TITLE : EFFECTS OF VOLUME LOADING ON BAROREFLEX CONTROL OF HEART RATE DURING LUMBAR EPIDURAL ANESTHESIA

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INTRODUCTION. Epidural anesthesia-induced hypotension is often associated with an absence of reflex tachycardia, suggesting an impairment of baroreflex (BR) control of heart rate (HR). Although a previous study (1) conducted under general anesthesia failed to demonstrate such an alteration during lumbar epidural anesthesia (LEA), we further investigated this topic in unpremedicated patients. Moreover, we studied the effects of associated LEA and increase in venous return (VR) by low body positive pressure (LBPP) (2), since LEA-induced decrease in VR may alter the cardiopulmonary and arterial BR control of HR.

METHODS. Six ASA 1 male unpremedicated patients (37 ± 6 years) (mean ± SEM) were studied prior orthopedic surgery. All gave informed consent for the study after approval by our Institutional Review Committee. Catheters were positionned in a peripheral vein for Ringer's lactate infusion (50 ml/hr) and drug injections, radial artery, lumbar epidural space (L3-L4) and right atrium via a basilic vein. The device for LBPP was set up on the legs. Systolic, diastolic and mean arterial pressures (respectively SAP, DAP and MAP), right atrial pressure (RAP) and ECG were continuously recorded. A cardiotachometer triggered by ECG provided records of HR. Three sets of measurements were obtained : 30 min after catheter insertion (control), 30 min after epidural injection of 8 ml of 0.5 per cent plain bupivacaine (LEA period) and at the end of a 10 min application of 40 mmHg LBPP (LBPP period). Each set of measurements included : MAP, RAP, HR, heart period (R-R interval) and BR testing performed by bolus of phenylephrine (PHE 100 mcg) and nitroglycerin (NG 100 mcg) to raise or lower SAP by 20-30 mm Hg. Each R-R interval was plotted as a function of the preceding SAP, beginning after the first noticeable change in R-R interval. The BR slope was determined by linear regression between SAP and R-R interval. The slope was accepted for further analysis only if the regression coefficient was 0.8 or greater. The superior level of analgesia was assessed by pin-prick. Values were means ± SEM. Two way analysis of variance was used for statistical analysis.

RESULTS. The superior level of analgesia was always inferior to T8. As shown in table I and figure 1, LEA induced : (i) a significant decrease in MAP and RAP without change in HR, (ii) a significant increase in BR slopes during either PHE or NG bolus, without changes in maximal NG and PHE-induced variations in SAP and R-R interval. After LBPP, MAP and BR slopes returned close to their control values, while RAP significantly increased, although remaining lower than its control value (table I, figure 1).

DISCUSSION. This study demonstrates that there is an impairment of BR control of HR during LEA. The increase in BR slope by LEA during PHE bolus indicates that LEA enhances parasympathetic tone. Two mechanisms lead to this enhancement : (i) a reduction of tonic BR inhibition from cardiopulmonary receptors related to the LEA-induced VR decrease, since the increase in BR slope during PHE bolus disappears after LBPP-induced increase in RAP, (ii) an increase in baroreceptor discharge due to the increase in sympathetic tone in sino-aortic areas which are not blocked by LEA (3). On the other hand, the increase in slope during NG bolus may be due to a shift to the left in the BR set point in such a way that decrease in MAP comes to work on a deeper portion of the stimulus-response curve (4). In conclusion LEA induces an impairment of BR control of HR which is mainly due to an increase in vagal tone and reversed by venous loading.

	CONTROL	LUMBAR EPIDURAL ANESTHESIA	
		LEA PERIOD	LBPP PERIOD
Mean Arterial Pressure (mm Hg)	91 ± 4	83 ± 4*	88 ± 5
Right Atrial Pressure (mm Hg)	3.8 ± 0.7	0.6 ± 0.8**	2.2 ± 0.9*●
Heart Rate (beats/min)	76 ± 4	75 ± 5	74 ± 6
R-R interval (msec)	803 ± 49	792 ± 47	805 ± 58
Baroreflex slope (PHE) (msec/mm Hg)	14.4 ± 3.1	20.3 ± 4.4**	16.4 ± 3.8●
Baroreflex slope (NG) (msec/mm Hg)	4.7 ± 1.4	7.6 ± 2.2*	5.9 ± 1.7

Table I. Basal values of MAP, RAP, HR and R-R interval before PHE and NG bolus and BR slopes during PHE and NG bolus, at control, LEA and LBPP periods. Significant change from control : * $p<0.05$, ** $p<0.01$. Significant change between LBPP and LEA : ● $p<0.05$.

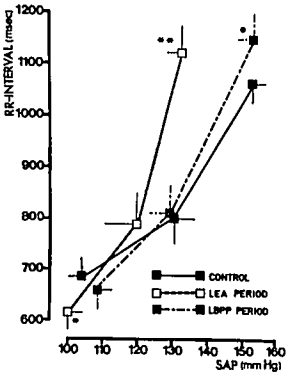

Figure 1. Baroreceptor reflex function curves and maximal NG and PHE-induced changes in SAP and R-R interval. Significant changes in BR slopes : symbols (*, **, ●) similar to those in table I.

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