Bioelectrical impedance analysis (BIA) in the measurements of neck fluid volume composition: Implications for sleep disordered breathing

2022 Lifespan Research Day Abstract

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Abstract

Background & Aim: Rostral fluid shifts are expected to occur during supine sleep and are linked to obstructive and central sleep apnea. Since neck circumference and more invasive/labor intensive measurements are not suitable to measure shifts, devices such as the Bioelectrical Impedance Analysis (BIA) device which can potentially measure changes in neck fluid composition accurately should be assessed. We aimed to determine whether the BIA device is useful in understanding sleep disordered breathing pathophysiology by assessing its ability and repeatability to detect fluid composition changes in different positions.

Methods: In 30 healthy participants, we measured neck height and circumference at the base of the hyoid bone. We modeled the neck as a cylinder to calculate its volume and weight. We placed two electrodes immediately below the right mastoid bone and two electrodes at the neck's base, immediately above the medial end of the left clavicle. We then obtained three consecutive BIA measures after 15 minutes in each of the following positions: upright, supine, and supine with legs raised.

Results: The mean age was 23.3 +/− 9.06 years old, and mean BMI was 22.63 +/− 3.34. 40% of participants were females; 60% were males. There was a significant increase in neck fluid volume between the upright and supine positions ($p < 0.001$) and between the upright and supine with legs raised positions ($p < 0.001$). However, there was no significant difference in neck fluid volume between the supine and supine with legs raised positions. Significant increases in fluid volumes were observed in both males and females between the upright and supine positions ($p < 0.001$ and $p = 0.0039$, respectively). Measurements in the upright, supine, and supine with legs raised positions achieved repeatability percentages of 3.38%, 7.44%, and 4.52%, respectively.

Conclusion: The BIA device can detect changes in neck fluid composition following postural changes in both males and females, and repeated measurements are within less than 7.5% of each other. Next, we will compare neck volume changes over various time intervals with ultrasound measurements.

Clinical Implications: The BIA device may assist in furthering our understanding of the pathophysiology of sleep disordered breathing.