STERILIZING SYRINGES IN A PRESSURE COOKER

Colonel H. C. JEFFREY
M.B., M.R.C.P.(Edin.), D.T.M. & H.
Professor of Pathology, Royal Army Medical College, Millbank.

G. M. HUNTER
M.B., M.R.C.S.
Formerly Captain, R.A.M.C.

STEWART (1957) tested syringe sterilization in a hospital autoclave and quoted previous observations. We have used his methods to test a pressure cooker and various syringe containers, taking account of size of syringe, state of assembly, lubrication, humidity, and pressure and time of sterilization. To test all these would have required nearly 3,000 experiments, so the work was simplified by testing a combination of factors until 100 per cent sterility was achieved and then pursuing a different combination. Some 1,600 syringes were contaminated and subsequently tested, with subsidiary tests for special features.

Equipment. A Pentecor pressure cooker was used with safety valves set at 40 lbs./in.² In each test 15 all-glass syringes (five each of 2, 5, and 10 ml.) were used without needles. We used four types of container: glass boiling tubes plugged with cotton wool, metal tubes of Hospital Apparatus Ltd. type, bags of double-thickness linen with a single-thickness flap, and kraft paper. The lubricants were vaseline, silicone and liquid paraffin. The contaminating organism mainly used was Bacillus cereus (N.C.T.C. 9687), which resisted boiling for over ten minutes and free steam for five, but did not survive autoclaving at 5 lbs./in.² for five minutes.

Methods. Before contamination, syringes were sterilized in a hot-air oven. Wet syringes were contaminated by drawing up 1 ml. of culture and exposing the inside of the barrel to it. When the syringe was assembled dry, only the plunger was contaminated by putting it in a culture and drying it off in an incubator. The syringes lubricated before contamination were lubricated before the initial sterilization. Syringes lubricated after contamination were perforce dried between contamination and lubrication. After the test period in the pressure cooker the inside of the barrel was irrigated with 1 ml. of medium, this was expelled into 9 ml. of broth, and the plunger was withdrawn and dipped into the broth too. Broth cultures were examined at 24 and 48 hours, and any growth was plated out to see whether it was the test organism. Two controls were set up: a few drops of the culture in a bijou bottle were included in each load, subsequently put into 10 ml. of glucose broth and incubated; in each test one 10 ml. syringe was treated in the same way as the others but not sterilized to show that the test organism was viable. Tests were done with combinations of pressure (lbs./in.²) and time (minutes) shown as 5/5, 10/10, 15/30, 30/20 and 35/30. In a separate series the inside and outside of both syringes and containers were examined for moisture after sterilization with these same five combinations.
Sterilizing Syringes in a Pressure Cooker

Results

The influence of syringe size. Unlubricated syringes (780), wet or dry, assembled or unassembled, in any type of container, were always sterilized by 15/20. Lubricated syringes (825) were frequently not sterilized (20.7 per cent) by 30/20, and once not even by 35/30. Far more tests were carried out on syringes lubricated before contamination than after, and the interpretation of the effect of time of contamination is unsatisfactory.

The influence of the lubricant. Vaseline was too viscous to apply and remove easily from the syringes, and it became so tacky when hot as to make the syringe useless. The initial results with vaseline were unsuccessful (83 per cent unsterile, compared with 23 per cent for silicone and 25 per cent for liquid paraffin at 15/20) so we stopped using it. There were no significant differences between silicone and liquid paraffin.

The influence of the state of assembly and of humidity. Results at 5/5 and 10/10, using unlubricated syringes showed that 18.9 per cent of dry assembled syringes, 8.8 per cent of wet assembled, 10.5 per cent of dry unassembled and 11.1 per cent of wet unassembled syringes, remained unsterile. These results are more or less what one would expect. The configuration of a dry, assembled syringe protects the organism by preventing the free access of steam, whereas if the syringe is wet there is a local production of steam. In unassembled unlubricated syringes, steam readily reaches the entire surface, and the humidity is of less moment.

The influence of the container has been judged mainly by the results on unlubricated syringes, where the numbers of tests with assembled or unassembled, wet or dry, syringes were comparable. The metal container was most unsatisfactory (25 per cent remaining unsterile) with glass tubes (7.5 per cent unsterile), linen bags (6 per cent unsterile) and kraft paper (none unsterile) far better.

The humidity of containers and syringes after sterilization. Results were little influenced by the pressure and time of sterilization, but the type of container made a great difference. For example, 83.3 per cent of the syringes were dry inside with glass containers, 80 per cent with metal, 36.7 per cent with linen, and 33.3 per cent with kraft paper; 90 to 100 per cent of the solid containers were dry on the outside compared with 6.7 to 20 per cent of the soft containers.

Discussion

The Medical Research Council Committee on the sterilization of syringes (1945) recommended a temperature of 120° centigrade (15 to 20 lbs./in.²) for 20 minutes to autoclave syringes, and they recommended light lubrication with liquid paraffin before sterilization. Our results, confirming and extending the observations of Stewart (1957), show that very many syringes contaminated with a spore-bearing organism would not thus be sterilized in a hospital autoclave, nor at higher pressure/time combinations in a pressure cooker. It appears that the general belief that syringes can be sterilized by autoclaving is wrong, and that only unlubricated syringes can be so sterilized. The maximum thermometer included with each load gave readings which overlapped between the pressure/time combinations. This emphasizes the need for wide safety margins in practice. Many syringes were moist inside when
removed from the pressure cooker, and so could not be used in taking blood for many purposes.

We know no published reference to the advantages and disadvantages of various syringe containers. It may be that our results may prove valuable, for the container can influence sterility. Some working points emerged. Glass tubes are easily broken, heavy and bulky, and need cotton wool, whereas the syringe can be seen inside and only one size of tube is necessary, provided the bottom contains cotton wool. Metal tubes are light, unbreakable, and robust, but their tops tend to jam, the syringe sometimes sticks in the tube, different sizes are needed for each syringe size, the syringe cannot be seen inside, and they are bulky and expensive. Linen bags are light and not bulky, can be re-used, and need be only one size. On the other hand syringes are invisible inside and needles must be protected. Kraft paper is light, not bulky, expendable, cheap, and can be cut to fit the syringe. It shares the disadvantages of linen bags and is more time consuming.

Summary

We have tested a Pentecon pressure cooker as a sterilizer for syringes. It sterilizes only un lubricated syringes. Lubricated syringes probably cannot be effectively sterilized by autoclaving. We used four types of syringe containers and assessed their advantages and disadvantages.

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