ORIGINAL ARTICLE

Are trauma victims with obesity lucky in penetrating trauma injuries?

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ABSTRACT

BACKGROUND: We aimed to reveal the protective effect of body mass index (BMI) and subcutaneous adipose tissue thickness (SATT), together with scores covering the abdomen, in patients with penetrating abdominal trauma.

METHODS: The data of 234 abdominal penetrating trauma patients over the age of 16 who applied to the emergency general surgery unit of Istanbul Medipol Hospital between 2017 and 2021 were analyzed retrospectively. Sex, age, types of penetrating injuries, BMI, need for blood transfusion and intensive care unit (ICU), mortality, Injury Severity Score (ISS), Penetrating Abdominal Trauma Index (PATI), and Flint Colon Injury Score (FCIS) were recorded.

RESULTS: The patients were divided into two groups: Gunshot Wound (GW) and Stab Wound (SW).While there was no significant difference in all parameters examined in all patients and GW patients in terms of BMI, a statistically significant difference was found in terms of blood transfusion need in SW patients (p=0.035). As a result of the Receiver Operating Characteristic curve analysis for the SATT variable, the cutoff value between mortality (p=0.866) and SATT (mm) values in all patients was 11 mm for all patients and 12 mm for GW patients. A significant difference was found in all patients and separately in GW and SW groups in terms of ICU and blood transfusion need, length of stay, ISS, PATI, and FCIS scores in non-operated patients (p<0.05). When all patients were examined, a statistically significant difference was found in terms of mortality (p=0.002).

CONCLUSION: It is the first study to evaluate penetrating abdominal injuries with both BMI and SATT comprehensively and with all abdominal scores. A cutoff value to be determined for SATT with larger and multicenter studies can take its place as a parameter in the penetrating trauma algorithm.

Keywords: Body mass index; penetrating trauma; subcutaneous adipose tissue.

INTRODUCTION

Obesity, as characterized by the World Health Organization,[1] has emerged as a pervasive non-communicable epidemic. It is well-documented that individuals afflicted by obesity face an elevated risk of comorbidities, including cancer, hypertension, heart diseases, diabetes mellitus, hyperlipidemia, and arthritis. Consequently, their overall mortality risk surpasses that of their non-obese counterparts. Extensive research has been dedicated to exploring the intricate relationship between obesity and these chronic diseases. However, the impact of obesity on traumatic injuries has not received commensurate attention in the medical literature.

In certain studies, obesity has been identified as an independent risk factor, particularly in the context of high-energy blunt trauma.[2] Nevertheless, the findings from diverse investigations comparing obese and non-obese trauma patients have yielded conflicting results. Some assert that obesity heightens the risk of mortality, while others contend that there is no significant disparity.[3]

Penetrating abdominal trauma, a subset of traumatic injuries, predominantly involves the small intestine as the most frequently injured organ, followed by the large intestine. Among

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the segments of the large intestine, the transverse colon sustains the highest incidence of injuries, trailed by the left colon and the right colon. Importantly, the severity of colonic injury exhibits a direct correlation with the degree of contamination, which, in turn, is linked to the systemic inflammatory response syndrome-multiorgan failure syndrome cascade.[4]

It is noteworthy that in the realm of penetrating abdominal trauma, the protective role of subcutaneous adipose tissue has garnered increasing attention. This adipose tissue can act as a protective barrier against trauma, with potential implications, particularly in obese patients. A noteworthy study comparing obese and non-obese trauma patients concerning mortality rates has suggested that obese individuals may experience a lower mortality rate, potentially attributed to the presence of excess adipose tissue.[5]

In light of these considerations, this study aims to elucidate the protective effects of body mass index (BMI) and subcutaneous adipose tissue thickness (SATT), in conjunction with abdominal scoring systems, among patients afflicted with penetrating abdominal trauma. By examining these variables, we seek to contribute to the growing body of knowledge on this critical topic, shedding light on the role of obesity in the context of traumatic injuries.

MATERIALS AND METHODS

Study Design

This retrospective study involved the comprehensive analysis of abdominal penetrating trauma patients aged 16 and above, who presented to the emergency general surgery unit of Istanbul Medipol Hospital during the period from 2017 to 2021. A total of 234 patients were included in this study. Patient data, encompassing their medical records, were meticulously reviewed and subsequently categorized into two distinct groups: Gunshot Wound (GW) and Stab Wound (SW). Key parameters, such as BMI and SATT, were derived from abdominal tomographic images for both the GW and SW groups.

Measurement of BMI and SATT

BMI was calculated for each patient by dividing their weight in kilograms by the square of their height in meters (kg/m^2). The patients were examined under the following six categories based on their BMI scores:

- Underweight (<18.5)
- Healthy weight (18.5–24.9)
- Overweight (25–29.9)
- Obesity Class I (30–34.9)
- Obesity Class II (35–39.9)
- Obesity Class III (>40).

