ORIGINAL ARTICLE

Is a guideline required to predict the intensive care unit need of patients over 65 years of age during the pre-operative period? A comparison of the American Society of Anesthesiologists, lung ultrasound score, Charlson age-added comorbidity index, surgical outcome risk tool indexes

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ABSTRACT

BACKGROUND: All pre-operative, intra-operative, and post-operative variables of the patients at 65 years of age who had a surgical procedure determine the necessity of post-operative intensive care unit (ICU) monitoring. The indication for post-operative ICU is detected through ideal scoring systems related to the surgery and anesthesia that will be performed easily and fast would prevent the development of morbidity and mortality in high-risk patients. In the present study, we compared the efficacy of the American Society of Anesthesiologists (ASA) score, lung ultrasound score (LUSS), Charlson age-added comorbidity index (CACI), and surgical outcome risk tool (SORT) score of the indication for ICU. The hypothesis of our study is to show that real visual LUSS is superior to the screening test SORT, CACI, and the other score, ASA, for ICU indication determination.

METHODS: The study enrolled 101 patients over 65 years of age who will have surgical procedures under elective conditions. Demographic features, clinical parameters, ICU indications, ASA, LUSS, CACI, and SORTs of the patients were calculated prospectively and recorded. The effects of patients' ASA, LUSS, CACI, and SORT on determining the need for postoperative ICU admission were examined.

RESULTS: The age of patients who needed post-operative ICU admission was significantly higher than those who did not need post-operative ICU admission (P<0.001). The groups did not show differences in terms of gender, body mass index, smoking, and type of anesthesia (P>0.05). ASA, LUSS, CACI, and SORT were significantly higher for patients who needed post-operative ICU admission (P<0.001). The proportion of patients who needed post-operative ICU admission was higher for patients with post-operative ICU indication (P<0.001). The number of consultations was significantly higher for patients who needed post-operative ICU admission (P<0.001). SORT was found to be the highest accuracy for predicting the need for post-operative ICU admission.

CONCLUSION: It was detected that ASA, LUSS, CACI, and SORT are effective for the determination of the ICU indication in the pre-operative evaluation process of patients over the age of 65 who had elective surgery. However, the efficiency of SORT was found to be superior to the others.

Keywords: American Society of Anesthesiologists Score; Charlson age-added comorbidity index; intensive care unit indication; lung ultrasound score; surgical outcome risk tool score.

Cite this article as: Vahapoğlu A, Çavuş Z, Korkan F, Özakin O, Aygen Türkmen Ü. Is a guideline required to predict the ıntensive care unit need of patients over 65 years of age during the pre-operative period? A comparison of the American Society of Anesthesiologists, lung ultrasound score, Charlson age-added comorbidity index, surgical outcome risk tool indexes. Ulus Travma Acil Cerrahi Derg 2023;29:1004-1012.

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Ulus Travma Acil Cerrahi Derg 2023;29(9):1004-1012 DOI: 10.14744/tjtes.2023.43082 Submitted: 12.10.2022 Revised: 14.06.2023 Accepted: 20.06.2023

INTRODUCTION

The proportion of geriatric patients receiving surgical treatment increases significantly due to the increasing geriatric population.[1] The physiological changes accompanying aging cause an increase in pre-operative risks and the development of post-operative complications in geriatric patients.[2] Perioperative adverse events may be prevented by identifying patients at risk with pre-operative consultations in geriatric patients; patients are tried to be returned to baseline and have better functional status after the surgical procedure.[1] The aging does not increase the surgical risk solely; however, advanced age is associated with an increased prevalence of chronic diseases and organ functions deteriorate.[3]

Some of the geriatric patients may need follow-up and treatment in the intensive care unit (ICU) after the surgery.[4] There are not any clear and objective criteria for estimating the need for post-operative ICU and having a decision.[5] The estimation of the post-operative ICU need is often done by considering the presence and severity of the comorbidities, higher American Society of Anesthesiologists (ASA) score, patient-related conditions such as poor general conditions, and surgical conditions such as the location, duration, and size of the surgery in the pre-operative evaluation.[6-8] This sometimes results in postponing the anesthesia and surgical procedure until the ICU preparation is complete to avoid the safety risk for the patient. Furthermore, unplanned admission to ICU may be needed because of possible complications associated with the procedure or anesthesia during the pre-operative period.

