

The Obesity Paradox in Emergency Abdominal Surgery: A Pilot Study

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Abstract

Background: Emergency surgery is associated with high mortality and morbidity and identifying the patients at highest risk of death represents a major challenge for intensivists. Obesity is a common comorbidity with increasing prevalence in the last 20 years. While conflicting results were reported on the association between obesity and mortality in elective surgery, very few data are available on this relationship in emergency surgery.

Methods: We investigated this association in 73 consecutive patients submitted to emergency abdominal surgery and admitted to our ICU (1st January 2016 - 31st December 2017).

Results: Obesity (BMI \geq 30) was present in 15 patients (20.5%). When compared to normal weight patients, obese patients showed a lower value of the comorbidity index (CCI: obese 4.7 ± 2 vs normal weight 5.8 ± 2 , $p=0.007$) and a higher incidence of surgical complications (obese pts: 6 vs normal weight pts: 9, $p=0.03$). A longer duration of mechanical ventilation was observed in obese patients (obese pts: 2 (1-6) vs normal weight pts: 10 (4-12) days, $p=0.021$). In hospital mortality rate was comparable between the two subgroups.

Conclusions: Our findings indicate that obesity is a common comorbidity in emergency abdominal surgery but obese patients did not show higher in-ICU mortality rate than normal weight patients, probably due to lower comorbidities. However, the incidence of surgical complication was higher in obese patient, as well as duration of mechanical ventilation.

Keywords: Emergency abdominal surgery; Obesity; Mortality; Complications.

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Introduction

Emergency surgery is associated with high mortality and morbidity and identifying the patients at highest risk of death represents a major challenge for intensivists. Obesity is a common comorbidity with increasing prevalence in the last 20 years. While conflicting results were reported on the association between obesity and mortality in elective surgery, very few data are available on this relationship in emergency surgery [1-3].

We investigated this association in 73 consecutive patients submitted to emergency abdominal surgery and admitted to our ICU (1st January 2016 - 31th December 2017).

Methods

Data were prospectively recorded in clinical registry and retrospectively analyzed. All patients (or their next of kin) signed a written informed consent for storing their clinical data. The study was approved by the Institutional Review Board of our hospital.

The study population comprises 73 consecutive patients submitted to emergency abdominal surgery (including emergency vascular surgery) and admitted to our ICU from 1st January 2016 and 31th December 2017.

Clinical variables were recorded for each patient from the electronic pre-anesthetic evaluation form and ICU chart. Age, gender, and body mass index (BMI) served as baseline variables. The presence of comorbidities was determined by taking the patients' history directly and the Charlson Comorbidity Scale index (CCI) was also calculated [4]. The Sequential Organ Failure Assessment (SOFA) was calculated before surgery and ICU admission [5]. Lactate values were measured before surgery and on ICU admission. The primary outcome was in-ICU mortality (that is during ICU stay).

Anaesthesiological technique

General anaesthesia was performed in all patients. Induction was conducted with a bolus of propofol (1-2.5 mg/kg) or midazolam (0.15-0.2 mg/kg) or ketamine (0.5-1 mg/kg) and remifentanyl (0.5-1 µg/kg/min) or fentanyl (1-2 µg/kg), and anaesthesia was maintained with sevoflurane or desflurane and fentanyl (25-100 µg) or remifentanyl (0.5-1 µg/kg/min). The neuromuscular block was achieved with atracurium (0.5-0.7 mg/kg) or rocuronium (0.6-1.2 mg/kg). Train of Four was used to monitor neuromuscular block. The Rapid Sequence Induction was undertaken in presence of inhalation risk. During the procedure, patients were mechanically ventilated with lung protective ventilation (tidal volume: 6 ml/kg; Peak Inspiratory Pressure <30 mmHg, and FiO₂: 40%-70%; positive end-expiratory pressure: 6-10 cm H₂O). All patients were monitored by means of the invasive arterial blood pressure, pulse rate, electrocardiogram, pulse oximetry and central venous saturation. The respiratory and metabolic status was monitored by means of blood gas analysis. Normothermia was maintained with a forced air warmer.

