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Keratoplasty in Contact Lens Related Acanthamoeba Keratitis

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1. Introduction

Acanthamoeba keratitis (AK) infection is a rather frequently occurring disease all over the world which can still cause serious or even total loss of vision despite improved diagnostic and therapeutic options. It may cause mostly keratitis, scleritis or chorioretinitis in people with competent immune systems.

It mainly affects contact lens wearers with poor hygiene. Corneal trauma due to foreign body injury and exposure to contaminated water may also be associated with *Acanthamoeba* infection.

Those with Acanthamoeba keratitis generally are immunocompetent. Nevertheless, these individuals do not develop protective immunity, and thus reinfection can occur. In the mid 1980s, an epidemic of Acanthamoeba keratitis occurred in the US which was attributed to increased contact lens use and poor lens hygiene.

Conditions promoting the disease include not only poor contact lens hygiene but also the use of home-made saline solutions and corneal abrasions (Stehr-Green at al., 1989).

In the United Kingdom, there was a marked rise in the number of cases in the first half of the 1990s, associated with the introduction and increasing popularity of disposable soft contact lenses shown to be due to irregular and/or chlorine based disinfection. After 1995 there was a decrease, perhaps resulting from an improvement in CL hygiene following the widespread dissemination of the results of a paper on Acanthamoeba keratitis as well as the gaining penetrance of new CL hygiene systems (Radford et al., 1995, 1998, 2002).

1.1 Features of Acanthamoeba

Free-living amoebae belonging to the genus *Acanthamoeba* are the causative agents of granulomatosus amoebic encephalitis, a fatal disease of the central nervous system, cutaneous lesions and sinusitis in immonodeficient patients and amoebic keratitis, a painful sight-threatening disease of the eyes in otherwise healthy individuals.

Acanthamoeba was first described by Castellani when he reported the presence of an amoeba in *Cryptococcus pararoseus* cultures. The genus *Acanthamoeba* was established later by Volkonsky in 1931 (Marciano-Cabral & Cabral, 2003).

The first suggestion that *Acanthamoeba* could cause disease in humans came in 1958 during polio vaccine safety trials. Plaques appeared in cell cultures used to prepare vaccine and

were thought to be virus induced because mice and monkeys died from encephalitis following inoculation of tissue culture fluid. These observations of experimental animals dying from encephalitis led Culbertson et al. to predict a role for free-living amoebae as agents of human disease. Human cases of amoebic encephalitis were reported soon thereafter. The first cases which clearly established *Acanthamoebae* as causative agents of disease in humans were reported in the early 1970s with many more reports of various diseases following ever since (Dunand et al., 1997; Gulett et al., 1979; Illingworth & Cook 1998; Jones et al., 1975; Martinez et al., 1994).

Acanthamoeba spp. are among the most prevalent protozoa found in the environment. They are distributed worldwide and have been isolated from soil, dust, air, natural and treated water, seawater, swimming pools, sewage, sediments, air-conditioning units, drinking water treatment plants, bottled water, dental treatment units, hospitals and dialysis units, eyewash stations, and contact lenses and lens cases and as contaminants in bacterial, yeast, and mammalian cell cultures *Acanthamoeba* spp. also have been isolated from vegetation, from animals including fish, amphibia, reptiles, and mammals, from the nasal mucosa and throats of apparently healthy humans, from infected brain and lung tissue, from skin lesions of immunosuppressed patients, and from corneal tissue of patients with Acanthamoeba keratitis. It has been shown to live in domestic tap water pipelines especially in the cold water systems (Gray et al., 1995; Kilvington et al., 2004; Marciano-Cabral & Cabral, 2003; Radford et al., 1995).

The life cycle of *Acanthamoeba* consists of two stages: an actively feeding, dividing trophozoite and a dormant cyst. The trophozoite varies in size from 25 to 40 μm and feeds on bacteria, algae, and yeast in the environment but can also exist axenically on nutrients in liquid taken up through pinocytosis. A double-walled wrinkled cyst composed of an ectocyst and an endocyst ranges in size from 13 to 20 μm and varies from species to species. Cyst formation occurs under adverse environmental conditions such as food deprivation, desiccation, and changes in temperature and pH. Cysts are resistant to biocides, chlorination, and antibiotics and survive low temperatures (0 to 2°C). But treatment with Freon or methylene oxide or autoclaving destroys cysts. Excystment occurs when trophozoites emerge from the cyst under suitable environmental conditions. It was demonstrated that cysts retained viable amoebae for over 24 years after storage in water at 4°C (Khan, 2001; Marciano-Cabral & Cabral, 2003).

The cellular organization of *Acanthamoeba* has been studied using electron microscopy. Organelles typically found in higher eukaryotic cells have been identified in *Acanthamoebae.* They have a Golgi complex, smooth and rough endoplasmic reticula, free ribosomes, digestive vacuoles, mitochondria, and microtubules in *Acanthamoeba* trophozoites. A trilaminar plasma membrane was found to surround the cytoplasmic contents of the trophozoite. In addition, distinguishing features of the trophozoite were the presence of spiny surface projections called acanthopodia, a prominent contractile vacuole in the cytoplasm that controls the water content of the cell, and a nucleus with a large central nucleolus. Generally, the amoebae are uninucleated, although multinucleated cells are common when *Acanthamoeba* are maintained in suspension culture. Reproduction occurs by binary fission (Marciano-Cabral & Cabral, 2003).

Pathogenic Acanthamoeba exhibited higher numbers (above hundred) of acanthopodia as compared to non-pathogens (below twenty) (Khan, 2001). *Acanthamoeba* species can be assigned to three different groups on the basis of their cyst morphology. Later the complete gene sequence of nuclear small ribosomal subunit RNA was determined and using this approach, *Acanthamoeba* species was classified into 53 isolates on the basis of 12 rDNA

sequence types (RNA genotypes) designated typing units T1 to T12. Additional sequence types may exist. Sequences of either nuclear (RNA) or mitochondrial rRNA genes are suitable for classifying isolates. Current classification schemes integrate the morphological groups with the 12 sequence types (RNA genotypes) (T1 to T12) so that group I includes sequence types T7, T8, and T9, group II includes sequence types T3, T4, and T11, and group III includes sequence types T1, T2, T5, T6, T10, andT12. Studies in which clinical isolates have been identified based on sequence types have shown that the majority of strains causing keratitis belong to sequence type 4 (Marciano-Cabral & Cabral, 2003).

Amoebae have been reported to exhibit different capabilities for binding and internalizing different species of bacteria. Bacterium amoebae interactions may lead to the establishment of an endosymbiotic state or, alternatively, to destruction of either the bacterium or the amoeba. The role of *Acanthamoeba* spp. as reservoirs or vectors for human pathogens has been examined. The intracellular growth of bacteria in *Acanthamoeba* has been associated with enhanced survival of bacteria in the environment, increased resistance of bacteria to biocides, and increased bacterial virulence. Intracellular survival within the amoebae has been postulated as a mode by which bacteria survive in substrate-limiting environmental ecosystems. Intracellular growth of bacteria in amoebae apparently also affects the resistance of bacteria to antibiotics (Marciano-Cabral & Cabral, 2003).

1.2 Pathogenesis

Pathogenic and nonpathogenic strains of *Acanthamoebae* have already been isolated from the environment, but the pathogenesis of infection and the biochemical determinants of virulence are poorly understood. Temperature tolerance, growth rate, adherence properties, cytolytic products produced by amoebae, and immune evasion mechanisms appear to constitute important factors in their pathogenicity. The virulence of pathogenic amoebae wanes during continuous culture in axenic medium but can be restored by brain passage in mice. It has been proposed that virulence may be related to distinct physiological characteristics of a strain and not to a dependence on environmental conditions (Marciano-Cabral & Cabral, 2003).

