TITLE: COLORIMETRIC END TIDAL CO2 MONITORING DURING INTERHOSPITAL TRANSPORT OF CRITICALLY ILL ADULT PATIENTS

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During interhospital transport the monitoring of ventilation (and of accidental disconnection from mechanical ventilator) is a important point of the patient safety . Many devices are available but they are expensive and need electrical power.

The aim of this study was to compare, in patients mechanically ventilated during interhospital transport, monitoring of End Tidal CO2 (ETCO2) measured by the FEF° CO2 colorimetric detector(FENEM Inc. New York) with ETCO2 measured by a portable capnometer, SaO2 , and EKG .

METHODS: After institutional approval 20 consecutive critically ill adult patients were ,prospectively studied during transport. They were mechanically ventilated , had no spontaneous breathing and were stabilized (PaO2 > 60 mmHg, normal BP). ETCO2 was measured by a portable infrared capnometer (POET Criticare System Inc.), continuously recorded , and data were analyzed by a micro computer. The capnometer's sensor was directly connected to the extremity of the tracheal tube. The FEF ° was placed after this sensor and no humidification system was added to the circuit. This device gives a simple evaluation of ETCO2 with 6 consecutive shade of color from purple(1) to yellow (6). Sa02 was measured by a digital sensor connected to the same device as infrared capnometry. Heart rate assessed by EKG and non invasive blood pressure were continuously monitored. Every five minutes during transport, colorimetric ETCO2 was recorded (color1 to 6) by an observer unaware of the infrared capnometer reading. In order to simulate accidental disconnection or extubation, every 15 minutes the patients were briefly disconnected from the ventilator such as for endotracheal tube suction and the time to observe any variations of the previous parameters was precisely recorded. Statistical analysis used unpaired Student's t test and data were expressed as mean ± SD.

RESULTS: Patients were 12 males and 8 females . The duration of transport (ambulance or helicopter) was 47 ± 24 min. All the patients remained hemodynamically stable, 6 out of the 20 were receiving vasoactive drugs. Colorimetric variations of the FEF CO2 detector were observed every single breath in all the patients, ranging from 1 to 3 at the inspiration and from 5 to 6 at the expiration. Minimum ETCO2 recorded was 25 mmHg and was detected as FEF° Color 1. The same color was observed in 2 patients with mild hypercarbia . SaO2 measurements were not possible in 6 patients because of peripheral vasoconstriction and remained stable in all others. Forty seven ventilator disconnection were performed . ETCO2 felled to 0 mmHg in 4±2 sec , FEF° returned to 1 in 10 ±6 sec (NS), SaO2 felled under 90% in 95±35 sec (p<0. 001 compared to ETCO2 and FEF°) ; Heart rate measured by the EKG and BP were not modified after 150 sec.

We conclude that FEF CO2 detector is a very simple to use monitoring during interhospital transport. In case accidental ventilator disconnection it gives rapid visual information and unlike many other monitoring devices it requires no electrical power or calibration.

REFERENCES
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Title: A SIMPLE DEVICE FOR TESTING PULSE OXIMETERS

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Introduction. Pulse oximeters rely on built in calibration curves for their accuracy. Because they require pulsatile blood,there is no easy way of testing these devices. An in vitro calibration method was recently described,but it is rather cumbersome,expensive and requires large quantities of blood.[1] We have developed a simple device for calibrating pulse oximeters which is inexpensive, and requires only 1mL of blood for each measurement. In order to evaluate this device, we investigated the effect of haemoglobin (Hb) concentration on the accuracy of two different pulse oximeters.

Methods. Construction details of the calibration device are illustrated on Fig1. Blood was obtained from one of the authors or the blood bank. Various Hb concentrations were prepared by dilution with plasma.A tonometer was used to prepare samples of blood of various oxygen saturations. Before assembling the calibration device,the space above the blood was filled with nitrous oxide. After assembly, the device was inserted into a Nellcor adult digit sensor.Pulsations in the device were produced by squeezing the bulb manually100 to 150 times a minute. The amplitude of the pulsations was observed in turn on a Nellcor (model N100) and on a Datex (model 251) pulse oximeter.Constant rate and amplitude were maintained until a stable oxygen saturation reading was obtained. The blood was then transferred anerobically to a syringe and its oxygen saturation and haemoglobin concentration determined using a hemoximeter (Radiometer OSM2b). The oxygen saturations determined by the oximeters were first compared to those obtained by the Hemoximeter for each Hb using linear regression analysis.The % error for each oximeter at several saturations was then calculated from differences between the lines thus obtained and the line of identity (Fig.2)

Results and discussion. The linear regression analysis showed excellent correlation between the hemoximeter and each of the pulse oximeters for a wide range of saturation and Hb.The results shown on Fig.2 indicate that the errors associated with pulse oximetry may depend not only on the degree of oxygen saturation of the blood, but also on the Hb concentration.The results also suggest that in addition to its utility for comparing different pulse oximeters ,this simple device may also be useful for exploring the physiological limits of pulse oximetry.

Reference: 1. IEEE Transactions on Biomedical Engineering 1989;36,625-27

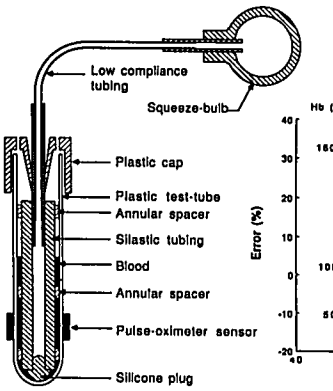

Fig.1

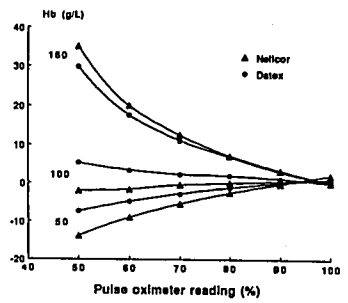

Fig.2