Statistical analysis

Statistical analysis has been conducted with SPSS 13.0 for Windows software (SPSS Inc, Chicago, IL). A two-tailed p value < 0.05 was considered statistically significant. Categorical variables are reported as frequencies and percentages; continuous variables

are reported as mean ± standard deviation (SD). For continuous variables, between-groups comparisons have been performed with Student's t-test or ANOVA (followed by Bonferroni post-tests if overall p was significant) or by means of Kruskal-Wallis H test. Categorical variables were compared with chi-square Univariate analysis (chi-square or Fisher's exact test for categorical data; Student's t test or Mann-Whitney U test for continuous data) was used to identify candidate variables for multivariate analysis which included those variables that resulted significant at univariate analysis or were considered clinically relevant. Backward stepwise logistic regression was performed in order to identify predictors of ICU mortality. Hosmer-Lemeshow goodness-of-fit test and Nagelkerke pseudo-R² are reported.

Results

Our population comprises 73 patients, mainly males (39/73, 53.4%) (Table 1). Patients aged > 75 years represented the majority of our series (44/73, 60%). Abdominal surgery was performed in most cases (65/73, 89%). The ICU-mortality rate was 26% (19/73). Obesity (BMI ≥ 30) was present in 15 patients (20.5%). When compared to normal weight patients, obese showed a lower comorbidity index value (p=0.007) and a higher incidence of surgical complications (p=0.03). A longer duration of mechanical ventilation was observed in obese patients (p=0.021). In-hospital mortality rate was comparable between the two subgroups.

At multivariate logistic regression analysis (Table 2) SOFA and lactate were independently associated with in-ICU mortality (when adjusted for BMI).

Table 1: Comparison between patients with BMI ≤ 30 and those with BMI > 30 - clinical characteristics.

	All	BMI ≤ 30	BMI > 30	p
Number	73	58 (79%)	15 (21%)	
Gender (M) (n,%)	39 (53.4%)	30 (55.5%)	9 (47.4%)	0.525*
Age (yrs) (mean ± SD)	73.5 ± 15	75 ± 15	68 ± 12	0.008(t)
Age > 75 yrs (n,%)	44 (60%)	39 (68%)	5 (33%)	0.016*
CCI (mean ± SD)	5.6 ± 2	5.8 ± 2	4.7 ± 2	0.007(t)
CCI ≥ 4	49 (67%)			
<i>Surgery (n,%)</i>				
Abdominal	65 (89%)	51 (88%)	14 (93%)	0.423*
Vascular	8 (11%)	7 (12%)	1 (7%)	
Mechanical ventilation (days) (median, IQR)	4 (1.75-8)	2 (1-6)	10 (4-12)	0.021#
LOS (days)	6 (4-10)	7 ± 5	9 ± 4	0.210 (t)
ICU mortality (n,%)	19 (26%)	13 (22%)	6 (40%)	0.166*

BMI: body mass index, CCI: Charlson comorbidity index, LOS: length of stay, ICU: intensive care unit. SD: standard deviation, IQR: interquartile range. (t): Student t test; *: chi square test; #: Kruskal-Wallis test.

Table 2: Comparison between patients with BMI ≤ 30 and those with BMI > 30- before surgery and ICU admission.

	ALL	BMI ≤ 30	BMI > 30	p
Number	74	58	15	
<i>Before Surgery</i>				
SOFA pre (mean ± SD)	4.05 ± 3.37	3.9 ± 3	4.2 ± 4	0.695 (t)
Lactate pre (mean ± SD)	4.68 ± 4.17	4.3 ± 3	4.5 ± 4	0.580 (t)
<i>ICU</i>				
SOFA ICU (mean ±SD)	6.36 ± 3.2	6.4 ± 3	6 ± 3.1	0.642 (t)
Lactate ICU (mean ±SD)	2.96 ± 2.74	3.1 ± 2	1.8 ± 0.9	0.006 (t)
<i>ICU complications (n,%)</i>				
Infections	8 (11%)	6 (10%)	2 (13%)	0.385*
Respiratory complications	5 (7%)	4 (7%)	1 (7%)	0.641*
Surgical complications	15 (21%)	9 (15%)	6 (40%)	0.031*

SOFA: Sequential Organ Failure Assessment; ICU: Intensive Care Unit. SD: standard deviation. (t): Student t test; *: chi square test.

