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Prognostic factors in critically ill cancer patients admitted to the intensive care unit

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ABSTRACT

Objective: The objective of this study is to identify factors predicting intensive care unit (ICU) mortality in cancer patients admitted to a medical ICU.

Patients and methods: We conducted a retrospective study in 162 consecutive cancer patients admitted to the medical ICU of a 1000-bed university hospital between January 2009 and June 2012. Medical history, physical and laboratory findings on admission, and therapeutic interventions during ICU stay were recorded. The study end point was ICU mortality. Logistic regression analysis was performed to identify independent risk factors for ICU mortality.

Results: The study cohort consisted of 104 (64.2%) patients with solid tumors and 58 patients (35.8%) with hematological malignancies. The major causes of ICU admission were sepsis/septic shock (66.7%) and respiratory failure (63.6%), respectively. Overall ICU mortality rate was 55 % (n = 89). The ICU mortality rates were similar in patients with hematological malignancies and solid tumors (57% vs 53.8%; $P = .744$). Four variables were independent predictors for ICU mortality in cancer patients: the remission status of the underlying cancer on ICU admission (odds ratio [OR], 0.113; 95% confidence interval [CI], 0.027-0.48; $P = .003$), Acute Physiology and Chronic Health Evaluation II score (OR, 1.12; 95% CI, 1.032-1.215; $P = .007$), sepsis/septic shock during ICU stay (OR, 8.94; 95% CI, 2.28-35; $P = .002$), and vasopressor requirement (OR 16.84; 95% CI, 3.98-71.24; $P = .0001$). Although Acute Physiology and Chronic Health Evaluation II score (OR, 1.30; 95% CI, 1.054-1.61; $P = .014$), admission through emergency service (OR, 0.005; 95% CI, 0.00-0.69; $P = .035$), and vasopressor requirement during ICU stay (OR, 140.64; 95% CI, 3.59-5505.5; $P = .008$) were independent predictors for ICU mortality in patients with hematological malignancies, Sequential Organ Failure Assessment score (OR, 1.83; 95% CI, 1.29-2.6; $P = .001$), lactate dehydrogenase level on admission (OR, 1.002; 95% CI, 1-1.005; $P = .028$), sepsis/septic shock during ICU stay (OR, 138.4; 95% CI, 12.54-1528.4; $P = .0001$), and complete or partial remission of the underlying cancer (OR, 0.026; 95% CI, 0.002-0.3; $P = .004$) were the independent risk factors in patients with solid tumors.

Conclusion: Intensive care unit mortality rate was 55% in our cancer patients, which suggests that patients with cancer can benefit from ICU admission. We also found that ICU mortality rates of patients with hematological malignancies and solid tumors were similar.

1. Introduction

The growing number of patients living with cancer leads to a similar increase in the number of patients requiring intensive care. Despite the general opinion that admission of cancer patients to intensive care units (ICUs) is usually futile and costly based on some older studies, ICU survival has been reported to be improved significantly in recent studies [1–4]. Increased survival expectancy in critically ill cancer patients led conduction of studies that investigate the prognostic factors that predict ICU outcome and guide ICU admission and management strategies [1–8]. We, therefore, analyzed our data retrospectively to determine the characteristics and outcomes of cancer patients admitted to our medical ICU and to identify the risk factors associated with ICU mortality.

2. Patients and methods

2.1. Study design

This study is a retrospective, observational study conducted in the 9-bed medical ICU of the Gazi University Hospital, a 1000-bed university

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hospital in Ankara, Turkey. Every adult patient (≥18 years old) with histologically proven cancer who required ICU admission was evaluated between January 1, 2009, and June 30, 2012. When ICU admission is considered in a cancer patient in our center, life expectancy should be longer than 3 months, and/or further treatment options to treat the underlying cancer should be available. Only the first admission was recorded in patients with multiple ICU admissions. Patients who stayed in the ICU for shorter than 24 hours were also excluded. This study was approved by the institutional review board.

A total of 162 consecutive cancer patients admitted to ICU during the study period were included in the study. The following information was abstracted from the medical charts of the patients: age and sex; comorbidities; type of cancer; characteristics of the cancer including presence of metastases; current status of the underlying cancer (complete or partial remission, relapsed, or progressive[1] disease); treatment modality that includes surgery, chemotherapy, and radiation therapy; the patient's preadmission performance status as determined by Eastern Cooperative Oncology Group (ECOG[2]) scale; hematopoietic stem cell transplantation (HSCT) status and type of HSCT (autologous and allogeneic); cause of ICU admission; source of admission (internal medicine, emergency service, etc); time from hospital to ICU admission; blood chemistries and complete blood count on day 1; presence and site of infection on admission and during ICU stay; severity of illness score using Acute Physiology and Chronic Health Evaluation (APACHE) II score; organ dysfunctions using Sequential Organ Failure Assessment (SOFA) score; therapeutic interventions during the ICU stay (use of vasopressors, mechanical ventilation, dialysis, chemotherapy), length of ICU stay; and ICU mortality rate.

