A Primary Amebic Meningoencephalitis Case Associated with Rafting on an Artificial Whitewater River

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Background

- Primary amebic meningoencephalitis (PAM) is a fulminant central nervous system infection with mortality ~87%.
- PAM is caused by Naegleria fowleri, a thermophilic free-living ameba that thrives in warm freshwater.
- Water temperature plays a role in the risk for PAM. PAM has been associated with temperatures >20°C.

Methods

- Site visit and meeting with USNWC staff to determine operational methods.
- Measured basic water quality parameters.
- Submitted for direct cultures and real-time PCR analysis.
- Culture and real-time PCR results indicate location of sampling.
- Water sample with organic matter promoting growth of N. fowleri.

Results

- Whitewater channels constructed with porous concrete filled with ~12 million gallons of water from onsite wells and county municipal water into river water is introduced into the system.
- Five filters of interlocking plastic disks, poor size 250 microns, total volume of water is intended to be replaced every 24 hours.
- Water is directed through an atrumatic distribution system after filtration.
- Chlorine is added as a liquid to the upper point only when coliform counts trend upward or algae growth is visibly increased.

Conclusions

- Based on epidemiologic investigation, most likely water exposure leading to PAM in this case patient was falling out of the raft at the USNWC.
- Supported by environmental sampling that was able to capture the whitewater channels to be positive for N. fowleri by PCR and culture.
- Conditions in the whitewater channels promoted the growth of N. fowleri.
- High water temperature.
- High turbidity.
- Heavy algal growth.
- Insufficient disinfection and inadequate distribution of the water.

U.S. National Whitewater Center (USNWC)

- Located in Charlotte, NC at 1108 acres along the Catawba River.
- Offers kayaking and rafting in recirculating artificial whitewater rivers.
- Measured basic water quality parameters.
- Submitted for direct cultures and real-time PCR analysis.

Water Quality Parameters Measured at the USNWC and Catawba River, June 22, 2016

<table>
<thead>
<tr>
<th>Sample Type</th>
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<th>Temperature (°C/°F)</th>
<th>Free chlorine residual (mg/L)</th>
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Water sample with organic material promoting growth of N. fowleri.

Real-time PCR Results on Samples Taken from the Whitewater Channels

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Impact of water temperature on growth of N. fowleri.

Examples of adverse conditions where water temperatures reached 28°C.

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