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Case Report

Successful treatment of multidrug-resistant *Candida auris* ventriculitis with Intraventricular Caspofungin: first report from Türkiye

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Abstract

Introduction: *Candida auris* is an emerging multidrug-resistant fungus with limited therapeutic options. Central nervous system (CNS) infections are exceptionally rare and difficult to treat due to poor antifungal penetration.

Case presentation: This case report presents a 55-year-old woman with hydrocephalus and an external ventricular drain who developed *Candida auris* ventriculitis on day 48 of her intensive care unit stay. Based on CLSI (Clinical and Laboratory Standards Institute) interpretive criteria, the isolate demonstrated resistance to amphotericin B (MIC 4 µg/mL) and caspofungin (MIC 8 µg/mL), while remaining susceptible to anidulafungin (MIC 0.5 µg/mL).

Results: Intravenous anidulafungin and intraventricular (IVT) caspofungin (10 mg daily) achieved cerebrospinal fluid sterilization within 72 hours, despite the high in-vitro MIC.

Conclusions: This first report from Türkiye demonstrates the potential efficacy of IVT caspofungin in multidrug-resistant *Candida auris* ventriculitis, emphasizing the importance of pharmacokinetic studies to refine CNS dosing strategies and susceptibility breakpoints.

Key words: *Candida auris*; external ventricular drain; ventriculitis.

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Introduction

Candida auris is an opportunistic fungal pathogen increasingly identified in healthcare settings, particularly among patients with underlying medical conditions and those requiring invasive medical devices. These infections, collectively referred to as candidiasis, range from superficial mucosal conditions to severe, life-threatening diseases such as bloodstream infections (candidemia) [1]. Due to its intrinsic resistance to many commonly used antifungal agents, difficulties in accurate identification by conventional laboratory methods, lack of standardized infection control strategies and resistance to widely used disinfectants, *C. auris* has been designated a critical priority fungal pathogen by the World Health Organization (WHO) [2].

Critically ill patients with neurological injuries who require cerebrospinal fluid (CSF) diversion devices, such as an external ventricular drain (EVD), are at increased risk for developing healthcare-associated infections, including ventriculitis. *C. auris* is a nosocomial pathogen characterized by multidrug resistance (MDR). *C. auris* related central nervous system (CNS) infections are exceedingly rare, with only a few cases reported globally and even fewer achieving microbiological cure [3-7].

Previous reports have described poor outcomes despite aggressive antifungal therapy, often involving amphotericin B or azoles, underscoring the therapeutic challenge posed by limited CNS drug penetration and uncertain antifungal pharmacokinetic and pharmacodynamic (PK/PD) in CSF [7,8]. The limited number of reported CNS infections and data on echinocandin efficacy highlight a critical gap in understanding optimal management strategies for *C. auris* ventriculitis.

The first case of *C. auris* ventriculitis from Türkiye successfully treated with intravenous (IV) anidulafungin and intraventricular (IVT) caspofungin is described in this case report, despite a high in vitro minimum inhibitory concentration (MIC) for caspofungin.

Case Report

A 55-year-old woman with no known chronic medical conditions presented to the emergency department with a subarachnoid hemorrhage and subsequently underwent neurosurgical intervention. On

Table 1. Antifungal susceptibility testing report of *Candida auris* ventriculitis.

Antifungal	MIC Breakpoints (µg/mL)	Susceptibility Testing Report/ATU *	CLSI Tentative Breakpoint
Fluconazole	> 256	R	≥ 32 = R
Voriconazole	8	N/A	No established breakpoint
Itraconazol	16	N/A	No established breakpoint
Amphotericin B	4	R	≥2 = R
Anidulafungin	0.5	S	≥ 4 = R
Caspofungin	8	R	≥ 2 = R
Fluorocytosin	0.25	N/A	No established breakpoint

