

LETTER



Hemodynamic response to prone ventilation in COVID-19 patients assessed with 3D transesophageal echocardiography

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Dear Editor,

Prone positioning (PP) is proposed in ventilated patients for acute respiratory distress syndrome (ARDS) due to Corona Virus Disease-19 (COVID-19) [1]. Hemodynamic assessment using transesophageal echocardiography (TEE) is proposed during PP in COVID-19 patients [2]. We sought to assess the hemodynamic response to PP using real-time three-dimensional (RT3D) TEE in patients with moderate-to-severe COVID-19 ARDS.

Ventilated patients with confirmed COVID-19 ARDS underwent a RT3D TEE assessment immediately before, 1 h after PP, and 16 h later back to supine position (Supplementary materials). Results are expressed as medians and 25th–75th percentiles.

Nine patients were studied, all being hemodynamically stable without vasopressor support or other organ failure (Supplementary Table 1). Despite mild acute pulmonary hypertension, the right ventricle (RV) was not dilated as reflected by normal indexed end-diastolic volume (RVEDVi). Cardiac index (CI), RV and LV ejection fraction (EF) and strain rate were normal (Supplementary Table 2). All patients responded to PP [$\text{PaO}_2/\text{FiO}_2$: 127 (94–141) vs. 77 (67–94); $p = 0.012$]. During PP, RVEDVi and LVEDVi decreased (Fig. 1), while respective EF and strain rate remained stable. Back in supine position, RVEDVi and LVEDVi increased but remained within normal range (Fig. 1), while biventricular EF, CI and strain rate kept steady. LV end-systolic eccentricity index (ESEI) normalized during PP and returned to

baseline values back in supine position (Supplementary Tables 2 and 3).

