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Research Article

# Prognostic Factors for Intensive Care Unit (ICU) Admission among Hospitalized Gastrointestinal and Hepatopancreatobiliary Cancer Patients with Systemic Urinary Tract Infection

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## Abstract

**Objectives:** Systemic infections in cancer patients are associated with increased intensive care unit (ICU) admissions. In this study, we aimed to determine the vital and laboratory parameters that predict ICU admission in the hospitalized gastrointestinal system (GIS) and hepatopancreatobiliary system (HPBS) cancer patients with urinary tract infection (UTI) during the paliateve treatment.

**Methods:** The files of 305 GIS or HPBS adult cancer patients followed up in the Oncology inpatient Clinic were retrospectively screened. Fifty-eight patients with positive urine cultures were included in the study. Risk factors of clinical and laboratory values associated with ICU admission were analyzed.

**Results:** Of 58 patients 56.8% (n=33) were female. The mean age was 63 years. The most isolated microorganisms in urine culture were *Escherichia coli* (n=20, 34.4%). In multivariate analysis, low thrombocyte (HR = 1.011, 95% CI 1.001-1,020, p=0.028) and high urea (HR = 0.973, 95% CI 0.02-0.74, p=0.021) values at discharge were independent prognostic risk factors for ICU admission.

**Conclusion:** In the case of thrombocytopenia and high urea levels in hospitalized GIS and HPBS cancer patients with UTI, preventive measures or treatment of these factors may reduce ICU admission.

**Keywords:** Cancer, urea, thrombocyte, systemic urinary tract infection, intensive care unit

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Cancer patients with impaired immunity due to malnutrition and treatment practices such as invasive procedures, surgery, chemotherapy, and radiotherapy are at risk for bacterial, viral, or fungal infections.[1-3] In this patient group, as a fragile population, increased fever or acute phase levels secondary to both infections and malignancy are common.[4] In particular, patients with a cancer diagnosis originating from the gastrointestinal system (GIS) or hepatopancreatobiliary system (HPBS) have impaired immunity and a higher risk for infections due to the doublet or triplet chemotherapy regimens. Also, malnutrition develops in these patients due to luminal dysfunction.[5, 6] Since inflammatory processes due to infection and malignancy are overlapped, it is not always possible to reveal the etiology that causes acute phase elevation with clinical and laboratory parameters.[7-9]

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The presence of infections in cancer patients may cause severe results such as delay in chemotherapy or radiotherapy, reduction of standard treatment doses, prolonged hospitalization in the service or intensive care unit, increased morbidity-mortality rates, and increased financial costs in health care services. Infectious microorganisms are manifested by nosocomial or community-acquired infections.[10] Regarding nosocomial infection etiology, resistant bacterial infections are more common in cancer patients.[11]

When we reviewed the literature, most of the studies on cancer patients focused on bloodstream infections, and there is not enough data on urinary tract infections. However, urinary tract infections (UTIs) are one of the most common infections in cancer patients due to long-term immunosuppression, complex multiple chemotherapy agents, and frequent catheterization procedures for the urinary system.[12] The main microorganisms causing UTIs are gram-negative bacteria such as *Escherichia coli*, *Klebsiella species*, *Proteus species*, *Pseudomonas aeruginosa*, *Enterobacter species*, *Enterococcus faecalis*.[13-15] In addition, some gram-positive bacteria and fungal infections may be responsible for UTIs.

Identifying prognostic subgroups in cancer patients with UTI may prevent treatment interruptions, prolonged service, and ICU. In this study, we aimed to determine the clinical and laboratory parameters that predict admission to the ICU in hospitalized GIS or HPBS cancer patients with UTI.

