ORIGINAL ARTICLE

Assessment of Risk Factors for Mortality in Patients in Medical Intensive Care Unit of a Tertiary Hospital

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Abstract

Background: Knowing the risk factors for patients in intensive care units (ICUs) facilitates patient's management. The goal of this study was to determine the risk agents that influence our medical ICU mortality.

Patients and methods: This 11-month retrospective trial was managed in the medical ICU. In this study, 340 patients who were followed up for at least 24 hours in ICUs were accepted. The clinical data on patients were recorded retrospectively, and the mortality-related factors were analyzed. A regression analysis was also performed to determine the independent risk factors for ICU mortality.

Results: The median age was 73 (53–82) years. The death rate was 23.8%. Length of stay (LOS) in ICU was 3 (2–5) days, and APACHE-II (acute physiologic and chronic health evaluation) score was 19 (13–25). The prevalence of chronic diseases was not dissimilar except acute and chronic renal failures among survivors and deceased patients ($p > 0.05$). Acute and chronic renal failures were higher in deceased patients than in survivors and were statistically important [107 (41.3%) vs 47 (58%), $p = 0.008$] and 38 (14.7%) vs 22 (27.2%), $p = 0.01$], respectively. In the binary logistic regression analysis, age, APACHE II score, need for invasive mechanical ventilation (IMV), decreased serum albumin levels, and increased creatinine levels were established to be independent risk factors for death [(OR (odds ratio): 1.045 (1.009–1.081), $p = 0.013$, OR: 1.076 (21.008–1.150), $p = 0.029$, OR: 19.655 (6.337–60.963), $p = 0.001$), OR: 2.673 (1.191–6.024), $p = 0.017$, OR: 1.422 (1.106–1.831), $p = 0.006$)], respectively.

Conclusion: The most significant risk agents of death were determined through high APACHE II score, decreased serum albumin levels, and increased creatinine levels.

Keywords: Albumin, Comorbidity, Creatinine, Intensive care unit, Mortality.

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Highlights

- ICUs are hospital units where patients with the worst prognosis are treated and the highest rates of death are observed.
- The older age, high APACHE II score, and serum albumin and creatinine levels are useful for the evaluation of mortality in patients in medical intensive care.

Introduction

Intensive care units (ICUs) serve patient populations subjected to many complex interventions. Although the mortality rates in the ICU vary depending on the underlying disease, ICUs have the high death rates compared to the other ward services of the hospital.[1] Infections, presence of underlying disease, length of hospitalization, sedation, mechanic ventilation, use of vasopressors drugs, advanced age of the patient, and interventional procedures increase mortality.[2] The mean death rate of ICU noticed in the United States is between 8 and 19%, and annual deaths are reported as approximately 500,000 people.[1] In studies reported from our country, the ICU mortality rate was reported to be between 20.5 and 40.2%.[3] The death rates of ICU patients attained 18% in Brazil.[4] However, we do not have national ICU mortality data. Although ICUs constitute less number of beds in the hospital, their cost to the hospital budget is high due to the serious disease follow-up. These high costs are generally explained by the long stay in ICU and the expensive and intensive treatments and interventions performed on the patients. For these reasons, interest has been shown around the world in measuring ICU mortality outcomes. Assessment of patients' condition and choosing appropriate instruments in diagnosis and treatment are vital to determine the level of care in order to increase the level of health services offered to patients in ICU. Physicians working in the ICU unit should know the mortality rates and risk factors for mortality of ICU patients.

This study was aimed to specify the death rate and risk agents of patients hospitalized in our ICU.

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Materials and Methods

This retrospective and single-center study was carried out at Gazi Yaşargil Training and Research Hospital, Department of Internal Medicine, Division of Intensive Care Unit. The study protocol was approved by the ethics committee of our hospital. Since the study was retrospective, informed consent was not obtained from the patients and their relatives. The patients were assessed retrospectively from January 2020 and November 2020. Patients were excluded from the study if they were younger than 18 years of age and were followed up in ICU for less than 24 hours. Three hundred and forty patients followed up in our ICU were included in the study. The individual clinical and demographic data of the patients were obtained from the electronic records of the hospital and the file archives of the patients. Patients' age, gender, APACHE II (acute physiologic and chronic health evaluation) score, need for invasive mechanical ventilation (IMV), LOS in ICU, chronic diseases, laboratory results on admission to ICU, GFR (glomerular filtration rate) value on admission to ICU, and death condition were recorded.

