

ANESTHESIOLOGY

■ Effects of Mechanical Ventilation Studied in Patients without Lung Injury. Choi *et al.* (page 689)

Previous studies have shown that mechanical ventilation with high tidal volumes can exacerbate preexisting lung injury. It is not known if patients without preexisting lung injuries are at risk for adverse effects from ventilator support. Accordingly, Choi *et al.* recruited healthy patients without histories of lung disease for their randomized study to compare the effects of two mechanical ventilation methods.

Participants in the study, who were scheduled for surgical procedures of 5 h or more, were randomized to receive mechanical ventilation with tidal volume of 12 ml/kg and no positive end-expiratory pressure (PEEP) or 6 ml/kg and 10 cm H₂O positive end-expiratory pressure. In addition to obtaining patients' consent, the authors also obtained consent to the study protocol from all involved physicians (surgeon, anesthesiologist, and pulmonologist). Anesthesiologists were allowed to change the ventilation protocol at any time point upon the surgeon's request, or if there were concerns about the patient's safety. Bronchoscopy and bronchoalveolar lavage were performed twice—just after mechanical ventilation in either the right middle lobe or lingua, and then 5 h later in the contralateral lung. Blood samples were drawn before both lavage procedures and hourly blood gas analyses were performed.

The authors found that higher tidal volumes caused activation of bronchoalveolar coagulation, as evidenced by an increase in thrombin-antithrombin complexes, soluble tissue factor, and factor VIIa after 5 h of mechanical ventilation. Bronchoalveolar fibrinolytic activity was not changed by either ventilation strategy. The procoagulant changes were largely prevented by use of lower tidal volumes and positive end-expiratory pressure. Although such procoagulant changes occur in settings of lung inflammation and injury, it is uncertain if intervention to treat such changes would improve resolution of injury, and further studies are needed to establish the relationship between procoagulant activity and patient outcomes.

■ Differential Behavioral and Electrophysiologic Effects of Four Anesthetics Tested in Rats. Jugovac *et al.* (page 764)

To compare the effects of four intravenous agents infused intracerebroventricularly in conscious rats, Jugovac *et al.* employed a battery of tests to assess electro-

encephalographic activity, somatosensory evoked potential, and other sensorimotor responses. During anesthesia, 42 rats were first equipped with intracerebroventricular infusion catheters, as well as hind-paw stimulation and epidural electrodes, to record electroencephalographic activity. To minimize the cerebrospinal spread of the drugs and focus anesthetic effects on the brain, the authors injected viscous silicone to block cerebrospinal fluid outflow at the fourth ventricle.

One hour after catheter placement, the animals received 50-min infusions of pentobarbital, fentanyl, propofol, or midazolam. Their vibrissal, olfactory, corneal, and tail-pinch responses were tested at 10-min intervals. All agents depressed the vibrissal, olfactory, and corneal responses, but propofol and pentobarbital produced the strongest effects. Fentanyl and pentobarbital produced the strongest depression of tail-pinch response, whereas propofol had no effect. Pentobarbital enhanced θ power; fentanyl decreased γ power; and all agents except fentanyl enhanced α and β power. Somatosensory evoked potential was increased by pentobarbital and decreased by midazolam, but neither change appeared to have a relationship to rats' behavioral responses.

The authors conclude from their findings that an increase in α and β power may reflect the sedative component of anesthetic action. A simultaneous increase in δ , α , and β power may correlate with loss of consciousness, whereas increases in both θ and δ power may be associated with surgical depth of anesthesia. Their results also suggest that immobility to noxious stimulation produced by pentobarbital, fentanyl, and midazolam may be mediated by supraspinal mechanisms.

■ Epidural Anesthesia Improves Pain Relief and Function after Prostatectomy. Gupta *et al.* (page 784)

In this issue, Gupta *et al.* report on a randomized, double-blind investigation of two pain management strategies in patients who underwent radical retropubic prostatectomy. Patients ($n = 60$) were randomized to receive either low thoracic epidural analgesia or patient-controlled intravenous analgesia for postoperative pain relief. During their operations, all patients had general anesthesia combined with thoracic epidural analgesia. After surgery, patients in the epidural group received an infusion of 1 mg/ml ropivacaine, 2 μ g/ml fentanyl, and 2

$\mu\text{g/ml}$ adrenaline, at a rate of 10 ml/h for the first 48 h, and also received placebo patient-controlled intravenous analgesia pumps. Patients in the patient-controlled intravenous analgesia group received an intravenous pump with morphine and placebo (saline solution) was delivered *via* the epidural catheter. In the postanesthesia care unit, a nurse blinded to patients' group assignments was allowed to administer an intravenous bolus of 1–2 mg morphine as needed to all patients experiencing inadequate pain relief during the first 48 h postsurgery.

Using a 0–10 numeric rating score, patients' pain at rest and on coughing was assessed every hour for 4 h, every 4–6 h up to 24 h, and then every 12 h through the second postoperative day. Analgesic consumption, total patient-controlled analgesia consumption, and opioid-related side effects were also measured. Secondary outcome measures, such as length of stay in the hospital, mobilization, respiratory function, and quality of life (using Short Form-36), were also measured.

A total of 56 patients completed the study. Incisional pain and pain on coughing were lower in the group who received epidural analgesia than those receiving patient-controlled intravenous analgesia. The epidural group also showed improved expiratory muscle function, as well as higher scores in the emotional role, physical functioning, and general health domains of the Short Form-36. It was not clear if systemic absorption of fentanyl contributed to the analgesic effect demonstrated here. This study agrees with some previous studies showing improved analgesia after major surgery with postoperative epidural analgesia. The rare complications and increased costs of this method should be weighed against the benefits shown in this study.

■ How Prevalent Is Persistent Chest Pain after Cardiac Surgery? Lahtinen *et al.* (page 794)

With the reported incidence of chronic poststernotomy pain varying from 21% to 56%, Lahtinen *et al.* prospectively determined the percentage of patients from their institution who experience chronic chest

pain 1 yr after open chest surgery. A questionnaire was distributed to 231 coronary artery bypass patients before their surgeries, 4 days afterward, and at 1, 3, 6, and 12 months postoperatively. Patients were asked about their expectations of pain preoperatively, and after surgery identified the location and intensity of any postoperative pain.

A total of 213 patients who completed the first postoperative questionnaire on the fourth day after surgery were included in the analysis. At the 1-month interval, the return rate for questionnaires was 95%; at 12 months, the response rate was 87%. In the preoperative questionnaire, 167 patients had expected postoperative pain in the chest, whereas 60 expected leg pain and 35 expected pain in the back. Patients experienced more pain postoperatively than they had expected. On postoperative day 4, only 7% of patients experienced severe pain at rest. In 143 patients, the pain was mild or moderate, and in 56 patients, there was no pain at rest. At 1 month after surgery, reported median pain values were mild at rest, during coughing, and upon movement, although there was wide individual variation during the follow-up period. One year after surgery, mild chronic poststernotomy pain at rest still occurred frequently in 26 patients; one patient had moderate pain and three reported severe pain. Persistent pain was more common during movement, with 45 patients reporting mild, 5 reporting moderate, and 7 reporting severe pain when moving. The authors also report that intramuscular opioid injections did not accomplish sufficient pain relief in the participating patients, with two-thirds experiencing moderate or severe pain at rest during the first few postoperative days. The authors suggest using other, more efficacious, methods for pain control—such as patient-controlled analgesia with opioids. In this prospective study, persistent chest pain was relatively common at 1 yr postsurgery, but was less frequent and less severe than has been reported in previous retrospective studies.

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