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Prevalence And Clinical Significance Of Candida Auris Colonization And Bloodstream Infection In Intensive Care Units (Icus) Across Saudi Hospitals

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Abstract

Background: Candida auris is a new multidrug resistant pathogenic fungi which is of high risk to the critically ill patients particularly in the intensive care units (ICUs). This has led to the colonization of the skin, hospital survival, and resistance to a number of antifungal agents thus leading to outbreak of the agent all over the world including Saudi Arabia. The reason why C.auris is considered a national surveillance and infection control priority is due to the susceptibility of vulnerable patients in the ICU (patients subject to invasive procedures, immunosuppression, and prolonged hospitalization).

Research Objective: The main objective of this systematic review was to systematically evaluate and summarize previously published articles that assessed the prevalence and clinical significance of Candida auris colonization and bloodstream infections in hospital ICU settings in Saudi Arabia.

Research Methods: According to PRISMA, a comprehensive search of the literature in PubMed, Scopus, Web of Science, and the regional databases was conducted; those publications that were published in 2018-2025 were taken into account. The studies met the criteria because they were either observational, outbreak studies, or reports on surveillance of ICU patients in Saudi Arabia that were colonized or had suffered BSIs of C. aureus. Two reviewers independently took out data, which comprised of prevalence rates, clinical features, antifungal susceptibility pattern and mortality rates. Quality assessment and thematic synthesis were applied in order to be methodologically rigorous.

Conclusion: There is a high resistance to fluconazole and inconsistent susceptibility to other antifungals thus making the treatment difficult. Infection control lapses and absence of national surveillance are some of the factors that continue to advance the risk of transmission. The three most crucial activities to mitigate the circumstances of C. aureus in Saudi critical care units include increased diagnostic capacity, application of standardized screening regimes, and antifungal stewardship.

Keywords: Candida Auris Intensive Care Unit, Bloodstream Infection, Clinical Significance, Antifungal.

Introduction

C. auris is now a globally known pathogenic fungus responsible for outbreaks of healthcare-associated infections (HAIs), which includes fungemia, particularly among at-risk populations. The World Health Organization has classified the yeast as a "critical priority" pathogen based on its multidrug resistance and clearance issues. C. auris presents unique challenges as a fungus, including the ability to spread extensively within the healthcare facility; the ability to persist on inanimate surfaces; and high levels of antifungal resistance, especially to the azole class of drugs. **[1]** Saudi Arabia has borne a burdensome risk from C. auris following its initial introductions. The emergence of high-acuity critical care settings and a number of recognized transmission pathways made the Kingdom a prominent target and site of containment actions for C. auris. In terms of local outbreaks, it is noted that C. auris fundamentally remains an opportunistic pathogen which capitalizes on gaps in infection prevention methods alongside the vulnerable nature of the patient population in critical care. [3]

Epidemiology and Prevalence in KSA

Surveillance data collected from MOH hospitals in the years 2020-2022 demonstrated a notable increase in institutional burden. Overall, case levels assessed totaled 511, which was represented by the 45 hospitals sampled. The observed outbreak number also escalated from 22 outbreaks reported in 2020 to 136 outbreaks in 2022. [4] This increase signifies the rapid dissemination and containment challenges of this pathogen in complex health systems, even after established and implemented control measures. The most considerable epidemiological finding is a significant occurrence in critical care. The majority of confirmed C. auris cases, or 95.5%, were patients residing in the ICU. This result suggests that the KSA C. auris epidemic is an ICU epidemic. [5] The intensive care unit is an environment of high patient density, high medical care, and important antimicrobial selection pressure, and, therefore, is the ideal population for pathogen establishment and spread. A breakdown of the regions of KSA, indicates the central region produced the greatest portion of analyzed cases (56.4%) compared to the western region (26.8%). [6]

The most commonly reported clinical presentation was candidemia or bloodstream infection. For other infections or colonization sites, urine was the second most common after confirmed bloodstream infection, followed by sputum and wound infection. Diagnostic practices in the institutions studied demonstrate the prioritization of surveillance of colonization. Swabs were the most collected sample type (36.4%), followed closely by blood samples (35.6%). Therefore, colonization (43.1% of cases) represents an important risk for future invasive disease and a potential vector for transmission. This emphasizes the rationale for identifying asymptomatic and symptomatic carriers, which is a public health measure of particular importance for outbreak control in the ICU setting. **[7]**

