CAPNOGRAPHY DOES NOT RELIABLY DETECT DOUBLE-LUMEN ENDOTRACHEAL TUBE MALPLACEMENT

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de Vries JW, Haanschoten MC. Capnography does not reliably detect double-lumen endotracheal tube malplacement.
J Clin Monit 1992:8;236–237

ABSTRACT. Two patients are described in whom double-lumen endotracheal tube malplacement and its ventilatory consequences were not detected by infrared capnography. Problems were suspected on auscultation, and the malplacement was diagnosed by means of bronchospirometry. We conclude that bronchospirometry helps detect problems with endotracheal intubation.

KEY WORDS. Monitoring: carbon dioxide. Measurement techniques: infrared; capnometry; bronchospirometry. Intubation: endobronchial. Equipment: tubes, endotracheal.

Infrared capnography was introduced into clinical practice in The Netherlands in 1956 (B. Smalhout, personal communication, 1991). It has since become a part of the minimum equipment requirements in operating theaters and has been acknowledged as a valuable monitor in patient care [1]. Since end-tidal carbon dioxide concentration (P_{ETCO_2}) is a result of ventilation, perfusion, and metabolism, it can help diagnose a variety of physiologic and pathologic phenomena [2]. Recently, a case was described in which endobronchial migration of an endotracheal tube was detected by capnography [3]. We describe 2 cases in which ventilatory problems occurred, but in which tube malplacement was not detected by capnography.

CASE REPORT

Case No. 1

An otherwise healthy 59-year-old man with a carcinoma of the distal esophagus was scheduled for esophagus resection. For the thoracic phase of the operation, a 41-Fr, left-sided, double-lumen tube (Mallinckrodt, Athlona, Ireland) was inserted after an uneventful induction, and the patient was manually ventilated by using a Mapleson C system. Auscultation revealed normal bilateral breath sounds. Mechanical ventilation (Dräger Spiromat 656, Lübeck, GFR [Germany]), with a tidal volume of 550 ml and a respiratory rate of 14 breaths/min, was instituted. Before positioning and draping the patient, the position of the tube was tested. When only the tracheal lumen was ventilated, the breath sounds on the left side were still audible. However, when the bronchial lumen was ventilated, inflation pressures were high and almost no breath sounds were heard. Bronchospirometry (Datex Capnomac Ultima SV, Helsinki Finland) revealed that the expired minute volume of the bronchial tube was only 1.2 L/min, yet P_{ETCO_2} did

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Received June 16, 1991, and in revised form Sept 13, 1991. Accepted for publication Oct 1, 1991.

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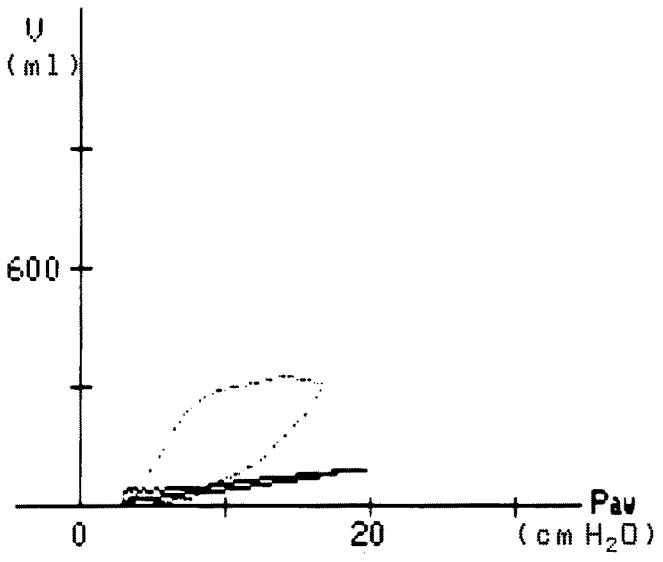

Volume-pressure diagram showing tracheal (dotted curve) *and bronchial* (solid curve) *volume-pressure relationships.*

not differ between tracheal and bronchial lumina. The volume-pressure loop is shown in the figure. Fiberoptic bronchospirometry showed that the endotracheal part of the tube was kinked and was obstructing much of the lumen of the tube.

Case No. 2

A 52-year-old man whose medical history included anteroseptal myocardial infarction, an operation for aortic valve replacement and coronary bypass grafting, and an incident of cardiac arrest (outside of the hospital) due to ventricular fibrillation was scheduled for implantation of an automatic cardioverter defibrillator. Because of the previous heart operation, we decided to implant the defibrillator through a left lateral thoracotomy. After an uneventful induction, a 41-Fr, left-sided, double-lumen tube was inserted. The patient was mechanically ventilated (Siemens Servo 900B), with the ventilator set to deliver a minute volume of 8 L/min and a respiratory rate of 20 breaths/min. On auscultation, normal breath sounds were heard. End-tidal P_{CO_2} concentrations from tracheal and bronchial lumina were 4.6% and 4.8%, respectively. The expired minute volumes, however, were 6.8 and 1.3 L/min, respectively. Fiberoptic bronchoscopy revealed that the tip of the endobronchial part of the tube was located in the left lower bronchus and that the inflated balloon was obstructing the left upper bronchus. After retracting the tube 2 cm, the volumes changed to 4.4 and 3.7 L/min, while values for P_{ETCO_2} remained unaltered. Anesthesia, surgery, and subsequent recovery were uneventful.

DISCUSSION

Infrared capnography is based on the concentration-dependent absorption of light by carbon dioxide and is not influenced by the total volume of the gas mixture [1]. Thus, in both patients, P_{ETCO_2} did not differ between the sample sites. In the first patient, both lungs were mainly ventilated through the tracheal lumen of the tube; the bronchial lumen was involved in ventilation only marginally. In this case, the distribution of gas flow was directed by the resistance of the tubes. In the second patient, the right lung was ventilated through the tracheal lumen, while only the left lower lobe was ventilated through the endobronchial lumen. In this case, the distribution was directed by the compliance of the lungs.

Malplacement of double-lumen tubes should be suspected if no breath sounds are heard on auscultation, or an abnormal distribution of breath sounds is heard that was not previously present. Malplacement may also be indicated when there is a large difference in compliance between tracheal and bronchial lumina. Bronchospirometry facilitates the detection of double-lumen tube malplacement.

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