## Methods

Between June-2020 and December-2022, the medical records of patients diagnosed with solid malignancy with a history of hospitalization in the Oncology Clinic of Basaksehir Cam and Sakura City Hospital, a tertiary care center, were retrospectively screened. Urine samples of 305 GIS and HPBS cancer patients were analyzed with a preliminary diagnosis of UTI. Aged ≥18 years, GIS or HPBS cancer diagnosis, and systemic urinary tract infection diagnosed in a standard laboratory were the inclusion criteria for the study. Individuals <18 years old, those with additional infection foci in the simultaneous blood and sputum cultures, those with contaminations or colonasition in their urine culture, those with cystitis, those with a second primary cancer and hematological cancers were excluded from the study. Fifty-eight patients were included in the study after patient selection. Demographic informations including age and gender were recorded. Cancer diagnoses, cancer stage, comorbidities, vital parameters, hospitalization and discharge laboratory values from clinical service, hospitalization days until discharge from clinical service or ICU admission, microorganisms grown in urine culture and antibiotic resistance patterns were investigated. This study was approved by Basaksehir Cam and Sakura City Hospital Ethics Committee (File no: 2022.02.50).

### Statistical Analysis

The SPSS 20.0 program was used for statistical analyzed. Participants were evaluated in two subgroups as those who were discharged from clinical service and those who were ICU admission. The suitability of the data to the normal distribution was tested with the Kolmogorov-Smirnov test. Numbers and percentages were given for categorical variables using descriptive statistics. Obtained parametric data were expressed as median ± standard deviation, minimum and maximum values. The analysis of categorical variables in both subgroups was evaluated with the Chi-square test. The comparison of parametric variables that did not meet the normal distribution condition in two independent groups was made using the Mann-Whitney U test. Median values of laboratory parameters were accepted as the cut-off point for analyzes. Hospitalization days were accepted from the date of application to the clinic to the date of discharge or ICU admission. Univariate and multivariate logistic regression analyzes were performed to determine the prognostic factors affecting ICU admission. P-value <0.05 was considered statistically significant.

## Results

### Demographic Findings

Urinary culture was positive in 58 (19.0%) of 305 GIS or HPBS cancer patients. Of the 58 GIS or HPBS cancer patients, 43.10% were female (n=25), and the mean was 63 years. The three most common comorbidities in the patients were hypertension, diabetes mellitus and ischemic heart disease, respectively. Details of the patients' age, gender and comorbidities are given in Table 1.

### Oncologic Features

Regarding tumor localization, 22 patients had esophagogastric cancer, 22 had colorectal cancer, and 14 had hepatopancreatobiliary cancer. Ten patients had a history of previous surgery (5 hemicolectomies, one total colectomy, one total gastrectomy, one subtotal gastrectomy, one low anterior resection of the rectum, and one Whipple surgery).Fifty-two patients had stage 4, four patients had stage 3, and 2 patients had stage 2 disease. Forty patients received one line, 19 received two lines, six received three lines, and two received four lines of chemotherapy. The details of the cancer diagnosis, staging and treatments are given in Table 2.

**Table 1.** Patients' Demographic and Clinical Features

| | n | % |
|---|---|---|
| Gender | | |
| Male | 25 | 43.1 |
| Female | 33 | 56.9 |
| Age* | 63±15 | 15.9-89.0 |
| Comorbidities | | |
| Hypertension | 24 | 41.4 |
| Diabetes mellitus | 18 | 31.0 |
| Dyslipidemia | 10 | 17.2 |
| Ischemic heart disease | 10 | 17.2 |
| Cardiac arrhythmia | 5 | 8.6 |
| Chronic renal failure | 6 | 10.3 |
| COPD or asthma | 2 | 3.4 |
| Hypothyroidism | 5 | 8.6 |
| Joint disease | 0 | 0.0 |
| Ischemic cerebrovascular event | 3 | 5.2 |
| Peripheral artery disease | 2 | 3.4 |
| Osteoporosis | 1 | 1.7 |
| Alzheimer | 2 | 3.4 |
| Depression | 1 | 1.8 |
| Inflammatory bowel disease | 1 | 1.7 |
| Chronic hepatitis B disease | 1 | 1.7 |

COPD: Chronic obstructive pulmonary disease; *: Mean±standard deviation is given instead of "n"; minimum and maximum are given instead of "%".

