Prevalence and Impact of Overweight and Obesity in Critically Ill Surgical Patients: Analysis of THAI-SICU Study

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Objective: *To investigate the prevalence of overweight and obesity, and their impacts in patients admitted to a surgical intensive care unit (SICU) in Thailand.*

Material and Method: *We conducted an analysis using the THAI-SICU database. All 4,579 patients who had weight and height measured were classified into four groups using body mass index (BMI) based on the World Health Organization criteria, which were 1) underweight (BMI <18.5 kg/m^2), 2) normal BMI (BMI 18.5-24.9 kg/m^2), 3) overweight (BMI 25-29.9 kg/m^2), and 4) obese (BMI ≥30 kg/m^2) groups. Primary outcome was prevalence of overweight and obesity. Secondary outcomes were 28-day survival, and SICU outcomes between four patient groups.*

Results: *There were 768 (16.8%) of underweight, 2,624 (57.3%) of normal BMI, 858 (18.7%) of overweight, and 329 (7.2%) of obese patients. Compared to other three patient groups, obese had the highest 28-day survival (log-rank, p<0.001), lowest incidence of systemic inflammatory response syndrome (SIRS) (underweight 41.1%, normal BMI 35.6%, overweight 34.5%, and obese 29.5%; p = 0.001), and lowest incidence of new infection (underweight 27.3%, normal BMI 23.3%, overweight 24.5%, and obese 20.4%; p = 0.047). After adjustment for related confounding factors, we found that every one unit increasing of BMI associated with lower risk of hospital mortality [odds ratio, OR, 0.97(95% confidence interval, CI, 0.94-0.99); p = 0.04], higher risk of acute respiratory distress syndrome (ARDS) [OR 1.06 (95% CI 1.03-1.08); p<0.001], and higher risk of intra-abdominal hypertension (IAH) [OR 1.06 (95% CI 1.03-1.09); p<0.001].*

Conclusion: *The prevalence of overweight and obesity in Thai critically ill surgical patients were 18.7% and 7.2%, respectively. Compared to patients with lower BMI, patients with higher BMI had significantly lower mortality but greater risk of ARDS and IAH.*

Keywords: *Obesity paradox, Obese, Mortality, ARDS, Intra-abdominal hypertension, ICU outcome*

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Obesity is a major problem and a risk factor for a number of chronic diseases worldwide[1] and it is found increases the risk of diabetes[2], cardiovascular disease[3], and metabolic syndrome[4]. Unfortunately, a similar trend of increasing rate of obesity has been observed in many countries around the world[5-8]. Compared to patients with normal range of body mass index (BMI), obese patients has a differ physiologic changes such as stiffer chest wall that leads to increased respiratory system elastance and alveolar collapse, as well as the thickness of preperitoneal fat that leads to higher baseline intra-abdominal pressure (IAP)[9]. Although these physiologic changes in obese may cause adverse effect, and several studies demonstrated that obesity augments the inflammatory

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response[10,11], there is growing evidence support that obese patients have lower mortality than lean patient in various types of critically ill such as severe sepsis[12], intra-abdominal infection[13], and cardiothoracic patients[14]. In Thailand, to date, there is no study of prevalence and impact of obesity on clinical outcomes in critically ill surgical patients. We examined the prevalence of overweight and obesity in Thai critically ill who were admitted to surgical intensive care unit (SICU). We hypothesized that in the case of critically ill surgical patients, whose primary disease entity differs from critically ill medical patients, obesity still confers a protective effect that is lowering mortality compared to patients with normal BMI.

Material and Method

Patients

We performed a retrospective cohort analysis using the THAI-Surgical Intensive Care Unit (THAI-SICU) cohort[15], which recruited 4,652 Thai patients who were admitted to the SICUs from nine university-based hospitals in Thailand during 19-month period (April 2011 to November 2012). Of these, 4,579 patients had height and body weights measured at the time of SICU admission and were recruited in this analysis. BMI was calculated as weight (in kilograms) divided by height (in meters) squared. The patients were categorized into four groups based on BMI criteria recommended by the World Health Organization (WHO)[16], which were 1) underweight (BMI <18.5 kg/m^2), 2) normal BMI (BMI 18.5-24.9 kg/m^2), 3) overweight (BMI 25-29.9 kg/m^2), and 4) obese (BMI $\geq$30 kg/m^2). Demographic data for all patients were collected such as age, gender, BMI, severity score (Acute Physiology and Chronic Health Evaluation; APACHE II), American Society of Anesthesiology (ASA) classification, and major sites of operation. The THAI-SICU study was approved by the research ethics boards of all participating centers, and written informed consent was obtained from all patients or their relatives.

