Lactate Non-Clearance versus Lactate Clearance: A Comparison of Hospital Mortality in High-Risk Surgical Patients

Thammasak Thawitsri MD*[1], Somkid Thongdee RN*[2],
Nalin Chokengarmwong MD*[1], Manasnun Kongwibulwut MD*[1],
Kanya Kumwilaisak MD*[1], Sahadol Poonyathawon MD*[1],
Pornlert Chatkaew MD*[1], Somrat Charuluxananan MD*[1]

*[1] *Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok, Thailand*
*[2] *Division of Nursing, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok, Thailand*

Objective: *The optimal endpoints of resuscitation in high-risk surgical patients remain controversial. Specifically, it is difficult to establish the effective predictive markers as the endpoints of resuscitation in this patient group. Therefore, the study was conducted to assess the predictive value of early lactate non-clearance condition on hospital mortality in high-risk surgical patients.*

Material and Method: *The study is a prospective analytic study. The data were collected in one university-based surgical intensive care unit (SICU) over a 5-month period. All consecutive adult high-risk surgical patients admitted to SICU in postoperative period were recruited to the study. Blood lactate levels were measured on SICU admission (0-hour), 12 hours later, and then calculated for 12-hour blood lactate clearance. The authors categorized the patients into two groups: lactate clearance (LC) and lactate non-clearance (LNC). After that, the patients were monitored until hospital discharge or in-hospital death.*

Results: *There were 122 high-risk surgical patients recruited to the study. As concerns the factors of interest, higher incidences of suspected or confirmed infection and mechanical ventilation were found among the LNC group. Regarding the main outcomes, hospital mortality was 5.3% among the LNC group and 3.9% among the LC group (p = 0.578), with no statistical significant differences in hospital mortality, hospital length of stay and SICU length of stay. The independent risk factors associated with LNC condition were considered. The factor of interest was suspected or confirmed infection by multiple logistic regression analysis after adjustment for age and sex revealed that the adjusted odds ratio was 2.70 with a 95% confidence interval of 0.85-8.55, p = 0.092.*

Conclusion: *In high-risk surgical patients, 12-hour LNC cannot demonstrate the prognostic value for hospital morbidity and mortality. However, there is a trend for the suspected or confirmed infection group to associate with the LNC condition, but with no statistical significance.*

Keywords: *Lactate clearance, High-risk surgical patients, Resuscitation, SICU*

J Med Assoc Thai 2016; 99 (Suppl. 6): S201-S208
Full text. e-Journal: *http://www.jmatonline.com*

Resuscitation guided by the use of hemodynamic protocol aiming for adequate tissue perfusion in high-risk surgical patients has been proven to decrease postoperative morbidity and mortality[1]; however, the optimal endpoints of resuscitation remain controversial.

In using ideal markers to ensure adequacy of resuscitation, these should be reliable in assessing the resolution of tissue ischemia and predicting patient outcomes. In addition, important information such as blood lactate level should be provided and added into time sequence to reevaluate the efficacy of early resuscitation and prevent prolonged organ ischemia[2,3]. In the past, it was established procedure to normalize the vital signs, especially blood pressure and heart rate, as the endpoints of resuscitation although these endpoints did not prove to be effective markers for adequate tissue perfusion[4]. Beyond that, there have been so many efforts to search for surrogates that could

Correspondence to:
Thawitsri T, Department of Anesthesiology, King Chulalongkorn Memorial Hospital, Bangkok 10330, Thailand.
Phone: +66-2-2564295, Fax: +66-2-2564294
E-mail: thawitsri@gmail.com

possibly aid in adequate resuscitation. Some studies represented blood lactate levels as reliable prognostic markers in severe sepsis or septic shock; whenever the oxygen supply was insufficient to normalize tissue oxygenation then blood lactate levels would rise[5,6].

