Title: A CLINICAL COMPARISON OF BOLUS VERSUS CONTINUOUS INFUSION OF FENTANYL FOR CORONARY ARTERY BYPASS SURGERY

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Introduction. Although high-dose fentanyl has achieved widespread acceptance as a primary anesthetic technique for cardiac surgery, supplemental agents are often required. Moldenhauer and Hug[1] suggested that hypertension and responsiveness occur when plasma fentanyl levels fall below 10 ng/ml. If most of the fentanyl is given as an early loading dose, this is likely to occur after cardiopulmonary bypass (CPB). Using a loading infusion to avoid the "post-bolus trough" obtained with a rapid initial bolus, they devised an infusion technique that provided high levels before CPB (when stimulation is intense) but maintained fentanyl levels of 20 ng/ml for the duration of the case. This controlled, prospective study was designed to compare bolus and infusion techniques of high-dose fentanyl for cardiac anesthesia.

Methods. After institutional approval, informed consent was obtained from 27 patients with normal ventricular function undergoing anesthesia for coronary artery bypass (CAB) surgery. Patients were divided into three groups. Group I received bolus fentanyl 50 ug/kg preinduction plus 25 ug/kg preincision. Group II received a loading infusion (2.4 ug/kg/min for 20 minutes) followed by a maintenance infusion (0.3 ug/kg/min) until admission to the intensive care unit[1]. Group III received similar loading and maintenance infusions, except that 10 min after the start of CPB, the infusion rate was decreased to 0.15 ug/kg/min. Control hemodynamic data were recorded preinduction (CONT) and then at points of stress: induction (IND), skin incision (INC), sternotomy (STY), aortic root dissection (AO), and sternal wiring (WIR) after CPB. The following data were recorded: heart rate (HR), systolic blood pressure (SBP), mean arterial blood pressure (MAP), central venous pressure (CVP), pulmonary artery wedge pressure (PAW), cardiac output (CO) and systemic vascular resistance (SVR). If SBP increased >20% from control and was not managed by nitroglycerin (<5 ug/kg/min) or nitroprusside (<3 ug/kg/min), supplemental fentanyl (maximum 1.0 mg) and then enflurane were provided. Response times (end surgery to response to verbal command) and extubation times (end surgery to extubation) were noted.

Results. Group II and Group III received significantly higher total doses of fentanyl than Group I. Time to extubation was significantly prolonged in Group II compared to Group I (Table 1). There were no significant differences in the requirement for supplemental anesthesia or the hemodynamic responses to stress (HR, SBP, MAP, CVP, PAW, CO, SVR) in the 3 groups. Changes in HR and SBP in the 3 groups are illustrated in Figs 1 and 2.

Discussion. The results suggest that there are no inherent advantages of giving fentanyl by infusion as opposed to bolus in the maintenance of adequate depth of anesthesia for CAB surgery. By the hemodynamic parameters used (HR, SBP, MAP, CVP, PAW, CO, SVR) there were no differences in anesthetic depth in the 3 different dosage groups. Indeed, when the dosage guideline of Moldenhauer and Hug was followed (Group II patients), it resulted in unacceptably delayed emergence after surgery. Halving the infusion rate during CPB shortened emergence time without compromizing anesthetic depth during surgery.

References.

1. Moldenhauer CC, Hug CC: Continuous infusion of fentanyl for cardiac surgery. Anesth Analg 61:206, 1982.

Table 1: Fentanyl Dose, Response Time, Extubation Time

	Group I	Group II	Group III
Fentanyl dose (ug/kg)	78.2 ±5.1	125.3 ±14.3††	99.6 ±12.7††
Response time (min)	166.7 ±55.5	324.7 ±184.7†	262.0 ±151.6
Extubation time (min)	1212.2 ±231.8	1938.3 ±678.0†	1562.0 ±547.8

†† p<0.01 (Bonferroni t-test, after ANOVA)
† Group I different to group II (p<0.01) (Bonferroni t-test, after ANOVA)

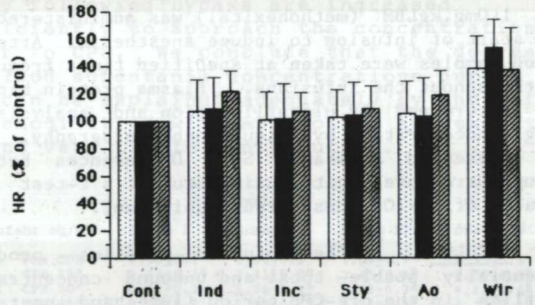

Fig.1. HR at points of stress (see text): % change from control. Means ± S.D.
= Group I = Group II = Group III
No differences were significant.

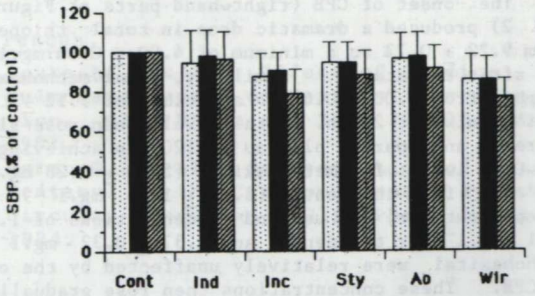

Fig.2. SBP at points of stress (see text): % change from control. Means ± S.D. Legend as for Fig 1. No differences were significant.