

Waveform-aided Triggering: a bench study on 5 mechanical ventilators

Dott. ERIC ARISI (1), Dott.ssa ANITA ORLANDO (2), Dott.ssa ROBERTA PUCE (2), Dott. ANDREA BORROMINI (1), Dott.ssa MARTINA PAGLINO (1), Dott.ssa ISABELLA BIANCHI (1), Dott. MARCO POZZI (2), Prof. GIORGIO ANTONIO IOTTI (1)(2), Prof. FRANCESCO MOJOLI (1)(2)

(1) Anesthesia, Intensive Care and Pain Therapy, University of Pavia, Viale Camillo Golgi, 19, Pavia, Italia.

(2) Anesthesia and Intensive Care, Fondazione IRCCS Policlinico S. Matteo, Viale Camillo Golgi, 19, Pavia, Italia.

Argomento: Insufficienza respiratoria acuta e ventilazione meccanica

Introduction: The aim of this study was to evaluate how different waveform-aided triggering systems affect asynchronies in pressure support ventilation (PSV) in a bench setting.

Methods: We tested 5 ventilators: IMT Medical Bellavista 1000, Hamilton Medical G5 and C6, Mindray SV300, Philips V200. An IngMar Medical ASL 5000 Breathing Simulator (Software Version 3.6) simulated 3 different lung mechanics: normal (Compliance (C) 60 ml/cmH₂O, airway resistance (R) 10 cmH₂O/l/s), obstructive (C 90, R 20) and restrictive (C 25, R 10). We tested two respiratory rates (RR 15/min and 30/min), 3 different levels of patient effort (P_{musc} -3, -6 and -12cmH₂O) and two pressure support levels (PS 10 and 20cmH₂O). The ventilators were tested in PSV with the default trigger settings (Inspiratory Trigger Sensitivity (ITS) 2 l/min, Expiratory Trigger Sensitivity (ETS) 25% and default Ramp) and with all the automatic waveform-aided options enabled. Data and waveforms patterns recorded by the ASL 5000 software were analysed with MedCalc (version 18.11 MedCalc Software). From the ASL data we obtained the Trigger Delay (TD), Cycling Delay (CD), the percentages of TD and CD above 300ms, of Early Cycling (EC) above 100ms, of Auto Triggers (AT), Ineffective Efforts (IE) and Double Triggers (DT). A paired t-test was used to compare the means between the Standard and Automatic Trigger on each ventilator.

Results Results are shown in the table as Mean ± SD. We found no DT.

Conclusion Compared to standard trigger, waveform-aided triggering systems show better performances in almost all the tested ventilators, with a reduction of CD and IE. Data show a trend towards the reduction of TD, even if it's not statistically significant for all the ventilators. Waveform-aided systems did not increase AT, whereas in 2 cases EC was more frequent.

	TD (ms)		CD(ms)		TD>300ms (%)		CD>300ms (%)		EC >100ms (%)		IE (%)		AT (%)	
	Std	Auto	Std	Auto	Std	Auto	Std	Auto	Std	Auto	Std	Auto	Std	Auto
Bellavista 1000	146,4 ± 81,6	134,2 ± 75,9	737,7 ± 778,2	249,1 ± 362,9 *	6,6 ± 21,3	4,3 ± 11,3	38,4 ± 48,8	13,5 ± 32,4 *	0	24,3 ± 42,8 *	17,1 ± 26,5	10,7 ± 21,4 *	0,3 ± 1,5	0,1 ± 0,8
C6	150,8 ± 87,5	125,5 ± 78,1*	573,1 ± 697,2	185,6 ± 69,0 *	7,9 ± 20,8	7,0 ± 18,2	34,7 ± 46,9	3,1 ± 8,7 *	8,4 ± 25,4	6,5 ± 20,7	17,1 ± 26,9	3,8 ± 10,1*	0,3 ± 0,9	0,1 ± 0,6
G5	172,9 ± 114,7	111,2 ± 71,3*	489,4 ± 640,4	209,7 ± 85,8 *	12,8 ± 28,3	4,6 ± 17,6 *	29,9 ± 45,4	12,7 ± 29,3 *	12,8 ± 32,6	4,9 ± 16,9 *	15,6 ± 26,3	0,9 ± 4,5 *	0	0
SV 300	209,8 ± 118,5	195,9 ± 116,1	805,8 ± 856,5	1150,7 ± 1350,3 *	23,6 ± 37,0	17,8 ± 30,1	49,2 ± 49,9	39,4 ± 46,8	0	10,7 ± 30,4 *	18,5 ± 27,9	21,2 ± 28,9	0,1 ± 0,4	0,1 ± 0,4
V200	165,7 ± 101,9	172,7 ± 98,3	579,3 ± 680,3	143,8 ± 179,5 *	12,4 ± 31,2	10,4 ± 22,8	33,3 ± 47,5	7,8 ± 25,8 *	10,4 ± 30,0	16,7 ± 37,8	14,9 ± 25,6	9,4 ± 20,5 *	0	0
ALL VENT	169,1 ± 103,2	147,9 ± 94,0 *	637,4 ± 735,2	400,4 ± 750,8 *	12,6 ± 28,7	8,8 ± 21,3	37,1 ± 47,7	15,3 ± 33,3 *	6,3 ± 23,2	12,6 ± 31,8 *	16,6 ± 26,4	9,2 ± 20,2 *	0,13 ± 0,8	0,1 ± 0,5

Data marked with * show a statistically significant difference (p<0.05)