A DISPOSABLE CONDENSER HUMIDIFIER FOR USE DURING ANAESTHESIA

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HUMIDIFICATION of anaesthetic gases is desirable both to prevent pulmonary damage during endotracheal anaesthesia,^{1,2,3} and to prevent heat loss and minimize falls in body temperature during surgery.⁴ Unfortunately, many of the methods which have been described for the humidification of anaesthetic gases are cumbersome, complicated, and are a potential source of danger.⁵

The heat and moisture exchanger (H.M.E.)^{6,7} provides a simple means of conserving heat and moisture within the respiratory tract during tracheal intubation. It has been demonstrated to maintain humidification during anaesthesia with minimal additional apparatus.⁸ The use of an H.M.E. during anaesthesia has not been widely adopted, however, due to the lack of a suitable low resistance model which can be easily sterilized.

A new disposable thermal humidifying filter* with a paper element was recently introduced for use with tracheostomy tubes. The performance of this device, which has been modified for use during anaesthesia, is the subject of this paper.

MATERIALS AND METHODS

The disposable H.M.E. for use during anaesthesia (see Figure 1) consists of a plastic cylinder provided with standard male and female 15 mm connections. Within the cylinder is an element consisting of a roll of micro-porous paper 21 mm in diameter and 16 mm in length. When this equipment is attached at the proximal end of a tracheal tube and incorporated into an anaesthetic circuit, apparatus dead space increased by 12 ml.

The efficiency of this H.M.E. as a humidifier was determined by measuring total water loss from the respiratory tract in a series of anaesthetized, intubated patients, before and after attaching the H.M.E. to the tracheal tube. Total respiratory tract water loss was measured using a T-piece system.⁹ The relative humidity and temperature of the mixed expired gases and dry fresh gas was measured using an AMLAB H-1 (Amlab Company) hygrometer and thermistor probe in the expiratory limb of the T-piece. From these measurements the absolute water content was calculated, which was equal to the total respiratory water loss. The accuracy of this method has been evaluated using a dummy lung in the laboratory.⁹

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FIGURE 1. The disposable heat and moisture exchanger (H.M.E.) and paper element.

RESULTS

The resistance of the H.M.E. was measured at various flow rates using a water manometer and the results are shown in Figure 2. These measurements were made on a new dry filter and on a filter which had been soaked in water. In normal use, however, with dry anaesthetic gases supplied from a standard anaesthetic machine, the H.M.E. does not become saturated with use.

Total respiratory water loss in 14 patients varying in age from 4 years to 18 years, before and after the addition of the H.M.E. to the proximal end of the tracheal tube, is shown in Figure 3. Note that water loss is decreased by approximately 50 per cent when the H.M.E. is used.

DISCUSSION

Despite the disappointing lack of direct clinical evidence that breathing dry gases for the duration of anaesthesia causes increased morbidity from pulmonary complications,¹⁰ many anaesthesiologists are convinced that dry gases must be harmful, a view which is supported by numerous laboratory studies. Certainly the role of adequate humidification as a means of maintaining body temperature is recognized. Failure of anaesthesiologists to provide routinely for humidification of inspired gases is largely a result of the lack of a safe, simple, and convenient humidifier.

FIGURE 2. Resistance to flow of the H.M.E. at various flow rates, measured (a) dry (dotted line) and (b) after soaking the element in water (continuous line).

The H.M.E. has been suggested repeatedly for use during anaesthesia,^{7,8,11} but has not gained wide popularity. The main problems have been cross infection and increasing resistance to ventilation after repeated use.⁵ The effective disposable low resistance condenser humidifier described above eliminates these problems.

The fact that a paper element acts efficiently in an H.M.E. is not surprising. Such devices perform optimally when the element is thermally isolated from the outside air, and when material of low heat conductivity is used which will permit the development of a temperature gradient between the ends of the element.¹² The design of the model which was tested embodies both these features, and this model equals the performance of metal screen condenser humidifiers,¹¹ which reduce the total respiratory water loss by as much as 50 per cent.

Condenser humidifiers will function more efficiently at higher ventilatory rates and lower tidal volumes, and hence are ideally suited to paediatric use. The

RESPIRATORY WATER LOSS DURING ANAESTHESIA EFFECT OF H.M.E. (PORTEX MODEL)

FIGURE 3. Total respiratory tract water loss during anaesthesia. Results in 14 patients measured before (continuous line) and after (dotted line) addition of the H.M.E. to the tracheal tube.

increase in apparatus dead space involved can be adequately overcome during controlled ventilation.

The H.M.E. has proven to be a very effective method of heat conservation in patients under anaesthesia. The maintenance of normothermia in small infants has been made easier; indeed, in a few patients the body temperature may even increase. In these cases other methods to warm the patient, e.g. heating blankets should be discontinued until normothermia is restored.

SUMMARY

A disposable heat and moisture exchanger ("Artificial Nose") which is designed for use during endotracheal anaesthesia is described together with an evaluation of its performance. It has a low dead space, minimal resistance to gas flow, and is potentially capable of conserving 50 per cent of the respiratory water loss in the intubated patient.

RÉSUMÉ

Un condensateur de vapeur d'eau à usage unique a été modifié pour l'utilisation en anesthésie. Il a été démontré qu'il conservait 50 pour cent environ de l'eau perdue dans les voies aériennes.

Ce condensateur a un espace mort de 12 ml et offre une résistance relativement faible au flux gazeux. Le fait que ce modèle jetable de condensateur de vapeur

d'eau soit valable permettrait d'éliminer les problèmes qui avaient dissuadé de l'utilisation de ce dispositif au cours de l'anesthésie.

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