Many scoring systems have been developed in modern medicine. None of the scoring systems developed over time could predict the patient's need for both anesthetic and surgical risk assessment, morbidity, mortality, and post-operative ICU admission.[9] The ASA has founded a numerical system to assess the physical health status and perioperative risk of the patient during anesthesia and surgical procedure in 1963. A higher ASA score was associated with higher post-operative complications, admission to ICU, and higher mortality.[10] The ASA score is routinely determined by the anesthetist subjectively before the anesthesia, and it is easily found in medical records.[11] Although the ASA score has been used to determine the indication for ICU in the pre-operative evaluation process of patients who have undergone surgery for many years, lung ultrasound score (LUSS), Charlson age-added comorbidity index (CACI), surgical outcome risk tool (SORT) score have been used for this purpose in recent years.

The SORT is a risk classification tool used to predict perioperative mortality.[12] This tool was developed to better identify the patients with higher post-operative morbidity and mortality risk.[13]

The bedside lung ultrasound examination has become a non-invasive, easy, fast, and reliable tool to estimate the diagnosis and guide the treatment of critically ill patients in recent years.[14] Lung ultrasound allows rapid and reliable diagnosis of lung consolidation, pleural effusion, or interstitial-alveolar diseases.[15,16] Ultrasound scan has become a user-friendly perioperative tool.

CACI was reported to be associated with higher readmission and risk of mortality in geriatric surgical patients.[17]

The aim of the present study was to determine the most effective classification by comparing the ASA, LUSS, CACI, and SORT scores with each other for determination of the post-operative ICU indication in the pre-operative evaluation process above 65 years of age. The hypothesis of the study is to demonstrate that LUSS, which is obtained by making a diagnosis with real visual ultrasound is superior to screening test SORT, CACI and another scoring, ASA.

MATERIALS AND METHODS

The study was approved by the Local Committee of Ethics of our hospital (No:30.10.2019 /87). Written informed consent form was obtained from the patients before inclusion in the study, and it was conducted prospectively between October 2019 and March 2020. A total of 101 patients over 65 years of age who will have surgical procedures under elective conditions and provided written consent were included in the study. The patients below 65 years of age, those who will have urgent surgical procedures, and the patients who did not provide written consent were excluded from the study. ASA assessment and lung ultrasound examination were performed by an experienced anesthesiologist. Lung ultrasound examination was performed preoperatively in the pre-operative resting unit and the patient was operated. CACI and SORT were calculated electronically after surgery, and the results were recorded. SORT http://www.sortsurgery.com/ access date: (October 01, 2019–March 31, 2020), CACI https://www.mdcalc.com/calc/3917/charlson-comorbidity-index-cci access date: (October 01, 2019–March 31, 2020) was calculated electronically.

Demographic features, clinical parameters, ICU indications, ASA, LUSS, CACI, SORT were calculated prospectively and recorded. The necessity of post-operative ICU was determined by the anesthesiologist before the operation by considering the presence and severity of comorbidities, the patient conditions such as higher ASA score, poor general condition, consultations, and the location, duration, and size of the surgery. The decision was made on the assumption that advanced age and comorbidities were important factors. The effect of ASA, LUSS, CACI, and SORT was reviewed on the determination of the admission to the ICU postoperatively.

ASA Classification

ASA is one of the most widely used pre-operative screening methods among all health-care professionals worldwide.[18] The concern in determining the ASA score is significant differences in how the attending physician would classify the same patient. Evaluation of patients may differ between anesthesiologists and other physicians due to subjective evaluations.[18] Adding samples to the ASA score for each score has been shown to help both anesthesiologists and other physicians to classify the patients accurately. The ASA established

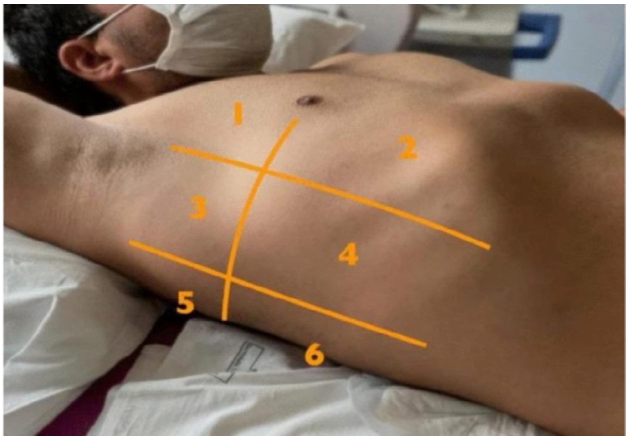

Figure 1. Representation of the 6-zone model for lung ultrasound score

a catalog of samples to reduce inter-observer variability in 2014. The ASA score is determined according to the presence and severity of a systemic disease.[19] Some common disease examples were listed, along with their scores. The letter E may be added to any category (i.e., ASA IIE) to specify an urgent case.[20]

LUSS

The scan was performed by Esaote MyLabSeven, a Getz Health-care Malaysia device with 2–5-MHz transducer by an experienced anesthesiologist. Lung ultrasound examinations were performed at the bedside; each hemithorax was divided into 6 quadrants, and twelve-zone examinations were performed, including anterior, lateral, and posterior regions (separated by anterior and posterior underarm lines), each was divided into upper and lower parts (Fig. 1). Each site was scored according to the LUSS model as follows: presence of lung shift with A-lines or less than two B-lines, 0 point; multiple B lines 1 point; the presence of multiple confluent B-lines, 2 points; and tissue pattern characterized by dynamic air bronchograms (lung consolidation), points 3. The worst ultrasound pattern observed on each region was recorded and total scores were calculated (total score=36).

