

Post-Exercise Reactive Hyperemia: A Novel Preoperative Risk Assessment Tool

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Background and Goal of Study

- Established ultrasound-derived parameters (i.e., flow-mediated dilation and peak flow velocity) measured in the brachial artery in response to reactive hyperaemia induced by cuff occlusion allows for the noninvasive assessment of vascular function (specifically endothelium-dependent vasodilatation).¹ These parameters have been reported to be reproducible after exercise.²
- A more recent vascular parameter utilizes digital thermal monitoring (DTM, Endothelix, Houston, TX, USA) to measure temperature rebound (TR) during reactive hyperaemia.
- We hypothesized that the dynamic effect of acute exercise would increase TR. Secondary objectives were to correlate TR response to exercise ($\Delta TR = TR_{\text{post-exercise}} - TR_{\text{pre-exercise}}$) with 1) established preoperative risk factors and 2) predefined postoperative complications.

Materials and Methods

- Following IRB approval, patients scheduled for major noncardiac surgery were prospectively enrolled.
- Preoperatively, fingertip probes measured TR (in °C) in response to upper arm cuff occlusion (2 minutes) and reperfusion both before and 10 minutes after peak exercise (ramp protocol with cycle ergometer).
- Measured and derived parameters (figure 1):

- TMP_1 : Initial fingertip temperature [°C]
- TMP_{\min} : Lowest temperature during 2-min cuff occlusion
- TMP_{\max} : Highest temperature reached after occlusion
- **TR: Temperature Rebound ($TMP_{\max} - TMP_1$)**
- NP: Nadir to peak
- SLP: Slope

- Data are presented as mean±SD. Statistical analysis utilized ANOVA and Fisher exact test. P-values <0.05 were regarded as significant.

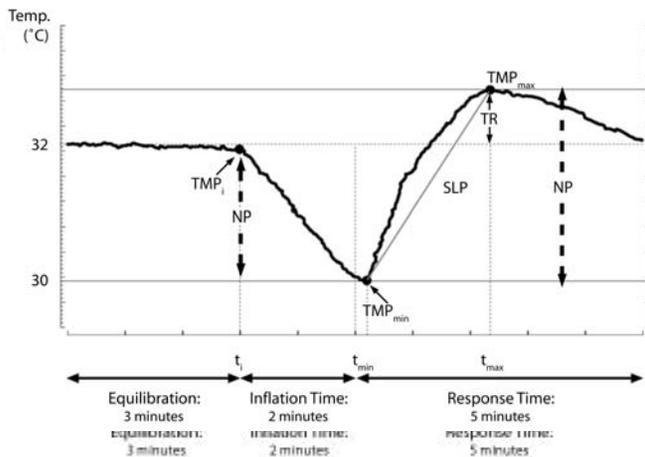


Figure 1. Fingertip Temperature Rebound (TR) after 2 minute upper arm cuff occlusion

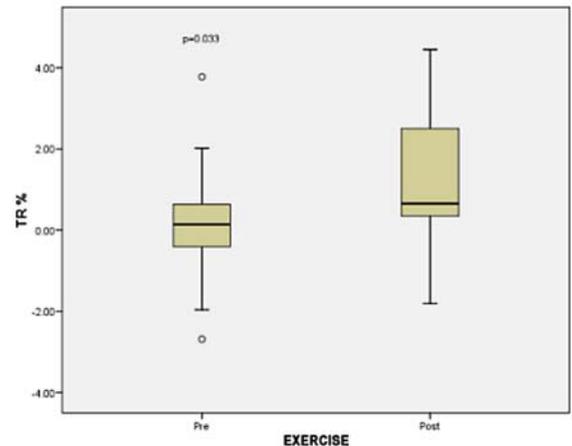


Figure 2. Temperature Rebound [% increase] after exercise

Results and Discussion:

- Thirty patients (mean age, 58±9 years) were studied. Baseline blood pressure and fingertip temperature did NOT differ before and after exercise.
- Following exercise, TR increased significantly (mean absolute, $0.53 \pm 0.95^\circ \text{C}$ vs. $0.04 \pm 0.42^\circ \text{C}$, $p=0.04$ and %change, $1.78 \pm 3.29\%$ vs. $0.14 \pm 1.27\%$, $p=0.03$; Figure 2).
- All patients with preoperative cardiac risk factors (modified Lee index >2, hypertension, diabetes mellitus) had ΔTR values in the lower 2 tertiles of the study population ($\Delta TR < 1.1\%$).
- Postoperative (cardiac, pulmonary, surgical) complications were threefold higher in patients with ΔTR values that in the lower 2 tertiles.

Conclusion:

- Exercise increases TR in response to occlusion-induced reactive hyperaemia.**
- Patients with preoperative cardiac risk factors had an impaired TR response to exercise, which in turn was associated with increased postoperative morbidity.**
- This inability to mount a dynamic microvascular response to exercise may improve preoperative risk stratification and our understanding of the pathophysiology associated with postoperative morbidity.**

References

- Celermajer DS et al. *Lancet* 1992; 340: 1111-5
- Harris RA et al. *Ultrasound Med Biol* 2007; 33: 1579-85