Following glycolysis and an aerobic metabolism, lactate is produced as a byproduct[7]. To change pyruvate to lactate, it has to be catalyzed by lactate dehydrogenase. In some unusual situations, the lactate level could rise in non-hypoxic conditions such as pyruvate dehydrogenase deficiency and stress-induced hyperglycolysis. While hyperlactatemia is behind the increasing risk of death among critically ill patients[8-12], it still cannot help in identifying a specific prognosis for individual patients[13]. Nevertheless, in the early phase of resuscitation, the capability of lactate clearance represents a strong predictor of decreasing morbidity and mortality in severe sepsis or septic shock patients[14-16] and critically ill patients[17,18].

There were some retrospective studies reported that within the early phase of surgical intensive care unit (SICU) admission, normalization of blood lactate level in this period is associated with decreasing mortality[19,20]. Still, there is a need for establishing effective and practical predictive markers for high-risk surgical patients; thus, this study was undertaken to assess the predictive value of early lactate non-clearance on hospital mortality among this patient group.

Material and Method

This study was designed as a prospective analytical study. The data were collected in one university-based SICU over a 5-month period from June 2014 to October 2014.

Patient population

All consecutive postoperative surgical patients over 18 years of age admitted to a single-center SICU were recruited to the study. For this study, these patients had to be defined as high-risk surgical patients according to the presence of a minimum of one criterion by Shoemaker et al[21]. These were also the indications for SICU admission in the study.

The exclusion criteria comprised hepatic encephalopathy, traumatic brain injury, epileptic seizures immediately before SICU admission, and post-cardiac arrest patients.

Sample size calculation

The sample size estimation based on the data from a similar previous study[16] that revealed a 45% mortality in 12-hour lactate non-clearance and a 20% mortality in 12-hour lactate clearance. Prior studies and the authors' database have shown the approximate ratio of 12-hour LC to LNC to be 2:1. The authors set up the alpha error = 0.05 and beta error = 0.20. Finally, the total sample size was around 120 subjects.

Research protocol and data collection

The authors initially confirmed the eligibility of the patients admitted to SICU immediately after the operation. Informed consent was obtained by the research team members. After the patients had entered into the study, their baseline characteristics and possible risk factors were recorded. Blood lactate levels were measured on SICU admission (0-hour) and 12 hours later by a drop of arterial or capillary blood and determined by a portable lactate analyzer (Accutrend Plus (Roche Diagnostics, Germany)). Thereafter, the 12-hour blood lactate clearance was calculated as the lactate level on SICU admission minus the lactate level at 12 hours divided by the lactate level on SICU admission and presented in percentage. After that, the authors categorized the participants into two conditions: 1) Lactate clearance (LC), a condition whereby the lactate level decreased within the first 12 hours and was greater than or equal to 10%; or both 0-hour and 12-hour lactate levels were less than 2 mmol/L; 2) Lactate non-clearance (LNC), a condition whereby the lactate level decreased within the first 12-hour less than 10%.

It was planned that during the first 6 hours of SICU admission, the patients achieve the resuscitation goals according to the Surviving Sepsis Campaign Guidelines 2012[22] as appropriate. The Sequential Organ Failure Assessment (SOFA) scores[23] of all patients in the study were recorded daily until SICU discharge. The authors followed-up on the patients until hospital discharge or in-hospital death. Finally, comparison of hospital mortality between LNC group and LC group was performed.

Ethics committee approval

All participants must have completed the standard informed consent document before entering into the study. If the patients could not give informed consent because of limited physical or mental capacity, then proxy consent was obtained from a relative or legal representative. The research proposal and all documents were approved by the ethical committee of the Faculty of Medicine, Chulalongkorn University.

Statistical analysis

The authors analyzed the data in IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Categorical data was reported in percentages. Continuous data were reported as mean and standard deviation (SD) or median and interquartile range (IQR) as appropriate. To analyze the differences between the groups, the authors used an unpaired t-test or Mann-Whitney U test as appropriate for all continuous data and used the Chi-square test or Fisher's exact test as appropriate for all categorical data. To demonstrate any relationships between risk factors and outcomes, the authors initially analyzed the variables comparing between groups, and selected those factors of interest with p values of less than 0.20 from bivariate analysis to be entered into the multiple logistic regression analysis model. All statistically significant differences were defined as having a *p*-value of less than 0.05.

