Intra operative respiratory mechanic with low tidal volume ventilation and PEEP using a simulator of artificial ventilation (SimVA), comparison with the Improve Study.

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Simulation in operating is an innovative method for teaching. Respiratory settings are responsible for some respiratory morbidity 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. Low tidal volume (V_T) and the use of PEEP has been shown to improve respiratory function in anesthetized patients. The goal of this study was to compare the 2 protocols of the Improve study[1] between virtual and real patients.

Method: Virtual cases were defined by various pulmonary compliance, total resistance, lung volumes, pressure-volume relation, pressure and volume recruitment coefficients. Patients had initially the ARDS network lung protective protocol.[2] The protocol was high V_T between 11 and 12 ml.kg^{-1} of PPW and no PEEP, vs Low V_T between 6 and 8 ml.kg^{-1} of PPW. Respiratory mechanic with each protocol on the same 10 virtual patients was recorded and compared to the results of the Improve study.

Results:

10 virtual cases were compared to the 400 patients of the Improve study

	Improve		SimVA	
$V_{T\ high}$	11,1	1,1	11,5	0,5
$V_{T\ low}$	6,4	0,8	6,1	5,0
PEEP $_{high\ VT}$	0,0	0,0	0,0	0,0
PEEP $_{low\ VT}$	6,0	1,0	6,9	0,9
Ppeak $_{high\ VT}$	20,1	4,9	20,0	2,2
Ppeak $_{low\ VT}$	20,0	4,0	19,1	1,5
Pplat $_{high\ VT}$	16,1	4,3	15,5	2,1
Pplat $_{low\ VT}$	15,2	3,0	14,6	1,0
C $_{RS\ high\ VT}$	45,1	12,9	45,5	3,0
C $_{RS\ low\ VT}$	55,2	26,7	54,7	1,5

V_T=Tidal Volume (ml); PEEP positive end expiratory pressure (cmH$_2$0); C_{RS}= Respiratory System Compliance (ml/cmH$_2$0).; Pplat=Plateau pressure (cmH$_2$0).

The protocols defined V_T and PEEP level, 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).

Improve Study
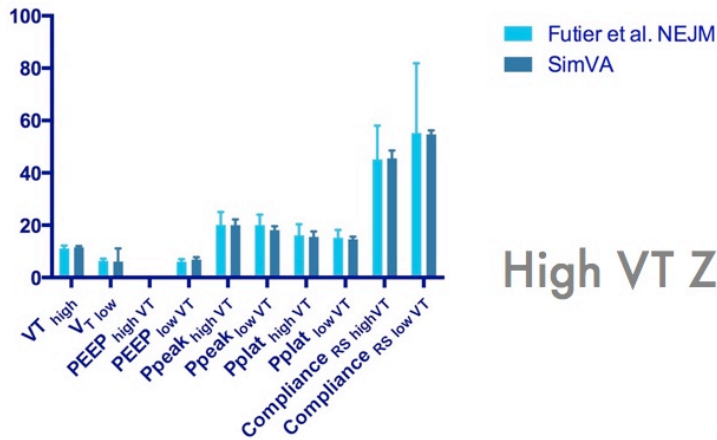
High VT ZEEP vs Low VT PEEP

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Discussion: Plateau pressure and compliance were able to change according to V_T and PEEP settings within the same range as the Improve study from Futier et al.[1] These settings in real patients were able to decrease respiratory complications and post operative patients length of stay in hospital. Simulation with the software SimVA is realistic and may help to teach interactively different intra operative ventilation strategies anywhere anytime without any risk for the patient.

1. *N Engl J Med. 2013;692:428-37*