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Microbial contamination of non-disposable instruments in otolaryngology out-patients

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Abstract

Nosocomial infections are an important cause of morbidity and contaminated equipment may contribute to this. There has been little work concerning contamination of non-disposable equipment in Otolaryngology. This study investigates the efficacy of the cleaning regimen for non-disposable instruments in an Otolaryngology out-patients clinic. Instruments were swabbed before each clinic, when they had been autoclaved, then after use on patients, when they had been washed with detergent and chlorhexidine. Swabs of 86 instruments were cultured using standardized microbiological techniques. Fifteen instruments (17 per cent) were contaminated, most with coagulase negative staphylococci. Two specimens of *Micrococcus luteus* were cultured and one each of *Pseudomonas aeruginosa*, *Acinetobacter lwoffii* and *Aureobacterium* spp. *Micrococcus luteus* and coagulase negative staphylococci may represent skin contaminants, but *Aureobacterium* spp. and *Acinetobacter lwoffii* can be sources of nosocomial infection. *Pseudomonas aeruginosa* is a potentially serious pathogen and is implicated in the aetiology of otitis externa. These findings question the efficacy of the current cleaning techniques.

Key words: Equipment Contamination; Cross Infection; *Pseudomonas aeruginosa*

Introduction

One third of all nosocomial infections may be preventable, and they are frequently caused by organisms within the hospital environment.[1] Contaminated instruments used for examination and treatment of patients may contribute to this. Non-sterile equipment such as stethoscopes have been found to be contaminated with high levels of coagulase-negative staphylococci and methicillin resistant *Staphylococcus aureus* (MRSA).[2–4] Sterile equipment, such as theatre instruments, have been found to have low levels of contamination, again with coagulase-negative staphylococci.[5]

There have been some studies of Otolaryngology equipment, but not in the clinic setting. One study in a community paediatric clinic[4] discovered that 90 per cent of auriscope handles were contaminated, 9.5 per cent with MRSA. Another study in the same setting,[6] looking at contamination of auriscope end pieces, found 86 per cent were colonized: nine per cent with MRSA. A general practice-based study found 93 per cent contamination on ear-pieces, with *Staphylococcus aureus* and *Aspergillus* sp identified.[7] The equipment used in these studies was cleaned only sporadically.

The equipment used in Otolaryngology out-patients is a special case. It is sterilized prior to the start of the clinic and placed in non-sterile trays. Between patients it is washed, sprayed with anti-microbial agent and allowed to air dry. There are no data available on the contamination of the instruments in Otolaryngology clinics. The aim of this study is to evaluate the level of microbial contamination on the non-disposable instruments in Otolaryngology out-patients, at the start of the clinics (after sterilization), and post-cleaning after use on each patient.

Methods

All of the instruments in the study, apart from the laryngeal mirrors, were autoclaved either in the evening after the day's clinics or in the morning prior to the start. They are placed in the SES Little Sister 3 Autoclave (Eschmann equipment) which heats the instruments to a temperature of 134°C for 3.5 minutes. This equipment is checked once each day with TST Control Integrator control strips (Albert Browne, Leicester, UK). After sterilization the equipment is handled by the nurses and placed on non-sterile trays in the examination rooms. Laryngeal mirrors are not placed in the autoclave as the mirror can be damaged. They are cleaned by the technique outlined below.

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TABLE I
CONTAMINATION RATES OF DIFFERENT INSTRUMENTS IN OTOLARYNGOLOGY OUT-PATIENTS

Instrument	Number investigated	Number of instruments contaminated (%)	Organisms identified (number)
Tongue depressor	11	1 (9.1)	Coagulase-negative staphylococci (1)
Wax hook	7	0 (0)	–
Jobson Horne probe	12	3 (25)	Coagulase-negative staphylococci (2) *Micrococcus luteus* (1)
Auriscope end piece	10	2 (20)	Coagulase-negative staphylococci (3)
Split speculum	6	0 (0)	–
Crocodile forceps	8	2 (25)	Coagulase-negative staphylococci (1) *Micrococcus luteus* (1) *Aureobacterium* sp. (1)
Laryngeal mirror	13	3 (23.1)	Coagulase-negative staphylococci (3) *Acinetobacter lwoffi* (1)
Suction tube	9	1 (11.1)	Coagulase-negative staphylococci (1)
Thudicum nasal speculum	10	3 (30)	Coagulase-negative staphylococci (2) *Pseudomonas aeruginosa* (1)

Between patients the nurses clean equipment in the room. Instruments are washed and scrubbed in hot water with Hospec® detergent (Lancare Ltd., Warrington, UK). A syringe and pipe cleaner are used to clean the bore of the suction tubes. The instruments are then rinsed in a separate bowl of hot water and placed on paper towels. They are sprayed with Hydrex DS Pink chlorhexidine gluconate spray (Adams Healthcare, Leeds, UK) and allowed to air dry.