Results

There were 122 consecutive patients admitted to SICU. They were eligible for the study and were recruited for the trial. According to baseline characteristics (Table 1), the authors classified the patients into LNC group and LC group. Regarding to age, sex, indication for SICU admission, and factors of interest, the comparison between LNC and LC did not show any statistical significant difference, except at the 12-hour lactate level.

The study evaluated several clinical outcomes, especially the primary outcome comparing hospital mortality between the LNC and LC groups with hospital mortality at 5.3% among the LNC group versus 3.9% among the LC group (*p*-value = 0.578). There was no significant statistical difference in hospital mortality, hospital length of stay and SICU length of stay. The authors also classified the patients according to hospital mortality (Table 2): 5 patients died in hospital while 117 patients survived. Only two variables showed significant differences between the non-survivor and survivor groups. While there was no significant difference in the admission SOFA scores, the study found significant differences in the mean SOFA scores (median (IQR); 5.8 (4.3-7.8) in the non-survivor group versus 2 (1-3.3) in the survivor group, $p = 0.016$) and maximum SOFA scores (median (IQR); 8 (5-9) in the non-survivor group versus 3 (1-5) in the survivor group, $p = 0.034$).

The independent risk factors associated with LNC condition were considered (Table 3). The relevant factor was suspected or confirmed infection; the crude odds ratio (OR) by bivariate analysis was 2.42; 95% confidence interval (CI) 0.80-7.32, $p = 0.117$. Further analysis by multiple logistic regression after adjustment for age and sex also revealed that the adjusted OR was 2.70; 95% CI 0.85-8.55, $p = 0.092$.

Discussion

Surgical patients with limited cardiopulmonary reserve or who have life-threatening conditions are categorized as high-risk surgical patients. In the post-operative period, these patients are usually admitted to SICU for optimum care, but occasionally have cardiovascular instability including occult tissue hypoperfusion. This problem can lead to organ ischemia and finally increasing morbidity and mortality; hence, there is a need for early detection and early adequate resuscitation. Standard hemodynamic monitoring aims to normalize macrocirculation that could not be the optimum end point of resuscitation[4]. Trying to detect tissue hypoperfusion in the early phase is now the cornerstone of hemodynamic monitoring. With the character of practicability and cost-effectiveness, blood lactate level as a surrogate for tissue hypoperfusion has been selected as one of the endpoints of resuscitation[8-10]. Further information has suggested that sequential blood lactate assessment strongly relates to the predictive value for morbidity and mortality[3,11,12,14-16].

The study cannot demonstrate any differences in the main outcomes between the LNC and LC groups. The results might be related to the inclusion criteria for the study. Some patients were admitted to SICU only for the need of optimum post-operative monitoring with a minimum risk of complications or without any obvious major organ dysfunction. The admission, maximum and mean SOFA scores were in the range of 2-3 for the median, which indicated the low severity of illness and ultimately to the low hospital mortality rate (5 in 122 patients; 4.1%). That is to say, the problem of not being able to predict an adequate prognosis for the LNC condition in high-risk surgical patients in this study might be related to the non-rigid inclusion criteria for high-risk surgical patients. Furthermore, the authors calculated the sample size by using the data from previous study that demonstrated hospital mortality in LNC 45% and LC 20%. However, hospital mortality in the study was too low (5.3% in LNC and 3.9% in LC) in comparison with the reference. Therefore, the authors might have underestimated the optimum sample size.

