



Contents lists available at ScienceDirect

Journal of Diabetes and Its Complications

journal homepage: WWW.JDCJOURNAL.COM

The impact of hyperglycemia and obesity on hospitalization costs and clinical outcome in general surgery patients

Lauren Buehler^a, Maya Fayfman^a, Anastasia-Stefania Alexopoulos^a, Liping Zhao^b, Farnoosh Farrokhi^a, Jeff Weaver^c, Dawn Smiley-Byrd^a, Francisco J. Pasquel^a, Priyathama Vellanki^a, Guillermo E. Umpierrez^{a,*}

^a Emory University Department of Medicine, Atlanta, GA, USA

^b Emory University Rollins School of Public Health, Atlanta, GA, USA

^c Information Technology, Emory University, Atlanta, GA, USA

ARTICLE INFO

Article history:

Received 16 June 2015

Received in revised form 31 July 2015

Accepted 31 July 2015

Available online xxxx

Keywords:

Type 2 diabetes

Inpatient hyperglycemia

Obesity

Obesity paradox

Hospitalization costs

ABSTRACT

Background: The impact of obesity on clinical outcomes and hospitalization costs in general surgery patients with and without diabetes (DM) is unknown.

Materials and Methods: We reviewed medical records of 2451 patients who underwent gastrointestinal surgery at two university hospitals. Hyperglycemia was defined as BG \geq 140 mg/dl. Overweight was defined by body mass index (BMI) between 25–29.9 kg/m² and obesity as a BMI \geq 30 kg/m². Hospital cost was calculated using cost-charge ratios from Centers for Medicare and Medicaid Services. Hospital complications included a composite of major cardiovascular events, pneumonia, bacteremia, acute kidney injury (AKI), respiratory failure, and death.

Results: Hyperglycemia was present in 1575 patients (74.8%). Compared to patients with normoglycemia, those with DM and non-DM with hyperglycemia had higher number of complications (8.9% vs. 35.8% vs. 30.0%, $p < 0.0001$), longer hospital stay (5 days vs. 9 days vs. 9 days, $p < 0.0001$), more readmissions within 30 days (9.3% vs. 18.8% vs. 17.2%, $p < 0.0001$), and higher hospitalization costs (\$20,273 vs. \$79,545 vs. \$72,675, $p < 0.0001$). In contrast, compared to normal-weight subjects, overweight and obesity were not associated with increased hospitalization costs (\$58,313 vs. \$58,173 vs. \$66,633, $p = 0.74$) or risk of complications, except for AKI (11.9% vs. 14.8% vs. 20.5%, $p < 0.0001$). Multivariate analysis revealed that DM (OR=4.4, 95% CI=2.8,7.0) or perioperative hyperglycemia (OR=4.1, 95% CI=2.7–6.2) were independently associated with increased risk of complications.

Conclusion: Hyperglycemia but not increasing BMI, in patients with and without diabetes undergoing gastrointestinal surgery was associated with a higher number of complications and hospitalization costs.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

Diabetes mellitus (DM) and obesity are leading causes of morbidity and mortality and represent growing burdens on the U.S. health care system. Currently, there are over 29 million Americans living with DM, and over a third of the American population is obese (Ogden, Carroll, Kit, & Flegal, 2014). Among surgical patients, DM and hyperglycemia are associated with perioperative complications, length of hospital stay (LOS), resource utilization, and mortality (Kwon et al., 2013; Noordzij et al., 2007; Mraovic et al., 2010). In addition, several studies and meta-analyses have shown that the development of hyperglycemia, in patients with and without diabetes, is independently associated with complications including pneumonia, bacteremia, urinary tract infection, skin infections, pulmonary embolism, acute kidney injury, and death (Abdelmalak et al., 2014; Frisch & Smiley, 2010; Kwon et al., 2013; Mraovic et al., 2010).

Conflicts of Interest Statements:

• Guillermo Umpierrez is supported in part by research grants from the American Diabetes Association (1-14-LLY-36), and PHS Grant UL1 RR025008 from the Clinical and Translational Science Award program, National Institutes of Health, National Center for Research Resources.

