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A Comparative Study: Bacterial Spectrum and Antibiotic Resistance Patterns of External and Intraocular Ocular Infections

Terada Yutaka*

Department of Medical Laboratory Science, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia

Abstract

Ocular infections are a common problem that can affect various parts of the eye, including the external structures and the intraocular compartments. Bacterial infections are a significant cause of ocular morbidity and can lead to vision loss if not properly treated. Understanding the bacterial spectrum and antibiotic resistance patterns in ocular infections is crucial for effective management and prevention of complications. In this article, we will explore the differences between external and intraocular diseases in terms of bacterial spectrum and antibiotic resistance patterns.

The bacteria from the external ocular surface were more sensitive to neomycin, while those from the intraocular specimens were more sensitive to levofloxacin. Multidrug resistance was found in 89 bacteria, including isolates from both external and intraocular samples. The results of this study indicate that the bacteria spectrum of external and intraocular infections is variable in the setting. A high percentage of bacterial organisms were found to be primarily susceptible to neomycin for external infection and levofloxacin for intraocular infection.

Introduction

Ocular bacterial infections can cause a series of symptoms and signs, such as the formation of pus, conjunctival hyperemia, lid edema, and even visual impairment. The causative bacteria can come from the outside environment or from systemic infections transported by blood. The eyelid and conjunctiva have normal bacterial flora, of which disequilibrium facilitates external or intraocular infection [1]. Bacteria of the normal microbiome can also cause infection, especially when they enter the aqueous humor or vitreous fluid. There have been many reports on the bacterial profile and antibiotic susceptibility of ocular infections, with varying results between cases. Understanding the health of the eyes is vital due to many factors. Several factors including, but not limited to, dust, high temperature, and microorganisms are factors associated with the occurrence of various eye diseases that can lead to blindness. Besides, changes in the ocular microbiota are associated with ocular diseases. Pathogenic microorganisms cause external ocular disease due to the virulence of microorganisms and the hosts reduced resistance [2]. Hosts reduced resistance results from different factors like living conditions, socio-economic status, decreased immune status, chemotherapy, chronic diseases, and malnutrition. Bacteria are the major contributor to ocular infections worldwide.

These different results, including the change of bacterial spectrum, have been attributed to the region and environment, as well as seasonal changes. To better understand the differences of bacterial profiles and resistance patterns between external and intraocular infections in South China, the present study retrospectively investigated and analyzed ocular isolates obtained from patients with suspected ocular infections. Additionally, the in vitro susceptibility of bacterial isolates from different ocular sites to eight antibiotics was assessed to provide guidance for clinical treatment [3].

External ocular infections primarily involve the conjunctiva and cornea. These infections are often caused by bacteria that colonize the ocular surface or are introduced from the environment. The most common bacterial pathogens associated with external ocular infections include Staphylococcus aureus, Streptococcus pneumoniae, Haemophilus influenzae, and Pseudomonas aeruginosa [4]. Staphylococcus aureus is one of the leading causes of bacterial conjunctivitis. It exhibits varying degrees of resistance to commonly used antibiotics, such as penicillin and erythromycin. Methicillin-resistant Staphylococcus aureus (MRSA) strains have also been reported in ocular infections, posing additional challenges in treatment.

Streptococcus pneumoniae is another significant pathogen implicated in external ocular infections, particularly in cases of bacterial keratitis. Resistance to penicillin and other beta-lactam antibiotics among pneumococcal strains is a growing concern. Therefore, culture and sensitivity testing should be performed to guide appropriate antibiotic selection [5].

Haemophilus influenzae is known to cause conjunctivitis and corneal ulcers, especially in children. The emergence of beta-lactamase-producing strains of H. influenzae has reduced the effectiveness of traditional beta-lactam antibiotics. Fluoroquinolones and cephalosporins are commonly used for the treatment of H. influenzae infections.