CACI

One point was assigned for each comorbidity; 17 comorbidities were calculated.[21] Then, the total score was obtained by summing the scores obtained for each comorbidity. This score has been adjusted for age; after 40 years, add 1 point to the total score for each decade (i.e., 1 point for the 50–59 age groups, 2 points for the 60–69 age groups)

SORT

It consists of six pre-operative variables, including type, severity, urgency, ASA, age, and presence or absence of cancer in the patient. The SORT may predict the 30-day risk of mortality in patients undergoing non-cardiac and non-neurological surgeries.[22] Although SORT was developed as a pre-operative risk assessment tool, it may also be applicable as a risk adjustment tool.

Statistical Analysis

Sample size calculation was performed assuming a large difference between pre-operative + and – groups regarding the scores (ordinal LUSS, ASA, CACI, and SORT) related to the primary interest of the study. Therefore, it is assumed to be a similar large effect size (ES) about the scores. Large ES was determined as Cogen's d standardized ES score as d=0.8. "Sample size required for the study was calculated based on Mann–Whitney U-test to compare post-operative – and + groups regarding ordinal LUSS, ASA, CACI, and SORT. Considering a type I error rate of 0.05 along with a 0.80 power; 27 participants in each group would be enough to detect a large ES (Cohen's d=0.8). G* Power version 3.1 was used for sample size calculation". At the end of the study, it is observed that the ES regarding these scores between groups were large, as assumed for sample size calculation. We also performed post hoc power analyses after the study was done, for comparison of two independent groups with Mann–Whitney U-test regarding LUSS, ASA, CACI, and SORT. Using the mean and standard deviation of post-operative ICU admission + and – groups reported in Table 1, taking Type-I error as 0.05, ES and statistical power of the test were calculated as ES: 0.80 Power: 0.948; ES: 1 Power: 0.994; ES: 1.5 Power: 0.999; ES: 1.09 Power: 0.998, respectively, for LUSS, ASA, CACI and SORT. Power analyses were performed with G* Power version 3.1.[23,24]

Numerical data were summarized as mean ± standard deviation along with median (minimum–maximum), whereas frequency and percentage, n (%), were used for categorical data. Shapiro–Wilk's test was used to test the normality of numerical data. Post-operative ICU admission groups were compared regarding demographical and clinical characteristics by Mann–Whitney U-test, Pearson's Chi-square test, or Fisher's exact test where appropriate. Univariate and multiple logistic regression models were run to assess the potential predictors of post-operative ICU admission. Odds ratio and 95% confidence intervals (CI) were reported. Area under the receiver operating characteristic (ROC) curve (Fig. 2). ROC curve analysis demonstrating the predictive value of

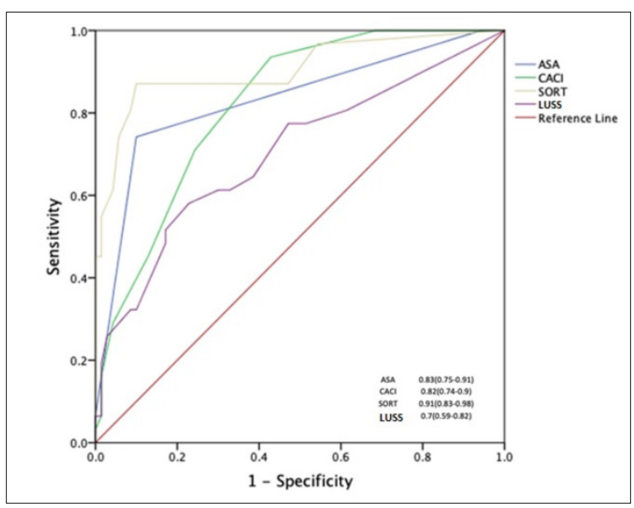

Figure 2. ROC curve analysis demonstrating the predictive value of the different risk scores for predicting post-operative ICU requirement

Table 1. Demographic and clinical features of the post-operative ICU admission groups

