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Analysis of Risk Factors Associated with Candidemia Among Patients with or without COVID-19 in Intensive Care Units During the Pandemic Process: A Multicenter Study

Pandemi Sürecinde COVID-19 ve COVID-19 Dışı Tanılar ile Yoğun Bakım Ünitelerinde Takip Edilen Hastaların Kandidemi Açısından Risk Faktörlerinin Analizi: Çok Merkezli Bir Çalışma

Taliha KARAKÖK[1](İD), Melih Gaffar GÖZÜKARA[2](İD), Yeşim UYGUN KIZMAZ[3](İD), Yakup DEMİR[4](İD), Melike TÖRÜYENLER COŞKUNPINAR[5](İD), Şerife ALTUN DEMİRCAN[6](İD), Yusuf ARSLAN[7](İD), Pelin İLKÖREN[8](İD), Eda ALP GÖKER[9](İD), Ahmet DOĞAN[10](İD), Türkan TÜZÜN[11](İD), Şükran SEVİM[12](İD), Yasemin ÇAKIR[13](İD), Mehmet Emirhan IŞIK[3](İD), Çiğdem MERMUTLUOĞLU[4](İD), Alpay AZAP[5](İD), Sami KINIKLI[6](İD), Süda TEKİN[8](İD), Serap ŞİMŞEK YAVUZ[9](İD), Sedef Zeliha ÖNER[14](İD)

[1] Clinic of Infectious Diseases and Clinical Microbiology, Fatsa State Hospital, Ordu, Türkiye
[2] Public Health, Sincan District Health Directorate, Ankara, Türkiye
[3] Clinic of Infectious Diseases and Clinical Microbiology, Kartal Koşuyolu High Specialization Training and Research Hospital, İstanbul, Türkiye
[4] Department of Infectipous Diseases and Clinical Microbiology, Dicle University Faculty of Medicine, Diyarbakır, Türkiye
[5] Department of Infectious Diseases and Clinical Microbiology, Ankara University Faculty of Medicine, Ankara, Türkiye
[6] Clinic of Infectious Diseases and Clinical Microbiology, Ankara Training and Research Hospital, Ankara, Türkiye
[7] Clinic of Infectious Diseases and Clinical Microbiology, Batman Training and Research Hospital, Batman, Türkiye
[8] Department of Infectious Diseases and Clinical Microbiology, Koç University Faculty of Medicine, İstanbul, Türkiye
[9] Department of Infectious Diseases and Clinical Microbiology, İstanbul University Faculty of Medicine, İstanbul, Türkiye
[10] Clinic of Infectious Diseases and Clinical Microbiology, Ordu State Hospital, Ordu, Türkiye
[11] Department of Infectious Diseases and Clinical Microbiology, Pamukkale University Faculty of Medicine, Denizli, Türkiye
[12] Clinic of Infectious Diseases and Clinical Microbiology, Mardin Kızıltepe State Hospital, Mardin, Türkiye
[13] Clinic of Infectious Diseases and Clinical Microbiology, Ağrı Doğubayazıt Dr. Yaşar Eryılmaz State Hospital, Ağrı, Türkiye
[14] Department of Microbiology, Pamukkale University Faculty of Medicine, Denizli, Türkiye

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ABSTRACT

Introduction: *The objective of this study was to compare the risk factors and mortality rates of candidemia among patients with and without COVID-19 in the intensive care units (ICU).*

Materials and Methods: *This study is a retrospective multicenter observational study, in ICUs of 12 hospitals (eight tertiary and four secondary hospitals) in Türkiye. All adult patients (>18 years) hospitalized in ICUs and developed candidemia between 01.01.2020-31.12.2021 were included. The following data were collected: age, gender, nasopharyngeal swab SARS-CoV-2 PCR test, species of*

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Candida (Candida albicans or non-albicans Candida), comorbidities, ICU stay, antibiotic use, corticosteroid, and anti-cytokine therapy, central venous catheter (CVC), abdominal surgery, parenteral nutrition, mechanical ventilation (MV), other cultures isolated Candida spp., echocardiography (ECO), mortality. Data from patients with or without COVID-19 were compared.

