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Overweight and Obesity does not Increase Severity of Pulmonary Embolism

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Abstract

Obesity defined as body mass index (BMI) ≥30 kg/m^2 has been shown to be a risk factor and a prognosticator in many populations. Whether obesity is specifically a prognosticator for pulmonary embolism is not well known. In the present study, 194 patients with BMI between 14 and 88 kg/m^2 (44% males mean age 59 ± 18 years, median BMI 30.3 kg/m^2) who were diagnosed with PE were included in this cross-sectional study. The logistic regression analysis showed that being overweight or obese (defined as BMI>25 kg/m^2) was an independent variable predicting being in a low-risk group with OR of 2.39 (95% confidence interval 1.10, 5.21) and p value of 0.028. Paradoxically, overweight or obese patients with PE have better prognostic outcomes compared to underweight or normal weight patients defined by the simplified PESI (sPESI) which is commonly used to estimate the risk of 30-day mortality in patients with acute pulmonary embolism (PE) in our study.

Keywords: Overweight; Pulmonary embolism; Severity of pulmonary embolism

Introduction

Pulmonary embolism (PE) is a common life threatening condition in daily practice. Incidence of PE has been reported to be 112.3 cases per 100,000 patients [1,2]. Several prognostic models have been examined in patients with acute PE. The Pulmonary Embolism Severity Index (PESI) and the simplified PESI (sPESI) are among the most well studied models. sPESI scoring system is shown in Table 1. Other prognosticators in acute PE are troponin, B-type natriuretic peptide (BNP), and serum sodium level.

Obesity is a one of the most common healthcare problems worldwide. Prevalence of obesity has been rising each year [3]. Obesity has been shown to be a risk factor and prognosticator in different diseases or conditions [4,5]. However, whether obesity has some prognostic value in acute PE has not been well reported.

From Simplification of the Pulmonary Embolism Severity Index for Prognostication in Patients With Acute Symptomatic Pulmonary Embolism

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		Score
Variable	Original PESI[a]	Simplified PESI[b]
Age > 80 yrs	Age in Years	1
Male Sex	+10	
History of Cancer	+30	1
History of Heart failure	+10	1[c]
History of Chronic lung disease	+10	
Pulse ≥ 110 beats/min	+20	1
Systolic blood pressure < 100 mm Hg	+30	1
Respiratory rate ≥ 30 beats/min	+20	
Temperature < 36°C	+20	
Altered mental Status	+60	
Arterial oxyhemoglobin saturation level < 90%	+20	1

[a]A total point score for a given patient is obtained by summing the patient's age in years and the points for each predictor when present.
The score corresponds with the following risk classes: 65 or less, class I; 66 to 85, class II; 86 to 105 class III; 106 to 125, class IV; and more than 125, class V. Patients in risk classes I and classes II are defined as being at low risk.
[b]A total point score for a given patient is obtained by summing the points. The score corresponds with the following risk classes: 0 low risks; 1 or more, high risk. Empty cells indicate that the variable was not included.
[c]The variables were combined into a single category of chronic cardiopulmonary disease.

Table 1: Original and simplified Pulmonary Embolism Severity Index (PESI).

Materials and Methods

The goal of this study was to examine whether being overweight and/or obese is associated with severity of pulmonary embolism using sPESI as a surrogate marker. In this retrospective cross-sectional study, 194 patients who were hospitalized with the diagnosis of pulmonary embolism between January 2005 and January 2013 were included. Clinical data was collected. Patients were categorized into "Lower severity group" if sPESI > 0 and "Higher severity group" if sPESI ≥ 0. Studied variables were examined in each group. Our primary studied variable was overweight and obesity defined by BMI>25 kg/m^2 and >30 kg/m^2 respectively by WHO criteria. Underweight was determined if BMI<18.5 kg/m^2. Secondary variables are oral hormonal contraceptives use, corrected serum calcium, serum sodium, hemoglobin, white blood cell count, platelet count and serum creatinine. Data was described in frequency and percentage for categorical variables, mean ± standard deviation for normally-distributed interval variables and median with range for interval variables with skewed distribution. Statistical analyses were performed with Pearson's chi square test, Student's t-test, Mann-Whitney test and univariate/multivariate logistic regression analysis. Statistical significance was set at p value less than 0.05 as p≤0.05.

