BODY WEIGHT DOES NOT AFFECT DEFIBRILLATION EFFICACY, RESUSCITATION OR SURVIVAL WITH A 150 J NON-ESCALATING BIPHASIC WAVEFORM DEFIBRILLATOR

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INTRODUCTION

Biphasic waveforms were introduced in automated external defibrillators (AEDs) for transthoracic defibrillation in 1996[1].

Biphasic waveforms had replaced traditional monophasic waveforms for implanted defibrillators because of demonstrated advantages in shock efficacy at lower energies, i.e., lower defibrillation thresholds and a broader safety margin[2-5]. These benefits have led to widespread adoption of biphasic waveforms by the AED industry, so that currently all manufacturers offer a biphasic waveform.

Some biphasic waveform AEDs still utilize the escalating energy protocols and dose levels traditionally implemented in monophasic devices. Questions remain regarding whether these legacy dose schemes are necessary for biphasic waveforms.

This study examines the influence of body weight on defibrillation, resuscitation and survival in patients with out-of-hospital cardiac arrest treated with a non-escalating impedance-compensating 150 J biphasic waveform defibrillator.

METHODS

This study was conducted under Institutional Review Board approval. Out-of -hospital cardiac arrest records from Rochester MN EMS from December 1996 through December 2002 were reviewed.

This EMS system employs fixed low energy biphasic AEDs (ForeRunner, Philips Medical Systems, Seattle, WA) used by first responders (police and fire personnel). Cases were included provided they were of known or presumed cardiac etiology and had shockable initial (presenting) rhythms.

Rhythms were categorized as shockable (ventricular fibrillation or shockable ventricular tachycardia), or non-shockable at 5 seconds post-shock. Five-seconds is the conventional criterion for assessment of shock efficacy, as defined in AHA Guidelines 2000[6]. Discharge survival was defined as OPC 1 or 2.

Body mass index (BMI) was calculated for patients with available data and used to classify subjects as underweight, normal, overweight, obese or extremely obese[7].

Defibrillation and resuscitation outcome variables were examined versus patient weight. Outcome variables included:

- initial shock success
- cumulative two-shock success
- success of the first "stack" of shocks (series of shocks prior to an interval for cardiopulmonary resuscitation (CPR))
- return of spontaneous circulation (ROSC) prior to the administration of advanced life support or cardio-active drugs (BLS ROSC)
- ROSC prior to transfer to the emergency department (Any ROSC)
- survival to hospital admission (Admission)
- survival to hospital discharge (Survival)

RESULTS

Patient weight data was available for 62 of the 68 patients who presented with a shockable rhythm.

The average age was 66 ± 14 years. Eighty-two percent (51) were male. The call to shock time averaged 5.9 ± 1.9 minutes; 85% of the patients had a witnessed arrest.

The average body weight was 84 ± 17 kg, minimum 53 kg, maximum 135 kg and was normally distributed (Figure 1). The mean shock impedance was 90 ± 21 ohms.

Height data was available for 46 patients. BMI was calculated as the weight in kilograms divided by the square of height in meters[7]. Based on BMI for 46 patients, patients were classified as:

- 41% overweight (BMI > 25)
- 24% obese (BMI > 30)
- 4% extremely obese (BMI > 40)
- 31% normal or underweight.

Table 1 contains the overall rates and means and standard deviations of weight for patients with each outcome.

- All patients included in this study were defibrillated. Initial shocks defibrillated 92% [83-97%] (95% confidence interval) of patients (Table 1). Cumulative success with 2 shocks was 98% and with 3 shocks 100%. Only 5 of 62 patients failed to convert on the first shock, and only 1 patient (weight 68 kg) did not convert with 2 shocks.
- First shock success was not related to weight; i.e., unsuccessful shocks were not associated with higher patient weight than successful shocks. Figure 1 shows the distribution of weight values for those patients with successful and unsuccessful first shock conversion.
- Cumulative efficacy through two shocks was unrelated to weight (figure 2), as was cumulative success through the first series of 3 shocks.
- There was no statistically significant effect of patient weight on BLS ROSC (figure 3), Any ROSC (figure 4), Admission (figure 5) or Discharge (figure 6).
- Figure 7 shows the relationship between impedance and weight for this group of patients. The squared correlation coefficient was 0.22 reflecting no substantial relationship.

CONCLUSIONS

In this study, body weight did not affect defibrillation success, resuscitation or survival outcomes. There was no relationship between patient impedance and weight.

With this BTE waveform, defibrillation efficacy was high (Table 1). This is consistent with previous reports in other out-of-hospital studies using this waveform8-10.

The lack of impact of body weight on defibrillation efficacy and resuscitation outcome leads us to conclude there is no need for energy escalation and the risk of dysfunction that comes with higher energies11-13.

The greater efficacy of biphasic waveforms at lower energies than their monophasic precursors, illustrates the shortcoming of simply applying historical escalation protocols to new therapies. The fixed-energy protocol employed by this AED in this BLS-use setting appears appropriate and effective with its impedance-compensated waveform.

