Noninvasive Ventilation for Acute Hypoxemic Respiratory Failure/ARDS: the Show Must Go on

Cesare Gregoretti, Andrea Cortegiani, Giuseppe Accurso, Santi Maurizio Raineri, Antonino Giarratano

Department of Biopathology and Medical Biotechnologies (DIBIMED). Section of Anesthesia, Analgesia, Intensive Care and Emergency. Policlinico P. Giaccone. University of Palermo, Italy

We would like to thanks Hill et al for his nice article on the "CONTRA" of the use of noninvasive ventilation (NIV) for acute hypoxemic respiratory failure (1, 2). Hill et al. underlined that, in hypoxemic patients, only one earlier study suggested that NIV might be more successfully used if limited to a selected sub-population (3). In addition, a sub-analysis of the LUNG SAFE study (4) showed that the mortality rate of patients with a P_aO_2/F_IO_2 <150 was actually greater in patients treated with NIV than in those treated with invasive mechanical ventilation. It is important to acknowledge, however, that that both the studies were not randomized controlled trials (RCT). Moreover, a word of caution was shed by Hill et al on the results of a single RCT comparing NIV to high flow nasal therapy (HFNT) and standard oxygen in acute hypoxemic respiratory failure (5). As a matter of fact, further RCTs would be necessary to determine if NIV improves or worsen outcomes, and this has not yet been done (6, 7).

The commentary by Hill et al also focused on the concern raised in recent years regarding the NIV treatment of hypoxemic "de novo" acute respiratory failure and the related risk of patient self inflicted lung injury (P-SILI) due to the high transpulmonary pressure and the generated potential injurious tidal volume (VT) (6, 8). As suggested by Brochard et al. (9) in both invasive and non invasive ventilation, better monitoring of spontaneous breathing including measurement of VT, respiratory drive (e.g., occlusion pressure or P0.1), and respiratory muscles activity (esophageal pressure, diaphragmatic activity) should be carried out. Hill et al. stressed the point that volume is hard to control during NIV due to the inability to adequately tailor sedation and analgesia. In addition, as opposed to invasive mechanical ventilation, the use of neuromuscular blocking agents cannot be accomplished.

In one recent study, VT averaging greater than 9.5 mL kg^{-1} predicted body weight were associated with higher rates of NIV failure (10). It should be noted that NIV can be delivered through dedicated single limb intentional leaks turbine driven ventilators or non intentional leaks, double limb limbs, high pressure or turbine driven ventilator with dedicated NIV modules (11). In the former one, the expiratory VT (VTe) is not measured but is estimated. This estimation has been found to be pretty accurate (12). In the latter, VTe is measured by a pneumotacograph set at the end of expiratory limb or proximally to the airway. In both cases, VTe measurement may be misleading during NIV (13). The higher the non-intentional leaks, the higher the inspiratory VT (VTi) and the lower the VTe. In other words, the VTi that is equal to the inspiratory flow over time, includes part of the real insufflated VTi plus the "volume" generated by the leaks. Furthermore, if part of VTe goes out from other way but the

ORCID IDs of the authors: C.G. 0000-0002-1442-1426; A.C. 0000-0003-1416-9993; A.G. 0000-0001-9344-8311.

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Address for Correspondence:
Cesare Gregoretti
E-mail: c.gregoretti@gmail.com
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expiratory port of the mask (i.e. from the mouth using a nasal mask or from a gap using a too loose oro-nasal mask), VTe is incorrectly measured as in pediatric population. In addition, when NIV is used with the helmet (14, 15) or some other interfaces VT cannot be measured (16, 17). In their RCT comparing the effect of NIV delivered via full-face mask or helmet in 80 patients, Patel et al did not measure VTe (17). Nonetheless, the rate of intubation (primary outcome), was significantly less (18%) with the helmet compared to a full-face mask (62%). From all these considerations, it may be argued that it is difficult to establish the role of VT when NIV is used in hypoxemic patients due to the difficulty in reliably measure it.

Last but not least, one other interesting aspect should be considered. In people undergoing strenuous effort and high tidal volumes, Olaffson et al found no evidence that lung mechanics changed during exhausting exercise in normal subjects (18). However, recent data (19) showed that after a half-marathon in non-asthmatic amateur runners, a high neutrophil counts in induced sputum could be detected. Neutrophil influx into the airways of athletes may be secondary to bronchialepithelial damage associated with intense exercise and respiratory efforts. These data may explain the worse damage of hypoxemic patients generating high VT when treated with NIV.

In conclusion, we agree with Hill et al that before abandon the use of NIV, some considerations should be done. First, measurement of VTe may be misleading using conventional pneumotacographic mode during NIV in presence of non-intentional leaks. Other options of VTs measurements, as inductive pletismography, should be considered to reliably measure VTe in RCTs in which VTs are challenged (20). Second, interfaces as helmet allowing continuous NIV application and, possibly, a higher PEEP may be important for NIV success and contribute to better outcomes. More RCTs are needed comparing NIV delivered by helmet or oro-nasal mask. By virtue of its effectiveness at oxygenation and greater tolerability, we should also need studies comparing continuous HFNT (6) vs continuous application of helmet Continuous Positive Airway Pressure (CPAP) (11). As during HFNT, in CPAP mode flow and volumes are only generated by the respiratory muscles. Third, the role of tidal should be further investigated in developing P-SILI.

It is mandatory to avoid delaying intubation in patients who do not respond to NIV and to keep in mind that sedation and protective invasive mechanical ventilation should still be considered the mainstay for the management of hypoxemic "de novo" acute respiratory failure. However, after almost three decades of research, many uncertainties remain about the use of NIV for hypoxemic patients. Thus, we believe that the "NIV show should go on".

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