endoscopy, it was determined that the lumen of the trachea was too narrow because of the tumour. Therefore, the Carlen's tube was not used for fear the tube, when inserted, might dislodge or tear off a large piece of the lesion, hence causing heavy bleeding.

Figure 2D shows a Tovell tube with a small plastic connector. This tube was kept in readiness in case the surgeon wanted to ventilate both lungs during the operation while he was operating on the lower segment of the trachea. This tube could fit over the carina and into both right and left bronchi with excellent sealing capabilities because of the special adapted rubber cuffs. The tube in figure 2A was meant to be used in the same fashion, but could be placed deeper into each bronchus.

The main emphasis with reference to figure 4 is not part A and B, but rather C and D. The use of these tubes is explained in the text (pp. 384–385). We feel that the captions to figures 2 and 4 show and explain clearly the special adaptations made to various endotracheal tubes.

We would like to thank you for the opportunity to share with you the experience reported by Dr Machell and in allowing us to answer the questions that Dr Machell raised.

Maurice Lippmann
Martin S. Mok
Los Angeles

A HEATED ARTIFICIAL LUNG

Sir,—In certain experimental work it is necessary to have an artificial lung which simulates the human lung in terms of resistance, compliance and temperature. A device of this nature has been described by Hayes and Robinson (1970).

In their design the working fluid was air of normal composition, but as a heat exchanging medium air is not particularly effective.

When a lung of this type was tested it was found difficult to maintain a stable temperature uniform throughout its volume, and the transfer of heat from the electrical heating element was inefficient without a means of inducing a strong flow of air over the element. A solution to these problems was found by using a heater element immersed in water (fig. 1). With this system the working fluid is air fully saturated with water vapour and the heat energy per unit volume is about 4 times greater than for dry air. This means that a given loss of heat as the lung expires air which has been warmed produces a far smaller decrease in temperature. In fact once equilibrium is regained the temperature variation is negligible.

As a result of the heat capacity of the volume of water used and the electrical input power available, the warm-up phase is relatively slow. This is revealed also by the length of time required to regain equilibrium after the ventilator is switched on, although the final temperature is steady at the original value of 36 °C. The precision of the control device (a thermistor driving a burst-firing thyristor circuit supplying the heater) is of the order of ± 0.5 °C.

G. E. Smyth
(formerly with Philips Medical Systems Ltd)

REFERENCE

INTERACTION BETWEEN MORPHINE AND DOXAPRAM

Sir,—In the excellent paper entitled “Interaction between morphine and doxapram in the rabbit and mouse” (Gregoretti and Pleuvry, 1977), the authors showed clearly that doxapram effectively reversed the respiratory depressant actions of morphine. These results, obtained in animal studies, correspond with our data obtained in human volunteers (Gasser and Bellville, 1975). Our study was designed to determine the respiratory effects of pentazocine and doxapram on the minute ventilation–end-expiratory $P_{CO_{2}}$ response curve in six healthy male subjects, aged 20–30 yr who had no laboratory or clinical evidence of respiratory, cardiovascular, liver or kidney disease. Pentazocine 30 mg i.m. produced marked respiratory depression and doxapram 60 mg i.m. produced significant respiratory stimulation. When this dose of doxapram was given in combination with pentazocine 30 mg, it produced significant reduction in the amount of respiratory depression induced by the narcotic. Our statistical analysis led to the conclusion that the considered effect was simply additive.

J. C. Gasser
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REFERENCES