Outcome measurements

The primary outcome was prevalence of overweight and obesity. Secondary outcomes included 28-day survival, incidence of systemic inflammatory response syndrome (SIRS), new infection, acute respiratory distress syndrome (ARDS), and intra-abdominal hypertension (IAH). SIRS was defined as the presence of symptoms meeting two or more SIRS criteria[17]; new infection was defined when the clinically suspected given antibiotics or positive culture from a sterile site. ARDS was defined using the American-European Consensus Criteria[18], which was the presence of bilateral pulmonary infiltration on chest radiography without evidence of left atrial hypertension by clinical signs or pulmonary capillary wedge pressure less than or equal to 18 mmHg, and PaO_2/FiO_2 less than or equal to 200. IAH was defined using World Society of the Abdominal Compartment Syndrome consensus definition[19], which was sustained or repeated pathological elevation in IAP, measured at end-expiration in supine via the bladder, more than or equal to 12 mmHg.

Statistical analysis

We tested for the differences in baseline characteristics between four groups of patients (underweight, normal BMI, overweight, and obese) by using a Kruskal-Wallis test for continuous variables or a chi-square test for categorical data, and we report the median and interquartile range (IQR). Prevalence of overweight and obesity were calculated and we reported the percentage. 28-day survival outcome was evaluated using log-rank test to compare Kaplan-Meier survival curves for underweight, normal BMI, overweight, and obese. We tested for differences in incidence of SIRS, new infection, ARDS, and IAH between four groups of patients using a Chi-square test, and we report the percentage. In multivariate analysis for risk of hospital mortality, SIRS, new infection, ARDS, and IAH, we tested for the influence of covariates, including age, gender, APACHE II score, patients' pre-existing diseases (diabetes, hypertension, coronary artery disease, chronic respiratory disease, and chronic kidney disease), and BMI by using logistic regression analysis, and the result was expressed as odds ratio (OR) with 95% confidence interval (CI). Differences were considered significant by using a two-tailed *p*-value of less than 0.05. Statistical analyses were performed using SPSS (v.23.0; IBM Corporation, NY, USA) statistical software packages.

Results

Patient characteristics and prevalence of overweight and obesity in SICU

There were 768 (16.8%) underweight, 2,624 (57.3%) normal BMI, 858 (18.7%) overweight, and 329 (7.2%) obese patients. Median BMIs of underweight, normal BMI, overweight, and obese patients were 17.1, 21.9, 26.7, and 33.3 kg/m^2, respectively (Table 1). Obese patients were youngest, followed by overweight, normal weight, and underweight patients (p<0.001).

Table 1. Baseline characteristic among four groups of patients based on patient's body mass index