	Post-operative ICU Admission (+) n=31	Post-operative ICU Admission (-) n=70	P-value
Age, years	80.3±8.2, 80 (69–95)	70.5±5.2, 69.5 (65–86)	<0.001£
Gender			
Male (%)	11 (26%)	32 (74%)	0.388¥
Female (%)	20 (26%)	38 (74%)	
BMI, kg/m^2	26.8±7.4 25.1 (17.8–48.9)	28.2±5.5 27.7 (17.7–41.6)	0.100£
Smoking			
Yes, n (%)	2 (14%)	12 (86%)	0.216ƒ
No, (%)	29 (33%)	58 (67%)	
Type of anesthesia			
General, n (%)	18 (27%)	49 (73%)	0.242¥
Regional, n (%)	13 (38%)	21 (62%)	
Type of surgery			
Laparotomy, n (%)	25 (37%)	42 (63%)	0.043¥
Laparoscopy, n (%)	6 (18%)	28 (82%)	
ASA	3±1 3 (2–4)	2±1 2 (1–3)	<0.001£
CACI	7±2 6 (4–13)	4±2 4 (2–10)	<0.001£
SORT	2.1±3 1.3 (0.1–13.3)	0.3±0.3 0.2 (0.1–1.6)	<0.001£
LUSS	8±6 9 (0–24)	4±4 2 (0–16)	<0.001£
Pre-operative ICU indication			
Yes, n (%)	29 (71%)	12 (29%)	<0.001ƒ
No, n (%)	2 (3%)	58 (97%)	
Number of consultations	1.9±0.9 2 (0–3)	0.9±0.8 1 (0–3)	<0.001£

Data are presented as mean±standard deviation along with median (minimum–maximum) for continuous variables and as frequency and percentage (n, _) for categorical variables. P-values are based on £: Mann–Whitney U-test; ¥: Chi-square test; ƒ: Fisher's Exact; BMI: Body mass index; ASA: American Society of Anesthesiologists; CACI: Charlson age-added comorbidity index; SORT: Surgical outcome risk tool; LUSS: Lung ultrasound score.

the different risk scores for predicting postoperative ICU requirement. Area under the receiver operating characteristic (ROC) curve (AUC) along with its 95% CIs were given to assess the diagnostic value of scores to discriminate between postoperative ICU admission.

Optimal cutoff values of laboratory measurements were determined by Youden's Index, i.e., the value corresponding to maximum (Sensitivity+Specificity-1). Evaluation of diagnostic validities for the cutoff values was reported with sensitivity and specificity with their 95% CIs. Analyses were performed with R version 4.2.0 statistical computing language. "coin" and "report ROC" libraries were used for non-parametric and diagnostic validity analyses, respectively. P<0.05 was considered statistically significant.

RESULTS

A total of 101 patients over 65 years of age who will have surgical procedures under elective conditions were included in the study. The ASA, LUSS, CACI, and SORT were calculated.

Table 1 shows the demographic and clinical features of the post-operative ICU admission groups. The age of patients who needed post-operative ICU admission was significantly higher than those who did not need post-operative ICU admission (P<0.001). The groups did not show differences in terms of gender, body mass index, smoking type of anesthesia (P>0.05). Patients who underwent laparotomy surgery were more likely to need post-operative ICU admission (37% of patients who underwent laparotomy surgery needed post-operative ICU admission, while 18% of patients who underwent laparoscopy surgery needed post-operative ICU admission; P=0.043). ASA, CACI, SORT, and LUSS were significantly higher for patients who needed post-operative ICU admission (P<0.001). The proportion of patients who needed post-operative ICU admission was higher for patients with post-operative ICU indication (P<0.001). Number of consultations was significantly higher for patients who needed post-operative ICU admission (P<0.001).

Odds ratio from univariate and multivariable logistic regression models, where the dependent variable is taken as post-operative ICU admission are presented in Table 2.

Table 2. Predictors of post-operative ICU admission

	OR (95%CI)	Adjusted OR (95%CI)
Age, 1-year increase	1.23 (1.13–1.34)	1.17 (1.05–1.31)
Gender (Female)	1.53 (0.64–3.67)	-
BMI, kg/m2	0.96 (0.90–1.04)	-
Smoking (Yes)	0.33 (0.07–1.89)	-
Type of anesthesia (Regional)	1.69 (0.70–4.05)	-
Type of surgery (Laparotomy)	2.78 (1.02–7.64)	-
ASA (1 unit increase)	22.7 (7.46–69.12)	10.74 (3.35–34.42)
CACI (1 unit increase)	2.01 (1.47–2.75)	1.60 (1.14–2.34)
SORT (1 unit increase)	41.66 (8.73–198.83)	21.99 (3.98–121.48)
LUSS (1 unit increase)	1.17 (1.07–1.27)	1.11 (1.01–1.22)
Pre-operative ICU indication (Yes)	70.08 (14.70–334.15)	39.9 (7.78–204.66)
Number of consultations (1 unit increase)	3.44 (1.96–6.03)	2.44 (1.30–4.60)

Adjusted OR: Adjusted for age; BMI: Body mass index; ASA: American Society of Anesthesiologists; CACI: Charlson age-added comorbidity index; SORT: Surgical outcome risk tool; LUSS: Lung ultrasound score; ICU: Intensive care unit.

