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Risk Factors for Surgical Site Infection After Gastrectomy with D2 Lymphadenectomy

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Abstract
Surgical site infection (SSI) is a potentially morbid and costly complication of surgery. We conducted this study to establish the preoperative and operative factors predisposing to SSI after gastric resection and D2 lymphadenectomy. Data on all patients undergoing gastrectomy and D2 lymphadenectomy within a 2-year period, at a tertiary reference hospital in Turkey, were collected retrospectively. The outcome of interest was a diagnosis of incisional SSI as defined by the Centers for Disease Control and Prevention. Multivariate analysis by stepwise logistic regression was then performed on those variables associated with incisional SSI. We identified 72 patients with SSI after gastrectomy and D2 lymphadenectomy. The median age of the patients was 61 years (range 31–81 years) and 43 were men. Incisional SSI was diagnosed in 15 (20.8%) patients. Of all the preoperative and operative variables measured, an increased patient body mass index was an independent predictor of incisional SSI. An increased incidence of SSI was found in overweight patients, but these infections were transient and not life threatening.

Key words Gastric cancer · Surgical site infection · Surgery

Introduction

Despite its decreasing prevalence in industrialized nations, gastric cancer remains one of the most common cancers in the world. Its detection prior to metastatic or locally advanced stages is critical for its effective treatment, and prognosis is determined by the tumor itself, as well as by certain patient-related factors.[1] Surgical site infections (SSIs) are the third most common type of hospital-acquired infections, accounting for 14%–16%, but for surgical patients, SSIs are the most common hospital-acquired infection. Several reports have described the substantial cost of these infections in terms of attributable mortality; increased morbidity, measured as prolonged postoperative hospital stay; and increased hospital costs.[2,3] On the other hand, few studies have addressed the influences of preoperative and operative factors on SSI after gastrectomy with D2 lymphadenectomy.[1] Our specific objective was to identify the risk factors for incisional SSI in this population.

The subjects of this study were 72 patients who underwent gastric resection and D2 lymphadenectomy for gastric cancer, at Ankara Numune Education and Research Hospital, between October 2004 and October 2006. We reviewed the patients' hospital records, clinical charts, and operating room records for initial data collection. All tumors were staged in accordance with the TNM Classification of Malignant Tumors.

The area to be operated on was shaven with electric clippers once the patient was in the operative suite just prior to surgical site preparation if necessary. For site preparation, povidone–iodine (betadine) scrub was used almost exclusively. All patients underwent gastrectomy and D2 lymphadenectomy. Depending on the location of the primary tumor, the surgeon performed either a total, proximal subtotal, or distal subtotal gastrectomy. Demographic and clinical variables were recorded at time of chart review. Specific intake variables for each patient included age, sex, height, weight, diagnosis, history of diabetes, preoperative steroid use, history of laparotomy, American Society of Anesthesiologists (ASA) score as determined by the anesthesiology team during their preoperative assessment, perioperative antibiotics (including type, when given at the time of the initial skin incision, intraoperative redosing, and continuation for 24 h of coverage),

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type of preoperative skin preparation, procedure performed, operative time, intraoperative hypotension, need for perioperative transfusions, and type of wound closure. The primary outcome of interest was a diagnosis of incisional SSI (superficial or deep incisional) as defined by the Centers for Disease Control and Prevention.[4]

Patient age was evaluated as a continuous variable. Body mass index (BMI) was evaluated as a dichotomized (<25 and ≥25) variable. Tumor location, pathological (p) T category, and the type of gastrectomy were evaluated as a categorical variable. Splenectomy and pancreatectomy were evaluated as a dichotomized variable (present/absent). Preoperative albumin was dichotomized, and the normal range was considered to be ≥3.5 g/dl. The ASA score was dichotomized into ≤2 or >2, which reflects the NNIS distinction of ASA scores >2. The operative time was categorized into four variables for analysis (<2 h, 2–3 h, 3–4 h, and >4 h). The use of transfusion of cellular or plasma products was evaluated as a single category. All other variables were already dichotomized and are presented in the results.

Bivariate comparisons of patients with and those without incisional SSI were unpaired, and all tests of significance were two-tailed. A comparative analysis of categorical variables was performed using χ^2 testing with Yates' continuity correction. Continuous variables were analyzed using Student's *t*-tests for normally distributed variables; otherwise, the Mann–Whitney *U*-test was used.