Animal studies have confirmed the clinical impression that contact lenses are vectors for transmitting trophozoites to the corneal surface and facilitating trophozoite binding to the corneal epithelium. Adherence of trophozoites to cells followed by injury and invasion of tissue are thought to represent important steps in the establishment of infections. Clinical isolates of *A. polyphaga*, *A. castellanii*, and *A. culbertsoni* have been shown to attach to corneal epithelial cells through a process which involves binding to cell surface carbohydrate moieties. *A. castellanii* binds to mannose containing glycoproteins on the corneal epithelium through a 136-kDa mannose-binding protein on the amoeba surface. The adherence of *Acanthamoeba* to corneal epithelial cells can be inhibited by mannose and methylmannose pyranoside but not by other sugars (Clarke & Niederkorn, 2003; Hurt et al., 2003; Marciano-Cabral & Cabral, 2003). Glycolipids of corneal epithelium reactive with *Acanthamoeba* may also play a role in the pathogenesis of Acanthamoeba keratitis by mediating the adherence of the amoebae to the cornea. Gordon et al., using binding assays, reported that *Acanthamoeba* binds preferentially to collagen IV, laminin, and fibronectin (Gordon et al., 1993).

Following adherence to cells, invasion and extensive tissue destruction occur in the host. Human epithelial cells, stromal keratocytes, and stromal cell homogenates have been used in vitro as models of Acanthamoeba keratitis. Damage to cells and tissue is thought to occur by phagocytic processes and by cytotoxic substances released by amoebae. Exposure to

mannose induces Acanthamoeba trophozoites to produce a 133-kDa protease termed mannose-induced-protein (MIP) 133. MIP133 produces contact independent cytolysis of corneal epithelial cells in vitro. Corneal organ culture studies have shown that binding to mannose glycoproteins on the traumatized corneal epithelium induces trophozoites to release cytopathic factors (including MIP133) that facilitate corneal destruction and invasion. Activated MMPs degrade components of the basement membrane and the extracellular matrix, including types I and II collagens, fibronectin and laminin (Clarke & Niederkorn, 2006; Hurt et al., 2003). Acanthamoeba trophozoites use multiple proteases with nonspecific collagenolytic activity to penetrate and degrade the stroma; these include serine proteases, cysteine protease, an elastase and a metalloproteinase. In addition, there is evidence that a collagenolytic enzyme could have a role in the generation of the ring-like stromal infiltrates and corneal lesions that are characteristic of Acanthamoeba keratitis. Trophozoite adherence was followed by penetration, a process which appeared to involve both secretion of lytic enzymes and phagocytosis (Clarke & Niederkorn, 2006; Hurt et al., 2003).

1.3 Epidemiology, risk factors

Acanthamoeba spp. are among the most prevalent protozoa found in the environment. This spp. are worldwide and could been isolated from different sites so as soil, dust, air, natural and treated water, seawater, swimming pools, domestic tap water, drinking water, or even bottled water. The number of Acanthamoeba in a freshwater lake bottom can be 200-2100 amoeba/g. In the Potomac River for example there was one amoeba per 3.4 L water. The highest percentage of pathogens is during spring and fall (Nwachuku & Gerba, 2004). Acanthamoebae have been detected in tap water and in swimming pools. In Mexico amoebae were found in 13% of the water samples from faucets in private residences. In Egypt 2/50 tap water samples were contaminated. In Germany amoebae were found in 56% of hot water taps examined in hospitals. In England amoebae were isolated from bathroom and kitchen cold water taps. Amoebae may survive pool and spa disinfection (bromine, chlorine) procedures because of their resistant cyst stages. In 1977 *Acanthamoebae* were recovered in the water of 27 out of 30 public pools. Acanthamoeba has been isolated in swimming pools in Germany, Mexico and in Norway, temperature-tolerant strains of Acanthamoeba in spas in New Zealand and Spain. Acanthamoeba was isolated from bottled water also in Mexico. Acanthamoeba cyst can be isolated from air, dust, air conditioner, cooling towers (Kilvington et al., 2004; Nwachuku & Gerba, 2004). Acanthamoebic keratitis first reported by Nagington et al. (Nagington et al., 1974) in Great Britain and by Jones et al. Jones et al., 1975) in the United States is a painful progressive sight-threatening corneal disease. Since acanthamoebic keratitis is not a reportable disease, the true incidence is not known. Published works suggest an incidence rate of 0.58-0.71 cases/1.000.000 in the general population, and 1.65-2.01/1.000.000 among contact lens wearers (Nwachuku & Gerba, 2004). The given incidence among contact lens wearers is 3-5/1.000.000 in Holland, and 33/1.000.000 in Hong Kong (Seal, 2003). Three recent multi centre Questionnaire Reporting Surveys of Acanthamoeba keratitis were conducted in England within the past twenty years. The first in 1992–96 gave an incidence rate of 0.25 per 10 000 contact lens wearers (CLW). The second and third surveys in England and Wales carried out in 1997–99 with one case in 47 620 CLW (or 0.21 per 10 000) and in 1998–99 with one case in 555 CLW (or 0.18 per 10 000) found that 80% of all infections were manifest in lens wearers, with 88% using hydrogel lenses and 12% rigid lenses The incidence of acanthamoeba keratitis with gas permeable and rigid contact lenses is much lower than with soft hydrogel CL (Seal,

2003). In non contact lens wearers history of trauma in a garden is a risk factor (Radford et al., 1998).

Patient ages range from 4 to 64 years, with a mean age of 30 years, with no difference in genders (Radford et al., 1998; Sharma et al., 2000). Infection usually affects only one eye, although the infection is occasionally bilateral (Illingworth & Cook, 1998; Parthasarathy et al., 2007; Radford et al., 1998; Wilhelmus et al., 2008). Among non contact lens wearers trauma and exposure to contaminated water have been identified as major risk factors (Chynn et al., 1995; Sharma et al., 2000). Multivariable analysis showed that this is largely attributable to a lack of disinfection, the use of non-sterile saline, and the use of chlorine based disinfection rather than alternative chemical systems (Radford et al., 1995). Many CL users are still contaminating their contact lenses with tap water either directly (showering, face washing, handling with wet hands) or by using water to rinse their storage case (Radford et al., 2002; Seal et al., 1999). Disposable soft contact lenses seem to be a risk factor for contact lens induced keratitis. 89% of the patients with keratitis used this type of contact lens (Dejaco-Ruhswurm et al., 2001). It was shown that adherence of amoeba to the lens was higher among disposable contact lenses (etafilcon A) than among the conventional lenses (polymacon) (Beattie et al., 2003, Lema et al., 2001). Attachment of Acanthamoeba was affected significantly by lens material type (P<0.001), with higher numbers of trophozoites attaching to the first-generation lotrafilcon A silicone hydrogel lens, compared with the second-generation galyfilcon A lens and the conventional hydrogel lens. Patient wear and the presence of a bacterial biofilm had no significant effect on the attachment to the lotrafilcon A lens but did significantly increase attachment to the galyfilcon A and the etafilcon A (P = 0.009) lenses. If exposed to Acanthamoeba (e.g., when showering or swimming, through non-continuous wear and ineffective lens care regimes), first-generation silicone hydrogel lenses may promote a greater risk of Acanthamoeba infection due to the enhanced attachment characteristics of this lens material (Beattie et al., 2006).