Results: *A total of 188 patients, 66 COVID-19 and 122 non-COVID-19, were included in the study. The median age of the patients was 69.5 and there were no differences between the groups. 185 (98.4%) patients had a history of antibiotic use. Sixteen patients, all from the COVID-19 group, had a history of anti-cytokine therapy. Corticosteroid use was higher in COVID-19 patients (p< 0.001). Intraabdominal surgery was higher in the non-COVID-19 group (p< 0.014). C. albicans was isolated from 36.7% of total patients and the remaining were non-albicans Candida species. The overall mortality was higher in COVID-19 patients (p= 0.014). Alzheimer's and malignancies were higher in non-COVID-19 patients. Intraabdominal surgery, MV, and CVC were higher in tertiary care hospitals whereas parenteral nutrition was higher in secondary care hospitals.*

Conclusion: *Immunosuppressive treatments administered to COVID-19 patients pose a risk in terms of candidemia. Risk factors may differ between secondary and tertiary care hospitals. Preventable risk factors should be determined on a hospital basis and appropriate infection control measures should be taken.*

Key Words: *Candidemia; COVID-19; Risk factors; Intensive care unit*

ÖZ

Pandemi Sürecinde COVID-19 ve COVID-19 Dışı Tanılar ile Yoğun Bakım Ünitelerinde Takip Edilen Hastaların Kandidemi Açısından Risk Faktörlerinin Analizi: Çok Merkezli Bir Çalışma

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[1] Fatsa Devlet Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Ordu, Türkiye
[2] Sincan İlçe Sağlık Müdürlüğü, Halk Sağlığı, Ankara, Türkiye
[3] Kartal Koşuyolu Yüksek İhtisas Eğitim ve Araştırma Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, İstanbul, Türkiye
[4] Dicle Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, Diyarbakır, Türkiye
[5] Ankara Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, Ankara, Türkiye
[6] Ankara Eğitim ve Araştırma Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Ankara, Türkiye
[7] Batman Eğitim ve Araştırma Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Batman, Türkiye
[8] Koç Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, İstanbul, Türkiye
[9] İstanbul Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, İstanbul, Türkiye
[10] Ordu Devlet Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Ordu, Türkiye
[11] Pamukkale Üniversitesi Tıp Fakültesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Anabilim Dalı, Denizli, Türkiye
[12] Mardin Kızıltepe Devlet Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Mardin, Türkiye
[13] Ağrı Doğubayazıt Dr. Yaşar Eryılmaz Devlet Hastanesi, İnfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Ağrı, Türkiye
[14] Pamukkale Üniversitesi Tıp Fakültesi, Mikrobiyoloji Anabilim Dalı, Denizli, Türkiye

Giriş: *Bu çalışmanın amacı, yoğun bakım ünitelerinde (YBÜ) COVID-19 olan ve olmayan hastalarda kandidemi risk faktörlerini ve ölüm oranlarını araştırmaktır.*

Materyal ve Metod: *Çalışma Türkiye'de sekizi üçüncü basamak dördü ikinci basamak olmak üzere 12 merkezde yürütülen çok merkezli retrospektif gözlemsel bir çalışmadır. 01.01.2020 ve 31.12.2021 tarihleri arasında 18 yaş ve üzeri yoğun bakımda takip edilen ve kandidemi gelişen tüm hastalar çalışmaya dahil edildi. Hastaların yaş, cinsiyet, nazofarengeal SARS-CoV-2 PCR sonuçları, üreyen kandida türü (Candida albicans veya non-albicans Candida olarak), komorbiditeleri, YBÜ yatış süresi, antibiyotik kullanımı, kortikosteroid ve anti-sitokin tedavi, santral venöz kateter (SVK), abdominal cerrahi, parenteral beslenme, mekanik ventilasyon (MV), kandida üreyen diğer kültürler, ekokardiografi (EKO) ve mortalite bilgileri kaydedildi. Veriler COVID-19 olan ve olmayan hastalar arasında karşılaştırıldı.*