A multivariable analysis, in which development of incisional SSI was the dependent outcome variable, was performed by logistic regression, using a Wald statistic backward stepwise selection. Independent variables with a value of $P \le 0.2$ for association with the development of SSI by bivariate statistics were included in the multivariable analysis, and determined prior to the analysis. The P value of ≤0.2 was taken so that no variable of importance was excluded from the multivariate analysis. The results of the logistic regression are reported as the odds ratios (OR) with 95% confidence intervals (CI). All P values are two-tailed, and $P \le 0.05$ was considered to indicate significance. All statistical analyses in this study were done using SPSS software (version 13.0, SPSS, Chicago, IL, USA).

The median age of the patients was 61 years (range 31–81) and there were 43 men. Total gastrectomy was performed in 35 (48.6%) patients, and distal gastrectomy was performed in the rest. Splenectomy was performed in 11 patients (15.2%) and distal pancreatectomy in 4 (5.52%). The overall operative mortality was 8.4% (6 of 71 patients). One of the patients who died after D2 gastrectomy had undergone splenectomy, and another had undergone splenectomy and distal pancreatectomy.

Incisional SSI was diagnosed in 20.8% of this cohort (15 patients). For the bivariate analysis, patients with and those without incisional SSI were compared. Patients with an incisional SSI were more likely to have a higher BMI; however, there was no difference in age or sex distribution. Diagnosis, preoperative albumin level <3.5 g/dl, preoperative steroid use, and prior laparotomy had no significant association with the development of incisional SSI. When evaluating the perioperative and operative characteristics, none of the factors recorded were significantly associated with the development of incisional SSI.

Following the bivariate analysis, the variables BMI, splenectomy, ASA score >2, and operative time were selected for stepwise logistic regression analysis as their P values for association with incisional SSI development were <0.2, being the predetermined cutoff for inclusion. The multivariate model for all SSIs demonstrated that overweight (OR, 3.42; 95% CI, 1.83–7.35; $P < .001$) was an independent predictor of SSI.

The findings of this study show clearly that overweight patients are at higher risk of SSI after gastrectomy with D2 dissection. The risk factors for the development of SSI after abdominal surgery have been investigated intensively. The presence of a preoperative cutaneous abscess or necrosis, sutures, or anastomoses of the bowel, postoperative abdominal drainage, surgical treatment for cancer, and postoperative anticoagulant therapy were all identified as risk factors for SSI after noncolorectal abdominal surgery.[5] However, overweight was not identified as a risk factor for SSI in any of these studies. Body mass index exhibited a direct relationship with the operative time of cholecystectomy, colectomy, and unilateral mastectomy, but it was not associated with surgical complications in these studies.[6,7] Thus, the BMI may not directly influence surgical complications or SSI after abdominal surgery, although increased operative time and blood loss secondary to BMI may be responsible for any identified negative outcome.[5–7]

Caucasians tend to have a higher BMI than Japanese people, and the incidence of morbid obesity among patients undergoing surgery is growing in the United States and Europe. Accordingly, the proportion of patients with a BMI ≥25 in the present study was 34.7%, whereas in a Japan study the proportion of patients with a BMI ≥25 was only 14.7%.[1] These differences in physique may partly explain the differences in mortality and morbidity between the Western and Japanese studies.[1,8,9]

The mortality of patients undergoing D2 dissection in the two Western studies was 13% and 10%, respectively, and the morbidity was 46% and 43%, respectively. Conversely, in the Japanese study there was only 1.3% mortality and 35.1% morbidity in overweight patients undergoing D2 or D3 dissection.[1] We noted only 8.5% mortality and 28.8% morbidity among overweight patients undergoing D2. In addition to possible differences in the patients' physique, the experience and workload of surgeons are important factors that could contribute to different surgical outcomes.

This study is limited by the small number of patients, so the results are not definitely conclusive; however, they clearly suggest that caution is needed when performing gastrectomy for gastric cancer in overweight patients. In conclusion, overweight increased the risk of SSI in patients undergoing gastrectomy with D2 lymphadenectomy.

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