Title: EARLY USE OF PEEP PREVENTS LUNG WATER ACCUMULATION DURING VOLUME INFUSION

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Introduction: A frequent cause of pulmonary edema (PE) in hypovolemic patients is the infusion of large volumes of crystalloid solution (1). In established experimental PE, the use of positive end-expiratory pressure (PEEP) may either have no effect, or actually increase lung water content. However, the use of PEEP prior to volume expansion as a possible means of preventing PE has not been studied.

Methods: Ten adult mongrel dogs were anesthetized with pentobarbital (25 mg/kg), intubated and ventilated to maintain a $PaCO_2$ of 35 - 40 mm Hg. They were then instrumented for measurement of cardiac index (CI) by thermodilution and pulmonary artery diastolic pressure (PAD). Lung water (LW) was measured by a multiple gas rebreathing technique during which a mixture of 10% helium, 1.5% acetylene and 0.5% carbon monoxide, 21% oxygen in nitrogen was continuously sampled and analyzed by a mass spectrometer. The data was collected on-line by a computer and analyzed by a method which has been shown to give results for LW which correlate well with wet minus dry lung weight (2). We have previously shown that the method is sensitive to small increases in LW during graded PE caused by elevation of left atrial pressure (3).

The study sequence consisted of an initial removal of 30% of the estimated blood volume over a 15 min. period followed by a 30 min. period of stabilization. 40 ml/kg of Ringer's lactate solution was then infused over a 30 min. period. Prior to volume expansion, 5 cm. H_2O of PEEP was initiated in the experimental group (n=5) whereas the control group (n=5) continued to receive IPPB without PEEP. Measurements of LW, CI, PAD and colloid oncotic pressure (COP) were made at 15 min. intervals throughout the experimental sequence. Results were evaluated by students-t analysis.

Results: There was significantly less accumulation of LW in the PEEP group compared to the control group ($p < 0.05$). The time course of this difference is shown in figure 1. Table 1 summarizes the data for CI, COP and pulmonary vascular driving pressure (PAD - COP). CI decreased by 50% after hemorrhage and returned to baseline after infusion. COP was decreased at the end of infusion, but driving pressure was increased compared to baseline. There was no significant difference ($p > 0.10$) in CI and driving pressure between the control group and the PEEP group.

Discussion. The data demonstrate that the use of 5 cm. H_2O PEEP prior to rapid volume infusion in a hypovolemic uninjured-lung dog model, prevents lung water accumulation. This was not due to a difference in pulmonary blood flow or driving pressure but probably to a positive change in interstitial pressure secondary to PEEP. The suggested clinical significance of this finding is that the early use of low-level PEEP may prevent PE due to fluid infusion, particularly if rapid infusion is planned in the presence of lung injury.

References: 1. Stein L, Beraud J-J, Morisette M, et al: Pulmonary edema during volume infusion. Circ 52: 483-489, 1975.
2. Friedman M, Kaufman SH. and Wilkens SA. Analysis of rebreathing measurements of pulmonary tissue volume in pulmonary edema. J Appl Physiol 48: 66-71, 1980.
3. Miller JN, McLeod M, and McIntyre RW. Estimation of cardiac output and pulmonary tissue volume by a multiple gas rebreathing technique. Abstracts of Scientific Papers, SCA Meeting, 1981.

Figure 1

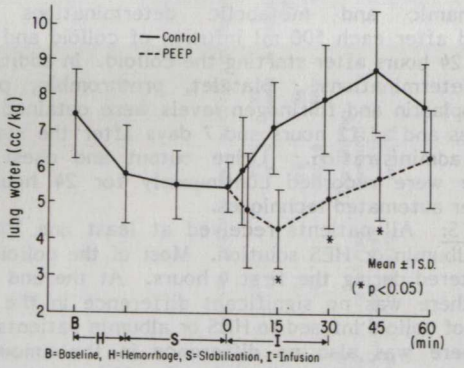

Table 1

	Baseline	Infusion-begin	Infusion-end
CI ($l.min.^{-1}kg^{-1}$)	0.16 ± 2.3	0.08 ± 0.03*	0.16 ± 0.02
COP (mmHg)	19.8 ± 2.3	17.3 ± 1.6	10.4 ± 1.4*
PAD - COP (mmHg)	-12.5 ± 2.7	-8.8 ± 4.1	+0.2 ± 3.5*

(Mean values ± SD; p*< 0.01 compared to baseline)