Bulgular: *Çalışmaya 66 COVID-19 ve 122 COVID-19 dışı olmak üzere toplam 188 hasta dahil edildi. Hastaların ortanca yaşı 69.5 olup gruplar arasında fark bulunmadı. Tüm hastaların 185'inde (%98.4) antibiyotik kullanım öyküsü vardı. Tamamı COVID-19 grubunda*

yer alan 16 hastanın anti-sitokin tedavi öyküsü vardı. COVID-19 hastalarında kortikosteroid kullanımı daha yüksek iken (p< 0.001) COVID-19 olmayan grupta karın içi cerrahi daha yüksek saptandı (p< 0.014). Tüm suşların %36.7'si C. albicans iken, geriye kalanlar non-albicans Candida türleriydi. Genel mortalite, COVID-19 hastalarında daha yüksek bulundu (p= 0.014). Alzheimer ve malignite, COVID-19 olmayan hastalarda daha yüksekti. Üçüncü basamak hastanelerde intraabdominal cerrahi, MV ve SVK daha yüksek iken, ikinci basamak hastanelerde parenteral beslenme anlamlı oranda yüksek saptandı.

***Sonuç:** COVID-19 hastalarında uygulanan immünsüpresif tedaviler kandidemi açısından risk oluşturmaktadır. Risk faktörleri ikinci ve üçüncü basamak hastaneler arasında farklılık gösterebilir. Önlenebilir risk faktörleri hastane bazında belirlenmeli ve uygun infeksiyon kontrol önlemleri alınmalıdır.*

***Anahtar Kelimeler:** Kandidemi; COVID-19; Risk faktörleri; Yoğun bakım ünitesi*

INTRODUCTION

Coronavirus disease-19 (COVID-19) pandemic has negatively affected healthcare in a variety of different aspects such as delayed diagnosis of major diseases including cancers, coronary heart disease, cessation in disease control and immunizations programs, and non-compliance with infection control and prevention measures[1-3]. The collateral effects of COVID-19 have received much attention towards the end of the pandemic. Secondary bacterial and fungal infections in COVID-19 patients are one of the most concerning issues about the collateral effects of COVID-19 on patient care[4]. Earlier studies suggest that the COVID-19 pandemic is associated with an increased rate of health-care associated infections (HAIs), especially central line-associated bloodstream infections (CLABSI)[5,6]. The increased workload of healthcare workers during the pandemic and shortage in supply of personal protective equipment may have contributed to increased risk of CLABSI by leading to disruptions in basic infection control measures such as hand hygiene. Multidrug-resistant organisms (MDRO) outbreaks attributed to inappropriate hand hygiene have been reported during the pandemic[7,8].

In addition to bacterial infections, an increase in incidence and mortality of candidemia has also been reported after the COVID-19 pandemic[9-12], which could be related to anti-cytokine and corti-costeroid therapies, disruption of mucosal barrier caused by COVID-19, immunosuppression, and lapses in infection prevention practices[10,11].

Previous studies have focused on the incidence and characteristics of candidemia patients with COVID-19 compared to historical non-COVID-19 patients[10,12]. Few researchers have addressed the characteristics of candidemia among patients with or without COVID-19 followed up for the same period.

This study aimed to compare the risk factors and mortality rates of candidemia among patients with and without COVID-19 at the intensive care units (ICU).

MATERIALS and METHODS

This study is a retrospective cross-sectional multicenter observational study, in ICUs of 12 hospitals, constituted of eight tertiary care hospitals and four secondary care hospitals in Türkiye; Kartal Koşuyolu High Specialization Training and Research Hospital, Dicle University Hospital, Ankara University Hospital, Ankara Training and Research Hospital, Batman Training and Research Hospital, Koç University Hospital, İstanbul University Hospital, Pamukkale University Hospital, Fatsa State Hospital, Ordu State Hospital, Kızıltepe State Hospital, Ağrı Doğubeyazıt Dr. Yaşar Eryılmaz State Hospital.

