

# Quantifying Temporal Association Between Intrathoracic Impedance and Atrial Fibrillation Using a Relational Strength Measure

Vilma Pluščiauskaitė\*, Andrius Petrėnas, Anneli Olsson, Rasmus Borgquist, Pyotr G. Platonov, Monika Butkuvienė

Biomedical Engineering Institute, Kaunas University of Technology, Kaunas, Lithuania

**Introduction:** Thoracic fluid congestion alters intrathoracic impedance and has been linked to atrial fibrillation (AF). Unlike previous studies, which mainly relied on the impedance-derived fluid index and assessed whether AF episodes occurred before or after exceeding a predefined threshold, this study examines the temporal association between intrathoracic impedance and AF burden across the entire observation period. In addition, it evaluates the cumulative fluid index together with intrathoracic impedance.

**Methods:** The study includes 115 patients with cardiac implantable electronic devices followed for a median of 668 days. AF occurred in 33 patients with a mean AF burden of 0.27 over the entire observation period. Impedance-related events are defined as either a 5% decrease in daily intrathoracic impedance relative to the patient-specific reference value or a fluid index above 60  $\Omega$ -days. Temporal associations with AF burden are assessed using a forward ( $\gamma_{\text{fwd}}$ ) and a reverse ( $\gamma_{\text{rev}}$ ) relational strength measure with pre- and post-event windows of  $T = 3$  and  $T = 30$  days.

**Results:** For impedance events, the forward relational strength measure is significantly higher than the control at  $T = 3$  days ( $p < 0.01$ ), with increased AF burden following a decrease in impedance, whereas fluid index events show a significant reverse association for  $T = 30$  days ( $p = 0.03$ ), with increased AF burden preceding an increase in the fluid index.

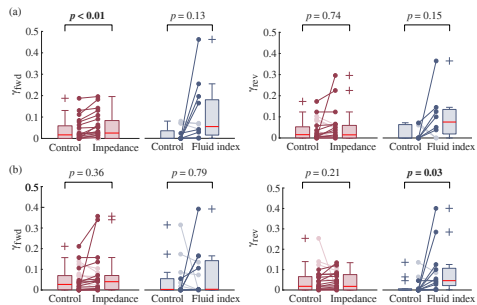


Fig. 1.  $\gamma_{\text{fwd}}$  and  $\gamma_{\text{rev}}$  for (a)  $T = 3$  and (b)  $T = 30$  days. Event-related  $\gamma$  is compared with control  $\gamma$  for impedance (red) and fluid index (blue) events.

**Conclusion:** These findings suggest that daily intrathoracic impedance and the fluid index should be considered complementary measures, with intrathoracic impedance being preferable for capturing short-term associations with AF burden.