Apart from the inclusion criteria, another factor

Table 1. Baseline characteristics and outcomes

Variable	LNC (n = 19)	LC (n = 103)	*p*-value
Age, year, mean (SD)	71.7 (11.8)	64.3 (17.3)	0.078
Sex, male, n (%)	8 (42.1)	64 (62.1)	0.103
Indication for SICU admission, n (%)			
Previous severe cardiorespiratory illness	1 (5.3)	12 (11.7)	0.689
Extensive surgery for carcinoma	8 (42.1)	41 (39.8)	0.851
Severe multiple trauma	0 (0.0)	2 (1.9)	1.000
Massive acute blood loss	0 (0.0)	8 (7.8)	0.355
Age >70 yrs. and limited physiological reserve of at least 1 vital organ	6 (31.6)	21 (20.4)	0.365
Shock; MAP <60 mmHg, CVP <15 cmH_2O, and urine output <20 mL/h	1 (5.3)	3 (2.9)	0.497
Acute abdominal event with hemodynamic instability	1 (5.3)	14 (13.6)	0.462
Late-stage vascular disease involving aortic disease	2 (10.5)	6 (5.8)	0.609
Underlying disease			
Hypertension	13 (68.4)	54 (52.4)	0.198
Underlying CAD	1 (5.3)	6 (5.8)	1.000
Underlying CHF	0 (0.0)	2 (1.9)	1.000
Underlying previous stroke	0 (0.0)	6 (5.8)	0.589
Other cardiovascular disease	3 (15.8)	19 (18.4)	1.000
DM	5 (26.3)	24 (23.3)	0.774
Asthma	1 (5.3)	2 (1.9)	0.401
COPD	1 (5.3)	1 (1.0)	0.288
Other respiratory disease	0 (0.0)	7 (6.8)	0.594
Cirrhosis	2 (10.5)	8 (7.8)	0.654
CKD	2 (10.5)	15 (14.6)	1.000
Admission SOFA score, median (IQR)	3 (2-4)	2 (1-4)	0.312
Maximum SOFA score, median (IQR)	3 (2-5)	3 (1-5)	0.469
Mean SOFA score, median (IQR)	2.5 (0.7-5.0)	2.0 (1.0-3.3)	0.352
Emergency surgery, n (%)	2 (10.5)	15 (14.6)	1.000
Suspected or confirmed infection, n (%)	6 (31.6)	16 (16.0)	0.118
Current use of vasopressor, n (%)	3 (16.7)	22 (21.6)	0.762
Mechanical ventilation, n (%)	10 (52.6)	48 (46.6)	0.629
0-hour lactate level, mmol/L, median (IQR)	1.7 (1.1-2.3)	2.2 (1.2-3.6)	0.090
12-hour lactate level, mmol/L, median (IQR)	2.8 (2.1-3.6)	0.9 (0.8-1.6)	<0.001
SICU length of stay, day, median (IQR)	1 (1-3)	1 (1-3)	0.962
Hospital length of stay, day, median (IQR)	27 (15-40)	22 (11-43)	0.701
Hospital mortality, n (%)	1 (5.3)	4 (3.9)	0.578

LNC = lactate non-clearance; LC = lactate clearance; SD = standard deviation, SICU = surgical intensive care unit, MAP = mean arterial blood pressure; CVP = central venous pressure; SOFA = Sequential Organ Failure Assessment; IQR = interquartile range; CAD = coronary artery disease; CHF = congestive heart failure; DM = diabetes mellitus; COPD = chronic obstructive pulmonary disease; CKD = chronic kidney disease

which should be reconsidered is lactate clearance time. Nguyen et al[14] demonstrated early lactate clearance in the first 6 hours of severe sepsis and septic shock among patients was associated with decreased mortality rate. After that, Nguyen et al[16] conducted a prospective cohort study in eight tertiary-care medical centers in Asia by adding 12-hour lactate clearance to the Surviving Sepsis Campaign (SSC) guidelines, and the addition of the 12-hour lactate to SSC bundle was proven as being associated with improved mortality. Meregalli et al[11] investigated serial blood lactate in 44 high-risk surgical patients at ICU admission at 12, 24, and 48 hours. Although the results showed similar blood lactate levels on ICU admission between survivors with non-survivors and slightly higher blood lactate levels at 24 and 48 hours in non-survivors, there