Patients

All adult patients (>18 years old) hospitalized in the ICUs of the participating centers and who developed candidemia from 01.01.2020 to 31.12.2021 were included in the study. All included candidemia patients were divided into two groups as COVID-19 group and non-COVID-19 group. Data of patients with and without COVID-19 diagnosis confirmed by a positive SARS-CoV-2 PCR test were compared. Patients who developed a positive test for COVID-19 during intensive care unit follow-up were included in the COVID-19 group.

Candidemia was defined as the isolation of *Candida* spp. from at least one bottle of blood cultures of the patients.

The following clinical data were collected: age, gender, nasopharyngeal swab SARS-CoV-2 polymerase chain reaction (PCR) test result, species of the *Candida* (*Candida albicans* or non-*albicans Candida*), comorbidities, ICU length of stay, antibiotic use, corticosteroid therapy, anti-cytokine therapy, presence of central venous catheter (CVC), recent abdominal surgery, parenteral nutrition, need for mechanical ventilation, sustained candidemia (defined as the isolation of the same *Candida* species from blood cultures for >48 hours), cultures of the other sides isolated *Candida* spp., echocardiography (ECO), mortality. Species of *Candida* were identified with automated identification systems of different hospitals.

To determine the differences between tertiary and secondary hospitals, a comparison was performed between centers.

Statistical Analysis

Statistical analysis was performed with SPSS (v26.0). The distribution of the data was checked by visual (histogram) and analytical methods (Kolmogorov-Smirnov), and it was observed that the analyzed data were distributed non-parametrically. In the presentation of demographic data, numbers (n), percent (%), and median (minimum-maximum-25. percentile-75. percentile) values are presented. Pearson Chi-square test and Fisher's Exact test were used in the statistical analysis of categorical data and also, the unadjusted odds ratio was calculated for statistically significant test results. Mann-Whitney U test was used to compare the numerical data of the two groups. A p value of <0.05 was considered significant for all tests.

The Ethics Committee of Ordu University approved the study on 14.10.2022, with decision number 221.

RESULTS

A total of 188 patients, 66 of whom were COVID-19 and 122 non-COVID-19, were included in the study. The median age of the patients was 69.5 (19-80) and no difference was found between the two groups (p= 0.067). 47% of the patients were female and 53% were male. A comparison of the characteristics of patients with candidemia among COVID-19 and non-COVID-19 patients is listed in Table 1.

185 (98.4%) of all patients had a history of antibiotic use. A total of 16 patients, all of them in the COVID-19 group, had a history of anti-cytokine therapy. It was observed that the overall mortality was higher in COVID-19 patients (p= 0.014). ECO was performed in 28.7% of COVID-19 patients and 62.2% of non-COVID-19 patients. Endocarditis was detected in only four of them. All patients with endocarditis were non-COVID-19 patients.

Candida albicans (*C. albicans*) was isolated from %36.7 of total patients and the remaining were non-*albicans Candida* species. There was no difference between COVID-19 and non-COVID-19 patients in terms of *C. albicans* and non-*albicans Candida* growth (p= 0.63).

Table 2 presents the differences observed among *Candida* species isolated from patients. It was found that *C. albicans* was significantly more prevalent in secondary care hospitals, whereas non-albicans *Candida* showed higher prevalence in tertiary care hospitals (p= 0.004).

Chronic diseases of the patients are listed in Table 3. Alzheimer's and malignancies were statistically higher in non-COVID-19 patients than in COVID-19 patients.

The differences between the second and tertiary care hospitals are given in Table 4. Intraabdominal surgery, mechanical ventilation, and central venous catheter were higher in tertiary care hospitals whereas parenteral nutrition was higher in secondary care hospitals.