SATT was meticulously measured in millimeters (mm) using axial plane abdominal computed tomography (CT) images. Specifically, SATT was calculated by measuring the distance from the middle part of the right rectus muscle to the skin in sections passing through the umbilicus on the axial plane abdominal CT images.[6]

Data Collection and Evaluation

In this study, we collected and evaluated a comprehensive set of parameters for all patients, including gender, age, length of hospital stay, the necessity for intensive care unit (ICU) hospitalization, requirement for blood transfusion, direct transfer from the emergency room to the operating room, mortality rate, Injury Severity Score (ISS), penetrating Abdominal Trauma Index (PATI), and Flint Colon Injury Score (FCIS).

1. ISS: The ISS is a widely accepted scoring system that quantifies the overall severity of trauma based on the anatomical regions of the body that are affected. It is calculated by summing the squares of the highest Abbreviated Injury Scale scores from three different body regions.
2. PATI: The PATI is a specific scoring system designed to assess the severity and predict outcomes of penetrating abdominal trauma. It takes into account various factors such as the location and extent of injury, vascular injuries, and associated injuries within the abdomen.
3. FCIS: The FCIS is a scoring system specifically focused on evaluating colonic injuries in trauma patients. It considers the location and extent of colonic injury to predict patient outcomes.

Exclusion and Inclusion Criteria

Patients were excluded from the study if they met any of the following criteria: Age ≤16 years, missing data in their medical records, non-abdominal trauma, pregnancy, or COVID-19-positive status. Inclusion criteria comprised patients aged 16 and above who had undergone CT imaging upon emergency admission and had complete height and weight data available in their medical records.

Ethical Considerations

This study was conducted by ethical guidelines and was approved by the İstanbul Medipol University Ethics Committee, with approval number E-10840098-772.02-2991, granted on June 23, 2021.

Statistical Analysis

SPSS 23.0 package program was used for the statistical analysis of the data. Categorical measurements were summarized as numbers and percentages, and continuous measurements as mean, deviation, and minimum-maximum. Conformity to normal distribution was examined using the Shapiro–Wilk test. The Chi-square test and Fisher's tests were used to compare categorical variables. Mann–Whitney U-test was used for pairwise analysis in groups that did not fit a normal distribution, and Kruskal–Wallis tests were used for the analysis of more than two groups. Post hoc Tamhane's T2 test was used for multiple comparisons and analyzes of heterogeneous groups. The sensitivity and specificity values to the SATT (mm) value were calculated based on the mortality variable of the patients included in the study, and the cutoff value was determined by examining the area under the Receiver Operating Characteristic (ROC) curve. The statistical significance level was taken as 0.05 in all tests.

RESULTS

A total of 234 patients were included in the study, 44 of which were GW and 190 were SW. The differences between the parameters related to the GW and SW groups of the patients included in the study were examined in Table 1. In the examination, it was determined that the patient's sex (p=0.292), age (p=0.065), and SATT (mm) (p=0.196) findings of the patients were comparable between the GW and SW groups.

BMI classification of the patients in the GW group, including gender (p=0.776), operation history (p=0.204), primary repair (p=0.425), stoma application (p=0.327), anastomosis ap-

Table 1. Examining the differences between parameters related to GW and SW groups

	Gunshot wound (n=44) n (%)	Stab wound (n=190) n (%)	p
Gender			
Male	42 (95.5)	172 (90.5)	0.292[a]
Female	2 (4.5)	18 (9.5)	
BMI Classification			
Underweight (<18.5)	5 (11.4)	44 (23.2)	0.083[a]
Normal (18.5-24.9)	12 (27.3)	51 (26.8)	NA[a]
Overweight (25-29.9)	9 (20.5)	53 (27.9)	0.314[a]
Class I obese (30-34.9)	5 (11.4)	33 (17.4)	0.330[a]
Class II obese (35-39.9)	6 (13.6)	9 (4.7)	0.030[*,a]
Class III obese (>40)	7 (15.9)	-	<0.001[**,a]
Operation	36 (81.8)	64 (33.7)	<0.001[**,a]
Primer repair	17 (47.2)	29 (46)	NA[a]
Stoma application	10 (27.8)	1 (1.6)	<0.001[**,a]
Anastomosis application	17 (47.2)	4 (6.3)	<0.001[**,a]
Direct surgery from the emergency room	10 (22.7)	14 (7.4)	0.002[**,a]
ICU need	17 (38.6)	24 (12.6)	<0.001[**,a]
Blood transfusion needs	20 (45.5)	26 (13.7)	<0.001[**,a]
Mortality	6 (13.6)	1 (0.5)	<0.001[**,a]
	Mean ± SD	Mean±SD	p
	Med (Min-Max)	Med (Min-Max)	
Age	32.3±11.6	29.1±10.7	0.065b
	31 (17-67)	26.5 (16-75)	
BMI	28.6±9.5	24.3±6.9	0.012[*,b]
	26.5 (10.8-48.8)	24.9 (10.1-37.6)	
ISS	24.1±19.3	6.91±8.6	<0.001[**,b]
	17 (4-75)	4 (1-75)	
PATI	21.2±16.5	3.76±6.3	<0.001[**,b]
	20 (1-79)	1 (1-60)	
FCIS	1.09±0.9	0.22±0.5	<0.001[**,b]
	1 (0-3)	0 (0-3)	
SATT (mm)	22.1±13.2	18.5±9.4	0.196[.b]
	19 (4-61)	17 (3-47)	
Length of stay	6.5±5.2	3.82±4.7	<0.001[**,b]
	6 (0-21)	2 (0-36)	