Table 2. Comparisons between non-survivors and survivors

Variable	Non-survivors (n = 5)	Survivors (n = 117)	*p*-value
Admission SOFA, median (IQR)	4 (3-6)	2 (1-4)	0.142
Maximal SOFA, median (IQR)	8 (5-9)	3 (1-5)	0.034
Mean SOFA, median (IQR)	5.8 (4.3-7.8)	2 (1-3.3)	0.016
Emergency surgery, n (%)	2 (40.0)	15 (12.8)	0.142
Suspected or confirmed infection, n (%)	1 (20.0)	21 (18.4)	1.000
Current use of vasopressor, n (%)	3 (60.0)	22 (19.1)	0.060
Mechanical ventilation, n (%)	4 (80.0)	54 (46.2)	0.190
0-hour lactate	3 (2.6-9.9)	2 (1.1-3.4)	0.091
12-hour lactate	2.5 (1.3-4.4)	1.1 (0.8-2.0)	0.098

SOFA = Sequential Organ Failure Assessment, IQR = interquartile range

Table 3. Multiple logistic regression analysis to determine the risk factors associated with the lactate non-clearance condition

Variable	Crude OR	95% CI	*p*-value	Adjusted OR	95% CI	*p*-value
Non suspected infection	reference			reference		
Suspected infection	2.42	0.80-7.32	0.117	2.70	0.85-8.55	0.092

Adjusted for age and sex
OR = odds ratio; CI = confidence interval

was no statistical significance. Statistically significant higher levels of 12-hour blood lactate were found in non-survivors compared to survivors. In this study, the authors could not demonstrate the predictive value of 12-hour LNC for hospital mortality in high-risk surgical patients. However, high-risk surgical patients still require optimum postoperative care. In the future, further study might be modified with more rigid inclusion criteria for the high-risk surgical patients and with other time points to evaluate lactate clearance such as the 6-hour point according to the SSC guidelines[22].

The authors also analyzed the differences between survivors and non-survivors, and the results demonstrated statistically significant higher maximum SOFA and mean SOFA scores in the non-survivor group. Finally, the authors attempted to analyze by using a multiple logistic regression model to demonstrate the independent risk factors associated with hospital mortality and the LNC condition. First, as concerns hospital mortality, because of the low mortality in the study (5 in 122 patients; 4.1%), the authors could not analyze the independent risk factors associated with hospital mortality. Second, because blood lactate level is the essential marker for defining septic shock patients[24] and the SSC guidelines[22] suggested that the blood lactate level should be normalized within the first 6 hours, the authors wished to search for independent risk factors associated with the LNC condition too. After being adjusted for age and sex, the authors found that suspected or confirmed infection was associated with the LNC condition, but with no statistical significance (adjusted OR 2.70; 95% CI 0.85-8.55, $p = 0.092$). However, this outcome correlates to previous studies demonstrating the prognostic value of the LNC condition in patients with severe sepsis and septic shock[3,11,12,14-16] and might suggest that intensivists should pay greater attention to high-risk surgical patients with suspected or confirmed infection in the early phase of SICU admission.

Conclusion

In high-risk surgical patients, 12-hour LNC cannot demonstrate prognostic value for hospital morbidity and mortality. However, the suspected or confirmed infection group was associated with the LNC condition but with no statistical significance. Further study into the predictive value of lactate-guided resuscitation with more rigid criteria for high-risk

surgical patients is still needed.

What is already known on this topic?

Resuscitation which has been guided by the use of hemodynamic protocol for the high-risk surgical patients can be proved to decrease postoperative morbidity and mortality. However, the optimal endpoints of resuscitation remain controversial. There had some retrospective studies reported that within the early phase of surgical intensive care unit (SICU) admission, normalization of blood lactate level in this period associated with decreasing mortality. Still, there is a need for establish the effective and practical predictive markers for adequate resuscitation in high-risk surgical patients.