DISCUSSION

A higher rate of mortality in patients with secondary infections than the overall mortality of COVID-19 patients has been reported[13]. In addition to the damage caused by primary organ involvement due to COVID-19, the disease has increased many crucial risk factors for healthcare-associated infections such as immunosuppressive treatments applied for its treatment, inappropriate antibiotic use, long duration of service, and intensive care hospitalizations.

Table 1. Comparison of the characteristics of COVID-19 and non-COVID-19 patients with candidemia

	COVID-19 patients	Non-COVID-19	p value	Unadjusted Odd's Ratio
	(median, min-max)[a] (25.-75. percentile)[b]			
Age (n= 188)	72.5 (20-90)[a] (58.75-79.25)[b] (n= 66)	66 (19-74)[a] (56-77)[b] (n= 122)	0.067*	-
Duration of hospitalization (days) (n= 188)	11 (0-73)[a] (5-19.5)[b] (n= 65)	14 (0-120)[a] (4-28)[b] (n= 122)	0.530*	-
Corticosteroid use duration (days) (n= 91)	10 (1-60) (6-14)[b] (n= 63)	6.5 (0-40) (2-12.5)[b] (n= 28)	**0.044***	-
	n (%[c])			
Female (n= 188)	32 (48.5)	57 (46.7)	0.817**	-
Antibiotic usage (n= 188)	64 (97.0)	121 (99.2)	0.248**	-
Additional microbial growth (n= 188)	43 (65.2)	87 (71.3)	0.383**	-
Corticosteroid use (n= 188)	63 (95.5)[d]	27 (22.1)	**<0.001****	**73.889 (21.499-253.950)**
Echocardiography infection findings (n= 71)	0 (0.0)	4 (7.7)	Cannot computed	-
Mechanical ventilation (n= 188)	57 (86.4)	94 (77.0)	0.125**	-
Intraabdominal surgery (n= 188)	3 (12.5)	21 (38.4)	**0.014****	**3.344 (1.251-15.151)**
Parenteral nutrition (n= 188)	39 (59.1)	74 (60.7)	0.834**	-
Central venous catheter (n= 188)	57 (86.4)	108 (88.5)	0.666**	-
Candida (n= 188)				
Candida albicans	25 (37.9)	44 (36.1)		
Non-*albicans Candida*	34 (51.5)	70 (57.4)	0.553**	-
Other *Candida* spp.	7 (10.6)	8 (6.6)		
Candida (n= 188)				
Candida albicans	25 (37.9)	44 (36.1)		
Non-albicans *Candida* + Other Candida	41 (62.1)	78 (63.9)	0.806**	-
Other culture (n= 188)	43 (6.2)	87 (71.3)	0.383**	-
Sustained candidemia (n= 188)	83 (68.0)	51 (77.3)	0.181**	-
Mortality (n= 188)	54 (81.8)[d]	79 (64.8)	**0.014****	**2.449 (1.183-5.070)**

a: (median, min-max), b: (25.-75. percentile), c: Row percentage, d: Reference category for Unadjusted odds ratio
*Mann-Whitney U test was applied, **Pearson's Chi-square test was applied.

Table 2. Comparison of variables of patients infected with *C. albicans* and non-albicans *Candida* species