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	All patients N = 194	Lower severity group N= 75	Higher severity group N = 119	p value
Age (year)	59 ± 18	49 ± 15	66 ± 17	<0.001
Male	86 (44.3%)	35 (46.7%)	51 (42.9%)	0.60
Median sPESI (range)	1 [0-4]	0	1 [1-4]	<0.001
History of malignancy	33 (17.0%)	0 (0)	33 (27.7%)	<0.001
History of CHF	9 (4.6%)	0 (0)	9 (7.6%)	0.015
History of CAD	31 (16.0%)	0 (0)	31 (26.1%)	<0.001
History of CLD	33 (17.0%)	0 (0)	33 (27.7%)	<0.001

Table 2: Baseline characteristics of the study population categorized by severity of PE
Data described in mean ± SD, median [range] and frequency (percentage). CHF-congestive heart failure, CAD-coronary artery disease, CLD-chronic lung disease.

	All patients N = 194	Lower severity group N = 75	Higher severity group N = 119	p value
Mean body weight (kg)	93.9 ± 34.3	100.7 ± 34.1	89.7 ± 33.8	0.03
Mean height (centimeter)	169 ± 11	171 ± 11	167 ± 10	0.01
Mean BMI (kg/m^2)	32.9 ± 11.7	34.4 ± 11.5	32.0 ± 11.8	0.18
Underweight	2(1%)	0(0)	2(1.7%)	0.26
Normal weight	40 (20.6%)	10 (13.3%)	30 (25.2%)	0.05
Overweight/Obesity	152 (78.4%)	65 (86.7%)	87 (73.1%)	0.03
OCP use	6 (3.1%)	5 (6.7%)	1 (0.8%)	0.02
Surgery-related event	65 (33.5%)	24 (32%)	41 (34.5%)	0.72
Corrected serum calcium (mg/dl)	9. ± 0.8	8.98 ± 0.6	9.04 ± 0.8	0.11
Serum sodium (mg/dl)	138.4 ± 3.7	138.5 ± 2.8	138.4 ± 4.2	0.55
Serum creatinine (mg/dl)	1 [0-13]	1 [0-8]	0.99 [0-13]	0.72
Hemoglobin (g/dl)	11.9 ± 2.3	12.6 ± 2.2	11.5 ± 2.3	<0.001
WBC counts (10^9/l)	8.9 [3-28]	8.9 [4-18]	8.9 [3-28]	0.56
Platelet counts (10^9/l)	211 [22-550]	225 [22-504]	210 [37-550]	0.51
Hospital stay (days)	5 [1-180]	3 [1-50]	6 [1-180]	0.001

Table 3: Studied variables categorized by severity of PE.
Data described in mean ± SD, median [range] and frequency (percentage). OCP-oral contraceptive pills, WBC-white blood cell.

Results

Patient characteristics

Our cohort comprised of 44% males with a mean age of 59 ± 18 years. There were 75 patients (39%) in lower severity group. The demographic and clinical features are listed in Table 2. Patients in the lower severity group were younger (49 ± 15 years *vs.* 66 ± 17 years; p<0.001) and none of them had history of malignancy, congestive heart failure (CHF), coronary artery disease (CAD) or chronic lung diseases (CLD). Both groups were comparable in gender (47% male *vs.* 43% male; p=0.60).

