Clinical Topics

Infection control revisited: dilemma facing today's bronchoscopists

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Abstract

The emergence of the acquired immune deficiency syndrome has provoked a widespread review of policies for infection control. Incomplete knowledge about the human immunodeficiency virus (HIV), hepatitis B virus, and mycobacteria has until now been compensated for by adopting "overkill" precautions for patients who were thought to harbour these organisms. This policy is no longer tenable, given the difficulty in identifying infected patients. The control of infection in hospitals must instead be based on the routine use of high standards of hygiene that are adequate to contain all pathogens. Attempts by bronchoscopists to formulate such a policy have been frustrated by the lack of a suitable disinfectant and by ignorance of the susceptibility of micro-organisms to cleaning and disinfection in a clinical environment.

Introduction

The requirements for the control of the human immunodeficiency virus (HIV) in endoscopy units are controversial. Fibreoptic instruments are a source of cross infection and are damaged by heat sterilisation and by most disinfectants. Few disinfectants are active against all the likely contaminants; some cause serious allergies among staff, and few have been tested under clinically relevant conditions. These difficulties have been compounded because clinicians are reluctant to accept any increase in the time taken for disinfection between procedures and also the Department of Health and Social Security say that further capital resources will not be provided without evidence that they are justified.

Cross infection at bronchoscopy

Of the many outbreaks of infection that have occurred after fibreoptic instruments were used most have been attributed to inadequate cleansing of the instrument or the use of the wrong disinfectant. Other causes are damaged instrument channels and contaminated rinsing water. Though the essential part of decontamination is thorough cleaning of the fibroscope, this may be confounded by the intricacies of the design of the instrument. Difficulty in dismantling biopsy valves on bronchoscopes, which were therefore immersed intact in disinfectant, led to cross infection with *Pseudomonas* spp and an outbreak of *Bacillus* spp.^{1,2} Though transmission of hepatitis B virus has not been reported at bronchoscopy, it was described after gastroscopy owing to failure to clean the instrument

air channel. Cross infection resulted despite the instrument being disinfected for 21 hours in 2% glutaraldehyde.³ Persistent contamination of two bronchoscopes with both *Mycobacterium chelonae* and *Pseudomonas* spp as a result of damage to the biopsy channel has been described.⁴ Infection with *M. chelonae* developed in two patients, one of whom died: specimens from nine patients were transiently colonised, and bronchoscopy samples from 72 patients were contaminated. Prolonged immersion in glutaraldehyde failed to decontaminate the instrument. *M. tuberculosis* infection has also been transmitted by a contaminated bronchoscope,⁵ and contamination of samples with *M. tuberculosis* and *M. avium-intracellulare* has been described.^{6,7} The disinfectants used were iodophors, cetrimide, and chlorhexidine, which have little mycobacterial activity. The use of 70% alcohol for disinfecting bronchoscopes has been implicated in the fatal transmission of *Serratia marcescens* and persistent contamination of bronchoscopic samples.^{8,9}

HIV and the lung

There is no evidence that HIV has been transmitted by fibreoptic instruments nor is bronchoscopy known to have transmitted any other virus. HIV has, however, been identified in alveolar macrophages, pulmonary lymphocytes, and lung biopsy tissue from patients with AIDS.¹⁰⁻¹³ Assays do not accurately quantify HIV nor, clearly, has the infectious dose for humans been determined. HIV infection in any patient should therefore imply a potential for cross infection, at least where the known routes of transmission exist.

HIV and health care

The incidence of seroconversion among health care workers after needlestick injuries from people infected with HIV is estimated to be under 0.9%, much lower than the 6-20% incidence from patients who are hepatitis B e antigen positive.¹⁴⁻¹⁶ Only five cases of seroconversion after splashing of the skin or mucosa have been reported, of whom three were hospital staff¹⁷ and two were members of the public who were providing nursing care to people with HIV infection.^{18,19}

Despite these reassuringly low figures the potential for transmitting HIV during bronchoscopy clearly exists. A bronchoscope contaminated with HIV may damage the nasopharyngeal or bronchial mucosa; biopsy forceps, which are difficult to clean, may inoculate material infected with HIV directly; furthermore, the bronchoscopist is at risk from spashing with blood or secretions coughed up by the patient.

