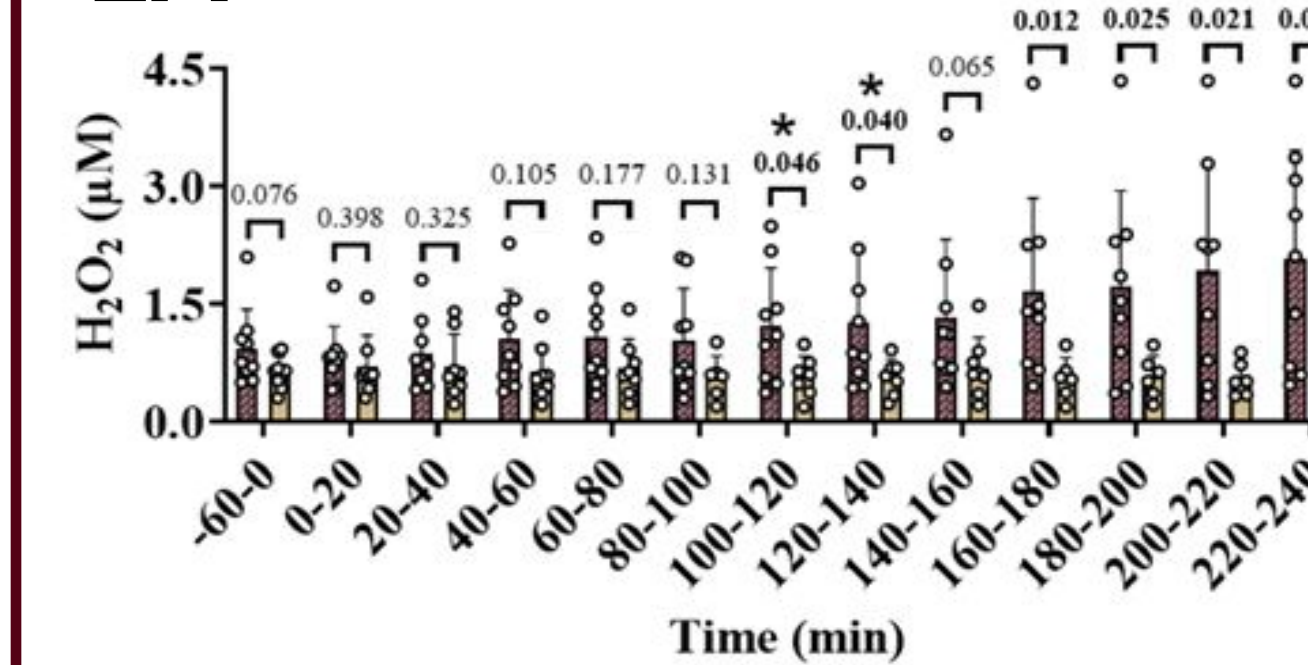


Images show a schematic illustration of the microdialysis technique (left) and microdialysis probes inserted into skeletal muscle (right).

