Research Article

The Relation between Sarcopenia and Mortality in Patients at Intensive Care Unit

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Background and Aim. Psoas muscle area (PMA) can reflect the status of skeletal muscle in the whole body. It has been also reported that decreased PMA was associated with postoperative mortality or morbidity after several surgical procedures. In this study, we aimed to investigate the relation between PMA and mortality in all age groups in intensive care unit (UNIT).

Materials and Method. The study consists of 362 consecutive patients. The demographic characteristics of patients, indications for ICU hospitalization, laboratory parameters, and clinical parameters consist of mortality and length of stay, and surgery history was obtained from intensive care archive records.

Results. The mean age was 61.2 ± 18.2 years, and the percentage of female was 33.3%. The mean duration of stay was 10.3 ± 24.4 days. Exitus ratio, partial healing, and healing were 25%, 70%, and 5%, respectively. The mean right, left, and total PMA were 8.7 ± 3.6, 8.9 ± 3.4, and 17.6 ± 6.9, respectively. The left and total PMA averages of the nonoperation patients were statistically significantly lower (p = 0.021, p = 0.043). The mean PMA between the ex and recovered patients were statistically significantly lower (p = 0.001, p = 0.001, p < 0.001). Dyspnoea, renal insufficiency, COPD, transfusion rate, operation rate, ventilator needy, and mean duration of hospitalization were statistically significant higher in patients with exitus. There is a significant difference in operation types, anesthesia type, and clinic rates.

Conclusion. Our data suggest that sarcopenia can be used to risk stratification in ICU patients. Future studies may use this technique to individualize postoperative interventions that may reduce the risk for an adverse discharge disposition related to critical illness, such as early mobilization, optimized nutritional support, and reduction of sedation and opioid dose.

1. Introduction

Every year, millions of patients are followed up in the intensive care unit (ICU) in postoperative period or various diseases and some of these patients died. There are many parameters used to determine mortality in patients in the ICU: age, gender, chronic illness, acute physiological values (vital findings), and laboratory values such as serum creatinine level, troponin, lactate, and serum cystatin C [1]. None of these parameters directly correlated with mortality. Therefore, the parameters that can predict mortality are being investigated [2].

Sarcopenia, which means decreasing volume and function of muscle tissue as it ages, generally refers to the reduction of the physiological reserve in the body [3]. Previous studies have shown that sarcopenia is associated with chronic heart failure, postoperative status, after surgery, trauma, extended mechanical ventilation, longer hospital stays, and mortality [4–8].

Psoas muscle area (PMA) because it is a core muscle can reflect the status of skeletal muscle in the whole body [5, 8]. It has been also reported that decreased PMA, as a marker of sarcopenia, was associated with postoperative mortality or morbidity after several surgical procedures [5]. While there were relatively more data available about the prognostic value of sarcopenia in patients suffered surgery, trauma, or cancer, its importance for patients with mortality in whole ICU patients, not only the elderly, was little [5, 6]. So, in this
study, we aimed to investigate the relation between PMA and mortality in all age groups with intensive care unit.

2. Methods

Our study has cross-sectional design and included patients in intensive care unit of our hospital between May 2012 and May 2017. The relationship between the incidence of in-hospital mortality and sarcopenia level was investigated. Three hundred sixty-two ICU patients were included in the study. CT scan images were used to determine the quantity of skeletal muscle. The skeletal muscle cross-sectional area (cm²) was manually measured at the caudal end of the third lumbar vertebra. Computed tomography images were used to determine the quantity of skeletal muscle. CT scans were retrieved to measure right and left psoas muscle area, to obtain the total psoas area. The PSA was measured by an observer who was blinded to the outcome and disease severity.

For each patient record, following data were collected including age, sex, smoking, number of comorbidities presenting, ASA score, and Glasgow Coma Scale Score. During the length of stay in ICU all laboratory measurements, the reasons of admission to ICU (urgent, surgical, or internal reasons), type of anesthesia, ventilator requirement in ICU, transfusion requirement, duration of stay, and final status were recorded. The relationship between each of these parameters and the psoas muscle area was evaluated separately.