Table 3. Diagnostic accuracy of scores for predicting post-operative ICU admission

	AUC (95% CI)	P	Cutoff*	Sensitivity (95% CI)	Specificity (95% CI)
ASA	0.83 (0.75–0.91)	<0.001	2.5	0.74 (0.59–0.9)	0.9 (0.83–0.97)
CACI	0.82 (0.74–0.9)	<0.001	4.5	0.94 (0.85–1)	0.57 (0.46–0.69)
SORT	0.91 (0.83–0.98)	<0.001	0.58	0.87 (0.75–0.99)	0.9 (0.83–0.97)
LUSS	0.7 (0.59–0.82)	<0.001	6.5	0.58 (0.41–0.75)	0.77 (0.67–0.87)

CI: Confidence Interval; *Cutoff values are determined by Younden's Index, i.e., the value corresponding to maximum (Sensitivity+Specificity-1); ASA: American Society of Anesthesiologists; CACI: Charlson age-added comorbidity index; SORT: Surgical outcome risk tool; LUSS: Lung ultrasound score.

In terms of the Odd ratio, 1 year increase in age increases the odds of the need for post-operative ICU admission 1.23 times (95% CI: 1.13–1.34). One unit increase in ASA score increases the odds of need of post-operative ICU admission 22.7 times (95% CI: 7.46–69.12). After adjusted for age (considering patients of the same age), one unit increase in ASA score increases the odds of need for post-operative ICU admission 10.74 times (95% CI: 3.35–34.42).

One unit increase in CACI increases the odds of need for post-operative ICU admission 2.01 times (95% CI: 1.47–2.75). After adjusted for age (considering patients of the same age), one unit increase in CACI increases the odds of need for post-operative ICU admission 1.69 times (95% CI: 1.14–2.34).

One unit increase in SORT increases the odds of need for post-operative ICU admission 41.66 times (95% CI: 8.73–198.83). After adjusted for age (considering patients of same age), one unit increase in SORT increases the odds of need of post-operative ICU admission 21.99 times (95% CI: 3.98–121.48).

One unit increase in LUSS increases the odds of need for post-operative ICU admission 1.17 times (95% CI: 1.07–1.27). After adjusted for age (considering patients of the same age), one unit increase in LUSS increases the odds of need for post-operative ICU admission 1.11 times (95% CI: 1.01–1.22).

Patients with post-operative ICU indications are 70.08 times more likely to need post-operative ICU admission (95% CI: 14.70–334.15). After adjusted for age (considering patients of the same age), patients with post-operative ICU indication are 39.9 times more likely to need post-operative ICU admission (95% CI: 7.78–204.66).

One unit increase in the number of consultations increases the odds of the need of post-operative ICU admission 3.44 times (95%CI: 1.96–6.03). After adjusted for age (considering patients of the same age), one unit increase in the number of consultations increases the odds of the need of post-operative ICU admission 2.44 times (95% CI: 1.30–4.60).

AUC can be interpreted as the accuracy of the scores in predicting post-operative ICU admission. Higher the AUC, the better the model is at distinguishing between patients those admitted to post-operative ICU or not. SORT was found to be the highest accuracy for predicting the need for post-operative ICU admission [Table 3]. For SORT, the AUC is 0.91 (95% CI: 0.83–0.98) means that there is a 91% chance that the SORT will be able to predict post-operative ICU admission. The sensitivity of a score is its ability to predict the post-operative ICU admission correctly. The specificity of a score is its ability to predict the non-post-operative ICU admission correctly. Furthermore, looking at its sensitivity and specificity of SORT, it will correctly identify 87% (sensitivity) of post-operative ICU admission, but it will also fail to identify 13%. Further, it will correctly identify 90% (specificity) of non-admission, but it will also identify 10% of patients as non-admission when they are not (Table 3).

ROC curve given in Figure 2 shows pairs of sensitivity (true-positive rate) and 1-specificity (false-positive rate) at several cutoff values for ASA, CACI, SORT, and LUSS. The more that the ROC curve is close to the top left corner of the plot, the better the marker does at classifying the patients into categories. Therefore, the closer AUC (area under the ROC curve) is close to 1, the better the marker. A marker with an AUC equal to 0.5 would be a perfectly diagonal line and it would represent a marker that makes random classifications. The reference line is the diagonal line with an AUC equal to 0.5, which is also used as a null hypothesis to test the significance of the AUC of each marker. SORT has the highest AUC, which indicates that it has the highest area under the ROC curve and is the best marker at correctly classifying patients into categories.