	Candia albicans	Non-albicans *Candida*	p value	Unadjusted Odds Ratio
	(median, min-max)[a] (25.-75. percentile)[b]			
Age (n= 188)	71 (19-93)[a] (59-78)[b] (n= 69)	67 (20-93)[a] (54.25-77)[b] (n= 104)	0.300*	-
Duration of hospitalization (days) (n= 188)	14 (1-63)[a] (5.25-24.75)[b] (n= 68)	13.5 (0-120)[a] (4-23.25)[b] (n= 104)	0.694*	-
Corticosteroid use duration (days) (n= 91)	10 (1-40) (5-12)[b] (n= 31)	10 (0-60) (4.25-16)[b] (n= 52)	0.588*	-
	n (%[c])			
Anti-cytokine therapy (n= 173)	4 (5.8)	11 (10.6)	0.274**	-
Parenteral nutrition (n= 173)	47 (68.1)[d]	55 (52.9)	**0.046****	**1.903 (1.008-3.595)**
Central venous catheter (n= 173)	57 (82.6)	94 (90.4)	0.133**	-
Mechanical ventilator	54 (78.3)	88 (84.6)	0.286**	-
Tertiary care hospital (n= 173)	48 (69.6)	91 (87.5)[d]	**0.004****	**3.063 (1.411-6.648)**
Female (n= 173)	28 (40.6)	51 (49.0)	0.274**	-
Antibiotic usage (n= 173)	69 (100)	102 (98.1)	Cannot computed	-
Steroid usage (n= 173)	31 (44.9)	51 (49.0)	0.596**	-
Hypertension (n= 173)	36 (52.2)	48 (46.2)	0.438**	-
Diabetes mellitus (n= 173)	24 (34.8)	32 (30.8)	0.581**	-
Coronary artery disease (n= 173)	24 (34.8)	44 (42.3)	0.321**	-
Chronic obstructive pulmonary disease (n= 173)	10 (14.7)	21 (20.2)	0.360**	-
Congestive heart failure (n= 173)	11 (15.9)	13 (12.5)	0.521**	-
Malignancy (n= 173)	18 (26.1)	23 (22.1)	0.547**	-
Cerebrovascular disease (n= 173)	10 (14.5)	17 (16.3)	0.742**	-
Alzheimer's (n= 173)	7 (10.1)	7 (6.7)	0.420**	-
Chronic kidney disease (n= 173)	9 (13.0)	20 (19.2)	0.286**	-
Other (n= 173)	13 (18.8)	24 (23.1)	0.506**	-

a: (median, min-max), b: (25.-75. percentile), c: Row percentage, d: Reference category for Unadjusted odds ratio, *Mann-Whitney U test was applied, **Pearson's Chi-square test was applied.

In our study, anti-cytokine therapy and corticosteroid use were higher in COViD-19 patients whereas intraabdominal surgery was higher in the non-COVID-19 group. Studies investigating the risk factors for candidemia in COVID-19 patients compared to non-COVID-19 patients have found different risk factors. Seagle et al.[14] reported corticosteroid, mechanical ventilation, and central venous catheter use were higher in COVID-19 patients than in non-COVID-19 controls, and mortality was found to be higher in the COVID-19 patient group. Chronic liver disease, solid-organ malignancies, gastrointestinal disease, and hepatitis C infection

Table 3. Chronic diseases of the patients compared with COVID-19 disease

Chronic disease	COVID-19 patients (n= 66)	Non-COVID-19 patients (n= 122)	p value	Unadjusted Odds Ratio (Confidence Interval)
	n (%[a])			
Hypertension (n= 188)	38 (57.6)	54 (44.3)	0.081*	-
Diabetes mellitus (n= 188)	25 (37.9)	37 (30.3)	0.293*	-
Coronary artery disease (n= 188)	22 (33.3)	50 (40.1)	0.303*	-
Chronic obstructive pulmonary disease (n= 187)	14 (21.5)	20 (16.5)	0.385*	-
Congestive heart failure (n= 188)	8 (12.1)	17 (13.9)	0.727*	-
Malignancy (n= 188)	9 (13.6)	32 (26.2b)	**0.046***	**2.252 (1.001-5.065)**
Cerebrovascular disease (n= 188)	8 (12.1)	24 (19.6)	0.189*	-
Alzheimer's (n= 188)	2 (3.3)	14 (11.5)	0.056**	-
Chronic kidney disease (n= 188)	11 (16.7)	20 (16.4)	0.962*	-
Other (n= 188)	9 (13.6)	31 (25.4)	0.060*	-