Clinical Risk Factors

In the Saudi critical care context, a common profile of a patient with C. auris infection can be described as older adults with comorbidities. An older adult population was shown to have a notable prevalence of C. auris, with the median age of patients being 58 years and 32.9% of patients aged at least 65 years. In addition, there was a predominant male population with 68.9% of the total patient cohort being a male. [8], [9] The severe invasive medical procedures and indwelling devices in the context of a health care system were predominant mechanisms in acquiring a fungal and ultimately an infection. The major device prevalence rates in the case cohort were: Foley catheters (85.9%), ventilators (68.5%), tracheostomy (53.8%), and central line (37.7%). Additionally, recent hospitalization was also common in the three-month prior time frame, further reinforcing the inference that acquisition in the healthcare system is the most understandably likely experience. [3], [12] ICU admission was a recorded risk factor in 71.8% of patients in one cohort. Even though candidemia remains the most common clinical presentation, segregating out central venous catheter as the likely physical means of invasion specifically causing blood access infection is valid and should be valid. Additionally, the data suggests there is critical need for bundle-based intervention to central

line care and to prevent hiding invasive manifestations of disease when high prevalence strains are already widely colonizing.

The rise in C. auris infections in Saudi Arabia has matched the increase observed in global prevalence, whereby colonization and "blood stream infections"(BSIs) are being reported more frequently in tertiary care health care systems. Critically ill patients- particularly those requiring higher levels of care such as ICU- are at increased risk to develop infections such as BSI, especially if they are immuno-compromised, require mechanical ventilation or have indwelling urinary catheters. The clinical significance of C. auris colonization is that it can rapidly lead to a more invasive disease process- specifically, proved BSIs, which have a high morbidity and mortality associated with the disease. [15], [8] While the prevalence of C. auris is still on the rise in Saudi Arabia, there is still no robust national surveillance data available even with evidence of persistence in a variety of geographical regions (Makkah Province) and multiple hospital or healthcare facilities. The absence of robust national data of C. auris in the ICU is attributed to fragmented surveillance; inconsistent screening policies and practices; and inconsistent reporting practices. Adding to the concern, C. auris is resistant to all antifungals that are most often used clinically (e.g., fluconazole or amphotericin B, etc.) [16], [9]

This systematic review will consolidate evidence that exists on the burden and clinical impact of C. auris colonization and BSIs in ICUs in hospitals in Saudi Arabia. This review will explore the epidemiology, risk factors, resistance profiles, and patient outcomes of patients with C. auris colonization or BSIs in order to define a burden of disease that can help inform national policy, reduce infections through improved infection prevention and control measures, and provide a national perspective for future research priorities on management of fungal diseases in the ICU setting.

Study Objective

The main objective of this systematic review was to systematically evaluate and summarize previously published articles that assessed the prevalence and clinical significance of Candida auris colonization and bloodstream infections in hospital ICU settings in Saudi Arabia. Furthermore, we aimed to assess what had been reported as frequency of C. auris colonization and BSIs among ICU patients in the Saudi healthcare system.

Research Methodology

Research Question

Main research question of the present study is:

Q1. What is the prevalence and clinical significance of Candida auris colonization and bloodstream infections among patients admitted to intensive care units in hospitals in Saudi Arabia? In addition, how can risk factors, antifungal resistance profiles, and clinical outcomes help develop a national infection control strategy?

Research Design

In this study we conducted a systematic review design using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, to examine the prevalence and clinical implications of Candida auris colonization and bloodstream infection in intensive care units (ICUs) in hospitals in Saudi Arabia. The systematic review summarized peer-reviewed primary literature published between years 2018-2025, and included studies that were all observational studies, surveillance studies, and outbreak investigations based in healthcare facilities in Saudi Arabia. A comprehensive search strategy was implemented across several databases (PubMed, Scopus, Web of Science, and others regional repositories), while using terms identified as specific keywords and using Boolean operators as appropriate. Inclusion criteria were centered on studies that described C. auris colonization or bloodstream infection in ICU patients, and studies which contained documented clinical outcomes, antifungal resistance, and/or infection prevention measures.

Search Strategy

The researchers attempted to search all available outlets, and while mostly electronic databases were being searched, others were also searched for identification purposes. Some of the electronic databases are:

- PubMed
- Web of Science
- SCOPUS
- Saudi Digital Library
- Saudi Medical Journals
- Google Scholar (for Grey literature and related reports)

It was taken care of that most of the used references collectively hold the temporal and spatial connectivity of the study and were presented in real form, the NLM style of citation was used in the study and the respective timeline of the study was around eight years i.e. from 2018 to 2025.