Special procedures are in place for human immunodeficiency virus (HIV) positive, MRSA positive or immunocompromised patients, but this study was concerned only with the routine cleaning methods used.

A range of instruments from two rooms in Otolaryngology out-patients was identified and labelled with autoclave tape (see Table I). The tape was applied before the instruments were autoclaved. Instruments were swabbed prior to the start of clinics, after they had been autoclaved and placed onto trays. They were also swabbed after each use, wash and spray. Individual instruments were followed through the clinics. Instruments were swabbed aseptically using sterile swabs moistened in sterile saline. The whole active end of each instrument was sampled in a standard way. Each swab was emulsified aseptically into 2 ml sterile brain heart infusion broth (BHI Lab M, Bury, UK). The broths were stored at 4°C and transported to the laboratory on the same day of testing. In the laboratory each broth was vortexed for one minute and a 50 µl sample was aseptically removed. This sample was inoculated onto a Columbia agar plate (Lab M, Bury, UK) supplemented with five per cent horse blood and 1 mg/L NAD (Sigma Chemical Company, Poole UK). All plates and the remainder of each broth sample were incubated overnight at 37°C in an aerobic atmosphere supplemented with five per cent carbon dioxide. All cultures were incubated for 48 hours.

After overnight incubation any bacterial colonies were identified using standard methods. A 10 µl sample of each broth was inoculated onto the same agar medium and incubated as described above. Colonies obtained via this enrichment process were also identified. Coagulase negative staphylococci were confirmed by their colonial appearance, Gram stain, catalase test and latex agglutination test for coagulase. *Pseudomonas aeruginosa* was confirmed as an oxidase positive Gram negative rod and confirmed to species level using the API 20 NE kit system (bioMérieux, Basingstoke, UK). *Micrococcus luteus* was confirmed by Gram stain, classical colonial appearance and confirmation using the API Staph system (bioMérieux, Basingstoke, UK). *Aureobacterium* sp. was identified by the Gram stain, catalase test and confirmed using the API Coryne Kit system (bioMérieux, Basingstoke, UK). *Acinetobacter lwoffii* was confirmed as an oxidase negative, Gram negative, coccobacillus using the API 20 NE kit.

Results

Contamination was detected on 17.4 per cent of the 86 instruments sampled. Coagulase-negative staphylococci were the commonest contaminant with 12.8 per cent of instruments contaminated with this organism alone, including one instrument with two different species of coagulase-negative staphylococci. One instrument (1.2 per cent) was contaminated with *Micrococcus luteus* alone and one (1.2 per cent) with *Pseudomonas aeruginosa* alone. A single instrument (1.2 per cent) was contaminated with both *Aureobacterium* sp. and *Micrococcus luteus* and another (1.2 per cent) was contaminated with both *Acinetobacter lwoffii* and coagulase-negative staphylococci.

A total of 43 instruments were sampled before the beginning of clinics. Of this sub-set, 12 (27.9 per cent) were contaminated. Most were contaminated with coagulase-negative staphylococci, but two *Micrococcus luteus*, one *Aureobacterium* sp. and one *Acinetobacter lwoffii* were also found. Three of the six laryngeal mirrors, which were not autoclaved before the start of clinics, were contaminated. Twenty-nine instruments were sampled after being first used on a patient and washed as outlined above. Of this sub-set only two instruments (6.9 per cent) were contaminated: one with *Pseudomonas aeruginosa* and the other with a coagulase-negative

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TABLE II
FOLLOW-UP TABLE OF SELECTED CONTAMINATED INSTRUMENTS: ORGANISMS GROWN

Instrument	Pre-use	Post 1st use and wash	Post 2nd use and wash
Thudicum-nasal speculum	No growth	*Pseudomonas aeruginosa* Enriched growth	–
Suction tube	Coagulase-negative staphylococci 81 colonies-direct growth	No growth	–
Crocodile forceps	*Micrococcus luteus, Aureobacterium* sp. Enriched growth	–	–
Laryngeal mirror	Coagulase-negative staphylococci *Acinetobacter lwoffi* Enriched growth	–	–

staphylococcus. A total of 13 instruments were sampled after second use on a patient and washing. One instrument (7.7 per cent) was contaminated with coagulase-negative staphylococci. The only instrument used a third time on a patient had no detectable contamination after washing.

Table I shows the contamination levels for the individual instruments investigated. All of the split speculae and wax hooks examined had no detectable contamination. The highest contamination rates were in the Thudicum nasal speculae, the crocodile forceps and the Jobson Horne probes.

Table II shows the progress of selected instruments through the clinics. The Thudicum nasal speculum had no detectable contamination at the start of the clinic, but after first use and wash was colonized with *Pseudomonas aeruginosa*. The suction tube was colonized with coagulase-negative staphylococci at the beginning of the clinic, then used on a patient. After washing it was sterile. The crocodile forceps and the laryngeal mirror were colonized with their respective organisms at the start of clinics, but were not used during the clinic.

