J. Hyg., Camb. (1977), **79**, 103
Printed in Great Britain

Water beds – a potential source of *Pseudomonas aeruginosa*

By K. M. ELHAG, ROSAMUND M. BAIRD
and ELIZABETH J. SHAW

Departments of Medical Microbiology and Pharmacy,
St Bartholomew's Hospital, London E.C. 1

(*Received* 4 *January* 1977)

SUMMARY

Water beds in use in this hospital were found to be contaminated with *Pseudomonas aeruginosa*. The addition of sodium hypochlorite, giving a final concentration of 200 parts/10^6 available chlorine, was found to be effective in preventing microbial contamination over a 6-month study period.

INTRODUCTION

The use of water beds for the prevention of decubitus ulcer was first suggested by Paget in 1873. It was not until the late 1960s, however, that water beds became commercially available for the treatment and prevention of pressure sores in patients predisposed to their development (Bliss, McLaren & Exton-Smith, 1966; Jones & Burniston, 1971; Jones, Hatzidoulis, Chestnut & Stewart, 1975). One aspect of their maintenance which has received little attention is that of keeping them free from bacterial contamination.

Water beds in this hospital were examined for microbiological contamination after a report that the water was foul and malodorous. We describe here a method which we found satisfactory for their disinfection.

MATERIALS AND METHODS

The five Belmedical water beds (MSA) in this hospital are maintained at a temperature of 37 °C when in use. Each bed has a water capacity of between 80 and 100 gallons. Beds are stored empty in stores or in a sideroom and transported to a ward when the need arises. Before this investigation there was no regular change of water or addition of disinfectant. At the start of the study three beds were in three widely separated wards. Two beds were in storage empty.

Water sampling and culture

100 ml of water was withdrawn from each bed, using a sterile 50 ml syringe. Tenfold serial dilutions were carried out and 0·2 ml was plated out in triplicate on nutrient agar. Plates were incubated aerobically at 37 and 25 °C for 1 and 4 days respectively. The remaining water was filtered aseptically through a 0·45 μm Millipore filter unit. The filter pad was then incubated on nutrient agar at 37 °C for 2 days. The resulting colonies were counted and identified.

Table 1. *Typing of* Ps. aeruginosa *strains from water beds and patients*

Ward	Source	Strains isolated: Serotype	Strains isolated: Bacteriophage type
1	Bed 1	3	44, 68, F8, 109, 352
		1*	7, 21, 44, 68, F8, 109, 352
		NT	NT
	Bedsore of patient on bed 1	2a/2b/5c	44, 109, 1214
2	Bed 2	7	NT
	Bedsore of patient on bed 2	3	NT
3	Bed 3	1*	7, 21, 44, 68, F8, 109, 119X, 352
	Patient on bed 3		
	Bedsore	11	24, 119X
	Urine	6	7, 73, 109, 119X, M4, Col 11,
		11	24, 119X

* Identical strains.

Disinfection of water beds

The mattresses were emptied and refilled with approximately 90 gallons of mains water. 900 ml of 10% sodium hypochlorite was then added to each bed, giving an approximate concentration of 200 parts/10^6 available chlorine.

Water samples were examined bacteriologically at 3 weekly intervals for a period of 27 weeks, as previously described. Before culture, water samples containing hypochlorite were first neutralized with 0·5 ml of 3% sodium thiosulphate solution.

The chlorine content of the water samples (50 ml) was estimated by liberation of iodine from potassium iodide and titrating against N/100 sodium thiosulphate solution using iodine indicator (BDH). Samples were taken from beds 1–4 at 3 weekly intervals for weeks 9–27 after the addition of hypochlorite solution and from bed 5 immediately after the addition of the disinfectant.

RESULTS

Pseudomonas aeruginosa was isolated in pure culture from each of the three water beds initially examined, with bacterial counts ranging from 10^6–10^7 organisms/ml. At the same time *Ps. aeruginosa* was also recovered from swabs of bedsores taken from all three patients on the water beds and from a urine specimen from one of the patients. The serological and bacteriophage typing results of these isolates is shown in Table 1. After the addition of hypochlorite to each of the water beds, no micro-organisms were recovered from any water sample by the methods used during the 6-month period. The available chlorine content of the water in the five beds is shown in Fig. 1.

