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Visceral adiposity but not subcutaneous fat associated with improved outcome of patients with acute cholecystitis

Eyal Leibovitz, MD,[a] *Nadav Ben-David, MD,*[b] *Lea Shibanov, MD,*[b] *Sorin Elias, MD,*[c] *and Mordechai Shimonov, MD*[b,d,*]

[a] *Department of Internal Medicine "A", Yoseftal Hospital, Eilat, Israel*
[b] *Department of Surgery "A", Wolfson Medical Center, Holon, Israel*
[c] *Department of Radiology, Wolfson Medical Center, Holon, Israel*
[d] *Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel*

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ABSTRACT

Background: The aim of this study to study the effect of visceral and subcutaneous fat tissue mass on short- and long-term prognosis of patients with acute calculus cholecystitis (ACC).
Methods: Retrospective analysis of medical records. Included were all patients admitted because of ACC. Computed tomography images at the level of L3 were analyzed for body composition using designated software (Slice-O-matic; TomoVision, Montreal, Quebec, Canada). General linear model was used to analyze the effect of body composition on length of hospital stay, and Cox regression analysis was used to ascertain the effect of the different parameters on 1-y survival.
Results: Included were 159 patients (mean age: 71.7 ± 15.8 y, 54.7% males). Fat was the most abundant tissue (401 ± 175 cm^2 of the computed tomography slices surface area), and visceral fat was 45.8 ± 14.1% of the fat area measured. Using the general linear model, we found that American Society of Anesthesiologists score, disease severity index, and age were positively associated with higher length of stay, whereas high visceral fat was associated with lower length of stay (estimated marginal means at 7.4 ± 1.4 d compared to 12.7 ± 1.4 d among patients with lower visceral fat surface area, $P = 0.010$). The Cox regression model showed that 1-y survival risk was significantly reduced by age, the Charlson Comorbidity Index and high muscle mass. High visceral adiposity was associated with improved survival (odds ratio: 0.216, 95% confidence interval: 0.064-0.724, $P = 0.013$). Subcutaneous adiposity did not affect prognosis.
Conclusions: Visceral adiposity is associated with shorter length of stay and improved 1-y survival among patients hospitalized with ACC.

Introduction

Acute calculus cholecystitis (ACC) is a disease of the gallbladder that is secondary to bile stone formation and obstruction of the cystic duct. Prevalence of this disease is high in westernized societies, where 10%-20% of the US population suffer from gallstones, and about one-third of them develop ACC.[1] The definitive treatment for ACC is gallbladder

* *Corresponding author*. Department of Surgery "A", Wolfson Medical Center, Tel Giborim, Holon, Israel. Tel./fax: +972 3 5028604.
E-mail address: shimonov.m@wmc.gov.il (M. Shimonov).
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resection with coadministration of antibiotics,[2] but disease severity may alter prognosis as well as the type and timing of treatment.[3]

ACC carries favorable prognosis in most of the cases. About 75% of the patients will show clinical improvement within the first couple of days of treatment, but one-fourth of the patients will suffer complications despite treatment. There are several prognostic factors for patients with ACC, such as disease severity index, American Society of Anesthesiologists (ASA) score, and more.

Recently, body composition, and especially muscle mass and fat mass were found to be associated with patient outcome among several chronic conditions.[4-6] Among patients admitted to the hospital, body composition was associated with length of stay,[7] but data regarding specific conditions are limited. Computed tomography (CT) imaging provides a means to precisely quantify fat and skeletal muscle[8,9] and is considered the gold standard for body composition assessment.[10]

The purpose of this study was to evaluate the effect of body composition, and most notably visceral and subcutaneous fat mass on hospital and long-term prognosis of patients with acute cholecystitis.

Methods

Study type

Retrospective single-center study.

Study population

A convenience sample of all adult patients who were admitted to the surgery "A" and "B" units of the Wolfson Medical Center in Holon, Israel, between January 1, 2010, and December 31, 2014.

Inclusion and exclusion criteria

Included were all patients admitted because of ACC who underwent an abdominal CT scan during the hospitalization period. Excluded were patients who did not have an abdominal CT scan performed.

Ethical issues

The research project was approved by the local institutional review board as a noninterventional study that precludes the need for informed consent.

Research protocol

For each patient enrolled, three successive CT images (slices) at the level of L3 were analyzed using designated software (see in the following section). Additional data extracted from the medical record included patient demographics, comorbidities, disease severity, ASA score, laboratory information, and prognosis parameters (length of hospital stay, 30-d, and 1-y mortality). For each patient, the Charlson Comorbidity Index was calculated.

Image analysis software and specifications

Muscle and fat masses were assessed at the third lumbar vertebra (L3) as described by others.[8] Once the L3 region was identified, analysis software (Slice-O-matic; TomoVision) was used to identify specific tissue demarcation using Hounsfield unit thresholds established for skeletal muscle (−29 to +150), visceral adipose tissue, subcutaneous adipose tissue, and intramuscular adipose tissue (−190 to −30 for all fat). Cross-sectional areas (cm^2) were computed for each tissue by summing tissue pixels and multiplying by the pixel surface area. Three successive images at the L3 level were assessed, and the final value was the average of the measurements. All readings were done by a single observer, and a random sample of five images were reexamined by a second observer to ascertain interobserver variation was less than 5%.

Statistical analysis

All data were recorded on excel sheets and transferred to SPSS software (SPSS Inc, Chicago, IL) for statistical analysis. Distribution of variables was tested for normality using the Kolmogorov–Smirnov test, with a cutoff of $P < 0.01$. Parameters with normal distribution are described as means ± standard deviation, whereas parameters that deviate from normal distribution are described as median ± min/max. Categorical variables such as sex are described as number (frequency %). Associations between variables will be measured using the Pearson or Spearman tests, accordingly. Continuous variables were tested across dichotomous groups using the *t*-test for independent samples or the Mann–Whitney *U* test accordingly. Associations between categorical variables were measured using the chi-square test Mann–Whitney *U* test. The median of all tissue types was calculated, and all patients were categorized as having above or below the median of each of the different tissues.

A general linear model was used to identify the parameters associated with either visceral or subcutaneous fat surface area. For each of the models, the different fat surface areas were entered as the dependent variables; sex and diabetes mellitus status were fixed factors; and age, creatinine level, and the other body composition parameters were the covariates. In addition, a general linear model was used to analyze the effect of body composition on length of hospital stay, and the Cox regression analysis was used to ascertain the effect of the different parameters on 1-y survival. Covariates were first tested for significance using univariate analysis. Later, multivariate analysis was performed, and the most parsimonious model was reached.

Results

Included in the analysis were 159 patients that fulfilled the inclusion and exclusion criteria. Mean age was 71.7 ± 15.8 y, and 54.7% were males. Demographic parameters, baseline laboratory data, and comorbidities are shown in Table 1. Mean ASA score was 2.5 ± 0.8, and 94.3% of the patients had ASA score of 3 or lower. Fifty one percent of patients had a moderate disease severity score, and 9% had severe disease.[11]