

Title: DOES A "SIGH BREATH" IMPROVE OXYGENATION IN THE INTUBATED PATIENT RECEIVING CPAP?

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Introduction. Tracheal intubation diminishes functional residual capacity (FRC) and may cause deterioration of arterial oxygenation and lung compliance. FRC can be restored to pre-intubation values by the administration of CPAP. In the early 1960's, intermittent hyperinflation of the lungs in intubated patients was advocated to reverse atelectasis and improve oxygenation. Today, many clinicians continue to use a "sigh breath" technique by administering one breath/min by way of intermittent mandatory ventilation (IMV-1). The purpose of this study was to determine if CPAP + IMV-1 provided better oxygenation than CPAP alone.

Methods. 30 adult patients in the Surgical Intensive Care Unit who required tracheal intubation, but not mechanical ventilation, were studied after approval of the Human Subjects Review Committee. They were randomized by hospital number to receive either CPAP alone or CPAP + IMV-1 initially. Patients who were to be extubated within 6 hrs received CPAP or CPAP + IMV-1, alternating after 3 hrs. Their data were analyzed independently from the second group of patients whose intubations were anticipated to exceed 24 hrs. These patients alternated between CPAP and CPAP + IMV-1 after 12 hrs. The level of CPAP and FiO_2 were kept constant. In the 6-hr group (N=22), data were collected 1-hr intervals. In the 24-hr group (N=8) data were collected every 4 hrs. CPAP was provided with a high continuous flow system with an inspiratory reservoir bag. IMV was provided with a tidal volume of 12 to 15 ml/kg with a volume-cycled mechanical ventilator. Data included arterial blood gas and pH measurement, respiratory rate (RR), mean systemic blood pressure (MAP), and heart rate (HR). When patients had pulmonary artery catheters inserted as part of their medical therapy, mixed venous blood gas, pH, and oxyhemoglobin saturations measurements, cardiac output, and central venous pressures were recorded. The $\text{PaO}_2/\text{FiO}_2$ ratio, the alveolar-arterial oxygen tension gradient (A-a DO_2), and (when available) the physiologic shunt fraction were used to assess arterial oxygenation. A one-way ANOVA was used to determine if results during CPAP differed from results during CPAP + IMV-1 during both 6 and 24 hr studies.

Results. Mean FiO_2 and level of CPAP during both modes did not differ (table). No differences in hemodynamic parameters between CPAP and CPAP + IMV-1

| X \pm SD | 2-HR GROUP | | 12-HR GROUP | |
|-----------------------------|----------------|---------------|----------------|----------------|
| | CPAP | IMV-1 | CPAP | IMV-1 |
| FiO_2 | .34 \pm .06 | .36 \pm .09 | .33 \pm .04 | .33 \pm .03 |
| CPAP | 6.0 \pm 4.9 | 7.5 \pm 4.7 | 5.5 \pm 2.1 | 6.0 \pm 1.8 |
| HR | 104 \pm 16 | 101 \pm 18 | 110 \pm 14 | 108 \pm 10 |
| MAP | 94 \pm 12 | 97 \pm 15 | 112 \pm 15 | 100 \pm 12 |
| CVP | 10 \pm 6 | 8 \pm 5 | 7 \pm 5 | 9 \pm 5 |
| PAOP | 12 \pm 4 | 11 \pm 5 | N/A | N/A |
| CO | 6.0 \pm 2.2 | 6.0 \pm 1.8 | 6.3 \pm 0.5 | 7.0 \pm .35 |
| $\text{PaO}_2/\text{FiO}_2$ | 278 \pm 88 | 303 \pm 113 | 277 \pm 72 | 299 \pm 81 |
| A-a DO_2 | 218 \pm 41 | 233 \pm 61 | 213 \pm 28 | 214 \pm 21 |
| Qs_p/Qt | .25 \pm .09 | .19 \pm .08 | .12 \pm .07 | .14 \pm .01 |
| VC | 1030 \pm 312 | 950 \pm 360 | 1720 \pm 580 | 1630 \pm 130 |

were observed in either the 6-hr or the 24-hr groups (table). Arterial oxygenation, as reflected by $\text{PaO}_2/\text{FiO}_2$, A-a DO_2 , and Qs_p/Qt was not statistically different when comparing CPAP to CPAP + IMV-1 either in the 6-hr group or the 24-hr group. At the outset of either CPAP or CPAP + IMV-1, in the 24-hr group, respiratory rate was similar. However, by 8-hrs and at 12-hrs, the RR of patients while they received CPAP was significantly lower than while they received CPAP + IMV-1 over the same period of time (figure) (p<.01). While receiving CPAP + IMV-1 patients experienced significant increase in RR during the 12-hr study period. However, during the 12-hrs of CPAP alone, RR did not change.

Discussion. CPAP + IMV-1 appeared to offer no advantage in gas exchange or hemodynamic effect over administering CPAP alone, either in patients who received either mode for a 3-hr period, or when modes were tested over 12-hr periods. In fact, as time progressed over 12 hrs, the patients' RR increased significantly after 4-8 hrs while they received CPAP + IMV-1, whereas their respiratory rates remained unchanged during the entire 12-hr period of CPAP alone. This may have been due to subtle changes in FRC were not significant enough to alter arterial oxygenation. Further study measuring FRC and pulmonary mechanics must be performed to confirm this hypothesis. Alternatively, the sensation of a single breath/min may have been unpleasant and caused an increase in RR over time because of discomfort. Because this was a time-dependent phenomenon, we did not observe it in the group where patients received each mode for only 3-hrs. Thus, it appears that CPAP alone or CPAP + IMV-1 offer no advantage over each other with respect to gas exchange or hemodynamics, but CPAP alone may offer some advantage in moderating RR. CPAP alone can be administered less expensively and with simpler technology than CPAP + IMV-1. Further, CPAP alone should generate lower mean and peak airway pressures than CPAP + IMV-1, and consequently CPAP alone

should carry less risk. Because neither mode affords an advantage with respect to gas exchange, there appears to be no reason to persist at delivering one mechanical breath per minute for this purpose.

