Factors Influencing Intensive Care Unit Outcomes in Elderly Patients with Solid Organ Tumors

Solid Organ Malignitesi Olan İleri Yaş Hastalarda Yoğun Bakım Sonuçlarını Etkileyen Faktörler

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ABSTRACT

Introduction: The increasing incidence of cancer in the elderly population causes challenges for intensive care units (ICU) due to age-associated complications and critical illness. Despite advancements in cancer treatment, managing these patients in the ICU remains complicated, with conflicting reports on outcomes. Therefore, in this study, we aimed to investigate the factors influencing ICU outcomes to guide the management and overall care of this vulnerable patient population
Materials and Methods: A retrospective cohort study was conducted in a 9-bed tertiary medical ICU of Gazi University Hospital from July 2019 to January 2023 to investigate factors influencing ICU outcomes in elderly patients with solid organ tumors. The primary outcome measure of the study was ICU mortality.
Results: Among 123 critically ill elderly patients with solid organ tumors, ICU mortality was 58%. ICU non-survivors had higher rates of metastatic disease (85% vs. 33%, p<0.01), underlying chronic obstructive pulmonary disease (COPD) (45% vs. 27%, p=0.03), higher APACHE II (27[24-34] vs. 15[12-19], p<0.01, SOFA (10[6-15] vs 4[2-5], p<0.01) and lower Glasgow Coma Scale (GCS) scores (13[10-15] vs 15[13-15], p=0.01). ICU non-survivors also had higher rates of sepsis (72% vs. 50%, p=0.01) and shock (80% vs. 35%, p<0.01) and lower albumin levels (2.3±0.5 vs. 2.6±0.6, p=0.03) at ICU admission. Sepsis at ICU admission (OR (95% CI): 5.5 (1.8-17.4), p<0.01), presence of metastasis (OR (95% CI): 2.12 (1.41-4.32), p<0.01), APACHE-II score (OR (95% CI): (1.8 (1.29-2.51), p<0.01) and invasive mechanical ventilation (OR (95% CI): (1.56 (1.14-2.01), p=0.01) were found as independent risk factors for ICU mortality in this patient population.
Conclusion: Metastasis, sepsis at ICU admission, APACHE-II score, and requirement of invasive mechanical ventilation were independent risk factors for ICU mortality in elderly solid organ tumor patients. Future studies should validate these findings in larger cohorts and focus on disease status and treatment modalities.

Keywords: Solid organ tumors, intensive care unit, mortality, outcome

ÖZET

Amaç: Yaşlı nüfusta kanser sıklığının artmasının bir sonucu olarak bu hastaların yaşa bağlı komplikasyonlar ve kritik hastalıklara bağlı yoğun bakım ünitelerine (YBÜ) daha sık yatışı bu hasta grubunda uğraşılması güç sorunları da beraberinde getirmektedir. Kanser tedavisindeki önemli gelişmelere rağmen, bu hastaların YBÜ'de yönetimi oldukça zordur ve YBÜ sonuçları konusunda da literatürde çelişkili veriler bulunmaktadır. Bu nedenle mevcut çalışma ile bu kırılgan hasta popülasyonunda YBÜ sonuçlarını etkileyen faktörleri araştırmayı amaçladık.
Gereç ve Yöntemler: Gazi Üniversitesi Hastanesi bünyesindeki 9 yatak kapasiteli üçüncü basamak dahili YBÜ'nde Temmuz 2019 ile Ocak 2023 tarihleri arasında yatan hastaların dahil edildiği solid organ tümörü olan yaşlı hastalardaki YBÜ sonuçlarını etkileyen faktörlerin araştırmasının hedeflendiği retrospektif kohort çalışmasıdır. Birincil sonlanım noktası YBÜ mortalitesi olarak belirlenmiştir
Bulgular: Solid organ tümörü olan 123 kritik yaşlı hasta hastanın değerlendirildiği çalışmada YBÜ mortalitesi %58 saptandı. YBÜ'de ölen hastalarda, sağ kalanlara göre daha sık metastatik hastalık (

