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## Brief Report

## Pseudomonas aeruginosa left ventricular assist device (LVAD) driveline infection acquired from the bathroom at home

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## Key Words:

Heart-Assist Devices

LVAD

Driveline infection

*Pseudomonas aeruginosa*

Community-acquired infections

## A B S T R A C T

We describe a patient with a left ventricular assist device (LVAD) infection by *Pseudomonas aeruginosa* acquired at home. The *Pseudomonas* from the driveline was similar to several surface cultures of the patient's home shower. This case illustrates the potential and importance of infection prevention measures at home.

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Driveline infections are feared complications in patients with left ventricular assist devices (LVAD), due to significant morbidity and mortality. The LVAD supports the cardiac function by reducing the workload of the left ventricle.<sup>1</sup> We describe a patient with a community-acquired driveline infection by *Pseudomonas aeruginosa*, where the source of infection was identified as the patients' bathroom at home. This case illustrates the need for infection prevention measures at home.

## CASE REPORT

A 54-year old patient suffering from end stage heart failure based on dilating cardiomyopathy was given an LVAD (HeartMate III Abbott) as bridge to heart transplant. Conform our clinical protocol, the patient refrained from showering during the first 3 months following LVAD surgery. At routine outpatient clinic evaluation, the surgery wound was healing as expected, and no signs of infection were present. The patient was allowed to shower at home 3 months after LVAD placement, with instructions to replace the dressing after

showering. The shower had been cleaned using cleaning products specifically for the bathroom. The bag containing the LVAD battery was not placed on the floor, but was hanging on the faucet. The patient was seated on a new shower chair as he was still recovering from the surgery, and used new bottles of soap and shampoo. Three days later, the patient first reported some wound discharge. Six days after showering, the patient came to the hospital with erythema that spread over a large part of the abdomen, induration could be felt over a length of 20 cm from the exit. Additionally there was purulent discharge from the exit site and elevated C-reactive protein. He was diagnosed with a deep driveline infection and intravenous cefuroxime was started immediately. *Pseudomonas aeruginosa* (*P. aeruginosa*) was cultured from the exit site, and treatment was switched to piperacillin/tazobactam followed by ceftazidime with ciprofloxacin.

Despite 6 weeks of antibiotics, a positron emission tomography and computed tomography (PET-CT) scan showed ongoing inflammation and the driveline was surgically relocated. Ceftazidime was continued for 14 days post-surgery.

To identify the source of the infection, culture swabs were taken and mid-stream shower 40 water was collected from the patient's bathroom at home (Fig 1). *P. aeruginosa* was found on the shower drain, a wall-mounted shower head, and the non-slip shower mat. The patient only used the main shower head and handheld shower head. The wall mounted shower heads were not used during showering, but they are rinsed and flushed on a regular basis to prevent stasis. Molecular typing by Multiple Locus Variable-Numbers Tandem Repeat Analysis (MLVA)<sup>2</sup>; a method that is used to determine the

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On behalf of the Rotterdam transplant group 3,4. 4 Collaborators of the Rotterdam transplant group, Jasper Brugts MD, PhD, Alina Constantinescu MD, PhD, Kadir Caliskan MD, PhD, Chantal de Bakker MSc and Jos Bekkers MD, PhD.

# Shared last author.

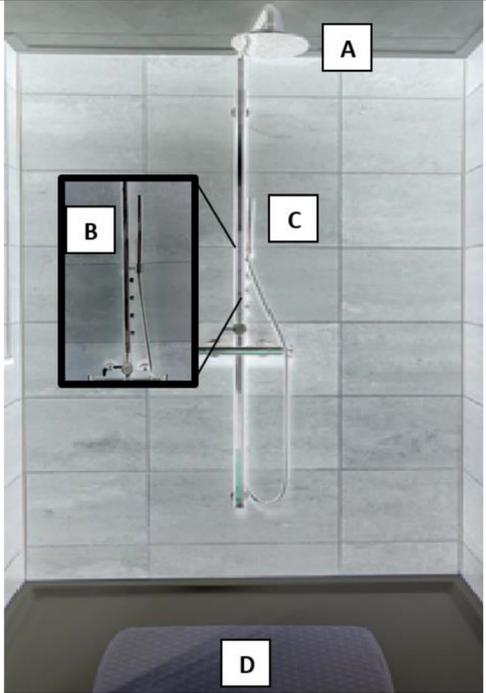
I	II	
	Culture location	<i>P. aeruginosa</i> MLVA type
	<b>Patient:</b> driveline exit site	1-5-11-2-6-12-8-4
	<b>A:</b> Main shower head	Negative
	<b>B:</b> Wall mounted shower jets	
	- 1	Negative
	- 2	Negative
	- 3	1-5-11-2-6-13-8-4
	- 4	Negative
	<b>C:</b> Handheld shower head	Negative
	<b>D:</b> Non-slip shower mat	
	- Top swab 1	1-5-11-2-6-13-8-4
	- Top swab 2	1-5-11-2-6-13-8-4
- Bottom swab 1	1-5-12-2-6-12-8-4	
- Bottom swab 2	1-5-11-2-6-12-8-4	
Shower drain		
- swab 1	1-5-12-2-6-12-8-4	
- swab 2	1-5-11-2-6-13-8-4	
Faucet	Negative	
1 litre of shower water	Negative	

