Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/19814
DOI URL: http://dx.doi.org/10.21474/IJAR01/19814

RESEARCH ARTICLE

CLINICAL PROFILE OF MICROSPORIDIAL KERATITIS AT A TERTIARY EYE CARE CENTER IN BUNDELKHAND REGION

Dr. Jitendra Kumar[1] and Dr. Devanshi Yadav[2]

1. M.S. Ophthalmology, Professor and Head of the Department, Department of Ophthalmology, M.L.B. Medical College, Jhansi (U.P.).
2. Junior Resident, Department of Ophthalmology, M.L.B. Medical College, Jhansi (U.P.).

Manuscript Info

Manuscript History
Received: 05 September 2024
Final Accepted: 09 October 2024
Published: November 2024

Key words:-
Keratoconjunctivitis, Microsporidiosis, Stromal Keratitis

Abstract

Background: Although rare, microsporidia are sometimes misdiagnosed as the cause of corneal infections. The ubiquitous, obligatory, intracellular parasite is the causal agent. In Asia, the prevalence of microsporidiosis is rising in tandem with the monsoon season. Immunosuppression (HIV infection, topical corticosteroids), contact lens usage, and injuries from water or dirt exposure are risk factors.

Purpose: To study clinical profile of patient with microsporidial keratitis in department of ophthalmology at M.L.B. Medical College Jhansi between April to October 2024. To summarizes the current literature on the etiology and clinical presentation of microsporidial infections of the cornea and highlights ongoing developments in available diagnostic modalities and treatment regimens.

Materials and Methods: Prospective study of 20 patients of microsporidial keratitis present in Department of Ophthalmology at M.L B Medical College Jhansi.

Results: A total of 20 patients were examined out of which 19 patients (95%) presented with pain and redness, 18 patients (90%) present with foreign body sensation and blurring of vision, 15 patients (75%) present with photophobia, 14 patients (70%) present with lid swelling. 18 patients (90%) have conjunctival hyperemia, 16 patients (50%) have diffuse punctate epitheliopathy and 1 have deep stromal infiltrateson examination.

Conclusion: Most commonly patients presents with redness and eye pain, followed by foreign body sensation, blurring of vision, photophobia and least commonly with lid swelling.

Introduction:-

The phylum Microspora & subkingdom Protista contain the unicellular, obligatory intracellular eukaryotic parasites known as microsporidia[1,2]. There have been descriptions of more than 1300 microsporidia species from about 200 genera[3,4]. Unclassified microsporidia, collectively known as Microsporidium, along with seven genera—Enterocytozoon species, Brachiola species, Encephalitozoon species, Pleistophora species, Nosema species, Vittaforma species, and Trachipleistophora species—have been linked to human illness. Microsporidia are

Corresponding Author:- Dr. Devanshi Yadav
Address:- Junior Resident, Department of Ophthalmology, M.L.B. Medical College, Jhansi (U.P.).

opportunistic pathogens that have been linked to infections of the central nervous system, muscles, kidneys, sinuses, lungs, and intestines[5]. Besides infections of the digestive tract, ocular disease is the second most common clinical manifestation of microsporidia[6].About 0.4% of instances of microbial keratitis in some populations are caused by microsporidia[7].

In 1973, Ashton and Wirasinha reported the first instance of ocular microsporidiosis in an 11-year-old Sri Lankan child[8]. It may manifest as an isolated infections and as a component of systemic diseases[9]. Although there are a few case reports of microsporidia-induced scleritis[10] and endophthalmitis[11, 12], ocular microsporidiosis often manifests as one of two types: Stromal keratitis or superficial keratoconjunctivitis.

The process by which microsporidial corneal infections arise remains unknown. Nonetheless, considering that microsporidia are aquatic pathogens, direct inoculation through exposure to polluted water in hot springs, rivers, and swimming pools has been implicated[13-15]. According to a retrospective case series, 50% of patient's eye has history of exposure to water contaminated with mud who have been found positive for microsporidial keratitis[16]. Although the extent of the corneal epithelium's damage was not specified, but 47% of respondents in another case series confirmed having a history of ocular trauma [17] . Wearing contact lenses is a significant risk factor since they may serve as a conduit for the organism to enter the cornea, particularly when there is inadequate lens cleanliness[18]. Rarely, microsporidial corneal infections have developed after ocular procedures such as collagen cross-linking (CXL), penetrating keratoplasty (PK), autodescemet stripping automated endothelial keratoplasty (DSAEK), and laser in situ keratomileusis (LASIK) [19-22]. Insect bites, topical corticosteroid use, and contact with household animals are additional risk factors [6, 23, 24].

