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Original article

Acute kidney injury in bariatric surgery patients requiring intensive care admission: a state-wide, multicenter, cohort study

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Abstract

Background: A multidisciplinary bariatric surgical approach is currently the most effective treatment for obesity. However, little is known about how the physiologic impact of weight reduction surgery superimposed on premorbid obesity–related co-morbidities may adversely influence perioperative renal function.

Methods: This observational, multicenter study investigated all bariatric surgery patients (n = 590) admitted to any intensive care unit (ICU) in Western Australia between 2007 and 2011. Using Acute Kidney Injury Network (AKIN) criteria, we ascertained the incidence and contributing risk factors for acute kidney injury (AKI).

Results: Acute kidney injury (AKI) occurred in 103 patients, accounting for 17.5% of all ICU admissions after bariatric surgery with 76.8% of the AKI episodes limited to AKIN stage 1. In a multivariate analysis, male gender, premorbid hypertension, higher admission APACHE II scores, and blood transfusions were all associated with AKI, while preexisting chronic kidney disease and body mass index (BMI) appeared not to influence renal decline. Both ICU (6.7 versus 2.5 d, $P < .001$) and hospital (18.6 versus 6.8 d, $P < .001$) length of stays were significantly increased after AKI. Six patients required hemodialysis while both ICU mortality (2.9 versus 0%, $P = .005$) and long-term mortality (18.2 versus 4.7 deaths per 1000 bariatric patient-yr, $P = .01$) were greater in patients experiencing AKI.

Conclusions: AKI is common in bariatric patients requiring critical care support leading to increased healthcare utilization, prolonged hospitalization, and is associated with a higher mortality. BMI, a previously described risk factor, was not predictive of AKI in this cohort. (Surg Obes Relat Dis 2015;▮:00–00.)

Keywords: Obesity; Postoperative; Complications; Critical care; Dialysis

Obesity is a chronic, societal health burden leading to an increased prevalence of insidious co-morbidities, specifically diabetes mellitus and hypertension, 2 of the main risk factors predisposing to both acute and chronic kidney diseases [1]. In response to increasing obesity rates there has been a sustained rise in the incidence of bariatric surgery with improving surgical and anesthetic techniques inevitably leading to more complex patients being offered weight reduction surgery [2–5]. A multidisciplinary bariatric surgical approach is currently the most effective treatment for the burgeoning problem of obesity with

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emerging short- and long-term data to support both its efficacy and safety [6–9]. However, the physiologic stress of surgery superimposed on preexisting obesity-related comorbidities has the ability to adversely influence perioperative renal function.

With the advent of standardized reporting criteria for acute kidney injury (AKI), using either AKIN or RIFLE staging [10,11], it has become apparent that even small rises in plasma creatinine concentrations are associated with an increased threat of adverse outcomes in high-risk surgical cohorts [1,12–15], and the need for acute dialysis is an established independent risk factor for death [12,16,17]. Despite these understandings, the frequency and clinical impact of AKI in the setting of bariatric surgery on patient and resource-centered outcomes is not well understood.

Methods

Study design and setting

This was a retrospective, multicenter, observational cohort study including all patients who underwent bariatric surgery, with particular scrutiny conferred to all bariatric patients admitted to any intensivist-run ICU, in the state of Western Australia over a 5-year period between January 1, 2007, and December 31, 2011, with a minimum 12-month follow up.

Data sources and participants

Participants were identified through the manual screening of 8 specialist-run ICU admissions databases. All patients older than 18 years were included in the study cohort if they were admitted to an ICU after bariatric surgery or as a result of a subsequent complication directly arising from bariatric surgery. Upon the identification of all appropriate ICU patients, their hospital medical records were reviewed by one of the authors using a preformatted data extraction tool.

The above ICU patient database was then merged with an administrational database of all bariatric admissions for the same jurisdiction and time period created by the Western Australian Department of Health Data Linkage Unit (DLU). The DLU systematically connects and updates all the available health data from 8 core data elements, including the state death registry, for every individual within the entire state of Western Australia using the 10th edition international classification of diseases (ICD-10) diagnostic and procedure codes [18,19]. Prior ethics approvals were granted from all 8 participating hospitals as well as the Western Australian Department of Health Human Research Ethics Committee.

Definitions

The diagnosis of AKI was determined by a comparison between baseline and peak postoperative plasma creatinine concentrations, using the modified Acute Kidney Injury Network (AKIN) criteria starting from the time of ICU admission [10]. Urinary output data were not collected due to the inconsistency in reliable recording across smaller participating ICUs during the study period. Estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI formula, which has been endorsed by the Australasian Creatinine Consensus Working Group since 2012 as the preferred method of estimating eGFR in Australia [20,21]. Premorbid chronic kidney disease was defined using the Kidney Disease Outcomes Quality Initiative (K/DOQI) guidelines first published in 2002 and modified in 2012 [22,23].

Statistical analysis

Categorical variables were described in absolute numbers and percentages with comparisons performed using the chi-squared test. Continuous variables were described in mean, standard deviation, median, and interquartile range with comparisons performed using the unpaired student t test. Nonparametric continuous data was analyzed using the Mann-Whitney U test. A multivariable logistic model was constructed to predict the occurrence of AKI with findings presented with odds ratios (OR) and corresponding 95% confidence intervals (CI). Mortality rates between AKIN stages were compared using Kaplan-Meier survival analysis. A P value $< .05$ was considered statistically significant. All analyses were performed by SPSS for Windows (Version 21, IBM Corp., Armonk, NY) or S-Plus (Version 8.0, Insightful Corp., Seattle, WA).

Results

The Western Australian Department of Health DLU database was utilized between 2007 and 2011 to derive state-wide bariatric procedure and mortality data. During this 5-year period there were a total of 12,062 patients who underwent bariatric surgery in Western Australia of which 590 (4.9%) patients required 650 ICU admissions. During this same time period there were an estimated 61,500 bariatric procedures undertaken nationally [24]. Table 1 outlines the incidence of AKI, chronic kidney disease (CKD), plasma creatinine concentrations, length of stay, and mortality in this higher-risk surgical cohort by different AKIN stages. There were 103 (17.5%) bariatric patients admitted to an ICU who developed 112 episodes of AKI with the vast majority of admissions (76.8%) not progressing beyond the mildest form of AKIN stage 1. As expected, patients with AKI were observed to have an increase in their peak plasma creatinine concentrations, ICU, and hospital length of stays compared with patients without AKI. More severe stages of AKI resulted in progressively worse outcomes. The overall mortality after all bariatric surgery in Western Australia during this time period was extremely