Title : RIGIDITY AND HYPERCARBIA ON FENTANYL-OXYGEN INDUCTION

Authors : M. Kim Comstock, M.D., Franklin L. Scamman, M.D., James G. Carter, M.D., John R. Moyers, M.D., Wendell C. Stevens, M.D.

Affiliation: University of Iowa Hospitals and Clinics, Department of Anesthesia, Iowa City, Iowa 52242

Introduction. We use high-dose fentanyl-oxygen anesthesia for open-heart surgery, predominately in patients with severe valvular disease or severely depressed left ventricular function. In contrast to others' experience[1,2] we have frequently encountered chest and abdominal wall rigidity with induction of anesthesia of such intensity as to impede spontaneous or even controlled ventilation. We have measured random $PaCO_2$ values during induction as high as 76 mmHg. Our study was designed to measure the incidence of muscle rigidity and the incidence and magnitude of hypercarbia during induction of fentanyl-oxygen anesthesia.

Methods. We studied 10 adult patients scheduled for open-heart surgery. A protocol developed by others[2] was followed meticulously; namely, pre-treatment with 1 mg pancuronium i.v.[3] followed by constant infusion of fentanyl at 200 µg/min, with a goal of neuromuscular blockade and intubation at a calculated dose of 50 µg/kg. Verbal stimuli and assisted ventilation were utilized in an effort to maintain near normal breathing. PaO_2, $PaCO_2$, and pH were measured pre-induction and every 2 minutes throughout the induction. The time of loss of response to commands was recorded. We recorded the times at which chest and abdominal wall rigidity became clinically apparent and at which it became necessary to produce neuromuscular blockade to maintain adequate breathing. Data collection ceased with neuromuscular blockade, whether or not the goal of 50 µg/kg fentanyl dosage was achieved.

Results. Pre-induction $PaCO_2$ averaged 37.4±1.4 S.E. while breathing oxygen spontaneously. No patient had a PaO_2 less than 400 mmHg during induction. One patient had no rigidity, while another developed rigidity near the fentanyl dosage calculated for intubation. Chest and abdominal wall rigidity necessitated neuromuscular blockade early in the induction of the remaining 8 patients (80%). In these 8 patients, loss of response to commands occurred at 15.8 µg/kg ± 0.9 S.E. (see table). Rigidity of the chest and abdominal wall became clinically apparent at 17.9 µg/kg±2.1 S.E., at which time $PaCO_2$ was 46.9 mmHg±2.4 S.E. Neuromuscular blockade was instituted at 21.3 µg/kg ± 2.3 S.E., at which time $PaCO_2$ was 51.4 mmHg ± 3.3 S.E. The differences in fentanyl dosage between "loss of response to commands", "onset of rigidity" and "neuromuscular blockade" were small, both 3.5 µg/kg fentanyl. The corresponding time intervals were short, both 1.3 minutes. Three patients required neuromuscular blockade while still responsive to commands.

Discussion. Our results show that induction with this anesthetic technique is attended by a high incidence of chest and abdominal wall rigidity and inability to ventilate the patient adequately. This results in progressive hypercarbia. Loss of consciousness and onset of muscle rigidity occurred at about the same time and dictated neuromuscular blockade in a high percentage of patients in order to provide adequate ventilation. We conclude that the safe application of this technique will often necessitate neuromuscular blockade about the time consciousness is lost, and in some circumstances, prior to loss of consciousness.

References.

1. Stanley TH, Webster LR: Anesthetic requirements and cardiovascular effects of fentanyl-oxygen and fentanyl-diazepam-oxygen anesthesia in man. Anesth Analg 57:411-416, 1978
2. Lunn JK, Webster L, Stanley TH, Eisele J, Woodward A: Fentanyl blood levels during high dose fentanyl anesthesia in man--Correlation with cardiovascular effects (Abstr). American Society of Anesthesiologists Annual Meeting, 1978, pp 583-584
3. Stanley TH: Personal communication at American Society of Anesthesiologists Annual Meeting, 1978

	Loss of Response to Commands	Onset of Rigidity	Induction of Neuromuscular Blockade
Time in minutes	5.8 (0.7)	6.1 (0.5)	7.43 (0.6)
Fentanyl µg/kg	15.8 (0.9)	17.9 (2.1)	21.3 (2.3)
$PaCO_2$ mmHg	46.2 (2.2)	46.9 (2.4)	51.4 (3.3)

( ) = ± 1 S.E.