	Underweight (n = 768)	Normal BMI (n = 2,624)	Overweight (n = 858)	Obese (n = 329)	*p*-value
Age, year	68 (52-78)	65 (51-75)	64 (53-74)	57 (42-69)	<0.001
Male, n (%)	437 (56.9)	1,628 (62.0)	478 (55.7)	147 (44.7)	<0.001
APACHE II score	12 (8-16)	10 (7-16)	10 (7-15)	8 (5-12)	<0.001
BMI, kg/m^2	17.1 (15.9-17.8)	21.9 (20.3-23.3)	26.7 (25.8-28.0)	33.3 (31.2-39.1)	<0.001
Pre-existing diseases, n (%)					
Diabetes	99 (12.9)	496 (18.9)	265 (30.9)	132 (40.1)	<0.001
Hypertension	280 (36.5)	1,213 (46.2)	515 (60.0)	222 (67.5)	<0.001
Coronary artery disease	49 (6.4)	261 (9.9)	104 (12.1)	37 (11.2)	0.001
Chronic respiratory disease	26 (3.4)	63 (2.4)	19 (2.2)	23 (7.0)	<0.001
Chronic kidney disease	63 (8.2)	242 (9.2)	88 (10.3)	37 (11.2)	0.330
ASA class, n (%)					
I	36 (6.7)	147 (7.4)	45 (6.5)	6 (2.1)	0.010
II	185 (34.3)	606 (30.5)	231 (33.2)	97 (34.2)	0.250
III	260 (48.1)	979 (49.3)	331 (47.6)	146 (51.4)	0.700
IV	55 (10.2)	218 (11.0)	81 (11.7)	33 (11.6)	0.840
V	4 (0.7)	35 (1.8)	7 (1.0)	2 (0.7)	0.140
Operated, n (%)	567 (73.8)	2,027 (77.2)	707 (82.4)	289 (87.8)	<0.010
Emergency surgery, n (%)	191 (36.3)	631 (33.0)	227 (33.3)	82 (28.8)	0.180
Major sites of surgery, n (%)					
Thoracic	54 (7.0)	101 (3.8)	27 (3.1)	6 (1.8)	<0.001
Upper abdomen	227 (29.6)	738 (28.1)	238 (27.7)	83 (25.2)	0.530
Lower abdomen	195 (25.4)	715 (27.2)	271 (31.6)	79 (24.0)	0.010
Others	372 (48.4)	1,331 (50.7)	414 (48.3)	177 (53.8)	0.240

Data are median (interquartile range) for continuous variables. The *p*-values compared between 4 groups of patients using the Chi-square test or Kruskal-Wallis test.
(APACHE = Acute Physiology and Chronic Health Evaluation; ASA = American Society of Anesthesiologist; BMI = body mass index; Others = maxillofacial, orthopedic, or vascular surgery)

Compared to the other three patient groups, obese was least frequently had male patients (underweight 56.9%, normal BMI 62%, overweight 55.7%, and obese 44.7%; $p<0.001$), had the lowest APACHE II score (underweight 12 (IQR 8-16), overweight 10 (IQR 7-15), normal BMI 10 (IQR 7-16), and obese 8 (IQR 5-12); $p<0.001$), and had highest proportion of patients with diabetes (underweight 12.9%, normal BMI 18.9%, overweight 30.9%, and obese 40.1%; $p<0.001$), hypertension (underweight 36.5%, normal BMI 46.2%, overweight 60%, and obese 67.5%; $p<0.001$), and chronic respiratory disease (underweight 3.4%, normal BMI 2.4%, overweight 2.2%, obese 7%; $p<0.001$). Compared to the other three patient groups, obese had lowest proportion of patients with ASA class 1 (underweight 6.7%, normal BMI 7.4%, overweight 6.5%, and obese 2.1%; $p = 0.01$), lowest proportion of patients underwent thoracic surgery (underweight 7%, normal BMI 3.8%, overweight 3.1%, and obese 1.8%; $p<0.001$) and lower abdominal surgery (underweight 25.4%, normal BMI 27.2%, overweight 31.6%, and obese 24%; $p = 0.01$).

28-day survival and effect of BMI on hospital mortality

We found that obese had the highest 28-day survival, followed by patients with overweight, normal BMI, and underweight patients ($p<0.001$) (Fig. 1A), this result still be the same when the patients in the obese group were sub-classified[16] into obese class I (BMI 30-34.9 kg/m^2), obese class II (BMI 35-39.9 kg/m^2), and obese class III ($\geq$40 kg/m^2) ($p<0.001$) (Fig. 1B). To validate these findings, we introduced BMI as a continuous variable in our regression analysis. After adjustment for factors that are known to influence mortality such as APACHE II score, and baseline characteristics that differ between groups such as age,