DISCUSSION

In this study; the efficacy of ASA, LUSS, CACI, and SORT were compared in determining the need for post-operative ICU during the pre-operative evaluation process in patients over 65 years of age who underwent elective surgery. The study concluded that ASA, LUSS, CACI, and SORT are effective in the determination of post-operative ICU indication. The aim was to show that LUSS, which is the real visual, was superior, but the effectiveness of the screening test, SORT, was found to be superior.

The success of the surgery covers the entire perioperative period; it is important to know the patient well, to anticipate the problems that may occur during the operation, to take the necessary precautions, and to plan in advance where and how the patient will be cared for in the early post-operative period during this period.[25] It is necessary to make the right decision about whether to care for the patient in the surgical clinic or in the ICU after a major surgical procedure.[26] Unnecessary hospitalization in the ICU will be prevented, and to put a critical patient under risk by following him/her outside the ICU will also be prevented. As in our country, ICUs are limited in number all over the world and ICU follow-up and treatment require higher costs.[27] The ability to predict the need to stay in the ICU after surgery may help clinicians in determining the post-operative situation plan before surgery.[28] Patients with pre-operative ICU indications were found to be 70.08 times more likely to be admitted to the ICU after surgery (95% CI: 14.70–334.15) in our study.

Oruç et al. evaluated elderly patients who needed emergency and elective surgical treatment in their study, and they showed that complications and mortality were increased in the elderly patient group (over 60 years of age), concomitant diseases, major operations, and ASA score were associated with poor outcomes.[29] The results of our study also suggest that age is an important factor to predict the post-operative ICU follow-up. It was determined that a 1-year increase in age increased the need for hospitalization in the ICU after surgery by 1.23 times (%95 CI: 1.13–1.34).

Elderly patients often have multiple comorbidities that increase the risk of intra-operative and post-operative mortality.[30] Many pre-operative risk factors may help distinguish which patients are most likely to have poor post-operative outcomes. Therefore, it is essential to determine pre-operative risk factors for all surgeries in general. Identifying comorbidities using a score helps to understand the overall medical condition of the patient.[31] Kilic et al. searched the existence of a comorbidity in their study and found that the ICU admission rate was 40.59% in the patient group without any comorbidity, whereas the ICU admission rate was found as 77.78% in the group with two comorbidities.[6] Accordingly, the increase of comorbidities caused a significant increase in the ICU admission rate postoperatively. The presence of comorbidities was investigated in this study; it was determined that an increase of comorbidities caused a significant increase in the rate of hospitalization in the post-operative ICU. It was detected that a one-unit increase in the number of consultations increased the probability of post-operative ICU admission need by 3.44 times. (95% CI: 1.96–6.03).

A multi-centered study describing high-risk surgical patients in the United Kingdom has tried to reveal the underlying causes of the higher post-operative mortality risk.[32] It was detected that 80% of high-risk surgical patients died in the post-operative period; however, one-third were admitted to the post-operative ICU. Furthermore, early decision-making was found to significantly improve survival when compared with patients admitted to the ICU immediately after surgery and patients whose post-operative decision is delayed and ICU admission is delayed. The insufficiency of ICU resources was shown as one of the reasons. This study has shown the potential disadvantages of insufficient ICU use. The evidence-based criteria for post-operative admission to ICU may help improve post-operative outcomes and to determine the patients who will have the most benefit from ICU admission. Jhanji et al. reported that only 35% of high-risk surgery patients were admitted to the ICU postoperatively.[33] They concluded that patients admitted to the ICU had higher survival rates than patients admitted to the ICU lately and that high-risk surgical patients could be improved by better use of ICUs.

Although ASA was developed and applied to summarize the pre-operative comorbidity, it continues to be used as a valuable parameter to determine the reimbursement, and to predict the perioperative risk and mortality as well as admission to the ICU.[34,35] In our study, it was found that a one-unit increase in the ASA score increased the need for post-operative ICU admission by 22.7 times (95% CI: 7.46–69.12). ASA is one of the most widely used standard scores of pre-operative evaluation for surgical patients, and its easy and simple application is an important advantage.[36] Occasionally, a patient with physical status ASA I or II requires unexpected post-operative admission to the ICU. Accurate determination of the need for post-operative ICU during the pre-operative evaluation period in this patient group may save time in the course of the disease and the confusion and anxiety of unexpected admission to the ICU. According to the ASA classification, it is known that mortality is very high in patients with IV and V. Quinn et al. associated higher ASA class and advanced age were associated with a higher rate of unplanned admission to the ICU.[37]

