Early ventilation settings in brain-injured patients: an update from VENTIBRAIN STUDY

C. Almondo[1], P. Pelosi[1,2], F. Graziano[3], FS. Taccone[4], G. Citerio[5,6], C. Robba[1,2]

1.University of Genoa

2.Anesthesia and Intensive Care, San Martino Policlinico Hospital, IRCCS for Oncology and Neuroscience, Genoa, Italy.

3.School of Medicine and Surgery, University of Milano-Bicocca, Monza, Italy; Bicocca Bioinformatics Biostatistics and Bioimaging Center B4, School of Medicine and Surgery, University of Milano-Bicocca, Milan, Italy

4.Department of Intensive Care, Erasme Hospital, Université Libre de Bruxelles (ULB), Brussels, Belgium.

5.School of Medicine and Surgery, University of Milano - Bicocca, Milan, Italy

6.Neurointensive Care Unit, Department Neuroscience, San Gerardo Hospital, ASST-Monza, Monza, Italy

Mechanical ventilation is frequently used in brain injured ill patients. [1] [2]Although necessary to optimize brain oxygen delivery, mechanical ventilation may cause pulmonary and cerebral damage, leading to an increasing of morbidity and mortality.[1] [3]However, it remains poorly described how current protective lung ventilation recommendations are applied in this setting. [4]

OBJECTIVES

The primary objective of this multi-center, international, prospective, observational, cohort study was to describe the ventilatory settings and targets used in the brain injured patients during their Intensive Care Unit (ICU) stay.

METHODS

Ongoing multicenter observational study on practice of ventilation in brain injured patients (VENTIBRAIN) study. Inclusion criteria are brain injured patients ≥18 years old, admitted in ICU with a diagnosis of Traumatic Brain Injury (TBI), Subarachnoid Haemorrhage (SAH), Intracranial Haemorrhage (ICH) or acute ischemic stroke (AIS) undergoing invasive mechanical ventilation. Demographic, baseline characteristics, and ventilation settings in the first 24 hours were recorded.

RESULTS

This analysis included 1784 patients enrolled from October 2021 to January 2023. The median age was 58 (IQR, 44-70) years, 1172 (65%) males. Seven hundred (39.4%) were admitted with diagnosis of TBI, 349 (19.5 %) of SAH, 477 (26.7%) of ICH, and 258(14.4%) of AIS. At the first neurological evaluation, the patients had a median motor GCS score of 4 (2-5). Median tidal volume was 480 (440-530) mL, median TV per ideal body weight was 7.15 (6.37-8.22) mL/Kg, respiratory rate 16 (14-18) breaths/min, PEEP 6 (5-8) cmH20 and inspiratory plateau pressure 15 (13-18) cmH2O. Median compliance of the respiratory system was 47.6 (38-61.1) mL/cmH2O and driving pressure 10 (8-12) cmH2O.

The median arterial partial pressure of oxygen/ fraction of inspired oxygen ratio was 275 mmHg (IQR 184.2-483.2).

Table 1. Baseline characteristics of patients and ventilatory settings at ICU admission

	Overall (n=1784)
Baseline patient characteristics	
Age, years, median (IQR)	58 (44; 70)
Gender, male, n (%)	1172 (65)
Height, cm, median (IQR)	175 (170; 180)
Weight, kg, median (IQR)	80 (73; 90)
BMI, kg/m^2, median (IQR)	26.3 (24.1; 29.7)
Chronic comorbidities	
Hypertension, yes, n (%)	517(29.5)
Diabetes mellitus, yes, n (%)	260 (14.6)
Cardiological hystory, yes, n (%)	144 (8.1)
Smoke, yes, n (%)	392(22)
COPD, yes, n (%)	156(8.8)
Cancer, yes, n (%)	18(1)
Type of brain injury	
TBI n (%)	700(39.4)
SAH n (%)	349(19.5)
ICH n (%)	477(26.7)
Stroke n(%)	258(14.4)
GCS motor ,median (IQR)	4 (2-5)
Respiratory rate, breaths/min, median (IQR)	16.0 (14.0; 18.0)
Positive end-expiratory pressure, cmH_2O, median (IQR)	6.00 (5.00; 8.00)
Plateau pressure, cmH_2O, median (IQR)	20.0 (17.0; 24.0)
Tidal volume, mL, median (IQR)	480 (440; 530)
Tidal volume, mL/kg PBW, median (IQR)	7.15 (6.37; 8.22)
Driving pressure, cmH_2O, median (IQR)	10.0 (8.00; 12.00)
Compliance of the respiratory system, mL/cmH_2O, median (IQR)	47.6 (38.0; 61.1)
Gas exchange	
Fraction of inspired oxygen (FiO_2), %, median (IQR)	50 (40; 78)
PaO_2, mmHg, median (IQR)	108.7 (83.2; 163.0)
PaO_2/ FiO_2 ratio, mmHg, median (IQR)	275 (184.2; 483.2)

CONCLUSIONS

This preliminary analysis shows that acute brain-injured patients during the first 24 hours in ICU are usually ventilated with a lung protective approach using low tidal volumes, low to moderate PEEP and low inspiratory plateau pressure.

REFERENCES

1. Slutsky AS. Lung Injury Caused by Mechanical Ventilation. *Chest*. 1999;116:9S-15S. doi:10.1378/chest.116.suppl_1.9S-a doi:10.1378/chest.116.suppl_1.9S-a
2. Tejerina EE, Pelosi P, Robba C, et al. Evolution Over Time of Ventilatory Management and Outcome of Patients With Neurologic Disease. *Crit Care Med*. 2021;Publish Ahead of Print. doi:10.1097/CCM.0000000000004921
3. Battaglini D, Siwicka Gieroba D, Brunetti I, et al. Mechanical ventilation in neurocritical care setting: A clinical approach. *Best Pract Res Clin Anaesthesiol*. 2021;35(2):207-220. doi:10.1016/j.bpa.2020.09.001
4. Carney N, Totten AM, O'Reilly C, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. *Neurosurgery*. 2017;80(1):6-15. doi:10.1227/NEU.0000000000001432