

Midwest Surgical Association

Obesity in trauma: outcomes and disposition trends

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KEYWORDS:

Obesity;
Wounds and injuries;
Body mass index;
Blunt trauma;
Fall;
Motor vehicle collision

Abstract

BACKGROUND: Obesity's effect on the outcomes of trauma patients remains inconclusive.

METHODS: A retrospective review of all falls, motor vehicle collisions (MVCs), and penetrating trauma patients admitted from January 2008 to December 2012 was performed. The outcomes evaluated included mortality, length of stay at hospital, and discharge disposition. Patients were grouped according to the body mass index (BMI) and stratified by injury severity scores.

RESULTS: Two thousand one hundred ninety six patients were analyzed; 132 penetrating, 913 falls, and 1,151 MVCs. Penetrating traumas had no significant difference in outcomes. In falls, obese patients had a lower mortality ($P = .035$). In MVCs, obese patients had longer hospitalizations ($P = .02$), and mild and moderate MVC injuries were less likely to be discharged home ($P = .032$ and $.003$). Obese patients sustained fewer head injuries in falls and MVCs ($P = .005$ and $.043$, respectively).

CONCLUSIONS: In falls, a higher BMI may benefit patients. However, an increasing BMI is associated with a longer length of stay at hospital, and decreased likelihood of discharge to home.

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The increasing prevalence of obesity in modern society poses special problems in trauma. Much of the literature suggests an increase in mortality and morbidity among hospitalized obese patients.^{1,2} This difference is attributed to impaired mobility, longer hospitalizations, higher incidence of respiratory complications, higher venous thromboembolic events, and higher nosocomial infection rates.^{1,2} The risk of poorer outcomes may be aggravated by the need for special equipments and technical difficulties in performing procedures related to body habitus.¹ However, the current literature on the effect of obesity on trauma population remains inconclusive, with some articles showing that obese patients have a higher mortality,³⁻⁶ while others

found no difference in mortality.⁷⁻⁹ In one study on high-energy blunt trauma comparison, the obese patients were found to have a lower mortality.¹⁰

Although the effect of obesity on mortality remains inconclusive, there seems to be relatively consistent differences in the injury patterns affecting the obese patients compared to nonobese patients. Obese trauma patients sustain fewer liver injuries, mandibular fractures, and cerebral injuries, but more pelvic fractures, rib fractures, and lower extremity fractures.⁸ Others have demonstrated a similar pattern, of fewer head injuries, but more chest injuries, and lower extremity injuries.⁷

It is difficult to interpret the body of literature on the interaction between obesity and trauma, in which articles vary widely in patient selection, stratification, and definition of outcomes. In an effort to perform a systematic review (unpublished), we note that some articles report the injury severity score (ISS) as patient characteristic, to assess whether clinical outcomes are different for matched injuries. However, if obesity is to be assessed as a risk factor for specific injuries, the ISS should more

The authors declare no conflicts of interest.

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Manuscript received July 16, 2013; revised manuscript October 19, 2013

appropriately be treated as an outcome measure. Some studies focus on specific injury mechanisms, such as penetrating, or blunt trauma and some further specify subsets of blunt mechanisms according to the energy of impact, while others fail to distinguish the mechanism of injury into separate analyses. Articles that focus on intensive care unit (ICU) patients tend to have rigorously documented clinical data, while most other articles exclude a large portion of their trauma patients because there is not enough information available to calculate the BMI. Additionally, much of the contemporary literature varies in the method of stratifying obesity into consistently defined cohorts according to body mass index (BMI). The National Institute of Health (NIH) defines the BMI according to the following scheme: BMI 18.5 to 24.9 = Normal weight; 25.0 to 29.9 = Overweight; 30.0 to 39.9 = Obese; and 40.0 and above = Extreme obesity.¹¹ Some articles utilize a BMI above 27 to identify obesity and most fail to distinguish underweight patients from normal patients, which might obscure findings when comparing rates of adverse outcomes.^{1,3-6}

The purpose of this article is to examine original data from the trauma registry of a state-designated Level I trauma center to compare the outcomes and injury patterns in patients stratified by mechanism of injury, body mass index, and ISS.

