Title : PULMONARY CAPILLARY PERMEABILITY IN CARDIOGENIC SHOCK

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Introduction. Pulmonary capillary damage due to the effect of proteolytic enzymes has been implicated in the development of the shock-lung syndrome[1]. It has been shown that polymorphonuclear leukocytes sequestered within the lung release proteases causing endothelial damage. This in turn leads to interstitial edema, hypoxia, acidosis and a rise in pulmonary vascular resistance. Prompted by findings that lysosomal hydrolases are released in high quantities from infarcted myocardial tissue[2], we investigated whether these enzymes may play a similar role in transcapillary fluid shifts seen after myocardial infarction. In addition, the possible protective effect of an enzyme inhibitor was evaluated.

Methods. 28 cats were anesthetized with 50 mg/kg ketamine, intubated and ventilated by a Drager-Servo-Respirator. Catheters were introduced into the carotid artery, jugular vein and femoral artery and vein. The carotid catheter was connected to a flow-through cuvette inserted into a radiation detection device permitting passage of blood from the carotid artery to the femoral vein. This arrangement was used to measure the dilution and extraction of radioactive iostopes injected into the jugular vein. Radioactive iodinated serum albumin (RISA I-131) which remains intravascular - at least during one circulation time - was used to measure the intravascular volume (IVV). Simultaneous injection of I-125 antipyrine, which crosses the pulmonary capillary membrane and distributes itself intra- as well as extravascularly, was employed to measure the extravascular fluid volume (EVV). Time concentration curves for both markers were plotted as the logarithm of concentration against time. In addition, arterial blood pressure, ECG, hematocrit, thrombocyte count and plasma volume were recorded. After control values had been established, a myocardial infarction was produced by ligation of the left descending coronary artery. The chest was then closed and the measurements repeated 1, 2 and 4 hours after myocardial infarction. 2 groups of animals were studied: one received 50,000 KIU aprotinin/kg, a proteolytic enzyme inhibitor; the control group received an equal volume of saline.

Results. All animals subjected to experimental infarction survived the coronary ligation procedure, but 5 died within the following 4 hours. Most showed ECG changes typical for myocardial infarction. Mean blood pressure dropped 24.6% from a preoperative control value of 133 ± 5.5 mmHg during the 4 hour observation period. There was a 36% increase in hematocrit and a 27% decrease in plasma volume. The mean control pulmonary extravascular water volume was 7.5 ± 0.8 ml, while the intravascular volume was 23.2 ± 1.3 ml. 20 minutes after myocardial infarction, the EVV increased by 30.5% reaching a maximum of 49.2% after 4 hours. The mean IVV fell by 8.1% immediately after infarction and showed a further decrease to 15.8% after 4 hours. These changes were statistically significant. As seen in Fig. 1, the transcapillary volume shift could be reduced by administration of aprotinin. This reduction in EVV was significant when compared to the non-treated controls. There was no significant difference between treated and untreated animals in blood pressure, IVV, ECG, hematocrit, thrombocyte count and plasma volume.

Discussion. We interpret our data as evidence that myocardial infarction can cause secondary disturbances in organs other than the heart. Since pulmonary EVV increases could be observed well in advance of left ventricular failure, a change in capillary permeability must be suspected. Administration of aprotinin immediately after infarction reduced the fluid shift into the extravascular space significantly, indicating inhibition of proteolytic injury to the endothelium. There was also evidence for the development of hemoconcentration with an increase in hematocrit and a fall in plasma volume. We conclude from these experiments that the increase in pulmonary extravascular volume seen after myocardial infarction is not solely the result of low output failure, but may in part reflect changes in capillary permeability secondary to enzymatic damage.

References.

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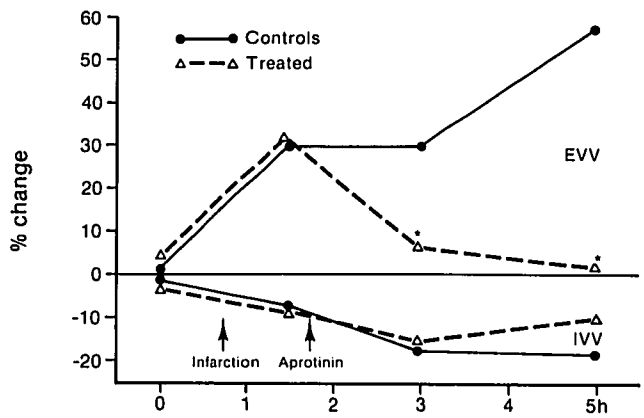

Fig. 1. Lung fluid changes after myocardial infarction with and without proteolytic enzyme inhibitor.