Statistical analyses were performed by SPSS 15.0 for Windows. In addition to descriptive statistics, mean, standard deviation, and minimum and maximum are used for numeric variables, and number and percentage for categorical variables. The Kolmogorov-Smirnov test was used to assess whether the variables were normally distributed. Student’s t-test or Mann–Whitney U test was used to compare the continuous variables between the groups according to whether it was normally distributed or not. Comparisons of ratios in groups were made with Chi Square Analysis. Binary logistic regression analysis (backward stepwise method) was performed to identify independently associated factors with mortality. Variables with a p value < 0.25 in univariate analysis were incorporated in the binary logistic regression analysis. Statistical significance level of alpha was accepted as p < 0.05.

3. Results

The general and operative characteristics of the study group are summarized in Table 1. The mean age was 61.2 ± 18.2 years, and the percentage of men was 63.3%. The mean duration of stay was 10.3 ± 24.4 days. Exitus ratio, partial healing, and healing were 25%, 71%, and 4%, respectively. The laboratory and PMA evaluations of the study group are summarized in Tables 2 and 3, respectively. The mean right, left, and total PMA were 8.7 ± 3.6, 8.9 ± 3.4, and 17.6 ± 6.9, respectively.

The mean right, left, and total PMA in patients with dyspnoea, COPD, CHF, female gender, and nonsmokers were statistically significantly lower (Table 4). The left and total PSOAS muscle area averages of the nonoperation patients were statistically significantly lower (p = 0.021; p = 0.043) (Table 5). We have obtained statistically significant difference in left PMA averages in anesthesia groups (p = 0.045) (Table 5). Patients’ left PMA averages, who had regional anesthesia, are lower than the others who has not taken anesthesia (p = 0.017) (Table 5). The mean PMA between the ex and recovered patients was statistically significantly lower (p = 0.001; p = 0.001 p < 0.001) (Table 6).
were found to be independently associated with mortality and total PMA (OR: 0.812 (CI: 0.741–0.890), p < 0.001) and COPD (OR: 0.307 (CI: 0.113–0.835), p < 0.001), and clinic rates (Table 9). In the multiple logistic regression analysis, COPD was a significant predictor of mortality and morbidity than chronological age and defining the fragility [13, 17–20]. Present study demonstrated that decreased skeletal muscle mass was a significant predictor of in-hospital mortality in the sample of patients.  

**Table 2: Laboratory parameters of the study population.**

|                  | Mean ± SD | Min–Max |
|------------------|-----------|---------|
| Glucose          | 152.3 ± 69.3 | 51–721 |
| Urea             | 65.8 ± 59.3  | 3.3–432 |
| CRE              | 1.67 ± 2.23  | 0.18–23.2 |
| AST              | 126.3 ± 369.7 | 4.3–3511 |
| ALT              | 770.0 ± 218.5 | 1–2499 |
| GGT              | 74.0 ± 121.4 | 5–1000 |
| ALP              | 106.2 ± 104.8 | 23.3–902 |
| T. Protein       | 5.0 ± 1.0    | 2.9–7 |
| Albumin          | 2.6 ± 0.6    | 0.9–5 |
| CK               | 259.5 ± 498.4 | 7.8–4838 |
| Sodium           | 136.4 ± 8.1  | 25–156 |
| Potassium        | 4.4 ± 3.0    | 2.06–59 |
| Calcium          | 7.7 ± 1.0    | 2.5–12 |
| CRP              | 121.2 ± 108.1 | 0.2–564 |
| WBC              | 14.7 ± 10.8  | 1.9–86.1 |
| RBC              | 3.8 ± 0.8    | 1.4–6 |
| HG               | 10.5 ± 2.2   | 2.3–17.7 |
| HCT              | 32.3 ± 1.6   | 10.9–54.2 |
| PLT              | 2300361 ± 1433560 | 11000–1233000 |
| Neutrophil       | 12.5 ± 9.6   | 1–83.5 |
| Lymphocyte       | 1.3 ± 1.3    | 0–11.9 |

CRE: Creatinine, GGT: Gama glutamyl transferase, ALP: Alkane Phosphate, CK: Creatinine kinase, AST: Aspartate dehydrogenase ALT: Alanine dehydrogenase, CRP: Cerum reactive proein, Wbc: White blood cells, RBC: Red blood cells, HG: Hemoglobin, HCT: Hematocrit, PLT: Platelet LDH: Lactate dehydrogenase.