An initial coinfection occurs, with the bacteria providing an additional food source for the amoebae. The presence of bacterial biofilm may also affect amoebal sensitivity to disinfectants (Illingworth & Cook, 1998).

Trophozoite and cyst adherence of two acanthamoeba keratitis strains to four types of unworn soft contact lens and their removal by cleaning agents were studied. Greater adherence of the trophozoites compared with the cysts was recorded. Trophozoites adhered in greater numbers to type I lenses (poly2-hydroxyethyl methacrylate), with no differences between type II (lidofilcon A), III (bufilcon A) and IV (etafilcon A) lenses. Adherence of the other trophozoites to type II lenses was lower compared with their adherence to the other lenses. Cysts of both strains showed greater adherence to type I and III lenses. Recommended cleaning procedures using three commercial solutions were effective in removing Acanthamoeba from the lenses (Kilvington, 1993).

1.4 Clinical symptoms

The clinical picture of acanthamoeba keratitis is remarkable for its varied manifestations, although these often seem to occur in a recognizable sequence. Most patients complain of symptoms of photophobia, pain, and tearing. The pain in acanthamoeba keratitis may be particularly severe, seemingly disproportionate to the signs, although the absence of severe pain does not preclude the diagnosis. Rarely, there may be an apparent precipitating event, such as an injury to the eye, swimming while wearing lenses, or insertion of a non-sterile lens. Symptoms may continue uninterrupted from the time of an injury, sometimes with

apparent failure of a corneal abrasion to heal, or rarely, there may be a delay of up to 2 weeks before the onset of symptoms. The earliest signs may be non-specific and may take the form of epithelial micro erosions, irregularities, opacities or microcystic oedema, often with patchy anterior stromal infiltrates. There may be no fluorescein staining at the onset. Commonly, there is a dendriform keratitis that is often initially treated as herpes simplex infection. Limbitis (limbal hyperaemia and oedema) is a very frequent finding in both early as well as late stages of the disease. A pattern of perineural infiltrates that occurs in a radial distribution (radial keratoneuritis) is virtually pathognomic for acanthamoeba keratitis. A ring infiltrate, usually with an overlying epithelial defect is commonly seen. Although initially the epithelium within the ring may be intact, in longstanding cases a central defect, which is often associated with stromal thinning, may occur. The ring may be incomplete, or occasionally it is double and concentric. The inflammation may involve the sclera, evidence of direct scleral invasion by amoebae has often been elusive, leading to the conclusion that scleritis is a secondary immunologic reaction. Posterior segment signs are rare, although occasional reports of optic nerve oedema, optic neuropathy and optic atrophy, retinal detachment, choroidal inflammation, and formation of a macular scar exist. Contra lateral chorioretinitis has also been observed. In up to 20% of cases cataract may occur, although this appears to be associated with severe or prolonged inflammation, and use of topical corticosteroids. Glaucoma is commonly reported, particularly in advanced stages (Illingworth & Cook, 1998; Radford et al., 1998; Reinhard & Sundmacher, 2000).

1.5 Diagnosis

The importance of early diagnosis cannot be overemphasized. We have to consider acanthamoeba keratitis when symptoms associated with trauma especially involving vegetable matter or exposure to contaminated water, such as lake -, sea-, or spring water are mentioned. Early diagnosis is essential to ensure a good prognosis. If effective therapy is delayed for 3 or more weeks the prognosis will deteriorate. Acanthamoeba keratitis should be considered in any case of corneal trauma complicated by exposure to soil or contaminated water, and in all CL wearers (Dart et al., 2009). We also have to question the patients about this during the history taking.

Acanthamoebic keratitis has to be differentiated from bacterial or fungal or herpes simplex virus (HSV) keratitis. In addition, the disease must be considered when there is a failure to respond to first-line therapy for bacterial or herpes simplex virus keratitis, even when there has been a positive culture for another organism, because 10% to 23% of cases of Acanthamoeba keratitis may be polymicrobial or co-infected. Perineural and/or ring infiltrates are characteristic clinical signs of the disease (Dart et al., 2009; Marciano-Cabral & Cabral, 2003; Radford et al., 1998).

Diagnosis may be achieved by using different methods, including non invasive confocal microscopy which is the preferred diagnostic technique in some centres, with sensitivity and specificity exceeding 90% (Dart et al., 2009). Another quick method is staining corneal scrapings with acridine orange, which reveal yellow-to-orange polygonal, cystic structures consistent with the appearance of *Acanthamoeba* among inflammatory cells and the corneal epithelial cells (Hahn et al., 1998). An additional advantage of the method is that no special solutions and staining techniques are required. A definitive diagnosis of Acanthamoeba keratitis can only be made on the basis of culture or histology, or by the identification of the presence of amoebic DNA with PCR (Dart et al., 2009). Corneal scrapes or corneal biopsy specimens are used for culture or for the identification of cysts or trophozoites in stained

tissue sections. For culture, material from a corneal scrape can be placed onto no nutrient agar containing *E. coli*. It should be incubated at 28 to 35°C and held for an extended interval (10 days or more to ensure time for excystation) because some species of *Acanthamoeba* do not grow well at 35°C or above. However, corneal scrapes may contain bacteria or yeast, which can confuse the diagnosis. Corneal biopsy has been suggested when repeated cultures of corneal scrapings are negative (Illingworth & Cook, 1998; Marciano-Cabral & Cabral, 2003). For a cytological diagnosis, various staining methods can be employed. The indirect immunofluorescent-antibody assay has been used to detect amoebae in corneal scrapings or in biopsy tissue. Calcofluor white, a chemo fluorescent dye with an affinity for the polysaccharide polymers of amoebic cysts, has been used to identify amoebic cysts in corneal tissue. Calcofluor white stains amoebic cyst walls bright apple green and this effect can be enhanced by prolonging the staining period. Evans blue is used to counter stain the background. Trophozoites and cysts in paraffin-embedded tissues can also be rapidly and differentially stained with calcofluor white (Marciano-Cabral & Cabral, 2003). For the rapid and sensitive identification of Acanthamoeba at the genus level, a polymerase chain reaction (PCR)-based method can be used. For typing *Acanthamoeba* isolates a restriction fragment length polymorphisms (RFLPs) is useful (Khan et al., 2001; Kilvington et al., 2004).

1.6 Treatment
The goals of medical therapy in Acanthamoeba keratitis include the eradication of viable cysts and trophozoites and rapid resolution of the associated inflammatory response.