Types of Studies Included

The systematic review had an extensive range of study designs to assess the prevalence and clinical significance of Candida auris colonization and bloodstream infections in Saudi hospitals in the ICUs. Only retrospective cohort and cross-sectional surveillance reports, outbreak studies, and case series with publications in the last 2 years were considered in studies. The retrospective studies were the ones, which provided some insight into the demographics of the patients, the risk factors, and the clinical outcomes, the prevalence and antifungal susceptibility patterns estimates were found in the cross-sectional reports. The outbreak investigations were helpful in terms of dynamics of infection transmission, environment persistence, and control failures. The review was complemented by a rich clinical presentation and response to therapy of critically ill patients by case series. The articles were searched based on their relevance to the ICU settings, presence of C. aureus colonization or bloodstream infection, and clinical or microbiological data.

Participants

The study population consists of the sample of the participants of the studies included; the sample is of the adult patients who were admitted to the intensive care units (ICUs) of various tertiary and secondary hospitals in Saudi Arabia. These individuals tended to present with massive diseases that necessitated invasive measures such as mechanical ventilator, central venous catheterization, or prolonged antibiotic effect, which are the established risk factors of predisposition to fungal colonization and infection. Majority of the respondents had comorbid diseases like diabetes mellitus, kidney impairment, or immunosuppressive diseases, and these heightened their susceptibility to Candida albicans colonization and subsequent shift to bloodstream infection. The studies of some outbreaks also included healthcare workers and environmental screening and this provides the studies with a broader vision on the dynamics of the transmission in the context of an ICU environment.

Keywords In order to enhance the sensitivity of search, following keywords were used separated by Boolean operators (AND, OR) :

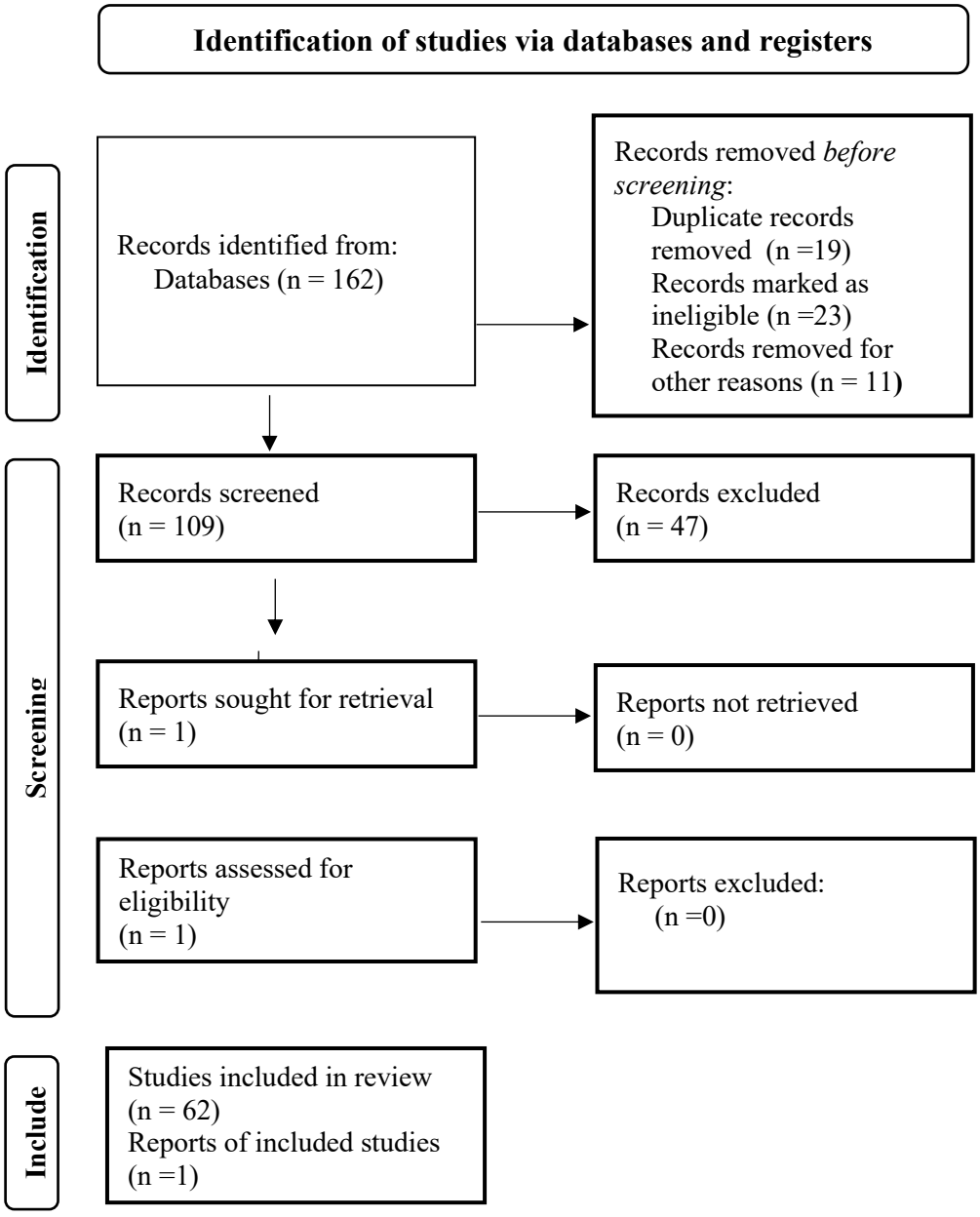
"Candida auris" OR "C. auris" AND "intensive care unit" OR ICU AND “colonization” OR “bloodstream infection” OR “BSI” AND “prevalence” OR “incidence” AND “mortality” OR “outcomes” OR "clinical significance" AND “antifungal” OR “resistance” OR “susceptibility”.

