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Myoclonus Following Sufentanil Without EEG Seizure Activity

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There are several reports of myoclonus resembling epileptic convulsions following administration of fentanyl,¹⁻⁴ and, recently, sufentanil.⁵ The etiology is unclear. Simultaneous EEG recordings were not made except in one case of myoclonus which occurred during infusion of fentanyl.⁴ In that case, there was no cortical seizure activity. In several studies of the effects of fentanyl and sufentanil on the EEG in humans, no seizure activity was reported.⁶⁻⁹ Myoclonus following administration of opioids may be closely related to "muscle rigidity," which is not caused by cortical seizure activity.¹⁰⁻¹¹ This case of myoclonus during induction of anesthesia with iv sufentanil was not accompanied by cortical seizure activity on a simultaneous EEG recording.

CASE REPORT

A 68-yr-old, 56-kg man presented for right inguinal herniorrhaphy. His past medical history was significant for alcohol abuse, lower extremity claudication, and vague difficulty with balance. CT scan of the head showed a low density area in the pons, of uncertain clinical significance. Physical examination and laboratory tests were otherwise normal. He was taking no medications. No anesthetic preoperative medications were given. After breathing oxygen, metocurine, 1 mg, and pancuronium, 0.25 mg, were given iv. Sufentanil, 1.3 µg/kg, was then administered iv over a period of 1 min. The EEG was recorded continuously with the Neurotrac monitor (Interspec[®]). The compressed spectral array (CSA) was displayed on the monitor screen and power bands (1-3, 4-7, 8-12, and 13-30 Hz) were recorded. Epochs of 4 s were used. Delta activity began to increase approximately 50 s following the end of the sufentanil dose, as shown in figure 1. Approximately 80 s following the end of the sufentanil dose, vigorous bilateral clonic muscle activity ensued, affecting the upper and lower extremities. The myoclonus in the upper extremities was most apparent; however, the lower extremities were restrained by a safety belt around the operating table. Truncal rigidity prevented ventilation with anesthesia mask and bag. At the onset of myoclonus, there was a substantial amount of delta activity, with a spectral edge¹² less than 12 Hz. This pattern was not altered during the episode of myoclonus, although some motion artifact was induced. Neither the CSA or the raw EEG showed any evidence of cortical seizure activity. Metocurine, 6 mg, and pancuronium,

1.5 mg, were given iv, terminating the myoclonus in less than 2 min. The power spectrum recorded at that time, and therefore free of motion artifact, continued to show a predominance of delta activity (fig. 1, inset).

During the myoclonic episode, arterial blood pressure increased from a baseline of 160/80 to 230/110 mmHg, and heart rate increased from 70 to 115 bpm. Following the termination of myoclonus by the muscle relaxant, thiopental and isoflurane were required in order to reduce the vital signs to baseline levels prior to tracheal intubation. There was no postoperative neurological abnormalities. The patient has no recall for events surrounding the induction of anesthesia.

DISCUSSION

Generalized myoclonus, resembling an epileptic convulsion, occurred in our patient in the absence of cortical seizure activity on the EEG recording. We have made several hundred EEG recordings, during the iv induction of anesthesia with fentanyl or sufentanil, without EEG seizure activity. Delta activity, as in this case report, is a typical EEG effect of sufentanil, 1.3 µg/kg, in our experience.† Other investigators have reported similar observations.⁸ We cannot say with certainty that previously reported cases of myoclonus, without simultaneous EEG recordings, were not due to cortical seizure activity. Molbegott *et al.* reported "suspected seizure activity" after sufentanil; however, EEG recordings were not made.⁵ This case report demonstrates that myoclonus after sufentanil does not necessarily imply cortical seizure activity, and that some other mechanism must be involved.

A variety of drugs may cause rigidity, myoclonus, and other abnormal movements, without cortical seizure activity. Opioids commonly induce muscle rigidity, affecting virtually all muscle groups.¹³ The mechanism is unknown, but cortical seizure activity is not involved. Myoclonus has occurred during fentanyl infusion, in the absence of cortical seizure activity.⁴ Etomidate causes myoclonus on a regular basis, again without any evidence of cortical seizure activity.¹⁴ A variety of drugs cause abnormal movements due to their action on the extrapyramidal motor system. Phenothiazines and butyrophenones, for example, may cause a variety of dystonic movements, probably by blocking dopamine receptors in the basal ganglia.¹⁵

