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Original research

Impact of intra-abdominal fat on surgical outcome and overall survival of patients with gastric cancer

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A B S T R A C T

Background: The aim of this study was to evaluate the impact of obesity on surgical outcome and prognosis in patients with gastric cancer.
Methods: A total of 304 patients who underwent curative gastrectomy for gastric adenocarcinoma between January 2005 and March 2008were enrolled. Body mass index (BMI) was calculated before the operation and visceral fat area (VFA) was measured by abdominal computed tomography (CT). The patients were divided according to BMI class and VFA quartile. The influence of BMI and VFA on surgical outcome and survival was evaluated.
Results: The median BMI was 23.3 kg/m^2 and the median VFA was 103 cm^2. There was a significant positive correlation between BMI and VFA. According to BMI class and VFA quartile, there were no significant differences in patients' characteristics or surgical outcome, with the exception of a significantly longer operation time and fewer retrieved lymph nodes in patients with a high BMI and VFA. The unadjusted overall and disease free survival were not significantly different between BMI classes or VFA quartiles.
Conclusions: Obesity, as represented by BMI and VFA, may not be a poor prognostic factor in patients with gastric cancer.

1. Introduction

According to 2013 World Health Organization report, overweight and obesity are the fifth leading risk for global deaths and at least 2.8 million adults die each year as a result of being overweight or obese [1]. Obesity has been correlated with an increased risk of various serious disease processes, including malignancy. Many epidemiological studies have indicated that obesity is associated with an increased incidence of cancer of the colon, breast, endometrium, kidney, and esophagus [2,3]. Similar to other malignancy, overweight and a high body mass index (BMI) are associated with an increased risk of gastric adenocarcinoma [4].

BMI is a simple index of weight-for-height that is commonly used to assess obesity. However, BMI is an imperfect measurement of abnormal or excessive fat accumulation, both because this value does not distinguish fat mass from lean body mass components and because the distribution of fat tissue differs greatly between individuals. Accordingly, visceral fat area (VFA) has been proposed as an alternative to BMI for assessment of the impact of obesity and fat distribution [5,6].

Several previous studies have suggested that obesity negatively affects the outcome of surgical treatment and results in a longer operative time, more blood loss during operations, and an increased risk of postoperative morbidity in patients with gastric cancer [6,7]. A higher BMI is not an independent prognostic factor for long-term survival in gastric cancer but is associated with more postoperative complications [8,9]. In recent studies, VFA was more accurate than BMI as a predictor of perioperative complications, operation time and blood loss [6,10–12]. Although the influence of BMI on the prognosis of patients with gastric cancer has been investigated, the relationship between VFA and prognosis of patient with gastric cancer remains controversial.

The aim of this study was to assess the influence of obesity and body fat distribution on surgical outcomes and overall survival after gastrectomy for gastric adenocarcinoma.

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2. Patients and methods

2.1. Patients

A total of 304 patients who underwent subtotal gastrectomy or total gastrectomy for primary gastric cancer between January 2005 and March 2008, at the Department of Surgery, St. Vincent's Hospital, The Catholic University of Korea, were enrolled in the study. The Institutional Review Board of St. Vincent's Hospital approved this study (VC13RISI0075). All included patients underwent abdominal computed tomography (CT) as a preoperative evaluation. We excluded patients (1) who had distant metastasis, (2) who underwent palliative operation or R1 resection, and (3) for whom VFA could not be calculated from the abdominal CT in the workstation. This study included patients who underwent curative gastrectomy with R0 resection (230 subtotal gastrectomy and 74 total gastrectomy cases) and lymph node dissection was performed based on the *Gastric cancer treatment guidelines in Japan* [13]. D2 lymph node dissection was performed in patients with advanced gastric cancer, whereas D1 plus lymph node dissection was performed in patients with early gastric cancer. The stage and histopathological classification of disease was based on the *Japanese Classification of Gastric Carcinoma* [14].