What this study adds?

Lactate non-clearance in 12 hours cannot demonstrate the prognostic value for hospital morbidity and mortality in high-risk surgical patients. The suspected or confirmed infection group tends to associate with lactate non-clearance condition but no statistical significant.

Acknowledgements

The authors would like to express their gratitude to the Statistical Consulting Unit, Graduate Division, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, and the surgical intensive care unit nurses at King Chulalongkorn Memorial Hospital, Bangkok, and Thailand. The publication fee was supported by Medical Association of Thailand (Prasert Prasarttong-osoth research fund).

Potential conflicts of interest

None.

References

1. Gurgel ST, do Nascimento P Jr. Maintaining tissue perfusion in high-risk surgical patients: a systematic review of randomized clinical trials. Anesth Analg 2011; 112: 1384-91.
2. Jansen TC, van Bommel J, Woodward R, Mulder PG, Bakker J. Association between blood lactate levels, Sequential Organ Failure Assessment subscores, and 28-day mortality during early and late intensive care unit stay: a retrospective observational study. Crit Care Med 2009; 37: 2369-74.
3. Nichol A, Bailey M, Egi M, Pettila V, French C, Stachowski E, et al. Dynamic lactate indices as predictors of outcome in critically ill patients. Crit Care 2011; 15: R242.
4. Scalea TM, Maltz S, Yelon J, Trooskin SZ, Duncan AO, Sclafani SJ. Resuscitation of multiple trauma and head injury: role of crystalloid fluids and inotropes. Crit Care Med 1994; 22: 1610-5.
5. Friedman G, Berlot G, Kahn RJ, Vincent JL. Combined measurements of blood lactate concentrations and gastric intramucosal pH in patients with severe sepsis. Crit Care Med 1995; 23: 1184-93.
6. Friedman G, De Backer D, Shahla M, Vincent JL. Oxygen supply dependency can characterize septic shock. Intensive Care Med 1998; 24: 118-23.
7. Okorie ON, Dellinger P. Lactate: biomarker and potential therapeutic target. Crit Care Clin 2011; 27: 299-326.
8. Trzeciak S, Dellinger RP, Chansky ME, Arnold RC, Schorr C, Milcarek B, et al. Serum lactate as a predictor of mortality in patients with infection. Intensive Care Med 2007; 33: 970-7.
9. Nichol AD, Egi M, Pettila V, Bellomo R, French C, Hart G, et al. Relative hyperlactatemia and hospital mortality in critically ill patients: a retrospective multi-centre study. Crit Care 2010; 14: R25.
10. Soliman HM, Vincent JL. Prognostic value of admission serum lactate concentrations in intensive care unit patients. Acta Clin Belg 2010; 65: 176-81.
11. Meregalli A, Oliveira RP, Friedman G. Occult hypoperfusion is associated with increased mortality in hemodynamically stable, high-risk, surgical patients. Crit Care 2004; 8: R60-5.
12. Martin MJ, FitzSullivan E, Salim A, Brown CV, Demetriades D, Long W. Discordance between lactate and base deficit in the surgical intensive care unit: which one do you trust? Am J Surg 2006; 191: 625-30.
13. Borthwick HA, Brunt LK, Mitchem KL, Chaloner C. Does lactate measurement performed on admission predict clinical outcome on the intensive care unit? A concise systematic review. Ann Clin Biochem 2012; 49: 391-4.
14. Nguyen HB, Rivers EP, Knoblich BP, Jacobsen G, Muzzin A, Ressler JA, et al. Early lactate clearance is associated with improved outcome in severe sepsis and septic shock. Crit Care Med 2004; 32: 1637-42.
15. Nguyen HB, Corbett SW, Steele R, Banta J, Clark RT, Hayes SR, et al. Implementation of a bundle of quality indicators for the early management of severe sepsis and septic shock is associated with