**Table 2.** Patients' Oncologic Features

| | n | % |
|---|---|---|
| Tumor Localization | | |
| Esophagogastric | 22 | 37,9 |
| Hepatopancreatobiliary | 14 | 24,1 |
| Colorectal | 22 | 37,9 |
| Stage | | |
| 1 | 0 | 0 |
| 2 | 2 | 3,4 |
| 3 | 4 | 6,8 |
| 4 | 52 | 89,6 |
| Chemotherapy Lines | | |
| First line | 40 | 69,0 |
| Second line | 19 | 32,8 |
| Third line | 6 | 10,3 |
| Fourth line | 2 | 3,4 |

## Bacterial Profiles Among Cancer Patients

Gram-negative bacteria, gram-positive bacteria, and fungi were isolated in the urine culture at a rate of 67%, 17% and 15%, respectively. The three most common gram-negative bacteria isolated were *E. coli* (n=20), *K. pneumonia* (n=7), and *P. aeruginosa* (n=6), respectively. *E. faecium* (n=5) and *E. faecalis* (n=3) were the most common gram-positive bacteria. The most commonly isolated agents from fungal infections are; *Trichosporonasahii* (n=3) and *Candida albicans* (n=2).

Regarding the resistance pattern of the agents, quinolone resistance was found in 20 patients, ampicillin resistance in 18 patients, ESBL in 11 patients, and carbapenem resistance in 1 patient. The factors and resistance patterns isolated in urine culture are given in Table 3.

## Laboratory Findings

In patients who went to the ICU, heart rate at admission; C-reactive protein, direct bilirubin, total bilirubin, blood urea level, phosphorus, procalcitonin, and neutrophil-lymphocyte ratio at discharge were significantly higher than the discharged patients from clinical service. Among discharged patients from clinical service, peripheral capillary oxygen saturation at admission; thrombocyte, lymphocyte, eosinophil, protein, albumin, albumin-total bilirubin (ALBI) ratio at discharge were significantly higher than the patients admitted to the ICU. There was no statistically significant difference between other laboratory parameters ($p>0.05$). Details of patients' vital and laboratory findings are shown in Table 4.

## Prognostic Factors and Survival

Twenty-six patients needed intensive care. The mean age of these patients was 61.6 years. The need for ICU was equal for both genders. Esophagogastric cancer was diagnosed in 13 patients, colorectal cancer in 10 patients, and hepatopancreatobiliary cancer in 3 patients.

In univariate analysis, patients with a increased heart rate at admission had a higher prognostic factor of ICU admission (HR=0.964, 95% CI 0.930-0.999, p=0.046). Low thrombocyte count at discharge from clinical service was determined as a prognostic factor for ICU admission (HR=1.010, 95% CI 1.003-1.016, p=0.004). In addition, lower urea values at discharge from clinical service were associated with lower ICU admission (HR=0.574, 95% CI 0.351-0.937, p=0.027). Patients with lower albumin values at discharge from clinical service had a higher prognostic factor for ICU admission (HR=1.193, 95% CI 1.053-1.352, p=0.006). Lower phosphorus levels at discharge from clinical service were associated with decreased risk for ICU admission (HR=0.574, 95% CI 0.351-0.937, p=0.027). When we evaluated the microorganisms as fungal factors and others, it did not affect ICU admission. Similarly, being gram-positive or negative after excluding fungal agents was no prognostic factor for ICU admission.

**Table 3.** Bacterial profiles in cancer patients

| Microorganism profile | Isolated agents | Outcome | Frequency | Percentage |
|---|---|---|---|---|
| Gram-Negative agents (n=40) | *Escherichia coli* | Discharge from clinical service | 11 | 18.96% |
| | | Need for intensive care unit | 9 | 15.51% |
| | *Klebsiella pneumoniae* | Discharge from clinical service | 2 | 3.44% |
| | | Need for intensive care unit | 5 | 8.62% |
| | *Pseudomonas aeruginosa* | Discharge from clinical service | 3 | 5.17% |
| | | Need for intensive care unit | 3 | 5.17% |
| | *Enterobacter cloacae* | Discharge from clinical service | 0 | 0% |
| | | Need for intensive care unit | 1 | 1.72% |
| | *Acinetobacter baumannii* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| | *Acinetobacter pittii* | Discharge from clinical service | 0 | 0% |
| | | Need for intensive care unit | 1 | 1.72% |
| | Burkholderia cepacia complex | Discharge from clinical service | 0 | 0% |
| | | Need for intensive care unit | 1 | 1.72% |
| | *Klebsiella aerogenes* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| | *Proteus mirabilis* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| | *Pseudomonas fluorescens* | Discharge from clinical service | 0 | 0% |
| | | Need for intensive care unit | 1 | 1.72% |
| Gram-Positive agents (n=9) | *Enterococcus faecium* | Discharge from clinical service | 3 | 5.17% |
| | | Need for intensive care unit | 2 | 3.44% |
| | *Enterococcus faecalis* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 2 | 3.44% |
| | *Streptococcus agalactiae* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| Fungal agents (n=9) | *Trichosporon asahii* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 2 | 3.44% |
| | *Candida albicans* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 1 | 1.72% |
| | *Candida dubliniensis* | Discharge from clinical service | 1 | 1.72% |
| | | N Need for intensive care unit | 0 | 0% |
| | *Candida glabrata* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| | *Candida kefyr* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |
| | *Candida lusitaniae* | Discharge from clinical service | 1 | 1.72% |
| | | Need for intensive care unit | 0 | 0% |

