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Impact of obesity on critical care treatment in adult patients

O impacto da obesidade no tratamento intensivo de adultos

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ABSTRACT

Study objective: Obese patients seem to have worse outcomes and more complications during intensive care unit (ICU) stay. This study describes the clinical course, complications and prognostic factors of obese patients admitted to an intensive care unit compared to a control group of nonobese patients.

Design: Retrospective observational study.

Setting: A 10-bed adult intensive care unit in a university-affiliated hospital.

Methods: All patients admitted to the intensive care unit over 52 months (April 01/2005 to November 30/2008) were included. Obese patients were defined as those with a body mass index (BMI) ≥ 30 Kg/M2. Demographic and intensive care unit related data were also collected. An clinical and demographical matching group of eutrophic patients selected from the data base as comparator for mortality and morbidity outcomes. The Mann-Whitney test was used for numeric data comparisons and the Chi Square test for categorical data comparisons.

Results: Two hundred nineteen patients were included. The obese group (n=73) was compared to the eutrophic group (n= 146). Most of this group BMI ranged between 30 – 35 Kg/M2. Only ten patients had body mass index ≥40 Kg/M2. Significant differences between the obese and eutrophic groups were observed in median APACHE II score (16 versus 12, respectively; p<0.05) and median intensive care unit length of stay (7 versus 5 days respectively; p<0,05). No significant differences were seen regarding risk of death, mortality rate, mechanical ventilation needs, days free of mechanical ventilation and tracheostomy rates. The observed mortality was higher than the APACHE II-predicted for both groups, but the larger differences were seen for morbid obese patients (BMI ≥40 Kg/M2).

Conclusions: Obesity did not increase the mortality rate, but improved intensive care unit length of stay. The current prognostic scoring systems do not include BMI, possibly underestimating the risk of death, and other quality of care indexes in obese patients. New studies could be useful to clarify how body mass index impacts the mortality rate.

Keywords: Obesity/mortality; Prognosis; Intensive care; Intensive care units; Apache; Body mass index; Mortality

INTRODUCTION

Worldwide, more than 1.6 billion adults are overweight, while 400 million people are obese. It is anticipated that in 2015, 2.3 billion people will be overweight, and 700 million, obese.[1] Obesity is categorized as overweight, obesity and morbid obesity. The criterion for this categorization is the body mass index (BMI), calculated as the weight in kilograms (kg) divided by the square of the height in meters (m). Overweight or Grade I obesity (BMI between 25 and 29 kg/m^2) is found in 35% of the adult population (20 to 74 years-old) in the United States of America; and for the same population, obesity or Grade II (BMI ≥ 30 kg/m^2) involves 27%.[(2)] The prevalence in adult women in the United States is 33.4%, while for man it is 27.5%. Morbid obesity or Grade III (BMI ≥ 40 kg/m^2) corresponds to 4.7% in the USA, while in Brazil, this percent is estimated to be from 0.5 to 1% of the adult population.[(3)] In Brazil, the prevalence of obese women is 12.4%, and 7% in men. Considering the urban population in Brazilian Southeast and Northeast regions, the obesity rate in 20 years or older subjects may be estimated as 12.9% in women and 8% in men.

The prognosis indicators were developed to quantify the patients' risk, and estimate their risk of death. They allow the comparison of different patients samples according to their disease severity. The most used indicators in intensive care units (ICUs) are the Acute Physiologic Chronic Health Evaluation (APACHE) II, the APACHE III, the Simplified Acute Physiological Score (SAPS) II and SAPS III. None of these take into consideration the patients' BMI. Thus, obesity is not captured by these prognostic indicators. An obese patient has other complications that directly impact their management: cervical anatomy changes, macroglossia, redundant oropharynx that may difficult intubation; restrictive lung disease, which may impact ventilation; increased risk of deep venous thrombosis and pulmonary thromboembolism, aggravated by the difficult bed mobilization; distorted anatomy, which may difficult installing and maintaining central venous lines,[(4)] and others.

These arguments are the support for this study. The authors believe that this is an increasingly prevalent condition, with scarce visibility and cumulative knowledge. The work hypothesis is that obesity increases the intensive care patients' mortality.

Thus, this study aimed to compare the morbidity and mortality between obese and nonobese patients staying in the adult intensive care unit (ICU) of the Hospital Geral do Grajaú, located in the extreme South of São Paulo city.