*p<0.05, **p<0.001, a: chi-square ve Fisher's test, b: Mann Whitney U test. (BMI: Body Mass Index; ISS: Injury Severity Score; PATI: Penetran Abdominal Trauma Index; FCIS: Flint Colon Injury Score; SATT: Subcutaneous Adipose Tissue Thickness).

plication (p=0.279), direct surgery from the emergency room (P=0.837), need for ICU admission (p=0.199), need for blood transfusion (p=0.668), presence of mortality (p=0.672), ISS (p=0.143), PATI (P=0.363), FCIS (p=0.052), and length of hospital stay (p=0.675) did not differ significantly (p>0.05) (Table 2).

In the SW group, the BMI classification of the patients, the operation history of the patients (p=NA), primary repair (p=0.446), stoma application (p=NA), anastomosis application (p=NA), direct operation from the emergency department (p=0.159), need for ICU admission (p=0.097), presence of mortality (p=NA), ISS (p=0.369), PATI (p=0.657), FCIS (p=0.277), and length of stay (p=0.797), there was no significant difference between the findings (p>0.05).

The prevalence of overweight and obesity in female patients was found to be higher than in male patients (p=0.026). The need for blood transfusion was higher in patients in the underweight group (p=0.035). It was observed that the patients in the obese group had higher SATT (mm) findings than the patients in the underweight, healthy, and overweight groups (p<0.001) (Table 3).

Gender (p=0.495), BMI classification, primary repair, stoma application, anastomosis application (p>0.05), direct surgery from the emergency room (p=0.090), presence of mortality (It was observed that there was no significant difference between the findings of p=0.214, BMI (p=0.180), age (p=NA), FMI (p=NA) and SATT (mm) (p=0.731), and the variable of undergoing surgery (p>0.05) (Table 4).

The need for hospitalization in the ICU (p=0.013), blood transfusion need (p=0.004), ISS (p<0.001), PATI (p<0.001), and length of stay (p=0.019) in patients who underwent surgery in the GW group findings were found to be higher than

Table 2. Examining the differences between parameters related to BMI classification of patients in the GW group

	Underweight (n=5) n (%)	Normal (n=12) n (%)	Overweight (n=9) n (%)	Obese (n=18) n (%)	p
Gender					
Male	5 (100)	11 (91.7)	9 (100)	17 (94.4)	0.776[a]
Female	-	1 (8.3)	-	1 (5.6)	
Operation	5 (100)	9 (75)	9 (100)	13 (72.2)	0.204[a]
Primer repair	3 (60)	3 (33.3)	3 (33.3)	8 (61.5)	0.425[a]
Stoma application	-	4 (44.4)	3 (33.3)	3 (23.1)	0.327[a]
Anastomosis application	4 (80)	4 (44.4)	5 (55.6)	4 (30.8)	0.279[a]
Direct surgery from the emergency room	1 (20)	2 (16.7)	3 (33.3)	4 (22.2)	0.837[a]
ICU need	1 (20)	3 (25)	6 (66.7)	7 (38.9)	0.199[a]
Blood transfusion needs	1 (20)	6 (50)	4 (44.4)	9 (50)	0.668[a]
Mortality	-	2 (16.7)	2 (22.2)	2 (11.1)	0.672[a]
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
	Med (Min-Max)	Med (Min-Max)	Med (Min-Max)	Med (Min-Max)	
Age	23.4±6.7	26.1±5.8	31.4±8.3	39.3±13.2	0.006[**,b]
	24 (17-33)	26 (18-37)	31 (22-47)	39.5 (18-67)	
ISS	20.4±7.9	22.3±18.9	35.4±23.5	20.6±18.7	0.143[b]
	16 (13-32)	16 (4-75)	29 (10-75)	16 (4-75)	
PATI	25.2±7.9	18.1±12.7	26.6±15	19.6±20.7	0.363[b]
	27 (14-34)	19 (1-36)	23 (4-52)	15.5 (1-79)	
FCIS	2.2±0.4	0.75±0.9	1.22±1.1	0.94±0.9	0.052[b]
	2 (2-3)	0.5 (0-2)	1 (0-3)	1 (0-3)	
SATT (mm)	6.8±2.7	14.3±6.4	18.7±5.9	33.2±2.3	<0.001[**,b]
	8 (4-10)	13.8 (4-30)	17 (11-33)	28 (21-61)	
Length of stay	7.2±3.5	5.91±3.6	7.33±5.4	6.33±6.5	0.675[b]
	7 (4-13)	6 (0-13)	7 (0-14)	4.5 (0-21)	

•p<0.05, **p<0.001, a: Chi-square ve Fisher's test, b: Kruskal Wallis test (ISS: Injury Severity Score; PATI: Penetran Abdominal Trauma Index; FCIS: Flint Colon Injury Score; SATT: Subcutaneous Adipose Tissue Thickness).