| | Isolated agents | | | |
|---|---|---|---|---|
| | *Escherichia coli (20)* | *Klebsiella pneumoniae (8)* | *Pseudomonas aeruginosa (7)* | *Enterococcus faecium/ faecalis (8)* |
| Resistance pattern | | | | |
| R1 | 40% | 37% | | |
| R2 | | 12.5% | | |
| R3 | 40% | 50% | 28.5% | 75% |
| R4 | 45% | 62.5% | 14.2% | 37.5% |

R1: ESBL (extended spectrum beta lactamase); R2: Carbapenem; R3: Quinolone; R4: Ampicillin.

In multivariate analysis, low thrombocyte count (HR =1.011, %95 GA 1.001-1.020, p=0.028) and high urea values (HR=0.973, %95 GA 0.02-0.74, p=0.021) at discharge from clinical service were determined as independent prognostic factors for ICU admission. Details of univariate and multivariate analyses are shown in Table 5.

**Table 4.** Clinical and laboratory parameters of patients discharged from clinical service or admitted to intensive care

| | Discharged from clinical service (32) | | Intensive care (26) | | |
|---|---|---|---|---|---|
| **Hospitalization parameters** | **Mean±SD** | **Min-Max** | **Mean±SD** | **Min-Max** | **P** |
| Heart rate (BPM) | 85±15 | 56-115 | 95±16 | 65-125 | 0.041 |
| Systolic blood pressure (mmHG) | 110±19 | 86-160 | 110±23 | 73-181 | 0.822 |
| Diastolic blood pressure (mmHG) | 70.5±12.2 | 56.0-104.0 | 70.0±12.9 | 50.0-104.0 | 0.945 |
| Peripheral capillary oxygen saturation (%) | 98±4 | 76-100 | 97±2 | 92-100 | 0.001 |
| Fever (°C) | 37±1 | 36-39 | 37±0 | 36-39 | 0.517 |
| Leukocyte ($10^9$/L) | 9.40±9.22 | .29-48.32 | 9.14±7.90 | 0.86-37.22 | 0.796 |
| Hemoglobin (g/dl) | 9.2±2.0 | 5.1-14.5 | 8.6±1.6 | 5.4-11.7 | 0.404 |
| Thrombocyte ($10^9$/L) | 282.0±183.1 | 19.0-768.0 | 223.0±163.1 | 30.0-605.0 | 0.617 |
| Neutrophil ($10^9$/L) | 6.04±8.45 | 0.01-44.00 | 7.57±7.01 | 0.35-31.26 | 0.628 |
| Lymphocyte ($10^9$/L) | 1.06±.85 | 0.22-3.14 | 0.96±.67 | 0.11-2.99 | 0.552 |
| Monocyte ($10^9$/L) | 0.66±.53 | 0.01-2.66 | 0.64±.61 | 0.10-2.79 | 0.796 |
| Eosinophil ($10^9$/L) | 0.03±.26 | 0.00-1.43 | 0.02±.16 | 0.00-.74 | 0.188 |
| Basophil ($10^9$/L) | 0.02±.03 | 0.00-.10 | 0.02±.04 | 0.00-.17 | 0.787 |
| ALT (IU/L) | 16±44 | 2-214 | 18±30 | 2-126 | 0.760 |
| AST (IU/L) | 29±35 | 7-154 | 35±54 | 9-240 | 0.321 |
| Glucose (mg/dl) | 98±41 | 56-220 | 119±45 | 45-240 | 0.377 |
| Creatinine (mg/dl) | 0.81±1 | 0.32-7 | 0.83±1 | 0.25-4 | 0.863 |
