

## This Month in

## ANESTHESIOLOGY

### ■ Carbon Dioxide and Sevoflurane Degradation

Detection of sevoflurane degradation products has sparked debate about the safety of low-flow or closed-circuit sevoflurane anesthesia. In a study of 16 patients undergoing resection of head and neck tumors, Bito and Ikeda (page 340) compare the carbon dioxide absorbency of soda lime and baralyme. During anesthesia exceeding 10 h duration, end-tidal carbon dioxide concentrations and inspired and end-tidal sevoflurane concentrations were monitored by mass spectrometry. The individual maximum concentration of compound A [ $\text{CF}_2=\text{C}(\text{CF}_3)\text{-O-CH}_2\text{F}$ ] was  $23.6 \pm 2.9$  ppm (12.0–37.4 ppm) when soda lime was used as the carbon dioxide absorbent. Concentrations of compound A increased to  $32.0 \pm 2.3$  ppm (23.5–41.3 ppm) when baralyme was used. The ratio of compound A concentration to end-tidal sevoflurane concentration at 3–10 h of anesthesia was 1.2–1.5 times greater for baralyme than for soda lime. Compound B [ $\text{CH}_3\text{OCF}_2\text{CH}(\text{CF}_3)\text{OCH}_2\text{F}$ ] was detected in the anesthetic circuit of two patients, but only in a concentration of 0.2 ppm.

### ■ Deliberate Mild Hypothermia: Safe during Craniotomy?

Decreasing body temperature confers protection against cerebral ischemic damage in animal models. However, potential risks of intraoperative hypothermia in humans require further investigation. Baker *et al.* (page 361) examine the feasibility and safety of deliberate mild hypothermia during craniotomy in 30 patients assigned to either a normothermic or mildly hypothermic group. Premedication with midazolam (0.03–0.05 mg/kg) and fentanyl (1.5–5  $\mu\text{g}/\text{kg}$ ) was followed by induction of general anesthesia with sodium thiopental (3–7 mg/kg). Temperature in the normothermic group was maintained between 36.5 and 37.0°C. Hypothermic patients were cooled with water blankets set at 25°C. Active cooling was stopped at 35°C, and body temperature was allowed to drift to 34.5°C. Temperatures associated with cerebral protection were achieved easily; aggressive rewarming was initiated at dural closure. Normothermic patients experienced no postoperative shivering, but 7 of 12 hypothermic patients had mild to moderate shivering.

Deliberate mild hypothermia with rewarming did not cause significant delays in emergence from anesthesia.

### ■ Improvements in Postoperative Pain Management

Is widespread use of epidural anesthesia and analgesia justified for pain management in postoperative cancer patients? In a 4-yr, 4,227-patient study, de Leon-Casasola *et al.* (page 368) evaluated perioperative morphine utilization, side effects, and complications. All study patients, 61% of whom were female, received general-epidural anesthesia followed by epidural analgesia with 0.05% or 0.1% bupivacaine and 0.01% morphine at a rate of 5–10 ml/h to keep dynamic visual analog pain scores less than 5/10. Patients were given continuous epidural infusions of bupivacaine-morphine instead of intermittent bolus infusions. Results revealed effective postoperative analgesia with a low incidence of side effects. Hypotension occurred in 3% of all patients, and nausea and vomiting were reported in 22%. Only 4% of patients experiencing pruritis (40/930) required therapy for the severity of their symptoms. Three cases (0.07%) of respiratory depression (less than 10 breaths/min) were treated successfully with 0.4 mg naloxone.

### ■ Synergistic Action of Rocuronium and Mivacurium

Using both isobolographic analysis and clinical studies, Naguib (page 388) demonstrate a synergistic interaction between rocuronium bromide and mivacurium chloride with respect to neuromuscular blocking activity. In an initial interaction study, 110 ASA physical status 1 or 2 patients were assigned randomly to 1 of 11 groups of 10 each. Groups received 30, 50, 70  $\mu\text{g}/\text{kg}$  mivacurium; 100, 200, 250, or 300  $\mu\text{g}/\text{kg}$  rocuronium; or equieffective combinations of both drugs. A second study randomly allocated 50 ASA physical status 1 or 2 patients, anesthetized with thiopental-fentanyl-nitrous oxide, to receive either rocuronium or mivacurium alone or in combination. Different mixtures yielded different clinical profiles. One mixture of 150  $\mu\text{g}/\text{kg}$  rocuronium plus 37.5  $\mu\text{g}/\text{kg}$  mivacurium was characterized by rapid onset (11.4 s) and short duration of action (14.7 min). Another mixture of 300  $\mu\text{g}/\text{kg}$  rocuronium plus 75  $\mu\text{g}/\text{kg}$  mivacurium resulted