Countries in South and Southeast Asia have seen the majority of cases of microsporidial corneal infections; a higher incidence has been observed during the July–October monsoon season, which is thought to be connected to either an increase in insect populations or water contaminated with microsporidia[16, 25, 26] .

In immunocompetent people, MKC (Microsporidial Keratoconjunctivitis) typically develops as a self-limiting illness as a result of encephalitozoon species[27]. Within a week following the commencement of symptoms, patients typically exhibit photophobia, redness, tears, sense of a foreign body, blurred vision, and eye pain[6, 26, 28].

The course of MSK (Microsporidial Stromal Keratitis) is slowly progressive; symptoms might appear anywhere from one month to two years before the initial presentation[29]. Usually, MSK develops as a result of Microsporidium or Vittaforma corneae (formerly Nosema corneum) [27, 30]. The symptoms of MSK include photophobia, conjunctival redness, unilateral eye discomfort, decreased visual acuity, and a sense of a foreign body[17].

Purpose:
This research article presents a clinical profile of microsporidial keratitis through a prospective study of 20 patients in department of ophthalmology at M.L.B. Medical College Jhansi between April to October 2024. It also tries to summarize the existing work on the etiology, clinical profile, management of corneal microsporidial infections.

Materials and Method:-

A hospital based prospective study of 20 patients complaining of eye pain, redness, watering, foreign body sensation, blurred vision, photophobia . Patients was recruited from the OPD of MLB medical college, Jhansi, Uttar Pradesh and followed from 24 April 2024 to 24 October 2024. It was performed under the Helsinki Declaration of 1975, as revised in 2000.The necessary permission from the Ethical and Research Committe was obtained for the study.

Inclusion Criteria:
All patients who presented to the OPD of MLB Medical College Jhansi with the complaint of pain, redness, foreign body sensation, photophobia, blurring of vision.

Exclusion Criteria:
1. Patients with ocular diseases that could affect conjunctiva and cornea.
2. Patients with other ocular disorders.
3. Patients with recent intraocular surgery.
4. Patients with the history of trauma.

All patients were subjected to a detailed history taking and complete ophthalmic examination including biomicroscopic slit lamp examination.

Results:-

A total of 20 patients were studied. We included eyes with complaint of pain, redness, foreign body sensation, photophobia, blurring of vision.

Among the patients 65% (n=13) were male and 35% (n=7) were female [table 1

Table 1:- Gender Distribution.

Gender	No. of patients(percentage)
Male	13(65%)
Female	7(35%)

The affected patients mostly belong to the age group of 20-30 years i.e. 55% (n=11) followed by age group of 40-50 years i.e. 30% (n=6) [table2]

Table 2:- Age Distribution.

Age	No. of patients(percentage)
20-30	11(55%)
30-40	3(15%)
40-50	6(30%)

Most common presenting symptoms were pain and redness i.e. 95% (n=19) followed by foreign body sensation i.e. 90% (n=18)

Table 3:- Presenting Symptoms.

Clinical symptoms	No. of patients(percentage)
Redness	19(95%)
Eyepain	19(95%)
Blurring of vision	18(90%)
Foreign body sensation	18(90%)
Photophobia	15(75%)
Lid swelling	14(70%)

Microsporidia is coomon almost equally in both immunocompotent and immunocompromised now-a-days

Table 4:- Immunocompromised status.

Immunity status	**No. of patients(percentage)**
Immunocompotent	12(60%)
Immunocompromised	8(40%)

Most common slit lamp examination finding were conjunctival hyperemia i.e. 90%(n=18)

Table 5:- Slit lamp examination findings.

