INFECTION CONTROL IN PRACTICE

Audit of bronchoscope disinfection: a survey of procedures in England and Wales and incidents of mycobacterial contamination

A. H. C. Uttley* and R. A. Simpson†

*Dulwich Public Health Laboratory and Regional Tuberculosis Centre, Dulwich Hospital, East Dulwich Grove, London SE22 8QF and †Division of Hospital Infection, Central Public Health Laboratory, 61 Colindale Avenue, London NW9 5HT, UK

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Summary: Procedures used for cleaning/disinfection of fiberoptic bronchoscopes and incidents of mycobacterial contamination were assessed by postal questionnaire. Information supplied by the Infection Control Doctor in 129 of 198 hospitals (65.2%) was used to audit local practice for compliance with national guidelines. Discrepancies between recommended and local practice included lack of specification of detergent/cleaning agent (57%), inadequate contact time for chemical disinfection (40%) and the use of tap water rather than sterile water for rinsing the disinfected bronchoscope (39.7%). Other procedural anomalies associated with mycobacterial contamination included failure to adhere to manufacturers' instructions to dismantle valves prior to cleaning and to autoclave valves/accessories. The association of mycobacterial incidents with the use of automatic washer/disinfector (17 of 18 incidents) together with Department of Health warnings of build-up of biofilm within these chemical-process machines gives further cause for concern.

Keywords: Bronchoscopes; disinfection; Mycobacterium chelonae; audit.

Introduction

Experience of bronchoscope contamination with Mycobacterium chelonae1-3 stimulated us to perform a survey to compare current practice with national guidelines for cleaning and disinfection of bronchoscopes.4,5 Records of the Regional Tuberculosis Centre (RTC), Dulwich Public Health Laboratory (PHL), London, revealed increasing referrals of strains of M. chelonae, often associated with bronchoscopes cleaned/disinfected in automatic washer/disinfector.6,7 Infection control doctors (ICDs) were often unaware of purchases of new equipment and their implications for disinfection policies. New purchases or policy flaws were often revealed when contamination occurred, frequently with M. chelonae. ICDs who had
encountered contamination also reported idiosyncratic local interpretation of the national guidelines.

Subjects and methods

Survey group and design of questionnaire
Questionnaires were sent to 253 medical microbiologists (members of the Association of Medical Microbiologists, Hospital Infection Society and PHLS Directors) in 198 hospitals in England (14 Regional Health Authorities, six Special Health Authorities) and Wales (six Health Authorities). The aim was to contact ICDs for each District Health Authority (DHA). Recipients were asked to ensure that only one questionnaire was returned from each DHA. Respondents were asked to provide information from their hospital unit which performed most bronchoscopies. No reminders or repeat mailings were sent. Assurance was given that responses would remain anonymous.

The questionnaire was designed to assess cleaning/disinfection practices for bronchoscopes, and included questions on number and type of bronchoscopes, workload, staff training and other factors relevant to infection control. A copy of each hospital's policy for bronchoscope cleaning/disinfection was requested. Information was sought of incidents of mycobacterial contamination of bronchoscopes in the preceding 4 years. The information provided in the questionnaires was compared with national guidelines and discrepancies highlighted.

Results

Questionnaires were returned from 129 hospitals (65.15%). The analysis is summarized as follows:

Bronchoscopes
Twenty-six per cent of units had one or more non-immersible bronchoscopes and 90% two or more. Less than 10% (6.2%) reported that their unit did not have a copy of the manufacturers' instructions.

Bronchoscope disinfection policy
Most units (84.5%) had written policies. Two without policies were prompted to write one on receipt of the questionnaire. Other policies were being revised. Surprise was expressed at discrepancies between written policies and actual practices.

ICDs or infection control teams had sole responsibility for writing policies in 39 hospitals (35.8%) and jointly with endoscopy staff in 24 (22.0%). In other hospitals, sole responsibility was given to endoscopy staff (28), theatre staff (5), a pharmacist and a radiographer, and the remainder to the DHA or manufacturers of bronchoscopes.
Guidelines from official bodies [British Thoracic Society (BTS), British Society of Gastroenterology (BSG)] were referred to in 83 policies (76.1%). Differences were noted between the guidance cited and the procedures stated in units’ policies.

Staffing and training
Designated individuals had responsibility for cleaning/disinfecting bronchoscopes in 117 (90.7%) units. Nursing staff usually were responsible for supervising (93%) and performing (89%) the tasks. Other staff who supervised or undertook cleaning/disinfection occasionally were doctors, operating theatres auxiliaries, technicians, a radiographer and a physicist. In three hospitals, the sterile services department was responsible.

