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Developing a Novel Neck-Wearable Piezoelectric Sensor for Early Carotid Artery Profile Screening in Habitual Snorers: A Pilot Study

Abstract: Carotid intima-media thickness (CIMT) and atherosclerosis, exacerbated by risk factors such as habitual snoring, are key indicators of cardiovascular disease. This study presents a novel wearable neck piezoelectric sensor (NPS) for non-invasive detection of snoring vibrations and carotid pulsations. We previously and successfully developed a curved NPS alongside a deep learning algorithm to differentiate severe sleep apnea from habitual snoring in a pilot study. The device was tested on 40 habitual snorers, measuring neck snoring vibration energy (SVE) over the common carotid artery during sleep. Multivariate linear regression models revealed that normalized SVE-10Hz ($\beta = -0.12$, 95% CI: -0.23 to -0.01), male gender ($\beta = -0.18$, 95% CI: -0.33 to -0.03), and neck circumference ($\beta = 0.04$, 95% CI: 0.02 to 0.06) were independently associated with ultrasound-determined CIMT (adjusted $R^2 = 0.34$). Furthermore, a robust multivariate categorical regression model for predicting atherosclerosis levels incorporated the 3% oxygen desaturation index ($\beta = 0.03$, SE = 0.07), diastolic blood pressure ($\beta = 0.36$, SE = 0.19), and normalized SVE-28Hz ($\beta = 0.03$, SE = 0.08) (adjusted $R^2 = 0.51$). These results highlight the NPS's potential as a materials-driven solution for early and convenient screening of unfavorable carotid artery profiles in high-risk individuals. Further research is necessary to validate these promising results in larger cohorts.

Keywords: neck piezoelectric sensor, atherosclerosis, carotid intima-media thickness, sleep apnea, snoring, ultrasound

Biography: Dr. Li-Ang Lee, MD, MSc, PhD, is a Professor in the Department of Otorhinolaryngology–Head and Neck Surgery at Linkou Chang Gung Memorial Hospital and Chang Gung University in Taoyuan, Taiwan. He also serves as Vice Director of the School of Medicine at National Tsing Hua University in Hsinchu, Taiwan. His areas of expertise include Otorhinolaryngology, Head and Neck Surgery, Sleep Medicine, and Medical Education.