2.2. Statistical analysis

Data were analyzed using SPSS 13.5 for Windows (SPSS, Inc, Chicago, IL). Descriptive statistics were computed for all study variables. A Kolmogorov-Smirnov test was used, and histograms and normal-quantile plots were examined to verify the normality of distribution of continuous variables. Discrete variables are expressed as counts (percentage), and continuous variables, as means ± SD or median (interquartile range, 25%-75%). For demographics and clinical characteristics of the study groups, differences between groups were assessed using a χ^2, Fisher exact test, Student t test, or Mann-Whitney U test, as appropriate. Multivariate logistic regression analysis with ICU mortality as the dependent variable was conducted in cancer patients. Only variables associated with a higher risk of ICU mortality ($P < .05$) on a univariate basis were introduced in the multivariate model. $P < .05$ was considered statistically significant.

3. Results

3.1. Results in the whole study cohort

There were 1130 admissions during the study period, among whom 162 (14.3%) were cancer patients who met the eligibility criteria of the study. Median age was 61 (48-71.3) years, and most patients were male (58.6%). The most common causes of ICU admission were sepsis/septic shock (66.7%) and respiratory failure (63.6%). The most common comorbidities of the patients were cardiovascular diseases, diabetes, and hypertension. Most patients were admitted to our medical ICU from emergency service. Two or more organ dysfunctions were found in 84 patients (52%) on admission. Renal and pulmonary dysfunctions were the most common organ dysfunctions. Most patients had thrombocytopenia (53.7%), whereas 46 patients had neutropenia. Sixty-eight patients required mechanical ventilation on admission. A possibility of an infectious etiology or isolation of a microorganism was seen in 147 patients on ICU admission.

Fifty-eight patients (35.8%) in our cohort had hematological malignancies, and 104 patients (64.2%) had solid tumors. Lymphoma was the most common solid tumor, whereas acute leukemia was the most common hematological malignancy. Colon, lung, and breast cancers were the other common solid tumors in our cohort (all types of cancer in our study group are presented in Table 1). Fifty-five patients had relapsed or progressive cancer, whereas 54 patients were newly diagnosed cancer patients. Performance status of the cancer patients was well (ECOG, 0-2) in 117 patients according to ECOG performance scale on ICU admission. One hundred fifteen patients had been treated with chemotherapy, and 84 patients had cancer therapy within a month before ICU admission. Eighteen of the patients were stem cell transplant recipients.

Renal replacement therapy was required in 53 patients (32.7%) during ICU stay. Mechanical ventilation (invasive or noninvasive) was applied to 109 patients. Intensive care unit–acquired nosocomial infection was detected in 62 patients (38.3%). Of the cancer patients, 73 (45%) survived, and 89 cancer patients (55%) died at the end of their ICU stay. Table 1 shows some baseline characteristics of the study population.

3.2. Results in hematological malignancies and solid tumors groups

Patients are categorized into 2 groups in terms of their type of cancer (patients with hematological malignancies and patients with solid tumors). Patients with solid tumors were older than the patients with hematological malignancies. Sequential Organ Failure Assessment scores were significantly higher in patients with hematological malignancies than in those with solid tumors. Patients with hematological malignancies had longer duration of hospital stay before ICU admission. Comorbidities varied among the groups, with a higher prevalence in patients with solid tumors. Anticancer treatment within a month before ICU admission was more common in patients with hematological malignancies. The frequency of infection on ICU admission was also more common in patients with hematological malignancies. Episodes of bacteremia were more frequent in patients with hematological malignancies compared with patients with solid tumors. The number of organ failure and renal dysfunction was more common in patients with hematological malignancies during ICU stay. Although neutropenia on and during admission to ICU and thrombocytopenia were more common in patients with hematological malignancies, ICU mortality rate was similar in patients with hematological malignancies and solid tumors. Table 1 shows some characteristics of the patients with hematological malignancies and solid tumors in our ICU.

3.3. Results in survivors and nonsurvivors

We subcategorized our cohort according to their outcome and reanalyzed: patients who survived (survivor—discharge or transfer) (73 patients, 45%) and who died (nonsurvivors) (89 patients, 55%). Acute Physiology and Chronic Health Evaluation II and SOFA scores were significantly lower, Glasgow Coma Scale (GCS) was significantly higher, and length of ICU stay and length of hospital stay before ICU admission were significantly shorter in survivors when compared with nonsurvivors. Nonsurvivors had more progressive and relapsed

[1] *Cancer recurrence* or *relapse* is defined as the return of cancer after treatment and after a period during which the cancer cannot be detected. When cancer spreads or gets worse, it is called progression. When a treatment completely eliminates the tumor and the tumor cannot be seen on the tests or cannot be measured after a period, it is called a complete response or complete remission. A partial response or partial remission means the cancer partly responded to treatment. Treatment partly controls the tumor and reduces the tumor size.

[2] Eastern Cooperative Oncology Group scale is used to assess how the disease affects the daily living abilities of the patient. They included the following: 0, fully active, able to carry on all predisease performance without restriction; 1, restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, for example, light house work, office work; 2, ambulatory and capable of all self-care but unable to carry out any work activities; 3, capable of only limited self-care, confined to bed or chair more than 50% of waking hours; and 4, completely disabled, cannot carry on any self-care, totally confined to bed or chair.

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