Antifungal susceptibility of *Candida auris* isolates obtained from cerebrospinal fluid using broth microdilution (Sensititre YeastOne® YO10 panel (Thermo Scientific, USA). MIC: minimum inhibitory concentration; S: Susceptible; R: resistant; N/A: non-applicable; ATU: area of technical uncertainty; CLSI: Clinical and Laboratory Standards Institute.

postoperative day 28, hydrocephalus developed (Glasgow Coma Scale score: 9), necessitating the placement of an EVD and admission to the intensive care unit (ICU). On day 42 of ICU stay, routine screening implemented following the identification of a recent *Candida auris* case in an adjacent patient detected *C. auris* colonization. Swabs were obtained from the groin, axilla, wound sites, and invasive device areas (e.g., central venous catheters, tracheostomy, and EVD). *C. auris* was isolated from multiple body sites as well as from the tip of the removed EVD catheter. No growth was observed in the CSF culture collected on the same day; thus, the patient was considered colonized at that time.

On day 48, *C. auris* was isolated from both the EVD catheter tip and CSF cultures. CSF analysis revealed 20 leukocytes and 30 erythrocytes, with glucose and protein levels of 82 mg/dL and 9 mg/dL, respectively. Empirical antifungal therapy was initiated with IV anidulafungin (200 mg loading dose, followed by 100 mg/day maintenance) and liposomal amphotericin B (7 mg/kg/day). Blood cultures collected concurrently with the CSF sample showed no growth, whereas deep tracheal aspirate (DTA) cultures yielded *C. auris*. Preliminary identification of *C. auris* isolates was performed using the BD Phoenix M50 automated system (BD, USA) and Candida Plus Agar (RTA, Türkiye). Molecular confirmation was obtained via a *Candida* quantitative PCR (qPCR) panel (BioSpeedy®, Bioeksen, Türkiye). Antifungal susceptibility testing was conducted using the broth microdilution method with the Sensititre YeastOne® YO10 panel (Thermo Scientific, USA). CSF Gram staining demonstrated the presence of fungal spores. According to Clinical and Laboratory Standards Institute (CLSI) tentative breakpoints, *C. auris* isolates from both DTA and CSF samples were resistant to amphotericin B (minimum inhibitory concentration [MIC] = 4 µg/mL) and caspofungin (MIC = 8 µg/mL), while remaining susceptible to anidulafungin (MIC = 0.5 µg/mL) (Table 1).

On day 52, the EVD catheter was replaced. By day 55, *C. auris* was again isolated from both the EVD catheter tip and CSF cultures, consistent with invasive CNS infection. On day 58, IVT amphotericin B (1 mg in 3 mL dextrose solution) was administered via the EVD, followed by clamping of the catheter for two hours, in addition to continued systemic antifungal therapy. Despite nine days of IVT amphotericin B, CSF cultures remained positive for *C. auris*. On day 67, IVT caspofungin (10 mg diluted in 5 mL normal saline) was introduced via the EVD, followed by catheter clamping for two hours. Both IVT and IV amphotericin B therapies were discontinued, while IV anidulafungin was maintained. CSF cultures collected on the third day following initiation of IVT caspofungin showed no growth of *C. auris*.

On day 81 of ICU stay, the patient developed a fever. Blood cultures revealed MDR *Klebsiella pneumoniae*, resistant to all available antibiotics in the country, including ceftazidime-avibactam and colistin. Combination antibiotic therapy was initiated. No *C. auris* growth was detected in the CSF culture obtained the same day. Unfortunately, the patient died due to

Table 2. Cerebrospinal fluid analysis and culture findings of a *Candida auris* ventriculitis.

