

Title: SMOKE INHALATION INJURY CAUSES MYOCARDIAL DEPRESSION IN SHEEP

Authors: K. Sugi, M.D., J. Newald, Ph.D., L. D. Traber, R.N., J. P. Maguire, M.D., D. N. Herndon, M.D., G. Schlag, M.D. and D. L. Traber, Ph.D.

Affiliation: 1. The Departments of Anesthesiology, Surgery and Physiology, The University of Texas Medical Branch, Galveston, Texas 77550.  
2. Shriners Burns Institute, Galveston, Texas 77550.  
3. The Ludwig Boltzman Institute for Traumatology, Vienna, Austria.

Introduction. It has previously been reported that sheep with inhalation injury require greater fluid resuscitation than maintenance due to cardiovascular depression<sup>1</sup>. It is hypothesized that this cardiovascular depression is a direct result of myocardial depression.

Methods. Under general anaesthesia, a left thoracotomy was performed on six sheep. Ultrasonic crystals were placed on the anterior, posterior, apex, and base of the heart to measure the external minor and major diameters. A pressure transducer was placed in the left ventricle via the apex. Aortic, Swan-Ganz, central venous and left atrial catheters were also inserted. After a five day recovery period, base line measurement were made. The animals were then insufflated with 4 series of 16 breaths (350 ml/breath) of cotton smoke using a modified bee smoker<sup>2</sup>. Lactated Ringer's solution was infused at a rate of 3 ml/kg/hr for maintenance fluids. Data was collected for 48 hrs. At baseline, 12, 24, 36 and 48 hrs, the afterload of the left ventricle was manipulated with phenylephrine to obtain the left ventricular end systolic pressure volume ratio (Emax).

Results. Twenty-four hrs after insufflation, the sheep showed a significant decrease in Emax (4.89±0.21) as compared to control (7.47±0.55), returning to control values at 48 hrs. The left ventricular end systolic and diastolic volumes (ESV,EDV) increased as evidenced by an increase in

major and minor diameters. The maximum dP/dt of the left ventricle (+dP/dt), Vmax and stroke work index (SWI) fell.

	ESV	EDV	+dP/dt	Vmax	SWI
baseline	53±13	100±11	1682±134	93±9	72±7
24 hrs	66±14*	119±21	1484±109*	77±3*	57±6*

(\* ; p<0.05 from baseline by Dunnetts Test)

Discussion. Maximum dP/dt, Vmax, and stroke work index were reduced despite the increase in end-diastolic volume. These changes and the reduction of Emax, (which has been shown to be independant of preload, afterload and heart rate<sup>3</sup>), suggests that the cardiovascular depression observed after a smoke inhalation injury, is directly due to myocardial depression.

References.

1. Herndon DN, Traber DL and Traber LD: The effect of resuscitation on inhalation injury. Surgery 100(2):248-251, 1986.
2. Kimura R, Traber LD, Herndon DN, Linares HA, Lubbesmeyer HJ, Traber DL: Increasing during of amoke exposure induces more severe lung injury in sheep: J Appl Physiol 64:1107-1113, 1988
3. Suga H, Sagawa K and Shoukas AA: Load independence of the instantaneous pressure-volume ratio of the canine left ventricle and effects of epinephrine and heart rate on the ratio. Circ Res 32:314-322, 1973. (Supported by NIH Grant #33324)