decreased mortality. Crit Care Med 2007; 35: 1105-12.
16. Nguyen HB, Kuan WS, Batech M, Shrikhande P, Mahadevan M, Li CH, et al. Outcome effectiveness of the severe sepsis resuscitation bundle with addition of lactate clearance as a bundle item: a multi-national evaluation. Crit Care 2011; 15: R229.
17. Jansen TC, van Bommel J, Schoonderbeek FJ, Sleeswijk Visser SJ, van der Klooster JM, Lima AP, et al. Early lactate-guided therapy in intensive care unit patients: a multicenter, open-label, randomized controlled trial. Am J Respir Crit Care Med 2010; 182: 752-61.
18. Attana P, Lazzeri C, Chiostri M, Picariello C, Gensini GF, Valente S. Lactate clearance in cardiogenic shock following ST elevation myocardial infarction: a pilot study. Acute Card Care 2012; 14: 20-6.
19. McNelis J, Marini CP, Jurkiewicz A, Szomstein S, Simms HH, Ritter G, et al. Prolonged lactate clearance is associated with increased mortality in the surgical intensive care unit. Am J Surg 2001; 182: 481-5.
20. Husain FA, Martin MJ, Mullenix PS, Steele SR, Elliott DC. Serum lactate and base deficit as predictors of mortality and morbidity. Am J Surg 2003; 185: 485-91.
21. Shoemaker WC, Appel PL, Kram HB, Waxman K, Lee TS. Prospective trial of supranormal values of survivors as therapeutic goals in high-risk surgical patients. Chest 1988; 94: 1176-86.
22. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 2013; 41: 580-637.
23. Ferreira FL, Bota DP, Bross A, Melot C, Vincent JL. Serial evaluation of the SOFA score to predict outcome in critically ill patients. JAMA 2001; 286: 1754-8.
24. Shankar-Hari M, Phillips GS, Levy ML, Seymour CW, Liu VX, Deutschman CS, et al. Developing a New Definition and Assessing New Clinical Criteria for Septic Shock: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2016; 315: 775-87.

การศึกษาเปรียบเทียบอัตราการเสียชีวิตภายในโรงพยาบาลของผู้ป่วยศัลยกรรมที่มีความเสี่ยงสูงระหว่างกลุ่มที่ไม่สามารถลดระดับแลคเตทในเลือดช่วง 12 ชั่วโมงกับกลุ่มที่สามารถลดระดับค่าแลคเตทในเลือดได้

ธรรมศักดิ์ ทวิชศรี, สมคิด ทองดี, นลิน โชคงามวงศ์, มนัสนันท์ คงวิบูลยวุฒิ, กัญญา คำวิลัยศักดิ์, สหดล ปุญญถาวร, พรเลิศ ฉัตรแก้ว, สมรัตน์ จารุลักษณานันท์

วัตถุประสงค์: การประเมินความเหมาะสมของการรักษาเพื่อให้ระบบไหลเวียนเลือดอยู่ในภาวะปกติ ยังไม่มีวิธีการที่ชัดเจนในกลุ่มผู้ป่วยศัลยกรรมที่มีความเสี่ยงสูง การศึกษานี้จึงทำการประเมินค่าการทำนายความเสี่ยงในการเสียชีวิตภายในโรงพยาบาลของผู้ป่วยศัลยกรรม ที่มีความเสี่ยงสูงเมื่อเกิดภาวะที่ไม่สามารถลดระดับค่าแลคเตทในเลือดในหอผู้ป่วยหนักศัลยกรรม