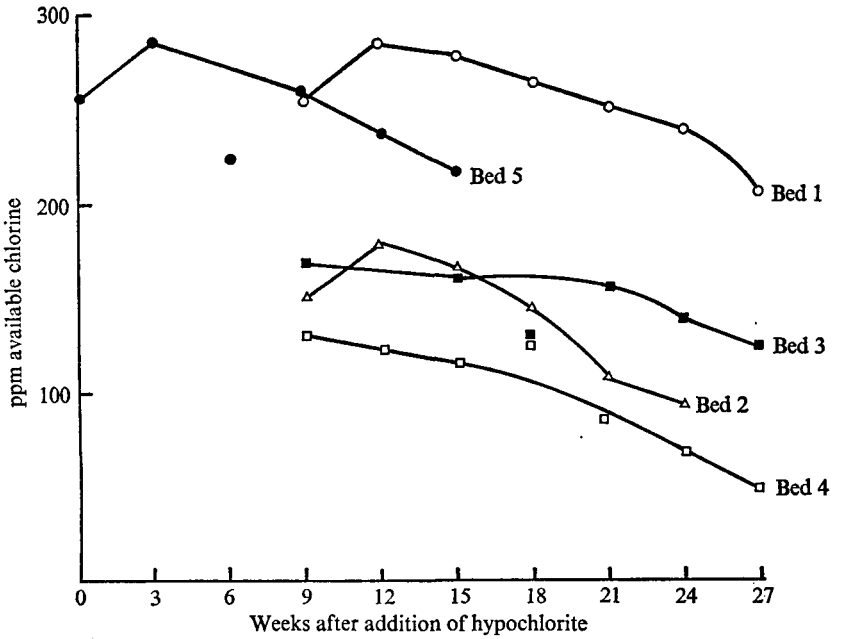

Fig. 1. Variation in chlorine content in water beds.

DISCUSSION

Storage of water in hospital environments has been shown to favour multiplication of gram-negative bacteria, particularly *Pseudomonas* spp. This has caused a number of problems in humidifiers, respirators, incubators and distillation units in pharmacies with the subsequent development of nosocomial infections (Bassett, 1971; Baird, Elhag & Shaw, 1976). This problem is augmented when the water is maintained at body temperature, as in water beds. Our results confirmed that these beds may be a source of *Ps. aeruginosa* which may be transmitted to other parts of the hospital when the beds are moved. The typing results indicated, however, that the strains of *Ps. aeruginosa* from the three patients were unrelated to the three strains from each of the water beds. Nevertheless, leakage of contaminated water may present a potential infection hazard to those patients who are ill and debilitated.

Prevention of microbial contamination in these water beds is most easily carried out by chemical disinfection. In a study on the effect of water bed flotation on premature infants, Korner, Kraemar, Haffner & Cosper, (1975) treated the water with an algicide (unspecified) and found that repeat cultures were negative during a one month's sampling period. One manufacturer has recently suggested the use of copper sulphate for the prevention of bacterial and algal growth. Our results have shown that use of hypochlorite provides a simple, effective and inexpensive way of maintaining water beds free from detectable microbial contamination. The available chlorine content within these enclosed mattresses was found to be maintained at a sufficient concentration to prevent microbial growth over a period of 6 months.

We are indebted to Miss Earl for first drawing our attention to the problem, the nursing staff for their co-operation in sampling the water beds, and the quality control department of the pharmacy for assaying the chlorine content of the water. We thank Dr M. T. Parker, Director of the Cross-Infection Reference Laboratory of the Public Health Laboratory Service, for typing the strains of *Ps. aeruginosa* and Professor R. A. Shooter for valuable advice.

REFERENCES

Baird, R. M., Elhag, K. M. & Shaw, E. J. (1976). *Pseudomonas thomasii* in a hospital distilled water supply. *Journal of Medical Microbiology* **9**, 493.

Bassett, D. C. J. (1971). Common-source outbreaks. *Proceedings of the Royal Society of Medicine* **64**, 980.

Bliss, M. R., McLaren, R. & Exton-Smith, A. N. (1966). Mattresses for preventing pressure sores in geriatric patients. *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* **25**, 238.

Jones, R. F. & Burniston, G. G. (1971). The water bed in a spinal injury unit. *Medical Journal of Australia* ii, 1215.

Jones, R. F., Hatzidoulis, C., Chestnut, U. & Stewart, L. (1975). The 'coast' hydrostatic bed. *Medical Journal of Australia* i, 333.

Korner, A. F., Kraemar, H. C., Haffner, M. E. & Cosper, L. M. (1975). Effects of water-bed flotation on premature infants: a pilot study. *Paediatrics* **56**, 361.

Paget, J. (1873). Clinical lectures on bed-sores. *Students' Journal and Hospital Gazette London* **1**, 144.