1.6.1 Medical treatment
There is no single drug capable of eliminating the infection therefore drug combinations have been suggested as a treatment regimen. Several drugs are known to be amoebicid and cysticid. There are currently no drugs that are effective as monoterapy in Acanthamoeba keratitis, so combinations are suggested. Acanthamoeba trophozoites are sensitive to most available chemotherapeutic agents (antibiotics, antiseptics, antifungals, antiprotozoals including metronidazole, antiviral, and antineoplastic agents). However, persistent infection is related to the presence of *Acanthamoeba* cysts, against which very few of these agents have any effect and only agents that are cysticidal in vitro against cysts can be expected to be effective as therapy. The diamidines and biguanides are currently the most effective cysticidal antiamoebics in vitro and their use is supported by substantial case series. Metronidazole (Flagyl; Pfizer Inc, New York, New York, USA) has been used for several cases in one series, but has proved to have no effect in vitro. For these reasons topical therapy with biguanides with or without the addition of diamidines is currently the mainstay of treatment for Acanthamoeba keratitis (Bacon et al., 1993; Dart et al., 2009; Illingworth et al., 1995; Illingworth & Cook, 1998; McCellan et al., 2001; Seal, 2003).
Biguanides: The two biguanides that are in use are polyhexamethylene biguanide (PHMB) 0.02% to 0.06% (200 to 600 g/ml) and chlorhexidine 0.02% to 0.2% (200 to 2000 g/ml). The biguanides interact with the cytoplasmic membrane, resulting in loss of cellular components and inhibition of respiratory enzymes. Both drugs have been effective clinically as primary therapy, as well as in cases where other agents have failed. Clinically, corneal epithelial toxicity has been minimal for both chlorhexidine 0.02% and PHMB 0.02%. Biguanides can be used as first-line treatment for Acanthamoeba keratitis either alone or in combination with diamidines, with which there may be a synergistic or additive effect (Bacon et al., 1993; Dart

et al., 2009; Illingworth et al., 1995; Illingworth & Cook, 1998; McCellan et al., 2001; Seal, 2003).

Diamidines. Available diamidines include propamidine isethionate 0.1% (1000 g/ml) and hexamidine 0.1% (1000 g/ml); these are licensed as antibacterials in some European countries. The antimicrobial effects of the diamidines result from the cationic surface-active properties inducing structural membrane changes affecting cell permeability. When these molecules penetrate into the amoebic cytoplasm, denaturation of cytoplasmic proteins and enzymes occurs. Propamidine and hexamidine have been effective clinically against both the trophozoite and cyst forms of *Acanthamoeba*. Clinically, the diamidines are well tolerated by ocular tissues, although prolonged treatment with propamidine may lead to toxic keratopathy (Bacon et al., 1993; Dart et al., 2009; Illingworth et al., 1995; Illingworth & Cook, 1998; McCellan et al., 2001; Seal, 2003).

Although neomycin has been widely used, it is ineffective against cysts in vitro. In addition, like all aminoglycosides it is toxic to the corneal epithelium and can often result in indolent corneal ulceration that may be incorrectly attributed to disease activity, nevertheless it is effective for the bacterial co-infection. Povidon-Iodine (Betadine) is amoebicid and cysticid generally, however it can be used in 0.5% concentrate as well (Bacon et al., 1993; Dart et al., 2009; Illingworth et al., 1995; Illingworth & Cook, 1998; McCellan et al., 2001; Seal, 2003).

Topical corticosteroids. The role of steroids is controversial, but we believe that topical corticosteroids can have an important and beneficial role in the management of some cases of Acanthamoeba keratitis. The dead cysts persist in the corneal stroma and remain antigenic. This can give rise to a serious inflammatory reaction. Steroid treatment is unnecessary in most cases diagnosed early, which usually respond rapidly to antiamoebic drugs. However, persisting inflammation (anterior scleritis, severe pain, indolent ulcers, corneal inflammation, and anterior chamber inflammation) may respond dramatically to the addition of even low-potency topical steroid therapy, e.g. prednisolone 0.5%, or dexamethasone 0.1% 4 times daily. Clinicians should be careful to avoid use of corticosteroids if possible because they suppress the activity of the macrophage, which is the 'scavenger' phagocytic cell responsible for host immunity to Acanthamoeba. Use of nonsteroidal anti-inflammatory drugs, particularly flurbiprofen, is encouraged and also acts as both an analgesic and a mydriatic. When attendant to the inflammation secondary glaucoma appears, anti-glaucomatic drops are used. Pupil dilatators are also used for moving the pupil (Bacon et al., 1993; Dart et al., 2009; Illingworth et al., 1995; Illingworth & Cook, 1998; McCellan et al., 2001; Seal, 2003).

1.6.2 Surgical treatment

With respect to the severity of the disease as well as the complications accompanying it there is a range of surgical methods to choose from.

Corneal abrasion or debridement of the affected area of corneal epithelium may be successful if performed at an early stage. Repeated debridement is used in some centres to improve drug penetration (Dart et al., 2009; Illingworth & Cook, 1998; Reinhard & Sundmacher, 2000).

Cryosurgery may be valuable in treating Acanthamoeba keratitis cases. Cryocoagulation to the ring infiltrate and central cornea breaks the infected cells and cyst walls (Amoils & Heney, 1999; Reinhard & Sundmacher, 2000).

Deep lamellar keratectomy with a conjunctival flap is a suitable approach to help control the infection and to help relieve pain in patients with advanced Acanthamoeba keratitis (Cremon et al., 2002; Parthasarathy & Tan, 2007).

Instead of conjunctiva, *amniotic membrane* is usable. This suggests that amnion cells in amniotic membrane release proteinase inhibitors and that stromal matrix selectively provide adhesion molecules for polymorphonuclear cells (Kim et al., 2000). Amniotic membrane transplantation may be a safe and effective treatment of severe Acanthamoeba keratitis, particularly during the inflammation phase. It may permit penetrating keratoplasty to be delayed (Bourcier et al., 2004).

The role of *keratoplasty* is now largely restricted to the visual rehabilitation of eyes in which a medical cure has been achieved. In advanced cases corneal transplantation may be necessary. Because of use of antiamoebal agents, penetrating keratoplasty is now usually unnecessary in the acute phase unless the cornea has become very thin, with consequent risk of perforation (Bacon et al, 1993; Dart et al., 2009; Illingworth & Cook, 1998; Reinhard & Sundmacher, 2000).

Deep lamellar keratoplasty (DLK) with total removal of infected stromal tissue may be performed in medically unresponsive cases of Acanthamoeba keratitis. Advantages of DLK in infectious keratitis include less risk of intraocular entry of infectious organisms at the time of surgery and the potential for improved graft survival rates caused by less endothelial rejection and failure. In patients with severe disease involving the visual axis, earlier surgery with DLK would allow debulking of the organisms as well as preservation of autogenous endothelial cell function (Parthasarathy & Tan, 2007; Por et al., 2009; Taenaka et al., 2007).

In some cases enucleation or evisceration is needed, because of inflammation, infection or secundary glaucoma (Bacon et al., 1993; Radford et al., 1998; Reinhard & Sundmacher, 2000).

2. Mean headings

2.1 Patients, methods and results

Patients' features and clinical data are summarised in Table 1.

pati-ent	age	sex	time till diagnosis	BCVA	diagnosis	clinical features	medical treatment	keratoplasty	surgical treatment	BCVA at latest follow up
1.	25	female	3 days	0.01	corneal scrape	corneal ulcus	dimopropamide +neomycine +ciprofloxacin +diclofenac +cyclopentholat	after 2 years urgency keratoplasty (7.75/8.0 mm) because descemetocele	aspiration lentis, scleral buckling, vitrectomy	light perceptio n
2.	26	female	2 weeks	0.01	clinical findings	central ring-infiltratio n	dimopropamide +PHMB +neomycine +ciprofloxacin +prednisolon +atropin +cyclopentholat	after 3 month proposed keratoplasty (7.0/7.25 mm)		0.7
3.	41	female	4 weeks	0.03	histology	central corneal ulcus, hypopyon	dimopropamide +PHMB +neomycine +ciprofloxacin +diclofenac	after 4 month proposed keratoplasty (7.0/7.75 mm)		1.0

pati-ent	age	sex	time till diagnosis	BCVA	diagnosis	clinical features	medical treatment	keratoplasty	surgical treatment	BCVA at latest follow up
4.	23	male	4 weeks	0.02	corneal scrape	central corneal abscess	dimopropamide +PHMB +neomycine +ciprofloxacin +diclofenac +timolol	after 1 month urgency keratoplasty (7.0/7.5 mm)		light perception
5.	33	female	4 weeks	0.02	histology	central infiltration	dimopropamide +neomycine +fluorometholon +cyclopentholat	after 6 month urgency keratoplasty (7.5/7.5 mm)	corneal abrasion, phaco-emulsifikation +IOL	0.9
6.	65	female	2 months	0.15	clinical findings	central ring-infiltration	dimopropamide +PHMB +neomycine +ciprofloxacin +diclofenac	after 2 years urgency keratoplasty (7.7/8.25 mm)	ECCE+PCL+ trabeculectomy after 1 year	light perception