ASA does not take intra-operative and post-operative complications as well as anesthesia and surgical management into account. The ASA score has often been questioned because it cannot accurately predict mortality. Therefore, another scoring system evaluated in our study was SORT. Since it is a system in which the physical condition and age as well as surgical status information of the patient are evaluated, which means having almost all the parameters that may cause the need for post-operative ICU, it was included in our comparisons. This test which is mainly used to determine post-operative mortality had the highest value to determine the need for ICU in our study. It was detected that a one-unit increase in the SORT score increased the need for admission to the ICU postoperatively by 41.66 times (%95 CI: 8.73–198.83). Oakland et al. reported that 25% of the admissions may be prevented by determining the high-risk patients who were admitted to the ICU unexpectedly since they have used SORT to determine the patients with high mortality risk and decide to admit to the ICU.[38]

SORT is a useful estimation tool including six pre-operative variables that results may be predicted easily with concomitant use of clinical presentation to estimate the mortality in cardiac and non-neurological patients.[13] Aboosalih et al. compared SORT and ASA in their study and they found that SORT provided a much better estimation of morbidity as a very useful prediction tool.[39] Accurate prediction of the patients who will need a longer hospitalization period and more intervention as a result of complications allows better planning and resource allocation.

Ultrasound has become a commonly used tool to evaluate pre-operative patients; however, its specific role has not been identified yet.[40] We designed our study assuming that LUSS could be superior because it is a real visual method in determining the indication of ICU. Ease of access to ultrasound, superiority for clinical decision-making, and ease of patient management give LUSS the potential to reach wider application and higher reliability. Some studies have demonstrated the innovative use of ultrasound in the pre-operative period; however, higher-level evidence is still limited to underline the potential advantages.[41] In our study, the predictive value of the LUSS for ICU indication was found to be low, and it is thought that it can be used as a support for other scoring systems.

The performance in the diagnosis of respiratory distress is superior to radiography.[42] It may be easily performed on the bedside.[14] LUSS has the capacity to serve as a better index to monitor the lung and guide treatment in a clinical practice setting.[43] It is possible for the ultrasound to become the stethoscope of the future.[44] It was detected in this study that a one-unit increase in the LUSS increased the need for post-operative ICU admission by 1.17 times. (95% CI: 1.07–1.27). It is known that the necessity of ICU follow-up is higher in geriatric patients in relation to respiratory complications in the post-operative period. Szabó et al. confirmed that LUSS is a valuable tool with higher sensitivity and specificity to detect post-operative pulmonary complications as well as identify developing complications or early stages of patients.[45] Zieleskiewicz et al. reported that LUSS may be an indicator of not only respiratory failure but also other post-operative pulmonary complications in post-operative patients who are not in the ICU.[46]

CACI has been reported to be associated with a higher risk of rehospitalization and mortality in older surgical patients.[47] Since age is an important risk factor for post-operative complications, combining comorbidities with age may be a more accurate predictor. Therefore, the CACI is an independent risk factor for all-cause mortality, which may be an appropriate prognostic indicator for identifying high-risk groups and administering appropriate therapy. It was detected that a one-unit increase in the CACI increases the need for admission to the ICU by 2.01 (95% CI: 1.47–2.75). Kılıç et al. reported that the CACI has provided the best value among ASA, Charlson comorbidity index, CACI, and SORT used to determine the post-operative ICU need. Zhang et al. associated a higher CACI with a higher risk of mortality and hospital readmission in their study conducted to emphasize the importance of assessment of comorbidities before pre-operative evaluation to predict adverse outcomes of elderly surgical patients.[17]

CONCLUSION

There is a need for easy and fast scoring systems that will be valid in the pre-, intra-, and post-operative period over 65 years of age, include both anesthetic and surgical risks, and have the advantage of predicting the need for post-operative ICU admission. There is a limited number of guidelines for ICU admission; however, there are not any universally accepted criteria for admission of surgical patients to the ICU. We believe that ASA, LUSS, CACI, and SORT are efficient in the determination of the need for admission to the ICU. We need a more comprehensive study regarding the high efficiency of SORT, which includes the patient's age, ASA, comorbidities, and surgical characteristics in determining the need for ICU and for LUSS used in daily anesthesia practice.

Limitations

This study has some limitations; the present study was single-centered; multi-centered studies with larger numbers of patients are needed to confirm our results. Elective cases were included in the study, but emergency cases were not included in the study. LUSS has user limitations. LUSS and correct interpretation of findings require training to acquire knowledge and skills. We believe that we should put an effort and aim to include this in the training curriculum as part of basic specialist training in anesthesiology. We demonstrated the effectiveness of SORT in determining the need for post-operative ICU in elective surgery patients. SORT is available at the bedside as an online risk estimation calculator accessible through a web browser and through smartphone apps. As mobile digital devices become more common, SORT will become more accessible for bedside use by anesthesiologists.

