INSTRUMENTING LUNG VENTILATION IN DIVERS USING ELECTRICAL IMPEDANCE TOMOGRAPHY

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Introduction: Lung mechanics during ventilation and breath hold in scuba divers is poorly understood. Current instruments are cumbersome and restrictive. We have begun to research the use of Electrical Impedance Tomography (EIT) for underwater use [1], since it can provide detailed breathing information in a non-invasive manner.

Hypothesis: Submersion-induced changes in respiratory biomechanics can be detected by EIT.

Methods: 3D EIT electrode belts (as per [1]) were placed circumferentially onto each participant's (N=6) chest. Breathing manoeuvres were performed out of pool (*dry*) in postures (left, right, prone, supine, fetal front/back) and subsequently in pool (1m depth, *wet*). Waveforms in regions of interest were analyzed, and tomographic images were reconstructed (Figures C&D, E&F).

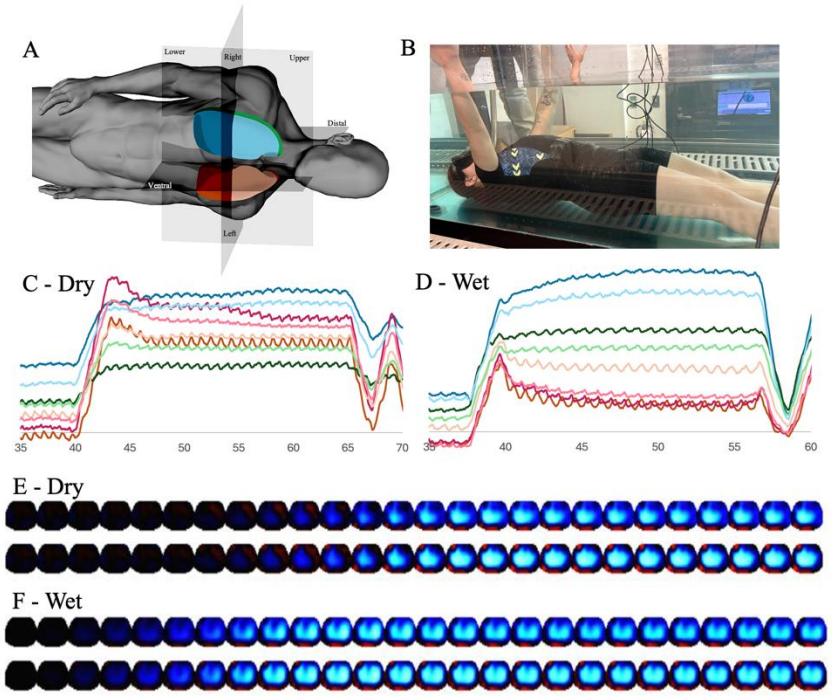

Figure: A: Illustration and B: photo of a participant. C&D: waveforms vs time (s) for an inspiratory hold. E&F: Series of tomographic sections showing upper and lower lung regions during inspiratory hold.

Results: Results demonstrate the feasibility of this method in water. We observed a clear difference between wet and dry signals. In the inspiration and breath hold, air redistributes after inspiration in wet more than in dry. We hypothesize this is due to hydrostatic pressure and larger diaphragmatic force.
We demonstrate that EIT can be used to investigate regional breathing dynamics in submerged participants. This is a promising methodology to understand respiratory biomechanics in divers.

Reference:
[1] Adler et al. (2025) In-water electrical impedance tomography: EIT and the sea. Physiol Meas, doi: 10.1088/1361-6579/adb82c