Table 1. Clinical data of our patients (BCVA=best corrected visual acuity)

2.1.1 Demographics

Between 2001 and 2006 we treated 11 patients with Acanthamoeba keratitis. The mean age of the patients was 30.2 years (16-65). The eight female and three male patients were all soft contact lens wearers. The right eye was affected in six and the left in five cases. 82% of the infections occurred in the summer period between June and September. The appropriate diagnosis of Acanthamoeba keratitis took 3 days to 2 months. Beside long-lasting conservative treatment perforating keratoplasty was performed in six cases. In the following we discuss these patients in details.

2.1.2 Risk factors

The infection was caused by poor and improper contact lens hygiene in each and every case. All lenses involved were hydrogel soft lenses: 1 daily, 4 monthly and 1 yearly disposable. None of the lenses have been applied for extended or continuous wear. Two patients rinsed the lenses in tap water, 4 patients went to swim in them. The half of the patients got the lenses from opticians, the other half from ophthalmologists.

2.1.3 Clinical findings and diagnosis

Significant visual decrease (0.15-0.01) was seen in almost all cases. Slit lamp examination showed corneal infiltration in 2 cases, ring infiltration (Fig. 1. and 2.) in 3 cases and corneal abscess in 1 case. The diagnosis was based on corneal scraping in 2 cases, on histology in 2 cases, and on clinical findings in 2 cases.

2.1.4 Medical treatment

Treatment started with antiamoebic agents in all patients: dibromopropamide or propamidin and polihexamethilen biguanidine was administerd hourly in the first week, and then 5 times/day for at least 6 months. All patients were administered antibiotic drops 5 times a day for 2 weeks. Two patients had to use antiglaucomatic drops because of secondary glaucoma. We used steroid or non-steroid agents against the inflammation in seven cases.
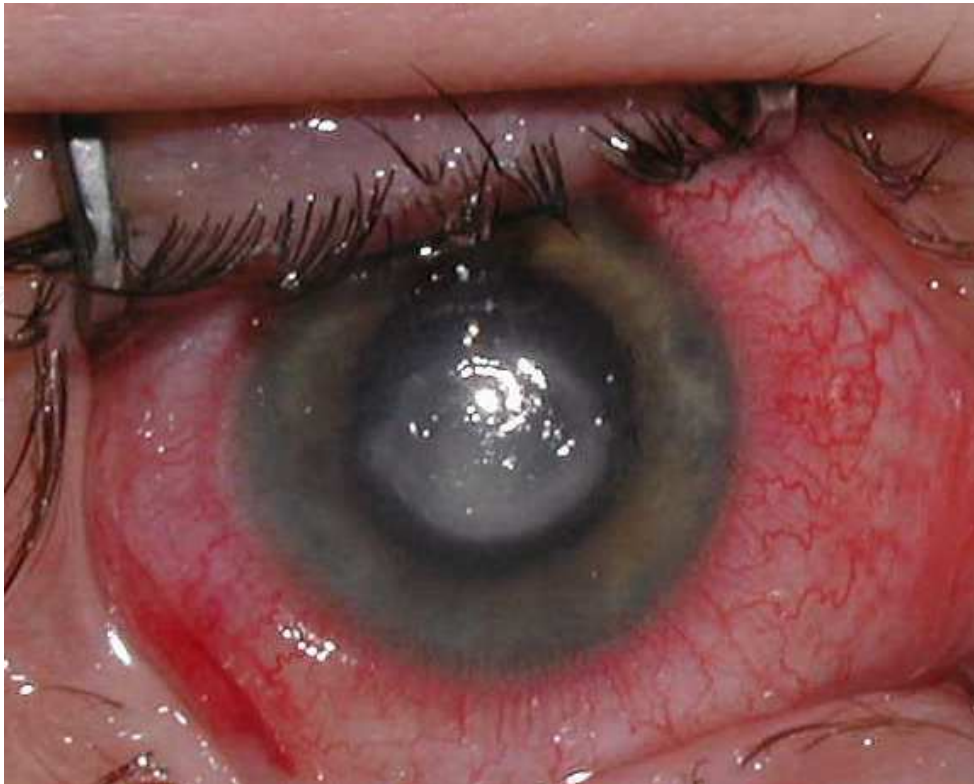
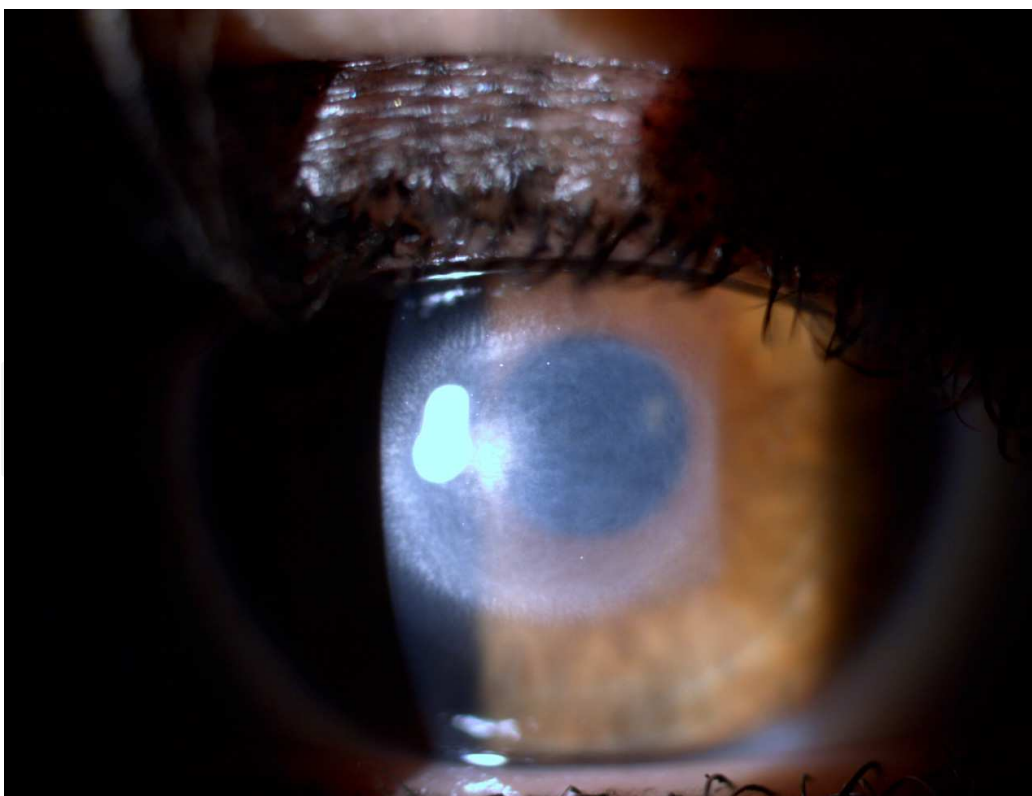Fig. 1. Anterior segment of patient No 5 before keratoplasty with corneal abscess

Fig. 2. Corneal scar of patient No 2 before optical keratoplasty

2.1.5 Indications for surgical intervention

In one case we performed corneal abrasion, but as it proved ineffective we followed it up with perforating keratoplasty.