Table 3. Examining the differences between parameters related to BMI classification of patients in the SW group

	Underweight (n=44) n (%)	Normal (n=51) n (%)	Overweight (n=53) n (%)	Obese (n=42) n (%)	p
Gender					
Male	42 (95.5)	47 (92.2)	50 (94.3)	33 (78.6)	0.026[a]
Female	2 (4.5)	4 (7.8)	3 (57)	9 (21.4)	
Operation	15 (34.1)	17 (33.3)	18 (34)	14 (33.3)	NA[a]
Primary repair	9 (60)	6 (35.3)	9 (52.9)	5 (35.7)	0.446[a]
Stoma application	-	1 (5.9)	-	-	NA[a]
Anastomosis application	1 (6.7)	1 (5.9)	1 (5.9)	1 (7.1)	NA[a]
Direct surgery from the emergency room	7 (15.9)	3 (5.9)	2 (3.8)	2 (4.8)	0.159[a]
ICU need	7 (15.9)	8 (15.7)	5 (9.4)	4 (9.5)	0.097[a]
Blood transfusion needs	11 (25)	8 (15.7)	5 (9.4)	2 (4.8)	0.035[*,a]
Mortality	1 (2.3)	-	-	-	NA
	Mean±SD Med (Min-Max)	Mean±SD Med (Min-Max)	Mean±SD Med (Min-Max)	Mean±SD Med (Min-Max)	p
Age	24.7±7.1	29±10.6	28.6±9.8	34.2±12.9	0.001[**,b,c]
	22 (16-43)	26 (16-62)	27 (17-60)	30 (19-75)	
ISS	9.3±12.6	5.94±6.4	6.9±7.5	5.6±6.3	0.369[b]
	4 (1-75)	4 (1-32)	4 (1-41)	4 (1-34)	
PATI	4.6±6.6	2.92±3.6	4.4±8.9	3.12±4	0.657[b]
	1 (1-27)	1 (1-16)	1 (1-60)	1 (1-15)	
FCIS	0.3±0.6	0.14±0.5	0.26±0.7	0.17±0.4	0.277[b]
	0 (0-2)	0 (0-2)	0 (0-3)	0 (0-2)	
SATT (mm)	8.4±2.5	14.5±4.2	22±6.7	29.6±6.9	<0.001[**,b,c]
	9 (3-14)	15 (5-31)	20 (5-37)	29 (16-47)	
Lenght of stay	3.54±2.8	4.1±5.7	4.5±5.9	2.95±2.5	0.797[b]
	2.5 (0-11)	2 (0-36)	2 (0-31)	2 (0-11)	

•p<0.05, **p<0.001, a: Chi- Square and Fisher's test; b: Kruskal Wallis test; c: Post hoc Tamhane's T2 test (ISS: Injury Severity Score; PATI: Penetran Abdominal Trauma Index; FCIS: Flint Colon Injury Score; SATT: Subcutaneous Adipose Tissue Thickness).

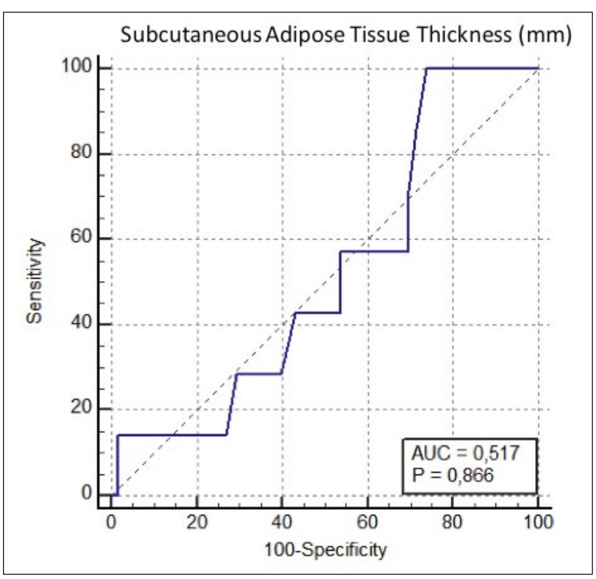

Figure 1. Evaluation of SATT (mm) finding by ROC curve analysis according to the presence of mortality variable (n=234).