**Table 3: Physical characteristics of study population, PSOAS muscle area.**

|             | Mean ± SD | Min–Max |
|-------------|-----------|---------|
| Right PSOAS | 8.7 ± 3.6 | 1.55–28.35 |
| Left PSOAS  | 8.9 ± 3.4 | 1.23–22.4 |
| Total PSOAS | 17.6 ± 6.9 | 2.78–45.94 |

There was a statistically significant positive correlation with glucose, ALT, CK, WBC, RBC, HG, Hct and negative correlation with age, ASA Score, urea, ALP, CRP, and right, left, and total PSOAS muscle area (Table 7). Dyspnea, renal insufficiency, COPD, transfusion rate, operation rate, ventilator needy, and mean duration of hospitalization were statistically significant higher in patients with exitus (Table 8). There is a significant difference in operation types, anesthesia type, and clinic rates (Table 9). In the multiple logistic regression analysis, COPD (OR: 0.307 (CI: 0.113–0.835), p = 0.021) and total PMA (OR: 0.812 (CI: 0.741–0.890), p < 0.000) were found to be independently associated with mortality (Table 10).  

**Table 4: Association of the demographic parameters and the physical characteristics in study population.**

|                  | Right PSOAS Mean ± SD | Left PSOAS Mean ± SD | Total PSOAS Mean ± SD |
|------------------|-----------------------|----------------------|-----------------------|
| Gender           |                       |                      |                       |
| Male             | 9.88 ± 3.55           | 10.14 ± 3.30         | 20.01 ± 6.65          |
| Female           | 6.33 ± 2.32           | 6.53 ± 2.19          | 12.86 ± 4.32          |
| Smoking          |                       |                      |                       |
| Yes              | 9.26 ± 3.51           | 9.57 ± 3.26          | 18.83 ± 6.59          |
| No               | 7.65 ± 3.54           | 7.78 ± 3.40          | 15.44 ± 6.79          |
| Diabetes Mellitus|                       |                      |                       |
| Yes              | 8.26 ± 2.57           | 8.54 ± 2.55          | 16.80 ± 4.97          |
| No               | 8.85 ± 3.98           | 9.07 ± 3.75          | 17.92 ± 7.56          |
| Dyspnea          |                       |                      |                       |
| Yes              | 8.02 ± 3.52           | 8.26 ± 3.31          | 16.28 ± 6.63          |
| No               | 9.72 ± 3.49           | 9.97 ± 3.35          | 19.69 ± 6.71          |
| Renal insufficiency|                    |                      |                       |
| Yes              | 8.28 ± 3.38           | 8.54 ± 2.96          | 16.83 ± 6.06          |
| No               | 8.86 ± 3.70           | 9.09 ± 3.63          | 17.93 ± 7.21          |
| Cancer           |                       |                      |                       |
| Yes              | 8.39 ± 3.00           | 8.68 ± 2.88          | 17.07 ± 5.78          |
| No               | 8.87 ± 3.99           | 9.07 ± 3.78          | 17.93 ± 7.56          |
| CHF              |                       |                      |                       |
| Yes              | 7.98 ± 3.41           | 8.30 ± 2.92          | 16.29 ± 6.08          |
| No               | 8.98 ± 3.65           | 9.18 ± 3.60          | 18.16 ± 7.12          |
| COPD             |                       |                      |                       |
| Yes              | 7.76 ± 3.68           | 7.77 ± 2.75          | 15.53 ± 6.10          |
| No               | 8.87 ± 3.55           | 9.16 ± 3.51          | 18.03 ± 6.94          |

CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease.

