Microvascular Regulation between Two Hemodynamic Steady States in the Forearm and Forehead using Wavelet Phase Coherence

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Background

- Interactions between regulation mechanisms characterize microcirculation flow patterns.
- Quantitative measurement of microvascular perfusion may yield insight into microvascular regulators' role in microvascular pathophysiology.

Objective & Hypothesis

Objective: To characterize regulation mechanism changes in different hemodynamic states using wavelet phase coherence[1].

Hypothesis: Regulation mechanisms across different locations will behave more concordantly under a simultaneous high temperature stimulus.

Methods

- Skin blood flux signals collected from healthy subjects via Laser Doppler Flowmetry[2] at forehead and forearm, in 35 °C and 45°C temperature states.
- Wavelet phase coherence calculated between spatial locations and compared between temperature states.
- Significant (effective) coherence determined via surrogate test[1].

Results

- High effective coherence in cardiac region in both temperature states.
- Significant difference ($p < 0.05$) in effective coherence between low and high temperature states in myogenic/neurogenic/metabolic region.

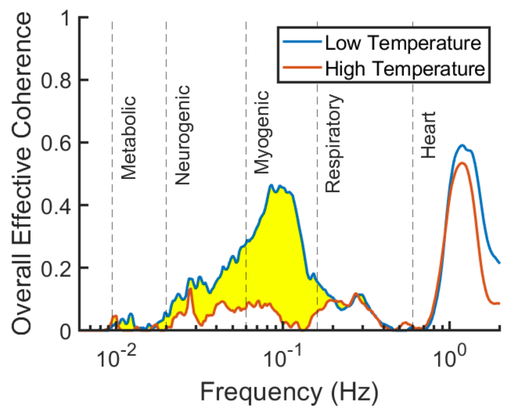

Figure 1. Time-averaged (overall) effective coherence, calculated as the average over all subjects (n=4), is compared between temperature states. Significant difference ($p < 0.05$) between two states is highlighted in yellow. Frequency ranges known to be primarily occupied by certain regulation mechanisms are labelled and marked with dotted lines[3].

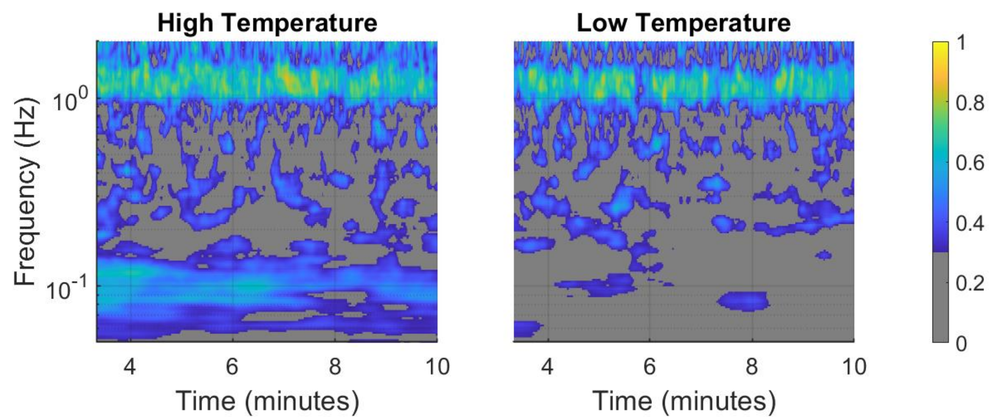

Figure 2. Time-localized effective coherence, displayed as the average over all subjects (n=4), is compared between high and low temperature hemodynamic states. Not all of time and frequency is displayed due to edge-effect artifacts[1].

Discussion

- Greater coherence is found between forehead and forearm when both locations are under a high temperature stimulus.
- Difference in coherence between temperature states is relatively consistent over time.
- Cause of myogenic/neurogenic/metabolic activation in high temperature stimulus is debated; most agree on sympathetic nervous system involvement[1,2].

Conclusion

- Current study is one of few to characterize the relationship between regulators in different conditions (e.g., high-low temp. heart), rather than their independent activity.
- Future studies will investigate possible coupling functions between different regulators (e.g., heart-myogenic).

Acknowledgements

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References

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