

Title : NEOSTIGMINE-ATROPINE AFTER CORONARY SURGERY

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Introduction: Coronary artery bypass grafting (CABG) is usually followed by mechanical ventilation overnight, even in patients with normal left ventricular and pulmonary function. Recently, some of these patients with good ventricular function have been extubated shortly after surgery.¹ Reversal of neuromuscular blockade may be needed for safe early extubation. However, the cardiovascular effects of reversal immediately after CABG are largely unknown. The purposes of this study are to quantify the effects of neostigmine and atropine (N&A) on myocardial oxygen supply and demand and on systemic and pulmonary hemodynamics.

Methods: Eight patients with normal ventricular and pulmonary function undergoing elective CABG gave informed consent for this study, approved by the Human Investigations Committee. All patients were maintained on propranolol until surgery. The anesthetic technique consisted of morphine (0.5mg/kg), diazepam (0.25mg/kg), 50% N₂O and enflurane. Muscle relaxation was produced with pancuronium (0.1mg/kg for intubation and 0.15mg/kg, total dose). Monitoring consisted of radial artery and thermodilution pulmonary artery catheters, ECG leads II and V₅, esophageal phonocardiogram, arterial and mixed venous blood gases, and a blockade monitor. At the end of surgery, control measurements were made while mechanical ventilation continued with 50% N₂O and O₂. Neostigmine 0.04mg/kg and atropine 0.02mg/kg were administered together over 30 sec. Heart rate (HR), blood pressure, filling pressures, and the ECG were continuously recorded. At 7 min after N&A, cardiac output, systolic time intervals, and blood gases were measured. A second dose of N&A was administered to a total of 0.07mg/kg and 0.035mg/kg, respectively. All measurements were repeated 7 and 14 min after the second dose. The ECG was analyzed every minute for changes in the PR interval, ST-segments, or arrhythmia development. Derived parameters included cardiac index (CI), pulmonary and systemic resistances, stroke work (SW), PEP/LVET, 1/PEP², rate pressure product (RPP), endocardial viability ratio (EVR), and pulmonary venous admixture (QSP/QT). Paired t tests were used to compare measurements to control values.

Results: Reversal of pancuronium blockade with N&A produced no detrimental hemodynamic changes (Table). Heart rate was elevated at 2 min, but returned to control by 7 min. There were no significant changes in the PR interval, ST-segments, or cardiac rhythm. The RPP decreased significantly at each interval measured, while EVR increased at 7 and 14 min. Mean arterial pressure (AP), pulmonary artery

pressure ($\overline{\text{PAP}}$) and SW decreased significantly, while PEP/LVET, 1/PEP², wedge pressure, resistances, and cardiac index did not change significantly. In addition, QSP/QT did not change and all PO₂ values were above 130 torr.

Discussion: Findings of importance to the CABG patient include the minimal effect on HR and rhythm, along with modest reductions in AP and $\overline{\text{PAP}}$, significant falls in rate pressure product, and increases in EVR. Our hemodynamic results confirm those found by Salem *et al*², with the notable addition of the favorable alteration in the oxygen supply/demand balance after N&A. This is related to the lack of change in indices of contractility, significant decreases in both right and left ventricular SW, and lack of change in pulmonary and systemic resistances. We conclude that reversal can be accomplished with minimal risk of hemodynamic compromise in CABG patients in whom early extubation is contemplated.

TABLE (\bar{x} values \pm 1 S.E.)

Parameter	Control	7 min	14 min	21 min
$\overline{\text{AP}}$ (torr)	93 ± 3.8	86* ± 3.9	79* ± 3.0	78* ± 3.4
$\overline{\text{PAP}}$ (torr)	16.0 ± 1.8	13.8 [†] ± 1.3	14.5 ^Δ ± 1.4	13.6 [†] ± 1.1
HR (beats/min)	79 ± 3.8	75 ± 2.3	77 ± 2.1	73 ± 2.0
CI ($\ell/\text{min}/\text{m}^2$)	2.40 ± 0.27	2.03 ± 0.12	2.04 ± 0.12	2.10 ± 0.14
1/PEP ²	50 ± 7	48 ± 6	46 ± 4	44 ± 5
RPP	9891 ± 688	8294 [†] ± 234	8161* ± 402	7613* ± 367
EVR	1.35 ± 0.05	1.54 [†] ± 0.07	1.47 [†] ± 0.05	1.54 ± 0.06
QSP/QT	0.14 ± 0.02	0.14 ± 0.01	0.13 ± 0.01	0.13 ± 0.01

† = P < 0.05; Δ = P < .01; * = P < 0.005

References:

1. Klineburg PL, Geer RT, et al: Early extubation after coronary artery bypass surgery. *Crit Care Med* 5:272-274, 1977.
2. Salem MR, Toyama T, et al: Hemodynamic responses to antagonism of tubocurarine block with atropine-neostigmine in children. *Br J Anaesth* 49:901-905, 1977.