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Original Article

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

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ABSTRACT

Aim: The increasing incidence of cancer in the older population presents challenges in intensive care units (ICU) due to age-associated complications and critical illness. Despite advancements in cancer treatment, the management of 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.

Methods: This 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, the ICU mortality rate was 58%. ICU non-survivors had higher rates of metastatic disease (85% vs. 33%, p<0.01), underlying chronic obstructive pulmonary disease (45% vs. 27%, p=0.03), higher Acute Physiology and Chronic Health Evaluation II (APACHE II) [27 (24-34) vs. 15 (12-19), p<0.01], Sequential Organ Failure Assessment [10 (6-15) vs. 4 (2-5), p<0.01] and lower Glasgow Coma Scale 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 [odds ratio (OR) 95% confidence interval (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 upon ICU admission, APACHE II score, and requirement for invasive mechanical ventilation were independent risk factors for ICU mortality in elderly patients with solid organ tumors. Future studies should validate these findings in larger cohorts and focus on disease states and treatment modalities.

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

Introduction

As the world population ages, the incidence of cancer also increases. Cancer is a leading cause of morbidity and mortality worldwide, with approximately 70% of cancer-related deaths occurring in individuals aged 65 years and older [1]. With advancements in medical care, more elderly patients with solid organ tumors are being admitted to intensive care units (ICU), where they manage disease-related complications and critical illness.

The decision to admit elderly patients with cancer 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, increased susceptibility to infections, and increased risks of treatment-related toxicities [3]. On the other hand, although mortality rates tend to increase with age,

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some elderly individuals admitted to the ICU have outcomes comparable to those of 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 care and making clinical decisions. While some studies have reported favorable outcomes and improved survival rates among this patient population, others have emphasized the high mortality rates and poor prognosis associated with critical illness in elderly patients with cancer [5-7]. While prior research has contributed to our understanding of the prognosis of these patients, there is a need to gather 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 between July 2019 and January 2023. The research protocol complied with the Declaration of Helsinki and was approved by the Gazi University Local Ethics Committee (number: 2024-507, date: 03.04.2024). 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, or were transferred from other ICUs.

Data Collection

Epidemiological and laboratory data were obtained from electronic hospital records and medical archives. Demographic information including age, sex, malignancy type, 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, 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 using the Sepsis-3 criteria [9]. Acute kidney injury (AKI) was diagnosed according to the RIFLE criteria upon ICU admission. The GCS, APACHE II, RIFLE, and SOFA scores were computed within 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 are presented as frequencies and percentages. Patients were divided into two groups according to ICU survival, and data were compared between ICU survivors and non-survivors. The Mann-Whitney U test or independent samples t-test was used to compare continuous variables, and the chi-square test or Fisher's exact test was used to compare categorical variables. Logistic regression analysis was used to identify independent risk factors for ICU mortality. A p value of <0.05 was considered statistically significant. All statistical analyses were performed using Statistical Package for Social Sciences 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 presented 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 [odds ratio (OR) 95% confidence interval (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 (Table 3).

Discussion

The findings of our study highlight the essential factors influencing 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, metastasis was found to be an independent risk factor for ICU mortality.

One of the key observations of our study was the significantly higher prevalence of metastatic disease among ICU non-survivors. The presence of metastasis was also an independent risk factor for ICU mortality. These findings are consistent with the existing literature highlighting the detrimental impact of advanced disease states on ICU outcomes in patients with cancer [10,11]. Metastatic disease, in particular, has been identified as a significant predictor of poor prognosis and

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
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 upon ICU admission, n (%)	69 (56)	28 (54)	41 (58)	0.40
Sepsis upon ICU admission, n (%)	77 (63)	26 (50)	51 (72)	**0.01**
Shock upon 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 II: Acute Physiology And Chronic Health Evaluation II, 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 (%)				
Non-invasive	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**
Vasopressor requirement, 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
Nosocomial infection rate, 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**
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 II, CI: Confidence interval

increased mortality in critically ill patients with cancer [12]. A study by Soares et al. [11] 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. Furthermore, Darmon et al. [10] reported similar findings, emphasizing the adverse impact of metastasis on short-term outcomes in critically ill patients with cancer. 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 confirmed 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, which is a common etiological factor among these patients, primarily due to smoking. 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 consistent with previous studies 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 highlights 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 patients with cancer, 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, which mainly highlighted the association between procalcitonin and 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 proinflammatory mediators, which may affect biomarker profiles. Although procalcitonin is commonly used as a marker of infection, its use in patients with cancer can be complicated by tumor-induced inflammation. Moreover, considering the relationship between procalcitonin level alterations and organ failure, the high incidence of sepsis and AKI in our cohort may further complicate the interpretation of these results.

Additionally, the current study highlights the impact of therapeutic interventions on ICU outcomes. Non-survivors in the ICU 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 those of previous studies demonstrating an association between invasive interventions and increased mortality in critically ill patients with cancer [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 consistent 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 the APACHE II score and ICU mortality highlights the prognostic value of severity scoring systems in this population. This 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 was similar to the findings of studies on critically ill patients with cancer, emphasizing the significance of respiratory support in determining patient outcomes [10,11].

Study Limitations

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 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 solid organ tumors. Future studies should aim to validate our results in larger prospective cohorts and to focus more on disease status and cancer treatment modalities.

Conclusion

Our study identified metastatic disease, COPD, severity scoring, 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.

Ethics

Ethics Committee Approval: The study was approved by the Gazi University Local Ethics Committee (number: 2024-507, date: 03.04.2024).

Informed Consent: Retrospective cohort study.

Authorship Contributions

Surgical and Medical Practices: K.İ., G.A., M.T., N.B.D., Concept: K.İ., N.B.D., A.Ö., Design: K.İ., G.A., Data Collection or Processing: K.İ., G.A., Analysis or Interpretation: M.T., K.İ., G.A., Literature Search: K.İ., N.B.D., Writing: K.İ., G.A.

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