Does Music in the OR Reduce Sedative and Analgesic Requirements? Koch et al. (page 300)

Koch et al. conducted two randomized, controlled trials to assess whether music influences intraoperative sedative and analgesic requirements. In Phase 1 of their investigation, the researchers telephoned 35 patients the night before their scheduled urologic procedures. The patients were told that they might have the opportunity to listen to music and were asked to bring their favorite compact disks with them to the hospital. Before their procedures, baseline sedation scores were determined; patients were instructed in using patient-controlled sedation devices, and they were again told that they might be listening to music. Patients were then randomized to control or music groups. Intrathecal lidocaine, bupivacaine, or tetracaine was administered; after confirmation of an adequate dermatomal level of anesthesia, patients received an intravenous loading dose of 1 mg/kg fentanyl citrate and 0.5 mg/kg propofol over 5 min. Patients were then attached to PCA pumps set to deliver 30 mg propofol as often as 3 min. Personnel placed occlusive headsets on the patients randomized to the music group and adjusted the volume to mask outside auditory input. The control group did not wear headsets and listened to regular operating room (OR) noise. The observers were not blinded, therefore, to group assignment. The number of patient-controlled demands and deliveries was recorded, as were blood pressure, heart rate, and subjective level of sedation (the latter determined during temporary interruptions in the music).

During Phase 2, 43 ASA physical status 1-3 patients scheduled for lithotripsy treatment of renal calculi were also advised preoperatively about the possibility of listening to music. In addition to baseline vital signs, the team also assessed this group of patients for their anxiety levels using Spielberger’s self-report state and trait anxiety inventory (STAI). Baseline pain and sedation scores were then obtained, and the patients were instructed in the use of PCA. After positioning on the lithotripter table, patients received intravenous midazolam, 20 mg/kg, metoclopramide, 10 mg, and alfentanil, 10 mg/kg, over 5 min. Patients in the music group were fitted with occlusive headsets and intravenous PCA pumps set to deliver 10 mg/kg of alfentanil with a 3-min lockout period. Blood pressure, heart rate, self-reported VAS pain and sedation, SLOS scores, and average stimulus load to which each patient was exposed from the lithotripter shock-wave generator were all recorded at 15-min intervals.

Patients in the Phase 1 music group required less propofol sedation than did the control group. Similarly, Phase 2 patients who listened to music required less alfentanil. Both findings persisted after adjusting for duration of surgery. However, because patients in the control groups did not wear headsets, it is possible that the decrease in sedative and analgesic requirements was a result of elimination of the ambient noise in the OR and not to the effects of music per se.

Relationship between Cerebral Metabolism and EEG during Anesthesia Explored. Alkire (page 323)

Alkire performed a retrospective analysis of EEG data gathered during studies on the regional cerebral metabolic effects of propofol and isoflurane in healthy, paid volunteers. The positron emission tomography (PET) data had been obtained from seven right-handed male patients who had undergone functional brain imaging using the $^{18}$fluorodeoxyglucose ($^{18}$FDG) technique to assess their cerebral glucose metabolic rates during either propofol sedation, propofol anesthesia, or isoflurane anesthesia. To ascertain the nature of the relationship between cerebral metabolism during anesthesia and the EEG, Alkire correlated those data with measurements of EEG descriptors that had also been simultaneously obtained at the time of the previous study. All study subjects were healthy nonsmokers and had fasted for 8 h preceding each scan session, conducted a minimum of 1 week apart. Intravenous catheters were inserted for administration of the $^{18}$FDG PET tracer, for blood sampling and for propofol infusion. In a small, darkened room, subjects were given anesthesia (isoflurane via mask or propofol as a 0.4 mg/kg bolus followed by infusion adjusted in increments to loss of consciousness; or propofol sedation infusions titrated to achieve sedation scores no lower than 3). After steady state anesthesia (or sedation) was reached, $^{18}$FDG was injected intravenously, and the subjects remained at the targeted level of anesthesia for 32 min. After emerging from the anesthetic, they were taken to the PET scanner where they fully recovered from the anesthetic. During the metabolism assessment, EEG was recorded continu-
ously using a frontal-mastoid montage. Cerebral metabolism data were analyzed as the percent absolute cerebral metabolic reduction (PACMR) of whole-brain glucose caused by anesthesia. Power spectrum variables, median frequency, 95% spectral edge, and bispectral index (BIS) values were later correlated with the PACMR.

