

## SPECIAL COMMUNICATION

**NAEGLARIA FOWLERI: THE BRAIN EATING AMOEBIA OR AN ENIGMA?****Fatima Mukhtar, Mohammad Salim Wazir\***

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*Naeglaria fowleri* (*N. fowleri*), popularly known as the brain eating amoeba is the causative agent of the fulminant disease, primary amoebic meningoencephalitis (PAM). Although a rare disease, it is a threat to human health with a case fatality rate ranging from 95–99%. PAM cases have been reported from the United States of America, Australia, Europe and Asia. From 1962 to 2014, 133 people have been infected by *N. fowleri* in the USA, out of which only three have survived. None of the PAM cases reported in Pakistan so far has survived. This underscores the importance to identify factors, which have led to the failure in decreasing case fatality associated with *N. fowleri* despite major advances in medical technology, health care; and prevention and control strategies since the first reported case in 1965. We need to focus on eliciting risk factors of the disease prevalent in our part of the world, which are at variance with the developed world. A predominant number of PAM cases in the West are reported in young males who had participated in recreational activities. However, majority of cases reported in Pakistan are also among young males but they were linked with the religious practice of ablution. What is required to better understand and hence manage this enigma is further research. Further research is to be conducted to discover potent antimicrobials, to test the effectiveness of the new transcribrial device in managing PAM, and to identify host factors, which make an individual susceptible to *N. fowleri*. Investigation of environmental factors related to *N. fowleri* also needs to be done. Doing so is of paramount importance, as it will help identify the preventive strategies to be employed against *N. fowleri*.

**Keywords:** *Naeglaria fowleri*, brain eating amoeba, primary amoebic meningoencephalitis.

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*Naeglaria fowleri* (*N. fowleri*), popularly known as the brain eating amoeba is a free-living, thermophilic, protist parasite which was first discovered in 1899. The brain eating amoeba has a world-wide distribution and is the causative agent of a fulminant disease which affects the central nervous system. This disease called primary amoebic meningoencephalitis (PAM) occurred in Virginia in 1937 but was first described in Australia in 1965. Cases have since been reported from the United States of America, Australia, Europe and Asia. An increase in the number of cases is seen due to rising temperatures, prolonged, hot summer months consequent to global warming, which provide ambient conditions for the multiplication of the amoeba. Other contributory factors are poor quality of water disinfection and deterioration in the water distribution systems.<sup>1-4</sup>

*N. fowleri* is commonly found in warm fresh water bodies such as lakes, rivers, ponds, geothermal springs and canals.<sup>5</sup> It has also been isolated from other water sources including domestic water supplies, industrial waste water, recreational water facilities, water discharge of electrical power plants and spas.<sup>1,6</sup>

Human beings get infected when water contaminated with *N. fowleri* enters the nose and travels up the olfactory nerve to the brain. This exposure to water containing *N. fowleri* might occur during recreational activities such as water sports, playing in

backyard wading pools and swimming, religious practices such as ablution or “wuzu” by Muslims and bathing in river Ganges by the Hindus and lastly cultural practices, such as the use of neti pots for nasal irrigation and Ayurveda.<sup>7</sup>

From 1962 to 2014, 133 people have been infected by *N. fowleri* in the USA, out of which only three have survived.<sup>8</sup> In Pakistan, cases have been reported from the mega city of Karachi and none have survived so far. The cases increased from 12 in 2008 to approximately 20 in 2010.<sup>1</sup> According to the 33<sup>rd</sup> issue of the Seasonal Awareness and Alert Newsletter (SAAL) published by the National Institute of Health, Islamabad the number of PAM cases in Pakistan were 10 in 2012, 3 in 2013, 14 in 2014 and till 30<sup>th</sup> May 2015 there were 7 reported cases.<sup>3</sup> A research undertaken by Yousaf *et al* demonstrated *N. fowleri* in 8% of drinking water samples in Karachi.<sup>9</sup> The presence of the pathogen in drinking water has many probable reasons. The source of Karachi’s water is two suburban freshwater lakes having poor quality of disinfection, there may be mixing of sewage water, which is a potential reservoir of *N. fowleri* with drinking water due to leaks in pipes, improper cleaning and disinfection of overhead tanks at homes and mosques and of water carriage tanks.<sup>1,4</sup>

Although PAM is a rare disease, nonetheless it is a threat to human health with a case fatality rate

ranging from 95–99%.<sup>1,3</sup> The factors, which need due consideration are: the failure to decrease case fatality associated with *N. fowleri* despite major advances in medical technology, health care; and prevention and control strategies since the first reported case in 1965. Research needs to focus on discovery of potent antimicrobials, which would assist in plunging the fatality rate associated with *N. fowleri*. Conventionally PAM is treated with amphotericin B and rifampicin, although fluconazole or itraconazole may also be given; but none lead to improved prognosis.<sup>4</sup> However, there is hope with the discovery of the new antimicrobial drug called miltefosine, which was administered with other drugs to the two survivors of PAM in the USA.<sup>2</sup> Also a non-invasive device called the transcribrial device has been invented which will help deliver drugs through the intranasal route across the cribriform plate and help attain the minimum inhibitory concentration of drugs in the CNS not possible to attain by giving drugs systemically.<sup>10</sup>

Additionally, we need to focus on eliciting risk factors of the disease prevalent in our part of the world, which are at variance with the developed world. A predominant number of PAM cases in the West have been reported in young males who had participated in recreational activities such as swimming in fresh water bodies in the long hot summer months.<sup>1,4</sup>

The probable reason cited for male vs female cases was a greater involvement of young males in outdoor recreational activities. However, majority of PAM cases reported in Pakistan to date are also among young males but most of them did not give a history of recreational activity. Rather, they were linked with the religious practice of ablution.<sup>4</sup> That's confusing! Why males? Why young males? What predisposes males as compared to females for developing PAM? Why the younger age group is most affected?

Various preventive and control strategies have been proposed including the use of nose clips, holding your nose closed, keeping one's head out of water while swimming or indulging in water activities, boiling and filtering water before use for ablution and education of public to make informed choices regarding swimming during summer months. Warning the public by sign posting next to water bodies containing *N. fowleri* is thought to be ineffective in preventing infection because no association has been demonstrated between presence of amoeba in water bodies and risk of infection.<sup>11</sup> But the most effective and efficient method seems to be adequate disinfection of drinking water distribution

system coupled with vigilant surveillance activities.<sup>5</sup>

What is required to better understand and hence manage this enigma is further research. Further research is to be conducted to discover therapeutic options, to test the effectiveness of the new transcribrial device in managing PAM, and to identify host factors, which make an individual susceptible to *N. fowleri*. Investigation of environmental factors related to *N. fowleri* also needs to be done. Doing so is of paramount importance, as it will help identify the preventive strategies to be employed against *N. fowleri*.

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