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A Review Article: Clean Water Contamination as a Risk Factor for Acanthamoeba Keratitis

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ABSTRACT

Introduction: Infectious keratitis is one of the main causes of visual impairment. The incidence of acanthamoeba keratitis is relatively rare, while the prevalence is around 1 to 9 cases per 100.000. One of the factors supporting the occurrence of *acanthamoeba* keratitis is the increasing use of contact lenses around the world.

Content: When there is microtrauma to the cornea, it can cause the expression of the mannose on the surface. With the emergence of mannose in the form of glycoproteins, it will be a requirement for the attachment of *Acanthamoeba* spp.

Conclusion: Keratitis *Acanthamoeba* is an infectious disease of the cornea due to the use of contact lenses that are too long exposed to water which causes the entry of *Acanthamoeba*. This disease has a good prognosis with immediate drug administration within the first 3 weeks after the onset of symptoms

Keywords: Keratitis; *achantamoeba*; cornea infection

GREEN MEDICAL JOURNAL
E-ISSN 2686-6668

Article history:
Received: 10 October 2022
Accepted: 15 November 2022
Published: 30 December 2022

Published by:
Faculty of Medicine
Universitas Muslim Indonesia

Address:
Jl. Urip Sumoharjo Km. 5, Makassar
South Sulawesi, Indonesia

Mobile number:
+62821 9721 0007

Email:
greenmedicaljournal@umi.ac.id

Introduction

Infectious keratitis is one of the main causes of visual impairment. Keratitis is a major cause of turbidity of the cornea. The main cause of keratitis in developing countries is due to work-related ocular trauma. Several occupations can have a high risk of contracting this disease, including divers and fishermen who work in aquatic environments[1]. Precise early diagnosis of the causative organism is important to provide appropriate therapy to the patient [2]. Incidence of acanthamoeba keratitis is relatively rare, while the prevalence is around 1 to 9 cases per 100.000 [3]. One of the factors supporting the occurrence of acanthamoeba keratitis is the increasing use of contact lenses around the world[4]. In the United States, the incidence of acanthamoeba keratitis is estimated at 1 to 2 new cases per 1 million contact lens wearers each year, whereas 16.7% of adults in the United States wear contact lenses.[5]Acanthamoeba keratitis was first discovered in South Texas, United States in 1973 by a farmer who washed his injured eye with tap water. When the infection is not treated promptly, the sequential spread of infection can occur to deeper parts of the eye structures and central nervous system which can manifest as granulomatous amoebic encephalitis.

One of the pathogens that can cause keratitis in coastal communities with the majority of work as divers and fishermen is *Acanthamoeba spp*. *Acanthamoeba* parasites can cause progressive infection of the cornea[8]. The main risk factor for *Acanthamoeba* (KA) is the use of contact lenses while swimming or diving. In 2 of the 8 species of *Acanthamoeba* there are 2 types of species that most often cause infection, namely *A. castellanii and A. polyphaga*. *Acanthamoeba* is an amoeba that is often found in swimming pools, sea water, rivers, tap water and contact lens fluid. A late diagnosis of KA can cause amoeba to penetratethe corneal stroma and affect the success of therapy so treatment will be more difficult [9]. Considering that the local content of the Faculty of Medicine, University of Mataram is Archipelagic Medicine, the authors are interested in discussing *Acanthamoeba* in Coastal Residents of West Nusa Tenggara.

Definition

Acanthamoeba keratitis (KA) is a pathological condition in the form of corneal infection of the eye caused by acanthamoeba[10]. A person who frequently uses contact lenses increases the risk of minimal trauma to the cornea so that acanthamoeba can enter through the eye.[1]

Epidemiology

According to research data from Basic Health Research in 2013, the prevalence of corneal opacities reached 5.5%.[12] The incidence rate of this incident was found to be high in groups with livelihoods of farmers/fishermen/laborers which may be related to a history of mechanical trauma or work accidents to

the eyebecause in Indonesia the use of personal protective equipment at work has not been optimally applied[13]. The research continued until 2019, it was found that around 5% of the incidence of KA was associated with the use of contact lenses caused by *Acanthamoeba spp*[14].