Examination findings	No. of patients(percentage)
Conjunctival hyperemia	18(90%)
Diffuse punctate epitheliopathy	16(80%)
Deep stromal infiltrates	1(0.05%)

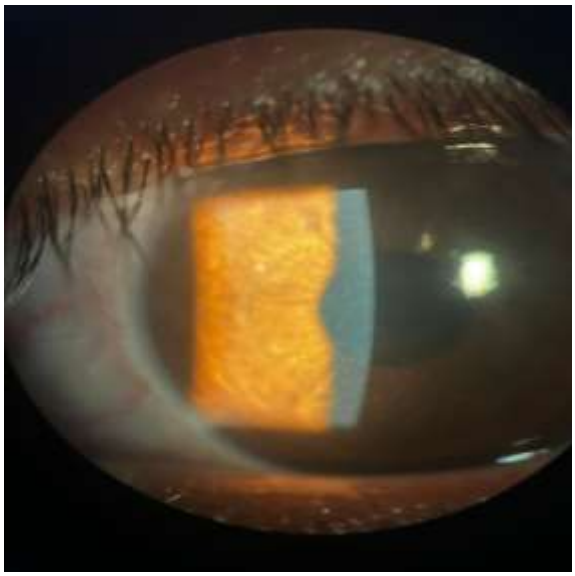

Figure 1:- Clinical appearance of left eye of patient on slit lamp examination showing conjunctival hyperemia and superficial punctuate keratitis.

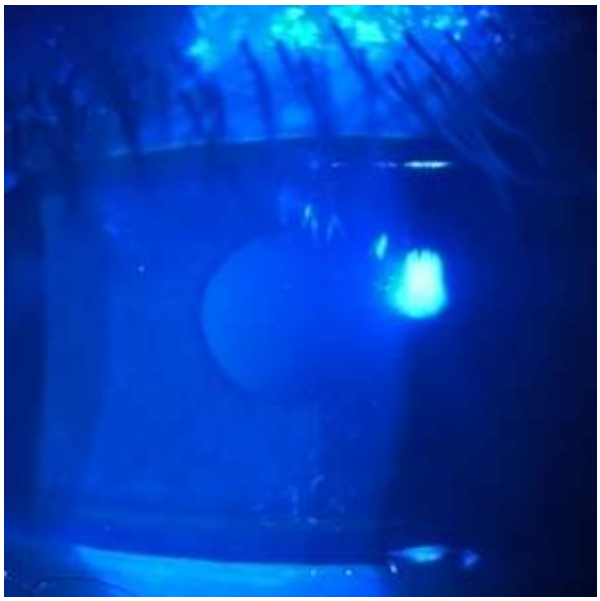

Figure 2:- Clinical appearance of left eye of patient after staining with fluorescent stain seen under cobalt blue filter light showing stain positive superficial punctuate keratitis.

Discussion:-

Two possible ways in which ocular microsporidiosis can manifest it are: isolated ocular microsporidiosis or as a component of a systemic illness. Ocular microsporidiosis has 2 main types: stromal keratitis, which usually affects immunocompetent people, and keratoconjunctivitis, which usually affects immunocompromised people[31, 32].

Mostly affecting immunocompetent patients, deep stromal keratitis start off subtly and resemble progressive herpes disciform keratitis with recurrent stromal infiltration and uveitis. Additionally, they have been reported to show as vascularized corneal scar and perforated corneal ulcer with hyphaema, which are clinical signs that resemble keratitis caused by the herpes simplex virus (HSV). Corneal biopsies can be used to make the diagnosis, however penetrating keratoplasty could be required for visual rehabilitation.

All three Encephalitozoon species (E. hellem, E. cuniculi, and E. intestinalis) have the potential to induce keratoconjunctivitis in HIV-infected patients. In addition to bilateral conjunctival inflammation, the majority of patients have bilateral punctate epithelial keratopathy, which impairs visual acuity. Keratoconjunctivitis is usually mild or asymptomatic, but it can occasionally be severe and infrequently results in corneal ulcers. Only individual case reports were provided for the other species (V. corneae, N. ocularum, T. hominis, M. ceylonensis, and M. africanum[33].

Table 1:- Characteristics of microsporidial keratoconjunctivitis and stromal keratitis[34].