- Lauren Buehler – Conflicts of interest: none
- Maya Fayfman – Conflicts of interest: none
- Anastasia-Stefania Alexopoulos – Conflicts of interest: none
- Liping Zhao – Conflicts of interest: none
- Farnoosh Farrokhi – Conflicts of interest: none
- Jeff Weaver – Conflicts of interest: none
- Dawn Smiley-Byrd – Conflicts of interest: none
- Francisco J. Pasquel – Conflicts of interest: none
- Priyathama Vellanki – Conflicts of interest: none

* Corresponding author at: Emory University School of Medicine, 49 Jesse Hill Jr. Drive, Atlanta, GA 30303, USA. Tel.: +1 404 778 1665.

E-mail address: geumpie@emory.edu (G.E. Umpierrez).

<http://dx.doi.org/10.1016/j.jdiacomp.2015.07.027>

1056-8727/\$© 2015 Elsevier Inc. All rights reserved.

Please cite this article as: Buehler, L., et al., The impact of hyperglycemia and obesity on hospitalization costs and clinical outcome in general surgery patients, *Journal of Diabetes and Its Complications* (2015), <http://dx.doi.org/10.1016/j.jdiacomp.2015.07.027>

Obesity is widely acknowledged to be a public health threat due to its association with multiple chronic conditions such as DM, hypertension, osteoarthritis, heart disease, some types of cancer (breast, colon, pancreas, and endometrium), and increased cardiovascular disease mortality (Flegal, Graubard, Williamson, & Gail, 2007; Haslam & James, 2005). There is a lack of consensus in the literature regarding the association between BMI and clinical outcome in surgical patients. In a meta-analysis of 18 orthopedic surgery studies (Kluczynski, Bisson, & Marzo, 2014), half of the studies found increased BMI to be associated with worse postoperative outcomes. Similarly, in hospitalized patients with severe trauma, obesity was reported to be associated with prolonged hospital stay and increased risk of complications (Bardou, Barkun, & Martel, 2013; Liu, Chen, Bai, Zheng, & Gao, 2013). In contrast, other studies have shown that obesity may actually be protective against morbidity and mortality in surgical and critically ill patients, a phenomenon which has been dubbed 'the obesity paradox' (Hutagalung et al., 2011; Schwann et al., 2001; Utzolino, Ditzel, Baier, Hopt, & Kaffarnik, 2014; Valentijn et al., 2013; Yamamoto et al., 2013). Despite the lack of a consensus in the literature on the association between obesity and postoperative complications, several studies have shown that surgeons are less likely to operate on obese patients compared to their normal weight counterparts, in particular in patients with diabetes (Reeves, Ascione, Chamberlain, & Angelini, 2003; Wang, Ramanathan, Stewart, Gamble, & White, 2013). Given the inconsistencies and gaps in evidence regarding the association between obesity and surgical outcomes, as well as the lack on information on the impact of diabetes in obese patients undergoing general surgery, we analyzed the effect of hyperglycemia and obesity on clinical outcomes and costs in patients undergoing gastrointestinal surgery.

2. Methods

This study analyzed prospectively gathered data on 2451 patients who underwent intra-abdominal surgery at Emory University Hospitals in Atlanta, Georgia between December 2010 and December 2012. After exclusion of patients who had missing information on BMI, hospital charges or blood glucose measures, a total of 2104 patients were included in the analysis. We included the 10 most commonly performed open and laparoscopic abdominal surgeries at our institution: appendectomy, cholecystectomy, gastric bypass, gastrectomy, colectomy, colostomy revision, hepatectomy, splenectomy, pancreatectomy, and small bowel excision/repairs. Patient selection and type of surgical procedures were identified using Current Procedural Terminology (CPT) codes established by the American Medical Association (AMA) (American Medical Association, 2013). The study was approved by the Emory University Institutional Review Board.

