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Pulmonary embolism is a serious and sometimes life-threatening event which according to one recent estimate may affect upwards of 500,000 Americans each year. Recent studies aimed at further clarifying the fundamental character of the dynamics of pulmonary embolism in an experimental model have shown that the hemodynamic consequence of pulmonary embolism is a strong function of the size of the embolus emanating from the venous vasculature(1). Analysis of the clot dynamics and their effects suggested that a second important factor determining the effects of injected pulmonary emboli were the physical-mechanical properties of the clots themselves. In a clinical setting one of the factors which may influence such a parameter is the length of time that the clot remains within the venous vasculature prior to its embolization to the lung. In order to provide data bearing on this question a method has been developed to permit one to compare the physiological effects of blood clots formed in vivo for varying lengths of time with the mechanical properties of these clots and clots formed in vitro for similar lengths of time.

In vivo clots are formed in the inferior vena cava and iliac vein of mongrel dogs and left intact for periods of time ranging from 24 to 96 hours. At the time of each initial procedure blood is drawn from each animal and placed in test tubes and allowed to clot in vitro. At 24 hour intervals the in vitro blood clots are sectioned into five to eight smaller segments and placed sequentially into a specially designed device capable of measuring the "blow out" pressure for each clot. This device consists of a plexiglass sealed chamber into which air is pumped at a constant rate after the clot segment has been loaded into the chamber. A small orifice at the bottom of the chamber and in intimate contact with the clot segment is the site at which the clot will "blow out" at a particular level of pressure monitored within the chamber. This "blow-out" pressure is thought to characterize some composite of the mechanical properties of the clot. At the end of a prescribed interval (24, 48, 72, or 96 hours) the clot formed in the iliac vein of the animal is surgically removed and its blow-out pressure determined in the chamber. Simultaneously the clot that was formed in the inferior vena cava is released from its in situ position and allowed to embolize to the pulmonary circulation. Changes in pulmonary artery pressure, systemic arterial blood pressure, cardiac output, EKG, and blood gasses following the embolism are determined. After a steady state pulmonary artery pressure is achieved (approximately 30-45 minutes) the animal is sacrificed and pieces of the clot which have embolized to the lung are recovered and the "blowout" pressure for these also determined. Preliminary results to date have shown that the predominant effect of the in vivo formed clot is associated with a transient peak elevation in mean pulmonary artery pressure ranging from 100% to 163% of the pre-embolism control value. Chan-

ges in cardiac output, electrocardiogram, systemic arterial blood pressure, and blood gasses are minimal. No clear relationship between the age of the clot and the effect on pulmonary artery pressure has been substantiated. However, it appears that older clots (96 hour) are not substantially different in their effects than the youngest clots. The analysis of the blow-out pressure for the in vitro formed clots has shown considerable variation apparently dependent upon the segment of the clot from which the sample was drawn. Similar variations are seen both across animals and as a function of the in vitro age of the clot. Preliminary data on the evaluation of the blow-out pressure of clots retrieved from the lung after embolization and for those taken from the iliac vein as a control appear to indicate some relationship between the observed physiological changes and the measured values of blow-out pressure. Further studies are underway to increase the physiological data base so as to provide further insight into the correlation between the clot mechanical properties, their age dependence and the physiological correlates of these properties.

(1) Mayrovitz, H.N., Castillo R., Llamas, R., and Raines, J. Dynamics of Sequential Large Pulmonary Emboli. Proceedings of the 3rd International Conference, Cardiovascular System Dynamics Society, Leiden, 1978. In Press.

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