Although specific training in bronchoscope cleaning/disinfection was reported in most units (83.7%), responsible persons had not received training in 16 units (12.4%). In some instances, training was provided for supervisors but not for staff who undertook the procedure. In three hospitals, specific training was given to neither.

Training on external courses, usually provided by endoscope manufacturers, had been completed by 86 (66.7%). Several respondents commented that courses were directed at gastrointestinal endoscopy with little or no reference to bronchoscopy. Two respondents indicated that external courses had been taken but trainees had left.

Procedures for cleaning and disinfection
Details given for cleaning/disinfection were audited against recommendations of the Working Party of the BTS which state that, ‘... before a bronchoscopy list and immediately after each case, the bronchoscope should be handled as follows:

(a) Dismantle the valve and thoroughly wash and brush all parts of the bronchoscope in neutral detergent.’

In this survey, dismantling of valves was confirmed by 57% of respondents and 43% stated the product used for cleaning. Neutral detergents were specified by 33% and enzymatic cleaners by 30%. Aqueous disinfectants, generally chlorhexidine-based, were used by 36% instead of or in addition to detergent. Two units used a disinfectant/detergent combined formulation. Ultrasonics were used as an adjunct to manual cleaning by 40 units (31%).

‘(b) Soak in 2% alkaline glutaraldehyde for 20 min between cases (this should suffice for a well-cleaned bronchoscope).’

Most units (87.6%) used 2% alkaline glutaraldehyde products for disinfection. Contact times ranged from 1 to 150 min. Forty per cent used less than the recommended minimum of 20 min.

‘(c) Rinse the channel and wipe the insertion tube with sterile water (or 70% alcohol) immediately before the next case.’

Sterile water for rinsing was used by 50% of units, tap water by 39.7%;
the remainder used filtered, distilled, softened or deionized water. Alcohol both as a final rinse and drying aid was used by 11%.

Use of endoscope washer/disinfector
Automatic machines for endoscope disinfection were used by 81 units (62·8%); 41 relied on manual methods and seven on a combination of manual cleaning and non-automatic disinfection trolleys. Less than half (43·2%) of those with an automatic machine stated that the cleaning/disinfection procedures included a prior, manual cleaning stage.

Sterilization of bronchoscope components and accessories
Valves/accessories were sterilized (autoclaved) with moist heat (steam sterilization) by 38 units (29·5%). Extended periods of immersion in chemical disinfectants were used by 52 units (40·3%). Thirty-nine units (30·2%) appeared to do neither.

Special policies for HIV and immunocompromised patients
More than half (52·7%) the units reported that one or more known or suspected HIV positive patients were seen each week. A bronchoscope was reserved for such patients in 12 units (9·3%). Some units changed procedures for patients suspected of having mycobacterial infection or who were immunocompromised.

Mycobacterial incidents
Eighteen units reported problems of mycobacterial contamination associated with bronchoscopes during the preceding four years. An automatic washer/disinfector machine was used in 17 incidents in which the final rinse was tap water (13), filtered (2), deionized (1) or sterile water (1). Remedial actions included thorough dismantling/cleaning of bronchoscopes, autoclaving valves before reuse, use of mains instead of tank water in the machine and rinsing bronchoscopes in sterile water. Two units assessed the risk associated with autodisinfectors to be sufficiently high to discontinue their use in favour of manual cleaning/disinfection.

Discussion
Discrepancies occurred between recommended and local practice and there were variations from local guidelines in many units. The BSG and BTS recommend that non-immersible bronchoscopes be phased out, not least because of the difficulty in cleaning. However, fully immersible bronchoscopes do not remove the need for dismantling and cleaning. Reported incidents of bronchoscopes [and in one case a colonoscope and gastroscope (personal communication)] contaminated with \textit{M. chelonae} highlight the need to dismantle and clean valves. Novel designs (e.g.
separation of biopsy/suction valves requiring autoclaving) must be notified to those responsible for cleaning/disinfection. In one incident, failure to autoclave a suction valve lead to infection with *M. tuberculosis*. Guidelines from manufacturers and official bodies have always recommended steam sterilization of dismantled valves and accessories. There was little evidence that this occurred routinely. It is essential that hospital policies refer to manufacturers' instructions. Wallcharts are valuable aide-memoires.

Many policies emphasized disinfection but not cleaning. Cleaning improves disinfection by removing most contaminating microorganisms (*M. chelonae* has a particular propensity to adhere to smooth surfaces and discouraging the build-up of biofilm, a barrier to disinfectant penetration. Few ICDs have technical knowledge of properties of detergents and their interference with disinfectants. There is little documented evidence on which to base detergent choice but a neutral product should be chosen which will not interfere with disinfectant activity. Policies must state the products chosen for cleaning and disinfection, based on information supplied by detergent, disinfectant and bronchoscope manufacturers.

