In Vivo Oxygen Consumption and Hemoglobin Levels in Human Thyroarytenoid Muscle

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Background

- Currently, there is no non-invasive, measurable method to determine if a symptom matches muscle function.

- **Visible light spectroscopy** (VLS) is the technology behind the FDA approved TSTAT® device.
Objective

Novel, pilot study was to determine if VLS is a reliable and valid method of measuring total hemoglobin (tHb) and oxygen saturation (StO₂) levels in the human thyroarytenoid/lateral cricoarytenoid (TA-LCA) muscle complex, thus providing information about typical muscle function.
Hypotheses

• After determining validity of device
• TA-LCA muscle complex will display a decrease in oxygen saturation during phonation (exercise) and a recovery back to baseline after cessation of the task.
• Total hemoglobin levels will raise during exercise and trend downward toward baseline after cessation of activity.
Methods

• Six participants total
• **Flexible laryngoscopy** performed using 4.9 mm channel port in non-contact fashion
  – 1.5 mm VLS sensor placed through working channel port
  – Endo-probe placed 1mm above one vocal fold
  – Baseline StO$_2$ and tHB obtained
  – Participants sustained loud “ah” for 60 seconds
  – Post-exercise measurements gathered
  – Three-minute voice rest before repetition of Trial 1
Methods

• Validity determined by inserting a 21-guage hollow LEMG needle into TA-LCA complex
  – Smaller VLS probe guided through LEMG needle to obtain direct $\text{StO}_2$ and tHB measurements
  – Same task completed with measurements at baseline, during, and after phonatory task
Figure 1 a,b. Measurement of (a) StO₂ via endo-probe and (b) tHb of the vocal folds in the TA-LCA muscle complex before and after phonation for one subject with the endo-probe.
Figure 2 a,b. Mean and standard deviation of StO2 (a) and rtHb (b) measurements made with the endo-probe before and after phonation.
Results

Figure 3a and Figure 3b. Time series of muscle StO$_2$ (a) and rtHb (b) measurements before during and after phonation for one subject with the LEMG needle-guided probe.
Results

Figure 4a, b. Mean and standard deviation of StO$_2$ (a) and rtHb (b) measurements made in the TA-LCA muscle before, during and after phonation with needle probe.
Results

Figure 5a, b. Comparison of StO$_2$ (a) and tHb (b) measurements made through the endo-probe (mucosa), and within the TA-LCA muscle.
Discussion

• Average StO$_2$ and tHb values were similar between fiberoptic and LEMG needle-guide probes at baseline and after phonation.
• Similar to what is seen in limb skeletal muscle
Future Directions

• Need more subjects
• Determine a way to measure levels with endo-probe during phonation
• Customize vocal tasks to get best outcome
• Continue studying other muscles in the larynx, as well as individuals with voice disorders.