CSF	D48	D55	D67	D70	D80	D90
White Cells (n)	20	70	720	0	0	0
Neutrophils (%)	Predominantly PMNs	Predominantly PMNs	Predominantly PMNs			
Red cells (n)	30	0	10	0	0	0
Gram-stain report	Fungal spores	Fungal spores	Fungal spores	No microorganisms	No microorganisms	No microorganisms
Culture report	*C. auris*	*C. auris*	*C. auris*	No growth	No growth	No growth
Glucose (mg/dL)	82	61	71	60	86	58
Protein (mg/dL)	9	14	29	30	57	56

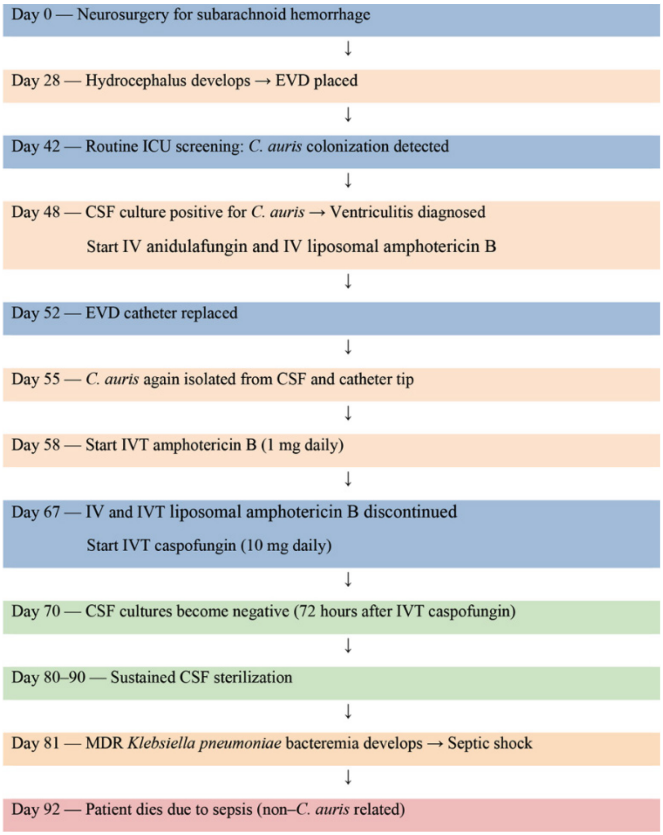
Day 48 corresponds to the initial diagnosis of *Candida auris* in the cerebrospinal fluid. It demonstrates progressive CSF sterilization and normalization of inflammatory parameters after the initiation of intraventricular caspofungin on day 67, with clearance of *C. auris* cultures by day 70. CSF: cerebrospinal fluid; EVD: external ventricular drain; PMNs: polymorphonuclear leukocytes.

sepsis on day 92 of hospitalization. Notably, no further *C. auris* growth was observed in CSF cultures following the third dose of IVT caspofungin. A summary of CSF laboratory findings throughout the ICU stay is presented in Table 2, and a comprehensive timeline of antifungal treatments, microbiological results, and clinical outcomes is provided in Figure 1.

Discussion

This case report represents the first known case of *Candida auris* ventriculitis in Türkiye. The rapid clinical and microbiological response to IVT caspofungin, despite resistance defined by tentative CLSI MIC breakpoints, raises important questions regarding the applicability of current echinocandin breakpoints for CNS infections. Compared with previously reported cases, including those by Singhal et al. [3] and Sridharan et al. [6], the patient received a comparable IVT caspofungin dose (10 mg daily). In those reports, caspofungin MIC values were within the susceptible range according to CLSI criteria, and combination antifungal regimens were used, including oral azoles such as voriconazole or enteral flucytosine. In contrast, the case demonstrated resistance to both amphotericin B (MIC = 4 µg/mL) and caspofungin (MIC = 8 µg/mL), while susceptibility to anidulafungin (MIC = 0.5 µg/mL) was preserved. This discrepancy between in vitro resistance and in vivo efficacy highlights the complex PK/PD considerations involved in the treatment of CNS infections.

Figure 1. Timeline depicting ICU course, antifungal regimen changes, and CSF culture results in a case of *Candida auris* ventriculitis.