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There are various strategies for protection against nosocomial transmission of HIV, but a standard infection control policy for all patients without recourse to serological testing has clear advantages.¹⁴⁻²⁰ Such a policy would ideally cover all pathogens encountered in clinical practice, including hepatitis B virus and mycobacteria, to remove completely the guesswork inherent in the current "two tier" approach to infection control. Ironically perhaps, the advent of HIV, which is not easily transmitted, has prompted a change in attitude to infection control that should have occurred decades ago after outbreaks in hospitals of hepatitis B virus infection. There are few published studies on the activity of disinfectants against HIV.²¹⁻²⁴ Although aldehydes are the only disinfectants suitable for use with fiberoptic instruments, in one study only was the activity of glutaraldehyde against HIV examined, and the method used does not permit reliable extrapolation of the results to clinical practice.²²

Alcohol has been considered an alternative to aldehydes for disinfecting fiberoptic instruments: 70% alcohol is effective against bacteria, mycobacteria, and viruses.²⁵ Using a tissue culture infectivity assay, 70% alcohol has been found to inactivate high concentrations of HIV in plasma in one minute at 23-27°C.²⁴ At this concentration, however, alcohol is a fire hazard; it also causes damage to the lens cements and flexible plastic and rubber seals of instruments. Several manufacturers have advised against its use, although immersing the insertion tube only for up to four minutes is acceptable if followed by thorough rinsing. Because alcohols penetrate organic matter poorly surfaces have to be scrupulously clean before disinfection, a factor which may underlie sporadic reports of its lack of efficacy.

Of the other disinfectants that do not damage fiberoptic instruments, Gigasept (formaldehyde and 1-4 dial/2,5 dimethoxytetrahydrofuran), Sporidicin (used as 0.125% glutaraldehyde and 0.44% phenol), and Dettol (quarternary ammonium compounds) are widely used. Sporidicin is said by the manufacturers to kill HIV in one minute at room temperature and mycobacteria in 10 minutes. It is, however, considerably less effective than 2% alkaline glutaraldehyde against vegetative bacteria.²⁵ Quarternary ammonium compounds are being used in many endoscopy units for disinfection, although they have poor activity against viruses and mycobacteria.²⁶

Hepatitis B virus and disinfectants

Although HIV has been the catalyst for reviewing infection control policies, the present two tier approach to infection control can be replaced only by a uniform policy that is also effective against hepatitis B virus and mycobacteria, the two other organisms for which special provisions are currently made. The susceptibility of hepatitis B virus to disinfectants is not fully understood because the virus cannot be propagated satisfactorily in vitro. In the limited studies that have been conducted either viral DNA polymerase assays or inoculation of treated virus into live chimpanzees were used to monitor viral inactivation. Viral DNA polymerase assays have little relevance to disinfection in clinical practice; animal studies have greater relevance, but the scarcity and cost of chimpanzees precludes achieving significant results. Using one chimpanzee per disinfectant, Bond *et al* showed that 2% alkaline glutaraldehyde, a 1:16 dilution of Sporidicin, and 70% alcohol all prevented transmission of hepatitis B after treating the virus (10⁸ chimpanzee infectious doses/ml) for 10 minutes at 22°C.²⁷ In a similar study using two chimpanzees per disinfectant virus was inactivated in 1% and 0.1% glutaraldehyde at 40°C for five minutes and 80% ethyl alcohol at 11°C for two minutes.²⁸

Although limited, these studies are perhaps important in dispelling the myth that hepatitis B virus is highly resistant to disinfectants.

Mycobacteria and disinfectants

Mycobacteria are the greatest obstacle to a uniform infection control policy for bronchoscopy units. Infection is often not suspected and rarely confirmed at the time of bronchoscopy. Despite this it is still current practice to rely on identifying infection before adopting effective precautions.