**4. Discussion**

Fragility is explicitly undefined and is known as failure to maintain homeostasis due to insufficient response to some stressors associated with reduced reserve in the multiple organ system [5–13]. It has been reported that frailty was predictor of mortality and morbidity than chronological age [14–17]. Some parameters such as physical activity level, unintentional weight loss, slow walking speed, fatigue, loss of physical strength, comorbid medical conditions, loss of independence for activities of daily living, low albumin levels, and cognitive impairments have been described in evaluating and defining the fragility [13, 17–20]. Present study demonstrated that decreased skeletal muscle mass was a significant predictor of in-hospital mortality in the sample of patients.
admitted to a tertiary medical center ICU. Sarcopenia, a frailty risk factor of particular interest is age-related loss of muscle mass and/or strength and performance and has been closely related to reduced quality of life, geriatric syndromes, greater morbidity, and mortality [20–24]. PMA because it is a core muscle can reflect the status of skeletal muscle in the whole body [12]. It has been reported that decreased PMA, as a marker of sarcopenia, was associated with postoperative mortality or morbidity after abdominal aortic aneurysm repair, liver transplantation, pancreatic cancer resection, adrenocortical cancer resection, colorectal cancer resection, radical cystectomy, and surgical or percutaneous aortic valve replacement [6]. It was also reported that direct measurement of muscle mass can give the best information about the physiological reserve. In some studies, measurement of the psoas muscle at the level of the third lumbar vertebra (L3) with CT has been used to determine the physiological reserve prior to some operations, such as liver transplantation [5, 12]. The prognostic value of sarcopenia has been determined for patients after surgery and trauma or with cancer. Moreover, Mueller et al. found that sarcopenia assessed with ultrasound predicts adverse discharge disposition as well as duration of hospitalization [9]. However their study did not conclude any comments on hospital mortality associated with sarcopenia. This is the first study, to the best of our knowledge, to examine the implications of sarcopenia evaluated by cross-sectional PMA, on mortality in ICU patients.

Single-slice muscle area has been found to be associated with total body muscle mass and as a predictor for the postoperative outcomes after various surgical procedures [5]. Similar to our study, Weij et al. demonstrated a relationship between the low skeletal muscle mass assessed by CT and extended mechanical ventilation, longer hospital stays, and mortality [7]. In line with our findings, Moisey et al. recently found that low muscle mass as assessed by CT scans was associated with mortality in 149 injured elderly ICU patients [8]. Besides that, in contrast to Moisey et al’s population, our findings are made in an ICU representative age group, and not in an elderly and only traumatic population. It is difficult to make these measurements in order to estimate skeletal muscle mass. It is often required as part of the initial study in patients. Therefore, it is possible that, in this patient population, an early evaluation of muscle mass and muscle cross-sectional view provide an objective method that estimates lean muscle easily obtained. So, in this study, CT was used to estimate total muscle mass determined by cross-sectional area of the psoas muscle as a marker of sarcopenia. Risk estimation, prediction, and the results achieved by bringing the perspective of resource allocation and assessment of quality of health services are important [25]. The individual approach to patient care in the intensive care unit following the treatment plan for each patient to identify the optimal risk-benefit ratio should be evaluated. Clinical characteristics that impact the mortality rate and the length of the hospital stay include multiple comorbidities such respiratory, cardiac, renal, and infectious problems. Several factors such as comorbidity can be evaluated in a variety of ways that help predict prognosis [26–32]. In spite of the apparent variability between observers, ASA classification

Table 5: Association between the clinical parameters and the physical characteristics in study population.