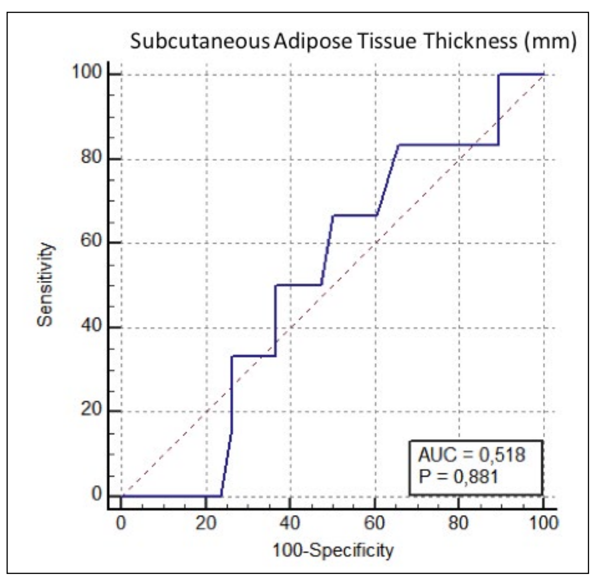

Figure 2. Evaluation of SATT (mm) finding in the GW patient group by ROC curve analysis according to the presence of mortality variable (n=44).

Table 4. Examination of the differences between the operation findings and related parameters of the patients in the GW group

	Non-op (n=8) n (%)	Op (n=36) n (%)	p
Gender			
Male	8 (100)	34 (94.4)	0.495[a]
Female	-	2 (5.6)	
BMI classification			
Underweight (<18.5)	-	5 (13.9)	0.263[a]
Normal (18.5-24.9)	3 (37.5)	9 (25)	0.473[a]
Overweight (25-29.9)	35 (27.8)	18 (28.1)	0.113[a]
Class I obese (30-34.9)	1 (12.5)	4 (11.1)	NA
Class II obese (35-39.9)	1 (12.5)	5 (13.9)	NA
Class III obese (>40)	3 (37.5)	4 (11.1)	0.065[a]
Primary repair	-	17 (47.2)	NA
Stoma application	-	10 (27.8)	NA
Anastomosis application	-	17 (47.2)	NA
Direct surgery from the emergency room	-	10 (27.8)	0.090[a]
ICU need	-	17 (47.2)	0.013[**a]
Blood transfusion	-	20 (55.6)	0.004[**a]
Mortality	-	6 (16.7)	0.214[a]
	Mean±SD	Mean±SD	p
	Med (Min-Max)	Med (Min-Max)	
Age	32.6±13.7	32.2±11.4	NA
	32 (18-55)	30.5 (17-67)	
BMI	32.6±9.6	27.7±9.4	0.180[b]
	34.3 (20.9-44.5)	26.5 (10.8-48.8)	
ISS	6.63±2.3	27.9±19.3	<0.001[**b]
	6.5 (4-9)	22.5 (4-75)	
PATI	2.13±1.7	25.5±15.2	<0.001[**b]
	1.5 (1-6)	23 (1-79)	
FCIS	-	1.33±0.9	NA
		1 (0-3)	
SATT (mm)	22.9±14.9	21.9±13.1	0.731[b]
	22 (4-51)	18.75 (4-61)	
Length of stay	3.12±2.5	7.27±5.4	0.019[*b]
	2.5 (1-9)	6.5 (0-21)	

* p<0.05, **p<0.001, a: Chi-Square and Fisher's test, b: Mann Whitney U test. (BMI: Body Mass Index; ISS: Injury Severity Score; PATI: Penetran Abdominal Trauma Index; FCIS: Flint Colon Injury Score; SATT: Subcutaneous Adipose Tissue Thickness).

the patients who did not undergo surgery and were statistically significant (p<0.05) (Table 4).

Gender (p=0.974), BMI classification, primary repair, stoma application, anastomosis application (p>0.05), presence of mortality (p=0.159), age (p=0.264) of the patients in the GW group, BMI (p=0.943), and SATT (mm) (p=0.559) values and there was no significant difference between the variables of undergoing surgery (p>0.05).

The frequency of direct surgery from the emergency room (p<0.001), the need for hospitalization in the ICU (p<0.001), the need for blood transfusion (p<0.001), and the ISS (p<0.001) in the patients who underwent surgery in the GW group, PATI (p<0.001), FCIS (p<0.001), and length of hospital stay (p<0.001) findings were found to have higher rates and were statistically significant (p<0.05) (Table 5).

According to the ROC curve, two groups were formed for all patients, the amount of which was 11 mm or less, and above 11 mm, according to the skin sub-fatty tissue thickness (Fig. 1).

According to the ROC curve findings, two groups were formed for the patients in the GW Group, with the amount of SATT 12 mm and below, and above 12 mm (Fig. 2).

