

Title: PERIOPERATIVE MYOCARDIAL ISCHEMIA IN THE NONCARDIAC SURGICAL PATIENT

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**Introduction.** Recent studies in patients undergoing cardiac surgery have addressed the importance of the preoperative ischemic pattern, the effects of anesthesia and surgery, and the incidence of postoperative ischemia (1,2). However, no study has addressed these important issues in high-risk patients undergoing non-cardiac surgery, even though they comprise the vast majority of the surgical population with coronary artery disease. In order to address these issues and characterize perioperative ischemia in these patients, we monitored for electrocardiographic (ECG) evidence of ischemia preoperatively, throughout surgery, and during the early postsurgical period. We compared the frequency, duration and severity of ischemic episodes during the three time periods, and related the occurrence of ischemia to preoperative cardiac risk factors and indices of supply and demand (S/D).

**Methods.** After informed consent and IRB approval, 50 men presenting for elective noncardiac surgery under general anesthesia were studied with continuous ECG monitoring (Marquette Electronic Series 8500). 28 had coronary artery disease and 22 had two or more cardiac risk factors. Recordings were obtained one to two days preoperatively (n=32), throughout surgery (n=50) and for 24-32 hours postoperatively (n=50). The total monitoring time was 2,664 hours. Leads CM5 and CC5 were monitored. Types of surgery included intraabdominal (13), intrathoracic (4), major vascular (11), peripheral vascular (8) and other (14). Anesthetic technique was not controlled. Using a Marquette 8000 analysis system, ST segments were trended over time. ECG changes consistent with myocardial ischemia were defined as reversible deviations from baseline of  $\geq 1$ mm horizontal or downsloping ST depression, or  $\geq 2$ mm ST elevation at J + 60 msec for at least one minute. Each episode was validated by 2 blinded investigators. Control HR (demand index) was taken at 10 minutes before the ischemic episode. Serial ECG's and CK-MB fractions were obtained daily until discharge. Infarction was defined as CK-MB > 60 units and Q-waves on ECG.

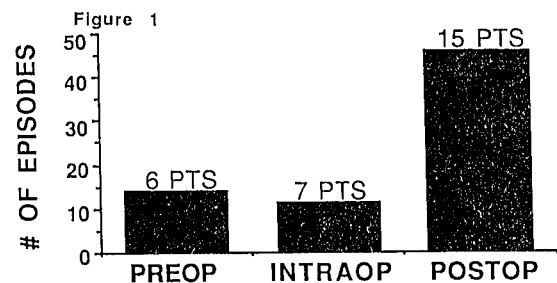
**Results.** Twenty (40%) patients developed 62 episodes of perioperative ischemia. All were ST depression. The characteristics are described in Figure 1 and Table 1. Preoperatively, six patients (19%) became ischemic. All episodes were silent. Intraoperatively, episodes were similar to the preoperative pattern in frequency, duration and heart rate. Postoperatively, 15 patients (30%) had episodes which were more frequent, lasted throughout the monitoring period (Figure 2), occurred at higher heart rates (110 vs. 85 bpm,  $p < 0.05$ ), and were silent (100%). Overall, 24% of the episodes were preceded by increases (20%) in heart rate (Figure 3). Ischemia tended to be more common in patients undergoing major vascular procedures (7/11) when compared to all other surgical procedures (12/39,  $p=0.08$  by Fisher's Exact Test). Ischemia occurred in nine patients with cardiac risk factors (41%) and in ten with coronary artery disease (37%). Cardiac outcomes (death, infarction, failure) occurred in 7 patients (14%), with 2/7 having perioperative ischemia.

**Discussion.** These results suggest that in high-risk patients undergoing noncardiac surgery: (1) Preoperatively - ischemia is clinically silent (100%) and unrelated to demand (93%); (2) Intraoperatively - anesthesia and surgery are not associated with an increased incidence of ischemia; (3) Postoperatively - ischemia occurs most commonly during the postoperative period, continues for at least one to two days after surgery, and is silent (100%); (4)

S/D - the majority of perioperative ischemia is not demand related; and (5) Prediction - patients with cardiac risk factors alone are equally likely to manifest ischemia in the perioperative period as those with known coronary artery disease.

**References.**

- 1) Knight A, et al: (ANESTHESIOLOGY: 68 In Press)
- 2) Slogoff S and Keats AS: (ANESTHESIOLOGY: 62:107-114)



	PREOP	INTRAOP	POSTOP
# PATIENTS WITH ISCHEMIA	6/32 (19%)	7/50 (14%)	15/50 (30%)
MEAN HOURS MONITORED	21.4	6.1	33.3
# EPISODES	14	11	46
ST CHANGE -1 to -1.9mm	12	7	37
ST CHANGE >-2.0mm	2	4	9
MEAN DURATION (minutes)	57	42.4	26
MEDIAN MAX. ST CHANGE (mm)	-1.6	-1.3	-1.6
# EPISODES WITH CHEST PAIN	0	-	0

Figure 2

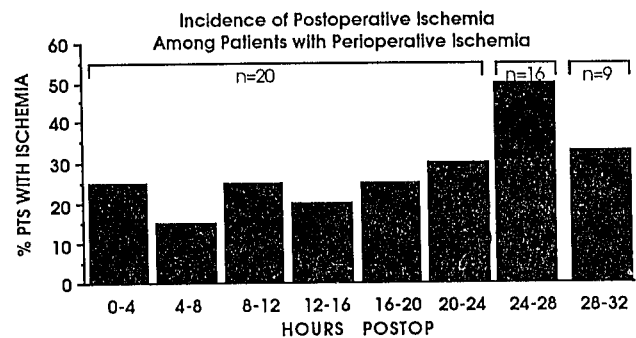


Figure 3