METHODS

This study was conducted in the Hospital Geral do Grajaú, a 250 beds hospital with an adult ICU with 10 beds, admitting about 380 patients yearly. The study design was observational and retrospective. The study period was from April 1st, 2005 to November 31, 2008 (52 months). All patients admitted to the ICU in this period were selected from the QuaTI [Intensive Care Quality] System database. The patients' weight and height were estimated by the same physician who was responsible for data collection and data entry to the QuaTI System available in this Unit. The system automatically calculates the body mass index (BMI) using the formula BMI = weight (kg)/ (height in meters)^2. The patients included in the obese group all had a BIM equal or above 30 kg/m^2. It was then built an eutrophic patients group with a 2:1 rate, extracted from the QuaTI System database, with the single criterion of age, for matching the obese group. When two or more matching patients were available, the choice was by chance. All other demographic and operational data were extracted from the QuaTI System database.

Were considered eutrophic those patients with BMI between 18.5 and 29.9 kg/m^2, Grade I obese those with BMI between 30 and 34.9 kg/m^2, Grade II obese those with BMI between 35 and 39.9 kg/m^2 and Grade III obese, or morbid obese, those with BMI equal or above 40 kg/m^2.

Statistical analysis

The numerical variables were presented as median, with the respective 25 and 75 percentiles, i.e., the interquartile interval. Dicotomic variables were presented as percentages. For the continuous measures, the Mann-Whitney test was used, and the Chi Square test was used for the dicotomical ones. The significance level used was 5%. The analysis was performed with the EPI INFO 3.5.1 software.

RESULTS

During this period, 1,397 patients were admitted, and 73 patients with BMI ≥ 30 (5.22%) were identified. Forty nine of the 73 obese patients (67%) came from the emergency room, 15 patients (21%) from the surgery room, 7 (10%) from the wards and 2 patients (2%) transferred from other hospitals. The ICU obese and nonobese patients' demographics are shown and compared on table 1.

The distribution and comparison of the main discharge diagnosis, according to the International Classification of Diseases, 10th edition (ICD-10), is presented on table 1, where it can be seen that no differences re-

Table 1 – Demographics and other patients' characteristics comparison of obese versus nonobese patients

Variables	Nonobese (N = 146)	Obese (N = 73)	P value
Gender M/F	61/85 (72)	18/55 (33)	0.01
Age (years)	49.1 (57.5 - 69.6)	49.7 (59.4 - 69.7)	0.90
APACHE II score	8 (12 - 16)	8 (16 - 20)	< 0.05
Risk of death (%)	6 (12 - 75)	7 (13 - 35)	0.0881
Mortality	44 (30.1)	28 (38.4)	0.28
Nosocomial infection	29 (19.8)	22 (30.1)	0.127
Length of stay in ICU (days)*	2.7 (5.0 - 9.8)	3.6 (7.0 - 15.6)	0.029
IMV	70 (48)	43 (59)	0.18
IMV time (days)**	5.0 (8.0 - 17.5)	7.0 (13.0 - 24.0)	0.33
Tracheostomized***	19/70 (27)	17/43 (39)	>0.20
Circulatory system diseases	46 (31.5)	23 (31.5)	1.0
Respiratory system diseases	24 (16.4)	15 (20.5)	0.45
Genitourinary system diseases	17 (11.6)	5 (6.8)	0.26
Infectious diseases	13 (8.9)	4 (5.4)	0.37
Neoplasms	10 (5.7)	5 (5.7)	1.0
Digestive system diseases	8 (5.4)	5 (6.8)	0.68
Endocrine diseases	5 (3.4)	6 (8.2)	0.12
Others	23 (15.7)	10 (13.7)	0.68
BMI (Kg/m^2)	20.8 (22.0 - 23.4)	31.2 (31.2 - 35.2)	0.0

M – male; F – female; APACHE II - Acute Physiology and Chronic Health Evaluation II; ICU – intensive care unit; IMV – invasive mechanic ventilation;.Values expressed as median (25-50 percentiles) or number (percent)*. Median ICU length of stay of survivors. ** median IMV time of survivors. *** Number of tracheostomized patients/Number of ventilated patients. Chi Square or Mann-Whitney tests.

garding diagnosis were identified for the groups. Circulatory system diseases were predominant, followed by Respiratory and Genitourinary systems.

Table 2 shows the BMI frequency and distribution in the obese patients group. It can be noticed that the below 35 kg/m^2 BMI patients largely prevailed. This was, thus, a group predominantly made of Grade I, or mild, obesity patients.