Perforating keratoplasty was performed in six cases. In four cases keratoplasty was performed as an emergency to save the eyeball (because of descemetocele), in two cases the operations were scheduled for visual rehabilitation. The emergency cases were the "late diagnostic" cases.

Shape and size of keratoplasty and surgical techniques: All keratoplasties were perforating (penetrating), and central. All surgical procedures were done by two experienced surgeons. All cases were performed under retrobulbar anaesthesia. The trephination was performed with modified Geuder trephines for the host cornea from the epithelial side, and the graft from the endothelial side. Donor corneas were from the Eye Bank of our department. Only grafts with an endothelial cell count above 2000 cells/mm² were used. The mean graft diameter was 7.7 mm (range 7.25 to 8.25 mm), with an average over sizing of 0.5 mm. Graft fixation was performed in all cases with running nylon 10/0 sutures. (Fig. 3.,4.)

2.1.6 Postoperative management

Topical antibiotic and steroid drops were used five times a day for 6 weeks, then only steroid drops for 6 months. Anti amoebatic drops 5 times/day for at least six months.

2.1.7 Complications

We have had no intraoperative complications. Postoperative glaucoma appeared in 2 cases, in one case trabeculectomy was performed. In 3 cases cataract operation was necessary after some months. In one case retinal detachment developed and therefore scleral buckling operation was needed.

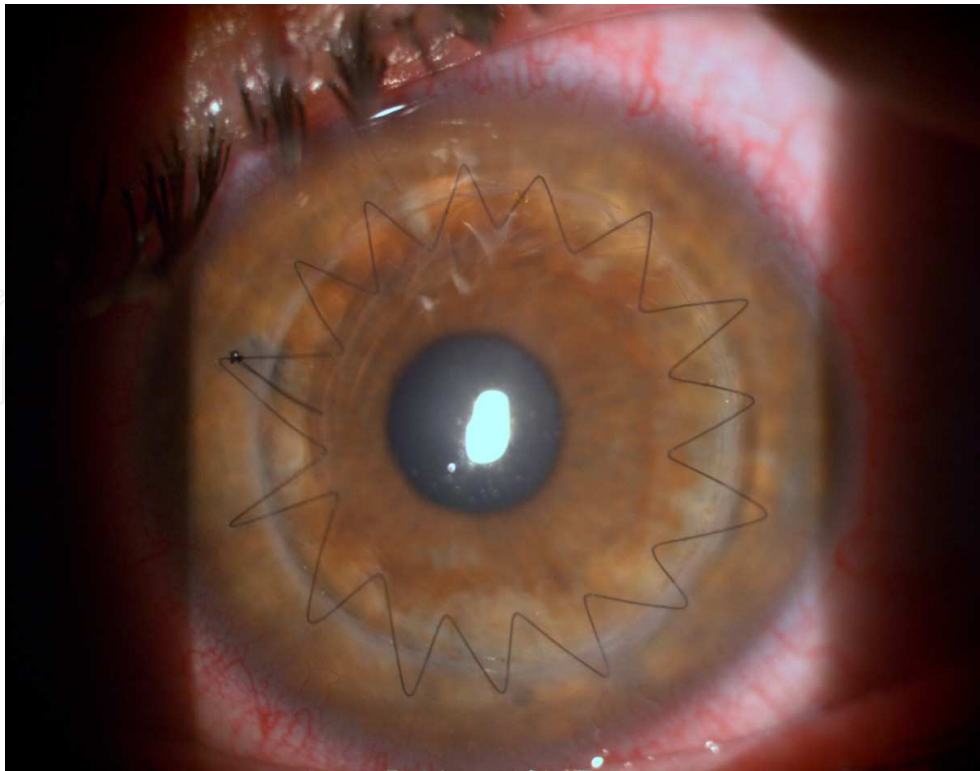Fig. 3. Postoperative status of perforated keratoplasty of patient N⁰ 5.

Fig. 4. Early postoperative status of patient № 2.

2.1.8 Graft clarity and visual acuity
At the last follow up visit the visual acuity was 0.43. In 3 cases it was only light perception, but the other 3 patients had very good visual acuity (0.7-1.0).

In the emergency cases the visual acuity was much worse (light perception in 3 cases and 0.9 in one case), then in the proposed cases (0.7 and 1.0). In 5 cases the cornea graft was clear, rejection and decompensation developed only in one case.

2.2 Corneal graft surgery/keratoplasty
2.2.1 Emergency keratoplasty
Emergency keratoplasty or keratoplasty à chaud is often the only possible intervention to prevent complete and irreversible vision loss in patients with severe corneal disorders. The main indications for this urgent surgical procedure are corneal perforations or imminent perforations, maintaining the integrity of the globe, as well as persisting infectious keratitis. Due to acute inflammation of the anterior ocular segment, emergency keratoplasty is supposed to have a worse outcome and more postoperative complications especially more immune reactions than scheduled keratoplasty. Keratoplasty for management of the acute complications of Acanthamoeba keratitis has with few exceptions in small numbers of patients (Illingworth & Cook, 1998; Nguyen et al., 2010; Maier et al., 2007; Shi et al., 2009), generally been reported to have poor results. Graft failure due to recurrent infection is common when keratoplasty is performed in an inflamed eye. In most cases, however, keratoplasty has been successful in maintaining the integrity of the globe, and a second procedure has often resulted in a good visual outcome (Illingworth & Cook, 1998; Maier et al., 2007).

Since the introduction of the biguanides as medical therapy, PK has not been recommended as a treatment for the elimination of organisms; emergency keratoplasty should therefore be reserved as a treatment for corneal perforation, imminent perforation and fulminant corneal abscess. Many of these eyes will be severely inflamed with uncontrolled scleritis and limbitis, which should be treated before surgery with systemic immunsuppression using prednisolone (0.5 to 1 mg/kg/day) and/or cyclosporine (3 to 7.5 mg/kg/day), which is tapered as inflammation is controlled in the post graft period (Dart et al. 2009; Maier et al., 2007). Performing PK before scleral or peripheral corneal extension can minimize the risk of recurrence and poor outcome (Nguyen et al., 2010; Tanhehco & Colby, 2010).

