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Clinical paper

Body mass index and outcomes of in-hospital ventricular tachycardia and ventricular fibrillation arrest☆

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ABSTRACT

Background: Due to higher transthoracic impedance, obese patients may be less likely to be successfully defibrillated from ventricular tachycardia or ventricular fibrillation (VT/VF) arrest. However, the association between patient body mass index (BMI), defibrillation success, and survival outcomes of VT/VF arrest are poorly understood.
Methods: We evaluated 7110 patients with in-hospital VT/VF arrest at 286 hospitals within the Get With The Guidelines®-Resuscitation (GWTG-R) Multicenter Observational Registry between 2006 and 2012. Patients were categorized as underweight (BMI < 18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), over-weight (BMI 25.0–29.9 kg/m^2), obese (BMI 30.0–34.9 kg/m^2), and extremely obese (BMI ≥ 35.0 kg/m^2). Using generalized linear mixed regression, we determined the risk-adjusted relationship between BMI and patient outcomes while accounting for clustering by hospitals. The primary outcome was successful first shock defibrillation (a post-shock rhythm other than VT/VF) with secondary outcomes of return of spontaneous circulation, survival to 24 h, and survival to discharge.
Results: Among adult patients suffering VT/VF arrest, 304 (4.3%) were underweight, 2061 (29.0%) were normal weight, 2139 (30.1%) were overweight, and 2606 (36.6%) were obese or extremely obese. In a risk-adjusted analysis, we observed no interaction between BMI and energy level for the successful termination of VT/VF with first shock. Furthermore, the risk-adjusted likelihood of successful first shock termination of VT/VF did not differ significantly across BMI categories. Finally, when compared to overweight patients, obese patients had similar risk-adjusted likelihood of survival to hospital discharge (odds ratio 0.786, 95% confidence interval 0.593–1.043).
Conclusions: There was no significant difference in the likelihood of successful defibrillation with the first shock attempt among different BMI categories.

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Introduction

Successful defibrillation of ventricular tachycardia or ventricular fibrillation (VT/VF) requires adequate delivery of transcardiac current.[1] In obese patients, the extent of transcardiac current may be reduced by higher transthoracic impedance,[2] leading to lower rates of successful defibrillation. However, studies are lacking to inform the relationship between obesity, defibrillation success, and survival outcomes of VT/VF arrest.

Some studies have argued for use of higher defibrillation energies to overcome higher transthoracic impedance in obese patients and increase rate of successful defibrillation.[2–4] Other studies suggest that biphasic defibrillators can overcome the influence of transthoracic impedance on defibrillation success.[5,6] As a result, the optimal energy for first shock of VT/VF in relation to BMI remains uncertain.

Using data from the Get With The Guidelines Resuscitation® (GWTG-R) registry, we sought to determine the association between body mass index (BMI) and patient outcomes of in-hospital VT/VF arrest. The present study primarily sought to

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determine whether obese patients (BMI ≥ 30 kg/m^2) require higher initial biphasic energy for defibrillation success, and secondarily, whether the differences in first shock success impact survival outcomes. We hypothesized that patients with increased BMI would require higher energies for success of defibrillation and therefore have a lower rate of risk-adjusted first shock termination of VT/VF after accounting for shock energy. As a result of less successful defibrillation, we anticipated patient outcomes including return of spontaneous circulation (ROSC) ≥20 min, 24-h survival, and survival to discharge would be lower in obese patients.

Methods

Source of data

We used data from the Get With The Guidelines Resuscitation® (GWTG-R) Multicenter Observational Registry – previously called The National Registry of Cardiopulmonary Resuscitation (NRCPR). GWTG-R® is an American Heart Association (AHA)-sponsored, prospective, multisite, observational registry of in-hospital resuscitation and is currently the largest registry of its kind.[7] Data on patients suffering in-hospital cardiac arrest (including apnea, absence of pulse, and unresponsiveness) are abstracted by specially trained research personnel at participating hospitals. Cardiopulmonary resuscitation events beginning outside of the hospital and patients with prior do-not-resuscitate (DNR) orders are not included in the registry. The source of information is the hospital medical records excluding specific patient identifiers. Each patient is assigned a unique code and data collection follows the Utstein in-hospital guidelines which include the following major categories of defined facility data; patient demographic data, pre-event data, event data, outcome data, and quality improvement data.[8] Collection of data on patient height and weight, important to our analysis, began in January 2006.

