Formalin Disinfectant Unit for Incubators

Most infants admitted to premature baby or neonatal surgical units are nursed in incubators during part of their stay in hospital. There are many advantages of nursing these infants in incubators, but there is also one great disadvantage, the danger of bacterial colonization and contamination inside the incubator. The temperature inside the incubator approaches that of the body and many of these babies are nursed in an atmosphere of high humidity; conditions are therefore very favourable for the survival and multiplication of bacteria, especially the Gram-negative species.

In order to reduce colonization with pathogenic bacteria it is therefore necessary to clean and disinfect incubators thoroughly at short intervals usually every two or three days. Many modern types of incubator are now so designed that they are relatively easy to clean, but efficient disinfection still presents a formidable problem. As in the past disinfection by formaldehyde vapour has been time consuming and ineffective, a unit that is able to disinfect incubators automatically and efficiently in a relatively short time should be of considerable value to every premature baby and neonatal surgical unit. The model 33 formalin disinfection unit manufactured by Vickers Ltd., Medical Engineering, has been designed to disinfect incubators, hyperbaric chambers, and possibly also some types of mechanical respirator.

The prototype of this machine has been used and tested in the Liverpool Regional Neonatal Surgical Unit for over a year and lately the production model

![Formalin disinfection unit showing disinfection cabinet and console.](image-url)
FIG. 2.—Disinfection cabinet opened to show arrangement of incubator and loose parts ready for disinfection.

of the same unit has been tested. It consists of a disinfection cabinet and a console, the latter housing the automatic timing mechanism, and the formaldehyde and ammonia gas generator (Fig. 1 and 2). 20 ml of a 20% formaldehyde solution are evaporated and circulated through the disinfection cabinet (Fig. 1 and 2). The formaldehyde is then exhausted to atmosphere and fresh air is introduced. Any remaining formaldehyde is neutralized by circulating ammonia produced by evaporating 20 ml of a 10% solution through the cabinet. Finally the ammonia is exhausted and fresh air is circulated through the chamber. The whole cycle is automatic and takes 3 hours to complete. Safety devices prevent the console and the cabinet door being opened during the disinfection process. Apart from an electric plug no special installations are needed, the fumes escaping via a tube lead out through a window.

It is important that the instructions regarding removal of fabrics, initial cleaning to remove gross contamination, opening of ports, arrangement of loose equipment, and operation of a fan during the cycle should be followed.

The following method of testing is used. 24-hour broth cultures of recently isolated strains of *Esch. coli*, a Klebsiella species, *Ps. pyocyanea*, and a non-pyogenic staphylococcus are diluted 1 in 10 in broth, and an autoclaved yeast suspension added to 2%. These are swabbed on to appropriate areas of the incubator about 2.5 cm square, and allowed to dry before the disinfection cycle is started. On completion, they are rubbed with a moist swab which is used to inoculate plates directly and then broken off in broth. After 48 hours' incubation the broth cultures are examined for growth, and, if necessary, subcultured. Parallel tests in which the inoculated incubator was left in air for the same length of time as the disinfection cycle gave vigorous growth with all organisms.

The results of repeated tests have been consistent. On exposed surfaces, even though these may have
been in sites where air circulation is impeded, there has been a complete bacterial kill. Where, however, there is close apposition of surfaces, as beneath the rubber gaskets surrounding the windows, bacteria have survived the disinfection process. Tests using \textit{C. albicans} have given the same results.

It appears, therefore, that careful preparation of incubators, followed by the recommended cycle, will result in a satisfactory kill of organisms which are most significant in neonatal infections in those areas of the incubator from which spread to the next occupant occurs. It is not considered that survival beneath closely fitting gaskets, which should not be disturbed during normal use, is a major disadvantage.

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\section*{Adult and Fetal Haemoglobin Haemolytic Disease of the Newborn}

Enumeration of adult cells in cord blood is frequently used as an index of efficiency of an intraperitoneal transfusion. There is still controversy about the proportion of adult and fetal haemoglobin found in rhesus affected babies not treated by intraperitoneal transfusion. Jonxis (1948), Schulman and Smith (1954), Brody and Engström (1960), and Oppé and Fraser (1961) found an increase in the proportion of adult haemoglobin in the cord blood of babies with rhesus haemolytic disease, while Ponder and Levine (1949) did not.

We have studied a new series of rhesus affected babies who had not received intraperitoneal transfusion, to see if there was a disproportionate increase in adult haemoglobin.

We report here a series of 14 rhesus affected babies of varying gestational ages in whom the proportion of adult and fetal haemoglobin did not differ significantly from that in a series of normal babies previously examined (Bhoyroo \textit{et al.}, 1970).

\section*{Methods}

Cord blood was taken from 14 infants (gestational ages 33-40 weeks) with rhesus haemolytic disease who had not received intraperitoneal transfusion. The percentage of fetal haemoglobin and of fetal cells was measured by the alkaline denaturation method of Singer, Chernoff, and Singer (1951) and the Kleihauer technique (Kleihauer, Braun, and Betke, 1957) respectively.

\section*{Results}

The data obtained are set out in the Table and illustrated in Fig. 1 and 2.

The percentage of fetal haemoglobin is shown in Fig. 1 and that of fetal cells in Fig. 2, in each case with reference to gestational age. In all except one case the results fell within the normal range for both techniques (Bhoyroo \textit{et al.}, 1970).

\section*{Discussion}

Mollison (1943) showed that when rhesus (D) positive adult cells were transfused into babies with haemolytic disease, these cells and the baby's cells were destroyed indiscriminately. However, on theoretical grounds one might expect a slight increase in the proportion of adult haemoglobin since the blood of a baby whose haemopoietic tissue is responding to haemolysis will contain a relatively younger population of cells.
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