Discussion

Due to the nature of Otolaryngology as a clinical speciality, a wide variety of patients, from neonates to the elderly, present to clinics. Certain groups such as the immunocompromised or those at the extremes of life may be more prone to nosocomial infection. An awareness of possible sources of infection is therefore vital to sound Otolaryngology practice. This study makes no attempt to assess the risk of acquiring an infection from contaminated instruments: no follow up was included to assess if infection resulted from contamination. The study seeks to discover if there is a potential source from which infection could develop.

This study has detected that 17.4 per cent of instruments in out-patients are contaminated. The main contaminants are coagulase-negative staphylococci and *Micrococcus luteus*. Coagulase-negative staphylococci are a part of the normal flora of the human skin while *Micrococcus luteus* may be an inhabitant or a contaminant of the skin. They are both usually harmless, but can cause infections in the immunocompromised. The main coagulase-negative staphylococcus is *Staphylococcus epidermidis*, that can cause infections related to prosthesis and indwelling devices.[8] Contamination with either of these organisms could originate from inadequate cleaning of instruments, which had been in contact with skin, handling of sterile equipment or putting sterile equipment in contact with non-sterile surfaces. Due to the microbiological techniques used, small colonies and even single organisms could potentially result in a positive culture.

Twenty-eight per cent of the sub-set of instruments sampled at the start of clinics in this study was contaminated, compared with 6.9 per cent after first use and wash and 7.7 per cent after second use and wash. The initial figure may seem very high, but the equipment at the start of the clinic is probably contaminated with normal skin flora from being handled between the autoclave and the out-patients' room, and then contaminated with any organisms in the non-sterile trays.

After use the equipment is washed, placed on paper towels, sprayed with antimicrobial spray and not touched until it is put back into the tray. Thus it is not surprising that contamination rates are lower.

One instrument was contaminated much more heavily than any of the others (Table II). The suction tube was the only instrument to have sufficient contamination for organisms to grow on direct inoculation without enrichment of the sample in broth. After use on a patient and washing, no contamination was detected, showing the efficacy of the cleaning regimen against the coagulase-negative staphylococci in this instance.

The other organisms found on the instruments at the start of clinics were *Acinetobacter lwoffii* and *Aureobacterium* sp. *Acinetobacter lwoffii* is widely distributed in soil and water, and may occasionally be isolated from skin. It can cause nosocomical infection such as pneumonia or bacteraemia in the immunocompromised. *Aureobacterium* sp. usually lives in the environment. It again causes infections such as bacteraemia in immunocompromised individuals.[9] While the *Acinetobacter lwoffii* may have been a skin contaminant, it is more uncertain as to where the *Aureobacterium* sp. originated.

After use on patients and washing, only three contaminated instruments were found. Two of these were contaminated with coagulase-negative staphylococci, and one was contaminated with *Pseudomonas aeruginosa* (Table II). *Pseudomonas aeruginosa* is widely distributed in soil and water. It may also exist in the intestine and in small numbers on the skin. It is pathogenic if the patient is immunocompromised or there is a breach in the

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normal immune defences such as a damaged mucous membrane. It can cause a range of conditions from meningitis to urinary tract infections. Of particular interest to Otolaryngologists is its role in the aetiology of otitis externa. *Pseudomonas* is also a very important cause of nosocomial infection. Serious outbreaks have caused mortality in a neonatal unit and severe respiratory infections in a respiratory unit.[10,11] The follow-up of the nasal speculum on which the *Pseudomonas aeruginosa* was found shows that it was not present at the start of the clinic. It was picked up between being selected for use, examining the patient's nose and being washed. A pure growth of *Pseudomonas* was obtained. It is known that *Pseudomonas* is able to resist cleaning solutions, and even live in them.[12] The chlorhexidine in this instance was not sampled. The origin of the *Pseudomonas* is uncertain, but it may have been from the colonization of the patient's nose, the cleaning solution or another source (although no other instruments were affected).

There are differences in the distribution of contamination between the various instruments, but the numbers are quite small. The results (Table I) show that most types of instruments were involved.

The results identify two main problems. The first is the high level of contamination of instruments at the start of clinics. The second is the survival of a potentially very serious pathogen on an instrument after it had been cleaned. The out-patients' clinic is not a sterile environment, containing many bacteria that commonly exist in the environment. This study only once detected the survival of *Pseudomonas aeruginosa* and more work would be needed to prove that greater numbers were killed by the current antimicrobials. Contamination of instruments could be reduced by using sterile trays for each clinic and minimizing the amount of handling of instruments. The Department of Health has a series of recommendations relating to the sterilization of instruments.[13] In a survey related to these, Otolaryngology departments were found to be one of the commonest clinical users of bench-top sterilizers,[14] but just 21 per cent of users were responsible for certifying the sterilizer fit for use. Further work is required to determine the efficacy of the autoclave and manual washing technique in Otolaryngology out-patients.

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