| Direct bilirubin (mg/dl) | 0.32±2 | 0.03-8 | 0.41±4 | 0.02-19 | 0.994 |
| Total bilirubin (mg/dl) | 0.61±2 | 0.07-9 | 0.80±5 | 0.2-22 | 0.448 |
| Calcium (mg/dl) | 8±6 | 5-41 | 8±2 | 6-15 | 0.472 |
| K (MeQ/L) | 4.11±0.69 | 3-6 | 3.97±0.91 | 2-6 | 0.808 |
| Total protein (g/dl) | 58±9 | 37-75 | 55±10 | 20-70 | 0.171 |
| Na (MeQ/L) | 135±6 | 123-148 | 136±6 | 117-146 | 0.772 |
| Urea (mg/dl) | 35±55 | 11-248 | 41±73 | 18-301 | 0.214 |
| Chlorine (MeQ/L) | 99±6 | 80-109 | 100±6 | 88-113 | 0.914 |
| Albumin (g/dl) | 28±7 | 16-40 | 26±7 | 5-39 | 0.061 |
| Amylase (IU/L) | 50±46 | 13-173 | 39±39 | 13-197 | 0.208 |
| GGT (IU/L) | 89±322 | 16-1482 | 50±175 | 3-766 | 0.184 |
| Phosphorus (mg/dl) | 3.25±1.08 | 1.38-7.13 | 3.23±2.66 | 1.91-15 | 0.579 |
| ALP (IU/L) | 175±157 | 45-699 | 122±302 | 7-1381 | 0.516 |
| LDH (IU/L) | 236±925 | 86-5168 | 248±521 | 103-2152 | 0.574 |
| Fibrinogen (mg/dl) | 429±156 | 176-863 | 381±184 | 153-797 | 0.864 |
| PCT (ug/L) | 0.23±18 | 0.03-79 | 0.72±1 | 0.07-3.06 | 0.051 |
| CRP (mg/L) | 51±82 | 3-380 | 100±58 | 13-266 | 0.012 |
| Ferritin (ng/mL) | 371±954 | 23-5178 | 423±4067 | 108-17985 | 0.179 |
| ESR (mm) | 65±27 | 9-127 | 63±24 | 26-118 | 0.952 |
| NLR | 6.02±8.83 | .01-28.76 | 7.70±9.54 | .87-47.81 | 0.364 |
| ALBIR | 43.60±83.75 | 3.93-485.71 | 30.16±32.54 | 1.61-125.00 | 0.247 |

ALBIR: Albumin/total bilirubin ratio; ALP: Alkaline phosphatase; ALT: Alanine aminotransferase; AST: Aspartic transaminase; BPM: Beats per minute; °C: Celsius; CRP: C-reactive protein; ESR: Erythrocyte Sedimentation Rate; GGT: Gamma-glutamyl transferase; K: Potassium; LDH: Lactate dehydrogenase; Max: Maximum; Min: Minimum; mmHG: Millimeters of mercury; Na: Sodium; NLR: Neutrophil/ Lymphocyte ratio; PCT: Procalcitonin; SD: Standard deviation; Bold values represent statistical significance ($p<0.05$).

## Discussion

Systemic urinary tract infections remain a significant health problem due to the high morbidity and mortality rates in cancer patients. This study investigated the prognostic factors for ICU admission in GIS or HPBS cancer patients with UTI. In previous studies, UTIs were mostly investigated in heterogeneous cancer groups.[12, 16] In our study, only GIS or HPBS cancer patients who needed pal-