Features	**Microsporidial keratoconjunctivitis(MSK)**	**Microsporidial stromal keratitis(MSK)**
Risk factors	Exposure to contaminated water or soil, ocular trauma, contact lens wear, ocular surgeries, topical steroid use, insect bites, contact with domestic animals	
Time of presentation	Acute	Delayed
Clinical presentation	Photophobia, redness, tearing, foreign body sensation, impaired visual acuity, eye pain	
Slit lamp finding	Grayish-white, coarse, multifocal, raised epithelial lesions and non-purulent conjunctivitis→ central epithelial lesions→ superficial punctate keratopathy→ subepithelial infiltrates or haze	Diffuse multifocal stromal infiltrates, non-purulent conjunctivitis, stromal edema, endothelial exudates; rarely, epithelial defects
Differential diagnosis	Thygeson's superficial punctate keratitis, Acanthamoeba keratitis, mycobacterial keratitis, adenoviral keratoconjunctivitis	Fungal, bacterial, or HSV stromal keratitis
Diagnostic technique	Transmission electron microscopy (TEM), light microscopy (LM) ± tissue staining, histopathology, polymerase chain reaction (PCR), in vivo confocal microscopy (IVCM), anterior segment optical coherence tomography (AS-OCT)	
Treatment option	Self-limiting; most often treated with monoor combination therapy consisting of topical fumagillin, oral albendazole, topical antibiotics, topical antifungals, and/or topical antiseptics	Usually requires corneal graft transplantation, though some reports exist of resolution with medical therapy alone
Prognosis	Excellent	Guarded

Routine microbiological diagnosis may be challenging since the organism can be isolated utilizing specialist tissue culture procedures that are only available in a small number of specialized laboratorie[35,36]. It has been shown that biopsy specimens and alcohol-fixed cytologic samples of conjunctival scrapings, corneal epithelium, or both are highly effective in identifying microsporidial blastospores[37,38]. Spores may be distinguished from bacteria and yeasts with help of light microscopy, which reveals that they are uniformly oval in shape and do not show budding[39][ix] Gram stain gives the spores a strong stain[40,41]. Other stains that can be used are giemsa stain & 1% acid fast stain. Electron microscopy, immunoflourescent staining technique and molecular techniques are recent diagnostic modalities. Two new diagnostic techniques that eliminate the necessity for corneal scrapings are anterior segment optical coherence tomography (AS-OCT) and in vivo confocal microscopy (IVCM) [34].

As of right now, there are no established protocols for treating ocular microsporidial infections. Albendazole, thiabenda zole, itraconazole, propamidine isethionate, fumagilin, chlorhexidine, metronidazole, polyhexa methylene biguanide, and benzimidazoles are among the anecdotal reports of particular pharmacological treatment for microsporidiosis; nevertheless, their efficacy is still up for deba[42, 43, 44, 45, 46, 47, 48, 49] . Although fluoroquinolones are recommended by some, a recent randomized clinical trial concluded that microsporidial keratoconjunctivitis is self-limited and does not require antimicrobial therapy[50]. Microsporidial keratoconjunctivitis often does not require surgery; nevertheless, there have been reports of the positive effects of epithelial debridement[48]. Debridement helps

to reduce the organisms load in the corneal epithelial layer.Another surgical option that might work well is penetrating keratoplasty because the infection seems to be limited to the stroma and shouldn't reoccur[51]. After surgery, topical fumagillin, which has been demonstrated to be beneficial in treating epithelial illness, can be administered without experiencing any serious negative side effects[52].

Conclusion:-

Microsporidia are an important cause of disease in both immunocompromised (40%) and immunocompetent (60%) patients among age group of 20-30 years (55%) most commonly. Due to its rarity, it is frequently disregarded as a diagnosis in first place. Therefore, for this condition to be diagnosed and treated quickly, a high suspicion index is required. Patients most often present with redness and eye pain.

Foreign body sensation, blurred vision, photophobia, and lid swelling are the less common.

Therefore, we recommend that ophthalmologists should consider microsporidia in the differential diagnosis of infectious keratitis more frequently.

