CASE STUDY

The Use of Capnography and NPPV in Hypercapnic Respiratory Failure

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PROFILE

A 73-year-old male with a complex history of COPD, hypertension and previous myocardial infarctions presented to the emergency department in severe respiratory distress. The patient was placed on Noninvasive Positive Pressure Ventilation (NPPV) using a Respironics BiPAP® Vision® Ventilatory Support System. To evaluate the adequacy of NPPV, End-Tidal CO_2 ($ETCO_2$) was continuously monitored via nasal cannula using the Respironics CO_2SMO® Capnograph with the CAPNOSTAT® CO_2 sensor in the sidestream mode.

CLINICAL COURSE

The patient presented to the emergency department at 0955 in severe respiratory distress. Although the patient was unable to speak more than two words, he was alert and cooperative. The patient received nebulized albuterol and atrovent with oxygen. Initial vital signs at 1000 were: RR 36, HR 101, BP 168/73, O_2 saturation 95% on 8 L/min O_2, and an End-Tidal CO_2 ($ETCO_2$) of 26 mmHg (Figure 1). The capnogram was indicative of alveolar hypoventilation and an incomplete expiratory phase.

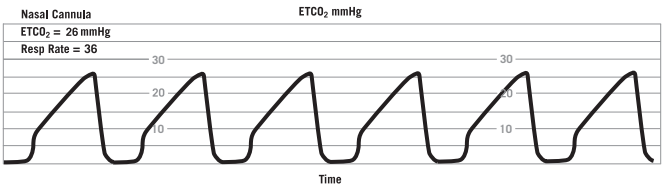

Figure 1

An ABG revealed a pH of 7.20, a $PaCO_2$ of 75 mmHg and a PaO_2 of 87 mmHg. At 1005 the patient was placed on NPPV with an IPAP of 10 cm H_2O, EPAP of 5 cm H_2O, and a FIO_2 of 0.40. At 1020, the respiratory rate had decreased to 30 and the $ETCO_2$ had increased to 45 mmHg. The capnogram changed, revealing a longer expiratory limb (Figure 2).

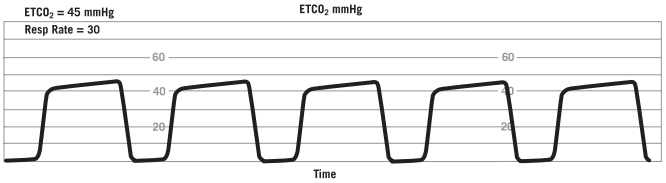

Figure 2

The respiratory rate had further decreased to 28 by 1035 with an $ETCO_2$ of 43 mmHg and a full expiratory waveform. At 1105 the vital signs were: RR 22, HR 102, BP 121/88, 97% O_2 saturation on 40% O_2, NPPV 10/5, and $ETCO_2$ 38 mmHg. At this point, the patient was able to speak in complete sentences. An ABG revealed a pH of 7.34, a $PaCO_2$ of 52 mmHg, and a PaO_2 of 80 mmHg.

The patient continued to improve. At 1135 with an RR of 28 and an $ETCO_2$ of 38 mmHg, the patient was removed from NPPV and placed on a mask with 40% FIO_2 (Figure 3).

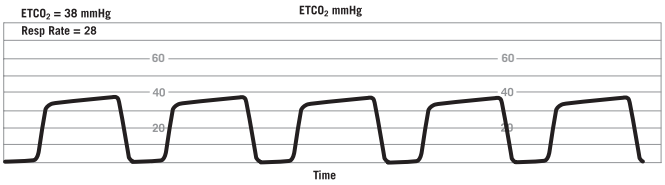

Figure 3

Patient monitoring with capnography was continued. Changes in both the waveform and $ETCO_2$ level were assessed. At 1205, the vital signs were: RR 24, HR 96, BP 131/52, 95% saturation on 40% FIO_2, and $ETCO_2$ 36 mmHg with no changes in waveform. The patient was placed on 4 L/min of oxygen via nasal cannula and 90 minutes later was transferred to a general care monitored room.

DISCUSSION

Capnography depicts $ETCO_2$ trends and enables alveolar assessment in real time. In this case, the baseline $ETCO_2$ - $PaCO_2$ was large, which is often indicative of a COPD patient. With capnography, alveolar ventilation changes can be detected without the need for serial arterial blood gas draws. Additionally, capnographic waveform analysis enables an accurate assessment of alveolar progression. The combination of capnography with NPPV can permit the rapid stabilization of the patient's respiratory condition and shorten the time needed for NPPV therapy.

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