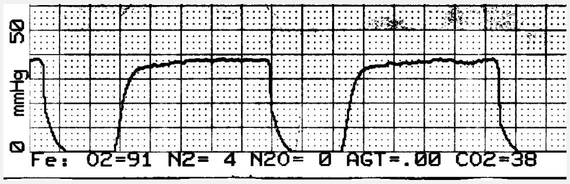
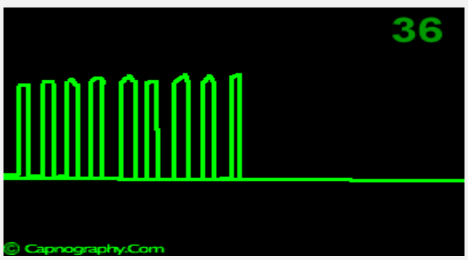
2010 ACLS Provider/Renewal
Capnography Study Guide

Key Principles:

- **End-tidal exhaled CO_2 is expressed as $PETCO_2$ and under most circumstances, correlates well with $PaCO_2$.**
  - **A normal $PETCO_2$ is 30-40 mm Hg; a normal $PaCo_2$ is 35-45 mm Hg.**
  - 

  - **The top of the waveform indicates the maximum exhaled CO_2.**
  - **$PETCO_2$ is generally graphed at slow and high speeds resulting in two different waveforms, the slower speed allows evaluation of individual waveforms in real time and the higher speed shows $PETCO_2$ trends over time.**



$PETCO_2$ trend

- **Increases in cardiac output and pulmonary blood flow result in better perfusion of the alveoli and a rise in $PETCO_2$.**
- **Decreases in cardiac output and pulmonary blood flow result in less perfusion of the alveoli and a drop in $PETCO_2$.**
- **A drop in $PETCO_2$ below 10 mmHg is indicates cardiac output is insufficient for ROSC.**
- **$PETCO_2$ above 10 mm Hg indicate adequate cardiac output (e.g good compressions) and ROSC is possible.**

Cardiac output and $PETCO_2$

Reduction in cardiac output and pulmonary blood flow result in a decrease in $PETCO_2$ and an increase in (a-ET)PC02. The percent decrease in $PETCO_2$ directly correlated with the percent decrease in cardiac output Also, the percent decrease in CO_2 elimination correlated with the percent decrease in cardiac output similarly. The changes in PETCTO2 and CO_2 elimination following hemodynamic perturbation were parallel. These findings suggest that decrease in $PETCO_2$ quantitatively reflect the decreases in CO_2 elimination.

Increases in cardiac output and pulmonary blood flow result in better perfusion of the alveoli and a rise in $PETCO_2$. Consequently alveolar dead space is reduced as is (a-ET)C02 The decrease in (a-ET)PC02 is due to an increase in the alveolar C02 with a relatively unchanged arterial C02 concentration, suggesting better excretion of C02 into the lungs. The improved C02 excretion is due to better perfusion of upper parts of the lung. Relationship between $PETCO_2$ and pulmonary artery blood flow was studied during separation from cardiopulmonary bypass. This showed that $PETCO_2$ is a useful index of pulmonary blood flow. A $PETCO_2$ greater than 30 mm Hg was invariably associated with a cardiac output more than 4 L/min or a cardiac index > 2 L/min. Furthermore, when $PETCO_2$ exceeded 34 mm Hg, pulmonary blood flow was more than 5 L/min (CI > 2.5 L).

Thus, under conditions of constant lung ventilation, $PETCO_2$ monitoring can be used as a monitor of pulmonary blood flow.

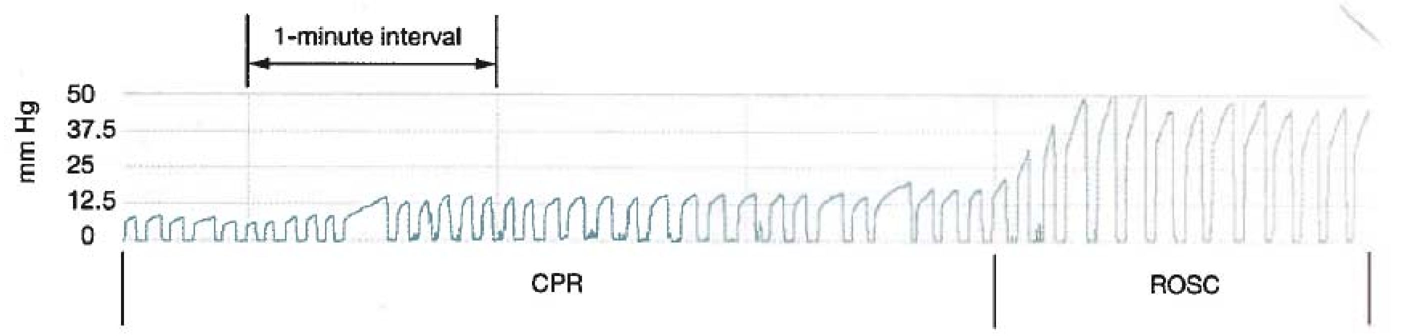


Figure 23. Waveform capnography during CPR with ROSC. This capnography tracing displays $PETCO_2$ in millimeters of mercury on the vertical axis over time. This patient is intubated and receiving CPR. Note that the ventilation rate is approximately 8 to 10 breaths per minute. Chest compressions are given continuously at a rate slightly faster than 100/min but are not visible with this tracing. The initial $PETCO_2$ is <12.5 mm Hg during the first minute, indicating very low blood flow. $PETCO_2$ increases to between 12.5 and 25 mm Hg during the second and third minutes, consistent with the increase in blood flow with ongoing resuscitation. ROSC occurs during the fourth minute. ROSC is recognized by the abrupt increase in $PETCO_2$ (visible just after the fourth vertical line) to >50 mm Hg, which is consistent with a substantial improvement in blood flow.