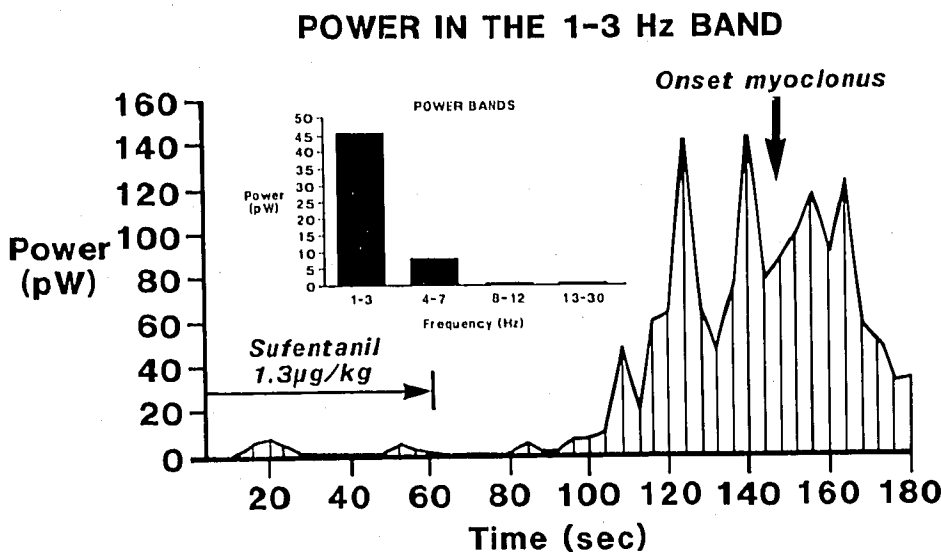
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ing was free of motion artifact, since muscle relaxants had been given to interrupt the myoclonus. The predominance of low frequency activity is typical of the EEG of an opioid such as sufentanil.

In rats, opioids produce a spectrum of movement abnormalities, including rigidity, myoclonus, and seizures. The mechanism of these effects involves subcortical neuronal pathways.^{16,17} Opioids appear to mediate neuroexcitatory effects in the limbic system, including subcortical seizure activity. Perhaps rigidity and myoclonus in humans are also mediated by limbic system pathways.

Blood pressure and heart rate increased significantly in this patient, even after the myoclonic activity was interrupted by muscle relaxants. Thiopental and isoflurane were required to return the vital signs to baseline levels. Similar increases in blood pressure and heart rate were noted in some, but not all, of the previously reported cases of myoclonus caused by fentanyl or sufentanil.¹⁻⁴ Therefore, it would appear that, in some patients, myoclonus is accompanied by an increase in sympathetic tone, not usually caused by opioid anesthesia. Mitchell *et al.* found that, in unanesthetized subjects, isometric muscle tension caused an immediate increase in heart rate and arterial pressure.¹⁶ Benthuisen *et al.* observed statistically significant increases in heart rate and central venous pressure with alfentanil-induced rigidity; however, arterial blood pressure fell and the hemodynamic changes were not clinically significant.¹⁵ Whatever the mechanism may be, clinically significant cardiovascular instability, which sometimes accompanies opioid-induced myoclonus, may be a significant cause of concern for patients with coronary or cerebrovascular disease.

This case suggests that myoclonus, following sufentanil administration, should not be regarded as a con-

vulsion or seizure, unless there is definite EEG evidence of seizure activity. Based on current knowledge, an effect on limbic system pathways is a more probable mechanism of narcotic-induced myoclonus than cortical seizure activity.

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Preoperative Anxiety: Does Anxiety Level the Afternoon Before Surgery Predict Anxiety Level Just Before Surgery?

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Although premedication prior to anesthesia and surgery can serve many purposes, current practice is to prescribe premedication largely to relieve anxiety.¹ The decision to administer premedication is generally based on the result of the preoperative interview by the anesthesiologist. Little research has been done to examine the relationship between anxiety witnessed during a preoperative interview, to the patient's state of anxiety just before s(he) is being transported into the operating room.

Patient interviews have been used in research studies to assess preoperative anxiety.^{2,3} However, quantitative techniques, such as rating scales and symptom enumeration, have become the standard for assessing moods⁴ and changes in mood after a stimulus,⁵ in addition, these quantitative techniques allow for fine determination between mild and moderate anxiety states.⁶ Multiple studies have shown a relationship between emo-

tional support and outcome.⁷⁻⁹ Given the extent of this research, it is surprising that the current standard techniques have been used so little for patients about to undergo surgery, and, in particular, for the time period immediately prior to surgery. The following study was designed to objectively compare patients' moods the afternoon before surgery to their moods immediately before transport into the operating room, and to test the hypothesis that patients' moods are similar at these two times.

METHODS

Over a 6-month period, patients between the ages of 21 and 60 yr scheduled to undergo abdominal operations estimated to last 1-4 h were asked to volunteer for a study to quantify mood changes prior to surgery. The study protocol and consent form were approved by our institutional human studies committee. Fifty-two consecutive patients met the criteria for study inclusion: they could complete information concerning name, date, and age, they were not currently receiving narcotics or anxiolytics, and they agreed to participate. We recorded demographics for each patient including details of age, sex, weight, operation to be performed, history of previous surgery, and whether the patient had been or might be diagnosed as having cancer. Patients completed the Profile of Mood States (POMS)¹⁰ both the afternoon before their surgery and again unpremedicated in the preoperative holding area, approximately 1 h prior to entering the operating room. The

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