Statistical Analysis

For the normality analysis of continuing variables, the Shapiro–Wilk test was used, and the data obtained were presented as median and IQR (interquartile range) or the mean and SD (standard deviation). In order to compare the results obtained from variables that were not normally distributed, the Mann–Whitney *U*-test was used. Student's *t*-test was used to compare the results obtained from the normally distributed variables. The differences between the groups in terms of categorical variables were evaluated by Chi-square or Fisher's exact test and presented as numbers (percentages). In order to understand whether the variables were significant or not, binary logistic regression analysis was used. The patients were separated into two groups: the survivors and deceased. The differences between two groups were analyzed for all parameters. The results of the logistic regression analysis were presented as odds ratio (OR) and 95% confidence interval (CI). A *p*-value of less than 0.05 was considered statistically meaningful. The results of the statistical analysis were obtained using the IBM SPSS version 22.0 program.

Results

Of 340 patients, 158 (46.5%) were female. The median age was 73 (53–82) years. The death rate was 23.8%. LOS in ICU was 3 (2–5) days. GFR on admission to ICU was 37 (15–81), and APACHE II score was 19 (13–25). In this study, 154 (45.3%) patients had acute renal failure, 80 (23.5%) patients had diabetes mellitus, 60 (17.6) patients had chronic renal failure, and 70 (20.6%) patients had hypertension. The frequency of comorbidities was not different except acute and chronic renal failures between survivors and deceased patients ($p > 0.05$). Acute and chronic renal failures were higher in deceased patients than in survivors significantly [107 (41.3%) vs 47 (58%), $p = 0,008$ and 38 (14.7%) vs 22 (27.2%), $p = 0.01$], respectively. The deceased patients had higher age [79 (72–86) vs 68 (44–80), $p = 0.001$], APACHE II score [27 (21–32) vs 17 (12–23), $p = 0.001$], need for IMV [40 (49.4%) vs 11 (4.2), $p = 0.001$], LOS in ICU [6 (3–12) vs 3 (2–4), $p = 0.001$], urea [155 (105–234) vs 81 (41–130), $p = 0.001$], creatinine [2.7 (1.4–4.2) vs 1.4 (0.8–2.9), $p = 0.001$], magnesium [2.1 (1.7–2.5) vs 1.9 (1.7–2.2), $p = 0.01$], phosphorus [4.3 (3.4–5.8) vs 3.4 (2.7–4.4), $p = 0.001$, 127 (82–178) vs 87 (33–188), $p = 0.05$], as compared in survivors. Survivors had higher albumin [3.3 (2.8–3.7) vs 2.7 (2.5–3.2), $p = 0.001$], total calcium [8.6 (8–9.1) vs 8.3 (7.6–8.8), $p = 0.002$], and GFR on admission to ICU [47 (19–86) vs 19 (11–38), $p = 0.001$], as compared in deceased patients. Detailed demographic features are defined in Table 1. APACHE II score, age, need for IMV, decreased serum albumin levels, and increased creatinine levels were determined to be independent risk predictors for death [OR: 1.045 (1.009–1.081), $p = 0.013$, OR: 1.076 (21.008–1.150), $p = 0.029$, OR: 19.655 (6.337–60.963), $p = 0.001$), OR: 2.673 (1.191–6.024), $p = 0.017$, OR: 1.422 (1.106–1.831), $p = 0.006$], respectively (Table 2).

