

ANESTHESIOLOGY

■ Effect of Inspired Oxygen Concentration on Formation of Atelectasis Studied. Edmark *et al.* (page 28)

Thorough preoxygenation prior to the induction of anesthesia is recommended to minimize the risk of hypoxia. However, the use of 100% oxygen during induction of anesthesia may produce atelectasis.

Edmark *et al.* designed a study to determine whether different inspired oxygen concentrations during induction of general anesthesia might influence the likelihood of atelectasis. For their randomized study, the team recruited 36 healthy, nonsmoking women scheduled for elective hysterectomy for benign disease. Electrocardiogram and peripheral oxygen saturation (SpO_2) were continuously assessed during the procedure, as were end-tidal carbon dioxide and end-tidal oxygen concentrations. The participants were randomly selected to breathe 100, 80, or 60% oxygen for 5 min during induction of general anesthesia. The investigators used computed tomography (CT) to assess the extent of atelectasis formation.

Data collection started when the patients began to breathe the randomly chosen oxygen concentration through a tightly fitted mask. After breathing spontaneously for 1 min, the patients were given bolus doses of fentanyl and alfentanil. A targeted, controlled propofol infusion was started 2 min after the beginning of preoxygenation, and the patients were paralyzed with rocuronium. Positive pressure ventilation by mask was initiated, and, at approximately 5.5 min after induction, the trachea was intubated. Immediately after endotracheal tube placement, ventilation ceased, and apnea was allowed to persist until the SpO_2 decreased to 90% (the endotracheal tube was open to air). The patients were then mechanically ventilated with a tidal volume of 10 ml/kg (no positive end-expiratory pressure), and CT scans of the chest were performed. These scans were performed as quickly as possible after the resumption of ventilation. Three scans—one above the dome of the right diaphragm, one at the hilus, and one at the lung apex—were taken and compared with the preanesthesia control scan. The radiologist assessing the CT scans was blinded to the individual patients' group assignments. The three groups of patients were apneic for different time periods until saturation had decreased to 90%, depending on their initial inspiratory oxygen concentration. The total time from the start of preoxygenation to the completion of CT scanning was 14 min in the 100%

oxygen group, 12 min in the 80% oxygen group, and 10.5 min in the 60% oxygen group.

In the group breathing 100% oxygen, $5.6 \pm 3.4\%$ of the total lung area was atelectatic. The groups breathing 80 and 60% oxygen had evidence of atelectasis in 0.6 ± 0.7 and $0.2 \pm 0.2\%$ of the total lung area, respectively. The time to reach 90% oxygen saturation was 411 ± 84 , 303 ± 59 , and 213 ± 60 s in the 100, 80, and 60% oxygen groups, respectively. The researchers concluded that preoxygenation with 80% oxygen seemed to be beneficial in reducing atelectasis compared with 100% oxygen, but that it also resulted in reduced apnea tolerance. This difference in apnea tolerance might make a difference in complicated anesthesia induction situations. Until a large clinical trial can prove significant morbidity from atelectasis during or after anesthesia, the authors recommend continuing the standard of using 100% oxygen for preoxygenation.

■ Parents' Responses to Induction of Anesthesia in Their Children. Kain *et al.* (page 58)

Many researchers have assessed the effects of parental presence during induction of anesthesia on children's preoperative anxiety. Kain *et al.* investigated the effects on the parents themselves who were present during anesthesia induction. To do this, they randomized 80 parents to one of three groups: those present during induction of anesthesia (PPIA), those in a control group (separated from their child at the operating room entrance), and those present during induction whose children were given oral midazolam (PPIA plus midazolam). The investigators used increase in heart rate and skin conductance level as physiologic measures of the stress response in the parents.

Upon arrival at the hospital on the day of surgery, the parents completed baseline measures of their anxiety (State Trait Anxiety Inventory) and coping style (Monitor Blunter Style Scale [MBSS]). Children's anxiety levels were assessed using the Modified Yale Preoperative Anxiety Scale. The researchers obtained baseline blood pressure measurements for all parents and then fitted them with a device that continuously records electrocardiographic parameters and skin conductance levels. Parents in the PPIA and PPIA plus midazolam groups accompanied their child into the operating room for induction of anesthesia. Parents in the control group accompanied

their child to the operating room doors and then returned to the waiting area. If a child exhibited intense anxiety upon separation from the parent, PPIA was offered as rescue therapy. Following separation, all parents completed a second measure of their anxiety, and their blood pressure was measured. The device was removed, and the data were downloaded into a computer for later analysis. Children's anxiety levels upon entrance to the operating room and introduction of the anesthesia mask were assessed by the anesthesiologist. As soon as anesthesia was induced, a research assistant accompanied the PPIA and PPIA plus midazolam group parents to the waiting area, where they also completed anxiety measures, and the recording devices were removed.