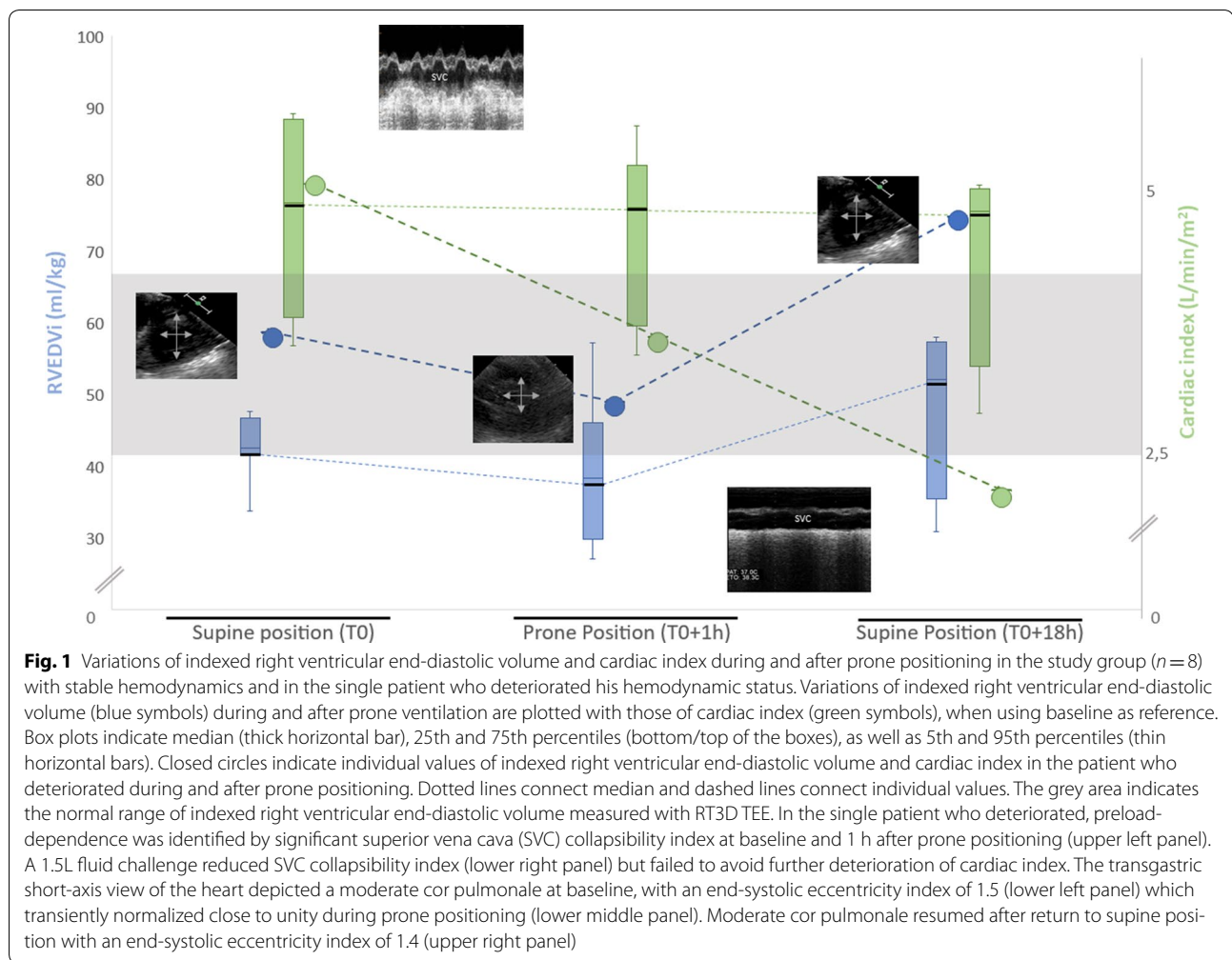
One patient had moderate acute cor pulmonale (ACP) with preserved LV systolic function at baseline. During PP, RVEDVi decreased and paradoxal septal motion disappeared, as reflected by a normalized LVESEI (Fig. 1). Despite normal mean blood pressure, CI, LVEF and LV strain rate decreased from 5.0 to 3.6 L/min/m², 61% to 35%, and – 20% to – 14%, respectively, whereas systemic vascular resistances (SVR) remained low (from 950 to 989 mmHg/L/min). The patient developed oliguria. A 1.5L fluid challenge was performed due to preload-dependence (Fig. 1). Back in supine position, hypotension occurred secondary to a drop of CI to 2.25 L/min/m² despite normalized SVR (1500 mmHg/L/min). Moderate ACP recurred as reflected by increased RVEDVi and LVESEI, while both LVEF and LV strain rate decreased to 25% and – 13%, respectively, in the absence of preload dependence (Fig. 1). Kidney function subsequently deteriorated (creatinine: 71 $\mu\text{mol/L}$ to 220 $\mu\text{mol/L}$).

During PP, RT3D echocardiography which has been validated against MRI [3], depicted a transient decrease of ventricular volumes which was not tracked by two-dimensional imaging (Supplementary Table 4), and a non-significant decrease of LV stroke volume compensated by increased heart rate. The significant yet reversible decrease of RVEDVi and normalization of LVESEI confirm the beneficial effect of PP on afterloaded RV [4]. Despite the transient reversal of a moderate ACP, one of our patients developed severe LV systolic dysfunction with decreased CI and altered myocardial contractility. This resulted in a worsened low flow state and subsequent acute renal failure. TEE during PP was well-tolerated [5]. Although this observational study is limited by

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its small sample size and warrant confirmation, it suggests that RT3D TEE monitoring is feasible and promises to track individual hemodynamic response to PP which may unpredictably be deleterious.

Electronic supplementary material

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Author contributions

BE and PV designed the study. BE, MG, ALF included the patients and performed the echocardiography. BE and MG reviewed off-line all echocardiography studies. BE and PV drafted the manuscript. MG and ALF critically reviewed the manuscript. All authors read and approved the final manuscript.

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Compliance with ethical standards

Conflicts of interest

The authors declared that they have no conflict of interest.

Ethical approval

Ethical Committee accepted this observational study and waived the need for informed consent.

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