Study variables

For overall cohort, median BMI was 30.3 kg/m^2 with a range between 14 and 88 kg/m^2. Clinical features and laboratory tests are summarized in Table 3. More than three quarter of the patients was overweight or obese. Compared to the lower severity group, those with higher severity of PE were less likely to be overweight or obese (p=0.03), less likely to use oral contraceptive pills (OCP) (p=0.02), have lower hemoglobin (p<0.001) and stay longer in the hospital (p=0.001). There were no statistically significant differences in frequency of surgery-related event, corrected serum calcium level, serum sodium level, serum creatinine level, white blood cell (WBC) counts and platelet counts. Being overweight or obese is an independent variable for having lower severity of PE defined as zero sPESI with an odd ratio of 2.4 and 95% confidence interval of 1.1 to 5.2 (p=0.028) in univariate logistic regression analysis.

Discussion

In this present study, we used a sPESI to categorize patients. It is a new easy-to-use clinical prognostic assessment tool for PE that has been shown to effectively predict all-cause and PE-related mortalities as well as serious adverse events. The simplified PESI has similar prognostic accuracy and clinical utility and greater ease of use compared with the original PESI but is less complicated than the original PESI. A total point score of zero indicates a low risk for mortality, while a score of one or more indicates a high risk. Those who were classified as low risk by the simplified PESI had a 30-day mortality of 1.0% (95% CI, 0.0%-2.1%) compared with 10.9% (8.5%-13.2%) in the high-risk group.

Obesity is a worldwide problem. Body mass index (BMI) is a simple tool that is commonly used to classify overweight and obesity in adults. By WHO definition, individual with a BMI greater than or equal to 25 are overweight and those with a BMI greater than or equal to 30 are obese. Being overweight is found to be independent risk factor for poor outcome of many chronic illness conditions [4,5]. There are many studies looking at the association between obesity and outcome in intensive care unit patients and the finding is still controversial. Some studies found that individuals with obesity had higher mortality [6-9] and others reported that obesity had no effect [10]. In contrast, there is a recent single large cohort study showed the paradoxical result that being overweight and obesity improved survival both 30 days and 1 year after ICU admission in adult patients [11]. Being overweight was also found to have a protective effect in many chronic illness such as heart failure and chronic kidney disease [11,12]. The exact mechanism remains unclear however many hypotheses have been proposed. The increase of adipocyte size and cell numbers in obesity is believed to produce higher levels of anti-inflammatory response and promote wound healing during critical illness [13-15]. We found that being overweight or obese is negatively associated with poor outcome defined by sPESI.

In our study, we found that overweight or obese patients with PE have better prognostic outcomes compared to underweight or normal weight patients defined by sPESI. This finding is consistent with prior studies of hospitalized patients showing mortality benefit [16-19]. The factors such as nutritional reserve might play major role in these groups of patients.

Interestingly, we found that oral contraceptive pill (OCP) is also possible use as a prognosticator in severity of PE. The mechanism of hormones lead to a prothrombotic state is not clearly understood. Women taking OCP may develop activated protein C resistances which will increase thrombotic risk [20] and lead to larger and multiple clots in PE patients. However it is hard to compare groups using OCP considering the high risk group only had one individual and the overall percentage within population was so small.

In our study, we also found that hemoglobin (Hb) level was an independent predictor for higher severity of PE (Hb level less than 13 g/dl in men and 12 g/dl in women). This finding was the same in a previous study which showed that PE patients with low Hb have a higher risk for fatal PE and poor survival rate at three months [21]. The Lower Hb may be associated with recent bleeding, an impaired hemodynamic profile and higher creatinine therefore patients with low Hb would have unstable vital signs and overall poor functional status than those with higher Hb.

In summary, our study found that overweight and obese patients have less severity of acute PE by using sPESI. This finding is similar to previous studies which showed the protective effect of obesity in ICU patients and the chronically ill. However, our study is pilot study and has limitations. Further study is needed to determine for better understanding of mechanism whether overweight has protective effect in survival rate and severity in acute PE in the future.

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