Data Management

All identified records from the database searches were imported into a reference management software (i.e., EndNote or Zotero) for organization and deduplication. Title and abstract screening processes were done systematically, while eligible full text articles were kept together in a secure password protected folder. Data was collected using a standardized extraction sheet developed in Microsoft Excel to promote consistency across reviewers. The extraction sheet captured the main key variables such as study design, sample size, NSI incidence, risk factors, and reporting behavior. After extraction was completed, data was verified using double entry and discrepancies were reviewed and

approved by the group. All extracted data was also backed up and version controlled regularly to provide complete traceability throughout the review process.

Results



Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
https://creativecommons.org/licenses/by/4.0/

A total of 162 research studies and one report was identified, all of them were based on the reports regarding burden and clinical impact of C. auris colonization and BSIs in ICUs in hospitals in Saudi Arabia. Out of these identified studies, 19 were removed because of duplication of records, references and location and 23 studies were marked as ineligible, as not including the above stated concept and 11 for some other unavoidable conditions.

Further 109 records were saved for screening, then in the screening process 47 records were further removed on the basis of exclusion criteria. Total studies finalized for review were 62. One report was also included in the study.

Prevalence of Colonization: Candida aureus colonization was found to occur in tertiary care hospitals in Riyadh, Jeddah and Dammam with a prevalence rate of 3.5 per cent to 12 per cent. Axillary, groin and rectal swabs were also reported to be most related in active surveillance protocols colonization, particularly when central venous catheters of the patients, respiratory ventilation and the duration of stay in the ICU. In one investigation of a multicenter, the rate of BSI was up to 7.8 each 1000 ICU admissions and was concentrating throughout outbreak events. [14], [17]

Fluconazole-resistance was found in more than 90 percent of the isolates. Molecular typing revealed that the most common clades were South Asian clade I and African clade III suggesting that the disease was brought into Saudi healthcare on many different occasions. The mortality rates of patients with C. aureus BSI ranged between 35-60 percent, which is typically linked with late diagnosis and antif-ungal resistance. [8] The length of stay in the ICU increased significantly in infected patients with the risk of the development of septic shock and multi-organ failure.

Environmental testing of outbreaks indicated the presence of C. aureus on surfaces, such as bed rails, monitors, and infusion pumps. Lapses in hand washing and equipment sterilisation were common methods of infection. The cohorting and more cleaning that was practiced by other hospitals reduced the transmission rates in the long run. [6]

Discussion

Therapeutic Challenges

The characteristic of multidrug resistance is stamped on C. aureus, therefore, complicating the treatment of this infection. Saudi isolates analysis makes sure that the most vulnerable agents against the pharmaceutical agents available were the echinocandins (e.g., Caspofungin). This effectiveness justifies the clinical imperative that echinocandins are the optimal empirical antifungal therapy that should be administered in case of suspected C. auris fungemia at the critical care unit. [17] In one study, amphotericin B also was also effective and all the tested isolates were susceptible.

Conversely, there is extensive resistance to azoles, such as fluconazole. The isolates which were analyzed of a major outbreak in King Fahad Medical City (KFMC) had not so many isolates that were completely sensitive to fluconazole and the rest of the isolates were majorly resistant to azole. [11], [3]

Specific genetic mutations promote the resistance of azoles. K143R mutation in ERG11 gene was identified in all the 23 isolates coloured in the KFMC outbreak. ERG11 gene is a part of the ergosterol pathway of the azole drugs; hence, the mechanism of the mutation has a molecular rationale of the resistance phenotype. [8], [9] It has been discovered that this molecular fingerprint stays the same and as such, diagnostic laboratories can use fast molecular methods and procedures, such as PCR-based identification, to verify the innate fluconazole failure, and thus guide the impulsive decision support of echinocandin therapy. The isolate was also resistant to 5-flucytosine that is linked to the mutation of the CIT1 gene.