Refrences:-

1. Keeling P. Five questions about microsporidia. PLoS Pathog. 2009. https://doi.org/10.1371/journal.ppat. 1000489.
2. Franzen C, Mu¨ller A. Molecular techniques for detection, species differentiation, and phylogenetic analysis of microsporidia. Clin Microbiol Rev. 1999. https://doi.org/10.1128/cmr.12.2.243
3. Didier ES, Stovall ME, Green LC, Brindley PJ, Sestak K, Didier PJ. Epidemiology of microsporidiosis: sources and modes of transmission. Vet Parasitol. 2004. https://doi.org/10.1016/j.vetpar.2004.09.006.
4. Va´vra J, Lukesˇ J. Microsporidia and 'The Art of Living Together'. Adv Parasitol. 2013;82:253–319. https://doi.org/10.1016/B978-0-12-407706-5. 00004-6.
5. Weber R, Bryan RT, Schwartz DA, Owen RL. Human microsporidial infections. Clin Microbiol Rev. 1994. https://doi.org/10.1128/CMR.7.4.426.
6. Sharma S, Das S, Joseph J, Vemuganti GK, Murthy S. Microsporidial keratitis: need for increased awareness. Surv Ophthalmol. 2011;56(1):1–22. https:// doi.org/10.1016/j.survophthal.2010.03.006.
7. Joseph J, Sridhar MS, Murthy S, Sharma S. Clinical and Microbiological profile of Microsporidial keratoconjunctivitis in Southern India. Ophthalmology. 2006;113(4):531–7. https://doi.org/10.1016/j. ophtha.2005.10.062.
8. Ashton N, Wirasinha PA. Encephalitozoonosis (nosematosis) of the cornea. Br J Ophthalmol. 1973. https://doi.org/10.1136/bjo.57.9.669.
9. Gunnarsson G, Hurlbut D, Degirolami PC, Federman M, Wanke C. Multiorgan microsporidiosis: report of five cases and review. Clin Infect Dis. 1995. https://doi.org/10.1093/clinids/21.1.37.
10. Mietz H, Franzen C, Hoppe T, Bartz-Schmidt KU. Microsporidia-induced sclerouveitis with retinal detachment. Arch Ophthalmol. 2002;120:864–5.
11. Yoken J, Forbes B, Maguire AM, Prenner JL, Carpentieri D. Microsporidial endophthalmitis in a patient with acute myelogenous leukemia. Retina. 2002. https://doi.org/10.1097/00006982- 200202000-00028.
12. Sood AB, Debiec MR, Yeh S, Grossniklaus HE, Randleman JB. Microsporidial stromal keratitis and endophthalmitis in an immunocompetent patient. J Ophthalmic Inflamm Infect. 2016;6(1):10–3. https://doi.org/10.1186/s12348-016-0099-7.
13. Fan NW, Wu CC, Chen TL, et al. Microsporidial keratitis in patients with hot springs exposure. J Clin Microbiol. 2012;50(2):414–8. https://doi.org/ 10.1128/JCM.05007-11.
14. Wang WY, Chu HS, Lin PC, et al. Outbreak of Microsporidial keratoconjunctivitis associated with water contamination in swimming pools in Taiwan. Am J Ophthalmol. 2018;194:101–9. https:// doi.org/10.1016/j.ajo.2018.07.019.
15. Dhakal R, Ramappa M, Sharma S. Punctate epithelial keratoconjunctivitis: a microsporidial infestation. Indian J Ophthalmol. 2018. https://doi.org/ 10.4103/ijo.IJO_917_17.
16. Loh RS, Chan CML, Ti SE, Lim L, Chan KS, Tan DTH. Emerging prevalence of Microsporidial keratitis in Singapore. Epidemiology, clinical features, and management. Ophthalmology. 2009. https:// doi.org/10.1016/j.ophtha.2009.05.004.