Ethics Committee Approval: This study was approved by the University of Health Sciences Taksim Training and Research Hospital Ethics Committee (Date: 30.10.2019, Decision No: 158).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.V., Z.Ç.; Design: A.V., Ü.A.T.; Supervision: F.K., Z.Ç., O.O.; Resource: A.V., Z.Ç.; Materials: A.V., F.K., O.O.; Data collection and/or processing: A.V., Ü.A.T.; Analysis and/or interpretation: Z.Ç., F.K., O.O.; Literature search: A.V., Ü.A.T., F.K.; Writing: Z.Ç., F.K.; Critical review: Ü.A.T., O.O., F.K., A.V.

Conflict of Interest: None declared.

Financial Disclosure: The author declared that this study has received no financial support.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Altmış beş yaş üstü hastalarda, preoperatif dönemde yoğun bakım ünitesi ihtiyacını öngörmede kılavuza ihtiyaç var mı? ASA, LUSS, CACI, SORT indekslerinin karşılaştırılması

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AMAÇ: Altmış beş yaş üstü cerrahi uygulanan hastaların, pre-intra ve postoperatif değişkenlerinin tümü postoperatif yoğun bakım ünitesi (YBÜ) takip gerekliliğini belirler. Ameliyat öncesi hem cerrahi hem anesteziyi ilgilendiren, kolay ve hızlı şekilde gerçekleştirilecek ideal skorlama sistemleri ile postoperatif YBÜ endikasyonu belirlenerek yüksek riskli hastalarda morbidite ve mortalite gelişimi engellenebilir. Çalışmamızda, YBÜ endikasyonunu belirlemede Amerikan Anesteziyolojistler Derneği (ASA) skoru, Akciğer Ultrason skoru (LUSS), Charlson Yaş Ekli Komorbidite İndeksi (CACI), Cerrahi Sonuç Risk Aracı (SORT) skorunun etkinliklerini karşılaştırdık. Çalışmamızın hipotezi, real görsel olan LUSS'un, YBÜ endikasyonu belirlemede tarama testi olan SORT, CACI ve diğer skor olan ASA'ya göre üstün olduğunu göstermektir.

GEREÇ VE YÖNTEM: Çalışmaya, 65 yaş üstü, elektif şartlarda cerrahi uygulanacak, 101 hasta alındı. Hastaların demografik özellikleri, klinik parametreleri, YBÜ endikasyonları, ASA, LUSS, CACI ve SORT'ları prospektif olarak hesaplanıp kaydedildi. Hastaların ASA, LUSS, CACI ve SORT'larının, postoperatif YBÜ'ne yatış ihtiyacının belirlenmesine etkisi incelendi.

BULGULAR: Ameliyat sonrası YBÜ'ne yatırılması gereken hastaların yaşı, ameliyat sonrası YBÜ'ne yatırılması gerekmeyenlere göre anlamlı derecede yüksekti ($p<0.001$). Gruplar cinsiyet, vücut kitle indeksi (VKİ), sigara kullanımı ve anestezi tipi açısından farklılık göstermedi ($p>0.05$). ASA, LUSS, CACI, SORT postop YBÜ'ne yatırılması gereken hastalarda anlamlı olarak daha yüksekti ($p<0.001$). Ameliyat sonrası YBÜ endikasyonu olan hastalardan, ameliyat sonrası YBÜ'ne ihtiyacı olan hastaların oranı daha yüksekti ($p<0.001$). Konsültasyon sayısı, ameliyat sonrası YBÜ'ne yatış gerektiren hastalarda anlamlı olarak daha yüksekti ($p<0.001$). SORT'un, ameliyat sonrası YBÜ'ne yatış ihtiyacını tahmin etmede en yüksek doğruluk olduğu bulundu.

SONUÇ: Altmış beş yaş üstü elektif cerrahi uygulanan hastaların preoperatif değerlendirme sürecinde YBÜ endikasyonunu belirlemede ASA, LUSS, CACI, SORT'un etkili olduğu tespit edilmiştir. Buna karşın SORT'un etkinliği diğerlerinden üstün bulunmuştur.

Anahtar sözcükler: Akciğer ultrason skoru; Amerikan anesteziyolojistler derneği skoru; cerrahi sonuç risk aracı skoru; Charlson yaş ekli komorbidite indeksi; yoğun bakım ünitesi endikasyonu.

Ulus Travma Acil Cerrahi Derg 2023;29(9):1004-1012 DOI: 10.14744/tjtes.2023.43082