**Table 4 (Continued).** Clinical and laboratory parameters of patients discharged from clinical service or admitted to intensive care

| | Discharged from clinical service (32) | | Intensive care (26) | | |
|---|---|---|---|---|---|
| **Discharge parameters** | **Mean±SD** | **Min-Max** | **Mean±SD** | **Min-Max** | **P** |
| Heart rate (BPM) | 89±21 | 52-164 | 103±21 | 50-138 | 0.143 |
| Systolic blood pressure (mmHG) | 111±16 | 78-142 | 99±24 | 55-172 | 0.117 |
| Diastolic blood pressure (mmHG) | 69.5±9.1 | 49.0-84.0 | 66.5±15.3 | 33.0-99.0 | 0.356 |
| Peripheral capillary oxygen saturation (%) | 97±8 | 50-100 | 95±6 | 78-100 | 0.089 |
| Fever (°C) | 36.3±.2 | 36.0-36.9 | 36.4±.4 | 35.5-37.2 | 0.950 |
| Leukocyte ($10^9$/L) | 8.72±6.15 | 3.42-23.77 | 9.00±10.65 | 1.50-52.12 | 0.988 |
| Hemoglobin (g/dl) | 9.5±1.2 | 7.5-12.2 | 8.7±2.0 | 5.1-13.9 | 0.549 |
| Thrombocyte ($10^9$/L) | 200.5±163.2 | 120.0-815.0 | 94.5±121.7 | 8.0-510.0 | **<0.001** |
| Neutrophil ($10^9$/L) | 6.56±5.56 | 2.08-20.76 | 7.36±10.24 | 1.23-50.01 | 0.532 |
| Lymphocyte ($10^9$/L) | 1.26±.98 | 0.09-3.61 | 0.64±.48 | 0.15-2.14 | **0.05** |
| Monocyte ($10^9$/L) | 0.57±.60 | 0.05-2.11 | 0.41±.59 | 0.07-2.90 | 0.174 |
| Eosinophil ($10^9$/L) | 0.0550±.3162 | 0.00-1.7400 | 0.01±.1194 | 0.00-.5000 | **0.015** |
| Basophil ($10^9$/L) | 0.02±.01 | 0.00-.06 | 0.01±.03 | 0.00-.11 | 0.402 |
| ALT (IU/L) | 17±19 | 4-84 | 13±86 | 2-288 | 1.00 |
| AST (IU/L) | 23±28 | 7-134 | 35±206 | 5-807 | 1.00 |
| Glucose (mg/dl) | 101±41 | 68-243 | 113±71 | 63-320 | 0.076 |
| Creatinine (mg/dl) | 0.84±1 | 0.35-4 | 0.81±1 | 0.27-5 | 0.913 |
| Direct bilirubin (mg/dl) | 0.26±1 | 0.04-5 | 0.65±5 | 0.11-16 | **0.021** |
| Total bilirubin (mg/dl) | 0.54±2 | 0.05-6 | 1.74±5 | 0.37-18 | **0.010** |
| Calcium (mg/dl) | 8±1 | 7-10 | 8±1 | 6-10 | 0.122 |
| K (MeQ/L) | 4±0.46 | 3-5 | 4±0.71 | 3-6 | 0.950 |
| Total protein (g/dl) | 55±7 | 44-79 | 52±9 | 30-67 | 0.049 |
| Na (MeQ/L) | 135±4 | 126-142 | 137±6 | 125-147 | 0.069 |
| Urea (mg/dl) | 32±28 | 11-130 | 60±79 | 11-272 | **0.004** |
| Chlorine (MeQ/L) | 101±6 | 79-115 | 102±7 | 87-116 | 0.150 |
| Albumin (g/dl) | 29±5 | 20-44 | 24±5 | 18-39 | **0.002** |
| Amylase (IU/L) | 50±33 | 3-135 | 48±46 | 3-216 | 0.931 |
| GGT (IU/L) | 95±258 | 16-1141 | 64±1812 | 9-9338 | 0.796 |
| Phosphorus (mg/dl) | 2.86±1 | 1-5 | 3.16±2 | 2-8 | **0.045** |
| ALP (IU/L) | 175±131 | 48-587 | 172±398 | 47-1860 | 0.833 |
| LDH (IU/L) | 237±877 | 154-5156 | 359±589 | 134-2584 | 0.171 |
| Fibrinogen (mg/dl) | 403±177 | 183-920 | 385±174 | 208-778 | 0.606 |
| PCT (ug/L) | 0.23±8 | 0.04-42 | 1.07±5 | 0.06-24 | **0.001** |
| CRP (mg/L) | 49±66 | 2-257 | 107±74 | 13-266 | **0.003** |
| Ferritin (ng/mL) | 337±885 | 26-4809 | 436±737 | 82-3114 | 0.90 |
| ESR (mm) | 62±27 | 12-133 | 57±30 | 4-140 | 0.931 |
| NLR | 4.64±24.52 | 0.97-133.89 | 12.10±23.32 | 2.11-94.38 | **0.011** |
| ALBIR | 44.08±107.50 | 4.70-620.00 | 13.17±25.83 | 1.51-105.41 | **0.004** |

