Title: URINARY BLADDER DISTENSION IN ANESTHETIZED RATS: A SOURCE OF CARDIAC ARRHYTHMIAS AND OTHER CV CHANGES

Authors: J. E. Heavner, Ph.D., M. Allon, B.A. and G. B. Racz, M.D.

Affiliation: Department of Anesthesiology and Physiology, Texas Tech University Health Sciences Center, Lubbock, TX 79430

Introduction. The relationship between urinary bladder distension and cardiovascular disturbances in anesthetized patients has been the subject of several clinical reports. We report here results of laboratory investigation in which we sought to confirm anecdotal reports incriminating bladder distension as a cause of cardiac dysrhythmias intraoperatively.

Methods. Sprague-Dawley rats weighing 250 - 350 gm were given halothane (N = 5), isoflurane (N = 4) or enflurane (N = 4). Following anesthetic induction, a carotid artery, a juglar vein and the trachea were cannulated after which the animals were mechanically ventilated with a Harvard rodent ventilator. The urethra and urinary bladder were exposed via a midline incision and the urethra was ligated. A double-lumen cannula was inserted into the apex of the bladder. Bladder pressure was recorded via one lumen of the cannula and saline was infused into the bladder via the other lumen. Bladder pressure, ECG and arterial blood pressure were recorded during infusion of saline into the bladder (160 or 250 μl/min for eight minutes) at three or more levels of anesthesia. Thirty minutes of equilibration were allowed at each level of anesthesia and the bladder was emptied between infusions. Arterial pH and blood gases were measured periodically and corrected as necessary.

Results. Two of the 13 rats developed notable ventricular rhythm disturbances during micturition reflexes. The disturbances were most pronounced in a rat during 0.5% halothane administration (Figure 1). This animal had ventricular premature beats, bigeminy and ventricular tachycardia which appeared to be related to high frequency oscillations of bladder pressure. Premature ventricular beats were also present during bladder contraction in a rat anesthetized with 1% isoflurane. In many cases, artifacts appeared on ECG lead II, but not lead I during high frequency oscillations in bladder pressure. No remarkable blood pressure or heart rate changes occurred during bladder distension when micturition reflexes were blocked by the anesthetic. This was so despite the fact that intraluminal bladder pressures sometimes exceeded 50 mmHg at the end of saline infusion. Blood pressure changes did occur when the micturition reflex was active. First pressure decreased, then increased, then returned to baseline (Figure 2). The magnitude of the change was variable. The micturition reflex was completely inhibited when inspired halothane concentration exceeded 0.8%, when inspired isoflurane concentration exceeded 1.5% and when inspired enflurane concentration exceeded 1.6%. Three components of the micturition reflex that we examined, namely spontaneous micturition reflexes, the sustained component of the micturition reflex, and high frequency oscillations present on the plateau of the sustained component, varied in consistent fashion in sensitivity to anesthetic depression. The spontaneous reflex was the most sensitive to anesthetic depression. The oscillatory component was intermediate and the sustained component was the least sensitive. Figure 2 illustrates the presence of the sustained and oscillatory phase of the MR during light halothane anesthesia, and the presence of the sustained but not the oscillatory phase during light enflurane anesthesia. Curiously, none of the rats moved during bladder distension until inspired anesthetic concentration was below 0.3 MAC, the MAC awake for humans.

Discussion. Results of this study confirm that urinary bladder distension can cause cardiac arrhythmias and other cardiovascular disturbances in anesthetized animals and probably in anesthetized humans. The most likely mechanism by which the arrhythmias are initiated involves autonomic nervous system unbalances. It has been demonstrated that in anesthetized dogs, bladder distension activates sympathetic efferent and inhibits parasympathetic efferent innervation of the heart.[1]

References.

1. Hassan MN, et al: Effect on efferent cardiac vagal nerve fibers of distension of the urinary bladder in the dog. Quart J Expt Physiol 72:473-481, 1987.

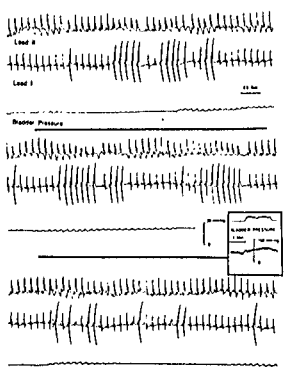

Figure 1. Recording of ventricular arrhythmias during a micturition reflex in a rat receiving 0.4% halothane. Insert shows micturition reflex and arterial blood pressure trace at slow chart speed.

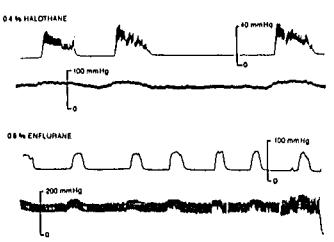

Figure 2. Intraluminal bladder pressure and arterial blood pressure traces from a rat inhaling 0.4% halothane (upper traces) and from a rat inhaling 0.8% enflurane (lower traces).