CSF: cerebrospinal fluid; EVD: external ventricular drain; ICU: Intensive Care Unit; IV: Intravenous; IVT intraventricular; MDR: Multidrug-Resistant.

Intraventricular or lumbar intrathecal antimicrobial administration can achieve substantially higher CSF concentrations than systemic therapy, enabling more rapid CSF sterilization in patients with meningitis or ventriculitis following neurosurgical procedures, particularly when systemic agents fail to reach therapeutic CSF levels [9]. Although echinocandins such as caspofungin exhibit poor CNS penetration under normal physiological conditions, inflamed meninges or direct IVT administration may significantly enhance drug delivery to the site of infection [10]. Factors including molecular size, lipophilicity, and low CSF protein binding may contribute to local antifungal activity that is not adequately predicted by serum-based MIC thresholds.

Interpretation of antifungal MIC values for *C. auris*, especially in the context of CNS infections, remains challenging. Standardized susceptibility breakpoints specific to *C. auris* have not been established, and existing interpretive criteria are largely extrapolated from other *Candida* species. Moreover, in vitro MIC results do not fully account for host immune responses, CNS specific PK/PD dynamics, or fungal burden. Therefore, laboratory findings should be interpreted in conjunction with clinical response and microbiological outcomes. The success observed in this case suggests that current CLSI tentative breakpoints may underestimate the clinical potential of caspofungin in CNS infections, particularly when administered directly into the ventricular system.

Although intraventricular antifungal therapy is infrequently employed, it is consistent with the Infectious Diseases Society of America (IDSA) 2017 guidelines, which recommend intrathecal or IVT administration for healthcare-associated ventriculitis and meningitis unresponsive to systemic therapy alone [11]. In the present case, systemic liposomal amphotericin B combined with IV anidulafungin failed to achieve CSF sterilization, whereas culture negativity was observed only after initiation of IVT caspofungin. This finding supports consideration of local antifungal therapy in selected cases, particularly when managing

multidrug-resistant fungi with limited systemic CNS penetration.

Reported cases of *C. auris* ventriculitis remain exceedingly rare, with most occurring in critically ill patients in ICU settings [3–7,12–14]. Management is further complicated by the absence of standardized antifungal susceptibility testing methods and CNS specific MIC breakpoints. Consequently, treatment strategies vary widely across reported cases, limiting the ability to define optimal therapeutic approaches or compare antifungal efficacy. The potential for rapid emergence of antifungal resistance during treatment represents an additional clinical challenge, while limited long-term follow-up data restrict assessment of treatment durability and recurrence risk.

Candida auris is also notable for its ability to persist on patients' skin and within healthcare environments for prolonged periods. In the present case, colonization with *C. auris* developed during EVD placement, a recognized risk factor for both colonization and subsequent invasive infection [15]. Although rare, the occurrence of *C. auris* ventriculitis underscores the need for heightened clinical awareness among healthcare professionals, particularly in patients with CNS devices. A history of *C. auris* colonization may predispose individuals to invasive disease, emphasizing the importance of stringent infection control measures, including targeted screening, environmental decontamination, and contact precautions, especially in high-risk units such as neurosurgical ICU. Early recognition and coordinated multidisciplinary management remain essential to improving outcomes in these complex infections.

Limitations

Antifungal susceptibility testing was not performed using the reference broth microdilution method, and antifungal serum and CSF concentration data were unavailable, limiting PK/PD assessment. In addition, molecular typing or whole-genome sequencing to identify the *C. auris* clade was not performed.

In conclusion, this case provides valuable insight into the management of *C. auris* CNS infections in the setting of antifungal resistance and limited therapeutic options. The findings highlight the potential role of IVT echinocandin therapy, challenge current MIC based interpretations of resistance, and underscore the importance of strict infection control measures to prevent nosocomial transmission. Further clinical studies and PK/PD modeling are needed to optimize treatment strategies and establish evidence-based guidelines for the management of *C. auris* ventriculitis.

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Conflict of interest

No conflict of interest is declared.

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