APPLICATION OF TRANSTRACHEAL PRESSURE OSCILLATIONS AS A MODIFICATION OF "DIFFUSION RESPIRATION"

Sir,—A disadvantage of diffusion respiration is the slow elimination of carbon dioxide. A method of oxygenation and carbon dioxide elimination without ventilation is needed for the clinical application of bronchoscopy, endo-thoracic surgical intervention, experimental research, and especially in neurophysiology, where a pulsation-free preparation of the brain is often sought.

Over the past few years we have developed a means of measuring cardiac performance by the myocardial reaction to pericardial pressure oscillations. The application of endo-thoracic pressure oscillations by transtracheal vibrations to measure transmyocardial pressure transmission was accompanied by cessation of ventilation, because the experiments required complete muscle relaxation. Thus the problem of gas exchange arose.

Methods.

In 3 dogs, after premedication (atropine 0.25 mg, morphine 10–15 mg), anaesthesia (chloralose 1%, 10 ml/kg) and muscle relaxation (suxamethonium 100 mg), an electromagnetic exciter was fitted on the tracheal tube and a pulse generator initiated vibrations in the thoracic cage. The volume shifted varied between 10 and 20 ml depending on the vibration frequency and the pressure amplitude (fig. 1). Pressure was measured in the pleural space or in the mediastinal tissue by small pressure capsules. In recent experiments the oesophageal pressure has served as a reference pressure to evaluate the effect of the vibrations. Blood samples were periodically taken by arterial catheterization.

Results.

Measurements from one experiment are shown in figure 2. The total period of vibration was 40 min. The partial pressure of oxygen varied by approximately 300 mm Hg. The oscillation frequency did not influence the absorption of oxygen in the wide ranges tested here. Carbon dioxide elimination was related to the frequency changes and, more important, to the amplitude of endo-thoracic vibrations. The optimum vibration frequency was found to lie between 25 and 40 Hz, depending on the size of the dog. The smaller the animal the higher the optimum frequency. Shifts of pH and of (HCO3) in this experiment indicate the development of a metabolic acidosis. As was illustrated in our recent experiments, this phenomenon occurs with the reappearance of muscle activity when the effect of relaxation ceases. In addition we observed a fall in arterial pressure and in heart rate when the parasympathetic blockade was no longer effective. An additional administration of atropine avoided this incident in all other cases. Finally it should be mentioned that the dogs survived without any sign of respiratory insufficiency. Recent results indicate that the optimum effect of the vibrations depends not only on the frequency and amplitude of the pressure oscillations but also on the extent of filling of the lungs. This finding suggests that the whole effect is a phenomenon of resonance and could explain the changing effect of vibrations of a given frequency and amplitude on carbon dioxide elimination over an extended period of observation.

On the basis of these first results we believe we have found a new way of proceeding for any length of time in thoracic surgery and in bronchoscopy by "rested" ventilation without excursions of the thoracic cage. Concerning bronchoscopy, in this form of vibration respiration, breathing would be assured via a side arm of the bronchoscope, which should have numerous lateral perforations.
REPEATED METHOXYFLURANE ANALGESIA FOR BURNS DRESSINGS

Sir,—Some of your readers will be using computers to which advocate repeated methoxyflurane analgesia for burns dressing changes (Marshall and Ozorio, 1972; Laird and Gray, 1971; Packer and Titel, 1969). None of these authors has assessed renal function in their patients. They have not discussed the potentially severe nephrotoxic effects of methoxyflurane. Since these articles will be of interest to clinicians of other disciplines, it is unfortunate that renal function was not discussed.

Methoxyflurane analgesia for burns dressing changes has been abandoned for more than a year at the Vancouver General Hospital since a patient developed profound polyuria while receiving methoxyflurane analgesia for burns dressing changes.

A 46-year-old male of average physique was admitted with burns to 40% of his body. He had no prior history of renal disease and renal function was well maintained during the early part of his hospitalization. Methoxyflurane analgesia was begun 10 days after admission. The patient had 120 minutes of exposure to methoxyflurane prior to the 27th hospital day. At this time his daily urine output exceeded 5 litres. Results of laboratory investigations included a blood urea nitrogen of 47 mg/100ml and a serum sodium concentration of 162 m.eqiv/l. Urine flow did not diminish after the administration of methoxyflurane for 9 days.

With appropriate intravenous replacement therapy the patient made a complete recovery. The clinicians attending this patient believe that methoxyflurane was the cause of this patient's polyuria. They could not find evidence of any other renal or extrarenal cause of this severe yet transient problem.

In other situations it might be quite inappropriate to abandon an analgesic technique after a single complication, but the work of several investigators supports this decision.

Corbett and Ball (1971) have demonstrated that trace concentrations of methoxyflurane can be detected in the end-tidal air for 10-18 days after a single methoxyflurane anaesthetic. Higher concentrations would be anticipated after repetitive administrations.

While methoxyflurane nephrotoxicity has been suspected for nearly a decade (Paddock, Parker and Guandagni, 1964; Crandell, Pappas and Macdonald, 1966), Mazze, Shue and Jackson (1971) have recently observed a syndrome following uncomplicated methoxyflurane anaesthesia characterized by polyuria, lack of responsiveness to infusion of vasopressin, marked weight loss and a delayed return to preoperative renal concentrating ability. While many patients regain renal function after supportive care, Hollenberg et al. (1972) have shown that irreversible renal failure may follow methoxyflurane anaesthesia. Taves, Fry, Freeman and Gillies (1970) have noted serum fluoride concentrations in nephrotoxic subjects. The authors have shown that free fluoride is released by the biotransformation of methoxyflurane. In a second article, Mazze, Trudell and Cousins (1971) demonstrated increases in serum and urinary inorganic fluoride in all patients studied after methoxyflurane anaesthesia.

These observations challenge the position of methoxyflurane as a popular anaesthetic agent. The toxic effect of the agent should be considered by clinicians contemplating the repeated use of methoxyflurane as an analgesic for the burned patient.

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REFERENCES


THE OCCURRENCE OF UNBLOCKED SEGMENTS DURING CONTINUOUS LUMBAR EPIDURAL ANALGESIA FOR PAIN RELIEF IN LABOUR

Sir,—The explanation given by Drs. Fletcher, Richardson and Meadows and by Dr. Ducrow (Brit. J. Anaesth., 1972 44, 290), for the incidence of unblocked segments during epidural analgesia in labour is ingenious but not convincing.

The cutaneous area of the groin supplied by the L1 dermatome overlies other structures which have different nerve supplies. Just as in the male the gubernaculum passes through the inguinal canal into the scrotum, so in the female the corresponding structure passes through the same canal into the labium majus. This female gubernaculum's side attachment to the uterus resulted in the ovary entering the pelvis during foetal development, drawing its vessels and nerves after it. The gubernaculum in the female becomes the ovarian ligament and the round ligament. Both structures maintain their original nerve supplies which is the same as that of the other mesonephric structures of ovary and testes which originates from T10 or sometimes slightly higher.

Painful stretching of the round ligament during uterine contractions can therefore account for groin pain despite the fact that the L1 dermatome is adequately blocked.

In my experience the unblocked segments occur as frequently bilaterally as unilaterally. Most can be abolished by adding more local anaesthetic until skin analgesia extends up to T8.

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