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%85'e karşı %33, p<0,01), kronik obstrüktif akciğer hastalığı (KOAH) (%45'e karşı %27, p=0,03), daha yüksek APACHE II (27[24-34]'e karşı 15[12-19], p<0,01), SOFA (10[6-15]'e karşı 4[2-5], p<0,01) ve GCS skorları (13[10-15]'e karşı 15[13-15], p=0,01) saptandı. YBÜ'de ölen hastalarda, sağ kalanlara göre ayrıca sepsis (%72'ye karşı %50, p=0,01) ve şok (%80'e karşı %35, p<0,01) oranları daha yüksek ve YBÜ kabulünde serum albümin düzeyleri (2,3±0,5'e karşı 2,6±0,6, p=0,03) daha düşük olarak saptandı. YBÜ kabulünde sepsis (OR (95% CI): 5,5 (1,8-17,4), p<0,01), metastaz varlığı (OR (95% CI): 2,12 (1,41-4,32), p<0,01), APACHE-II skoru (OR (95% CI): (1,8 (1,29-2,51), p<0,01) ve invaziv mekanik ventilasyon gereksinimi (OR (95% CI): (1,56 (1,14-2,01), p=0,01) çalışma hasta popülasyonunda YBÜ mortalitesi için bağımsız risk faktörleri olarak saptandı

Sonuç: Metastatik hastalık, YBÜ kabulünde sepsis, APACHE-II skoru ve invaziv mekanik ventilasyon gereksinimi, solid organ tümörü olan yaşlı hastalarda mortalite ile ilişkili bağımsız risk faktörleridir. Gelecek çalışmaların bu bulguları daha büyük hasta gruplarında hastalık durumu ile tedavi modalitelerine daha odaklanı bir şekilde doğrulaması gerekmektedir.

Anahtar Kelimeler: Solid organ tümörü, yoğun bakım ünitesi, mortalite, yoğun bakım sonuçları

Introduction

As the world population ages, the incidence of cancer also increases. Cancer stands as a leading cause of morbidity and mortality worldwide, with approximately 70% of cancer-related deaths occurring in individuals aged 65 and above [1]. With advancements in medical care, more elderly patients with solid organ tumors are finding themselves in intensive care units (ICU), dealing with disease-related complications and critical illness.

The decision to accept an elderly cancer patient to the ICU is influenced by various factors, such as the patient's performance status, comorbidities, treatment methods, and the status of the underlying malignancy [2]. Despite advancements in cancer treatment, managing elderly patients with solid organ tumors in the ICU presents several challenges, including compromised physiological reserves, higher susceptibility to infections, and increased risks of treatment-related toxicities [3]. On the other hand, while mortality rates tend to increase with age, some elderly individuals admitted to the ICU have outcomes comparable to younger patients [4]. Thus, comorbid conditions and frailty rather than age as just a number should have priority in assessing ICU requirements [4,5].

Understanding the outcomes of elderly patients with solid tumors in the ICU is crucial for optimizing their care and making several clinical decisions. While some studies report favorable outcomes and improved survival rates among this patient population, others emphasize high mortality rates and poor prognosis associated with critical illness in elderly cancer patients [5-7]. While prior research has contributed to our understanding of prognosis in these patients, there is a need for gathering diverse and up-to-date data to guide future advancements in patient care [5,8].

Therefore, in this study, we aimed to investigate the factors influencing ICU outcomes to guide the management and overall care of this vulnerable patient population.

Methods

Study Design and Setting

This retrospective cohort study was conducted in the nine-bed tertiary medical ICU of Gazi University Hospital from July 2019 to January 2023. The research protocol complied with the Declaration of Helsinki and was approved by the Local Ethics Committee (Ethics Committee of Gazi University, Faculty of Medicine, Approval Number: 2024-507). The

primary outcome measure of the study was ICU mortality.

Participants

Patients were included if they were ≥65 years old and had a confirmed diagnosis of solid organ tumor. Patients were excluded if they were terminally ill, stayed less than 24 hours, and were transferred from other ICUs.