It was desired to establish a cutoff value according to the

Table 5. Examination of the differences between the operation findings and related parameters of the patients in the SW group

	Non-op (n=126) n (%)	Op (64) n (%)	p
Gender			
Male	114 (90.5)	58 (90.6)	0.974[a]
Female	12 (9.5)	6 (9.4)	
BMI classification			
Underweight (<18.5)	29 (23)	15 (23.4)	NA
Normal (18.5-24.9)	34 (27)	17 (26.6)	NA
Overweight (25-29.9)	35 (27.8)	18 (28.1)	NA
Class I obese (30-34.9)	20 (15.9)	13 (20.3)	0.445[a]
Class II obese (35-39.9)	8 (6.3)	1 (1.6)	0.142[a]
Class III obese (>40)	-	-	NA
Primary repair	-	29 (46)	NA
Stoma application	-	1 (1.6)	NA
Anastomosis application	-	4 (6.3)	NA
Direct surgery from the emergency room	-	14 (21.9)	<0.001[**a]
ICU need	-	24 (37.5)	<0.001[**a]
Blood transfusion	2 (1.6)	24 (37.5)	<0.001[**a]
Mortality	-	1 (1.6)	0.159[a]
	Mean±SD Med (Min-Max)	Mean±SD Med (Min-Max)	
Age	28.7±10.8	29.8±10.5	0.264[b]
	25.5 (16-75)	28 (16-62)	
BMI	24.3±6.9	24.2±6.7	0.943[b]
	25 (10.1-37.6)	24.9 (10.7-36.3)	
ISS	3.29±2.6	14.0±11.4	<0.001[**b]
	4 (1-16)	9 (1-75)	
PATI	1.35±0.8	8.52±9.0	<0.001[**b]
	1 (1-5)	6 (1-60)	
FCIS	-	0.64±0.76	<0.001[**b]
		0 (0-3)	
SATT (mm)	18.4±9.7	18.8±8.6	0.559[b]
	16.5 (3-47)	18 (4-43)	
Length of stay	2.71±4.8	6.0±3.4	
	2 (0-36)	5 (0-16)	<0.001[**b]

* p<0.05, **p<0.001, a: Qi-Square Test ve Fisher's test, b: Mann Whitney U test. (BMI: Body Mass Index; ISS: Injury Severity Score; PATI: Penetran Abdominal Trauma Index; FCIS: Flint Colon Injury Score; SATT: Subcutaneous Adipose Tissue Thickness).

variable of the presence of mortality of SATT (mm). As a result of the ROC curve analysis; it was determined that there was no significant threshold value between the findings of the presence of mortality in all patients (p=0.866) and the patients in the GW group (p=0.881) and the SATT (mm) values (P>0.05). ROC curve analysis could not be performed because mortality was observed in one patient in the SW group.

It was seen that SATT (mm) was statistically insignificant when analyzed according to the variables of ISS (p=0.745), PATI (p=0.570), and FCIS (p=0.573). According to the ROC curve findings, two groups were formed for the patients in the GW group, with SATT (mm) of 12 mm and below, and above 12 mm. When the groups formed were compared with the parameters, it was found that the presence of anastomosis was observed more frequently (p=0.023) in those with SATT (mm) of 12 mm or less.

DISCUSSION

Many studies have focused on the relationship between obesity and the diseases we have mentioned, but the role of obesity in trauma has remained in the background. The studies reviewed revealed that obesity is an independent risk factor in high-energy blunt trauma.[2]

Body mass index is a mathematical formula calculated as kg/ m^2. While it has been shown in the literature that patients with BMI ≥30 have increased post-traumatic morbidity, there is no definitive evidence that it increases mortality.[7] These studies had conflicting results, some showed increased rates, while others showed no difference.

In a prospective study conducted by Durgun et al., penetrating abdominal, thorax, head, and extremity traumas were evaluated and it was reported that the mortality rate increased as the BMI value increased.[8] In addition, it has been reported that the length of stay in the ICU and YSS increase in direct proportion to BMI. However, patients with blunt trauma were also included in the aforementioned study. In this study, however, no difference was found between the necessity of hospitalization in the ICU and between ISS and BMI in both GW and SW patients. The reason for the difference here may be due to the different protective effects of BMI in blunt and penetrating traumas. It can be thought that the two types of injuries with different mechanisms of occurrence should be evaluated in terms of BMI with separate studies.

In a study conducted by Bloom et al., in which the need for an ICU, presence of mortality, ICU length of stay, and direct admission to the operating room in SW were evaluated, it was reported that thin patients needed more surgery than obese patients.[9] In addition, the length of stay in the ICU was found to be longer. In the aforementioned study, it was reported that the rate of surgery was 79%. In the same study, the protective effect of the patient's BMI in anterior abdominal SW was definitively reported, and it was stated that life-threatening injuries increased significantly in patients with low adipose tissue.[10] In this study, it was determined that BMI was not important in terms of whether or not direct surgery was performed in the SW patient group.