วัสดุและวิธีการ: เป็นการศึกษาเชิงวิเคราะห์แบบดำเนินไปข้างหน้า การเก็บข้อมูลได้ดำเนินการในหอผู้ป่วยหนักศัลยกรรมในโรงพยาบาลโรงเรียนแพทย์หนึ่งแห่งเป็นระยะเวลา 5 เดือน ผู้ป่วยหนักศัลยกรรมหลังผ่าตัดทุกรายจะได้รับการพิจารณาก่อนนำสู่การศึกษา เริ่มต้นด้วยการวัดระดับค่าแลคเตทในเลือดเมื่อรับเข้าหอผู้ป่วยหนักศัลยกรรมและวัดซ้ำอีกครั้งในเวลา 12 ชั่วโมงถัดมา จากนั้นนำมาคำนวนค่าความสามารถในการลดระดับค่าแลคเตทในเลือด ผู้ป่วยจะถูกแบ่งประเภทเป็น 2 กลุ่มตามความสามารถในการลดระดับ ค่าแลคเตทในเลือดคือ กลุ่มที่สามารถลดระดับค่าแลคเตทในเลือดได้และกลุ่มที่ไม่สามารถลดระดับค่าแลคเตทในเลือด หลังจากนั้นผู้ป่วยจะถูกเฝ้าติดตาม สังเกตไปจนกระทั่งถูกจำหน่ายออกจากโรงพยาบาลหรือเสียชีวิตในโรงพยาบาล

ผลการศึกษา: ผู้ป่วยศัลยกรรมที่มีความเสี่ยงสูงจำนวน 122 ราย ถูกนำเข้าสู่การศึกษา โดยผลการศึกษาพบว่าข้อบ่งชี้ที่พบบ่อยที่สุดสำหรับการเข้ารับการรักษาในหอผู้ป่วยหนักศัลยกรรมคือ เข้ารับการผ่าตัดใหญ่เพื่อรักษามะเร็ง เมื่อคำนึงถึงปัจจัยที่น่าสนใจพบว่าการติดเชื้อและการได้รับเครื่องช่วยหายใจเป็น 2 ปัจจัยที่พบได้มากกว่าในกลุ่มที่ไม่สามารถลดระดับค่าแลคเตทในเลือด ในแง่ผลการศึกษาหลักพบว่าอัตราตายในโรงพยาบาลของกลุ่มที่ไม่สามารถลดระดับค่าแลคเตทในเลือดคือ 5.3% และของกลุ่มที่สามารถลดระดับค่าแลคเตทในเลือดได้คือ 3.9% ($p = 0.578$) โดยพบว่าไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างทั้งสองกลุ่มในแง่ของอัตราการเสียชีวิตในโรงพยาบาล ระยะเวลาการรักษาในโรงพยาบาล และระยะเวลาการรักษาในหอผู้ป่วยหนักศัลยกรรม เมื่อพิจารณาถึงปัจจัยเสี่ยงที่อาจสัมพันธ์กับการเกิดภาวะที่ไม่สามารถลดระดับค่าแลขเตทในเลือด พบว่าปัจจัยที่น่าสนใจคือการติดเชื้อ โดยการวิเคราะห์การถดถอยโลจิสติก พบว่าการติดเชื้อมีแนวโน้มที่เพิ่มโอกาสการเกิดภาวะที่ไม่สามารถลดระดับค่าแลคเตทในเลือดเป็น 2.42 เท่าเมื่อเทียบกับกลุ่มอ้างอิงคือผู้ป่วยไม่ติดเชื้อ แต่ทว่าไม่มีนัยสำคัญทางสถิติ (adjusted odds ratio 2.70; 95% confidence interval 0.85-8.55, $p = 0.092$)

สรุป: ในผู้ป่วยศัลยกรรมที่มีความเสี่ยงสูง ภาวะที่ไม่สามารถลดระดับค่าแลคเตทในเลือดภายใน 12 ชั่วโมงแรก ไม่สามารถแสดงค่าการทำนายต่อความเสี่ยงในการเกิดความพิการและการเสียชีวิตในโรงพยาบาลได้ ในกลุ่มที่มีการติดเชื้อมีแนวโน้มที่เพิ่มโอกาสการเกิดภาวะที่ไม่สามารถลดระดับค่าแลขเตทในเลือด แต่ทว่าไม่มีนัยสำคัญทางสถิติ