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EFFECTS OF DIFFERENT ECMO GAS FLOWS ON THE BREATHING PATTERN OF SEVERE ARDS PATIENTS DURING PRESSURE SUPPORT AND NAVA

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INTRODUCTION. Assisted mechanical ventilation (MV) might improve respiratory muscles function and gas exchange, decrease sedation needs and weaning time in severe acute respiratory distress syndrome (ARDS) patients undergoing extracorporeal membrane oxygenation (ECMO). During assisted MV, tidal volumes (Vt) should remain in the protective range. However, in ECMO patients, they might depend from physician's setting of the ventilator as well as from the amount of CO₂ removed by ECMO (1,2).

OBJECTIVES. Aim of this study was to evaluate, in severe ARDS patients, tidal volumes and other respiratory parameters at different levels of extracorporeal CO₂ removal by ECMO during both pressure support ventilation (PSV) and neurally-adjusted ventilatory assist (NAVA).

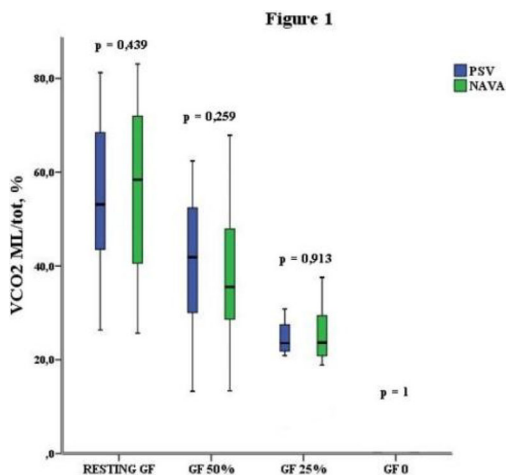
METHODS. We performed a prospective interventional randomized cross-over study on severe ARDS patients undergoing ECMO and assisted MV. ECMO sweep gas flow (GF) was decreased from resting conditions (i.e., p0.1 < 2 cmH₂O and RR ≤ 20 bpm) to 50 %-25 %-0 % during PSV and NAVA (20 min step, random order). Support and NAVA gain were chosen to obtain, at the highest GF, similar Vt (i.e., ≈ 6 mL/kg) and peak airway pressure (i.e., < 25 cmH₂O). Continuous recording of airway pressure, flow, esophageal pressure and electrical activity of the diaphragm were recorded during all study phases and analyzed off-line by dedicated software. Variables were compared by two-way repeated measures ANOVA with GF and ventilator mode as co-variables. Data are presented as median [IQR].

RESULTS. Eight severe ARDS patients (5 male) were recruited: they were on ECMO since 20 days [14-49], age was 51 [40-54] year-old, PEEP was 14 [10-16] cmH₂O and Crs 33 [26-45] mL/cmH₂O. During assisted MV and NAVA, decreasing GF led to a similar decrease in the amount of CO₂ removed by ECMO (Figure 1) and increase of respiratory rate, p0.1 and electrical activity of the diaphragm (p < 0.001 for different GF; p = n.s. for ventilation modes and interaction). Tidal volume (Figure 2), peak airway pressure, minute ventilation and transpulmonary pressure increased at lower GF, albeit their increase was more pronounced during NAVA than during PSV (p < 0.05 for different GF and ventilation modes; p = n.s. for interaction). In fact, when GF was zeroed during NAVA, Vt was > 6 mL/kg in 90 % of patients and > 8 mL/kg in 50 %.

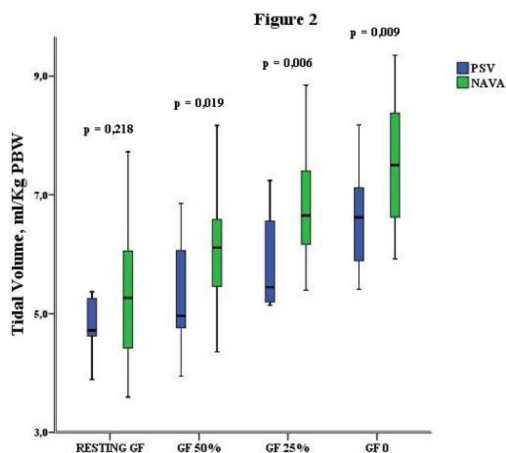
CONCLUSIONS. In severe ARDS patients undergoing assisted MV and ECMO, decreasing CO₂ removal by ECMO significantly increases ventilation pressure and volume. Particular attention should be paid to NAVA settings when changing ECMO gas flow.

REFERENCE(S). 1. T. Mauri et al. Intensive Care Med 2013; 2. T. Langer et al. Crit Care Med 2014.

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[Figure 1]



[Figure 2]

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INTENSIVIST DELIVERED QUATERNARY SEVERE RESPIRATORY FAILURE RETRIEVAL SERVICE WITH MOBILE EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO) CAPABILITIES

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INTRODUCTION. Transfer to an extra-corporeal membrane oxygenation (ECMO)-capable respiratory failure centre is associated with improvement in disability-free survival in adult patients with severe respiratory failure (SRF) [1]. However, the secondary inter-hospital transfer of severely hypoxic/hypercapnic patients poses significant challenges, and mobile ECMO during retrieval is frequently indicated. Although the use of mobile ECMO is well established, the ideal make-up of the retrieval team remains to be demonstrated. Trials to date predominantly utilise a surgeon and large retrieval team.