In a study conducted by Evans et al., a negative correlation was found between BMI and the presence of in-hospital mortality, that is, the presence of mortality was found to be higher in patients with low BMI.[11] However, in the aforementioned study, the relationship between the presence of SATT measured by CT from the abdominal region and mortality was not evaluated. BMI is a general measurement and cannot show the protectiveness of the adipose tissue in the abdomen. Therefore, there is a need for designed studies evaluating the effects of fat distribution on mortality and morbidity in obese or non-obese patients. In another study, no difference was found between obese and non-obese patients in terms of length of hospital stay, discharge rate, and mortality.[12] In addition, when the patients were examined in five subgroups according to their BMI values, no difference was found. In a prospective study conducted in 2006, obesity was reported to be an independent risk factor for infection, ISS, and the need for ICU admission.[13] It has been stated that obese patients are more prone to urinary and pulmonary system infections and to the hospitalization in ICU. Thus, obesity has been reported to be an independent risk factor for ICU length of stay, presence of mortality, and ISS, and it is positively correlated with BMI.[14] In this study, complications such as urinary and pulmonary system infections and related ICU length of stay parameters were not evaluated in terms of study design. When examined in terms of mortality, no relationship was found. There was no correlation between BMI and the presence of mortality and the need for ICU admission. The same is true for SATT. In other words, it is not correct to conclude that as SATT increases, mortality and the need for ICU admission decrease. However here, the SATT cutoff value can be reached and a contribution can be made to manage the patient algorithm over this value. The cutoff values we found in all patients and especially in GW in the study may be beneficial for the clinician in terms of deciding whether to operate with abdominal CT performed in penetrating injuries who applied to the emergency department with further studies to be conducted.

The choice of treatment is made by the trauma surgeon who deals with the trauma patient. Before the treatment, all patients are evaluated according to the emergency trauma algorithm and it is decided whether or not to have surgery. The incidence of unnecessary laparotomy varies between 23 and 53% in patients with SW and between 5.3 and 27% in patients with GW.[15] Complications may develop after unnecessary laparotomy with a rate of 2.5–41%.[15] The acute abdomen or hemodynamic disorder that develops in the patient eliminates the possibility of non-surgical follow-up and leads the patient to the decision of surgery. Today, selective non-surgical management saves the patient from the need for ICU admission and blood transfusion, thus shortening the hospital stay, and current guidelines recommend this in practice in penetrating traumas.[15] The need for hospitalization in the ICU, the need for blood transfusion, and, as expected, the patients who were operated on ISS, PATI, and FCIS are higher both in all patients and in patients grouped as GW and SW. In addition, the mortality rate in all patients was higher in the operated group.

In the literature, subcutaneous adipose tissue is protective against abdominal trauma by providing a cushioning effect in blunt abdominal injuries.[16] However, there is no study evaluating SATT in penetrating injuries, especially in colon injuries and other abdominal organ injuries. In this study, a large-scale study was designed to evaluate the scores available for colon injuries with FCIS, ISS, and PATI and all abdominal organs. However, in penetrating injuries, it was thought that SATT might not be as protective as mentioned in the studies, since penetrating sharps and firearms penetrate directly into the abdomen with high energy. On the other hand, since energy can be absorbed in blunt traumas, it can be argued that the effect on the abdomen may have remained more limited. Therefore, in this study, it has been shown that SATT may not be protective in penetrating injuries where the direct effect of energy is reflected in the abdomen, and this study is valuable in this sense.

In recent years, several studies have explored the impact of subcutaneous fat and visceral fat in the context of penetrating and gunshot injuries.[17,18] These investigations have shed light on the intricate relationship between adipose tissue distribution and trauma outcomes. Notably, research has highlighted that subcutaneous adipose tissue, beyond serving as a passive energy reserve, may have dynamic roles in modulating inflammation and influencing wound healing processes. Furthermore, visceral fat, often linked to metabolic comorbidities, has been implicated in the systemic response to trauma. These emerging findings underscore the importance of considering adipose tissue distribution as a potential factor affecting outcomes in trauma patients. While our study primarily focused on the SATT index, future research could delve deeper into the impact of visceral fat and abdominal fat distribution to provide a more comprehensive understanding of how adiposity influences the response to penetrating and gunshot injuries.

This study has some limitations. The first of these is that it was designed retrospectively through file scanning. Apart from this, the superiority of radiographic measurement methods (USG, DEXA, CT, and MR) over each other has not been evaluated. Apart from these, the relatively low number of patients and the single-center study are other limitations. In addition, complication rates and types were not evaluated in this study. Apart from these, nutritional reserve, pre-injury condition, nutritional disorders, and habits are not included in the study as criteria.