Data Collection

Epidemiological and laboratory data were obtained from electronic hospital records and medical archives for analysis in this study. Demographic information including age, gender, type of malignancy, presence of metastasis, and clinical severity scores like the Glasgow Coma Scale (GCS), Acute Physiology and Chronic Health Evaluation II (APACHE II) score, Sequential Organ Failure Assessment (SOFA) score, and Risk, Injury, Failure Loss and End-stage kidney disease (RIFLE) score and admission laboratory parameters (C-reactive protein (CRP), procalcitonin, and albumin levels) were collected. Additionally, data regarding the cause and clinical parameters related to ICU admission, comorbidities, need for hemodialysis, invasive procedures, nosocomial infections, and ICU mortality rates were documented. Sepsis was defined by the Sepsis-3 criteria [9]. Acute kidney injury (AKI) was diagnosed according to RIFLE criteria on ICU admission. The GCS, APACHE II, RIFLE, and SOFA scores were computed within the initial 24 hours of ICU admission to assess the severity of the illness.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation or median with interquartile range based on their distribution. Categorical variables were presented as frequencies and percentages. Patients were divided into two groups according to survival in the ICU, and data were compared between ICU survivors and non-survivors. The Mann-Whitney U test or Independent Samples T-test was used to compare the continuous variables, and the chi-squared test or Fisher's exact test was used to compare the categorical variables. Logistic regression analysis was used to determine independent risk factors for ICU mortality. A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using SPSS Version 22.0 software (IBM Corp, New York, NY).

Results

ICU mortality was 58% (n=71) in 123 critically ill elderly patients with solid organ tumors. Detailed information regarding baseline characteristics, ICU admission, and follow-up data of the patients is given in Tables 1 and 2. ICU non-survivors had higher rates of metastatic disease (85% vs 33%, p<0.01) and underlying chronic obstructive pulmonary disease (COPD) (45% vs 27%, p=0.03) than ICU survivors. ICU non-survivors also had higher APACHE II (27[24-34] vs. 15[12-19], p<0.01) and SOFA (10[6-15] vs. 4[2-5], p<0.01) scores, lower GCS scores (13[10-15] vs. 15[13-15], p=0.01), higher rates of sepsis (72% vs 50%, p=0.01) and shock (80% vs 35%, p<0.01), and lower albumin levels (2.3±0.5 vs 2.6±0.6, p=0.03) at ICU admission (Table 1). Moreover, ICU non-survivors had higher rates of invasive mechanical ventilation (92% vs. 33%, p<0.01), renal replacement therapy (65% vs. 10%, p<0.01), central venous catheterization (86% vs. 48%, p<0.01), vasopressor requirement (97% vs 37%, p<0.01), and more frequent nosocomial infections (58% vs. 29%, p<0.01) than ICU survivors during the ICU follow-up (Table 2). Sepsis at ICU admission (OR (95% CI): 5.5 (1.8-17.4), p<0.01), presence of metastasis (OR (95% CI): 2.12 (1.41-4.32), p<0.01), APACHE-II score (OR (95% CI): (1.8 (1.29-2.51), p<0.01), and invasive mechanical ventilation (OR (95% CI): (1.56 (1.14-2.01), p=0.01) were found as

Table 1. Baseline Characteristics and ICU Admission Data of Elderly Patients with Solid Organ Tumors