Fig 1. I Shower lay-out, with enlargement of wall-mounted jets. II: corresponding MLVA typing.

genetic relatedness among bacterial strains, revealed that all environmental isolates were similar to the *P. aeruginosa* from the exit site (Fig 1). The driveline exit site MLVA type was 1-5-11-2-6-12-8-4. These results were confirmed by whole genome sequencing. Environmental isolates differed only 1-9 loci (out of 5967) from the clinical isolate (Illumina technology in BioNumerics v7.6; Applied Maths, St-Martens-Latem, Belgium), well below the proposed cut-off value of 13 alleles difference.<sup>3</sup> All belonged to Sequence Type (ST)348.

Community-acquired *P. aeruginosa* infection in an LVAD patient has been described before, but, to the best of our knowledge, not with a proven source. *P. aeruginosa* is a Gram-negative pathogen that thrives in moist environments. Contaminated drains and sinks are known causes of nosocomial infections.<sup>4</sup> Our patient was most likely infected at home by upward transmission (eg, splashing, via towel use) from the mat (D) and shower drain, as both tested positive for *P. aeruginosa*. The wall-mounted shower jet (B) also tested positive, but was not used. Direct transmission from water by showering seems unlikely as the main showerhead (A) and the water tested negative. Airborne transmission from the drain has been reported, with *Pseudomonas* positive air samples after showering.<sup>5</sup> However, this was not investigated in our case. The common presence of *Pseudomonas* in moist surroundings, the relation in time between showering and development of infection, and the fact that there were no signs of infection on previous routine outpatient visits all indicate that the patient was most likely infected at his shower at home. No environmental samples were obtained before the patient's first shower, therefore transmission from the driveline into the shower cannot completely be excluded. However, as the driveline does not make contact with any of the shower surfaces, this seems unlikely.

Prevention of LVAD driveline infections is of utmost importance to reduce hospital re-admissions, repeated surgery and costs. Current focus is on (peri-operative) wound care, without specific measures to protect patients at home.<sup>6</sup> Preventing infection with waterborne pathogens should include control of shower water quality. Point of care filters might contribute to this, but are costly and can be difficult to install and use correctly. In our centre, a dedicated LVAD nurse informs all patients on infection risks and prevention measures, wound dressing and care following LVAD surgery. Evidence-based guidelines are needed to prevent infections. We suggest to consider this list of additional recommendations to prevent infection with *Pseudomonas* at home:

#### GENERAL

- Make sure that the hands are rinsed, disinfected with 70% alcohol and properly dried before handling the LVAD
- If possible, let a caregiver clean and dress the LVAD exit site
- Keep the driveline exit site as dry as possible
- Keep all cleaning attributes at a separate dry space
- Wash all non-disposable cleaning textile at 60° Celsius immediately after use

#### SINK

- Prevent splashing of water, preferably by installing a covering drain top
- Dry the sink and its surroundings after using, from outwards to inwards. Avoid contact of the drying towel with the drain

- In case a rubber plug is used to close the sink, dry after each use. Clean the plug in the washing machine or dishwasher once a week, preferably at 60° Celsius or higher

#### SHOWER

- Dry the shower cabin after use, as it is more difficult for waterborne pathogens to grow in a dry environment
- Avoid any obstruction of water flow into the drain and water should not directly hit the drain
- Thoroughly clean the shower once a week. All cleaning materials should be washed at 60° Celsius immediately after use
- Consider the shower floor and sink as potentially contaminated with pathogens. Avoid contact, including by towels and other cleaning attributes
- Dry the LVAD attributes after exposure to water with disposable wipes or towels. If a non-disposable towel is used, use only clean and unused ones
- The use of a non-slip shower mat is highly discouraged, as bacteria can easily attach and grow on the material. The use of non-slip footwear such as slippers is preferred. Clean the footwear in the washing machine or dishwasher once a week, preferably at 60° Celsius or higher

This list could increase awareness about community infection risks and might also be protective of other waterborne pathogens. As we assume the patients' entire shower system contains a biofilm with *P. aeruginosa*, we additionally advised faucet filters to sterilize water.

#### SUMMARY

In case of *P. aeruginosa* LVAD driveline infection, consider the patient's bathroom at home as a potential source of infection. Protec-

tive measures at home, on top of the current standards, could aid in preventing infections.

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#### Ethical statement

This work has been conducted in line with ethical guidelines.

The patient has signed a release form on 20 September 2021, stating that permission is granted for the anonymized use of medical records for scientific purposes, with the aim of manuscript publication. The original signed document is in possession of the Erasmus MC University Medical Center Rotterdam.

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