

The Heat Exchanger: Another Possible Source of Infection in Heart Surgery

Billy J. Applegate, C.C.P.; William F. Gabrhel, C.C.P.

Associates in Thoracic Surgery, P.C.

Introduction

In this day and age of disposables and pre-sterilized products, the most important precautions are frequently being taken for granted. Sterilization and cleanliness are of the utmost importance in all the non-disposable equipment used in surgery. Sometimes it takes the occurrence of an infection before the importance of this is realized.

Most of the non-disposable equipment has a cleaning procedure recommended by each manufacturer. Occasionally this procedure is overlooked, and sometimes an assumption is made that the manufacturer's cleaning procedure is adequate. This article deals with a manufacturer's cleaning procedure of a self-contained heat exchanger unit, and presents a variation from the suggested manufacturer's cleaning procedure in order to prevent the heat exchanger from being a potential source of infection.

The occurrence of *Pseudomonas* Septicemias in several cardiac patients and one vascular patient was reported to the director of the operating room at a Tucson hospital. This report prompted an immediate investigation. One of the microbiologists suggested a series of environmental cultures be done on equipment used in the cardiovascular room. Positive cultures of *Pseudomonas maltophilia* and *Pseudomonas aeruginosa* were grown from specimens taken from the heat exchanger unit.

In the investigation it was established that the heat exchanger unit was purchased in August, just one

month before the first reported case of infection. Immediate steps were taken to ensure that the correct manufacturer's cleaning procedure was carried out. Further cultures were done and resulted in positive *Pseudomonas* present in the heat exchanger unit. It was determined that the manufacturer's cleaning procedure was inadequate in prevention of *Pseudomonas* regrowth between cleanings. At this point, several cleaning procedures were tried, but the heat exchanger unit could not be totally drained and dried. Due to the moisture left in the unit's plumbing, the environment for *Pseudomonas* still existed.

Discussion

Pseudomonas is an ubiquitous free-living microbe which may be an opportunistic pathogen for man. Through experience, it was found that the prevention of *Pseudomonas* growth in the heat exchanger unit was very difficult to accomplish with these daily cleaning procedures. Because the water in the heat exchanger unit did not come in contact with the blood or the patient directly, it was not believed the heat exchanger unit could be the source of infection. However, there are several indirect ways that infection can be transmitted to the patient from the heat exchanger unit. It is possible, in the process of connecting and disconnecting the unit, that water could come in contact with the hands, floor, and heart pump. A person inadvertently dipping his hands inside the water reservoir is another possibility. These are only two examples demonstrating the possibility of transmitting infection from the unit.

The manufacturer's instructions indicate that the

Request for reprints: Associates in Thoracic Surgery, P.C., 5200 East Grant Road, Suite 612, Tucson, Arizona 85712

heat exchanger unit should be totally drained when not in use. Although all water is drained from the reservoir, a very small amount of water and moisture is trapped in the recirculating pump and internal plumbing. The moisture left in the unit is an excellent environment for *Pseudomonas* regrowth to occur overnight. Sterile water placed in the unit the following day is soon contaminated with *Pseudomonas*, as was confirmed with our daily cultures. The contaminated water then becomes a potential source of infection.

Due to the fact *Pseudomonas* growth is so difficult to control in the heat exchanger unit, a revised cleaning procedure was introduced. The new cleaning procedure left the germicidal solution in the unit's plumbing overnight. The unit was not rinsed until the next day, prior to its use. The procedure used is:

1. Fill the tank with two gallons of distilled H₂O.
2. Add two teaspoons of germicidal solution.
3. Wash the machine thoroughly, leaving the previous tubing attached.
4. Turn the selector switch to maximum cooling mode for thirty minutes.
5. Switch to recirculating mode for five minutes.
6. Drain the heat exchanger unit through the stopcock.
7. Do not rinse with water; leave the germicidal solution in the plumbing.
8. Attach new sterile tubing before use.
9. Prior to use, rinse machine thoroughly with distilled H₂O, washing out the remaining germicidal solution.
10. Fill the heat exchanger unit with sterile distilled water.

This cleaning procedure has been used for the past eight months with no positive cultures of bacterial regrowth to date, nor has there been an occurrence of *Pseudomonas* in any cardiac or vascular patient resulting from the heat exchanger unit.

Summary

In this case, the manufacturer's cleaning procedure was not effective in controlling *Pseudomonas* growth. Even though no direct contact is made with the heat exchanger unit's water, it is possible to transmit the infection indirectly. It is very difficult to control *Pseudomonas* growth in a damp environment closed to the outside atmosphere. The most important step in the cleaning procedure is to leave the germicidal solution in the unit's plumbing until the unit is ready to be used again. It was found that if the unit was cleaned, rinsed with water, and left overnight, *Pseudomonas* regrowth occurred. Cultures taken after this new cleaning procedure was employed resulted in negative cultures for *Pseudomonas* from the heat exchanger unit.

Conclusions

Although a heat exchanger unit does not seem to be a likely source of infection, no other origin of infection in the open heart surgical suite could be found. Therefore, it is likely that the heat exchanger unit was the source of the infection. It is possible that similar dangers may exist in all self-contained heat exchanger units, and one should be aware of the possibility that manufacturer's instructions are not infallible.

Infection is a major concern in surgery, and requires an awareness of possible sources of infections as well as the ability to take advantage of environmental cultures.

The manufacturer of this heat exchanger unit contributed in eliminating this problem by recommending the cleaning procedure.

References

1. Blair, JE, Lennette, EH, Truant, JP: *Manual of Clinical Microbiology*, Maryland: Williams and Wilkins American Society for Microbiology, 1970, pp. 176-180.
2. Cabrera, HA, Drake, MA: An epidemic in a coronary care unit caused by *Pseudomonas* species, *American Journal of Clinical Pathology* 64:700, 1975.
3. Flick, MR, Cluff, LE: *Pseudomonas* bacteremia, *The American Journal of Medicine* 60:501, 1976.
4. White, A, Crowder, JG: *Pseudomonas* diseases, *Advances in Internal Medicine* 20:23, 1975.