Characteristics	All Patients n=123	Survivors n=52 (42%)	Non-Survivors n=71 (58%)	P value
Age (years)*	70[69-77]	70[66-73]	70[69-74]	0.56
Female, n (%)	43(35)	20(38)	23(32)	0.31
Solid Organ Tumor, n (%)				
Gastrointestinal	37(30)	16(31)	21(30)	0.52
Lung	35(28)	12(23)	23(32)	0.18
Genitourinary	26(21)	11(21)	15(21)	0.58
Head and Neck	8(7)	4(8)	4(6)	0.46
Breast	12(10)	7(13)	5(7)	0.19
Rare Tumors	6(5)	4(8)	2(3)	0.21
Presence of Metastasis	77(63)	17(33)	60(85)	<0.01
Additional Comorbidities, n (%)				
Hypertension	75(61)	30(58)	45(63)	0.35
COPD	46(37)	14(27)	32(45)	0.03
Diabetes mellitus	36(29)	18(35)	18(25)	0.18
Neurological disease	21(17)	9(17)	12(17)	0.56
Severity and Organ Failure Scores				
APACHE II score*	25[20-31]	15[12-19]	27[24-34]	<0.01
SOFA score*	8[4-10]	4[2-5]	10[6-15]	<0.01
Glasgow Coma Scale*	13[6-15]	15[13-15]	13[10-15]	0.01
Laboratory Parameters				
C-Reactive Protein*	142[81-242]	112[87-277]	149[79-242]	0.53
Procalcitonin*	1.4[0.4-4]	1.34[0.3-3.7]	1.9[0.4-5.9]	0.11
Albumin (mean±SD)	2.4±0.5	2.6±0.6	2.3±0.5	0.03
AKI at ICU Admission, n (%)	69(56)	28(54)	41(58)	0.40
Sepsis at ICU Admission, n (%)	77(63)	26(50)	51(72)	0.01
Shock at ICU Admission, n (%)	75(61)	18(35)	57(80)	<0.01

*Median [interquartile range], n; number, SD: Standard deviation
ICU: Intensive Care Unit, COPD: Chronic obstructive pulmonary disease, APACHE: Acute Physiology And Chronic Health Evaluation, SOFA: Sequential Organ Failure Assessment, GCS: Glasgow Coma Scale, AKI: Acute kidney Injury.

Table 2. ICU Follow-up Data of Elderly Patients with Solid Organ Tumors

Characteristics	All Patients n=123	Survivors n=52 (42%)	Non-Survivors n=71 (58%)	P value
Mechanical Ventilation, n (%)				
Noninvasive	34(28)	16(31)	18(25)	0.34
Invasive	82(67)	17(33)	65(92)	<0.01
Length of ICU Stay (days)*	15[8-25]	16[11-25]	15[8-25]	0.25
New Onset AKI, n (%)	28(23)	12(23)	16(23)	0.46
Renal Replacement Therapy, n (%)	41(33)	34(65)	7(10)	<0.01
Central Venous Line, n (%)	86(70)	25(48)	61(86)	<0.01
Requirement of Vasopressors, n (%)	88(72)	19(37)	69(97)	<0.01
Blood Product Replacement, n (%)	63(51)	22(42)	41(58)	0.06
Parenteral Nutrition, n (%)	24(20)	10(19)	14(20)	0.61
Nasocomial Infection, n (%)	56(46)	15(29)	41(58)	<0.01

*Median [interquartile range], n; number,
AKI: Acute kidney Injury. ICU: Intensive Care Unit.

Table 3. Independent Risk Factors for ICU Mortality in Elderly Patients with Solid Organ Tumors

Factor	Odds ratio (95 %CI)	p-value
Sepsis at ICU Admission	5.5(1.8-17.4)	<0.01
Presence of Metastasis	2.12(1.41-4.32)	<0.01
APACHE-II Score	1.8(1.29-2.51)	<0.01
Invasive Mechanical Ventilation	1.56(1.14-2.01)	0.01

ICU: Intensive care unit, APACHE-II: Acute physiology and chronic health evaluation

independent risk factors for ICU mortality in this patient population (Table 3).

Discussion

The findings of our study highlight essential factors influencing the ICU outcomes in elderly patients with solid organ tumors. In summary, ICU mortality was high, and ICU non-survivors had higher rates of metastatic disease, underlying COPD, and worse prognostic scores at ICU admission. Moreover, ICU non-survivors had higher rates of invasive mechanical ventilation, renal replacement therapy, central venous catheterization, and vasopressor therapy requirement and more frequent nosocomial infections during the ICU follow-up than ICU survivors. In addition to worse prognostic scores and IMV requirement, the presence of metastasis was found to be an independent risk factor for ICU mortality.

