

Respiratory mechanic using a simulator of artificial ventilation (SimVA), in virtual ARDS patients with the protocols of the ARMA and Express studies.

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Simulation in intensive care is an innovative method for teaching. Respiratory settings are responsible for some morbi-mortality of our patient. For this reason we develop a simulator of artificial ventilation (SimVA) and virtual patients. Mathematical model resolved differential equations of chest and lung movements in order to match with a clinical data base. The goal of this study was to evaluate and compare virtual patients respiratory mechanic with the results of 4 different protocols of ventilation from 2 large randomised controlled trial: Arma¹ and Express².

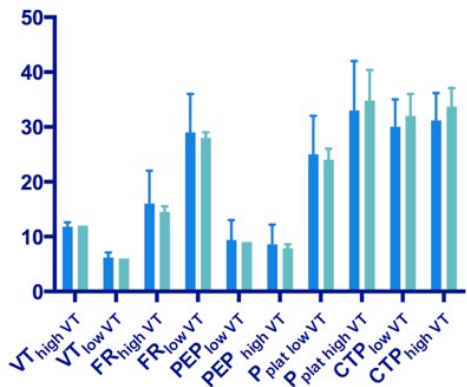
Method: Virtual case were ARDS, defined by thoracic and pulmonar compliance, total resistance, lung volumes, pressure-volume relation, pressure and volume recruitment coefficients. Ventilatory protocols were High vs Low V_T (Arma study) and Max vs Min distension according to PEP (Express study). Each virtual case was titrated with the 4 protocols. Respiratory mechanic after titration was recorded and compared to results of the 2 studies.

Results:

Protocols	Arma High V_T		Arma Low V_T		Express Distension min		Express Distension max	
	Real	Virtual	Real	Virtual	Real	Virtual	Real	Virtual
V_T ml	11,8(6,2)	12(0)	6,2(0,9)	6(0)	6,1(0,4)	6(0)	6,1(0,3)	6(0)
Pplat cmH ₂ O	33(9)	34,1(3,6)	25,0(7,0)	24,0(2,0)	21,1(4,7)	22(0,8)	27,5(2,4)	28(0,2)
PEP cmH ₂ O	8,6(3,6)	7,9(0,7)	9,4(3,6)	9,0(0)	7,1(1,8)	7,1(0,8)	14,6(3,2)	14,7(4,3)
PEPtot cmH ₂ O	Na	8,5(0,9)	Na	10,0(1,0)	8,4(1,9)	8(0,8)	15,8(2,9)	15,7(4,4)
RF cycle/min	16,0(6,0)	14,5(1,0)	29,0(7,0)	28,0(1,0)	27,8(5,4)	28,1(1,2)	28,2(5,4)	28,1(1,2)
Vm L/min	12,6(4,5)	13,3(1,7)	12,9(3,6)	13,0(2,0)	11,2(2,8)	13,2(1,3)	11,3(2,7)	13,2(1,8)
Ctp ml/ cmH ₂ O	Na	33,7(3,4)	Na	32,0(4,0)	33,7(14,3)	31(1,6)	37,2(22,7)	36,2(7,9)

Ctp=Thoracopulmonar compliance (ml/cmH₂O)

The 4 arms of the protocols defined tidal volume, respiratory frequency and PEEP, the software simulates the corresponding values of pressures and thoraco-pulmonary compliances. The difference between virtual cases and patients were not significant (Table 1 and Figure 1).

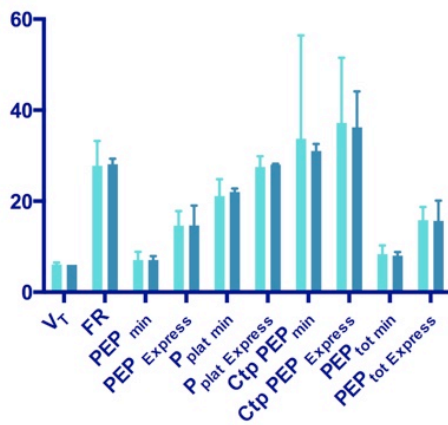


Arma Study

High vs Low V_T



N Engl J Med 2000;342:1301-8



Express Study

High vs Low PEP



JAMA. 2008;299(6):646-655



Discussion: Compliance was able to change according to PEP or V_T settings within the same range as large RCT studies. Simulation with the software SimVA is realistic and may help to teach interactively ventilatory settings in ARDS anywhere without any risk for the patient.

1. *N Engl J Med*. 2000;342:1301-8
2. *JAMA*. 2008;299:646-655