2.2.2 Therapeutic/optical keratoplasty
Several authors (Awwad et al., 2005; Por et al., 2009) recommend observing for at least 3 months of clinical inactivity after completion of antiamoebic therapy before attempting PK. Most recently, Kitzmann et al. (Kitzmann et al., 2009) compared outcomes of 22 eyes with Acanthamoeba keratitis undergoing emergency penetrating or anterior lamellar keratoplasty and 9 eyes undergoing optical penetrating or anterior lamellar keratoplasty. Although all eyes ultimately achieved microbiological cure, there was a 41% recurrence rate of Acanthamoeba keratitis after emergency keratoplasty compared with 22% recurrence rate after optical keratoplasty. The Kaplan–Meier graft survival was 37.5% (95% confidence interval, 16.8–58.4) at 5 years in the therapeutic group compared with 100% in the optical group. Shi et al. (Shi et al., 2009) reported 28% recurrence after emergency PK. For acanthamoeba keratitis, Ficker et al. (Ficker et al., 1993) found that clear graft survival was only 20% if penetrating keratoplasty was performed during the acute, inflamed state of the disease compared to 100% clear graft survival when penetrating keratoplasty was performed in a quiet state of the disease. The reason for the difference compared to other results might possibly be differences in case selection at the time of diagnosis, preoperative treatment and the time point of the decision for emergency keratoplasty seem to be most important for the outcome of the graft (Maier et al., 2007). Dart et al. (Dart et al., 2009) present cases, when therapeutic keratoplasty is rarely used but lamellar or PK to improve vision is carried out in patients with scarred corneas and/or irregular astigmatism. The outcome of corneal transplantation is good in this group of patients. Exacerbations of scleritis and limbitis may occur following graft surgery in these eyes and may need to be treated with systemic anti-inflammatory treatment (Dart et al., 2009). Quian et al. (Qian et al., 2010) performed 8 optical perforating keratoplasty after at least 4 months medical treatment, with great success. Awwad et al. (Awwad et al., 2005) published an article about 13 eyes which underwent optical PK for visual rehabilitation after acanthamoeba keratitis. They mean that PK for visual restoration after resolution of *Acanthamoeba* keratitis in quiet eyes that are judged cyst-free by preoperative confocal microscopy appears to have an excellent long-term prognosis. Waiting at least 3 months after the discontinuation of medical therapy also appears helpful to rule out latent infection because of cyst reactivation and to allow the active inflammation to cease.
The success of keratoplasty in the literature are summarised in Table 2.

2.2.3 Donor size
The extent of the infected corneal tissue cannot be identified and should be assumed to include the entire cornea so that, unlike grafts for other corneal infections, which should be large enough to remove all contaminated tissue, the graft for Acanthamoeba keratitis should

author	year	total	acute	success %	optical	success %
Kitzmann	2009	30	22	45.5	8	100
Nguyen	2010	9	9	100		
Ficker	1993	13	7	20	6	100
Maier	2007	13	13	73		
Kashiwabuchi	2008	32	32	43.8		
Awwad	2005	13			13	100
Tanhehco	2010	8	8	50		
Qian	2010	8			8	100
Por	2009	15	12		3	
Illengworth	1995	9	9	100		
Bacon	1993	34	21	35	13	69
Radford	1998	31				
Sharma	2000	3	3	0		

Table 2. Success rate of keratoplasty

be kept to the minimum size required to excise all ulcerated and necrotic tissue, retaining clinically healthy (but usually subclinically infected) tissue. This is because of the risk of rejection with large grafts and because repeating grafting may be needed as a result of recurrence; a further graft represents a new food source for the organism and can be used to attract residual amoebae. Recurrence of disease in a graft was frequent in the first 2 weeks after surgery when keratoplasty was performed in an inflamed eye before the introduction of biguanides; it typically involved the donor periphery, usually without clinical involvement of the host. Late recurrences, several months after surgery, may also occur. The use of large grafts worsens the prognosis because it increases the chances of an immune response to the graft. Furthermore, the use of a large graft indicates a more severe preoperative infection (Ficker et al., 1993).

Host trephination size ranged from 7 to 11 mm depending on the extent of the corneal infiltration. The trephination should be performed beyond the clinical areas of infiltrate, including satellite lesions. Confocal microscopy can be used to outline the extent of involvement or the size of the trephination (Kashiwabuchiet al., 2008; Nguyen et al., 2010).

Meier et al. reported about a trend toward improved clear graft survival and fewer immune reactions following emergency keratoplasty using smaller grafts (≤8.00 mm) (Awwad et al., 2005; Maier et al., 2007).

Ideally, a corneal scar should be debulked as much as possible because residual cysts might still be present and might lead potentially to a recurrence of the disease when exposed to topical corticosteroids after PK. In those cases, rather than jeopardizing graft survival by trephining a large donor button (sizes of 9 mm and beyond), we suggest waiting for a longer period of time after the discontinuation of medical treatment, with repetitive confocal examination when available, before committing the patient to surgery (Awwad et al, 2005).

3. Prevention

Acanthamoeba keratitis is a potentially blinding condition of the eye, and any steps toward prevention of this disease are encouraged. It is recommended contact lens wearers to use daily disposable contact lenses to eliminate the contact lens case as a reservoir for Acanthamoeba. If daily disposable contact lens can not be used, then hydrogen peroxide cleaning solutions are preferred over the more common multipurpose solutions because of the increased efficacy of hydrogen peroxide against Acanthamoeba cysts. Planned replacement of contact lens storage cases may also help reduce contamination. It is important for eye care professionals not only to emphasize proper contact lens wear and hygiene in the prevention of infectious keratitis but also to maintain a high clinical suspicion for Acanthamoeba keratitis because an early diagnosis may lead to a better visual outcome (Tanhehco & Colby, 2010). The use of surfactant cleaner has been shown to be an effective way of removing Acanthamoeba trophozoites and cysts (Kilvington, 1993). In the light of these findings further research into the types of disinfectant used by patients with Acanthamoeba keratitis is required, with a view to calculating the relative risks of different lens type and disinfectant combinations. This series also show the importance of the fact that contact lens practitioners should ensure at the time of prescribing lenses that patients have understood all the disinfectant procedures (Illingworth et al., 1995). Gray et al. suggest leaving contact lens case open to dry air after heat disinfection. If hydrogen peroxide disinfection is the preferred solution, one has to use a two step hydrogen peroxide system. It is necessary to call one's attention to wash hands properly before handling contact lens cases and what is more important is to avoid homemade saline. The contact lens case should be replaced regularly. Nowadays the use of more frequently disposable contact lenses is highly recommended (Gray et al., 1995). Also the rub and rinse step should be mentioned as the critical part of the disinfection that may reduce significantly the microbiological load (Shih et al., 1985). Detailed education of contact lens wearers concerning of the entire disinfection procedure could reduce the incidence of Acanthamoeba keratitis further on. There is a persistent need to educate contact lens wearers continuously about the possible risk factors of Acanthamoeba keratitis, and since the frequency of Acanthamoeba keratitis appears to be largely determined by the ever changing trends in contact lens use, continued monitoring is indicated (Radford et al., 1998). All of the eye care practitioners have to call attention of all contact lens users to aware the wearing of soft contact lenses in case of swimming so as to reduce the number of patients with Acanthamoeba keratitis (Kaji et al., 2005; Kettesy et al., 2010). If even a soft contact lens wearer wants to swim, then daily disposable contact lens and swimming spectacles should be used.