The minimum contact time of chemical disinfectants and frequency of use of fresh solutions have been widely discussed. The range of contact times for disinfection in this survey indicated either a lack of awareness of official recommendations, or deliberate amendments to meet local needs. Extension of disinfectant contact time in excess of that recommended for mycobacteria has little justification. More disturbing was evidence that 40% of units had policies which recommended less than the minimum contact time of 20 min, some recommending only 1 min. The BSG guidelines clearly recommend different disinfection times for bronchoscopic and gastrointestinal endoscopy. Recent work has demonstrated the ease with which *M. tuberculosis* and other mycobacteria can be recovered from faeces (Dr C. Pankhurst, personal communication). The Association of Practitioners in Infection Control recommend, and we concur, that all endoscopes should be disinfected for 20 min. The activity of 2% glutaraldehyde solution freshly activated but unused has been demonstrated to decrease to 1.35% over 1 week at room temperature, and to 1.0% after 1 week of repeated use in automatic washer/disinfectors. Inactivation was less with manual processing. The minimum cidal concentration of glutaraldehyde for *M. chelonae* is not known but evidence suggests that freshly activated solution should be used for each bronchoscopy list.

The water quality required to remove disinfectant was often neglected. The BTS recommends sterile water as the final rinse, based on experience of bacterial contamination and endotoxin reactions. Department of Health (DoH) guidance stresses the use of rinse water with suitable microbiological quality and hardness. Our survey demonstrated the risk of using tap water from mains supplies or storage tanks, or distilled, deionized, softened or filtered water. There is evidence of increasing resistance of *M. chelonae* to
glutaraldehyde,\[16\] which reinforces the need to avoid contact of bronchoscopes with potential sources of the organism such as tap water.

Some units dedicated a bronchoscope for high-risk patients. This is irrational and contrary to BSG and BTS Guidelines.

Eighteen incidents of mycobacterial contamination were reported, probably an underestimate. There was no response to questionnaires from 35% of DHAs, and few laboratories subculture bronchoalveolar lavage/biopsy specimens under optional conditions for *M. chelonae.*\[17\] Seventeen of the 18 incidents were associated with use of automatic washer/disinfectors. It was impossible to determine whether this was equipment design or user error. Recontamination of endoscopes has occurred as a result of inadequate cleaning/disinfection of tanks and fluid pathways of endoscope washer/disinfectors.\[4,5\] The advantages of automated processes must be offset against risks associated with recirculation of tap water, decreasing concentrations of disinfectant and the ability of environmental bacteria to become established in biofilms on machine surfaces. Validation of recommended cleaning/disinfection and machine ‘self-disinfection’ procedures, including ‘worst-case situations’, is required.

Emphasis in UK endoscopy practice on chemical disinfection at room temperature, contrasts with preferences in Scandinavia, the Netherlands and German-speaking countries, for conventional washing machines using lower concentrations of chemical at elevated temperatures (up to 60°C). The development of European standards for performance specification of washer/disinfectors, including microbiological efficacy and user safety, may increase awareness of the advantages of heat or thermochemical disinfection, and increase the availability of reliable machines in the UK.

**Conclusions**

There are several key steps crucial for the prevention of mycobacterial contamination during cleaning/disinfection of bronchoscopes.

1. There must be awareness of changes in bronchoscope design which may require dismantling of two suction/biopsy valves.
2. Thorough manual cleaning must be performed, and organic matter, which lodges beneath the suction valve ‘O’ ring, must be removed.
3. Valves/accessories such as biopsy forceps must be autoclaved.
4. Neutral cleaning agents should be used which do not interfere with disinfectant activity.
5. Appropriate contact time for chemical disinfection must be strictly adhered to before, during and after lists, and disinfectant must be replaced frequently.
6. Water hardness and microbiological quality is critical. Ideally rinse water should be sterile, and should always be so when used as the final rinse.
7. Bronchoscopes should be suspended in purpose-built cupboards to ensure dryness of channels. They should not be stored in carrying cases.
Bronchoscope disinfection

Training in cleaning and disinfection of endoscopes is mandatory. This may include attendance at external courses as well as regular in-house training directed towards specific endoscopes.

We recommend manual disinfection for bronchoscopes, particularly if bronchoscopy is not performed daily. This recommendation is based on analysis of responses to the survey and continuing referrals to the RTC of strains of *M. chelonae* associated with bronchoscopes disinfected in automatic washer/disinfectors. This is despite the DoH Safety Action Bulletins circulated to alert users of such equipment about recontamination of endoscopes. Reliance must not be placed on automatic washer/disinfectors. In the absence of evidence to the contrary, build-up of biofilm and consequent colonization with mycobacteria and other opportunistic pathogens must be assumed.

References