Discussion

Traditionally, ICUs are departments of hospital units where patients with the worst prognosis are treated and the highest rates of death are observed. Information about the death of ICU patients in ICU can guide in decision of the success ratios. Due to different clinical diagnoses and different age groups of the patients, studies have reported different mortality rates in the ICU. As a result of this study, a mortality rate of 23.8% was found in patients hospitalized in a tertiary medical ICU in Diyarbakır Province in southeastern Turkey. Mortality rates in different ICUs in our country have been reported to be between 20.5 and 60.4%.[5] The average annual ICU mortality rate reported from hospitals in the United States ranges from 8 to 19%.[6] The death rate is seemed the same or high when compared to studies of another ICU researchers. There are many studies in the literature on the factors affecting mortality in ICU patients. This study elaborated the risk factors for mortality in the medical ICU patients; age, APACHE II score, need for IMV, decreased serum albumin levels, and increased creatinine levels were identified to be the independent risk agents for death. Elderly patients hospitalized in the ICU constitute the complicated patient group. Generally, elderly patients are hospitalized for acute deterioration due to chronic diseases or multiorgan failure due to sepsis. Therefore, the risk of mortality increases in older patients. Additionally, it has been shown in studies that age is the constant indicator of death in the ICU patients.[7,8] In our results, the highest mortality rate was observed in elderly patients. The APACHE II score is used to determine the severity of the condition of patients admitted to the critical care units and to predict their prognosis. In this study, APACHE II score was seemed to be high in deceased patients. This result is consistent with the knowledge that APACHE II score, which is also included in the literature, is an important marker in predicting ICU mortality.[9,10] The high need for IMV and the high incidence of ventilator-related side effects in the patient groups included in this study were accepted as predictors of mortality. The patients who underwent mechanical ventilation had a 19.655 higher probability of mortality compared to patients who did not require mechanical ventilation [95% CI: (6.337–60.963), $p = 0.001$]. In a study conducted in Singapore, the use of mechanical ventilation was identified as an independent risk factor for in-hospital mortality in the population of geriatric patients hospitalized in the ICU.[6] In another study, it was reported that the mortality rate was 66.7% in the group of elderly ICU patients who needed mechanical ventilation.[11] The need for invasive mechanical ventilator in intubated patients with end-stage renal disease hospitalized with a diagnosis of coronavirus disease-2019 (COVID-19) in the ICU was determined as an independent risk factor for hospital mortality.[12] As it is known, serum albumin is one of the most important indicators of nutrition as well as a negative acute-phase indicator whose level decreases in the presence of a chronic systemic disease. Therefore, mortality is expected to be high in patients with low albumin levels, which was shown in the regression analysis in our study. Snipelisky et al. indicated that lower serum albumin concentrations in patients with pulmonary arterial hypertension are associated with higher mortality.[13] Chen et al. showed that severe hypoalbuminemia is a potent risk agent for acute respiratory failure in patients with chronic obstructive

Table 1: Baseline characteristics of the patients

Variables	*Total* *n = 340*	*Survivors* *n = 259*	*Non-survivors* *n = 81*	*p*
Age, (y)	73 (53–82)	68 (44–80)	79 (72–86)	0.001
Female, ***n*** (%)	158 (46.5)	118 (45.6)	40 (49.4)	0.547
APACHE II score	19 (13–25)	17 (12–23)	27 (21–32)	0.001
Need for IMV, ***n*** (%)	51 (15)	11 (4.2)	40 (49.4)	0.001
Comorbidity, ***n*** (%)				
COPD	33 (9.7)	23 (8.9)	10 (12.3)	0.358
CAD	42 (12.4)	28 (10.8)	14 (17.3)	0.122
HTN	70 (20.6)	24 (20.8)	16 (19.8)	0.831
CHD	32 (9.4)	23 (8.9)	9 (11.1)	0.548
CVD	15 (4.4)	10 (3.9)	5 (6.2)	0.363
ARF	154 (45.3)	107 (41.3)	47 (58)	0.008
CRF	60 (17.6)	38 (14.7)	22 (27.2)	0.01
DM	80 (23.5)	63 (24.3)	17 (21)	0.537
Malignant disease	8 (2.4)	5 (1.9)	3 (3.7)	0.402
Laboratory parameters on admission to ICU				
Urea	154 (107–229)	81 (41–130)	155 (105–234)	0.001
Creatinine	1.6 (0.9–3.2)	1.4 (0.8–2.9)	2.7 (1.4–4.2)	0.001
Potassium	4.4 (3.9–5.1)	4.4 (4–5)	4.7 (3.9–5.3)	0.256
Chloride	103 (97–108)	103 (97–108)	103 (97–109)	0.829
Albumin	3.1 (2.7–3.6)	3.3 (2.8–3.7)	2.7 (2.5–3.2)	0.001
Magnesium	1.9 (1.7–2.2)	1.9 (1.7–2.2)	2.1 (1.7–2.5)	0.01
Sodium	137 (133–141)	137 (133–140)	137 (133–142)	0.208
Total calcium	8.5 (7.9–9)	8.6 (8–9.1)	8.3 (7.6–8.8)	0.002
Phosphorus	3.6 (2.8–4.8)	3.4 (2.7–4.4)	4.3 (3.4–5.8)	0.001
Hb (g/dL)	11 ± 3.5	11.1 ± 3.6	10.8 ± 3.1	0.465
GFR on admission to ICU (mL/minute/1.73 m^2)	37 (15–81)	47 (19–86)	19 (11–38)	0.001
LOS in ICU, days	3 (2–5)	3 (2–4)	6 (3–12)	0.001