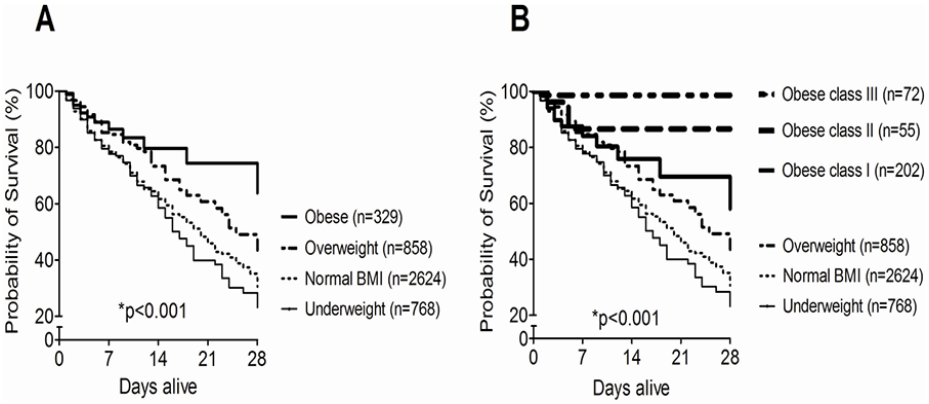

Fig. 1 28-day Kaplan-Meier survival curves compared among four groups of patients (A), and further analysis by sub-classification of the patients in obese group into obese class I, class II, and class III (B) (Log-rank analysis, *p<0.001).

gender, operated (vs. non-operated), and patients' pre-existing diseases (diabetes, hypertension, coronary artery disease, chronic respiratory disease, and chronic kidney disease), we found that every 1 unit increase in BMI is associated with lower risk of hospital mortality with an OR of 0.97 (95% CI: 0.94-0.99, p = 0.04) (Table 2).

Table 2. Multivariate analysis for hospital mortality

	Odds ratio	95% CI	p-value
Age (per year)	1.01	0.99-1.02	0.130
Male (vs. female)	1.13	0.86-1.48	0.400
Body mass index (per 1 unit)	0.97	0.94-0.99	0.040
APACHE II (per score)	1.25	1.23-1.27	<0.001
Chronic kidney disease	2.06	1.32-3.22	0.002
Operated (vs. non-operated)	2.49	1.92-3.24	<0.001

Adjusted to age, gender, APACHE II score, operated/non-operated, patients' pre-existing diseases (diabetes, hypertension, coronary artery disease, chronic respiratory disease, and chronic kidney disease), and body mass index; logistic regression analysis.

Incidence of SIRS, new infection, ARDS, and IAH

During SICU stay, there were 1,643 (35.9%), 1,098 (24.0%), 173 (3.8%), and 244 (5.3%) patients were diagnosed SIRS, new infection, ARDS, and IAH, respectively. Among four groups, obese had lowest incidence of SIRS (underweight 41.1%, normal BMI 35.6%, overweight 34.5%, and obese 29.5%; p = 0.001) (Fig. 2A) and new infection (underweight 27.3%, normal BMI 23.3%, overweight 24.5%, and obese 20.4%; p = 0.047) (Fig. 2B). Conversely, we found that overweight and obese had significantly higher incidence of ARDS (underweight 2.1%, normal BMI 4.0%, overweight 4.5%, and obese 4.3%; p = 0.048) (Fig. 2C) and IAH (underweight 0.7%, normal BMI 1.4%, overweight 2.3%, and obese 2.4%; p = 0.03) (Fig. 2D), compared to patients with normal BMI and underweight. To validate the effect of obesity on these outcomes, we performed multivariate analysis and introduced BMI as a continuous variables in regression model, following adjusted to age, gender, APACHE II, operated/non-operated, and patients' pre-existing diseases, we found that every 1 unit of increase in BMI is associated with increased risk of ARDS with OR of 1.06 (95% CI 1.03-1.08, p<0.001), and increased risk of IAH with OR 1.06 (95% CI 1.03-1.09, p<0.001). There was no association between BMI and risk of SIRS (OR 0.99, 95% CI 0.98-1.01; p = 0.23), or new infection (OR 0.99; 95% CI 0.99-1.02; p = 0.99).

Discussion

In a survey of prevalence of obesity on the national level, previous studies in Thailand demonstrated that prevalence of overweight and obesity was high, and there was increasing trend of BMI per decade[7]. Using WHO criteria[16], prevalence of overweight and obesity in Thai population were found between 19-26% and 4-9%[7,8], which was close to our study. We found a prevalence of overweight and obesity in critically ill Thai patients admitted to the SICU of 18.7% and 7.2%. Our study has validated the facts that obesity is increased risk of diabetes and cardiovascular disease by demonstrating that, compared to patients with normal BMI and underweight, we found that patient with overweight and obese had significantly higher proportion of

patients with diabetes, hypertension, and coronary artery disease.

