

Respiratory mechanic using a simulator of artificial ventilation (SimVA) during weaning with the mode NAVA, comparison between real and virtual patients.

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Simulation in intensive care is an innovative method for teaching. Patient-ventilator synchrony during weaning are associated with mortality. For this reason we develop a simulator of artificial ventilation (SimVA) and virtual patients breathing spontaneously. Mathematical model resolved differential equations of chest movements with spontaneous muscle pressure and diaphragm electrical activity in order to match with a clinical database of patients under NAVA. The goal of this study was to evaluate and compare 2 virtual patients respiratory mechanic during NAVA titration with patients from our unit: NAVA vs SimNAVA.

Introduction: With NAVA assist is proportional and synchronized to diaphragmatic electrical activity (EAdi). EAdi represent the diaphragmatic neural drive. We titrate NAVA according the EAdi_{max} recorded during a failed spontaneous breathing trial (SBT) in the real patients and during a NAVA level of 0,1 cmH₂O/μvolt in the virtual patients. NAVA level was titrated in order to reduce the respiratory load until EAdi/ EAdi_{max} = 60% (1). The pressure Electricity index: Pmus/Eadi index (PEI) was measured. (2) The purpose of this study was to assess SimNAVA through respiratory mechanic between real and virtual cases with our NAVA protocol.

Material and methods: Observational study, real patients recovering from pneumonitis and acute respiratory failure. SBT was Pressure Support Ventilation with 7 cmH₂O of assist and no PEP. PEI was calculated under NAVA from airway pressure drop during end-expiratory occlusions, muscular pressure (Pmus) was estimated from PEI (2).

Results: Results are summarized in the table.

Patients	EAdimax (μvolt)	NAVA level (cmH ₂ O/μvolt)	EAdi (μvolt)	VT (ml.kg ⁻¹)	Paw-PEP (cmH ₂ O)	PEP (cmH ₂ O)	PEI (cmH ₂ O/μvolt)	Pmus (cmH ₂ O)
Real	27	1.2	16	6,2	17	6.5	0.60	7
NAVA n=14	[15-32]	[0.8-2.0]	[12-20]	[4,7-6,7]	[13-22]	[5.0-8.0]	[0.30-0.68]	[4-11]
Virtual	16	2.2	10	6,2	16	6.0	1.00	10
SimNAVA N=2	[15-16]	[2.0-2.5]	[9.5-10]	[5.6-6.9]	[14-18]	[6.0-6.0]	[1.0-1.0]	[9.5-10]

Results are expressed as median [min-max]

No real patient had respiratory distress under NAVA. Respiratory mechanics with our NAVA titration protocol based on EAdi under SimNAVA was very close to real patients (figure). With SimNAVA, NAVA level titration increased from 0.1 to 2.2 cmH₂O/ μ volt which reduced EAdi from 16 to 10 μ volt and maintained V_T with protective ventilation.

Conclusion: Simulation with the software SimVA and the mode SimNAVA is realistic and may help to teach interactively patient-ventilator interaction during NAVA level titration with Pmus within acceptable range.

1. Intensive Care Med. 2011;37:1087–94. 2. Crit Care Med. 2013;41:1483–91

