

Naegleria Fowleri in Pakistan - An Emerging Catastrophe

Khalid Mahmood

Naegleria fowleri biologically belongs to kingdom Protista, also known as the brain-eating amoeba, is the etiological organism for Primary Amoebic Meningo-Encephalitis (PAML). It was first reported in medical literature by M. Fowler and R.F. Carter in 1965 in Australia.¹

Naegleria fowleri is commonly found as an amoeba or as a free flagellum in warm lakes, hot springs as well as in fresh water reservoirs such as rivers, ponds and unchlorinated swimming pools. Since *Naegleria fowleri* is a heat tolerant (thermophilic) protist, it thrives during summer when temperatures are high.² The organism gains access to the human brain through the nostrils while washing face, swimming or performing ritual ablution. It then pierces the cribriform plate to enter central nervous system where it causes granulomatous inflammation leading to primary amoebic meningo-encephalitis.³

Primary amoebic meningoencephalitis due to *Naegleria fowleri* is an acute, fulminant, necrotizing, hemorrhagic meningoencephalitis, characterised by severe headache, stiff neck, fever (38.5°C - 41°C), altered mental state, seizures and coma, and is almost always fatal within an average of 3 - 7 days.^{4,5} Other symptoms such as photophobia, mental status abnormalities, lethargy, dizziness, ataxia, cranial nerve palsies, hallucinations and delirium have been reported.

Naegleria fowleri can be diagnosed by detection of a specific *Naegleria fowleri* nucleic acid, antigen or the organism itself in a sample of CSF, biopsy or tissue. It can be directly visualized in a fresh CSF sample using Giemsa-Wright or modified trichome stain.⁶ Antibodies against its antigens, coupled with immunofluorescence are used in tissues.⁷ Amplification of its DNA in CSF or tissue can be done by PCR or can be grown in culture to increase the likelihood of detecting the amoeba by direct visualization or PCR.⁸⁻¹² Unfortunately, about 75% of diagnoses are made after the death of the patient.

Amoebic meningoencephalitis caused by *Naegleria fowleri* is an emerging medical threat related to its high fatality rate. Most cases of Primary Amoebic Meningo-encephalitis (PAM) caused by *Naegleria fowleri* infection

in the world have been fatal with very few survivors as the fulminant nature of this disease makes its treatment very difficult.¹³⁻¹⁶ However, its early diagnosis and treatment by the administration of drugs such as amphotericin B, fluconazole, and rifampicin, has provided some hope of curing this infection.¹⁷

An investigational breast cancer and anti leishmanial agent, Miltefosine, has shown some promising results against the amoeba. Though extremely rare, few remarkable instances where the patient exhibits recovery, instill hope for the successful cure for future cases.¹⁸

Pakistan, and specifically Karachi being a subtropical region, predominantly has a warm climate which provides a favourable ecological niche for this organism to occupy. The first case of *Naegleria fowleri* was reported in Pakistan in 2008. Since then maximum number of reported cases has been from Karachi and its ever increasing occurrence rate over the years is making it particularly worrisome. In 2011, 13 cases of this rare life-threatening infection were reported from Karachi.¹⁹ In 2014, one more fatal case was noted.²⁰ These cases have thrown light on various factors leading to acquisition of this infection and resultant high mortality.

People who swim in warm lakes or non-chlorinated water for recreational purposes are the ones considered mostly at risk and until recently, the rare *Naegleria* infection was associated mainly with swimming in freshwater lakes and rivers, particularly during periods of high temperature and low water levels. However, in reported cases from Karachi, there was no association with swimming.

Ablution is an integral and indispensable religious rite or ritual performed by Muslims, before praying. It includes nasal irrigation with water. Most patients in Karachi acquired this disease while performing 'wuzu' (nasal irrigation) with tap water, contaminated with the amoeba. This seems to be the most significant route of transmission. Global warming, which has raised the temperatures of water has also contributed to the increase in number of cases of primary amoebic meningoencephalitis.^{19,20}

This precarious organism is found to be associated with poorly chlorinated water; chlorination is the only trusted defense mechanism that the country can count on to protect against the brain-eating amoeba. According to the World Health Organization, for effective chlorine disinfection there should be a residual concentration of free chlorine equal or greater than 0.5 mg/L, after at

Department of Medicine, Dow Medical College, Karachi.

Correspondence: Prof. Khalid Mahmood, House C-1/9,
Street 1, Bath Island, Karachi.

E-mail: khalid_khas1@hotmail.com

Received: November 21, 2014; Accepted: February 27, 2015

least 30 minutes contact time (at 20°C) at pH less than 8.0. This level should be maintained throughout the distribution system.²¹

The significance and enormity of this amoebic infection can be explained in terms of its alarming mortality rate. Pakistan is a Muslim country, where majority of the people practice nasal irrigation as part of ablution and necessary measures for the proper sanitation and chlorination of water are not taken. It is likely that cases of *Naegleria fowleri* infections will continue to peak. Public awareness regarding this disease, along with proper treatment of water, either by chlorination or boiling, should be carried out to ensure that the risk of infection declines, else cases of primary amoebic meningoencephalitis will continue to rise in Pakistan.

