Title: MEASUREMENT OF EXTRAVASCULAR LUNG WATER BY MEANS OF SHORT-LIVED ISOTOPES

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Introduction. The clinician currently lacks non-invasive means for measuring extravascular lung water (EVLW). An imaging procedure is described in which rubidium-82 is used as an intravascular tracer and oxygen -15 labeled water as a diffusible tracer. EVLW was measured in oleic-acid treated and in hypotensive dogs with pulmonary edema (PED). This procedure is less invasive than current methods such as the thermodye method, and in addition to these it allows the determination of regional water content.

Methods. Eight mongrel dogs were anesthetized and a Swan-Ganz catheter was placed into the main pulmonary artery for measurement of cardiac output. A compact bolus of Rb-82 (t½ = 75 sec) and H2O (0-15) (t½ = 122 sec) was then injected rapidly through the tip of the catheter. The time required for injection of the bolus varied from 1.5 to 3.0 sec. Total and regional mean transit times were obtained by dynamic imaging with 0.15-sec time frames with a suitably collimated gamma camera and integrating the area under the normalized time-activity curves. (EVLW = mean transit time X cardiac output). All radioactivity was present briefly in the lungs after injection before any portion reached the left heart. Three dogs were studied as controls. In one experimental animal bilateral PED was induced by infusion of 0.05 cc/kg of oleic acid into the main pulmonary artery. In two animals, unilateral PED was induced through injection of oleic acid with Swan-Ganz catheter advanced and wedged in one pulmonary artery. Two other animals were bled to a mean arterial pressure of 50 mmHg, with subsequent reinfusion of the blood and crystalloid resuscitation until the BP had returned to the baseline level. The development of PED was followed at serial intervals.

Results. The earlier observation that Rb ions remain intravascular during the first pass through the lungs was confirmed by comparison with both Tc-99m-labeled albumin and Tc-99m-labeled RBC's (4.3% coefficient of variance). In 6 instances, the maximum EVLW detected by this method was 54% of the total LW determined by the wet-dry weight ratio (published values range from 40 to 60%). Baseline determinations of EVLW in 2 dogs gave 5.3 and 6.2 cc/kg. In bilateral oleic-acid induced PED, the maximum EVLW was 8.6 cc/kg. Unilateral oleic-acid induced PED in 2 other dogs showed a mean increase of 10% in EVLW in the edematous compared to the normal lung. In 2 dogs bleeding followed by reinfusion of blood and crystalloid yielded EVLW values of 4.7 and 8.0 cc/kg. Compartmental analysis on the computer using the SAAM-27 program gave results which differed by only 6.4 ± 1.6% from those obtained with the height-area method. Discussion. Thermodye technique yields an average EVLW vol, whereas this technique makes possible the measurement of regional water content. Because of the short t½ this method allows EVLW determinations at 10-min intervals without needing arterial sampling, providing much-needed data on pulmonary fluid balance in critical phases of postop management of patients.