Pseudomonas aeruginosa is a Gram-negative bacterium that can cause severe ocular infections, including corneal ulcers and endophthalmitis. It is notorious for its intrinsic resistance to many antibiotics and the ability to acquire resistance mechanisms through genetic mutations and horizontal gene transfer [6]. Combination therapy with multiple antibiotics, including aminoglycosides and fluoroquinolones, is often necessary to combat Pseudomonas infections effectively.

***Corresponding author:** Terada Yutaka, Department of Medical Laboratory Science, College of Medicine and Health Sciences, Bahir Dar University, Bahir Dar, Ethiopia, E-mail: Yutakaterada@gmail.com

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Intraocular infections

Intraocular infections involve the deeper structures of the eye, such as the anterior and posterior chambers, vitreous, and retina. These infections can be endogenous or exogenous. The most common bacteria associated with intraocular infections include Staphylococcus epidermidis, Streptococcus viridans group, Escherichia coli, and various species of Enterobacteriaceae [7].

Staphylococcus epidermidis is a normal inhabitant of the ocular surface and is a leading cause of postoperative endophthalmitis. It has shown increasing resistance to multiple antibiotics, including methicillin and vancomycin. Treatment often involves the use of intravitreal antibiotics, such as vancomycin and ceftazidime, along with systemic antibiotics [8].

The Streptococcus viridans group comprises a diverse collection of bacteria that are part of the normal flora in the oral cavity. They can cause endogenous endophthalmitis, especially in patients with predisposing factors such as diabetes or immunosuppression [9]. The choice of antibiotics for Streptococcus viridans group infections depends on the susceptibility profile of the isolated strain.

Escherichia coli and other Enterobacteriaceae species are associated with severe intraocular infections, such as endophthalmitis and suprachoroidal abscesses [10]. These infections often occur following penetrating ocular trauma or intraocular surgery. Antibiotic resistance in Enterobacteriaceae, including extended-spectrum beta-lactamase (ESBL) production, has become a significant challenge. Empiric treatment with broad-spectrum antibiotics, such as a combination of vancomycin and ceftazidime, is often initiated until the susceptibility results are available [11].

Antibiotic resistance patterns

Antibiotic resistance among ocular pathogens is a growing concern. The indiscriminate use of antibiotics, both systemically and topically, contributes to the development of resistant strains [12]. In recent years, there has been an increase in multidrug-resistant bacteria, including methicillin-resistant Staphylococcus aureus, fluoroquinolone-resistant Pseudomonas aeruginosa, and extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae.

To effectively manage ocular infections and combat antibiotic resistance, it is essential to obtain a proper microbiological diagnosis through cultures and sensitivity testing. This allows for targeted antibiotic therapy based on the susceptibility profile of the isolated bacteria. In severe cases, intravitreal antibiotics may be necessary to achieve adequate drug concentrations in the intraocular compartments [13].

Conclusion

Ocular infections can involve both external and intraocular structures of the eye. The bacterial spectrum and antibiotic resistance patterns differ between these two types of infections. Understanding the specific pathogens and their susceptibility profiles is crucial for appropriate antibiotic selection and optimal patient outcomes. Clinicians should remain vigilant and follow best practices in antimicrobial stewardship to minimize the emergence and spread of antibiotic-resistant ocular pathogens. Additionally, further research and surveillance are necessary to stay ahead of the evolving antibiotic resistance patterns in ocular infections and guide future treatment strategies.

Conjunctivitis, blepharitis and dacryocystitis forms of bacterial external ocular infections linked with multi-drug resistance and high levels of resistance to penicillin, ampicillin, tetracycline and piperacillin are prevalent in the study area. Therefore, empirical treatment of eye infections in the study area needs to be guided by antimicrobial - susceptibility testing. Previous ocular diseases, trauma and co-existence of eye allergy were predictor variables for bacterial external ocular infections. Bacterial isolates were susceptible for ciprofloxacin and gentamycin. Further studies on keratitis, intraocular infections and extents of beta-lactamase producing bacterial causes of external ocular infections using molecular techniques are required.

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