n, number; *y*, year; *p*, probability; APACHE II, acute physiologic and chronic health evaluation; IMV, invasive mechanical ventilation; COPD, chronic obstructive pulmonary disease; CAD, coronary artery disease; HTN, hypertension; CHD, chronic heart disease; CVD, cerebrovascular disease; ARF, acute renal failure; CRF, chronic renal failure; DM, diabetes mellitus; Hb, hemoglobin; GFR, glomerular filtration rate; LOS, length of stay; ICU, intensive care unit

Table 2: Multivariable binary logistic regression modeling of parameters for mortality

Variables	*OR*	*%95 CI*	*p*
Age	1.045	1.009–1.081	0.013
APACHE II score	1.076	1.008–1.150	0.029
Need for IMV	19.655	6.337–60.963	0.001
ARF	1.308	0.288–5.939	0.728
CRF	2.683	0.473–15.213	0.265
Urea	1.007	0.999–1.014	0.08
Creatinine	1.422	1.106–1.831	0.006
Albumin	2.673	1.191–6.024	0.017
Magnesium	2.260	0.920–5.553	0.075
Total calcium	1.304	0.787–2.158	0.303
Phosphorus	1.171	0.928–1.479	0.183
GFR	1.005	0.976–1.034	0.715
LOS in ICU	0.987	0.930–1.187	0.006

OR, odds ratio; CI, confidence interval; *p*, probability; APACHE II, acute physiologic and chronic health evaluation; IMV, invasive mechanical ventilation; ARF, acute renal failure; CRF, chronic renal failure; GFR, glomerular filtration rate; LOS, length of stay; ICU, intensive care unit

pulmonary disease.[14] Moon and his colleagues have shown that initial hypoalbuminemia is effective in short- and long-term mortality in patients undergoing continuous renal replacement therapy.[15] In our study, it was found that mortality increased compared to the serum creatinine value at admission. Although we do not have the follow-up data, there are data indicating that creatinine level is an important indicator of mortality in hospitalized patients. Numerous strong studies have been published showing that even very little changes in serum creatinine value reflect an increased mortality in hospitalized patients. Xie et al. demonstrated that acute kidney injury patients diagnosed by increased serum creatinine had a higher risk of in-hospital death following non-cardiac surgery.[16] Samuels et al. have shown that even small increases in serum creatinine in critically ill patients with cancer are associated with long-term ICU stay and increased hospital death. There were several limitations in our study. Although the number of patients included in the study was sufficient, it was conducted retrospectively in a single-center hospital, and selection bias cannot be ruled out. Also, other agents affecting the death of patients in critical care unit were not evaluated in this study. In conclusion, basic data during hospitalization in the ICU can be very valuable in predicting the mortality of patients. This study showed that comorbidities, such as acute and chronic renal failures, increased the risk of mortality, and the multivariate analysis revealed that the risk factors for death in patients admitted to the critical care unit are age, APACHE II score, need for IMV, decreased serum albumin levels, and increased creatinine levels. Our findings may help clinicians estimate the mortality rates in the ICU and also facilitate to manage the treatment of patients.

Author Contributions

All authors involved in conceptualization. IS, SO, and JK involved in data curation and formal analysis. All authors involved in project administration, visualization, and writing the original draft. BSK involved in writing the review and editing.