Table 1. Effect of Weight on Defibrillation, Resuscitation and Survival

WEIGHT ANALYSIS	OVERALL % [95% confidence interval] n=62	WEIGHT (kg) mean ± std dev Successful/yes	WEIGHT (kg) mean ± std dev Failed/no	P value
1st shock	92 [83-97]	83 ± 17 n=57	88 ± 14 n=5	.74
Cumm 2 shock	98 [92-100]	84 ± 17 n=61	68 n=1	1.0
Stack shock	100 [95-100]	84 ± 17 n=62	n=0	NA
BLS ROSC	37 [25-50]	85 ± 18 n=23	83 ± 16 n=39	.53
Any ROSC	77 [66-87]	84 ± 16 n=48	84 ± 21 n=14	.19
Admission	74 [62-84]	83 ± 16 n=46	85 ± 20 n=16	.30
Discharge	44 [31-57]	86 ± 17 n=27	82 ± 17 n=35	.89

Figure 7.
Correlation between patient weight (kg) and impedance (ohms).

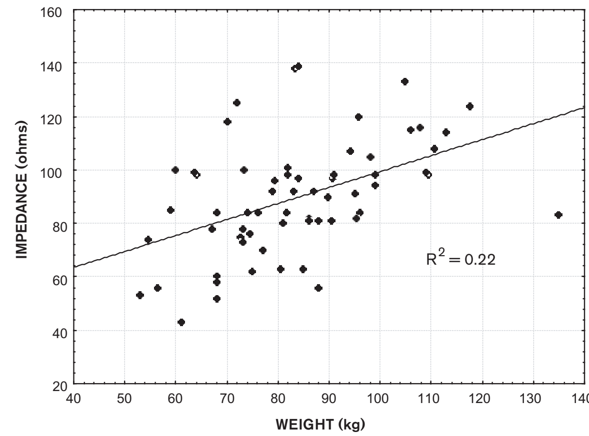


Figure 1.
First shock success/failure versus patient weight.

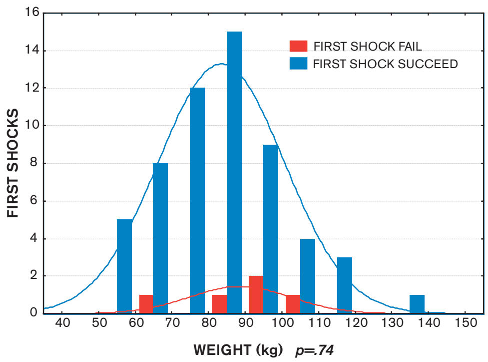


Figure 4.
Any ROSC success/failure versus patient weight.

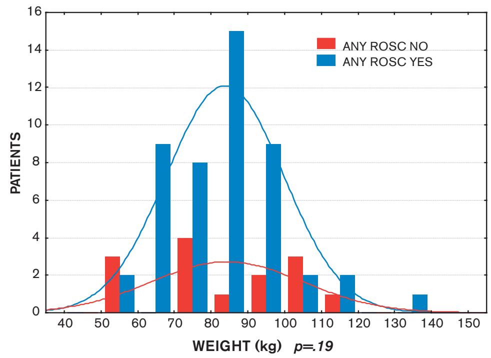


Figure 2.
Cumulative 2 shock success/failure versus patient weight.

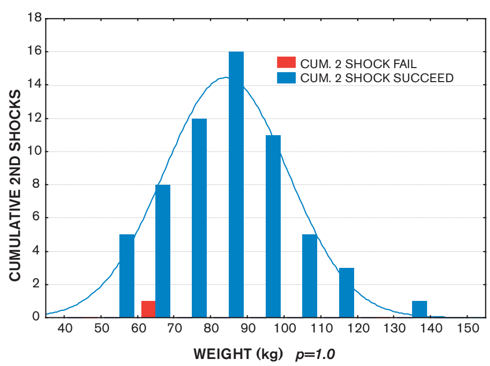


Figure 5.
Admission success/failure versus patient weight.

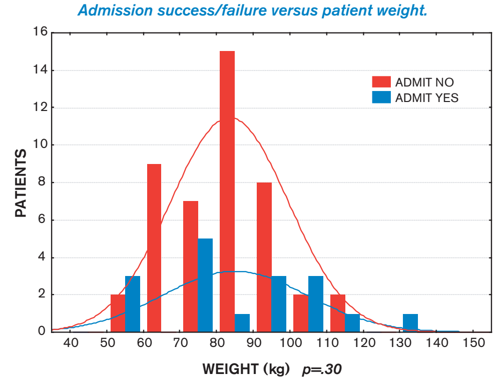


Figure 3.
BLS ROSC success/failure versus patient weight.

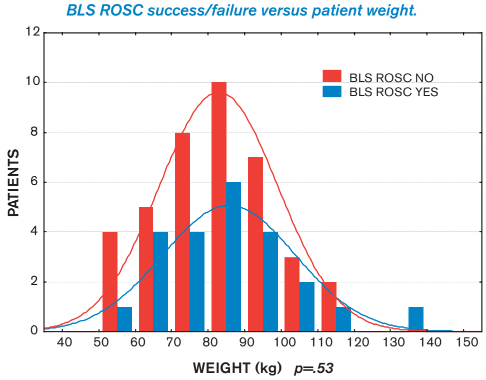
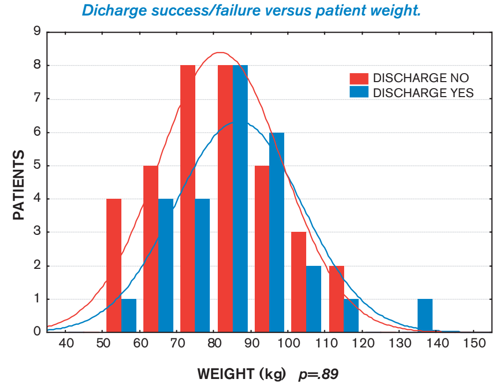


Figure 6.
Dicharge success/failure versus patient weight.



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