OBJECTIVES. We describe the logistics and outcomes for an intensivist (non-surgeon) delivered SRF retrieval service with mobile ECMO capabilities.

METHODS. Retrospective observational study of all patients retrieved to St Thomas' hospital between 02/2013 and 01/2014.

RESULTS. Of the 60 patients analysed, 57 % were female and the mean ± SD age was 44.1 ± 13.6 years. The median (IQR) Murray score and mean ± SD PaO₂/FiO₂ ratio were 3.2 (3-3.5) and 10.2 ± 4.1 kPa respectively. At referral, 16.7 % were receiving protective lung ventilation according to ARDSnet criteria, 47 were receiving neuromuscular blockers, eight were ventilated in the prone position, two were on high frequency oscillatory ventilation and three were on inhaled nitric oxide.

Forty eight patients (80 %) required venovenous ECMO initiation at the referring centre. All patients that required ECMO were successfully cannulated. Cannulation techniques were bifemoral (85.4 %), femoral-jugular (10.4 %) and dual-lumen jugular Avalon cannulation (4.2 %). There were no cannulation or ECMO related complications. Mean ± SD pump blood flow and sweep gas flow during transport were 4.5 ± 0.7 and 4.4 ± 1.7 Lmin⁻¹ respectively. One patient with multi-organ failure died prior to transfer.

There were no serious adverse events during retrieval. The mean ± SD lowest SpO₂ and SBP were 91 ± 6 % and 105 ± 19 mmHg respectively. Following retrieval, there was a significant improvement in PaO₂/FiO₂ ratio, ventilator FiO₂, Pplat, pH and PaCO₂ (table 1).

	At referral	Immediately following retrieval	P-value
PaO ₂ /FiO ₂ ratio mean ± SD, kPa	10.2 ± 4.1	26.2 ± 15.5	<0.0001*
Ventilator FiO ₂ median (IQR)	1.0 (0.9-1)	0.4 (0.3-0.7)	<0.0001*
Pplat mean ± SD, cmH ₂ O	32.8 ± 5.8	23.0 ± 5.5	<0.0001*
pH mean ± SD	7.15 ± 0.16	7.32 ± 0.09	<0.0001*
PaCO ₂ mean ± SD, kPa	10.6 ± 4.4	6.4 ± 1.7	<0.0001*

[Ventilatory data pre & immediately post-retrieval]

Survival to critical care discharge was 77 % for patients initiated on ECMO and 75 % for those retrieved conventionally.

CONCLUSIONS. Despite very high illness severity, patients who fail mechanical ventilation can be safely transferred to a specialist respiratory failure centre. An intensivist delivered mobile ECMO service delivers safe patient retrieval and a high survival rate.

REFERENCE(S). 1. Peek GJ et al. Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial. Lancet. 2009 Oct 17;374(9698):1351-63.

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COST ANALYSIS OF THE USE OF EXTRACORPOREAL CARBON DIOXIDE REMOVAL TO AVOID INTUBATION IN PATIENTS FAILING NON-INVASIVE VENTILATION

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INTRODUCTION. Extracorporeal carbon dioxide removal (ECCO₂R) is increasingly applied in patients with refractory hypercapnia on invasive mechanical ventilation (IMV), but little is known about the economic impact of this new technology. A new indication for ECCO₂R is its pre-emptive application to avoid IMV altogether.

OBJECTIVES. To evaluate the financial implications of this new treatment strategy. **METHODS.** Retrospective ancillary cost analysis using data from a recently published multicentre case-control-study (1) on the use of ECCO₂R to avoid IMV in patients with acute on chronic ventilatory failure of different aetiology showing a reduction in hospital length of stay. Cost calculations and comparison between the two treatment groups and subgroups were based on direct costs of the ECCO₂R and on average daily treatment costs for ICU and normal wards.

RESULTS. In the patient group treated with ECCO₂R IMV could be avoided in 90 % of cases and hospital length of stay (LOS) was shorter than in the matched control group treated with IMV (median 23 vs. 42 days). The overall average hospital treatment costs did not differ between the two groups (41,134 vs. 39,366 €, p = 0.8). A subgroup analysis of each 12 cases and 12 matched controls with chronic obstructive pulmonary disease (COPD) revealed significantly lower hospital treatment costs for the ECCO₂R group (19,610 vs. 46,552, p < 0.05).

CONCLUSIONS. Avoiding mechanical ventilation by the use of ECCO₂R and thereby reducing hospital LOS was associated with similar treatment costs for a mixed group of patient with acute on chronic ventilatory failure. In the subgroup of COPD patients treatment costs were even lower, implying that in selected patient groups a strategy of ECCO₂R to avoid intubation may not only hold clinical advantages, but also some beneficial economic impact. Further prospective economic analyses in larger patient groups are warranted to confirm these preliminary results.