

# Pressure control, pressure support and neurally adjusted ventilation have different effects on the cardio-respiratory coupling in critically ill patients

Dott. DAVIDE OTTOLINA (1), Dott. TOMMASO FOSSALI (1), Dott. DAVIDE MARASCO (2), Dott.ssa MARTINA MONTI (2), Dott. ANDREA GIANCANE (2), Dott.ssa MARTINA ROSSI (2), Dott. GIUSEPPE MARCHESI (2), Dott. ROBERTO RECH (1), Dott. EMANUELE CATENA (1)

(1) Anestesia e Rianimazione, ASST Fatebenefratelli Sacco, Ospedale Luigi Sacco, Via G.B. Grassi 74, 20157 Milano, Italia.

(2) Università Degli Studi di Milano, Scuola di Specializzazione in Anestesia e Rianimazione, Italia.

Argomento: Funzione cardiovascolare in terapia intensiva

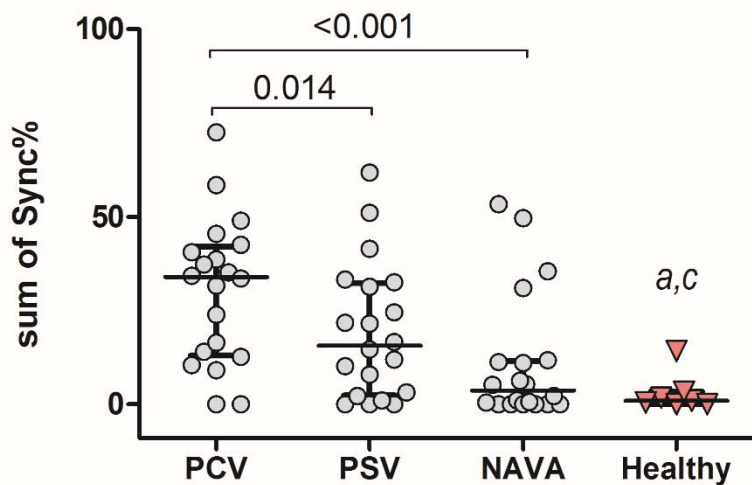
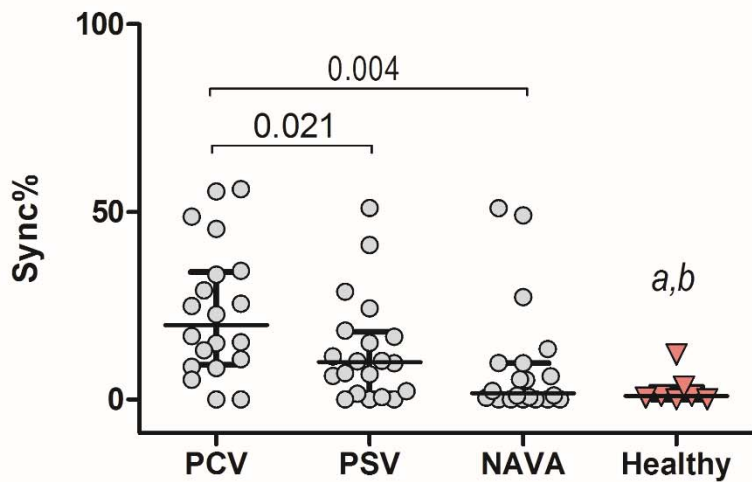
**Razionale:** Respiration and cardiac activity are strictly interconnected with bi-directional reciprocal influences. Together act as weakly coupled oscillators showing variable degrees of phase synchronization which can ultimately be affected by mechanical ventilation modes.

**Objectives:** The study aimed to measure the effects of three different ventilatory modes on the cardio-respiratory coupling in critically ill patients.

**Methods:** The coupling between respiration and heartbeats was studied by cardio-respiratory phase synchronization analysis during Pressure Control Ventilation (PCV), Pressure Support Ventilation (PSV) and Neurally Adjusted Ventilatory Assist (NAVA) in critically ill patients. The cardiorespiratory coupling was also assessed in a sample of healthy subjects breathing spontaneously.

**Measurements and Main Results:** 20 patients and 7 healthy subjects were studied. The cardio-respiratory phase synchronization changed significantly between ventilatory modes ( $p < 0.001$ ). There was a high synchronization during controlled mode and lower synchronization in supported ventilatory modes. The sum of all Sync was higher in PCV than in PSV (median 33.9%, 95%CI 21.3-39.3 vs. 15.7%, 95%CI 10.9-27.8,  $p = 0.014$ ) and NAVA (3.7%, 95%CI 3.3-19.2,  $p < 0.001$  vs. PCV). The sum of all Sync was different between healthy subjects and patients in PCV ( $p = 0.003$ ) and PSV ( $p = 0.021$ ).

**Conclusion:** Controlled mechanical ventilation induced a significant amount of cardio-respiratory phase synchronization, which diminishes towards the ventilatory modes driven by the patients similarly to spontaneously breathing healthy subjects. If different couplings might provide clinical prognostic insight in critically ill should be further addressed.



**Figure 1**

Results of cardio-respiratory synchronization analysis among critically ill patients (circles) and healthy controls (triangles). Cardiorespiratory phase synchronization was defined as a repetitive occurrence of  $m$  heartbeats at the same relative phases within  $n$  consecutive breathing cycle, named phase locking ratio ( $n:m$ ), and quantified by synchronization index (Sync%) - the percentage of beats in which it could be observed the most frequent phase locking ratio -, and sum of Sync% - the sum of all the synchrogram indices present within the series.

Differences between study phases was checked by one-way ANOVA for repeated measures followed by Bonferroni's *post hoc* test. Differences between groups (patients vs. healthy controls) was checked by Mann-Whitney U test.

<sup>a</sup>  $p=0.003$  vs. PCV

<sup>b</sup>  $p=0.042$  vs. PSV

<sup>c</sup>  $p=0.021$  vs. PSV