Pathophysiology

In general, humans have a high resistance to *Acanthamoeba spp* due to the high concentration of immunoglobulin A in the lacrimal fluid which functions as an anti-protozoal. *Acanthamoeba spp* can enter the cornea, one of which is when there is microtrauma from the corneal epithelial layer and contact with a polluted environment. Upon entering the eye, *Acanthamoeba spp.* will attach to the corneal epithelium through glycoproteins present in epithelial cells and *mannose* located on the trophozoite membrane. When there is microtrauma to the cornea, it can cause the expression of the *mannose* on the surface. With the emergence of *mannose* in the form of glycoproteins, it will be a requirement for the attachment *of Acanthamoeba spp*. When the number of expressions is greater, *Acanthamoeba spp* will become more virulent and release toxic factors. An important component of KA is the protease MIP133 (Mannose Induced Cytopathic Protein) which can damage keratocytes, epithelial cells, and endothelial cells, causing apoptosis of macrophages[7]. There are 2 stages in the life cycle of acanthamoeba namely, the vegetative trophozoite stage and the dormant cystic stage[1].

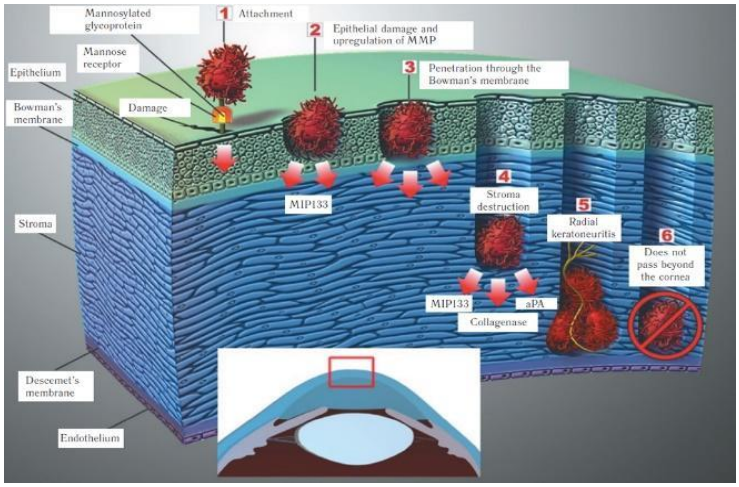

Figure 1. Pathogenesis of Acanthamoeba[7]

Clinical manifestations

Keratitis *Acanthamoeba* (KA) is often delayed or misdiagnosed with another infectious keratitis. The difficulty of diagnosis is because,in the early stages of the disease course, the clinical manifestations of KA are often non-specific and resemble the clinical manifestations of other corneal infections. Complaints of ocular irritation, blurred vision, and splitting are usually minimal. However, in KA there is a characteristic symptom in which the patient often complains of severe pain in the ocular or periocular area that is followingother clinical signs found. In addition, in KA the infection is almost always unilateral and will slowly progress from the epithelium to the stroma. Other complaints that may occur are eye redness, photophobia, discharge, and the sensation of a foreign body entering the eye[15].

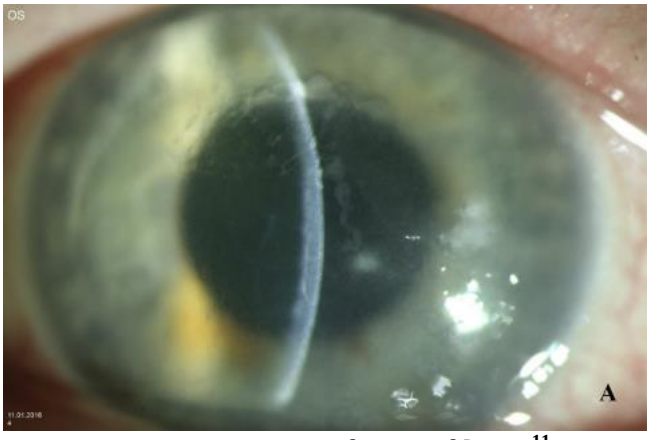

Figure 2. Overview of ring infiltrate[11]

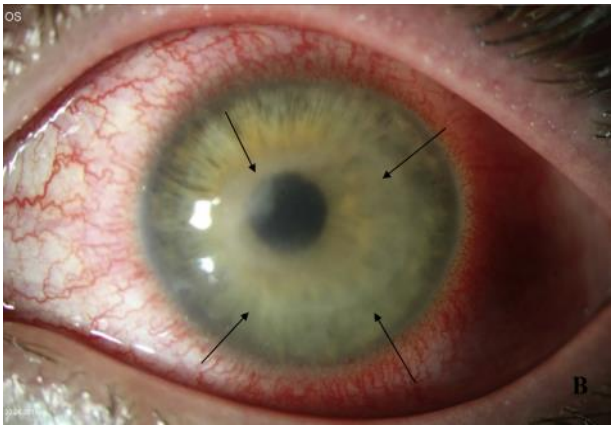

Figure 3. *Perineural infiltrate*[11]

