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Title: An early non-invasive detection of the patient inspiratory effort for patient-ventilator synchronization

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Body: Background: In ICU NIV setting, patient-ventilator asynchrony imposes an additional burden on the respiratory system and may lead to NIV failure. Breath triggering using pneumatic variables (pressure, flow or volume) may be affected by air leaks, contributing to patient-ventilator asynchrony. LPG sensors (Long-Period Grating-fiber optic sensing) may be used to measure curvature of the rib cage, allowing measurement of breathing movements and volumes, providing a trigger variable independent on air leaks. Timing of the LPG breathing signal compared to the pneumatic signal is essential for triggering. Goal: Compare the timing of the breathing volume signals obtained by pneumotachograph (by flow signal integration) and LPG sensor (calculated from torso curvature measurement). Methods: Silicon rubber encapsulated LPG sensor patches were used for the movement/volume measurements. The self-adhesive sensor (1.4x6cm) was attached to the subject’s lower ribs. All measurements lasted 60 sec, with subjects in supine position and an ICU ventilator pneumotachometer (PTM) used for comparisson. Results: Measurements were done in 9 healthy volunteers (4 male, 5 female). A systematic delay was observed in PTM with respect to LPG signal. The mean delay (by crosscorrelation method) of the PTM with respect to LPG sensor volume curves was 156±59 ms, while the mean delay during breath initiation (first 200 ms of each breath) was 166±66 ms. Conclusions: LPG sensors provide a robust and non-invasive detection of the patient inspiratory effort significantly earlier than that provided by PTM method, which is independent of air leaks and can be used to substantially improve the triggering algorithms.