Methods

A retrospective review of our prospective trauma registry at a state-designated, micro urban, Level I trauma center was used as the primary data source, on the basis of an institutional review board approved protocol. All trauma patients admitted between January 2008 and December 2012 were screened. Patients were excluded if they were under the age of 18 years, pregnant, or sustained burns. All patients who did not have a height, weight, and ISS documented in the registry were also excluded. Three groups were defined according to the mechanism of injury: penetrating trauma, blunt trauma secondary to motor vehicle collision (MVC), and blunt trauma secondary to falls. Patients injured by fall were confined to those who fell from a height of <1 story and included falls from standing, falls from sitting, and fall down <1 flight of stairs. Patients included in the motor vehicle collision (MVC) category included automobiles, motorcycle collisions, snowmobiles, and all-terrain vehicles. These were grouped as high-energy injuries. Patients were then stratified by BMI according to the NIH classification system. Additionally, patients whose BMI was <18.5 were extracted into a separate group for comparison. Data extracted included the following: age, sex, ISS, mechanism of injury, list of injuries (injury pattern), length of stay (LOS), discharge disposition, complications, and mortality.

Patients in each mechanism group were initially stratified as obese or nonobese based on a BMI of <30 versus >30 and were compared for injury patterns, complications, LOS, discharge disposition, and mortality rates. The same outcomes

were then analyzed in blunt trauma patients, distinguishing between those injured by MVC or falls, after further stratification into the 4 BMI groups defined by NIH. Subsequently, patients with MVC or fall mechanisms were stratified into a matrix by BMI and ISS to analyze LOS, disposition, and mortality. Injury severity was stratified by the ISS as follows: Mild <9; Moderate 9 to 14; Severe 15 to 25; and Critical >25.

Categorical variables were compared using a chi-square analysis and the Cochran–Armitage trend test. Continuous variables were compared using the independent *t* test and Pearson correlation test. Multivariate regression analysis of the mortality rate with respect to age, ISS, Glasgow coma scale (GCS), and BMI was also performed. All statistical comparisons were performed with SAS 9.2 (SAS Institute, Inc, Cary, NC), Microsoft Excel 2011 (Microsoft Corporation, Redmond, Washington), and with consultation with an academic statistician.

Results

The trauma registry contained 3,768 patients for the time period reviewed. Of these, 1,572 required exclusion by age, pregnancy, burn, or incomplete specification of height, weight, and ISS. The remaining 2,196 (58.3%) patients constitute the subjects of this analysis. Of the 1,151 patients injured by MVC, 381 (33.1%) were obese. Of the 913 patients injured by fall, 233 (25.4%) were obese. Of the 132 patients with penetrating injuries, 42 (31.8%) were obese (Fig. 1).

Effect of obesity in patients with penetrating injury

In the penetrating injury group, chi-square analysis of obese versus nonobese patients demonstrated no difference in the mortality rate, LOS, or rate of discharge to home. Patients were subsequently stratified into 5 groups of BMI as follows: Underweight <18.5, Normal 18.5 to <25, Overweight >25 to 29.9, Obese \geq 30 to 39.9, Morbidly obese \geq 40; and into 4 groups by ISS as follows: Mild <9, Moderate 9 to 14, Severe 15 to 25, and Critical >25. The Cochran–Armitage trend test confirmed that no difference in the mortality rate, LOS, or rate of discharge to home was found in the penetrating trauma group at any level of stratification. There was no difference in the injury pattern or complications based on BMI in the penetrating trauma patients. Because of the relatively few obese patients with penetrating injury, the subsequent focus of this analysis is on the group of patients who sustained blunt trauma.

Effect of obesity in patients with blunt trauma from motor vehicle crash

Among the 1,151 patients injured by MVC, there was no difference in age or gender distribution between those with a BMI <30 or the obese patients. There was no difference in the overall mortality between the obese and nonobese

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