47.

Comparison of Devices Used While Ventilating a Non-Intubated Mannikin Model

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Purpose: The purpose of this study was to determine if there were differences in tidal volume (Vt), minute volume (MV), average mask leak per breath (ML), gastric insufflation (GI), and peak airway pressure (PAP) when ventilating a non-intubated mannikin with a bag-valve (BV), manually triggered ventilator (MTV) and automated ventilator (AV). Our hypothesis was that there would be no differences among devices for any of these variables.

Methods: This was a prospective *in vitro* experimental model. A convenience sample of 19 emergency medical technicians (EMTs) ventilated a non-intubated mannikin-mechanical test lung model with BV, MTV (flow rate 40 L/min; pressure relief 55 cm H_2O), and AV (800 ml/breath; rate 12). Each subject, blinded to volume and pressure gauges, used each device for two minutes at both normal (0.1 cm H_2O) and poor (0.04 cm H_2O) compliances. Vt, MV, GI, and PAP were measured directly and ML was calculated. Data were analyzed with repeated measures ANOVA and Bonferoni-Dunn multiple comparison test with alpha set at 0.05.

Results:

Mean (SD)
0.1 cm H_2O compliance

	BV	MTV	AV
Vt (ml)	886 (262)	775 (153)	724 (153)
MV(L)	10.80 (3.46)#	9.33 (2.33)	7.93 (1.72)
PAP(cm H_2O)	13.90 (4.15)*#	9.91 (2.44)	9.02 (1.77)
ML (cc/breath)	378 (311)	262 (144)	235 (152)
GI (cc/minute)	0	0	0

**p <0.05 for BV vs. MTV* *#p <0.05 for BV vs. AV*

Mean (SD)
0.04 cm H_2O compliance

	BV	MTV	AV
Vt (ml)	642 (184)	598 (151)	655 (75)
MV(L)	8.41 (2.89)	7.60 (2.21)	7.34 (1.04)
PAP(cm H_2O)	20.36 (2.97)*#	17.91 (3.01)	18.07 (1.68)
ML (cc/breath)	531 (410)#	378 (237)	238 (101)
GI (cc/minute)	294 (257)*#	0	0

**p <0.05 for BV vs. MTV* *#p <0.05 for BV vs. AV*

Conclusions: The three devices provided similar volumes when used by EMTs, but BV was associated with higher pressures and with greater mask leak, and gastric insufflation.

49.

Waveform Design Based on Cardiac Electrophysiology Can Improve Transchest Defibrillation

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Introduction: Monophasic defibrillation waveforms are presently the standard of care in clinical use for trans-thoracic defibrillation. Recently, there has been renewed interest in biphasic waveforms. This interest reflects the superior performance demonstrated with biphasic waveforms in implantable defibrillators (ICD). External defibrillation research on two biphasic truncated exponential waveforms has been reported in which the waveforms were compared clinically to a damped sine waveform. A limitation of these transthoracic waveforms is the insufficiency of fundamental design principles used to determine the waveform characteristics.

Methods: We developed design principles to determine the optimal waveform characteristics of an external biphasic truncated exponential waveform based on myocardial cell response model. The cell response model incorporates critical transthoracic elements into a recently published and experimentally validated intracardiac model used to design ICD waveforms. We determined the optimal leading-edge voltage (LEV), phase durations (in milliseconds, Ph1 D, Ph2 D), and delivered energies (ED) for the reported external biphasic waveforms (WF) using the model with 78 W for trans-chest resistance. We compared our results against those reported for the biphasic waveforms.

Results:

Biphasic WF	Reported LEV	Reported Ph1 D	Reported Ph2 D	Reported ED(J)
70 µF	1860	4	4	115
105 µF	1610	7	5	130

Biphasic WF	Optimal LEV	Optimal Ph1 D	Optimal Ph2 D	Optimal ED(J)
70 µF	1690	3.2	1.6	80
105 µF	1450	3.8	1.5	80

Waveform design principles demonstrate a 10% reduction voltage, a 40% to 55% reduction in waveform duration, and greater than a 30% reduction in delivered energy. Similar improvements have been validated clinically for ICD waveforms using these design principles.

Conclusions: Design principles based on cardiac Electrophysiology may provide a means to further reduce the voltages and energies required for safe and effective external defibrillation when using biphasic waveforms.