Title: LUNG MECHANICS IN EXPERIMENTAL PANCREATITIS

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Introduction: Pulmonary insufficiency occurs in from 4 to 30% of all patients with acute pancreatitis[1,2]. The pathogenesis of the respiratory failure is unknown, but capillary injury secondary to local free acid (FFA) release, and or surfactant destruction by circulating phopholipase A appear to be the most likely mechanisms. This study was performed to evaluate the frequency and extent of the changes in the mechanical characteristics of the lung in experimental acute pancreatitis.

Method: Fourteen dogs weighing between 18 to 25 Kg were anesthetized with intravenous pentobarbital sodium (30 mg/Kg of body weight). The dogs were randomly assigned to one of the following groups: Group A (5 dogs): these animals served as nonoperative controls. The animals were sacrificed by exsanguination after blood was withdrawn for amylase determination. Group B (3 dogs): These animals served as operative controls. After tracheal intubation, a sham operation consisting of a small midline abdominal incision and duodenotomy was performed, no other procedure was carried out. Group C (6 dogs): After tracheal intubation, alaparatomy was performed under sterile conditions as in Group B. Through a small duodenotomy, haemorrhagic pancreatitis was induced by injecting a mixture of 6 ml of trypsin (40,000 U) and 6 ml of the dogs own bile into the main pancreatic duct. In Group B and C blood was withdrawn for amylase determination after induction of general anesthesia but before the laparotomy and again at the time of sacrifice. Thirty-six hours after the operation, the dogs were anesthetized again with pentobarbital sodium and sacrificed by exsanguination. In all animals the abdomen opened to determine the condition of pancreas. The lungs were removed and weighed. The pressure volume relationship of each lobe was determined. Lung/body weight and lobe wet/dry weight ratios were determined from both upper and lower lobes of each side of the lung.

Results: Group A: Serum amylase levels was 518.6 CAR. U./DL. The lungs and pancreas were normal in all animals. The average lung/body and lobe wet/dry weight ratios were 4.162± 0.298 and 0.00807± 0.00009 respectively. The pressure volume curve was as shown in Fig. I. Group B: The dogs were normal after recovery from anesthesia. Pancreas was normal and there was no ascites. Serum amylase was not increased after the sham operation. The lungs were grossly normal. The lung/body and lobe wet/dry weight ratios were identical to Group A. The pressure-volume curve was no different from the Group A. Group C: After recovery from anesthesia, the animals became inactive and lost appetite. No clinical signs of respiratory failure in any of the dogs. Amylase level increased markedly from 455.3 CAR.U/DL to 1831.6 CAR. U/DL. There were from 300 to 500 ml of sanguinous fluid in the peritoneal cavity. In each animal, the pancreas was markedly edematous and haemorrhagic. Fat necrosis was seen in the adjacent tissues. The lungs appeared edematous with areas of atelectasis. The lung/body weight and lobe wet/dry weight ratios were markedly increased to 0.01345± 0.00145 and 5.502±0.501 respectively. The increased ratios were statistically significant. The pressure-volume curve was markedly depressed at all levels of transpulmonary pressures, particularly at the level of 15, 10 and 5 cm of H_2O pressures (Fig. I). The differences between Group C to other groups were statistically significant.

Discussion: The results of this study demonstrate an early involvement of the lung in experimental acute pancreatitis, even in the absence of any clinical signs of pulmonary insufficiency. The lungs became edematous as demonstrated by increases in the lung/body and lobe wet/dry weight ratios. These data support the concept that disruption of the alveolar-capillary membrane is the early underlying injury. Surfactant is a phopholipid, a major component of which is lecithin. The release of phospholipase A (or Lecithinase) in the blood by the acutely inflamed pancreas could result in surfactant destruction in the lung with an early drop in the elastic recoil of the lung. The depression of the pressure-volume curves in the animals with acute pancreatitis suggest this concept. The early increase in the lung weight following the onset of the pancreatitis suggests the concept that a capillary leak occurs early and frequently in acute pancreatitis. Although clinically respiratory failure is seen in only 4 to 30 percent of all patients with acute pancreatitis, this study suggests that pulmonary injury may be much more frequent, and that clinical evidence might just be a matter of degree.

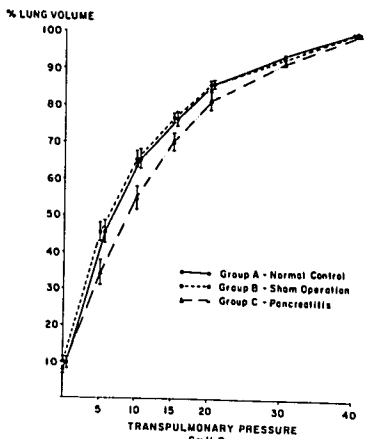

Fig. 1. Changes in Pressure-Volume Deflation Curves in the 3 groups. Values are presented as the mean ±1 S.E.

References:

1. Gliedman, M.L., Bolooki, H. and Rosen, R.G.; Acute Pancreatitis Current Surgical Problems In Surgery. Yearbook Medical Publishers, Inc. Chicago, pp. 16-19, 1970.
2. Ranson, J.H.C., Turner, J.W., Rosen, D.F., Rifkind, K.M., Spencer, E.C.: Respiratory Complications in Acute Pancreatitis. Ann. Surg. 179:557-566, 1974.