The mean propofol infusion rate was $4.5 \pm 1.0$ mg·kg$^{-1}$·h$^{-1}$ during sedation and $9 \pm 2$ mg·kg$^{-1}$·h$^{-1}$ during unresponsiveness. A nonlinear regression analysis revealed that the anesthetic type correlated with cerebral metabolic reduction. For the dosage ranges of propofol and isoflurane anesthesia in this study, several EEG descriptors (median frequency, spectral edge, relative beta power, total power, and BIS) correlated roughly in a linear manner with the magnitude of the PACMR caused by anesthesia. After controlling for anesthetic type, only BIS and alpha power approached significance for explaining residual PACMR prediction error. According to the author, these results suggest that there is a mathematically quantifiable physiologic link between the EEG and cerebral metabolism during anesthesia.

Producing Pain Relief in Nulliparous Patients with Intrathecal Sufentanil. Arkoosh et al. (page 364)

To determine the dose of intrathecal sufentanil that will produce acceptable pain relief in 50% of nulliparous patients (ED$_{50}$), Arkoosh et al. enrolled 50 women in labor with their first baby and who were requesting spinal opioid analgesia. Women receiving systemic analgesia or oxytocin were excluded from the study. All patients enrolled were in spontaneous labor, with less than 5 cm cervical dilation. At the time they requested analgesia, the women were assigned to receive intrathecal sufentanil, 2, 3, 5, or $10 \mu g$, in 3 ml preservative-free saline. The initial part of the study involved only 24 women (four in each dosage group). The results suggested an ED$_{50}$ of less than 2 $\mu g$. A second randomization list was generated, and an additional 26 patients were enrolled, 10 of whom received a 1 $\mu g$ dose. An additional four patients were added to each of the other dosage groups. The sufentanil solutions used in both parts of the study were prepared by a physician not involved with data collection or decision-making regarding timing of the analgesia. The patients and data collectors were blinded as to dose of drug administered.

Assigned doses of intrathecal sufentanil were injected after each patient had received a 250-ml intravenous bolus of balanced salt solution and had been placed in the left lateral position. Blood pressure, room air oxygen saturation, respiratory rate, and visual analog scales (VAS) for pain, pain relief, nausea, and pruritus were obtained at baseline and also recorded at 2, 5, 10, 15, 20, 25, and 30 min intervals after drug injection. Patients who believed that they had inadequate pain relief at 30 min received local anesthetic through the epidural catheter. Probit analysis of the number of patients in each group asking for additional pain medication at 30 min was used to determine the ED$_{50}$, which was 1.8 $\mu g$. Side effects of the sufentanil included pruritus, mild decreases in oxygen saturation, a 5-min decrease in oxygen saturation in one of the 5-µg group patients, and detectable sensory changes to temperature at 30 min in several other patients. Two women in the 3-µg group and one in the 10-µg group complained of mild positional headaches after delivery, but these were fully resolved with oral ibuprofen and caffeine. None of the fetuses experienced severe bradycardia, and none of the neonates had an APGAR score less than 8 at 5 min after delivery. Women in more advanced labor, who are multiparous, or receiving intravenous oxytocin would be expected to have a higher dose requirement to achieve adequate analgesia.

Transmural Pressure Gradient of Spinal Epidural Veins in the Pig. Nystrom et al. (page 449)

In an effort to explain the low risk of spinal hematoma despite the frequency of encountering blood during delivery of spinal and epidural anesthesia, Nystrom et al. set out to determine the transmural pressure gradient of epidural veins in pigs. Hypothesizing that a low pressure gradient between epidural veins and the epidural space might account for minimal bleeding after vascular trauma, the team sedated 14 male pigs with intramuscular ketamine (16 mg/kg), anesthetized them with halothane (0.5–0.8%, end-tidal), and maintained their body temperatures at 39°C with heating pads. They inserted needles into the epidural and subarachnoid space and threaded a catheter into an epidural vein. They measured pressures in these structures during controlled and spontaneous ventilation and during abdominal, thoracic, and combined abdominal and thoracic compression (applying firm manual pressure for about 15 s at 30- to 45-s intervals). In the lumbar and thoracic areas, the team found a low pressure gradient (approximately 1–2 mmHg) between the epidural vein.
and the surrounding epidural space. Vein, epidural space, and cerebrospinal fluid pressure increased together and became more phasic during the three compression maneuvers. Increasing the airway pressure from ZEEP to 10 cm H₂O PEEP increased the absolute transmural pressures about 1 mmHg in the lumbar and thoracic areas, but had only minimal impact on the pressure gradient. This gradient was likewise not much affected by increased abdominal or thoracic pressure.

The findings of this study may indicate that extravasation of even small amounts of blood could provide enough back pressure to tamponade bleeding because the pressure driving blood out of the veins is only 1–2 mmHg. However, given the differences in spinal cord anatomy between pigs and humans, the results may not be clinically applicable.

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