4. Conclusion

Acanthamoebic keratitis, first reported by Nagington et al. in Great Britain and by Jones et al. in the United States, is a painful progressive sight-threatening corneal disease. The infection is a rather frequently occurring disease all over the world which can still cause serious or even total loss of vision despite improved diagnostic and therapeutic options. *Acanthamoeba* spp. are among the most prevalent protozoa found in the environment. They are distributed worldwide and have been isolated from soil, dust, air, natural and treated water, seawater, swimming pools, sewage, sediments, air-conditioning units, drinking water

treatment plants, bottled water, dental treatment units, hospitals and dialysis units, eyewash stations, and contact lenses and lens cases and as contaminants in bacterial, yeast, and mammalian cells. It mainly affects contact lens wearers with poor hygiene. In non contact lens wearers history of trauma in a garden is a risk factor. Patients' ages range from 4 to 64 years, with a mean age of 30 years, with no difference in genders. Infection usually affects only one eye, although it is occasionally bilateral. Most patients complain of symptoms of photophobia, pain, and tearing. The earliest signs may be non-specific and may take the form of epithelial micro erosions, irregularities, opacities or microcystic oedema, often with patchy anterior stromal infiltrates. There may be no fluorescein staining at the onset. Commonly, there is a dendriform keratitis that is often initially treated as herpes simplex infection. A ring infiltrate, usually with an overlying epithelial defect, is commonly seen. The ring may be incomplete, or occasionally it is double and concentric. The importance of early diagnosis cannot be overemphasized. We have to consider Acanthamoeba keratitis when symptoms associated with trauma especially involving vegetable matter or exposure to contaminated water, such as lake-, sea-, or spring water are mentioned. Acanthamoebic keratitis has to be differentiated from bacterial or fungal or herpes simplex virus keratitis. Diagnosis may be achieved by using different methods, including non invasive confocal microscopy, staining corneal scrapings with acridine orange, corneal scrapes or corneal biopsy specimens onto no nutrient agar containing *E. coli.*, cytological various staining methods, like indirect immunofluorescent-antibody assay, polymerase chain reaction (PCR)-based method. The goals of medical therapy in Acanthamoeba keratitis include the eradication of viable cysts and trophozoites and rapid resolution of the associated inflammatory response. There is no single drug capable of eliminating the infection therefore drug combinations have been suggested as a treatment regimen. There are currently no drugs that are effective as monotherapy in Acanthamoeba keratitis, hence combinations are suggested. Acanthamoeba trophozoites are sensitive to most available chemotherapeutic agents (antibiotics, antiseptics, antifungals, antiprotozoals including metronidazole, antiviral, and antineoplastic agents). The diamidines and biguanides are currently the most effective cysticidal antiamoebics. With respect to the severity of the disease as well as the complications accompanying it there is a range of surgical methods to choose from. Corneal abrasion, cryosurgery, deep lamellar keratectomy with a conjunctival flap, amnion membrane transplantation, keratoplasty, deep lamellar keratoplasty. In some cases enucleation or evisceration is needed, because of severe inflammation, infection or secondary glaucoma. Antiamoebic therapy should be used before surgery and be continued postoperatively using drugs and doses that will minimize or avoid signs of toxicity. PHMB 0.02% has low clinical toxicity in most patients and is clinically less than that with either of the diamidines. We use PHMB 0.02% 6 to 8 times daily immediately after surgery, with an adequate level of topical steroid to control inflammation. This should be continued for at least 3 weeks while results of culture of the host keratectomy specimen are awaited. If viable organisms are cultured it is prudent to continue antiamoebic therapy 4 times daily while high-doses of steroids are needed usually for 6 months after surgery, as recurrent Acanthamoeba keratitis has occurred up to 3 months after an initially successful transplant. If culture of the excised host cornea is negative after 3 weeks we assume that most viable amoebae have been treated, and the topical antiamoebic therapy is reduced to 4 times daily and stopped after 1 month.

Between 2001 and 2006 we treated 11 patients with Acanthamoeba keratitis. The patients were all soft contact lens wearers. The right eye was affected in six and the left in five cases. 82% of the infections occurred in the summer period between June and September. Beside long-lasting conservative treatment perforating keratoplasty was performed nearly in half of the cases.

In every case the infection was caused by poor and improper contact lens hygiene. All lenses involved were hydrogel soft lenses: 1 daily, 4 monthly and 1 yearly disposable. None of the lenses were extended or continuous wear. The half of the patients got the lenses from opticians, the other half from ophthalmologists.

Significant visual decrease was seen in almost all cases. Slit lamp examination showed corneal infiltration in 2 cases, ring infiltration (Fig. 1. and 2.) in 3 cases and corneal abscess in 1 case. The diagnosis of Acanthamoeba keratitis was based on corneal scraping in 2 cases, histology in 2 cases, and clinical findings in 2 cases.

Treatment started with antiamoebic agents in all patients: dibromopropamide or propamidin and polihexamethilen biguanidine was administered hourly in the first week, and then 5 times/day for at least 6 months. All patients were administered antibiotic drops 5 times a day for 2 weeks. We used steroid or non-steroid agents against the inflammation in seven cases.

In one case we performed corneal abrasion, but as it proved ineffective we followed it up with perforating keratoplasty.

Altogether penetrating keratoplasty was performed in six cases. In four cases keratoplasty was performed as an emergency (because of descemetocele) to save the eyeball, in two cases the operations were scheduled for visual rehabilitation.

All keratoplasties were perforating (penetrating), and central. All surgical procedures were done by two experienced surgeons. All cases were performed under retrobulbar anaesthesia. The trephination was performed with modified Geuder trephines. Donor corneas were obtained from the Eye Bank of our department. Only grafts with an endothelial cell count above 2000 cells/mm² were used. Graft fixation was performed in all cases with running nylon 10/0 sutures. We have had no intraoperative complications.

At the last follow up visit the average visual acuity was 0.43. In 3 cases it was only light perception, but the other 3 patients had very good corrected visual acuity (0.7-1.0).

In the emergency cases the visual acuity was much worse (light perception in 3 cases and 0.9 in one case, respectively), then in the proposed cases (0.7 and 1.0). In 5 cases the cornea graft was clear, rejection and decompensation developed only in one case.

Emergency keratoplasty is often the only possible intervention to prevent complete and irreversible vision loss in some cases. The main indications for this urgent surgical procedure are corneal perforations or imminent perforations, maintaining the integrity of the eyeball. Performing penetrating keratoplasty before scleral or peripheral corneal extension can minimize the risk of recurrence and poor outcome. Clear graft survival is lower if penetrating keratoplasty was performed during the acute, inflamed period of the disease compared to much higher clear graft survival when penetrating keratoplasty was performed in a quiet state of the disease. Perforating keratoplasty for visual restoration after resolution of *Acanthamoeba* keratitis in quiet eyes that are judged cyst-free by preoperative confocal microscopy appears to have an excellent long-term prognosis. Waiting at least 3 months after the discontinuation of medical therapy also appears helpful to rule out latent infection because of cyst reactivation and to allow the active inflammation to cease.

Acanthamoeba keratitis is a potentially blinding condition of the eye, and any steps toward prevention of this disease are encouraged. For prevention contact lens wearers are recommended to use daily disposable contact lenses to eliminate the contact lens case as a reservoir for Acanthamoeba. Hydrogen peroxide cleaning solutions are preferred over the more common multipurpose solutions. Planned replacement of contact lens storage cases may also help to reduce contamination. The rub and rinse step should be mentioned as the critical part of the disinfection. Detailed education of contact lens wearers concerning the entire disinfection procedure could minimize the incidence of Acanthamoeba keratitis further on. All of the eye care practitioners have to call attention of all contact lens users to aware the wearing of soft contact lenses in case of swimming so as to diminish the number of patients with Acanthamoeba keratitis. If even a soft contact lens wearer wants to swim, then daily disposable contact lens and swimming spectacles should be applied.

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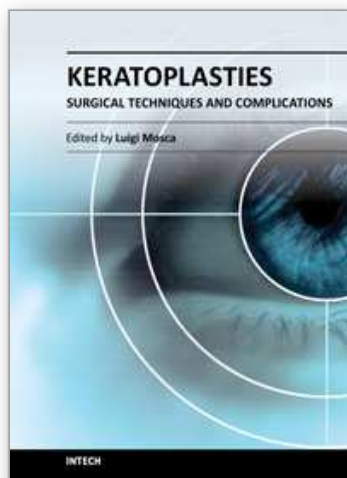
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