While obesity links to increased risk of diabetes, metabolic syndrome, and cardiovascular disease[2-4], obese patient with severe infection was found associated with significantly lower mortality compared to the patients with normal BMI[12]. In critically ill surgical patients there is a growing body of evidence supports the hypothesis that obesity is associated with higher survival compared to patients with normal BMI[13,20,21]. The mechanisms of the "obesity paradox" phenomenon, by which obesity might protect the patients against critical injury during admission to the SICU, are unclear. However, there are potential possibilities why obese patients had higher survival compared to lean patients. For example, during initial phase of critical illness when an extremely high catabolic state occurs, the obese had more adipose tissue caloric reserve which may provide more energy production. In addition, during early phase of severe infection, it was found that the obese patient expressed lower pro-inflammatory cytokine than lean patient[12]. Moreover, excessive fluid status plays a role in increased hospital mortality[22]. It was found that, per kilogram, obese and overweight patients received less fluid and had lower positive fluid balance than patients with BMI less than 25 kg/m^2 during the first four days in a cohort of patients with severe sepsis[12]. In addition, BMI might be unreliable to predict a nutritional status, as a high BMI can be the result from either high muscle mass or high adipose tissue in the body. Our major findings were that obese and overweight had significantly higher survival compared to patients with normal BMI and underweight patients. And we confirmed our hypothesis by adjusting the possible known confounding factors related to mortality, and we still found that increased BMI was associated with lower hospital mortality.

Moreover, we found that obese and overweight had lower incidence of SIRS and new infection compared to underweight and normal BMI. These results align to previous studies in patients with severe sepsis, which demonstrated that the interleukin-6 inflammatory response was muted in overweight and obese patients, and obese patients had less susceptibility to fungal and pulmonary infection[12]. However, after we adjusted for the important confounding factors in multivariate analysis for the risk of SIRS and new infection, it turned out that there was no an association between BMI and the risk of SIRS or new infection. So, we assumed that a lower incidence of SIRS and new infection in obese may be a result from lower baseline severity (APACHE II score) in obese groups compared to other groups of patients.

Obese patients have more soft tissue thickening in both thoracic and abdominal wall regions.

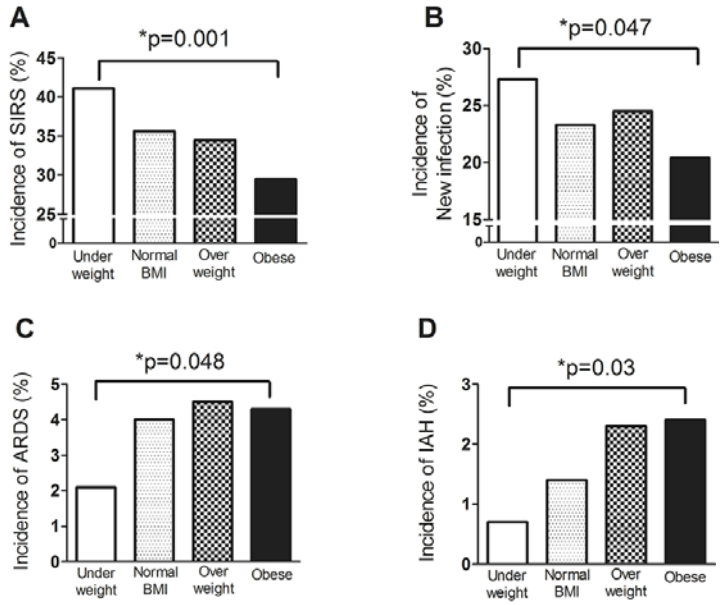

Fig. 2 Incidence of systemic inflammatory response syndrome (SIRS) (A), new infection (B), acute respiratory distress syndrome (ARDS) (C), and intra-abdominal hypertension (IAH)(D) among four groups of patients based on their body mass index (BMI) (Chi-square test, * p<0.05).