17. Sabhapandit S, Murthy SI, Garg P, Korwar V, Vemuganti GK, Sharma S. Microsporidial stromal keratitis: clinical features, unique diagnostic criteria, and treatment outcomes in a large case series. Cornea. 2016;35(12):1569–74. https://doi.org/10. 1097/ICO.0000000000000939.
18. Theng J, Chan C, Ling ML, Tan D. Microsporidial keratoconjunctivitis in a healthy contact lens wearer without human immunodeficiency virus infection. Ophthalmology. 2001;108(5):976–8. https://doi.org/10.1016/S0161-6420(01)00542-5.
19. Moon SJ, Mann PM, Matoba AY. Microsporidial keratoconjunctivitis in a healthy patient with a history of LASIK surgery. Cornea. 2003;22(3):271–2. https://doi.org/10.1097/00003226-200304000- 00020.
20. Pradhan S, Mascarenhas J, Srinivasan M. Microsporidial stromal keratitis masquerading as acute graft rejection. Cornea. 2015;34(3):353–4. https:// doi.org/10.1097/ICO.0000000000000337.
21. Ueno S, Eguchi H, Hotta F, et al. Microsporidial keratitis retrospectively diagnosed by ultrastructural study of formalin-fixed paraffin-embedded corneal tissue: a case report. Ann Clin Microbiol Antimicrob. 2019;18(1):1–5. https://doi.org/10. 1186/s12941-019-0316-y.
22. Jhanji V, Satpathy G, Khokhar S, Agarwal T. Microsporidial keratitis after collagen cross-linking. Ocul Immunol Inflamm. 2013;21(6):495–7. https:// doi.org/10.3109/09273948.2013.824105.
23. Curry A, Mudhar HS, Dewan S, Canning EU, Wagner BE. A case of bilateral microsporidial keratitis from Bangladesh— infection by an insect parasite from the genus Nosema. J Med Microbiol. 2007;56(9):1250–2. https://doi.org/10.1099/jmm.0. 47297-0.
24. Pradhan S, Uddaraju M, Mascarenhas J. Unusual course of microsporidial keratoconjunctivitis as an occupational hazard in a veterinary physician. Can J Ophthalmol. 2016;51(4):e127–9. https://doi.org/ 10.1016/j.jcjo.2016.04.012.
25. Reddy AK, Balne PK, Garg P, Krishnaiah S. Is microsporidial keratitis a seasonal infection in India? Clin Microbiol Infect. 2011;17(7):1114–6. https://doi.org/10.1111/j.1469-0691.2010.03084.x.
26. Das S, Sharma S, Sahu SK, Nayak SS, Kar S. Diagnosis, clinical features and treatment outcome of microsporidial keratoconjunctivitis. Br J Ophthalmol. 2012;96(6):793–5. https://doi.org/10.1136/ bjophthalmol-2011-301227.
27. Alkatan HM, Al-Zaaidi S, Athmanathan S. Microsporidial keratitis: literature review and report of 2 cases in a tertiary eye care center. Saudi J Ophthalmol. 2012;26(2):199–203. https://doi.org/10.1016/ j.sjopt.2012.02.007
28. Agashe R, Radhakrishnan N, Pradhan S, Srinivasan M, Prajna VN, Lalitha P. Clinical and demographic study of microsporidial keratoconjunctivitis in South India: a 3-year study (2013–2015). Br J Ophthalmol. 2017;101(10):1436–9. https://doi.org/10. 1136/bjophthalmol-2016-309845.
29. Bhosale NK, Ganesan N. Microsporidial keratitis. J Bacteriol Parasitol. 2015;06(06):5–8. https://doi. org/10.4172/2155-9597.1000248
30. Hsiao YC, Tsai IL, Kuo CT, Yang TL. Diagnosis of microsporidial keratitis with in vivo confocal microscopy. J Xray Sci Technol. 2013;21(1):103–10. https://doi.org/10.3233/XST-130357.
31. S. Das, S. Sharma, S.K. Sahu, S.S. Nayak, S. Kar, New microbial spectrum of epidemic keratoconjunctivitis: clinical and laboratory aspects of an outbreak, Br J Ophthalmol, 92 (6) (2008), pp. 861-862
32. J. Joseph, G.K. Vemuganti, S. Sharma, Microsporidia: emerging ocular pathogens, Ind J Med Microbiol, 23 (2) (2005), pp. 80-91
33. Friedberg DN, Ritterband DC. Ocular Microsporidiosis In: The Microsporidia and Microsporidiosis, Wittner M, Weiss LM, editors. Washington DC: Am Soc Microbiol; 1999. p. 293-314.
34. Moshirfar, M., Somani, S.N., Shmunes, K.M. et al. A Narrative Review of Microsporidial Infections of the Cornea. Ophthalmol Ther **9**, 265–278 (2020). https://doi.org/10.1007/s40123-020-00243-z
35.Shadduck JA, Meccoli RA, Davis R, Font RL. Isolation of a microsporidian from a human patient. J Infect Dis 1990;162:773–6.
36. Didier ES, Didier PJ, Friedberg DN, et al. Isolation and characterization of a new human microsporidian, Encephalitozoon hellum from three AIDS patients with keratoconjunctivitis. J Infect Dis 1991;163:617–21.
37. Davis RM, Font RL, Keisler MS, Shadduck JA. Corneal microsporidiosis. A case report including ultrastructural observations. Ophthalmology 1990;97:953–7
38. Schwartz DA, Visvesvara GS, Diesenhouse MC, et al. Pathologic features and immuno-fluorescent antibody demonstration of ocular microsporidiosis in seven patients with acquired immunodeficiency syndrome. Am J Ophthalmol 1993;115:285–92.
39.Schwartz DA, Sobottka I, Leitch GJ, et al. Pathology of microsporidiosis. Emerging parasitic infections in patients with the AIDS. Arch Pathol Lab Med 1996;120:173–88.
40.Lowder CY, Meister M, McMahon JT, et al. Microsporidia infection of the cornea in a man seropostive for HIV virus. Am J Ophthalmol 1990;109:242–4.

