Unobtrusive estimation of ventilatory and muscle activity for COPD assessment
Peer-reviewed author version

Blanco-Almazan, D.; Groenendaal, W.; Lozano-Garcia, M.; Estrada-Petrocelli, L.;
Lijnen, L.; ONDER, Rana; Smeets, C.; RUTTENS, David; Catthoor, F. & Jane, R.

Unobtrusive estimation of ventilatory and muscle activity for COPD assessment

Abstract

D Blanco-Almazán, W Groenendaal, M Lozano-García, L Estrada-Petrocelli, L Lijnen, R Önder, C Smeets, D Ruttens, F Catthoor, R Jané

Introduction: Thoracic bioimpedance (bioZ) is a technique proposed to noninvasively measure respiration due to its linear relationship with respiratory volume. Surface mechanomyogram (sMMG) and surface electromyogram (sEMG) have been suggested to provide information related to the respiratory muscle activation when measured in the lower intercostal spaces (sEMGlic and sMMGlic). The aim of the present study was to investigate the combination of ventilatory and muscle activity information acquired exclusively through unobtrusively measures in COPD.

Methods: 65 COPD patients (17 female, median (IQR) age 65 (59-70) years, BMI 24.96 (22.40-29.43) kg·m-2, FEV1 50.40 (40.03-69.63) %pred), performed an inspiratory threshold loading protocol at 12, 24, 36, 48 and 60% of maximum inspiratory mouth pressure. BioZ was measured with a wearable device using a tetrapolar configuration. sEMGlic and sMMGlic were acquired on the right seventh/eighth intercostal spaces and analysed using fixed sample entropy (fSampEn). We estimated the respiratory cycles using exclusively bioZ and further, a bioZ index was calculated as the amplitude over the inspiratory time. This bioZ index was combined with the fSampEn sEMGlic and fSampEn sMMGlic as a ratio, and evaluated for two levels of COPD severity, moderate for FEV1 ≥ 50 % pred and severe for FEV1 < 50 % pred.

Results: The combination of bioZ and fSampEn sEMGlic, and fSampEn sMMGlic showed significant differences between the COPD severity groups ($p<0.05$) in quiet and loaded breathing.

Conclusion: The significant differences between COPD severity suggest the clinical potential value of the combination of thoracic bioimpedance and muscular activation information for COPD assessment.