EQUIPMENT REVIEW

The MiniCAP[®] III CO₂ Detector*: assessment of a device to distinguish oesophageal from tracheal intubation

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SUMMARY

A new portable infra-red CO₂ detector was assessed in 50 intubated patients. This device was 100% accurate in distinguishing between tracheal and oesophageal intubation when used by nursing and paramedic personnel.

INTRODUCTION

Failure to intubate the trachea is still a significant cause of morbidity and mortality (Brahms, 1989). The confidential enquiry into maternal deaths (1985–87) lists five cases in which failure to intubate the trachea was a direct cause of maternal death (HMSO, 1991).

There are many devices available for detecting tracheal intubation. The oesophageal detector device (Wee, 1988) relies on the relative rigidity of the trachea compared to the oesophagus. However, a recent report cites three failures of the device in patients with upper airway obstruction (Williams & Nunn, 1989). The best indication of tracheal intubation is the presence of CO₂ in exhaled gases (Baraka, 1991; Birmingham *et al.*, 1991). The Fenem CO₂ Detector* (Linko *et al.*,

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* MiniCAP III CO₂ Detector is manufactured by MSA Instrument Division, East Shawhead, Coatbridge ML5 4TD, U.K.

† Fenem CO₂ Detector (now called Easy Cap) is manufactured by Nellcor Inc., 25495 White Cell Street, Hayward, CA 94545, U.S.A.

1993) relies on a colour indicator change from purple to yellow to identify tracheal intubation. However, the MiniCAP III[®] utilises infra-red spectrophotometry and thus the same technology as larger capnographs in operating theatres.

METHODS

Apparatus and technique

The MiniCAP III CO₂ Detector[®] is a battery-operated instrument designed to identify the presence and absence of CO₂ in a respiratory cycle (Fig. 1). The sensor is a solid state, non-dispersive infra-red mainstream CO₂ detector which clips over the airway. The sensor has incorporated a specific filter to eliminate the interference of other gases such as oxygen and nitrous oxide. Each airway adaptor is discarded after use.

The instrument gives both a visual and audible indication of CO₂ in each respiratory cycle. The green LED light will illuminate briefly accompanied by a short high-pitched tone. Two red LED lights flash together with a loud continuous warning sound when the detector has not sensed a complete respiratory cycle within ISS. This time interval can be manually altered from between 5 and 60 s. Carbon dioxide may be detected in the stomach due to mixing of expired gases during manual ventilation via a face mask or the 'cola' complication (Denman *et al.*

Fig. 1. The MiniCAP III CO₂ Detector[®].

1990). This falls rapidly to zero within five ventilating cycles. Therefore detection of CO₂ after this time confirms tracheal intubation.

Subjects

Following ethics committee approval, 50 patients (ASA I + II) aged 16–70 years, in whom tracheal intubation was intended for elective surgery, were included in the study. Those patients with oesophageal, gastric or intestinal disease were excluded. The patients were anaesthetized in a manner appropriate to clinical need and the trachea intubated. All patients had full monitoring as recommended by the Association of Anaesthetists (Zbinden & Schupfer, 1989). A second tracheal tube was passed into the oesophagus and the cuff inflated with 3–5 ml of air. The relative positions of the two tracheal tubes were allocated randomly. The patients were pre-oxygenated with 100% CO₂ and an increased concentration of volatile agent for 5 min before disconnection of the anaesthesia circuit. Nurses and paramedics working in the theatre suite who were unaware of the relative positions of the tracheal tubes were invited to test the CO₂ Detector on each tube.

RESULTS

Patients consisted 21 males (mean age 31.2 years) and 29 females (mean age 29.3 years). The low mean ages were accounted for by the use of the CO₂ Detector in orthopaedic and gynaecological patients.

On all occasions the assessor was able to determine the appropriate tubes after 15 s. Indeed, tracheal intubation was confirmed in all cases within 15 s by the green flashing LED light and audible sound. On no occasion was any result inconclusive.

DISCUSSION

Failure to intubate the trachea and misplacement of the tracheal tube into the oesophagus is potentially life threatening if not detected quickly.

Paramedics and doctors on advanced trauma and life support courses are now being taught intubation as part of their training programme. However, intubation in a field situation can be hazardous, especially for those with limited experience. Alternatively, initial correction of hypoxia and control of the airway before transfer to hospital can improve patient outcome.

This device rapidly identified oesophageal intubation to non-medically qualified personnel. It is light, portable, robust and uses infra-red spectroscopy (the same technology used by anaesthetists in theatre) to detect a qualitative change in CO₂. It has both visual and audible indications of tracheal and oesophageal intubation and has many uses.

These include use in the field situation by paramedics during intubation and as a ventilator alarm while transferring to hospital. Thus it can detect tracheal tube

displacement quickly. It is also of use to inexperienced junior doctors in A&E departments who can confidently secure the airway before proceeding to further resuscitative measures.

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