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References

1. Siddiqui S. Mortality profile across our intensive care units: a 5-year database report from a Singapore restructured hospital. Indian J Crit Care Med 2015;19(12):726–727. DOI: 10.4103/0972-5229.171401.
2. Soares Pinheiro FGM, Santana Santos E, Barreto ÍDC, Weiss C, Vaez AC, Oliveira JC, et al. Mortality predictors and associated factors in patients in the intensive care unit: a cross-sectional study. Crit Care Res Pract 2020;2020:1483827. DOI: 10.1155/2020/1483827.
3. Altıay G, Tabakoğlu E, Özdemir L, Tokuç B, Çevirme L, Hatipoğlu ON, et al. Solunum Yoğun Bakım Hastalarında Mortalite Oranları ve İlişkili Faktörlerin Belirlenmesi. Toraks Dergisi 2007;8:79–84 .
4. Associação Brasileira de Medicina Intensiva. 2019. Available from: http://www.utisbrasileiras.com.br.
5. Çakır E, Kocabeyoğlu GM, Gürbüz Ö, BÖ Sevil, Mutlu NM, ÖT Işıl. Yoğun Bakım Ünitesinde Mortalite Sıklığı ve Risk Faktörlerinin Değerlendirilmesi. Ankara Eğt Arş Hast Derg 2020;53(1):20–24. DOI: 10.20492/aeahtd.537879.
6. Mukhopadhyay A, Tai BC, See KC, Ng WY, Lim TK, Onsiong S, et al. Risk factors for hospital and long-term mortality of critically ill elderly patients admitted to an Intensive Care Unit. Biomed Res Int 2014;2014:960575. DOI: 10.1155/2014/960575.
7. Wang M, Jiang L, Zhu B, Li W, Du B, Kang Y, et al. The prevalence, risk factors, and outcomes of sepsis in critically ill patients in China: a multicenter prospective cohort study. Front Med (Lausanne) 2020;7:593808. DOI: 10.3389/fmed.2020.593808.
8. Magro B, Zuccaro V, Novelli L, Zileri L, Celsa C, Raimondi F, et al. Predicting in-hospital mortality from coronavirus disease 2019: a simple validated app for clinical use. PLoS One 2021;16(1):e0245281. DOI: 10.1371/journal.pone.0245281.
9. Zou X, Li S, Fang M, Hu M, Bian Y, Ling J, et al. Acute physiology and chronic health evaluation ii score as a predictor of hospital mortality in patients of coronavirus disease 2019. Crit Care Med 2020;48(8):e657–e665. DOI: 10.1097/CCM.0000000000004411
10. Qu R, Hu L, Ling Y, Hou Y, Fang H, Zhang H, et al. C-reactive protein concentration as a risk predictor of mortality in intensive care unit: a multicenter, prospective, observational study. BMC Anesthesiol 2020;20(1):292. DOI: 10.1186/s12871-020-01207-3.
11. Van Den Noortgate N, Vogelaers D, Afschrift M, Colardyn F. Intensive care for very elderly patients: outcome and risk factors for inhospital mortality. Age Ageing 1999;28(3):253–256. DOI: 10.1093/ageing/28.3.253.
12. Ng JH, Hirsch JS, Hazzan A, Wanchoo R, Shah HH, Malieckal DA, et al. Outcomes among patients hospitalized with COVID-19 and acute kidney injury. Am J Kidney Dis 2020:S0272-6386(20)30998-7. DOI: 10.1053/j.ajkd.2020.09.002.
13. Snipelisky D, Jentzer J, Batal O, Dardari Z, Mathier M. Serum albumin concentration as an independent prognostic indicator in patients with pulmonary arterial hypertension. Clin Cardiol 2018;41(6):782–787. DOI: 10.1002/clc.22954.
14. Chen CW, Chen YY, Lu CL, Chen SC, Chen YJ, Lin MS, et al. Severe hypoalbuminemia is a strong independent risk factor for acute respiratory failure in COPD: a nationwide cohort study. Int J Chron Obstruct Pulmon Dis 2015;10:1147–1154. DOI: 10.2147/COPD.S85831.
15. Moon JJ, Kim Y, Kim DK, Joo KW, Kim YS, Han SS. Association of hypoalbuminemia with short-term and long-term mortality in patients undergoing continuous renal replacement therapy. Kidney Res Clin Pract 2020;39(1):47–53. DOI: 10.23876/j.krcp.19.088.
16. Xie M, Li N, Qiao H, Guo JF, Li SL. Acute kidney injury diagnosed by elevated serum creatinine increases mortality in ICU patients following non-cardiac surgery. Zhonghua Yi Xue Za Zhi 2020;100(42): 3285–3290. DOI: 10.3760/cma.j.cn112137-20200318-00824.