Interestingly, in our study, even obese had a higher survival compared to lean patient; we found an association between BMI and the risk of ARDS and IAH. Regarding to the risk of ARDS in the obese, there is experimental evidence supporting the notion that pulmonary vascular endothelial function can be impaired by obesity-induced imbalance of adipokine[23]. In addition, more soft tissue around thoracic regions, a higher chest wall elastance can also lead to difficulty of lung expansion and cause more pulmonary atelectasis. It is known that high tidal volume ventilation may aggravate lung injury[24], there was evidence to support the notion that compared to patients with a BMI of less than 25 kg/m^2, obese patients received significantly higher tidal volume ventilation[12]. Therefore, high tidal volume ventilation in obese may be one possible cause why obese had increased risk of ARDS. However, due to our lack of serum adipokine data as well as ventilator setting parameters, this was hypothesis generated only. According to our findings, patients with higher BMI were associated with an increased risk of IAH. Previous studies found that the baseline IAP in the obese is greater than normal weight population and morbidity in the obese can cause chronic increase of IAP[9,25]. In addition to critical illness with stress conditions such as sepsis, burn, or postoperative major surgery, these conditions commonly require aggressive fluid therapy and may aggravate the risk of IAH in the obese. To validate this hypothesis, further well-controlled clinical trials are needed.

The strength of this study is that our study is derived from a multicenter study that recruited the critically ill patients who were admitted to the SICU from nine university-based hospitals in Thailand. Nevertheless, there are several limitations to our study. According to a nature of retrospective analysis, we had no important baseline laboratory variables such as white cell counts, central venous oxygen saturation, or serum lactate to confirm difference in baseline severity of the illness between four groups of patients. So, we used APACHE II score solely as a determinant of illness severity. In addition, there were some patients who were not measured for weight and height and this could effect to a real prevalence of overweight and obese in our cohort. However, the prevalence of overweight and obese patients in our study was closed to the previous studies in Thailand[7,8]. In addition, we had no data of ventilator setting and pulmonary mechanics to explore possible factors why the obese and overweight were associated with increased risk of ARDS. Therefore, our results still need further well-controlled study to confirm these findings.

Conclusion

The present study demonstrated the prevalence of overweight and obesity in critically ill Thai surgical patients was 18.7% and 7.2%. The overweight and obese had significantly higher 28-day survival than patients with underweight and with normal BMI. However, compared to a lower BMI patient, patients with higher BMI were associated with increased risk of ARDS and IAH. Our findings need further experimental studies to validate and assess the influence of body weight on these clinical outcomes.

What is already known on this topic?

Obesity was found associated with increased survival in critically ill patients, the so-called “obesity paradox”.

What this study adds?

Compared to the patients with lower body mass index (BMI), the patients with higher BMI had significantly higher survival; however, these patients had increased risk of acute respiratory distress syndrome and intra-abdominal hypertension.

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Potential conflicts of interest

The abstract of this study was presented in the 36th International Society of Intensive Care and Emergency Medicine (ISICEM) conference.