Inpatient hyperglycemia was defined by American Diabetes Association and Endocrine Society guidelines, as any BG value ≥ 140 mg/dL (7.8 mmol/L) (Moghissi, Korytkowski, DiNardo et al., 2009; Umpierrez et al., 2012) either in the operating room or during the hospital stay, up to seven days postoperatively. For the BMI analysis, BMI was calculated as weight (kg) divided by height squared (m^2), and patients were categorized into three groups: normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25–29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2). We excluded patients who were underweight (BMI < 18.5 kg/m^2) as these patients made up $< 5\%$ of our study population ($n=107$). The main outcomes for this study included inpatient complications, length of hospital stay, resource utilization, and cost of hospitalization. Prior diagnoses of DM and hospital complications were identified by ICD-9 codes generated during the hospitalization. Complications included a composite of major cardiovascular events, pneumonia, bacteremia, acute kidney injury (AKI), wound infection, and in-hospital mortality. ICD-9 codes were used to determining the presence of complications for all of these except for acute kidney

injury, which was defined as an increase in serum creatinine greater than 50% from the patient's baseline admission creatinine (Bagshaw et al., 2010).

Total hospital cost was calculated from total hospitalization charges using the 2011 and 2012 cost-charge ratios from Centers for Medicare & Medicaid Services. Data identified for extraction included ICD-9, CPT, MS-DRG codes as well as resource utilization data and related hospital charges. These were obtained from the electronic health record and billing/coding departments at Emory University Hospital.

2.1. Statistical analysis

Descriptive statistics were used to examine the distribution of patient demographics and clinical characteristics in the overall study population. Bivariate analyses comparing baseline demographics, complications, and cost by glycemic status and BMI category were performed using χ^2 test for categorical variables, ANOVA test for continuous variables with Gaussian distribution, and the Kruskal-Wallis test for continuous nonparametric data. Multiple logistic regression models adjusted for age, gender, race, and type of surgery were used to determine odds ratios and 95% confidence intervals for the relationship between hyperglycemia, BMI, and complications. An interaction term for BMI and glycemic status was included in the model to assess for a potential additive effect between these two variables. Hospital costs were modeled with gamma distribution to estimate adjusted costs by glycemic status or BMI category. Two-sided $p < 0.05$ was considered statistically significant. All analyses were performed using Statistical Analysis Software (SAS) version 9.4.

3. Results

Of the 2104 patients included in the analysis, 453 (21.5%) had a documented diagnosis of diabetes prior to surgery, and 1651 (78.5%) had no known history of diabetes. Of the patients without diabetes, 1122 (68.0%) had ≥ 1 blood glucose value greater than 140 mg/dL during their hospital stay. The mean BMI of all participants was 28.3 ± 6.6 kg/m^2 . A total of 716 patients (34.0%) were normal weight, 702 (33.4%) were overweight, and 686 (32.6%) were obese. The mean age of the study population at the time of admission was 55.6 ± 15.0 years, and 1052 (49.5%) of patients were male.

Compared to non-diabetic patients with normoglycemia, patients with DM and non-DM with hyperglycemia were older (48 vs. 60 vs. 57 years, $p < 0.0001$) and had a greater percentage of male subjects (44.0% vs. 57.4% vs. 49.7%, $p = 0.0002$) (Table 1). Patients with DM had a higher mean BMI compared to patients without DM with and without hyperglycemia, respectively (30.0 vs. 28.0 vs. 27.6 kg/m^2 , $p < 0.0001$). In addition, patients with DM and non-DM patients with hyperglycemia had a longer median length of stay, a higher likelihood of admission to the ICU, and a higher risk for readmission within 30 days after discharge, (all $p < 0.0001$) (Table 1).

Composite complications were approximately four times more likely among patients with DM (OR=4.49, 95% CI=2.85, 7.07) and non-DM patients with hyperglycemia (OR=4.08 95% CI=2.69, 6.18) compared to normoglycemia patients (both $p < 0.0001$) (Table 1). Individual complications that were significantly more common among DM and non-DM patients with hyperglycemia include major cardiovascular events, wound infection, pneumonia, AKI and death (all, $p < 0.05$) (Table 1).

Table 2 summarizes the comparison of patient demographic by BMI category (normal weight, overweight, and obese). Obese subjects were younger (54.3 vs. 56.6 vs. 55.8 years, $p = 0.0122$) and were more likely to be female ($p < 0.0001$) than patients in the overweight and normal weight categories. There were no significant differences in length of hospital stay ($p = 0.43$) or likelihood of readmission within 30 days ($p = 0.39$) among the three groups. Likewise, there was no

Download English Version:

<https://daneshyari.com/en/article/5902343>

Download Persian Version:

<https://daneshyari.com/article/5902343>

[Daneshyari.com](https://daneshyari.com)