Pakistan has been seen as a developing country, with a high rate of illiteracy and many people living below the poverty line. The health systems delivery is far from satisfactory level and health facilities are still non-existent and unreachable for many. Lack of potable water supply and proper sanitation, with lack of awareness, further adds to such problems of epidemics of water borne diseases. It is high time that authorities identify the health problems of masses and take concrete measures to salvage the misery.

REFERENCES

- Heggie TW. Swimming with death: *Naegleria fowleri* infections in recreational waters. *Travel Med Infect Dis* 2010; **8**:201-6.
- Shakoor S, Beg MA, Mahmood SF, Bandea R, Sriram R, Noman F, et al. Primary amoebic meningoencephalitis caused by *Naegleria fowleri*, Karachi, Pakistan. *Emerg Infect Dis* 2011; **17**:258-61.
- Symmers WC. Primary amoebic meningoencephalitis in Britain. *Br Med J* 1969; **4**:449-54.
- Yoder JS, Eddy BA, Visvesvara GS, Capewell L, Beach MJ. The epidemiology of primary amoebic meningoencephalitis in the USA, 1962-2008. *Epidemiol Infect* 2010; **138**:968-75.
- CDC. Available from: <http://www.cdc.gov/parasites/naegleria/faqs.html#symptoms>
- Visvesvara GS. Amoebic meningoencephalitis and keratitis: challenges in diagnosis and treatment. *Curr Opin Infect Dis* 2010; **23**:590-4.
- da Rocha-Azevedo B, Tanowitz HB, Marciano-Cabral F. Diagnosis of infections caused by pathogenic free-living amoebae. *Interdiscip Perspect Infect Dis* 2009; **2009**:251406.
- Qvarnstrom Y, Visvesvara GS, Sriram R, da Silva AJ. Multiplex real-time PCR assay for simultaneous detection of *Acanthamoeba* spp., *Balamuthia mandrillaris*, and *Naegleria fowleri*. *J Clin Microbiol* 2006; **44**:3589-95.
- Robinson BS, Monis PT, Dobson PJ. Rapid, sensitive, and discriminating identification of *Naegleria* spp. by real-time PCR and melting-curve analysis. *Appl Environ Microbiol* 2006; **72**:5857-63.
- Marciano-Cabral F, MacLean R, Mensah A, LaPat-Polasko L. Identification of *Naegleria fowleri* in domestic water sources by nested PCR. *Appl Environ Microbiol* 2003; **69**:5864-9.
- Visvesvara GS. Parasite culture: *Acanthamoeba* and *Naegleria* spp. In: Garcia LS, editor. Clinical microbiology procedures handbook. 3rd ed. Washington, DC: ASM Press; 2010.
- CDC. Available from <http://www.cdc.gov/parasites/naegleria/diagnosis.html>
- Yoder JS, Eddy BA, Visvesvara GS, Capewell L, Beach MJ. The epidemiology of primary amoebic meningoencephalitis in the USA, 1962-2008. *Epidemiol Infect* 2010; **138**:968-75.
- Seidel JS, Harmatz P, Visvesvara GS, Cohen A, Edwards J, Turner J. Successful treatment of primary amoebic meningoencephalitis. *N Engl J Med* 1982; **306**:346-8.
- Visvesvara GS, Moura H, Schuster FL. Pathogenic and opportunistic free-living amoebae: *Acanthamoeba* spp, *Balamuthia mandrillaris*, *Naegleria fowleri*, and *Sappinia diploidea*. *FEMS Immunol Med Microbiol* 2007; **50**:1-26.
- Vargas-Zepeda J, Gomez-Alcala AV, Vasquez-Morales JA, Licea-Amaya L, De Jonckheere JF, Lores-Villa F. Successful treatment of *Naegleria* PAM using IV amphotericin B, fluconazole, and rifampicin. *Arch Med Res* 2005; **36**:83-6.
- Vargas-Zepeda J, Gomez-Alcala AV, Vasquez-Morales JA, Licea-Amaya L, De Jonckheere JF, La res Villa F. Successful treatment of *Naegleria fowleri* meningoencephalitis by using intravenous amphotericin B, fluconazole and rifampicin. *Arch Med Res* 2005; **36**: 83-86.
- Kim JH, Jung SY, Lee YJ, Song KJ, Kwon D, Kim K, et al. Effect of therapeutic chemical agents in vitro and on experimental meningoencephalitis due to *Naegleria fowleri*. *Antimicrob Agents Chemother* 2008; **52**:4010-16.
- Shakoor S, Beg MA, Mahmood SF, Bandea R, Sriram R, Noman F, et al. Primary amoebic meningoencephalitis caused by *Naegleria fowleri*, Karachi, Pakistan. *Emerg Infect Dis* 2011; **17**:258-61.
- Shariq A, Afridi FI, Farooqi BJ, Ahmed S, Hussain A. Fatal primary meningoencephalitis caused by *Naegleria fowleri*. *J Coll Physicians Surg Pak* 2014; **24**:523-5.
- Cited on 28th Jan 2015. Available from http://www.who.int/water_sanitation_health/dwq/chlorine.pdf