ALBIR: Albumin/total bilirubin ratio; ALP: Alkaline phosphatase; ALT: Alanine aminotransferase; AST: Aspartic transaminase; BPM: Beats per minute; °C: Celsius; CRP: C-reactive protein; ESR: Erythrocyte Sedimentation Rate; GGT: Gamma-glutamyl transferase; K: Potassium; LDH: Lactate dehydrogenase; Max: Maximum; Min: Minimum; mmHG: Millimeters of mercury; Na: Sodium; NLR: Neutrophil/ Lymphocyte ratio; PCT: Procalcitonin; SD: Standard deviation; Bold values represent statistical significance ( p<0.05).

liative support were examined to reduce selection bias. In our cohort, we identified discharge thrombocyte and urea levels from clinical service as independent prognostic factors for ICU admission.

Occult or symptomatic urinary tract infections increase with age in both men and women.[17] In our study, patients with urine culture growth were predominantly female, consistent with other studies.[18, 19] In addition to cancer diagnosis, 63%

**Table 5.** Risks features in determining death. univariate and multivariate logistic regression analysis

| | Prognostic factors | P | OR | 95.0% CI |
|---|---|---|---|---|
| Univariate Cox Regression Analysis | | | | |
| Hospitalization | Heart rate | **0.046** | 0.964 | 0.930-0.999 |
| Discharge from clinical service | Thrombocyte | **0.004** | 1.010 | 1.003-1.016 |
| | Urea | **0.006** | 0.979 | 0.964-0.994 |
| | Albumin | **0.006** | 1.193 | 1.053-1.352 |
| | Phosphorus | **0.027** | 0.574 | 0.351-0.937 |
| Multivariate Cox Regression Analysi | Discharge from clinical service | | | |
| | Thrombocyte | **0.028** | 1.011 | 1.001-1.020 |
| | Urea | **0.012** | 0.973 | 0.953-0.994 |

Bold font represents p<0.05; CI: Confidence interval; OR: Odds ratio.

of our patients had at least one additional chronic disease history. Studies emphasized that additional chronic diseases with cancer cause the release of inflammatory and oxidative substances, impairing immunomodulation and making patient vulnerable to systemic infections.[20, 21] Consistent with the studies, our cohort is a high-risk population for UTI due to the older age, the high number of women, and additional chronic diseases in most of the patients.

In a study by Fentie A et al., a heterogeneous group including different cancer subtypes was evaluated, and the patients' bacterial profile and antibiotic resistance were investigated. In the study, bacterial growth was detected in 16.8% of 191 patients' urine cultures.[12] Similar to this study, in our cohort, pathogenic bacteria growth was detected in 16.06% of 305 patients.

Studies investigating UTIs without distinguishing cancer subtypes determined that *E. coli* strains were most frequently grown in urine cultures at a rate of 44.4% in Ethiopia, 37.8% in Egypt and 40% in India.[13, 22, 23] Similarly, in our study, the most common bacteria isolated in urine culture was *E. coli* strains (34.4%). We detected that extended-spectrum beta-lactamase resistances in *E. coli* and *Klebsiella* isolates were 40% and 37%, respectively. In a study in Nepal where the antibiotic resistance of *E. coli* strains detected in cancer patients' urine samples was tested, fluoroquinolone resistance was 71%, and ampicillin resistance was 66%.[16] Although the incidence rates of *E. coli* strains were similar in the studies, antibiotic resistance rates significantly differed.[12, 24-26] This may be associated with the different frequencies of the use of antibiotics for prophylaxis in cancer or non-cancer patients in different populations. In addition, a carbapenem-resistant *Klebsiella pneumoniae* strain was found in 1 patient in our study. These strains, which started to be detected in the early 2010s, have an increasing incidence in many countries and seriously threaten life.[27-29] In our case, the need for intensive care developed one week after detecting the carbapenem-resistant *Klebsiella pneumoniae* strain. He survived one day after admitting to ICU. In our study, the resistance patterns of other strains were not discussed separately in the discussion section, considering that the number of patients in the subgroups could lead to misleading results.

