This Month in

ANESTHESIOLOGY

Anesthetic Requirements during Pregnancy

In pregnant ewes and rats, minimum alveolar concentration (MAC) for inhalational agents is reduced. Rabbit studies suggest the lower analgesia requirement may be due to increased concentrations of progesterone during pregnancy, which mediates the pain response. Gin and Chan (page 829) compared the MAC of isoflurane in women undergoing termination of pregnancies with that in nonpregnant women having elective gynecologic surgery. All participants received inhalational induction of anesthesia with isoflurane and tracheal intubation. MAC was determined by testing responses to a 10-s transcutaneous tetanic (50 Hz, 80 mA) electrical stimulus to the ulnar nerve at varying isoflurane concentrations. MAC for each patient was taken as the mean of the two concentrations that just permitted and just prevented movement. The MAC of isoflurane was 28% less in women 8–12 weeks pregnant than in the nonpregnant control subjects. However, because of ethical and practical considerations, it is not possible to speculate as to what may occur at other stages of pregnancy.

Analyzing Anesthesia Recovery

Terminal half-lives of many drugs do not predict the rate of washout after short durations of infusions used in anesthesia. Many anesthetic drugs instead fit a three-compartment mammillary model, comprised of three volumes of distribution (V_1 (central), V_2, and V_3 (peripheral)) and three clearances (Cl_1 (elimination or metabolic), Cl_2, and Cl_3 (distribution)). Youngs and Shafer (page 833) investigated the role of these pharmacokinetic parameters (PKP) to better determine values contributing to rapid recovery after different dosing schemes. Three sets of computer simulations were performed based on a three-compartment mammillary model of fentanyl, alfentanil, and sufentanil. Findings reveal a small V_1 and a large Cl_1 are beneficial if a rapid decrease in C_P is desired after an infusion. During longer infusions when a large decrease in C_P is desired, a smaller V_2, V_3, Cl_2, and Cl_3 are desirable. These findings may add a new dimension to the understanding of recovery from anesthetic drugs.

Initial *Versus* Subsequent Increases in Desflurane: Cardiovascular Response

Do repetitive increases of end-tidal desflurane to concentrations exceeding 1 MAC evoke a smaller sympathetic and cardiovascular response than does the initial increase of desflurane? To test this hypothesis, Weiskopf *et al.* (page 843) induced anesthesia in nine healthy male volunteers with propofol and maintained it with 4% end-tidal desflurane for 32 min. Desflurane was increased 8% (1.1 MAC) for 1 min and maintained at that concentration for 10 min. Desflurane then was decreased to 4% for 32 min, and the process was repeated twice. In a later phase of the study, four subjects received the initial desflurane increase 75 min after anesthesia, and four received it in a background of 60% N_2O. The initial increase in desflurane concentration increased heart rate (HR) from 57 ± 2 to a peak of 119 ± 7 beats/min and mean arterial blood pressure (MAP) from 66 ± 3 to 119 ± 5 mmHg, and plasma epinephrine increased tenfold. However, the second and third increases in desflurane concentration yielded increases in HR and MAP that were smaller than 20% of the initial increases. After the increases in HR and MAP from the initial rapid increases of desflurane concentration subside, subsequent rapid increases of desflurane may not elicit sympathetic-mediated cardiovascular stimulation. Although the mechanisms are not fully understood, desflurane and other anesthetics may stimulate a receptor that adapts rapidly to a strong stimulus and remains adapted for a substantial period of time.

Airway Resistance in Patients with Asthma

Controversy exists regarding whether sympathetic innervation has an influence on bronchial smooth muscle tone. Groeben *et al.* (page 868) evaluated lung function preceding and during the presence of pulmonary sympatholysis induced by high thoracic epidural anesthesia in patients with known bronchial hyperreactivity. Twenty unpremedicated patients (ASA physical status 2–3) were enrolled in the study. All had histories of acute dyspneic attacks relieved by inhalation of a bronchodilating aerosol, but none used the aerosols within 24 h before the investigation. Bronchial hyperreactivity was verified 2–4 days before surgery by in-

halation provocation with acetylcholine, and the airways of all subjects were comparably hyperreactive. In the first part of the study, ten patients received 0.75% epidural bupivacaine, with dosages adjusted to patient's height (mean dose 7.9 ± 0.7 ml), and four received epidural saline. During the second part of the study, six patients received bupivacaine intravenously and saline epidurally. Both epidural and intravenous bupivacaine significantly attenuated the response to an inhalational challenge with acetylcholine, but no changes occurred after epidural saline. The study also showed that, in patients with bronchial hyperreactivity, blockage of sympathetic efferent drive of the lungs does not increase airway resistance. These findings suggest that reported cases of severe bronchospasm during epidural anesthesia may be unrelated to sympathetic blockade and may be caused by mechanisms other than pulmonary sympathetic denervation.

■ Less Cerebral Damage with Low-flow Hypothermic Cardiopulmonary Bypass

Low-flow hypothermic cardiopulmonary bypass (CPB) often is used during surgery to correct complex congenital cardiac defects in children. Schwartz *et al.* (page 959) determined whether cerebral blood flow (CBF) was stable over time during hypothermic low-flow CPB performed on seven baboons. Anesthesia was induced with intramuscular ketamine (10 mg/kg) and maintained with fentanyl (mean total dose 87 ± 49 μg/kg) for a total surgical time of 334 ± 61 min. CPB was initiated at a flow rate of 2.5 $l \cdot min^{-1} \cdot m^{-2}$. Baboons in the study were cooled at a rate of 0.7–1.4°C per minute until tympanic membrane temperature decreased to 18°C, at which point CPB pump flow rate was decreased to 0.5 $l \cdot min^{-1} \cdot m^{-2}$ and maintained constant for at least 77 min. During low-flow CPB, CBF decreased to 50% of prebypass rate and to 30% of the value during full-flow CPB. Subsequent measurements of CBF during low-flow CPB showed no time-dependent decrease in CBF. Finding that CBF is maintained without a time-dependent change strengthens the preference for hypothermic low-flow bypass, especially in infants and children.

■ Crush-proof, Thin-walled Endotracheal Tubes Tested

Using a superelastic shape memory alloy (SMA), Kolobow *et al.* (page 1061) fabricated an ultra-thin-walled, wire-reinforced, nonkinking endotracheal tube (ETT), which they then tested *in vitro* and *in vivo* to assess its potential clinical usefulness. Because of the properties of the superelastic nickel-titanium alloy (Nitinol), the ETTs were essentially crush-proof, *i.e.,* recovery was complete after forceful manual compression. Soft, pliable, doughnut-shaped rings of polyurethane were attached to an egg-shaped laryngeal segment to occlude voids for potential air leaks from within the larynx. *In vitro* pressure-flow studies revealed a four- to fivefold decrease in air-flow resistance in the adult ETT range. *In vivo* studies conducted in sheep for 24-h periods showed no air leaks at airway pressure to 30 cmH_2O, with minimal leak beyond. To assess the clinical effectiveness of the tube-cuff design, further testing in humans is required.

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