Title: MYOCARDIAL ISCHEMIA AFTER NEUROMUSCULAR BLOCKADE REVERSAL

Authors: W. Tse, M.D., G. Bause, M.D., and P.G. Barash, M.D.

Affiliation: Department of Anesthesiology, Yale University School of Medicine, New Haven, CT 06510

Introduction. When systemically administered, neuromuscular blockade reversal agents act upon the autonomic nervous system, altering a patient's hemodynamic state.[1] In patients with impaired myocardial perfusion, this autonomic interaction could produce cardiovascular changes leading to myocardial ischemia. To investigate myocardial ischemia during reversal of neuromuscular blockade, we continously monitored intraoperative and postoperative ST segment changes in a population with a high prevalence of demonstrated as well as occult coronary artery disease.

Methods. Following Human Investigation Committee approval, thirty-eight (n=38) patients undergoing non-cardiac surgical procedures requiring general anesthesia were randomly selected solely on the type of anesthetic management to be used. Twenty-seven subjects (n=27) in the neuromuscular blockade (NMB) group received pancuronium and reversal with pyridostigmine and glycopyrrolate. Eleven subjects in the control group (CONTROL) did not receive these agents. Other than the use and reversal of neuromuscular blockade, all subjects received similar anesthetic management. Through the surgical procedure, all subjects were continuously monitored with ST segment voltage, electrocardiography, blood pressure, twitch response, pulse oximetry, and capnometry. A modified Hewlett-Packard electrocardiographic monitor quantified the magnitude (mV) of ST segment elevation/depression in two leads (V_5 and II). Reversal agent dose was 0.14 mg/kg pyridostigmine and 0.0072 mg/kg glycopyrrolate.[2] Data are expressed as mean ± standard deviation of the mean. Student t-test for unpaired data, and Spearman's rank order correlation were used for statistical analysis; $p < 0.05$ was considered significant.

Results. For the five minutes prior to closure/reversal administration, NMB and CONTROL patients had similar ST segment voltages and hemodynamic parameters. In the operating room after reversal, there were no ST segment voltage differences between the two groups. However, in the recovery room, NMB patients had greater ST segment changes (0.64 ± 0.73 mV) compared to CONTROLS (0.23 ± 0.19 mV) (p = N.S.). For NMB patients, maximal recovery room ST segment change correlated well with maximal recovery room rate-pressure product changes ($r = 0.64$, $p < 0.02$). Separate correlations of heart rate changes and blood pressure changes with ST segment voltage changes demonstrated that in NMB patients only heart rate changes correlated significantly with ST segment voltage changes ($r = 0.78$, $p < 0.001$). No significant correlations between ST segment changes and any other measured physiologic parameters were established for CONTROL patients. Two patients (2/27) in the NMB group sustained ST segment depressions greater than -2 mV (none in CONTROL group). One of these patients sustained a postoperative subendocardial myocardial infarction. In this patient, the only perioperative ischemia was noted to occur four minutes after neuromuscular reversal. ST segment voltage decreased to -2.1 mV from -0.5 mV baseline. In the recovery room, the patient did not complain of chest pain but was treated with labetolol.

Discussion. Postoperatively, multiple factors such as postoperative pain, shivering, hypercarbia, and confusional mental status may contribute to tachycardia or hyperdynamic stages, thereby increasing myocardial work. The combination of increased myocardial work and the vagolytic effects of glycopyrrolate which are clinically significant for two to three hours with an elimination half-life of sixty minutes[3] could indeed explain (1) recovery room ST segment voltage differences between control and relaxed patients and (2) the strong correlation of these ST segment voltage differences with heart rate rather than with blood pressure.

References.

1. Randall LO: Pharmacology of the anticholinesterase drugs Mestinon, Prostigmine, Tensilon, and TEPP. Am J Med 19:673-678, 1955.
2. Fogdall HP, Miller RD: Antagonism of d-tubocurarine and pancuronium-induced neuromuscular blockade by pyridostigmine in man. Anesthesiology 39:504-550, 1973.
3. Board JS: A.H. Robbins Co. personal communications. 25 February 1987.