41. Diesenhouse MC, Wilson LA, Corrent GF, et al. Treatment of microsporidial keratoconjunctivitis with topical fumagillin. Am J Ophthalmol 1993;115:293–8.
42. Diesenhouse MC, Wilson LA, Corrent GF, et al. Treatment of microsporidial keratoconjunctivitis with topical fumagillin. Am J Ophthalmol. 1993;115(3):293—8
43. Gritz DC, Holsclaw DS, Negar RE, et al. Ocular and sinus microsporidial infection cured with systemic albendazole. Am J Ophthalmol. 1997;124(2):241—3
44. Joseph J, Sridhar MS, Murthy S, et al. Clinical and microbiological profile of microsporidial keratoconjunctivitis in southern India. Ophthalmology. 2006;113(4): 531—537
45. Metcalfe TW, Doran RM, Rowlands PL, et al. Microsporidial keratoconjunctivitis in a patient with AIDS. Br J Ophthalmol. 1992;76(3):177—8
46. Rosberger DF, Serdarevic ON, Erlandson RA, et al. Successful treatment of microsporidial keratoconjunctivitis with 20 Surv Ophthalmol 56 (1) January--February 2011 SHARMA ET AL topical fumagillin in a patient with AIDS. Cornea. 1993; 12(3):261—5
47. Rossi P, Urbani C, Donelli G, et al. Resolution of microsporidial sinusitis and keratoconjunctivitis by itraconazole treatment. Am J Ophthalmol. 1999;127(2):210—2
48. Sridhar MS, Sharma S. Microsporidial keratoconjunctivitis in a HIV-seronegative patient treated with debridement and oral itraconazole. Am J Ophthalmol. 2003;136(4): 745—746
49. Yee RW, Tio FO, Martinez JA, et al. Resolution of microsporidial epithelial keratopathy in a patient with AIDS. Ophthalmology. 1991;98(2):196—201
50. Loh RS, Chan CM, Ti SE, et al. Emerging prevalence of microsporidial keratitis in Singapore: epidemiology, clinical features, and management. Ophthalmology. 2009; 116(120):2348--53
51. Vemuganti GK, Garg P, Sharma S, et al. Is Microsporidial keratitis an emerging cause of stromal keratitis? A case series study. BMC Ophthalmology. 2005;5:19
52. Font RL, Samaha AN, Keener MJ, et al. Corneal microsporidiosis. Report of case, including electron microscopic observations. Ophthalmology. 2000;107(9):1769—75.