Effect of Methoxyflurane on Plastic Catheters

Takao Saito, M.D.*

Methoxyflurane seems to affect various plastics, especially p.v.c., to considerable degree and this may be a problem in clinical use of the agent.

Methoxyflurane (vapor)-oxygen mixture passing through an endotracheal catheter made of p.v.c. or like substance forms numerous tiny droplets on the inner surface of the catheter within a relatively short time, if methoxyflurane concentration is above 1 per cent.

Three Rusch transparent endotracheal catheters were used in the experiment. Only oxygen passed through one tube, 1 per cent methoxyflurane through the second one and 1.8 per cent methoxyflurane through the third one for thirty minutes. Many droplets could be seen in the third tube.

The droplets grew gradually and a considerable amount of liquid accumulated in the catheter within several hours.

The same phenomenon was observed with a Foregger endotracheal catheter (transparent), a Cole endotracheal catheter and other transparent endotracheal catheters made of p.v.c. or similar substance.

The liquid obtained from the catheter was examined by infrared spectrophotometry and gas chromatography for identification. The figure shows the result of infrared spectrophotometry. The liquid from the catheter apparently contained both methoxyflurane and DOP (di-octylphthalate), commonly used plasticizer added to p.v.c. Gas chromatography confirmed the findings.

Dissolution of methoxyflurane into p.v.c. and accumulation of DOP-methoxyflurane mixture in the tube might rarely result in direct contact of the solution with the tracheobronchial mucosa and irritation. Also, plasticity of the catheter will be reduced particularly at the inner surface of the catheter. Another problem is the fact that "Tenthrane odor" of the catheter remains for a long time, until the droplets are practically dried up.

Halothane also dissolves the plasticizer, as Dr. Sadove and Dr. Wallace pointed out, and p.v.c. becomes hard apparently because of losing plasticizer following long and repeated exposure. However, halothane seems to form droplets on the inner surface of p.v.c. endotracheal catheter only in relatively high con-

Infrared spectrophotometry. —— Liquid from catheter; ———— DOP; ——— methoxyflurane.
centration. Halothane vapor of clinically common concentration, usually below 4 per cent did not form any droplets within a few hours.

Methoxyflurane dissolves into DOP approximately 4.6 times more than halothane at 31°C, according to our experiments. This may be the cause of the difference.

Extensive studies are now in progress about this problem by Dr. K. Wakisaka of our department and Prof. F. Kametani, School of Pharmacy, Tokushima University.

Reference

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GADGETS

Equipment for Respiratory Resuscitation (2)

JOHN W. PEARSON, B.M., AND JOSEPH S. REDDING, M.D.*

In a previous communication we pointed out that one model of self-inflating bag for respiratory resuscitation delivered a low volume of air per squeeze.

The Western Anesthesia Equipment Company (Palo Alto, California) has made yet another model of Pulmonator bag. It is interesting to consider what would be the desirable characteristics of such a bag, and to see to what extent available equipment meets these standards.

Variables that can be studied include "single breath" or tidal volume, refill time, force needed to squeeze, durability, and cost. Although resuscitation victims may not need a large tidal volume, many rescuers are inexpert at achieving a snug fit with a mask and large leaks occur. We believe that the required tidal volume of the bag should be at least 1,000 ml. Refill time governs the maximal rate of ventilation of the victim, and the maximal minute volume. To control ventilation in some patients with dyspnea, such as those with pulmonary edema, we believe that a rate of at least 40 squeezes per minute should be possible. Considerable force should not be needed to squeeze the bag because resuscitation may be prolonged and arm and hand cramps may develop in the rescuer. Durability and cost are of lesser, though sometimes significant, importance.

A study was undertaken to evaluate four available types of self-inflating bag. One bag was the large-size old model Pulmonator, a thin rubber bag filled with sponge rubber. Another was a newer model Pulmonator consisting of a thick shell of black neoprene. A new model Pulmonator was also tested: this consists of a thin shell of red polyvinyl and polyethylene plastic. The fourth model was a new Ambu bag (Air-Shields Inc., Hatboro, Pennsylvania).

### Evaluation of Four Types of Self-inflating Bag

<table>
<thead>
<tr>
<th>Tidal Volume, ml (mean and range)</th>
<th>Rate Per Minute (mean and range)</th>
<th>Minute Volume, Liters (mean and range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonator old model</td>
<td>1451 (920–1,800)</td>
<td>30.4 (21–39)</td>
</tr>
<tr>
<td>Pulmonator neoprene shell</td>
<td>75 (500–870)</td>
<td>75.4 (63–98)</td>
</tr>
<tr>
<td>Pulmonator polyvinyl shell</td>
<td>1212 (825–1,600)</td>
<td>57.8 (37–84)</td>
</tr>
<tr>
<td>Ambu</td>
<td>1250 (720–1,600)</td>
<td>40.0 (24–67)</td>
</tr>
</tbody>
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