

TITLE: TEMPORAL RELATIONSHIP BETWEEN ATRIAL NATRIURETIC FACTOR LEVELS AND ALTERED RENAL FUNCTION DURING PEEP VENTILATION

AUTHORS: E. D. Kharasch, M.D., Ph.D., K.-T. Yeo, Ph.D.*, M. A. Kenny, Ph.D.*, C. W. Buffington, M.D.

AFFILIATION: Departments of Anesthesiology and *Laboratory Medicine
University of Washington School of Medicine
Seattle, Washington 98195

Introduction. Mechanical ventilation with positive end-expiratory pressure (PEEP) rapidly decreases urine output and sodium excretion. Factors including decreased cardiac output and renal blood flow, enhanced plasma renin activity and increased ADH release do not fully explain PEEP-induced alterations in renal function. Atrial natriuretic factor (ANF) is secreted in response to atrial distension and increases urine output and sodium excretion. We have shown previously that PEEP decreases right atrial distension and decreases ANF levels, with subsequent alterations in renal function.¹ These measurements were made after 40 min of PEEP. Presently, we questioned whether ANF levels diminish rapidly enough to explain the renal function changes which immediately follow the onset and release of PEEP.

Methods. Five dogs were instrumented sterilely with sonomicrometer crystals for measurement of maximum right atrial dimension (RAD), a right atrial catheter for pressure measurement (RAP), and an arterial catheter. An intrathoracic silicon rubber wafer was sutured to the pericardium over the right atrium to measure juxtacardiac pressure (JCP). For experiments, dogs were anesthetized with halothane (1-1.5%), given lactated Ringers (50 cc/kg), and ventilated mechanically (15 cc/kg). An equilibration period was followed by consecutive periods of 0 PEEP (ZEEP, 40 min), 10 cm H₂O PEEP (60 min), and 0 PEEP (60 min). Urine and arterial blood samples were obtained 5, 10, 15, 20, 30, 40, and 60 min after initiation and cessation of PEEP for determination of urine output (UV), sodium excretion (U_{Na}V) and plasma ANF by radioimmunoassay. Transmural right atrial pressure (RAP_{tm}) was calculated as RAP-JCP.

Results. Time course of changes in atrial distension, ANF levels and renal function is presented in the Figure. Initiation of PEEP was followed immediately by decreases in RAD and RAD_{tm}, which reached their nadir in 5 min. This was associated with an immediate decline in ANF concentration. Urine output and sodium excretion also decreased immediately after initiation of PEEP. Cessation of PEEP was followed by an immediate increase in RAD, RAD_{tm}, plasma ANF, urine output, and sodium excretion.

Conclusions. There was a close temporal relationship between changes in atrial distension (atrial dimension and atrial transmural pressure), plasma ANF concentration, and urine output and sodium excretion during initiation and cessation of PEEP. These results further support the concept that decreased ANF release mediates in part, the antidiuretic and antinatriuretic effects of PEEP.

Thus the ANF-mediated reduction in urine output and sodium excretion during PEEP represents a physiologic mechanism for attempted restoration of intravascular volume which atrial stretch receptors perceive to be decreased.

Reference.

1. Kharasch ED, Yeo KT, Laposky L, Kenny MA, Buffington CW: Atrial natriuretic peptide and the renal effects of PEEP ventilation. *Anesthesiology* 67:A330, 1987

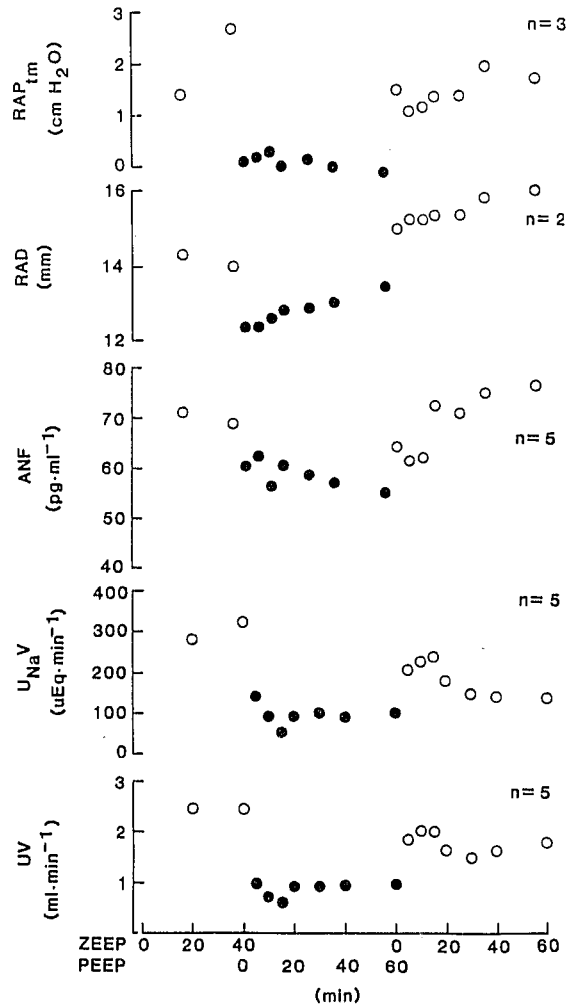


Figure. Time course of changes in atrial distension (RAD, RAP_{tm}), plasma ANF concentration and renal function (UV, U_{Na}V) during 0 PEEP (ZEEP, open circles) and 10 cm H₂O PEEP (closed circles).