A METHOD OF DISINFECTING ANAESTHETIC EQUIPMENT

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SUMMARY

Attention is drawn to the degree of contamination of anaesthetic equipment and the responsibility resting upon anaesthetists for disinfecting all apparatus between cases. Possible methods of disinfection are briefly reviewed. Reasons of efficiency, convenience, cost and practicability are given for suggesting that a domestic washing-up machine is the best form of disinfection so far devised.

Although Ziegler and Jacoby (1956) suggested that corrugated tubing and reservoir bags may not be significantly contaminated with bacteria by patients, anaesthetists have become increasingly aware of the existence and dangers of such contamination of the equipment they use. The role played by this vehicle in postoperative infection has not yet been ascertained but it is now well known that ventilators used in intensive care can be responsible for both re-infection and cross-infection. An editorial on this matter (1964) leaves the reader in no doubt that the risk is real and that the anaesthetist must make it his duty to ensure that cross-infection will not occur. The editorial goes so far as to suggest that the same standards should be applied to the work of the anaesthetist as to that of the surgeon.

Our interest in this problem was sharply stimulated by two recent outbreaks of postoperative chest infection which followed the opening of theatre suites. Before the introduction of the method of disinfection herein described, only the endotracheal tubes, connections and the pharyngeal airways received attention. These were thoroughly washed by hand, autoclaved and packaged. Laryngoscopes were washed under the tap by the theatre attendant.

Under these circumstances bacteriological investigation showed that parts of the anaesthetic equipment yielded profuse growths of Staph. aureus, Strep. faecalis, Esch. coli, Klebsiella aerogenes, as well as Ps. pyocyanea and Prot. vulgaris.

The accepted methods of disinfection were considered, namely high and low temperature autoclaving, boiling, steeping in antiseptic, e.g. chlorhexidine (Stratford, Clark and Dixson, 1964), and hand washing in soap and water. All were rejected, for various reasons given below, in favour of some automatic device which would both wash and pasteurize.

METHOD OF DISINFECTION

The baskets of a Swan Maid domestic washing-up machine were modified to accept anaesthetic equipment in such a way as to be most advantageous for the washing action of this machine.

The machine is then put through its normal cycle, the thermostat having been originally set as high as is allowed by the adjustment lever. The detergent agent, Hygleam C (recommended by the manufacturers for use in their machine for dish-washing) is added in the recommended way and quantity before closing the machine and so starting the cycle.

Figure 2 shows the temperature recorded by a thermocouple during a complete cycle. In one case the thermocouple was placed at the lower
Anaesthetic equipment positioned ready for disinfection.

Temperature within anaesthetic equipment during disinfection in the Swan Maid washing-up machine.

- Thermocouple inside a corrugated hose halfway along it at the apex of the curve.
- Thermocouple at the lower end of a catheter mount.

BACTERIOLOGICAL STUDIES OF THE ACTION OF THE "SWAN MAID" MACHINE

Corrugated hose was heavily contaminated with 24-hour broth cultures of Staph. aureus, Esch. coli, Proteus vulgaris, Ps. pyocyanea and Strep. faecalis, and then processed in the machine. At the completion of the cycle the tubing was removed and washed with sterile nutrient broth, and these washings cultured. No growth was obtained after 24 and 48 hours incubation at 37°C.

This procedure was repeated with a mixture of sputum specimens and cultures of the above organisms. The tubing was left lying on the laboratory bench for 2 hours before being processed in the machine. Again washings with nutrient broth were sterile after incubation for 48 hours.

Facepieces, connectors and laryngoscope blades were investigated in a similar manner. After thorough preliminary contamination with cultures, they were processed in the machine. Again washings were sterile in all instances.

No extensive studies were made with heat-resistant organisms such as spore bearers or viruses. In one preliminary study, however, using B. subtilis, a growth was obtained only from the corrugated tubing, and none from metal parts, catheter mount or reservoir bag.

DISCUSSION

Stark, Green and Pask (1962), although advising that all equipment coming into direct contact with the patient should be sterilized, do not consider the risk of infection from the remainder of equipment likely. They suggest that to keep separate apparatus for known infected patients is adequate. Stratford, Clark and Dixon (1964), on the other hand, disagree with this view. They rightly regard the hazard of cross-infection
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as existing even in patients apparently free from upper respiratory infection. They conclude that this hazard must be removed.

It is the duty of every anaesthetist to make sure that the equipment used is as free as possible of pathogenic bacteria. To be completely sterile is impracticable for two reasons, these being cost and the very nature of the manoeuvres required during general anaesthesia.

