

## Nosocomial nontuberculous mycobacteria infections associated with heater-cooler devices

The July, 2013, opening of a new wing at Duke University Hospital (Durham, NC, USA) was shortly followed by a two-phased outbreak of nosocomial nontuberculous mycobacteria (NTM) infections, investigators recently reported. All 95 affected patients tested positive for *Mycobacterium abscessus*, a fast-growing NTM found in the Durham municipal water supply and concentrated in the high-efficiency water distribution system of the new wing. 13 (54%) of 24 affected patients from the second phase were patients who had had cardiac surgery. The mortality reached 41% for infected cardiothoracic patients from both phases combined (nine of 22 patients). The outbreak of NTM infections among patients who had undergone open-chest cardiac surgery was terminated by instituting changes to the way that heater-cooler devices were used during cardiopulmonary bypass. First author of the study Arthur Baker, of the Duke Division of Infectious Diseases, explains, "Our primary heater-cooler device-related interventions were the use of sterile water in these devices, intensification of the heater-cooler device disinfection protocol, and purchase of new heater-cooler devices".

This study is the latest in a series of international reports on the outbreak of life-threatening NTM infections in patients who had cardiothoracic surgery during which contaminated heater-cooler devices were used. A 2013 report from Switzerland described the first two observed cases of disseminated *Mycobacterium chimaera* infection following cardiothoracic surgery. Since then, more cases have been reported in The Netherlands, Germany, the USA, the UK, Denmark, and Australia. The origin of these *M chimaera* infections was linked to heater-cooler devices by German investigators, who isolated nearly identical strains of *M chimaera* from three sources: infected cardiothoracic patients (n=5) who underwent cardiopulmonary bypass with heater-cooler devices from one manufacturer; heater-cooler devices from this manufacturer used in operating rooms in Germany, The Netherlands, and Switzerland; and new heater-cooler devices and environmental samples from the production line at the manufacturer's facility.

Heater-cooler devices circulate water via closed circuits to external devices used to maintain the temperature of the body and blood during cardiopulmonary bypass; none of the water pumped by the heater-cooler device comes into direct contact with the surgical patient. However, the internal water tanks of the heater-cooler device comprise an open system that needs to be filled with water. NTM, which are commonly found in water and soil, are relatively resistant to chlorination and are difficult to eradicate from municipal water supplies. If water in the internal heater-cooler device reservoirs is contaminated with NTM organisms, bacteria-containing

aerosols can be created by the agitation produced by the heater-cooler device pump, and the resulting bioaerosols can be dispersed throughout the operating room by the heater-cooler device cooling fan—potentially contaminating the surgical field. Thus, design features common to all heater-cooler devices are potentially conducive to growth, aerosolisation, and dispersal of environmental mycobacteria.

Exposure to environmental NTM rarely affects healthy individuals. However, in the USA, at least 250 000 cardiopulmonary bypass procedures that employ heater-cooler devices are conducted each year; accordingly, thousands of high-risk cardiothoracic surgery patients have been notified of their potential risk for NTM infection from heater-cooler device use during cardiopulmonary bypass. Kiran Perkins, Medical Officer at the US Centers for Disease Control and Prevention (Atlanta, GA, USA), noted that there are three main take-home points from the current international outbreak of *M chimaera* infections in cardiac surgery patients: "Focus on increasing patient and provider awareness of risk of infection, on making sure that heater-cooler devices are being maintained by manufacturer and [US Food and Drug Administration] FDA guidelines, and on reducing the possibility of aerosolised particles reaching the sterile field".

The FDA has developed guidelines for reducing the risk of heater-cooler device-related NTM infections in cardiothoracic patients. Recommendations include maintaining regular schedules for cleaning and disinfecting each heater-cooler device according to the device manufacturer's most recent instructions, using only sterile or filtered water in the heater-cooler device water tanks, and directing the exhaust from the cooling fan of the heater-cooler device away from the sterile field and towards an exhaust vent in the operating room. The FDA recommends that heater-cooler devices that have tested positive for *M chimaera* or that have been linked to *M chimaera* infection in patients should be removed from service. The guidelines also advise that facilities with Stöckert 3T heater-cooler devices produced before September, 2014, give serious consideration to phasing out use of these units for cardiothoracic surgery until the manufacturer issues risk mitigation strategies for the devices; in the interim, using these units for open-chest cardiac surgery should be limited to emergency or life-threatening situations in which other heater-cooler devices are not available. Baker summarised: "We do not have a protocol or data on disinfecting heater-cooler devices that have become colonised with NTM. The key is to prevent heater-cooler device colonisation with careful maintenance and preventative practices".

Judith A Gilbert



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For more on the **recent two-phase outbreak of nosocomial NTM infections** see <https://dx.doi.org/10.1093/cid/ciw877>

For more on the **2013 report from Switzerland** see <http://dx.doi.org/10.1128/JCM.00435-13>

For more on ***M chimaera* infection cases in The Netherlands** see <http://dx.doi.org/10.1093/eurheartj/ehv342>

For more on ***M chimaera* infection cases in Germany** see <http://dx.doi.org/10.1093/eurheartj/ehv342>

For more on ***M chimaera* infection cases in the USA** see <https://www.cdc.gov/mmwr/volumes/65/wr/mm6540a6.htm>

For more on ***M chimaera* infection cases in the UK** see <http://dx.doi.org/10.1093/cid/ciw754>

For more on ***M chimaera* infection cases in Denmark** see <http://dx.doi.org/10.3201/eid2303.161941>

For more on ***M chimaera* infection cases in Australia** see <http://dx.doi.org/10.1056/NEJMc1612023>

For more on **heater-cooler device cooling fans** see <http://dx.doi.org/10.3201/eid2206.160045>

For more on **limiting units for use only in emergency or life-threatening open-chest cardiac surgery** see <http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/CardiovascularDevices/Heater-CoolerDevices/ucm492583.htm>