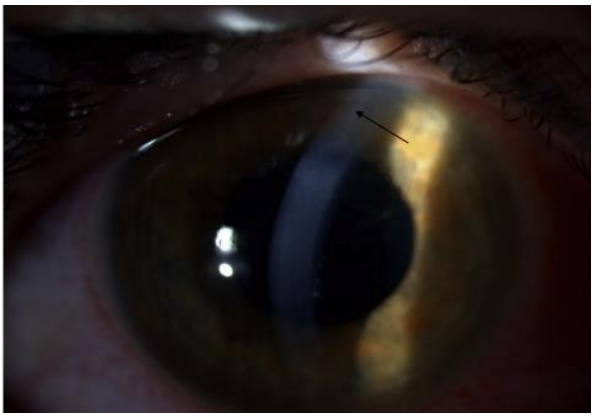

Figure 4. Features of scleritis, mature cataracts, iris atrophy, and persistent mydriasis[11]

Diagnosis

A thorough examination starting from the anamnesis data collection, physical examination, and supporting examinations is required in establishing the diagnosis of KA. In the history, it is necessary to obtain a history of using contact lenses, swimming or exposure to contaminated water or soil, as well as a history of trauma to the eye area which is the main risk factor for KA[14]. On physical examination, an in-depth ocular examination using a Slit Lamp. On this examination, chameleon-like epithelial changes or dirty epithelium in the first 2 weeks after the first symptoms appear. The dirty epithelium can be found in 50% of patients with KA. Furthermore, a ring infiltrate or Wessley immune ring will appear in the first 2 weeks to 1 month. The infiltration that occurs will continue and in the 6th week there will be a perineural infiltrate that can be found in 63% of cases of KA. If it is not treated in the following months, common complications of KA can occur in the form of mature cataracts, persistent endothelial defects, iris atrophy, secondary glaucoma, and other complications such as scleritis, sterile anterior uveitis, choriorenitis, and retinal vasculitis, which are less common happen[11].

Based on the depth of the lesion or defect that occurs in the cornea, infectious keratitis including KA is classified using grading as follows:

Table 1. Infectious keratitis grading[16]

Grade	Type of Infectious Keratitis
1	The defect occurs only in the epithelium
2	Mild thinning of the stromal layer, <50% corneal thinning
3	Thinning in the stromal layer, >50% corneal thinning
4	Descematocele (protrusion of intact Descemet's membrane)
5	Corneal perforation, defects

in all layers of the cornea

Investigations need to be done to ensure that the keratitis iscaused by *Acanthamoeba spp*. The supporting examination that has been consideredthe golden standard for establishing the diagnosis of KA is culture on agar media which is coated with *E. coli* bacteria. In addition, the high sensitivity (100%) and specificity (96%) of the polymerase chain reaction (PCR) examination shows the potential for PCR to become the golden standard for the diagnosis of KA in the future. IVCM (In Vivo Confocal Microscopy) has also been chosen because of its non-invasive procedure and high sensitivity (85.3%) and specificity (100%) [11].

Treatment

Conservative therapy of KA requires the use of a combination of two topical drugs. The combination of Polyhexamethylene biguanide (PHMB) with 0.02% chlorhexidine is a first-line therapy for KA which is quite effective to treat *Acanthamoeba spp* in trophpzite and cyst. Other combinations that can be chosen are the combination of chlorhexidine with natamicin or the combination of chlorhexidine with aromatic diamidines such as propamidine isethionate Brolene 0.1%, dibromopropamidine 0.15%, or hexamidine 0.1% [6]. During the first 3 days after corneal debridement, the selected combination of topical therapy was applied every hour. The frequency of application of the topical medication is then reduced to every 3 hours and continued for at least 3 - 4 weeks. If after 2 weeks of topical therapy there is no improvement in the condition of the cornea, surgical procedures such as corneal cryotherapy, amniotic membrane transplantation, or penetrating keratoplasty are necessary[11].

Prognosis

The severity of the disease and the time of initiation of therapy are two factors that greatly affect the prognosis. KA treated since the first 3 weeks after the appearance of symptoms mostly has a good prognosis. However, KA that is diagnosed late or that is accompanied by complications such as cataracts and scleritis is much more difficult to treat and has a poor prognosis. [17]

Conclusion

Keratitis *Acanthamoeba* (KA) is an infectious disease of the cornea due to prolonged use of contact lenses in water which causes the entry of *Acanthamoeba spp*. Symptoms that can be felt such as ocular irritation, blurred vision and splitting. The golden standard in the diagnosis of KA is to culture on agar media coated with *E. Coli*. This disease has a good prognosis with immediate drug administration within the first 3 weeks after the onset of symptoms.

Conflict of Interest

There is no conflict of interest

Funding Sources

There is no funding sources

Acknowledgment

There is no acknowledgment

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