| Operation | Right PSOAS Mean ± SD | Left PSOAS Mean ± SD | Total PSOAS Mean ± SD |
|-----------|-----------------------|----------------------|-----------------------|
| Yes       | 8.86 ± 3.57           | 9.19 ± 3.48          | 18.04 ± 6.93          |
| No        | 8.31 ± 3.63           | 8.39 ± 3.37          | 16.69 ± 6.66          |
|           | 0.091                 | 0.021                | 0.043                 |
| Operation |                       |                       |                       |
| Urgent    | 8.82 ± 3.64           | 9.17 ± 3.59          | 17.99 ± 7.06          |
| Elective  | 8.90 ± 3.53           | 9.20 ± 3.39          | 18.10 ± 6.84          |
| None      | 8.31 ± 3.63           | 8.39 ± 3.37          | 16.69 ± 6.66          |
|           | 0.228                 | 0.067                | 0.124                 |
| Type of anesthesia |     |                       |                       |
| General   | 8.92 ± 3.63           | 9.25 ± 3.53          | 18.17 ± 7.03          |
| Regional  | 7.95 ± 2.45           | 8.13 ± 2.44          | 16.08 ± 4.82          |
| None      | 8.31 ± 3.63           | 8.39 ± 3.37          | 16.69 ± 6.66          |
|           | 0.188                 | 0.045                | 0.087                 |
| Clinic    |                       |                       |                       |
| Urgent    | 8.60 ± 3.33           | 8.93 ± 3.42          | 17.50 ± 6.63          |
| Surgical  | 8.72 ± 3.55           | 9.06 ± 3.47          | 17.78 ± 6.91          |
| Internal  | 8.45 ± 4.13           | 8.16 ± 3.14          | 16.63 ± 6.88          |
|           | 0.644                 | 0.181                | 0.402                 |
| Transfusion |                 |                       |                       |
| Yes       | 8.65 ± 3.94           | 8.87 ± 3.61          | 17.52 ± 7.35          |
| No        | 8.68 ± 3.02           | 8.96 ± 3.12          | 17.63 ± 6.03          |
|           | 0.404                 | 0.518                | 0.442                 |
| GCS       |                       |                       |                       |
| 0–8       | 8.62 ± 4.48           | 8.13 ± 3.13          | 16.71 ± 7.20          |
| >9        | 8.65 ± 3.46           | 8.99 ± 3.46          | 17.64 ± 6.80          |
|           | 0.562                 | 0.116                | 0.256                 |
| Final status |                 |                       |                       |
| Recovery  | 8.95 ± 3.48           | 9.22 ± 3.44          | 18.17 ± 6.79          |
| Ex        | 7.80 ± 3.83           | 7.96 ± 3.21          | 15.75 ± 6.77          |
|           | 0.010                 | 0.009                | 0.006                 |
| Final status |                 |                       |                       |
| Ex        | 7.80 ± 3.83           | 7.96 ± 3.21          | 15.75 ± 6.77          |
| Partial recovery | 8.87 ± 3.43 | 9.13 ± 3.38          | 18.00 ± 6.67          |
| Recovery  | 10.40 ± 4.10          | 10.73 ± 4.20         | 21.13 ± 8.19          |
|           | 0.001                 | 0.001                | <0.001                |

GCS: Glasgow Coma Scale.

Table 6: Association between the PMA and mortality in study population.