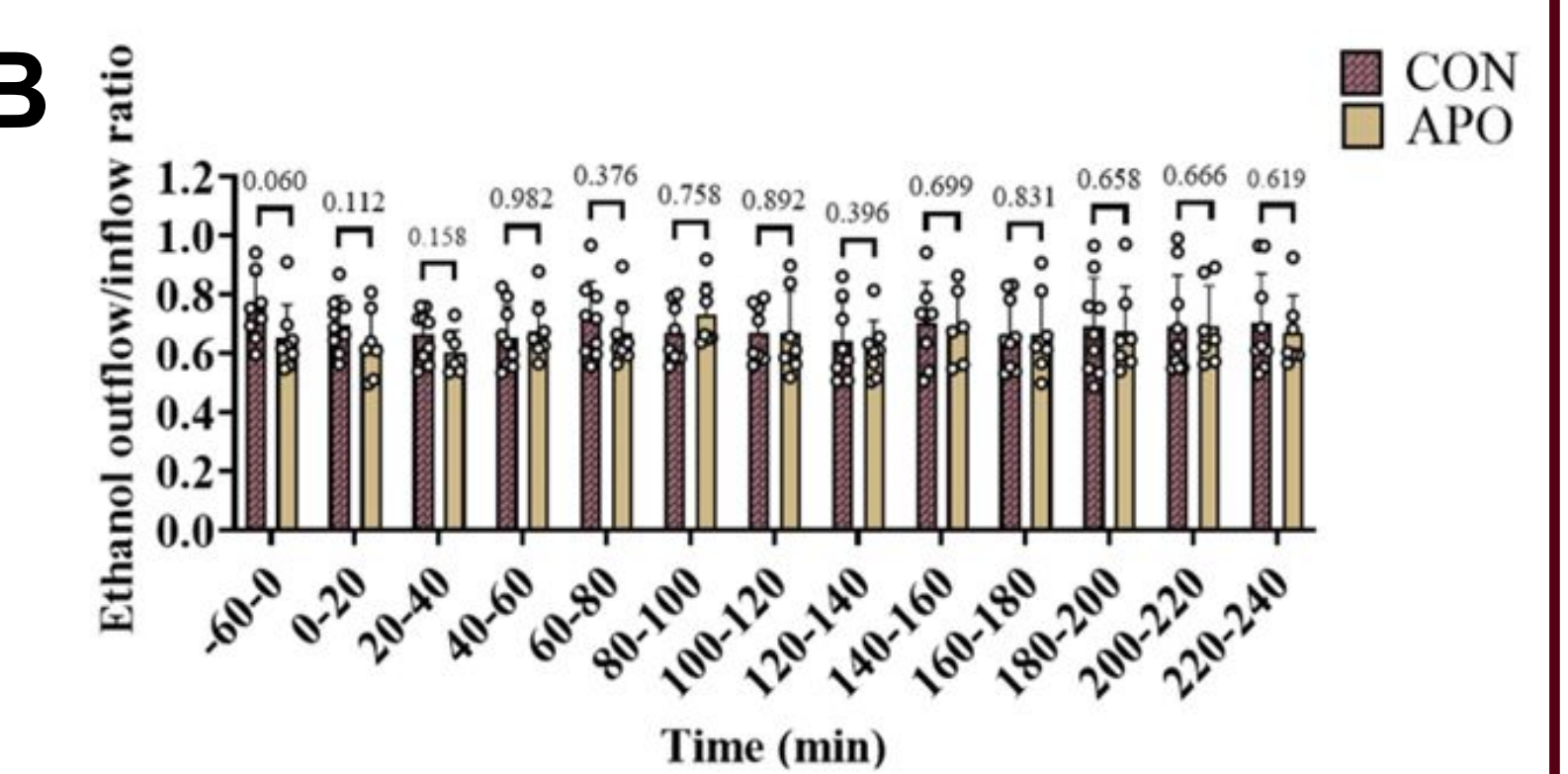


Results

2A



2B



2C

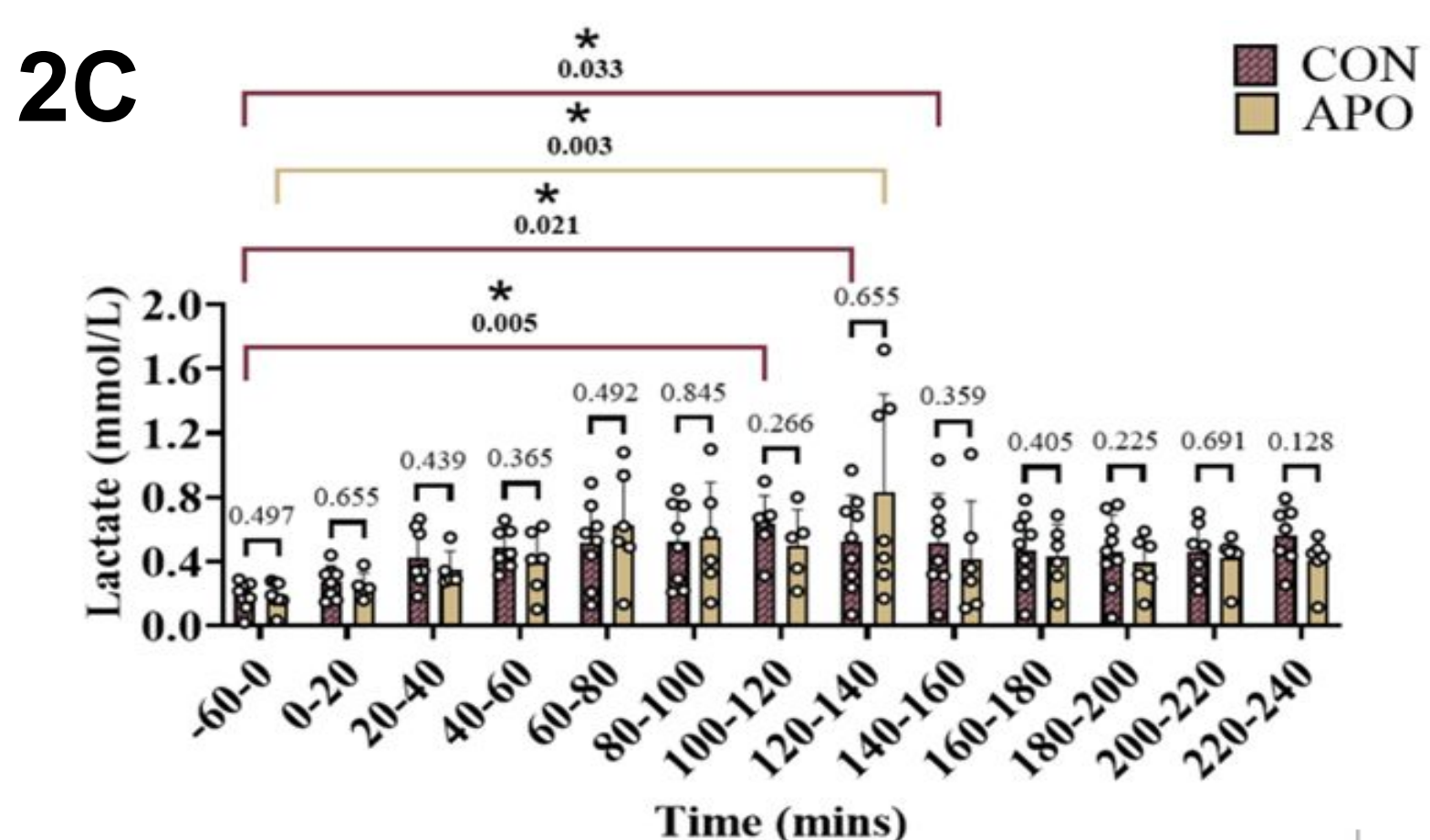


Figure 2A: Dialysate H₂O₂ concentrations from APO compared to CON probe following a high carbohydrate meal. *Significance marked as a P-value ≤ 0.05.

Figure 2B: Ethanol outflow/inflow ratio from APO compared to CON probe following a high carbohydrate meal. *Significance marked as a P-value ≤ 0.05.

Figure 2C: Dialysate lactate concentrations from APO compared to CON probe following a high carbohydrate meal. *Significance marked as a P-value ≤ 0.05.

Conclusions

- Apocynin is a potent NOX-inhibitor, consistent with literature.
- Following HC meal consumption, there was no significant change in SMBF between CON and APO groups.
- Thus, SMBF may not be as negatively affected by NOX-produced ROS as previously thought.
- However, there was a strong positive correlation between NOX-produced H₂O₂ (ROS) and increases in lactate following HC meal consumption suggesting a link between the two molecules may exist.

References

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