STERILIZATION OF SURGICAL RUBBER GLOVES

BY

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The article by Sanford and Cookson in the *Journal* of March 28 (p. 412) contains certain unanswered questions, and makes me wonder whether it may not be of interest and use to surgeons to have some almost entirely practical figures on the methods and results of sterilization of rubber gloves, derived from the individual life-history of every pair which I have used in private during more than 30 years. I have not heard of the previous publication of any such record.

It is agreed that the value of a method of sterilization depends upon its results in respect of (1) absolute sterility, and (2) length of life of the glove—that is, the rate of deterioration of the rubber after repeated sterilizations. The first of these problems is easily settled, but the second is controversial. Most investigators wish to obtain their results within weeks, and therefore use rapid tests. The practical questions for the surgeon, however, are how many operations may be obtained from a pair of gloves safely sterilized before each operation, what is the most economical method of sterilization, and how different brands of gloves compare with one another. To answer these questions a careful record for many years is required, and observations based upon the experience of more than 30 years should provide this.

Only gloves used in private are included, as it has been found impossible to prevent the mixing of gloves in the hospital theatre. The conditions have remained unchanged. The gloves have been packed in the same way throughout, and for the last 27 years by the same nurse-assistant, whose method ensures the identity of each pair of gloves. I have sterilized them all myself, and in the same sterilizer. An occasional pair of gloves, but very rarely indeed, has been badly damaged in, say, a bone operation, and has been eliminated; but it is surprising, when the life-history of every individual pair is known, how nearly the life of all other gloves conforms to the average for the special brand of glove.

Technique

In a piece of calico two pockets are made, and each glove, powdered with french chalk inside and outside, is put into a pocket. A piece of gauze from the inside of the glove should extend from the roots of the fingers out at the cuff opening, so that close apposition of the rubber may not prevent the entrance of steam. The calico is folded upon its long axis, and, in hospital, where all the gloves are used at one sitting, gloves so packed are put into a container for sterilization. For private work, in which a couple of dozen gloves may be sterilized at once and used at intervals, the calico is next folded along its transverse axis into a square, is wrapped in a piece of gamgee tissue as a bacterial filter, and for convenience is tied up in "balloon fabric" or similar material, each pair of gloves being in a separate little package about $5\frac{1}{2}$ inches square and 2 inches thick. The gloves in these packages remain sterile certainly for many weeks, and the coverings last for years. The gloves are subjected for 20 minutes to steam at a pressure of 5 to 7 lb. The sterilizer used has been of the vertical cylindrical pattern, in which steam is generated by a large Bunsen gas-burner from water in the outer compartment, passes into the top of the inner compartment, and can be blown out by a large tap at the lower part. The gas flame is easily regulated so as to give the required pressure, but to a hospital sterilizer on a steam circuit must be attached a reducing valve, which pays for itself in economy of gloves. My sterilizer has not the negative-pressure attachment of the modern sterilizer, and the latter, indeed, seems to me to be fundamentally unsound, for in nothing but an impossible perfect vacuum will all the air be extracted, and sterilization is conducted by an unknown mixture of steam and inert hot air. In the old-fashioned sterilizer the air is completely blown out before pressure is allowed to rise. This accounts for the results of Sanford and Cookson, who found that when negative

pressure was produced once in the sterilizer the period of sterilization was 40 minutes, but when it was produced twice the period was 25 minutes—no doubt because more air had been extracted. The packages of gloves are put directly into the sterilizer (though of course they can be put into drums) and covered with non-absorbent wool. The upper layer may be superficially damp, but drying is rapid.

Sterility.—On numerous occasions small pieces of gauze soaked in cultures of various bacteria, including resistant spore-bearers, have been packed inside the tips of the various glove-fingers—presumably the most difficult part to sterilize—and in no case has a growth been obtained after sterilization by the above method.

Deterioration of Gloves

The decision that a pair of gloves must be discarded has usually been made at operation time—perhaps at the moment of putting them on—when it is considered that they would not stand another sterilization and remain trustworthy—a conclusion which, with experience, is reached with almost perfect accuracy. It is difficult to see how by any other means we can answer the surgeon's fundamental questions as to the most economical method of sterilization, the comparative value of the gloves of different makers, and the number of operations obtainable from each. For example, some years ago a well-known firm put on the market gloves which, they claimed, stood 40 successive sterilizations. Probably they did so, but, tested by the method above described, they survived on an average 11 operations only.

From our careful record the following statements are made with confidence: Gloves, loosely packed, are sterile after exposure to steam for 20 minutes at a pressure of 5 lb., provided all air has been removed from the sterilizer. As pressure is raised from the atmospheric there is no increase in deterioration of gloves until 7 lb. is exceeded. Thereafter rise in pressure means increased deterioration: thus if pressure mounts up to 10 lb. for even 10 minutes, an average of one or two fewer operations will be obtained from each pair of gloves in the batch. I have formed the definite opinion, though I have no actual proof, that gloves last longest if they have a "rest" of two or three weeks before resterilization. Sterilization by boiling in a perforated case along with the instruments causes more rapid deterioration, contrary to the opinion usually expressed, than steam sterilization as described above. At present, as before this war, the best obtainable glove is good for 9 to 10 operations; one much-advertised brand for only 3. Thirty years ago the average number of operations was 18 or more per pair of gloves; by 1920 it was 14; and there has since been a progressive diminution. I can offer no explanation of the change of quality; I can only state the fact.

The question was recently asked in this *Journal* (April 18, p. 514) why rubber gloves should not be sterilized by soaking in antiseptic, as heat causes some deterioration. The reasons are: (1) Such sterilization of rubber is uncertain, especially when, as in the case of gloves, the rubber is stretched in actual use. (2) Rubber deteriorates when soaked in an antiseptic. (3) If even a slight trace of antiseptic remains inside the glove the skin of the surgeon's hands is soon damaged. (4) If the antiseptic is thoroughly washed out by several washings in sterile water, each washing involves a risk of contamination.

Summary

Facts are given regarding sterilization of rubber gloves, based upon the life-history of every individual pair used during more than thirty years.

Sterilization by steam at a pressure of 5 lb. for 20 minutes is efficient provided all air is removed from the sterilizer.

There is no increased deterioration with increased pressure till 7 lb. is reached. Thereafter deterioration is progressive.

Boiling causes more deterioration than steam sterilization as described.

About 9 or 10 operations may be expected from a good brand of gloves at the present time.

The British Standards Institution has received a communication from the Minister of Production to the effect that the Government recognizes the British Standards Institution as the sole organization for the issue, in consultation with any Government, professional, or industrial bodies concerned, of standards having a national application.