Title: VIOLATION OF RPP EXERCISE THRESHOLD IN CORONARY PATIENTS

Authors: J.G. Reves, M.D., P.N. Samuelson, M.D., W.A. Lell, M.D., M. Linnan, B.S., H.G. McDaniel, M.D., N.T. Kouchoukos, M.D., and Lloyd R. Smith, M.A.

Affiliation: Departments of Anesthesia, Medicine and Surgery, University of Alabama Medical Center, Birmingham, Alabama 35294

Introduction. The readily obtained heart rate systolic blood pressure product (RPP) is an excellent correlate of myocardial oxygen consumption (MVO_2) in patients with ischemic heart disease (IHD)[1]. The purpose of this investigation was threefold: 1) determine the mean and range of threshold (TRPP) at which angina or ST changes occurred during exercise testing (GXT) in IHD patients scheduled for coronary artery bypass (CABG) surgery; 2) determine the incidence of subsequent TRPP violation during anesthesia for CABG and 3) determine if intraoperative violation of TRPP resulted in myocardial damage.

Methods. Entry criteria for the 19 patients were IHD, elective CABG surgery and pre-surgical GXT. The peak RPP at which the GXT was terminated was calculated (TRPP). * Subsequently, anesthetic management was as follows: patients were premedicated with diazepam (.15 mg/kg), morphine (.1 mg/kg), and scopolamine (.3-.4 mg). Anesthesia induction consisted of diazepam .3-.5 mg/kg i.v., pancuronium .1 mg/kg and either enflurane 0-3% inspired (8 patients) or halothane 0-1.5% (11 patients).* Five minutes after induction orotracheal intubation was performed following topical lidocaine to the larynx. Anesthesia maintenance consisted of varied concentrations of enflurane or halothane and adjuvant agents to maintain the RPP ± 30% of the patient's normal resting value. In all patients, Lead II and/or V_5 electrocardiograms and systolic (SBP), diastolic systemic blood pressures were monitored, and left atrial pressure after sternotomy. Serial blood samples were obtained for determination of creatine phosphokinase (CK) and CK isoenzyme MB (CK-MB) at preinduction, prior to bypass and at regular intervals during and after bypass extending to 66 hours. Control (prior to induction) and peak RPP were compared with TRPP and examined for significance using the paired t-test with each patient as his own control. The release of CK-MB was compared in patients who exceeded the TRPP versus those who did not.

Results. The GXT mean TRPP was 20,067 (range 9,120 - 33,150 and SEM = 1,176). There was no difference between RPP or CK-MB data in patients anesthetized with halothane or enflurane; therefore, the values of all patients are included in Table I. Peak increases in RPP occurred with intubation in all patients and lasted 1-3 minutes. Two of the 19 patients (10.5%) exceeded their TRPP. Their average prebypass CK-MB (1 IU/L)** and peak CK-MB (6.5 IU/L) were slightly less than the mean CK-MB values for all patients (Table I). There were no observed ST changes suggestive of ischemia in any of the patients. During the peak increase in RPP the HR increased 34% and the SBP 25% (not significantly different). CK-MB levels were no different in patients in whom HR increases exceeded SBP increases (Table II).

Discussion: Anesthetic management with halothane or enflurane and adjuvant agents is effective in minimizing increases in myocardial oxygen demand in the majority of patients undergoing CABG. Transient elevations of myocardial oxygen demand as evidenced by violations of TRPP during intubation do not result in myocardial damage as detected by EKG and CK-MB enzyme methods. Sustained elevations of MVO_2, deficiencies in myocardial oxygen supply, inadequate myocardial preservation during bypass and incomplete revascularization remain potential sources of ischemic myocardial damage during CABG.

* Participants in the investigations gave informed consent for this study which was approved by the Institutional Review Board.

** 1-2 IU/L is within error of measurement in our laboratory.

References.

1. Gobel FL, et al.: The rate-pressure product as an index of myocardial oxygen consumption during exercise in patients with angina pectoris. Circulation 57:549, 1978

Table I Mean values for 19 patients anesthetized for CABG surgery

	TRPP	CRPP	PRPP	CK-MB (BP)	CK-MB (P)
$\bar{x}$	20,067	9,748	15,852	1.5	7.6
SE	1,176	508	1,009	.49	1.07

Where: TRPP = Threshold, CRPP = control, PRPP = peak RPP, (BP) = prior to bypass, and (P) = maximal value after bypass.

Table II Comparison of CK-MB released as a function relative to changes in HR and SBP.

	CK-MB(BP) HR>SBP	CK-MB(BP) HR<SBP	CK-MB(P) HR>SBP	CK-MB(P) HR<SBP
$\bar{x}$	1.9	1.0	7.8	7.5
SE	.83	.22	1.4	1.8
N	11	8	11	8

Where: HR>SBP = pts. with greater increase in HR, HR<SBP =pts. with SBP increases greater than HR, (BP) = prior to bypass, and (P) = peak.