| Recovery | Exitus | P  |
|----------|--------|----|
| Mean ± SD (median) | Ave. ± SD (median) | P |
| Right PSOAS | 8.95 ± 3.48 (9) | 7.79 ± 3.83 (7) | 0.001 |
| Left PSOAS  | 9.22 ± 3.44 (9) | 7.95 ± 3.21 (7) | 0.001 |
| Total PSOAS | 18.2 ± 6.8 (18) | 15.7 ± 6.8 (14) | 0.001 |
|                        | Right PSOAS |          | Left PSOAS |          | Total PSOAS |          |
|------------------------|-------------|----------|------------|----------|-------------|----------|
|                        | rho         | p        | rho        | p        | rho         | p        |
| **Age**                | −0.365      | <0.001   | −0.359     | <0.001   | −0.370      | <0.001   |
| **ASA Score**          | −0.209      | 0.001    | −0.182     | 0.004    | −0.200      | 0.002    |
| **GCS**                | 0.090       | 0.088    | 0.119      | 0.024    | 0.110       | 0.037    |
| **Ventilator requirement (day)** | −0.157 | 0.033 | −0.140 | 0.057 | −0.149 | 0.043 |
| **Duration of stay mean ± SD** | −0.089 | 0.091 | −0.075 | 0.155 | −0.084 | 0.109 |
| **Glucose**            | 0.165       | 0.002    | 0.139      | 0.008    | 0.158       | 0.003    |
| **Urea**               | −0.124      | 0.018    | −0.118     | 0.026    | −0.119      | 0.024    |
| **CRE**                | 0.044       | 0.411    | 0.023      | 0.676    | 0.038       | 0.487    |
| **AST**                | 0.045       | 0.415    | 0.006      | 0.910    | 0.028       | 0.616    |
| **ALT**                | 0.197       | <0.001   | 0.165      | 0.003    | 0.189       | 0.001    |
| **GGT**                | −0.036      | 0.549    | −0.049     | 0.423    | −0.040      | 0.514    |
| **ALP**                | −0.180      | 0.004    | −0.191     | 0.002    | −0.189      | 0.003    |
| **T. protein**         | −0.050      | 0.579    | −0.068     | 0.445    | −0.052      | 0.560    |
| **Albumin**            | 0.100       | 0.068    | 0.071      | 0.195    | 0.090       | 0.100    |
| **CK**                 | 0.182       | 0.028    | 0.209      | 0.012    | 0.209       | 0.012    |
| **NA**                 | −0.018      | 0.737    | −0.021     | 0.693    | −0.019      | 0.717    |
| **K**                  | 0.165       | 0.002    | 0.181      | 0.001    | 0.178       | 0.001    |
| **CA**                 | 0.052       | 0.329    | 0.036      | 0.502    | 0.045       | 0.392    |
| **CRP**                | −0.158      | 0.003    | −0.137     | 0.010    | −0.149      | 0.005    |
| **WBC**                | 0.125       | 0.017    | 0.079      | 0.135    | 0.106       | 0.044    |
| **RBC**                | 0.116       | 0.027    | 0.110      | 0.038    | 0.115       | 0.029    |
| **HG**                 | 0.154       | 0.003    | 0.159      | 0.002    | 0.157       | 0.003    |
| **HCT**                | 0.132       | 0.012    | 0.144      | 0.006    | 0.139       | 0.008    |
| **PLT**                | 0.001       | 0.996    | −0.028     | 0.602    | −0.010      | 0.850    |
| **Neutrophil**         | 0.115       | 0.030    | 0.077      | 0.146    | 0.102       | 0.054    |
| **Lymphocyte**         | 0.072       | 0.172    | 0.019      | 0.719    | 0.045       | 0.390    |
| **PT**                 | −0.051      | 0.339    | −0.036     | 0.502    | −0.047      | 0.372    |
| **PTT**                | −0.074      | 0.164    | −0.035     | 0.506    | −0.058      | 0.271    |
| **INR**                | −0.019      | 0.714    | 0.001      | 0.981    | −0.012      | 0.814    |

has been widely accepted in the prediction of morbidity and mortality [28–33].

Regardless of anesthesia application, it is expected to increase mortality and morbidity in patients with systematic disease. [32, 34]. Therefore, patients in bad health condition are expected to have higher rates of admission to the ICU [32, 35–37]. Our study showed that mortality, length of stay in the ICU, and duration of mechanical ventilation increased as PMA decreased.

All these scoring systems can help in the prediction of patient program, although it should be noted that the prognosis for each patient may be different [38]. Frail patients may have a lower functional capacity and decreased ability to mobilize at baseline. Thus, they are vulnerable against severe physiologic stressors, predisposing them to functional dependence at discharge and death.