CONCLUSION

In this study, in which the incidence of penetrating abdominal trauma was high due to the location of our center, there was no difference in BMI in all patients and isolated GW patients, while a difference was found only in blood transfusion needed in isolated SW patients. Considering that BMI cannot be the only criterion, it was examined together with SATT and it was found to be insignificant for both GW and SW patients. However, a cutoff value to be determined by larger and multicenter studies can take its place as a parameter in the penetrating trauma algorithm and contribute to it. In addition, all existing abdominal trauma scores (ISS, PATI, and FCIS) were examined in the study, and they are important because they have not been evaluated in this sense in the literature before. In addition, this study is one of the rare studies that try to show how the common obesity disease affects traumas. In this context, it can be a guide for future studies as a pilot study.

Ethics Committee Approval: This study was approved by the İstanbul Medipol University Ethics Committee (Date: 23.06.2021, Decision No: 717).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Obez travma mağdurları penetran travma yaralanmalarında şanslılar mıdır?

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AMAÇ: Obezite, Dünya Sağlık Örgütü (DSÖ) tarafından açıklanan verilere göre bulaşıcı olmayan en önemli salgın hastalıktır. Birçok çalışma obezite ile komorbid hastalıklar arasındaki ilişkiyi ortaya koyarken obezitenin penetran travmadaki rolü geri planda kalmıştır. Bu çalışmada, penetran abdominal travma hastalarında vücut kitle indeksinin (VKİ) ve subkutan yağ dokusunun abdomeni kapsayan skorlar ile birlikte koruyucu etkisini ortaya koymayı amaçladık.

GEREÇ VE YÖNTEM: 2017-2021 yılları arasında İstanbul Medipol Hastanesi acil genel cerrahi ünitesine başvuran 16 yaş üstü 234 abdominal penetran travma hastasının verileri retrospektif olarak incelendi. Hastaların cinsiyet, yaş, penetran yaralanma türleri (Ateşli Silah Yaralanması (ASY) ve Delici Kesici Alet Yaralanması (DKAY)), VKİ, operasyon varlığı, cerrahi onarım tekniği, acil servisten direkt ameliyata alınma durumu, kan transfüzyon ihtiyacı ve yoğun bakım ünitesi ihtiyacı, mortalite, Yaralanma Şiddet Skoru (YŞS), Penetran Abdominal Travma İndeksi (PATİ), Flint Kolon Yaralanması İndeksi (FKYİ) ve yatış süreleri kaydedildi. Cilt altı yağ dokusu kalınlığı (CAYDK) mevcut batın bilgisayarlı tomografileri ile ölçüldü.

BULGULAR: Hastalar, ASY ve DKAY olmak üzere 2 gruba ayrıldı. ASY grubunda operasyon öyküsü (p<0.001); stoma uygulaması (p<0.001) ve anastomoz uygulaması (p<0.001); acil servisten direkt ameliyata alınma durumu (p=0.002); YBÜ ihtiyacı (p<0.001); kan transfüzyon ihtiyacı (p<0.001) ve mortalite (p<0.001) bulguları DKAY grubuna göre daha yüksekti. VKİ ile tüm hastalarda ve ASY grubunda VKİ açısından tüm değişkenlerde anlamlı fark yokken, DKAY grubunda kan transfüzyonu ihtiyacı değişkeni açısından fark saptanmıştır (p=0.035). CAYDK açısından yapılan ROC analizi sonucunda tüm hastalarda mortalite (p=0.866) ile CAYDK (mm) değerleri arasında kestirim değeri tüm hastalar için 11 mm, ASY hastaları için ise 12 mm olarak tespit edildi. Tüm hastalarda, DKAY ve ASY hastalarında YBÜ ve kan transfüzyonu ihtiyacı, yatış süreleri, YŞS, PATİ ve FKYİ açısından opere edilen ve edilmeyen hastalarda anlamlı fark tespit edilmiştir (p<0.05). Tüm hastalarda mortalite (p=0.002) açısından istatistiksel anlamlı fark saptanmıştır. Ameliyat edilen ve edilmeyen tüm hastalara, ASY ve DKAY hastalarına karşılaştırıldığında hem VKİ hem de CAYDK kriterlerinde YŞS, PATİ ve FKYİ'nin anlamsız oldukları tespit edildi (p>0.05).

SONUÇ: Çalışmamız penetran abdominal yaralanması mevcut hastaları hem VKİ hem de CAYDK ile geniş kapsamlı ve tüm abdominal skorlar ile değerlendiren ilk çalışma olması nedeniyle değerlidir. VKİ ve CAYDK ile mortalite arasında ilişki saptanmazken, DKAY grubunda zayıf hasta popülasyonun daha fazla kan transfüzyonuna ihtiyaç duyduğu bulunmuştur. Bu çalışma, künt travmalarda koruyuculuğu bildirilen CAYDK'nın penetran travmalarda koruyucu bir etkisinin olmadığını göstermiştir. Daha geniş çaplı ve çok merkezli çalışmalarla CAYDK için tespit edilecek kestirim bir değer, penetran travma algoritmasında bir parametre olarak kendisine yer edinerek katkı sağlayabilir.

Anahtar sözcükler: Cilt altı yağ dokusu; penetran travma; vücut kitle indeksi.

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