The ideal method of disinfection is by sterilization in an autoclave. To avoid the rapid deterioration of all equipment not made of metal, the autoclave must be a low temperature model. Such a machine is costly, and would have to be used by all theatres in the hospital. This would dictate an enormous stock of equipment, and also large and costly containers (probably disposable envelopes).

Jenkins and Edgar (1964) suggested a much cheaper method, one of pasteurization as was suggested for cystoscopes by Francis (1959). This method is quite impractical for several reasons. First, there is no mechanical washing to remove collections of saliva, pus, etc. Second, air pocketing is nearly impossible to overcome in tubing, and boiling will not disinfect tubing if air pocketing occurs (Meynell, unpublished observation, 1965). Third, much of the equipment after such treatment is wet. Corrugated tubing and reservoir bags are almost impossible to dry. It would be only too easy, when using a facepiece during induction of anaesthesia, inadvertently to pour water on the patient's face.

Stratford, Clark and Dixson (1964) make the economical suggestion of immersing all equipment in 0.1 per cent chlorhexidine for 20 minutes. They show that this gives a reasonable degree of disinfection. However, once again all apparatus is taken out soaking with solution. Further, all apparatus would have to be mechanically washed before immersion, as it would before pasteurization.

The nature of the Swan Maid washing-up machine overcomes these various disadvantages. It is economical at £120 when one machine will serve twin theatres. The equipment gets a thorough mechanical wash in a detergent solution. It is heated three times in such a manner as to kill all but sporing organisms and, presumably, some viruses.

The rather surprising degree of disinfection obtained may in part be attributable to the detergent. Hygleam C (Swan Brand name of Bulpitt & Sons adopted for Freedom made by Procter & Gamble Ltd.) at 1 oz. (manufacturers' recommended quantity) in 1½ gallons of water, which is the capacity of the tank, provides, theoretically, 33 p.p.m. of available chlorine. Pirie and colleagues (1965) showed that, in alkaline solution without chlorine, Esch. coli was killed in 2 minutes and coagulase positive Staph. aureus in 30 minutes at a temperature of 52°C. But when 20 p.p.m. of chlorine (actual amount) was available both organisms were killed in 15 seconds at the same temperature. During the washing part of the cycle of the Swan Maid machine the temperature ranges between 55° and 65°C, and the available chlorine is 33 p.p.m. (theoretical value).

Provided the equipment is left inside the closed machine for 20 minutes after the end of the cycle, even the corrugated tubing is taken out quite dry—the whole process taking 45 minutes. If taken out immediately, the equipment is wet, but not soaking, and so is usable in 25 minutes. Therefore no large stock of equipment is required, and since the machine is sited in the theatre suite, no costly packaging is necessary.

Endotracheal tubes have been processed in this way before autoclaving in packages for storing.

It is not claimed that the Swan Maid machine will guarantee absolute sterility; rather that it will kill those pathogenic bacteria with which anaesthetic equipment is likely to become contaminated. It is felt very strongly that this machine provides an economic and easy method of securing an acceptable degree of disinfection, a degree of disinfection which it is our duty to provide each time after equipment is used.

The Swan Maid washing-up machine is made by Bulpitt & Son of Birmingham. Any Swan Maid agent can obtain from them baskets modified and re-dipped for use with anaesthetic equipment.

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REFERENCES


BOOK REVIEW

Fourteen clinical papers deal with parenteral nutrition in various fields of surgery, including reports on balanced therapy over many weeks, up to 90 days in the only paper given in English. For energy supply a sugar: fat ratio of 3:1 in grammes is recommended. Fat emulsions may cause haemoglobin reduction and serum bilirubin increase. If amino-acids are used more potassium than contained in the standard solutions ought to be given, and for infants histidin ought to be added to Aminofusin. In several institutes mixed parenteral nutrition is given during the pre-operative period.

One author prefers enteral to parenteral nutrition, either by stomach tube or by gastrotomy (Witzel fistula), as the digestive juices can then act and overloading of the circulation is avoided.

Of special interest are observations in gynaecology and obstetrics. Differences in utilization and excretion of various amino-acids in pregnant and non-pregnant women have been investigated. Fat emulsions given during labour hardly raise the total lipids in the baby and are not deposited in the placenta. An unexpected side effect of fat infusions is an increase of uterine motility which has been utilized to produce abortion in cases of planned interruption of pregnancy and to induce labour in post-maturity cases. One suggested explanation is the stimulating action of unsaturated fatty acids on all smooth muscle.

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