In the current study, we confirmed associations between decreasing muscle mass and increased mortality in ICU patients. According to the results of our study, there was a close relationship between PMA values and mortality in ICU patients independent of other variables. Thus, fragility was quantitatively calculated and the prevalence of ICU patients emerged.

Because skeletal muscle atrophy can cause physical decline such as impaired cytokine [39, 40] and insulin signaling [41–43] that may result in glucose intolerance, we speculate that stratification by muscle mass may reflect physical condition. Due to the design of the study, sarcopenia and the relationship between the mechanisms of poor prognosis cannot be determined with certainty. However, the results of the current study emphasize mass and function of skeletal muscle in ICU patients.

As a result, it is appropriate to consider that frailty may be important in the treatment options and follow-up of the patients. While PMA is quantitatively indicative of frailty, CT exposure to PE patients is already present, but exposure to
Table 8: Clinical parameters of survivors and dead patients at follow-up period in ICU.

|                               | Recovery      | Exitus        | p           |
|-------------------------------|---------------|---------------|-------------|
| Gender Median ± SD (median)   | 60.1 ± 18.7   | 64.5 ± 16.4   | 0.070       |
| Gender n (%)                  |               |               |             |
| Male                          | 182 (67.2)    | 56 (61.5)     | 0.328       |
| Female                        | 89 (32.8)     | 35 (38.5)     |             |
| Cigarette                     | 170 (62.7)    | 57 (62.6)     | 1.000       |
| Additional diseases n (%)     |               |               |             |
| Diabetes                      | 80 (29.5)     | 36 (39.6)     | 0.076       |
| Dyspnea                       | 142 (52.4)    | 84 (92.3)     | <0.001      |
| Renal insufficiency           | 72 (26.6)     | 50 (54.9)     | <0.001      |
| Cancer                        | 123 (45.4)    | 33 (36.3)     | 0.128       |
| KKY                           | 81 (29.9)     | 34 (37.4)     | 0.185       |
| KOAH                          | 40 (14.8)     | 28 (30.8)     | 0.001       |
| Transfusion n (%)             | 155 (57.2)    | 65 (71.4)     | 0.016       |
| Operation n (%)               | 202 (74.5)    | 31 (34.1)     | <0.001      |
| Type of Anesthesia n (%)      |               |               |             |
| General                       | 189 (69.7)    | 30 (33.0)     | <0.001      |
| Regional                      | 13 (4.8)      | 1 (1.1)       |             |
| None                          | 69 (25.5)     | 60 (65.9)     |             |
| Clinic n (%)                  |               |               |             |
| Urgent                        | 87 (32.1)     | 23 (25.3)     |             |
| Elective                      | 115 (42.4)    | 8 (8.8)       | <0.001      |
| None                          | 69 (25.5)     | 60 (65.9)     |             |
| ASA Score n (%)               | 2.4 ± 0.9     | 2.9 ± 1.1     | 0.011       |
| 1                             | 39 (18.9)     | 5 (13.2)      |             |
| 2                             | 67 (32.5)     | 8 (21.1)      |             |
| 3                             | 77 (37.4)     | 13 (34.2)     | 0.023       |
| 4                             | 21 (10.2)     | 11 (28.9)     |             |
| 5                             | 2 (1.0)       | 1 (2.6)       |             |
| GCS mean ± SD (Min–Max)       | 13.9 ± 2.6    | 11.5 ± 4.1    | <0.001      |
| 0–8                           | 20 (7.4)      | 20 (22.2)     |             |
| >9                            | 249 (92.6)    | 70 (77.8)     | <0.001      |
| Ventilator need (day) Ave. ± SD (Min–Max) | 10.6 ± 3.0   | 18.4 ± 2.7   | <0.001      |
| Duration of stay Ave. ± SD (Min–Max) | 7.2 ± 2.1    | 19.5 ± 2.9   | <0.001      |

radiation and contrast remains. For this reason, it is plausible to plan studies to understand whether clinical frailty scores, such as Fried scoring or simple “FRAIL” Questionnaire Screening, on the outcome of PMA can influence the prognosis of ICU patients and lead to treatment [16, 18]. Mortality during hospital stay or functional information about the risk of dependence makes informed decisions about the goals of care may help.