Discussion

The main findings of our investigation, performed in 73 consecutive patients submitted to emergency abdominal surgery, are as follows: a) obesity (BMI > 30) is a common but it is not associated with increased ICU mortality than normal weight patients; b) SOFA and lactate are independent predictors for early mortality.

Our series, constituted by consecutive adult patients submitted to emergency abdominal surgery who needed post operative ICU admission, comprises mainly elderly patients (aged ≥ 75 yrs, 60%) with several comorbidities (as indicated by the Charlson Comorbidity Index, CCI ≥ 4, 67.1%), thus representing a high-risk population. Mortality rate in our series was comparable to that reported in previous studies [6,7] performed in high volume centres.

In our series, obesity is a common finding being encountered in the 21%, but, differently from previous papers on surgical patients [1,3], it is not associated with increased age or comorbidities (as indicated by CCI) probably due to the high percentage of elderly patients in our population. In the American College of Surgeons National Quality Improvement Program database from 2005 to 2010 [3] the incidence of obesity was slightly higher (32%) than that reported in our study but the discrepancy may be related to geographic variations and differences in obesity prevalence among different countries.

The main finding of our investigation is that obese patients submitted to emergency abdominal surgery showed a comparable ICU mortality rate than normal weight patients. Few data are so far available on the outcomes of obese patients submitted to emergency abdominal surgery. The paper by Benjamin et al [3] was the only investigation addressing this topic. In this large volume database, obesity was found to be protective against 30-d mortality while underweight patients were at increased risk of morbidity and mortality. Our results are in keeping with those by Benjamin et al [3], though we specifically focused on obesity (BMI > 30). However the novelty of our investigation is that we confirm the protective role of obesity in emergency abdominal surgery in a subset at high risk, constituted mainly by elderly patients with

several comorbidities. In the cohort described by Benjamin et al [3] the percentage of old patients (≥65 years) was only 24.5%, while in our series elderly patients (≥75%) were more than a half of the entire population. The high incidence of comorbidities observed in our series is in keeping with previous findings in surgical patients [8-10].

In our series, obese patients showed a higher incidence of surgical complications than normal weight patients, in agreement with previous reports. In a single-center investigation [1] including 4293 patients undergoing general surgery, obesity alone was a risk factor for wound infection, more surgical blood loss and a longer operation time, though these complications did not affect long term survival. In a large series of 7543 patients, mild obesity was not a risk factor for 30-day outcome after vascular surgery [11]. Impaired immunity and increased glucose levels frequently encountered in obese patients may represent contributing factors for the higher incidence of complications [12,13].

In our series, SOFA score, assessed both before surgery and on ICU admission, was an independent risk factor for ICU death in our series. To date, SOFA has not been extensively investigated in surgical patients. In a pilot study [14], including 33 surgical patients, the combination of SOFA score and biomarkers (NGAL, calprotectin, KIM-1, cystatin C, and GDF-15) proved to have a great prognostic value in post surgical patients. The addition of lactate values improved the accuracy of quick SOFA in predicting mortality in a retrospective analysis of 457 surgical patients with complicated intra-abdominal infections [15].

Study limitations

It is a single-centre study, thus comprising quite a small sample size. However, all patients are consecutive and submitted to a emergency abdominal surgery in a high volume center and afterwards managed by the same medical team during ICU stay. However, our results should be confirmed in a prospective multicenter investigation.

Our findings indicate that obesity is a common comorbidity in emergency surgery but obese patients did not show higher in-ICU mortality rate than normal weight patients, probably due to lower comorbidities. However, the incidence of surgical complication was higher in obese patient, as well as duration of mechanical ventilation.

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