

Title: POSITIVE END-EXPIRATORY PRESSURE WORSENS THE SEVERITY OF RIGHT VENTRICULAR ISCHEMIA

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**Introduction.** The mechanisms whereby positive end-expiratory pressure (PEEP) decreases stroke volume remain controversial.<sup>1</sup> In addition to decreasing venous return,<sup>1,2</sup> PEEP may limit right ventricular (RV) contractile performance by reducing coronary blood flow.<sup>3</sup> Under these circumstances, an increase in pulmonary artery pressure (PAP) and RV afterload could precipitate RV free wall ischemia. We postulate that PEEP predisposes the RV to ischemia and tested this hypothesis in a canine model of RV infarction.

**Methods.** Through a median sternotomy incision in 13 anesthetized dogs, the pericardium was opened for exposure of the right coronary artery (RCA) which was loosely encircled with a rubber snare near its origin. Additional loose ligatures were placed around obvious overlapping vessels from the left anterior descending and circumflex coronary arteries which perfused the RV free wall. Millar MPC-500 micromanometer-tipped catheters were placed in the aorta and RV. Cardiac output was measured by thermodilution. 2 mm diameter ultrasonic dimension gauges were implanted in the RV ischemic zone to quantitate segmental shortening. The edges of the pericardium were reapproximated, and the sternal wound was closed. Regional myocardial blood flow was determined by radioactive microspheres.

Group I (n=7) had 0 cmH<sub>2</sub>O PEEP; Group II (n=6) had 15 cmH<sub>2</sub>O PEEP attached to the ventilatory circuit. Each animal underwent 90 minutes of RV ischemia produced by ligating the RCA and overlapping vessels followed by 120 minutes of reperfusion. Measurements were taken at baseline, after 5 and 75 minutes of ischemia, and after 5 and 75 minutes of reperfusion. In both groups, mean arterial pressure (MAP) was maintained above 90 mmHg using a phenylephrine infusion as necessary. Following a lethal dose of KCL, the area of infarction, as determined by triphenyltetrazolium chloride infused through the aortic root, was quantitated gravimetrically and expressed as a percent of the total RV free wall.

This study was approved by the Institutional Research Practices Committee. Preliminary data, expressed as mean  $\pm$  SEM, were analyzed by a multivariate analysis of variance for repeated measures.

**Results.** With RV ischemia in Group I, stroke volume decreased by 32%, while segmental shortening was reduced by 109% (p < 0.05, respectively). PEEP and RV ischemia in Group II caused a greater reduction in stroke volume by 36% as segmental shortening decreased nearly 115% (p < 0.05, respectively). These changes persisted throughout the periods of ischemia and reperfusion. PAP and pulmonary vascular resistance (PVR) remained constant in Group I animals. In contrast, PEEP increased PAP by 23%

and PVR by 168% in Group II animals (p < 0.05, respectively).

In the areas which subsequently developed necrosis, myocardial blood flow decreased during ischemia to  $6.3 \pm 1.9$  ml/min/100gr in Group I and  $3.2 \pm 0.9$  ml/min/100gr in Group II (p < 0.05 vs baseline, respectively). At 5 minutes of reperfusion, hyperemia was observed in both groups. However, the amount of RV free wall necrosis was greater in Group II ( $40.7 \pm 7.0\%$ ) than Group I animals ( $17.7 \pm 7.2\%$ ; p < 0.05) (Figure 1).

**Discussion.** Our results clearly demonstrate that PEEP worsens the amount of RV ischemic injury. Since MAP was maintained throughout the experiments, we postulate that PEEP potentiates RV ischemia by increasing PAP and, consequently, RV afterload. In the areas which developed necrosis, both groups had similar reductions in RV blood flow. Therefore, a larger amount of the RV free wall was at risk from ischemia with PEEP and subsequently developed necrosis.

In addition to reducing preload, PEEP may depress RV systolic function by inducing ischemia. Further studies are warranted to answer whether the application of PEEP to patients with ongoing RV ischemia is contraindicated.

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#### References.

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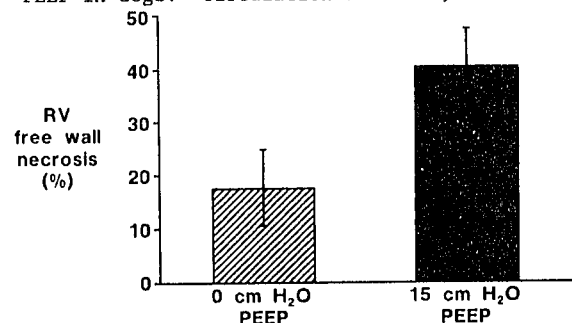


Figure 1: RV free wall necrosis following ischemia with and without PEEP