During Resuscitation:

- Use PETCO2 to confirm and monitor placement of an ET tube.
- Use PETCO2 to evaluate compression, ventilations and cardiac output
    - Check technique
    - Adequate rate and depth of compressions
    - Complete recoil between compression to allow adequate cardiac refill.
    - Ventilatory rate with BMV of 8 to 10 breaths/minute

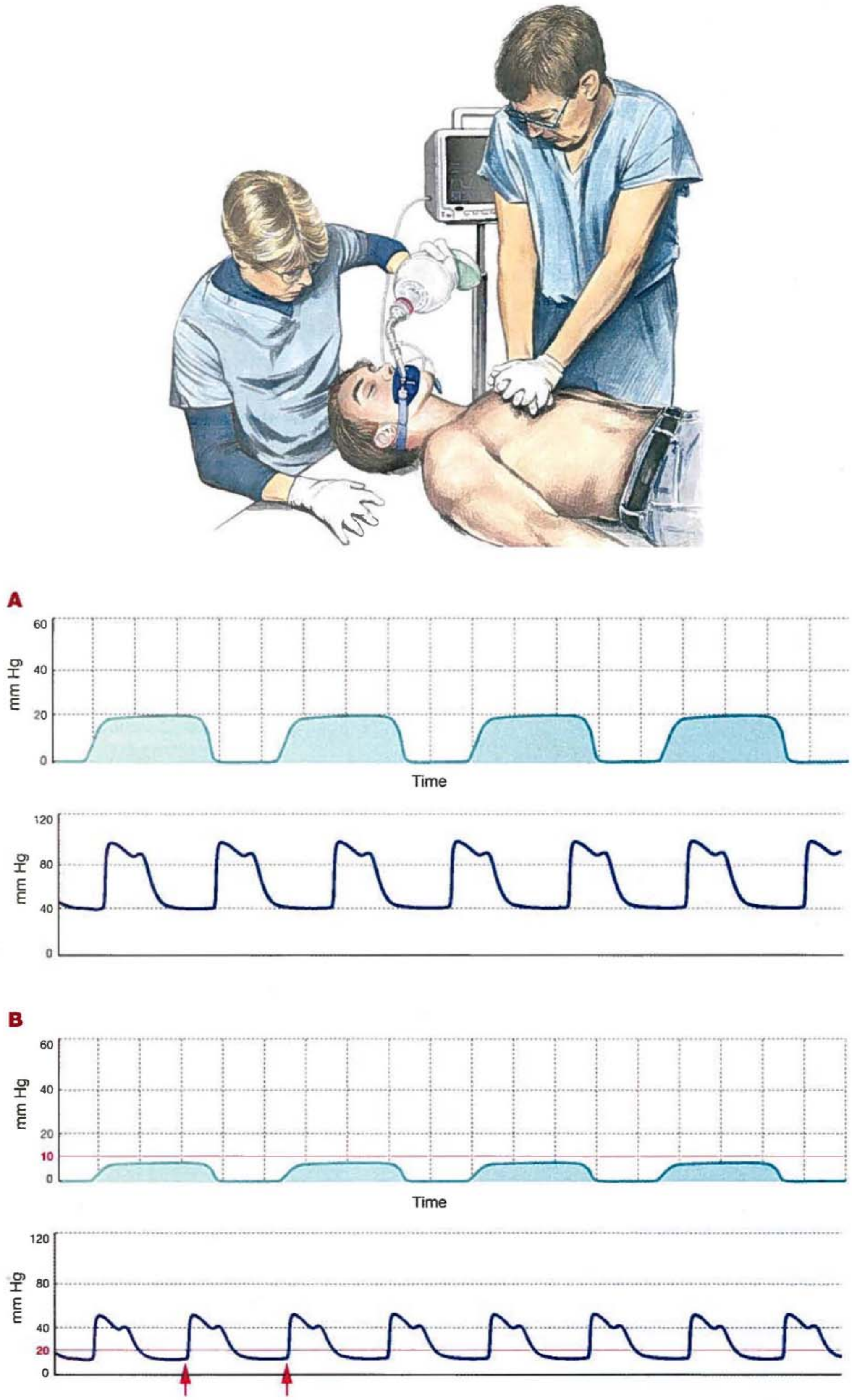


Figure 22. Physiologic monitoring during CPR. **A,** High-quality compressions are shown through waveform capnography and intra-arterial relaxation pressure. P_{ETCO_2} values <10 mm Hg in intubated patients or intra-arterial relaxation pressures <20 mm Hg indicate that cardiac output is inadequate to achieve ROSC. In either of those cases it is reasonable to consider trying to improve quality of CPR by optimizing chest compression parameters or giving a vasopressor or both. **B,** Ineffective CPR compressions shown through waveform capnography and intra-arterial relaxation pressure.