[a]: Column percentage, [b]: Reference category for unadjusted odds ratio, *Pearson's Chi-squared test was applied, **Fisher's Exact test was applied.

were less common among those with COVID-19 compared with those without in this study. In the study by Mastrangelo et al.[15], immunosuppressive therapy was found to be higher in the COVID-19 group, and malignancies were detected more frequently in the non-COVID-19 group, similar to our study. Kayaaslan et al.[12], reported COVID-19 cases had a higher rate of corticosteroid use and risk factors for candidemia were similar among candidemia cases with and without COVID-19, except for gastrointestinal instrumentation or surgery, which was higher in non-COVID-19 patients. Our findings in terms of risk factors were found to be similar to other studies.

C. albicans accounted for 36.7% of all isolates and there was no difference between COVID-19 and non-COVID-19 patients in terms of *Candida* type in our study. *C. albicans* was shown to be the most prevalent species in candidemia patients with COVID-19 in most studies[12,16]. However, many *C. auris* outbreaks have been reported during the pandemic period[17-19]. In the reviews and meta-analyses, researchers showed that the rate of *C. auris* infections did not increase during the pandemic and emphasized that there may be regional differences[20,21]. In our study, we found that non-*albicans Candida* species were more common in tertiary hospitals. The literature shows that prior gastrointestinal surgery is associated with non-albicans candidemia[22,23]. The high rate of gastrointestinal surgery in tertiary hospitals may have caused this difference in *Candida* species in our study.

One of the reasons for the differences between studies investigating candidemia risk factors among COVID-19 patients may be inter-hospital practices and differences. As supporting this claim, in our study in which the secondary care and tertiary care hospitals were included, differences were found in terms of risk factors between the centers. Intraabdominal surgery, mechanical ventilation, and CVC were higher in tertiary care hospitals whereas parenteral nutrition was higher in secondary care hospitals. We are of the opinion that the significant difference in species of *Candida* between secondary and tertiary centers as albicans and non-*albicans Candida* is due to the difference in risk factors between centers. The need for close monitoring of critically ill patients who undergo intra-abdominal surgery, require mechanical ventilation, and have catheters in place within tertiary hospitals may contribute to inter-hospital variations. Similar differences can also be seen between tertiary hospitals, depending on the practices applied in advanced specialized hospitals. This highlights the importance of individual hospitals

Table 4. Comparison of variables among secondary and tertiary care hospitals

	Secondary care hospital	Tertiary care hospital	p value	Unadjusted Odds Ratio (Confidence Interval)
Age (n= 188)	76 (26-99)[a] (66-84)[b] (n= 47)	67 (19-93)[a] (53.5-76)[b] (n= 141)	<0.001*	-
Duration of hospitalization (days) (n= 188)	14 (2-94)[a] (9-30)[b] (n= 47)	13 (0-120)[a] (4-22.75)[b] (n= 140)	0.068*	-
Corticosteroid use duration (days) (n= 91)	9 (2-18) (6-12)[b] (n= 23)	10 (0-60) (5-14.75)[b] (n= 68)	0.898*	-
	n (%[c])			
Female (n= 188)	23 (49.9)	66 (46.8)	0.800**	-
COVID-19 (n= 188)	20 (42.6)	46 (32.6)	0.217**	-
Mortality (n= 188)	36 (76.6)	97 (68.8)	0.309**	-
Antibiotic usage (n= 188)	46 (97.9)	139 (98.6)	0.737**	-
Additional microbial growth (n= 188)	38 (80.9)[d]	92 (65.2)	**0.045****	**2.247 (1.005-5.025)**
Corticosteroid use (n= 188)	23 (48.9)	67 (47.5)	0.866**	-
Echocardiography infection findings (n= 71)	0 (0)	4 (6.5)	1***	-
Intraabdominal surgery (n= 188)	2 (4.3)	22 (15.6)[d]	**0.045*****	-
Mechanical ventilation (n= 188)	32 (68.1)	119 (84.4)[d]	**0.014****	**2.538 (1.182-5.434)**
Central venous catheter (n= 188)	33 (70.2)	132 (93.6)[d]	**<0.001****	**6.211 (1.221-15.625)**
Parenteral nutrition (n= 188)	39 (83.0)[d]	74 (52.5)	**<0.001****	**4.414 (1.926-10.116)**
Hypertension (n= 188)	27 (54.4)	65 (46.1)	0.178**	-
Diabetes mellitus (n= 188)	17 (36.2)	45 (31.9)	0.591**	-
Coronary artery disease (n= 188)	19 (40.4)	53 (37.6)	0.729**	-
Chronic obstructive pulmonary disease (n= 188)	10 (21.3)	24 (17.1)	0.525**	-
Congestive heart failure (n= 188)	6 (12.8)	19 (13.5)	0.901**	-
Malignancy (n= 188)	6 (12.8)	35 (24.8)	0.83**	-
Cerebrovascular disease (n= 188)	12 (25.5)	20 (14.2)	0.73**	-
Alzheimer's (n= 188)	8 (17.0)[d]	8 (5.7)	**0.03*****	**3.412 (1.201-9.708)**
Chronic kidney disease (n= 188)	5 (10.6)	26 (18.4)	0.212**	-
Other (n= 188)	8 (17.0)	32 (22.7)	0.410**	-