References

1. McLellan F. Obesity rising to alarming levels around the world. Lancet 2002; 359: 1412.
2. Dandona P, Aljada A, Chaudhuri A, Mohanty P, Garg R. Metabolic syndrome: a comprehensive perspective based on interactions between obesity, diabetes, and inflammation. Circulation 2005; 111: 1448-54.
3. Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P, et al. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: a case-control study. Lancet 2005; 366: 1640-9.
4. Wahba IM, Mak RH. Obesity and obesity-initiated metabolic syndrome: mechanistic links to chronic kidney disease. Clin J Am Soc Nephrol 2007; 2: 550-62.
5. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA 2001; 286: 1195-200.
6. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA 2003; 289: 76-9.
7. Aekplakorn W, Inthawong R, Kessomboon P, Sangthong R, Chariyalertsak S, Putwatana P, et al. Prevalence and trends of obesity and association with socioeconomic status in Thai adults: National Health Examination Surveys, 1991-2009. J Obes 2014; 2014: 410259.
8. Jitnarin N, Kosulwat V, Rojroongwasinkul N, Boonpraderm A, Haddock CK, Poston WS. Prevalence of overweight and obesity in Thai population: results of the National Thai Food Consumption Survey. Eat Weight Disord 2011; 16: e242-9.
9. Wilson A, Longhi J, Goldman C, McNatt S. Intra-abdominal pressure and the morbidly obese patients: the effect of body mass index. J Trauma 2010; 69: 78-83.
10. Wisse BE. The inflammatory syndrome: the role of adipose tissue cytokines in metabolic disorders linked to obesity. J Am Soc Nephrol 2004; 15: 2792-800.
11. Benson S, Arck PC, Tan S, Mann K, Hahn S, Janssen OE, et al. Effects of obesity on neuroendocrine, cardiovascular, and immune cell responses to acute psychosocial stress in premenopausal women. Psychoneuroendocrinology 2009; 34: 181-9.
12. Wacharasint P, Boyd JH, Russell JA, Walley KR. One size does not fit all in severe infection: obesity alters outcome, susceptibility, treatment, and inflammatory response. Crit Care 2013; 17: R122.
13. Utzolino S, Ditzel CM, Baier PK, Hopt UT, Kaffarnik MF. The obesity paradox in surgical intensive care patients with peritonitis. J Crit Care 2014; 29: 887-5.
14. Goh R, Darvall J, Wynne R, Tatoulis J. Obesity prevalence and associated outcomes in cardiothoracic patients: a single-centre experience. Anaesth Intensive Care 2016; 44: 77-84.
15. Chittawatanarat K, Chaiwat O, Morakul S, Pipanmekaporn T, Thawitsri T, Wacharasint P, et al. A multi-center Thai university-based surgical intensive care units study (THAI-SICU study): methodology and ICU characteristics. J Med Assoc Thai 2014; 97 (Suppl 1): S45-54.
16. World Health Organization. BMI classification [Internet]. 2016 [cited 2016 Jan 1]. Available from: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
17. American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference: definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. Crit Care Med 1992; 20: 864-74.
18. Bernard GR, Artigas A, Brigham KL, Carlet J, Falke K, Hudson L, et al. The American-European Consensus Conference on ARDS. Definitions, mechanisms, relevant outcomes, and clinical trial coordination. Am J Respir Crit Care Med 1994; 149: 818-24.
19. Kirkpatrick AW, Roberts DJ, De Waele J, Jaeschke R, Malbrain ML, De Keulenaer B, et al. Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from

the World Society of the Abdominal Compartment Syndrome. Intensive Care Med 2013; 39: 1190-206.
20. Valentijn TM, Galal W, Hoeks SE, van Gestel YR, Verhagen HJ, Stolker RJ. Impact of obesity on postoperative and long-term outcomes in a general surgery population: a retrospective cohort study. World J Surg 2013; 37: 2561-8.
21. Hutagalung R, Marques J, Kobylka K, Zeidan M, Kabisch B, Brunkhorst F, et al. The obesity paradox in surgical intensive care unit patients. Intensive Care Med 2011; 37: 1793-9.
22. Silva JM Jr, de Oliveira AM, Nogueira FA, Vianna PM, Pereira Filho MC, Dias LF, et al. The effect of excess fluid balance on the mortality rate of surgical patients: a multicenter prospective study. Crit Care 2013; 17: R288.
23. Shah D, Romero F, Duong M, Wang N, Paudyal B, Suratt BT, et al. Obesity-induced adipokine imbalance impairs mouse pulmonary vascular endothelial function and primes the lung for injury. Sci Rep 2015; 5: 11362.
24. Mascia L, Zavala E, Bosma K, Pasero D, Decaroli D, Andrews P, et al. High tidal volume is associated with the development of acute lung injury after severe brain injury: an international observational study. Crit Care Med 2007; 35: 1815-20.
25. Frezza EE, Shebani KO, Robertson J, Wachtel MS. Morbid obesity causes chronic increase of intra-abdominal pressure. Dig Dis Sci 2007; 52: 1038-41.

ความชุกและผลกระทบทางคลินิกของผู้ป่วยวิกฤตทางศัลยกรรมที่มีภาวะน้ำหนักเกินและโรคอ้วน (วิเคราะห์จากการศึกษา THAI-SICU)

เพชร วัชรสินธุ์, ภูษิต เฟื่องฟู, ราม รังสินธุ์, สัณฐิติ โมรากุล, กวีศักดิ์ จิตตวัฒนรัตน์, อรอุมา ชัยวัฒน์, กลุ่มศึกษา THAI-SICU

วัตถุประสงค์: *เพื่อศึกษาถึงความชุกและผลกระทบทางคลินิกของผู้ป่วยที่มีภาวะน้ำหนักเกินและโรคอ้วน ซึ่งเข้ารับการรักษาตัวในหออภิบาลผู้ป่วยวิกฤต ทางศัลยกรรมในประเทศไทย*