2.2. Data collection

Demographic, operative, perioperative, radiologic and pathologic data from all patients were obtained from a retrospective medical record review. Prior to surgery, BMI was calculated as weight divided by height squared (kg/m^2). Operative time, intraoperative blood loss, intraoperative transfusion, the number of lymph nodes retrieved, postoperative complications, and the duration of the postoperative hospital stay were investigated as surgical outcomes. Follow-up was based on outpatient evaluation according to a predetermined schedule. The protocol included clinical and hematological examinations, chest X-rays, upper gastrointestinal endoscopic assessment, and CT. Follow-up was closed on April 30, 2013. All surviving patients were followed up for at least 5 years, and the mean follow-up period in these cases was 64 months.

2.3. Measurement of total fat area and visceral fat area

The total fat area (TFA) and VFA were measured using a cross-sectional image from 16-detector row CT imaging of the abdomen (Somatom Sensation 16, Siemens Medical Solutions, Forchheim, Germany) at the level of the umbilicus (Fig. 1). On CT scans, adipose tissue was determined by setting the attenuation level within the range of −190 to −30 Hounsfield units (HU). To measure these parameters, the fat margin was manually traced and the cross-sectional area of each parameter was calculated in cm^2 using CT Software (Rapidia 2.8; INFINITT, Seoul, Korea). The subcutaneous fat area (SFA) was obtained by determining the difference between the TFA and the VFA.

2.4. Statistical methods

Values were expressed as a percentage or median (quartile), as appropriate. Correlations were studied using Pearson's r correlation. Fisher's exact test was used to compare differences in discrete or categorical variables and the Kruskal–Wallis test was used for continuous variables. BMI was categorized as underweight (<18.5 kg/m^2), normal weight (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), obese grade I (25.0–29.9 kg/m^2), or obese grade II (≥30.0 kg/m^2) as described by the World Health Organization/International Association for the Study of Obesity/International Obesity Task Force (2000): Asian-Pacific standard [15]. Surface areas were categorized using the quartiles as the cutoff point. Overall survival was estimated by Kaplan–Meier method, the log-rank test was used to compare survival curves, and Cox proportional hazards models were used to obtain the hazard ratio. $P < 0.05$ was considered to indicate a statistically significant difference with a 95% confidence interval (95% CI).

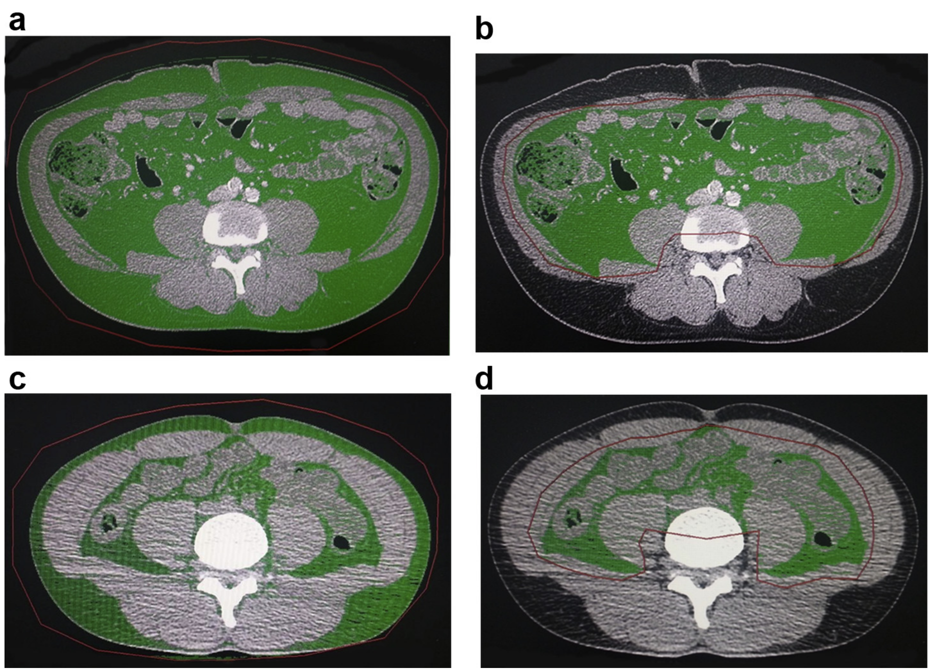

Fig. 1. Quantification of visceral fat area. The outer red line was manually generated with a cursor to determine the total fat area (a, c), in which attenuation was measured. The inner red line indicates visceral fat (b, d). These pictures are from individuals who had different distribution of fat tissue despite having the same BMI.