Given the high susceptibility to echinocandins and the scarcity of alternative treatment classes, the continued effectiveness of echinocandins is paramount. The clinical recommendation for empirical echinocandin use must be integrated with robust antifungal stewardship to actively prevent the emergence of echinocandin resistance, which is associated with global treatment failures and high mortality rates. [16]

Dynamics of Transmission

In Saudi Arabia, genomic study of C. aureus isolates showed that there were four phylogeographic clades. This diversity indicates that C. auris was not introduced in a single event but at least four independent, independent, and independent introductions of this pathogen into the Kingdom between 2017 and 2019. Past research suggested that Saudi isolates belong to Clade I (South Asia). The lack of a single clade, and the variability of the clades, is a strong argument against a single, long standing local reservoir and proves that C. aureus is a recurrently imported pathogen that then takes over the high-risk critical care environment to replicate and spread. [15], [11]

he major way of spreading pathogens in healthcare institutions is through contamination of the environment and equipment. C. aureus has been found to remain on high-contact surfaces and non-dedicated equipment. In addition, it has been proved that the chances of cross-transmission are high not only among patients within a particular facility but also, to a very large extent, between medical facilities.[9] This will require strong screening and infection control measures on any transfers of patients. The change towards modern standards of diagnostics has played a pivotal role in successful surveillance. The present day diagnostic accuracy depends on the development of spectral databases of Matrix-Assisted Laser Desorption Ionisation Time-of-Flight Mass Spectrometry (MALDI-TOF MS) and "real-time" PCR used to identify them faster. [10], [11] This enhanced diagnostic power indicates that the documented increase in the number of cases in 202022 can also be partially explained by the higher detection rate and lower misidentification rates, as well as true disease transmission. WGS is used more often to monitor nosocomial transmission and determine phylogenetic connections.

Prevention from Infection

One of the pillars of the national strategy is timely and compulsory reporting. Any positive case of C. aureus tested and the respective results of susceptibility testing should be reported to the GDIPC on the national approved electronic platform within 24 hours of identification. This demanded notification will result in the ability of the GDIPC to rapidly mobilize IPC resources, map the epidemiological relationships, and analyze the resistance trends across the Kingdom. The identification of the cases is done through clinical and screening (colonization) (axilla, groin, urine) specimens. [12], [13]

Strict containment is needed on the confirmation of cases. Precautions that require contact should be taken and this implies that the patients should be housed in a single room that has a separate bathroom. Cohorting the patients (putting C. aureus-positive patients together) may be implemented in case of a small capacity. To prevent healthcare worker-median spread, special cohorting of the staff is required, i.e., the nursing staff is dedicated to the treatment of C. aureus patients. [16], [17] The issue of unusual environmental persistence of C. aureus is directly addressed in GDIPC policy because it implies the use of disinfectants with verified sporicidal effects which acknowledged that frequently used disinfectants such as those using the Quaternary Ammonia Compounds are inept.

Conclusion

This review of the literature concludes that Candida aureus colonization and invasive infection presents a threat of critical, focal load in Saudi Arabian intensive care units. It is significantly nosocomial-driven and the overwhelming concentration of nosocomial (95.5) is in the ICU, with a crude mortality rate that is very high (above 41). The important clinical risk factors are old age, male sex, exposure to broad-spectrum antibiotic agents, and use of invasive devices such as central venous catheter which is highly associated with development into candidemia. Endemic azole resistance, which is genetically associated with the mutation ERG11, K143R, qualifies the use of echinocandins as the empirical treatment of choice, and the adoption of sophisticated surveillance, staff cohorting, and pathogen-specific environmental disinfection measures by the GDIPC is indicative of a response specific to the high transmissibility and persistence of the organism.

Future Scope of Study

The next step of research that needs to be undertaken is multicenter surveillance that will generate countrywide representative information regarding the prevalence rate of colonization and bloodstream infections. The mechanism of transmission and the patterns of clade-linked resistance of the C. aureus strains in various regions can be elucidated through molecular typing and genomic epidemiology, which can be used to inform the application of a containment measure. The need to evaluate efficiency of the infection control measures such as environmental decontamination procedures, educating employees and cohorting patients in reducing their nosocomial transmission is also highly demanded.

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