Table 3 shows the mortality distribution according to different BMI ranges. No cumulative mortality was found as the BMI increased. A trend was observed, but due to the small numbers of patients with a ≥ 40 kg/m^2 BMI, we are lead to conclude for the Null hypothesis.

Table 4 shows the predicted and actual mortality rates according to the different BMI ranges. It was observed that the largest difference was seen for patients with BMI ≥ 40 kg/m^2, although statistically non-significant.

Table 2 – Body mass indexes (BMI) ≥ 30 kg/m^2 frequencies for the obese patients group

BMI classes	Frequency	Relative frequency (%)	∑%
30 ----|35	53	72.6	72.6
35 ----|40	10	13.7	86.3
40 ----|45	6	8.2	94.5
45 ----|50	3	4.1	98.6
50 ----|55	0	0	98.6
55 ----|60	1	1.4	100
Total	73	100	100

Table 3 – Mortality frequency and comparison by body mass index

BMI(Kg/M^2)	Dead	Alive	Total
Nonobese< 30	44 (30.1)	102 (69.9)	146 (100)
Obese 30--|40	24 (38.1)	39 (61.9)	63 (100)
Morbid > 40	4 (40.0)	6 (60.0)	10 (100)
Total	72 (32.9)	147 (67.1)	219 (100)

$X^2 = 1.50$ p = 0.471.

Table 4 – Mortality frequency and comparison for anticipated and actual mortality, by body mass index

BMI (Kg/M^2)	Anticipated mortality (N)	Actual mortality (N)	P/A rate
Nonobese < 30	24	44	1.83
Obese 30--|40	14	24	1.71
Morbid > 40	2	4	2.0

DISCUSSION

This study failed to show obese patients to have increased ICU mortality versus nonobese patients. Goulenok[5] and El-Solh[6] found different results, with increased mortality for obese patients. The Garroust-Orgeas[7] study also failed to show increased obese patients mortality.

Some considerations are due. In this study, weight and height were estimated, not measured. Another relevant question is the obese group patients composition. There are several differences according to the study design. Table 2 analysis shows that in this study, 72.6% of the patients clustered as obese had BMIs between 30 and 35 kg/m^2. Thus, this sample was predominantly made of Grade I obese patients. Yet, in El-Solh's[6] study, comparing eutrophic patients, with BMI < 30 kg/m^2 to morbid obese patients, BMI > 40 kg/m^2, these authors found increased morbid obese patients' mortality. In the El-Solh's[6] study it can be seen that the groups involved large BMI differences, i.e., the tension was bigger, as was the number of included patients. In the Garroust-Orgeas[7] study, the patients were divided into four groups according to their BMI. The first group involved malnutrition patients, with BMI ≤ 18.5 kg/m^2 and the last obese patients with BMI ≥ 30 kg/m^2. Increased mortality was found for the malnutrition patients group. As in our study, Garroust-Orgeas'[7] study had a Grade I obese patients predominance. In our study, only 10 out 73 patients (13.7%) had BMI > 40 kg/m^2. In these, the mortality was 40%. Hogue et al.,[8] in a recent meta-analysis including 88,051 patients, also failed to find increased mortality for obese patients.

The groups' composition was an arbitrary investigator's choice. It was based on the World Health Organization's recommended classification,[9] driven by the BMI. In this study, the 30 kg/m^2 boundary was chosen for the groups. Other authors segmented their samples, and used the 75 or 85 percentiles cutoff for forming their groups.[5] With this procedure, there is a specificity loss, but a larger sample. We chose to include in the obese group patients with BMI > 30 kg/m^2. With the sample reduction to 73 obese patients, we considered appropriate to establish a comparison with a group with twice the obese patients sample size, otherwise, the groups sizes would be too different. The criterion chosen for matching was age, as we aimed to compare the clinical outcomes, prognostic scores and risk of death. Age is one of the most impacting parameters for these indexes, then its choice to achieve an appropriate groups' match. Another important outcomes determinant is the patients' diagnosis. Table 1 shows that there were no significant differences between the groups according to the discharge diagnosis, indicating a satisfactory groups' homogeneity.

There was a predominance of women in the obese group, and no age differences between the groups. The APACHE II score was higher in the obese group, but the risk of death was not different between the groups. The mortality rate, the incidence of nosocomial infections, the invasive mechanic ventilation (IMV) need, IMV survivors' time, and tracheostomy frequency, were not different between the groups. The ICU length of stay was longer in the obese group survivors versus the nonobese group survivors.