in briefer onset time (69 s) but an intermediate duration of action (34 min). Thus the anesthesiologist can choose a combination of two nondepolarizing neuromuscular blocking agents and achieve both a rapid onset and longer duration of action.

### ■ Predicting Depth of Anesthesia

Using a single anesthetic agent, Dwyer *et al.* (page 403) test the hypothesis that electroencephalogram measures predict depth of anesthesia as defined by the response to surgical incision, to verbal command or the development of memory. Thirty-four ASA physical status 1 or 2 patients, scheduled for elective surgery, participated in group 1. The electroencephalogram was recorded at least 15 min after the last administration of propofol ( $1.2 \pm 0.6$  mg/kg intravenously, mean  $\pm$  SD) or nitrous oxide; after 10 min at a stable end-tidal concentration of 0.6 MAC isoflurane; and before the start of surgery. During surgery, the electroencephalogram was recorded again after equilibration for at least 10 min at 1.0 and 1.4 MAC isoflurane. Answers to general knowledge questions were played intraoperatively into audio headsets. Subjects then were interviewed 24 h postoperatively to ascertain their memory of input. The electroencephalogram did not predict recall of verbal information presented during anesthesia, nor did it predict movers *versus* nonmovers at 1.0 MAC. However, changes in  $\delta$  and  $\alpha$  power may be a warning of light anesthesia—in a previous study, increased  $\delta$  power predicted imminent eye-opening.

### ■ Who Is Vulnerable to Critical Respiratory Events?

Patients who experience ventilatory problems during surgery are at an increased risk of cardiac events, prolonged stay in the postanesthetic care unit and unexpected intensive care unit admissions. Rose *et al.* (page 410) studied 24,157 patients receiving a general anesthetic over a 33-month period to determine the incidence of critical respiratory events (CREs). CREs were defined as unanticipated hypoxemia ( $Sp_{O_2}$  less than

90%), hypoventilation (respiratory rate less than 8 or  $Pa_{CO_2}$  greater than 50 mmHg), or upper airway obstruction (stridor or laryngospasm) requiring active and/or specific interventions (ventilation, tracheal intubation, opioid or muscle relaxant antagonism, insertion of oral/nasal airway or airway manipulation). In the patient population studied, the risk of a CRE was 1.3%. Certain patient characteristics increased risk of a CRE: age older than 60 yr, male gender, diabetes, and obesity. Emergency procedures and operations longer than 4 h also increased risk. The authors' study also demonstrated that using premedication (sedatives with or without opioids) as well as intraoperative opioids (fentanyl more than  $2.0 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$  and fentanyl with morphine) were significant factors in postoperative respiratory problems.

### ■ Anesthesiologists Comment on Production Pressure

To assess attitudes and experiences of anesthesiologists regarding production pressure, Gaba *et al.* (page 488) conducted a random, repeated-mailing survey of 647 members of the American Society of Anesthesiologists in California. Forty-seven percent of those sampled returned surveys. Although 39% of respondents agreed that hospital administrators insisted on minimizing case turnover time, most respondents seemed relatively resistant to pressures to start cases prematurely or to leave unstable patients in the postanesthesia care unit to begin another case. Nearly half (49%) of respondents reported observing an anesthesiologist pressured to conduct anesthesia in an unsafe fashion. Respondents also reported experiencing explicitly external pressure from surgeons to proceed with cases rather than canceling them, as well as to hasten procedures. Additional factors that could compromise anesthesia safety included work-load fatigue and inadequate time to evaluate outpatients before surgery. For the most part, respondents felt evaluation time for *inpatients* was adequate.

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