One of the key observations from our study is the significantly higher prevalence of metastatic disease among ICU non-survivors. The presence of metastasis was also found as an independent risk factor for ICU mortality. These findings are consistent with existing literature highlighting the detrimental impact of advanced disease states on ICU outcomes in cancer patients [10,11]. Metastatic disease, in particular, has been identified as a significant predictor of poor prognosis and increased mortality in critically ill cancer patients [12]. A study by Soares et al. found that metastatic cancer was associated with increased mortality among patients admitted to ICUs, corroborating our observation of higher ICU mortality among elderly patients with metastatic disease [11]. Furthermore, Darmon et al. reported similar findings, emphasizing the adverse impact of metastasis on short-term outcomes in critically ill cancer patients [10]. By explicitly examining this relationship in elderly patients with solid organ tumors, our study contributes to the factors influencing ICU outcomes in this population.

Furthermore, our study confirms the association between underlying COPD and ICU mortality. The higher mortality rate observed in patients with COPD may be attributed to the higher incidence of lung cancer, a common etiological factor shared among these patients, primarily due to smoking. Moreover, in our study, ICU non-survivors had higher APACHE II and SOFA scores and lower GCS scores, indicating greater physiological derangement and organ dysfunction at ICU admission. These findings are compatible with previous research demonstrating the prognostic value of severity scoring systems in predicting mortality among critically ill patients [13,14].

The higher prevalence of sepsis and shock among ICU non-survivors underlines the critical role of systemic inflammatory response and hemodynamic instability in determining outcomes in this patient cohort. Sepsis, in particular, has been identified as a significant contributor to mortality in critically ill cancer patients, highlighting the importance of early recognition and

aggressive management of sepsis and its complications [15,16].

According to our results, CRP and procalcitonin levels did not significantly differ between ICU survivors and non-survivors. This result may seem at odds with the existing literature, mainly associating procalcitonin with mortality risk in critically ill patients [17]. On the other hand, considering the influence of tumor-related inflammation, it is important to interpret this finding cautiously [18]. Solid organ tumors can modulate the host immune response and release pro-inflammatory mediators, which may affect biomarker profiles. While procalcitonin is commonly used as a marker of infection, its utility in cancer patients can be complicated by tumor-induced inflammation. Moreover, considering the relationship between procalcitonin level alterations and organ failure, the high incidence of sepsis and acute kidney injury in our cohort may further complicate the interpretation of these results.

Additionally, our study highlights the impact of therapeutic interventions on ICU outcomes. ICU non-survivors were more likely to require invasive mechanical ventilation, renal replacement therapy, central venous catheterization, and vasopressor therapy, reflecting the higher burden of organ support and resuscitative measures in this subgroup. These findings are consistent with previous studies demonstrating the association between invasive interventions and increased mortality in critically ill cancer patients [19,20].

In this single-center experience, our study contributes to the existing body of literature by identifying critical independent risk factors for ICU mortality among elderly patients with solid organ tumors. Our finding of sepsis at ICU admission is parallel with previous data highlighting the detrimental impact of septic complications on outcomes in ICU patients with solid organ tumors [15,19]. Similarly, the association between APACHE-II score and ICU mortality highlights the prognostic value of severity scoring systems in this population. It is consistent with prior research demonstrating their use in predicting outcomes in ICU patients with various underlying conditions [14,21]. Furthermore, our observation of invasive mechanical ventilation as a risk factor is similar to the findings from studies in critically ill cancer patients, emphasizing the significance of respiratory support in determining patient outcomes [10,11].

The results of this study have significant findings related to identifying factors related to ICU outcomes in elderly patients with solid organ tumors. However, it is important to acknowledge several limitations of our study, including its retrospective nature and the reliance on a single center cohort. Moreover, our study lacks data regarding the timing and regimen of oncological treatment methods before ICU admission. Additionally, we only had data on whether the patient had metastatic disease. We did not have detailed information regarding the stages of the solid organ tumor. Future studies should aim to validate our results in larger, prospective cohorts and focus more on the disease status and cancer treatment modalities.

Conclusion

Our study identifies metastatic disease, COPD, severity scoring and organ failure assessment systems, sepsis, and therapeutic interventions as significant determinants of ICU outcomes in elderly patients with solid organ tumors. These findings emphasize the importance of early recognition and tailored management strategies to improve outcomes.

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