

Is Ritual Cleansing a Missing Link Between Fatal Infection and Brain-Eating Amoebae?

Every summer, we witness the death of young men due to single-celled protist, *Naegleria fowleri*, also known as “brain-eating amoebae” [1–3]. Amoebic encephalitis is reported in persons who swim in fresh water during summer months [4–6]. Amoebae invade the nervous system via the nose when contaminated water is deeply inhaled.

Invasion of the nasal mucosa is followed by migration along nerve fibers and invasion of the olfactory bulb. Amoebae travel along the olfactory neuroepithelium route through the floor of the cranium via the cribriform plate and into the brain to produce hemorrhaging, resulting in fatal consequences within days [4–6]. Within a week of contracting infection, the victim experiences symptoms, such as headache, fever, nausea, stiff neck, confusion, seizures, and hallucinations [4–6]. The brain image analyses of patients with primary amoebic meningoencephalitis (PAM) are unremarkable. The death almost always follows within days, even with premortem diagnosis, owing to lack of effective treatment.

In addition to exposure to warm recreational waters, ritual ablution is a potential risk factor in contracting PAM in Muslim communities. This religious practice involves the repeated irrigation of mouth, ears, face, arms, feet, and nostrils for cleansing. Some persons irrigate their sinuses vehemently by pushing water forcefully up the nostrils even though it is not required as part of the ablution practice. Developing countries such as Pakistan face serious water scarcity and thus increased public reliance on water storage tanks and wells that are breeding grounds for pathogenic free-living amoebae such as *N. fowleri*. The water supplied by municipalities suffers from older plumbing and poor maintenance and treatment [7, 8]. The situation is exacerbated by a warm climate that favors growth of amoebae. For the first time in Karachi, Pakistan, Shakoor et al [9] reported 20 deaths due to *N. fowleri* infection from a small hospital in 2010 alone. All patients were male, but none of them had a history of swimming. All patients were devout Muslims, who performed ritual ablution regularly. Although Muslims comprise the largest population in Karachi, it is a cosmopolitan city in which persons of all faiths are exposed to common water supplies, yet

this fatal infection occurred only in Muslim communities. Thus, it is tempting to speculate that ritual ablution is a potential risk factor in contracting PAM. The poor water quality combined with rigorous ablution practice could be a deadly combination. It is disturbing that such an alarming number of deaths were reported from a private hospital in Karachi, which suggests that the state of affairs must be that much worse, indeed calamitous, in poor rural communities. It is likely that a vast number of infections are undetected and the actual burden is significantly higher than reported. Notably, *N. fowleri* and *Acanthamoeba* species were isolated in our laboratory from water supplies in Karachi.

Ritual ablution with clean water supplies can have immense medical benefits in decontaminating the body of pathogenic microbes, heavy metals, and so forth, but it is effective only when clean water is used. The use of safe water (at least boiled), together with cautious ablution and/or sinus irrigation, is desired to prevent fatal brain infection caused by pathogenic free-living amoebae.

Note

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

Ruqaiyyah Siddiqui and Naveed Ahmed Khan

Department of Biological and Biomedical Sciences, Aga Khan University, Karachi, Pakistan

References

1. Brain-eating amoeba claims second victim this month. Available at: <http://news.yahoo.com/blogs/lookout/brain-eating-amoeba-claims-second-victim-month-161107259.html>. Accessed 20 October 2011.
2. <http://www.webmd.com/brain/news/20110818/brain-eating-amoeba-faq>. Accessed 20 October 2011.
3. http://www.momlogic.com/2010/09/boy_dies_of_brain-eating_amoeba_in_lake.php. Accessed 20 October 2011.

4. 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.
5. da Rocha-Azevedo B, Tanowitz HB, Marciano-Cabral F. Diagnosis of infections caused by pathogenic free-living amoebae. Interdiscip Perspect Infect Dis **2009**; 251406.
6. Cerva L, Zimák V, Novák K. Amoebic meningoencephalitis: a new amoeba isolate. Science **1969**; 163:575–6.
7. Pakistan Council for Research in Water Resources. Annual report 2005–2006. Part 2. Islamabad, Pakistan: PCRWR **2008**. Available at: <http://www.pcrwr.gov>. Accessed 8 November 2011.
8. World Wide Fund for Nature—Pakistan. Pakistan's waters at risk: water and health related issues in Pakistan and key recommendations. Available at: http://www.wwfpak.org/freshwater/pakistans_waters_at_risk.php. Accessed 8 November 2011.
9. Shakoor S, Beg MA, Mahmood SF, et al. Primary amoebic meningoencephalitis caused by *Naegleria fowleri*, Karachi, Pakistan. Emerg Infect Dis **2011**; 17:258–61.

Correspondence: Naveed Ahmed Khan, BSc, MSc, PhD, Dept of Biological and Biomedical Sciences, Aga Khan University, Stadium Road, Karachi, Pakistan (Naveed5438@gmail.com).

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