The limitations of the present study are the lack of outpatient and surveys. Moreover, this is a retrospective analysis that could not lead to the conclusion which might only represent the background for future perspective studies that will confirm the impact of sarcopenia in ICU. Moreover, due to its retrospective nature, we could not assess our nutritional status of patients. We can clearly show the relationship between sarcopenia and malnutrition status of patients with tests such as the Mini Nutritional Assessment in further studies. Consequently, our data suggest that sarcopenia can be used in risk stratification in ICU patients. CT is a valid and simple technique that could also be used for longitudinal assessment of treatment success. Future studies may use this technique to individualize postoperative interventions that may reduce the risk for an adverse discharge disposition related to critical illness, such as early mobilization, optimized nutritional support, and reduction of sedation and opioid dose.
Table 9: Laboratory parameters of survivors and dead patients at follow-up period in ICU.

| Recovery | Exitus | p   |
|----------|--------|-----|
| Ave. ± SD (median) | Ave. ± SD (median) |     |
| **Glucose** | 152.1 ± 58.5 (139) | 152.7 ± 95.6 (128.5) | 0.136 |
| **Urea** | 59.6 ± 61.0 (39) | 85.0 ± 49.0 (77.5) | <0.001 |
| **Creatinine** | 1.61 ± 2.42 (0.95) | 1.94 ± 1.53 (1.11) | 0.003 |
| **AST** | 105.5 ± 337.6 (31) | 189.6 ± 449.9 (40) | 0.017 |
| **ALT** | 71.4 ± 232.3 (20) | 93.9 ± 170.5 (27) | 0.126 |
| **GGT** | 67.2 ± 104.8 (31) | 94.7 ± 168.0 (50.5) | 0.005 |
| **ALP** | 102.2 ± 109.2 (69) | 118.2 ± 90.0 (80.6) | 0.002 |
| **T. Protein** | 5.0 ± 1.0 (5) | 5.0 ± 1.0 (5) | 0.762 |
| **Albumin** | 2.6 ± 0.6 (2.6) | 2.4 ± 0.6 (2.4) | 0.012 |
| **CK** | 294.9 ± 570.6 (137) | 172.6 ± 226.8 (83.5) | 0.086 |
| **NA** | 136.0 ± 8.3 (137) | 137.6 ± 8.3 (138) | 0.011 |
| **K** | 4.4 ± 1.0 (4.2) | 4.4 ± 1.0 (4.2) | 0.170 |
| **CA** | 7.8 ± 0.9 (7.85) | 7.7 ± 1.1 (7.77) | 0.106 |
| **CRP** | 114.8 ± 106.4 (88.5) | 140.9 ± 111.7 (111) | 0.050 |
| **WBC** | 13.7 ± 8.5 (12.5) | 17.8 ± 15.6 (12.64) | 0.016 |
| **RBC** | 10.9 ± 0.7 (10.9) | 9.7 ± 2.5 (9.6) | <0.001 |
| **HCT** | 107.9 ± 6.4 (33.2) | 30.3 ± 7.0 (30) | 0.001 |
| **PLT** | 242239.9 ± 132297.6 (225000) | 192876.4 ± 168797.7 (158000) | <0.001 |
| **Neutrophil** | 11.5 ± 7.4 (10.25) | 15.3 ± 14.1 (10.9) | 0.157 |
| **Lymphocyte** | 1.26 ± 1.21 (1) | 1.42 ± 1.55 (1) | 0.700 |

Table 10: Multivariate regression analysis of predictors for mortality.

| Variables | Odds ratio (95% confidence interval) | p   |
|-----------|--------------------------------------|-----|
| COPD      | 0.307 (0.113–0.835)                  | 0.021 |
| Total PMA | 0.812 (0.741–0.890)                  | <0.000 |

Conflicts of Interest

The authors have declared that no conflicts of interest exist.

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