The obesity incidence in this study (5.2%) was lower than in other studies.[5-7] Obesity was more frequent in women (Table 1), and this reflected the known increased prevalence in women, determined by the hormone profile in this gender. The APACHE II score, as well as the risk of death, estimated by this index, were higher in the obese group (Table 1). This difference came from the obesity associated diseases, impacting the score. The actual risk of death and mortality were not significantly different. However, it should be emphasized that in the ≥ 40 kg/m^2 BMI group the largest differences between predicted and actual mortality were seen.

The ICU length of stay (survivors) for obese patients was longer than for nonobese. This finding coincided with other studies findings.[5-7] Invasive mechanic ventilation (IMV) need, as well as the IMV time (survivors) were not different between the groups. The same was seen for the nosocomial infections rates. Both variables are the main determinants for ICU length of stay. Regarding the tracheostomy need, also no difference was found for the groups.

One of this study's limitations was the weight and height estimation, instead of actual measurement. Unfortunately, among us, most of ICUs estimate weight and height, as bed scales are still few, mainly in hospitals which are part of the Governmental Health System. Other limitations were the single center design and the perhaps insufficient number of morbid obese patients to reach the statistical significance level set by the investigators. A longer time span would be needed, or a multicenter design, to obtain a larger morbid obese patients sample, as this condition estimated prevalence in the Brazilian population is relatively small (0.5 to 1.0%). Thus, it can be stated that, if the morbid obese patients (BMI > 40 kg/m^2) was larger in different studies, the mortality may also changed. The results suggest that a BMI cutoff level may exist from which increased mortality will be seen in the obese patients group.

CONCLUSIONS

The obese and nonobese patients' prognosis, as measured with the APACHE II, was not different. The actual mortality rate for both groups was also not different. Increased obese patients morbidity was identified. Obesity is not considered in the main prognosis indicators used for severely ill patients, and this could underestimate this group of patients' mortality rates. Including BMI in the prognosis scores remains controversial. New studies, with larger BMI > 40 kg/m^2 patients' numbers could be useful to improve the understanding of this condition, which is growingly prevalent in the Brazilian population, and thus drive strategies for these patients care improvement.

RESUMO

Objetivos: Verificar o prognóstico de pacientes obesos e eutróficos internados em Unidade de Terapia Intensiva (UTI) de adultos.

Desenho: Estudo retrospectivo e observacional

Métodos: Todos os pacientes admitidos na UTI durante 52 meses foram incluídos. Foram selecionados pacientes com IMC ≥30 Kg/M^2 para compor o grupo obeso e outros com IMC < 30 Kg/M^2, com características clínicas e demográficas semelhantes, que formaram o grupo eutrófico. Foram comparadas a mortalidade e a morbidade entre os grupos. O teste de Mann- Whitney foi usado para as variáveis numéricas e o teste do qui quadrado para as categóricas.

Resultados: Duzentos e dezenove pacientes foram incluídos. O grupo obeso (n=73) foi comparado com o grupo eutrófico (n=146). A maioria dos pacientes do grupo de obesos apresentou IMC na faixa de 30 a 35 Kg/M^2, enquanto que os obesos mórbidos (IMC> 40 Kg/M^2) totalizaram apenas 10 pacientes. Não se observou diferença na taxa de mortalidade real, na mortalidade prevista pelo APACHE II, na mediana do tempo de ventilação mecânica e na freqüência da realização de traqueostomia. As diferenças observadas foram na mediana do tempo de internação na unidade de terapia intensiva (7,0 versus 5,0 dias respectivamente; p<0,05), na mediana do escore do APACHE II (16,0 versus 12,0 respectivamente; p<0,05). A mortalidade observada foi sempre maior que a predita, segundo o APACHE II, nos dois grupos, porém o maior descolamento foi registrado nos pacientes com IMC > 40Kg/M^2.

Conclusões: Neste estudo a obesidade não aumentou a taxa de mortalidade, mas aumentou o tempo médio de permanência na UTI. Os atuais indicadores prognósticos ao não incluírem o IMC poderiam subestimar o risco de morrer e interferir em outros indicadores de qualidade do desempenho assistencial. Como ainda não há um consenso sobre a interferência da obesidade na mortalidade, a inclusão do índice de massa corpórea nos indicadores permanece controversa. Novos estudos, com maior número de obesos, poderão apontar qual o ponto de corte a partir do qual o índice de massa corpórea determinaria o incremento da taxa de mortalidade.

Descritores: Obesidade/mortalidade; Prognósticos; Cuidados intensivos; Unidades de terapia intensiva; Apache; Índice de massa corporal; Mortalidade

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