A case-control study conducted on 622 cancer patients in the United States urban medical center investigated the relationship between sinus tachycardia and mortality. Heart rate (HR) >100 was accepted as sinus tachycardia. Different cancer subtypes, mainly diagnosed with the stage-4 disease, were included in the study. As a result of the study, the mortality rate was significantly higher in the patient group with sinus tachycardia (HR 2.9, 95% CI: 1.8–5; p<0.001).[30] Although we detected a significant relationship between baseline heart rate and ICU admission in univariate analysis, no significant relationship was observed in multivariate analysis.

Thrombocytopenia is a common laboratory abnormality in ICU patients. It is associated with multi-organ failure, cancer treatments, and decreased bone marrow reserve rather than a primary hematological disorder. In two large reviews including 20,696 and 6,894 patients; the prevalence of thrombocytopenia, which was investigated during the hospitalization of the patients admitted to the ICU due to medical, cardiac, surgical and trauma, including cancer patients, was 8.3%-67.6%. In these two studies, both the presence and depth of thrombocytopenia predicted mortality.[31, 32] In our study, the thrombocyte level at discharge from clinical service was an independent prognostic factor predicting ICU admission. Thrombocytopenia seems to be a significant prognostic factor for both ICU need and mortality.

High urea level at discharge from clinical service was an independent prognostic factor for ICU admission in our cohort. It was determined that high urea levels were significantly positively correlated with mortality risk in cancer and non-cancer patients who needed intensive care.[33-35]

We can suggest that high urea levels increase the need for intensive care hospitalization and the risk of death.

In an observational study conducted by Namendys-Silva SA et al., serum albumin values in the first 24 hours of 200 patients with different cancer types admitted to the ICU were examined. The study determined that low serum albumin value was associated with high mortality risk.[36] Although albumin level is prognostic in various cancer patients hospitalized in the ICU, it does not predict the need for ICU in GIS or HPBS cancer patients with UTI in our study.

In a retrospective study conducted by Al Harbi SA et al. involving 1422 adult patients admitted to l ICU with sepsis or septic shock, serum phosphate values were measured on the first day of ICU. They observed that patients with high serum phosphate levels have higher mortality rates than patients with normal or low serum phosphate levels.[37] Similarly, a meta-analysis including ten studies with 60,358 patients showed that hyperphosphatemia is associated with high mortality rates in critically ill patients with intensive care follow-up.[38] Unlike these studies, we found that high phosphate value at discharge from clinical service is a prognostic factor that increases the need for intensive care. Hyperphosphatemia appears to be associated with increased catabolism and mortality in cancer patients.

The low number of patients, the retrospective design, and the single-center experience are the most important limitations of our study. Our conflicting findings with other studies may be associated with current limitations. In addition, the fact that our cohort consisted of patients with UTI with GIS and HPBS cancer made it difficult to generalize our results.

This study is the first example of examining the UTI of our country's GIS and HPBS cancer patients. In our study, high levels of antibiotic resistance were detected in both discharged patients from clinical service, and patients admitted to ICU. This resistance situation significantly affects the effectiveness of antibiotic treatment negatively. As a result, standard antibiotic resistance models should be established among cancer patients. GIS and HPBS cancer patients with UTI followed for palliative purposes should be closely observed in case of thrombocytopenia and elevated urea. The need for ICU of patients can be reduced by identifying and treating the etiological causes that may cause this condition.

### Disclosures

**Ethics Committee Approval:** This study was approved by Basaksehir Cam and Sakura City Hospital Ethics Committee (File no: 2022.02.50).The ethical committee had agreed to the retrospective analysis of routinely collected clinical data without prior informed consent of patients. The data sets used and/or analyzed during the present study are available from the corresponding author on reasonable request.

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