Patient population

We identified 35,549 adults suffering in-hospital VT/VF cardiac arrest at 286 hospitals participating in GWTG-R® from 2006 to 2012. As biphasic waveform defibrillators dominate current resuscitation practice (>95% of in-hospital defibrillation in U.S. practice[9]), we limited our analysis to the 13,928 (39.2%) patients receiving an initial shock with a biphasic waveform defibrillator. Sample size is further reduced because of missing data on key variables including BMI leaving 7110 (64.8%) to be analyzed. Details are given in Fig. 1.

Exposure measure

Patients were categorized according to World Health Organization (WHO) classification of BMI including underweight (BMI < 18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), obese (BMI 30.0–34.9 kg/m^2), and extremely obese (BMI ≥ 35.0 kg/m^2).[10] Shock energy levels were categorized as 100–150 J, 150–200 J, and 200–360 J.

Outcome measures

The primary outcome was first shock termination of VT/VF defined as any immediate post-shock rhythm other than VT/VF. This electrical outcome measure most closely reflects the effect of the shock without participation of other factors and is consistent with prior studies of defibrillation effectiveness.[11,12] Secondary outcome measures included ROSC ≥ 20 min, survival to 24 h, and survival to discharge.

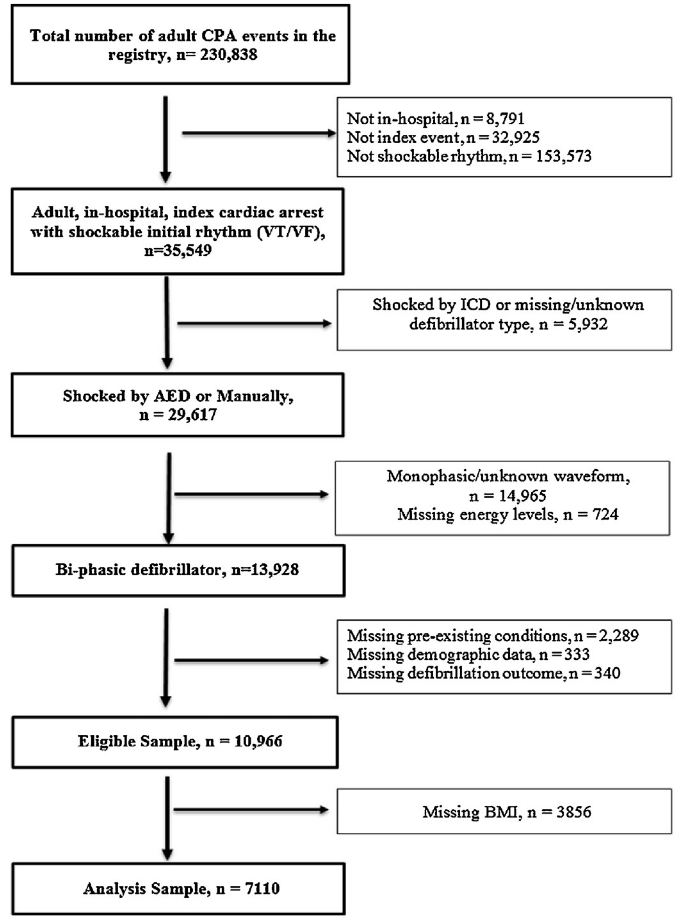

Fig. 1. Study cohort. AED, automated external defibrillator; VF, ventricular fibrillation; VT, pulseless ventricular tachycardia.

Statistical analyses

Patient characteristics across BMI categories were compared using analysis of variance (ANOVA) for continuous variables and chi-square analyses for categorical variables. The likelihood of successful termination of VT/VF with the first defibrillation attempt was evaluated using a generalized linear mixed regression model with a compound symmetry correlation structure in order to adjust for patient arrest characteristics and comorbidities, while also accounting for possible clustering of patients within the same institution. The independent variables consisted of BMI category and energy levels. To assess if the likelihood of successful defibrillation simultaneously depends on BMI category as well as energy levels, the interaction effect of BMI category and energy level was also included in the model. Based on clinical reasoning and existing literature, all models were adjusted for patient age in years, gender, race, illness category (medical cardiac, surgical cardiac, medical non-cardiac, surgical non-cardiac, and trauma), time to first shock ≤2 min, and other comorbid conditions (congestive heart failure [CHF] during the current admission, CHF during any prior admission, myocardial infarction [MI] during current admission, MI during any prior admission, arrhythmia, hypotension or hypo-perfusion, respiratory insufficiency, renal insufficiency, hepatic insufficiency, metabolic electrolyte abnormality, diabetes, baseline depression in central nervous system [CNS] function, acute stroke, acute CNS non-stroke event, major trauma, metastatic or hematologic malignancy, and other infections such as pneumonia or septicemia). Based on the results of a recent BMI-focused in-hospital cardiac arrest study,[13] the