In the United Kingdom and since 1982 in the United States product licences have been issued on the basis of experimental evidence submitted by the manufacturer alone. Before 1982 about half of disinfectants evaluated by the Environmental Protection Agency in the United States failed to live up to their manufacturers' claims.²⁹ In 1985 the agency called for a reappraisal of manufacturers' claims about the mycobactericidal properties of their products, which led to an increase in recommended disinfection times from 10 minutes to one hour.³⁰ This large discrepancy resulted from the use of different assays and an initial failure to account for important variables that influence the mycobactericidal properties of disinfectants in clinical practice.³¹

Bronchoscopes and bronchoscopy lists

The complexity and fragility of fiberoptic instruments are not conducive to thorough cleaning, which should be performed only by trained staff. Cleaning in detergent can achieve a 2.5 log reduction in organisms and is the mainstay of the decontamination procedure.²⁵ Furthermore, disinfectants may be ineffective in the presence of organic material. Despite the development of fully immersible fiberoptic instruments many units still, illogically, reserve their older, non-immersible scopes for infected patients. Advances in bronchoscope design, with the introduction of extra channels and more complex valves, may regrettably make them more difficult to clean. This is a problem that deserves careful consideration from instrument manufacturers.

The number of bronchoscopes needed to perform bronchoscopy on a list of patients is expressed by the simple formula $d/b+1$, where d is the time taken for cleaning and disinfection and b the time taken to perform the bronchoscopy. In the current debate only the time taken to perform a bronchoscopy is constant: any suggestion that the cleaning and disinfection time are increased is met with requests from clinicians for more bronchoscopes. If a bronchoscopy lasts on average 20 minutes the procedures can be conducted without delays using two instruments, provided that cleaning and disinfection take no longer than this. The evidence presented here suggests that this is more than adequate for all organisms apart from mycobacteria. Indeed, it may be argued that thorough cleaning might reduce the disinfection requirements to only four minutes in 2% glutaraldehyde.³² But routinely adopting a 60 minute disinfection time to cover mycobacteria would cause delays between patients unless four bronchoscopes were used.

Conclusions

Pending the results of applied experiments on fiberoptic decontamination, bronchoscopists should ensure that their infection control practices routinely cover hepatitis B virus and HIV: this would not be unduly onerous. Covering mycobacteria also would be the ideal, and it may be argued that the number of patients on the list for bronchoscopy should be reduced or the number of available bronchoscopes increased to achieve this. The plea that "HIV is not a problem in

our area" is not an argument against change, with an estimated 1:1000 people in the United Kingdom now infected with HIV, a prevalence that is doubling every 10 months.

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How to do it

Develop diabetic care in general practice

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It is generally accepted that the quality of care provided for people with diabetes can be considerably improved, both in general practice and in hospital clinics. Although we concentrate here on general practice, there must be a cooperative arrangement between the generalist and the specialist, each with defined areas of responsibility if a good standard of care is to come about.

The division of responsibility will depend heavily on local factors such as what is available in the diabetic clinic and what skills general practitioners already have or can learn. The needs of different geographic areas will also vary. The final decision on what system of care is used in a practice must rest with the general practitioners since they have the responsibility of ensuring that it works.

What follows is based on our experience in a rural area of mid-Wales, with practices centred on small towns, some with general practitioner hospitals, and served by district hospitals some of which are up to 40 miles away.

Staged approach to improving care

Tackling the problem head on is a daunting prospect, and we found that a staged approach minimised the potential trauma. The stages were as follows: (a) Produce a register of all known patients with diabetes in the practice. (b) Do a baseline survey of the current state of care of these patients. (c) Then identify areas where improvement is necessary and agree a

practice protocol for diabetic care. (d) Implement a system of recall and clinical review for diabetic patients. (e) At regular intervals thereafter repeat the initial survey of care to identify any problem areas and evaluate the exercise.

In a busy practice the elements of this plan that are most likely to be omitted are the baseline and follow up surveys because of the amount of work entailed. Diabetic care in the practice is likely to improve without them, but it will not be possible to quantify the improvement or identify those areas in which problems remain.

Producing a register

Producing a register of diabetic patients in the practice will require little of the doctors' time. The receptionists and practice staff are asked to record all patients who receive repeat prescriptions for insulin, hypoglycaemic drugs, or testing sticks. Everybody in the practice tries to remember which patients have diabetes; the local diabetic clinic can be asked for a list of patients from the practice who attend, though this information may not be available. If there is sufficient demand, however, it should become available.

For each diabetic patient identified a small card is made out, recording the patient's name, address, sex, general practitioner's name, type of treatment, and the date the patient was last seen. The cards are stored in alphabetical order using a card index, and patients' notes are tagged with a coloured sticker. This process

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