วัสดุและวิธีการ: *ดำเนินการศึกษาแบบย้อนหลังโดยใช้กลุ่มตัวอย่างผู้ป่วยจากการศึกษา THAI-SICU ซึ่งศึกษาในผู้ป่วยที่รับการรักษาตัวในหออภิบาล ผู้ป่วยวิกฤตทางศัลยกรรมจากโรงพยาบาล 9 แห่งในประเทศไทยระหว่างเดือนเมษายน พ.ศ. 2554 ถึงเดือนพฤศจิกายน พ.ศ. 2555 ผู้ป่วยที่มีข้อมูล น้ำหนักและส่วนสูงทั้งหมด 4,579 คน ถูกแบ่งออกเป็น 4 กลุ่ม ตามระดับดัชนีมวลกาย (body mass index) ซึ่งแนะนำโดยองค์การอนามัยโลกได้แก่ 1) ผู้ป่วยที่มีน้ำหนักน้อย (ดัชนีมวลกายน้อยกว่า 18.5 กก./ม^2 2) ผู้ป่วยน้ำหนักปกติ (ดัชนีมวลกาย 18.5-24.9 กก./ม^2) 3) ผู้ป่วยที่มีภาวะน้ำหนักเกิน (ดัชนีมวลกาย 25-29.9 กก./ม^2) และ 4) ผู้ป่วยที่มีโรคอ้วน (ดัชนีมวลกายมากกว่าหรือเท่ากับ 30 กก./ม^2) วัตถุประสงค์หลักคือ ความชุกของผู้ป่วยหนักศัลยกรรมที่มีภาวะน้ำหนักเกินและโรคอ้วน วัตถุประสงค์รองได้แก่ การเปรียบเทียบโอกาสรอดชีวิต การเกิดภาวะกระตุ้นการอักเสบของร่างกาย (systemic inflammatory response syndrome; SIRS) ภาวะติดเชื้อที่เกิดขึ้นใหม่ ภาวะหายใจล้มเหลวฉับพลันและภาวะความดันในช่องท้องสูง ระหว่างผู้ป่วยทั้ง 4 กลุ่ม*

ผลการศึกษา: *พบผู้ป่วยที่มีน้ำหนักน้อย 768 คน (ร้อยละ 16.8) น้ำหนักปกติ 2,624 คน (ร้อยละ 57.3) น้ำหนักเกิน 858 คน (ร้อยละ 18.7) และโรคอ้วน 329 คน (ร้อยละ 7.2) เมื่อเปรียบเทียบกับผู้ป่วยอีก 3 กลุ่ม พบว่าผู้ป่วยกลุ่มที่มีโรคอ้วนมีโอกาสรอดชีวิตสูงสุดและมีอัตราการเกิดภาวะ SIRS และภาวะติดเชื้อต่ำสุด เมื่อวิเคราะห์เพิ่มเติมโดยการควบคุมตัวแปรพบว่าทุก ๆ ค่าดัชนีมวลกายที่เพิ่มขึ้น 1 กก./ม^2 จะลดอัตราตายในโรงพยาบาลลง โดยมี odds ratio (OR) 0.97 (ร้อยละ 95 ของความเชื่อมั่น, 95% CI, 0.94-0.99, p = 0.04) แต่กลับเพิ่มโอกาสในการเกิดภาวะหายใจล้มเหลวฉับพลัน และภาวะความดันในช่องท้องสูงโดยมี OR 1.06 (95% CI 1.03-1.08, p<0.001) และ 1.06 (95% CI 1.03-1.09, p<0.001) ตามลำดับ*

สรุป: *การศึกษานี้พบความชุกของผู้ป่วยวิกฤตทางศัลยกรรมที่มีภาวะน้ำหนักเกินร้อยละ 18.7 และโรคอ้วนร้อยละ 7.2 เมื่อเปรียบเทียบกับผู้ป่วย ที่มีค่าดัชนีมวลกายต่ำ พบว่าผู้ป่วยวิกฤตทางศัลยกรรมที่มีค่าดัชนีมวลกายสูง จะมีอัตราตายน้อยกว่าแต่มีความเสี่ยงในการเกิดภาวะหายใจล้มเหลวฉับพลัน และภาวะความดันในช่องท้องสูงมากกว่าอย่างมีนัยสำคัญ*