

Title: RPP: MAY IT R.I.P.

Authors: P.G. Barash, M.D., F. Seinfeld, M.D., H. Kay, M.D., S. Condos, B.S.,
S. Hashim, M.D., J. Tinker, M.D. and A.S. Geha, M.D., M.S.

Affiliation: Departments of Anesthesiology and Surgery, Yale University School of Medicine,
New Haven, Connecticut 06510 and the Department of Anesthesiology, Mayo
Medical School, Rochester, Minnesota 55901

Introduction. Despite data showing that rate pressure product (RPP) is a poor indirect index of myocardial oxygen consumption ($\dot{M}V\text{O}_2$) in a canine model with normal coronary arteries, this index continues to be widely used in patients with coronary artery disease.¹ To resolve this apparent dilemma, we tested this correlation (RPP vs. $\dot{M}V\text{O}_2$) in a canine model with a fixed stenosis of the left anterior descending coronary artery (LAD).

Methods. Seven dogs were placed on total right heart bypass with both caevae, pulmonary hila and azygous vein ligated, which allowed a right ventricular (RV) cannula to drain coronary blood flow (CBF). A 50% luminal LAD stenosis was created. Subendocardial electrogram and central aortic pressure were monitored continuously. $\dot{M}V\text{O}_2$ (Fick principle) and myocardial lactate extraction were calculated from arterial and coronary sinus samples. Heart rate was controlled with an external pacemaker after the sinoatrial node had been ablated. SBP was manipulated by mechanically altering afterload. Cardiac output was maintained constant at 50 cc/kg/min. Fifty-four determinations of $\dot{M}V\text{O}_2$ were made at RPP's in the low (<12,000 mmHg beat/min) medium (18-25,000) and high (>25,000) range. At each range, RPP was kept constant, but in different subsets SBP and HR components of RPP were separately manipulated such that HR=SBP, HR/SBP >1.2, or SBP/HR >1.2. Data are expressed as the mean values \pm SEM, and statistical analysis was performed using two way analysis of variance and coefficient of correlation.

Results. Overall correlation between RPP and $\dot{M}V\text{O}_2$ was $r=0.44$, $p<0.005$ (n=54) (Figure). Furthermore, there also was poor correlation between RPP and $\dot{M}V\text{O}_2$ in the various hemodynamic subsets evaluated (Table 1). Neither heart rate nor SBP independently increased $\dot{M}V\text{O}_2$ ($p<0.05$) (Table 2). Myocardial ischemia manifest as lactate production showed no consistent correlation with any level of RPP ($r=0$) ($p>0.05$).

Discussion. RPP correlates poorly with $\dot{M}V\text{O}_2$ in the presence of fixed stenosis of the LAD. On the basis of changes in myocardial lactate extraction, a given level of RPP that consistently predicted myocardial ischemia was not found. On the basis of this study, RPP should not be used as an index of $\dot{M}V\text{O}_2$ or predictor of

ischemia in the presence of proximal coronary artery occlusive disease in the anesthetized patient.

L. Barash PG et al: Rate Pressure Product: A reliable index of myocardial oxygen consumption? Anesthesiology 55:A37, 1981.

TABLE 1
Correlation Coefficients
between RPP and $\dot{M}V\text{O}_2$ in Different Subsets

	RPP (mmHg beats/min)		
	12,000	18-25,000	25,000
HR=SBP	0.52*	0.00	0.00
HR>SBP	0.17	0.14	0.82*
SBP>HR	0.28	0.14	0.00

$p < .05$

TABLE 2
Total Cardiac $\dot{M}V\text{O}_2$ (ml/min/100g)

	HR (bpm)	HR (bpm)		
		< 130	131-159	> 160
SBP	< 130	7.0 \pm 0.9	6.9 \pm 1.3	11.1 \pm 1.6
131-159	> 160	6.4 \pm 0.8	9.8 \pm 2.9	12.3 \pm 2.3
(mmHg)	> 160	10.8 \pm 2.4	15.2 \pm 5.6	12.5 \pm 1.8

CORRELATION BETWEEN
MYOCARDIAL OXYGEN CONSUMPTION ($\dot{M}V\text{O}_2$)
AND RATE PRESSURE PRODUCT (RPP)
(Coronary Stenosis)

