

**TITLE:** INDUCTION OF ANESTHESIA WITH SMALL DOSES OF SUFENTANIL OR FENTANYL: DOSE VERSUS EEG RESPONSE, SPEED OF ONSET, AND THIOPENTAL REQUIREMENT

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**Introduction.** A small dose of fentanyl or sufentanil may be used as the primary agent for induction of anesthesia, in combination with other drugs, such as thiopental. Even relatively small doses of opioid appear to enhance hemodynamic stability during induction and intubation, and reduce the dose of thiopental required to produce unconsciousness. However, the dose-response relationship for induction with opioids has not been completely characterized. The speed of onset has not been determined for a range of bolus doses, and the thiopental requirement to produce unresponsiveness after opioid administration has not been determined, except for two doses of sufentanil.

EEG activity in the delta frequency band (<4 Hz) appears to be sensitive for measuring the opioid drug effect. Delta activity is normally minimal, but becomes quite prominent in response to fentanyl or sufentanil. We have examined the effect of a range of doses of fentanyl (5,7,10 and 13 mcg/kg) and sufentanil (0.5,0.7,1.0, and 1.3 mcg/kg) on the EEG. The dose of thiopental required to produce unconsciousness after each dose of opioid was also determined.

**Methods.** Eighty male surgical patients (mean age, 64 years) gave institutionally approved, informed consent and were randomly divided into 8 groups of 10. No preoperative medications were given. EEG recordings were made with the Neurotrac computerized EEG monitor (Interspec). Sufentanil or fentanyl was administered i.v. at a constant rate over a period of one minute. EEG activity was recorded for an additional 2-3 minutes, depending upon the time required to reach maximum power. Thiopental was then administered i.v. in 25 mg increments, every 30 seconds until the patient was unconscious as judged by absence of response to verbal and tactile stimulation.

Power values in the 1-3 Hz band from the left and right hemispheres were averaged, for each 4 second epoch of the EEG record for a total of 45 epochs. The 3 epochs with the greatest power were averaged to give the maximum power value. The epoch at which half the maximum power was first reached (T50) was determined and used to evaluate speed of onset. Mean results from the 8 dose groups were compared by one-way ANOVA with post hoc comparisons by Fisher PLSD.

**Results.** Dose versus response (maximum power) curves were constructed (Fig 1) and the potency of sufentanil and fentanyl were compared by superimposing the curves. The potency ratio was 1:8 (sufentanil:fentanyl). Doses of fentanyl, 10 or 13 mcg/kg, or sufentanil, 1.3 mcg/kg were substantially more effective than smaller doses of either drug; the maximum power increased significantly between 7 and 10 mcg/kg of fentanyl and 1.0 and 1.3 mcg/kg of sufentanil ( $p < 0.0001$ ). Mean T50 was similar for sufentanil, 0.5, 0.7, and 1.0 mcg/kg ( $132 \pm 21$  secs, including the 60 sec infusion) and fentanyl, 5 and 7 mcg/kg ( $132 \pm 20$  secs). Mean T50 was significantly less ( $p < 0.0001$ ) for sufentanil, 1.3 mcg/kg ( $92 \pm 22$  secs) compared to an equipotent dose of fentanyl, 10 mcg/kg ( $112 \pm 18$ ). The thiopental dose requirement was inversely related to the dose of opioid and was generally less for sufentanil compared to fentanyl (Fig 2). Nine of 10

patients receiving sufentanil, 1.3 mcg/kg did not require thiopental.

**Discussion.** Several results of this study have clinical importance. Sufentanil and fentanyl act rapidly. Maximum EEG effects occurred less than 2 minutes after the end of opioid administration in most patients. Sufentanil, 1.3 mcg/kg was faster in onset than an equipotent dose of fentanyl (10 mcg/kg), however there was not a significant difference in speed of onset between smaller doses of sufentanil and fentanyl, based on T50 values. Sufentanil, 1.3 mcg/kg and fentanyl, 10 and 13 mcg/kg, produced significantly faster, more intense EEG slowing, compared to smaller doses of either drug. Therefore, when rapid, profound opioid effects are desired, these doses should be selected.

Fentanyl and sufentanil reduced the thiopental requirement in a dose related fashion. There was a tendency for a smaller thiopental requirement with sufentanil, compared to fentanyl. Sufentanil, 1.3 mcg/kg, produced unconsciousness in most patients without thiopental. When this occurs, a hypnotic agent (such as thiopental) is not needed for induction of anesthesia.

**References.**

1. Brizgys RV, Morales R, Owens B. Anesthesiology 63:A377, 1985

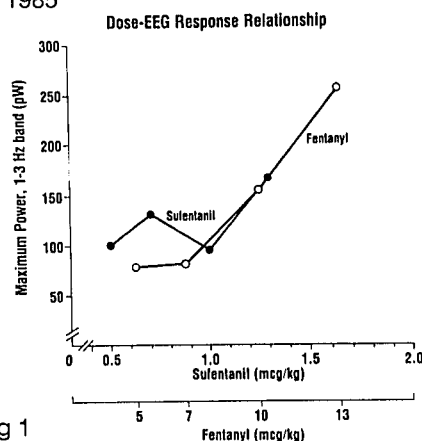


Fig 1

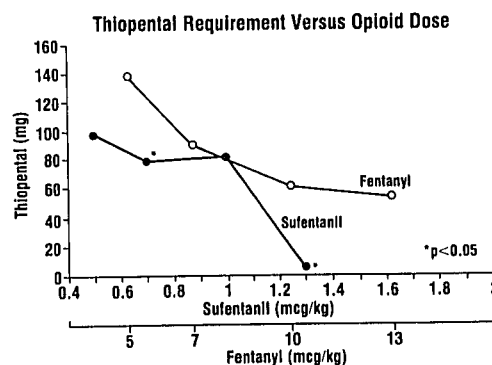


Fig 2 \*  $p < 0.05$ , sufentanil vs. fentanyl