The parents who were present during their child's induction of anesthesia exhibited increased heart rate and skin conductance levels. Interestingly, these parents' self-reports of anxiety did not differ from those of parents who were absent during induction. Men reported lower anxiety levels than did women, both in the holding area and after separation from their child. Parents in both PPIA groups who scored "high monitoring" on the MBSS measure reported lower anxiety in the holding area and after separation compared with high monitoring parents in the control group. However, their heart rates upon their child's entrance into the operating room were significantly higher than the heart rates of high monitoring parents in the control group. Despite the association between PPIA and increases in heart rate and skin conductance level, the researchers report that they did not find any increased incidence of electrocardiographic abnormalities in parents present during induction of anesthesia.

■ Cardiac Outcomes in Elderly Patients Receiving Epidural Analgesia. Matot *et al.* (page 156)

Approximately one third of elderly patients who undergo hip fracture surgery experience perioperative myocardial ischemia. To assess whether epidural analgesia given during the stressful presurgical period would decrease the incidence of adverse cardiac events in this patient population, Matot *et al.* conducted a randomized clinical trial in elderly patients with or at risk for coronary artery disease (CAD) who had sustained a traumatic hip fracture.

Upon admission to the emergency room, patients with either known CAD or at high risk for CAD were assigned to receive the usual analgesic regimen, with intramuscu-

lar meperidine or continuous epidural infusion of local anesthetic and opioid. For purposes of the study, high risk for CAD was defined by the presence of at least two of the following cardiac risk factors: age greater than 65 years, hypertension, current smoker, cholesterol concentration greater than 240 mg/dl, and diabetes mellitus. There were 34 patients in each group. Electrocardiography and standard biochemical and hematologic tests were performed, and serum cardiac enzyme concentrations were obtained at regular intervals before and after surgery, until the third postoperative day, and again on the day of discharge. All cardiac medications were continued until surgery. The anesthetic technique and the amount of anesthetics administered during the orthopedic procedure were chosen by the anesthesiologist who cared for each patient. Adverse outcomes were validated by two other investigators blinded to the patient's pain reduction regimen.

Seven of the 34 patients in the control group experienced preoperative adverse cardiac events: three had fatal myocardial infarctions, one had fatal congestive heart failure, one had nonfatal congestive heart failure, and two experienced new-onset atrial fibrillation. All of the events occurred while the patients were waiting in the orthopedic department for their surgery. There were no such adverse events in the epidural group. The significant difference between the two groups prompted interruption of the study after the planned interim analysis. Although the study was not blinded, the study group was small, and the researchers did not relate cardiac events to changes in hemodynamics, the results warrant further study of preoperative epidural analgesia in this population.

■ Effects of Spinal Opioid Analgesia on Endogenous Analgesia in the Rat. Schmitt *et al.* (page 195)

To assess whether peripheral endogenous analgesia mechanisms are mediated by the central nervous system, Schmitt *et al.* tested male Wistar rats for paw pressure threshold, paw volume, and paw temperature before and after tissue injury. Inflammation of the rats' hind paws was induced by intraplantar injection of 150 ml Freund's complete adjuvant (FCA), and the rats were randomly assigned to intrathecal morphine or intrathecal saline (control) groups. Mechanical nociceptive thresholds and inflammation were assessed before and after the initiation of intrathecal morphine and concomitant FCA inflammation. Intrathecal pumps were disconnected at

either 6 or 48 h after initiation of treatment, after which the rats given FCA were killed, and subcutaneous paw tissue was harvested for histologic and immunohistochemical examination. In a separate set of experiments, the investigators discontinued intrathecal treatments after 6 or 48 h and subjected those groups of animals to the cold water swim (CWS) stress test. The rats' paw pressure thresholds were evaluated at regular intervals following the CWS test.

Out of a total of 166 animals, 126 rats were included for evaluation at the conclusion of the experiments. The investigators found that 10 $\mu\text{g}/\text{h}$ intrathecal morphine resulted in a significant and stable increase in paw pres-

sure threshold, without changing the inflammation, as evaluated by paw volume, temperature, and flow cytometry. At 48 h postinjury, both the number of β -endorphin-containing cells and CWS-induced antinociception were significantly reduced in rats receiving intrathecal morphine. These reductions were not seen at 6 h postinjury, however. The findings suggest that stimulation of nociceptive afferents strong enough to reach the central nervous system provokes opioid-containing immune cells to migrate to the injured tissue, where they release β -endorphin to produce analgesia.

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