a: (median, min-max), b: (25.-75. percentile), c: Row percentage, d: Reference category for unadjusted odds ratio, *Mann-Whitney U test was applied, **Pearson's Chi-square test was applied.

conducting risk factor evaluations based on their specific conditions. It also emphasizes the need for tailored treatment strategies targeting *Candida* species associated with the identified risk factors within each hospital.

Our findings support an increased mortality in candidemia patients with COVID-19 like the other studies[12,16]. Defining the exact cause of this increased mortality in candidemia patients with COVID-19 is difficult as it is entangled with the primary damage of coronavirus and the risk factors that precipitate candidemia.

An important limitation of our study is that we could not present non-*albicans Candida* subtypes because non-*albicans Candida* typing could not be performed in every center.

As a result, we are facing the problem of increased candidemia and mortality with COVID-19. This increased risk was thought to be due to immunosuppressive treatments in conjunction with the COVID-19 effect, as demonstrated by other studies and our study. As in the past and present, the utilization of immunosuppressive therapies in the treatment of viral pneumonia, as well as the potential future emergence of viral pathogens, may frequently lead to a heightened challenge of candidemia. Treatment strategies for these patients should be carefully planned, taking into account the benefits and risks associated with immunosuppressive therapies. It is crucial to identify preventable risk factors specific to each hospital and implement appropriate infection control measures to mitigate the occurrence of infections.

ETHICS COMMITTEE APPROVAL

This study was approved by the Ordu University Clinical Research Ethics Committee (Decision no: 2022/221, Date: 14.10.2022).

CONFLICT of INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article.

AUTHORSHIP CONTRIBUTIONS

Concept and Design: TK, YA, YUK, TT, AA, ST, SK

Analysis/Interpretation: TK, MGG, MTC, AA, ŞAD, YA, SK, Pİ, TA, TT, YÇ

Data Collection or Processing: TK, YUK, YD, MTC, ŞAD, YA, Pİ, EA, AD, TT, SS, YÇ, MET, ÇM

Writing: TK, SZG, SK, YUK, ÇM, SSY, AA, ST, MET, YA

Review and Correction: MGG, SSY, ŞAD, Pİ, EA, TT, SS, ST, MEİ, AA, SK

Final Approval: TK, SSY

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Address for Correspondence/Yazışma Adresi

Dr. Taliha KARAKÖK

Clinic of Infectious Diseases and Clinical Microbiology,
Fatsa State Hospital,
Ordu-Türkiye

E-posta: talihapala@hotmail.com