

ANESTHESIOLOGY

■ Effects of Induction Techniques on Postoperative Hoarseness and Vocal Cord Injury. Mencke *et al.* (page 1049)

While several risk factors have been identified as leading to laryngeal injury during general anesthesia, the quality of endotracheal intubation has not been clearly implicated. Accordingly, Mencke *et al.* recruited 80 healthy volunteers scheduled to undergo elective ear surgery and randomly assigned them to one of two groups. The first group received 0.5 mg/kg atracurium prior to intubation, while the second group received a saline preparation. The anesthesiologist performing the intubations was blinded as to study drugs, and the induction regimen with propofol and fentanyl was standardized for both groups of patients.

Intubation techniques were evaluated and scored according to the consensus conference on Good Clinical Research Practice (GCRP) in Pharmacodynamic Studies of Neuromuscular Blocking Agents. An independent observer also assessed and recorded other parameters, including visualization of the vocal cords, time to intubation, and number of intubation attempts. In the post-anesthesia care unit (PACU), an investigator blinded to group assignment evaluated patients for hoarseness, and recorded any vocal cord sequelae, including thickening of vocal folds, edema, or hematoma.

Of the final 73 evaluable patients, the rate of excellent intubation scores was significantly higher in the group receiving atracurium as opposed to saline. In the group receiving atracurium, postoperative hoarseness was limited to time spent in the PACU, while postoperative hoarseness persisted into the postoperative period in 5 patients from the saline group. Fifty patients in the saline group had evidence of some vocal cord sequelae (VCS) postoperatively, while only 5 from the atracurium group had VCS. In patients for whom the intubating conditions had been rated excellent, there was less frequent postoperative hoarseness and VCS. Adding atracurium to the propofol/fentanyl induction regimen significantly improved the quality of endotracheal intubation and reduced postoperative laryngeal morbidity. Building on these results, additional research could be conducted to determine the best timing of intubation for individual patients (based on neuromuscular monitoring) and to develop special strategies for prevention and treatment of PH in patients who use their voices professionally.

[*Editor-in-Chief's comment:* Direct laryngoscopy/endotracheal intubation is perhaps the single most com-

mon procedure performed by anesthesiologists (other than the insertion of IV catheters). The procedure is now so routine that while we worry about our failures to secure the airway, we have largely ignored the possible adverse consequences of our success in placing a plastic tube through the vocal cords. We've all told patients that "your hoarseness is due to that tube we put in your throat—don't worry, it will go away." However, that hoarseness is unquestionably the result of at least some degree of laryngeal injury, and hoarseness that doesn't resolve before PACU discharge should (perhaps) be viewed as a serious laryngeal injury. Our colleagues in otolaryngology also tell us that patients with even more severe dysfunction are not rare.

One major problem is that so little work has been done to carefully define the true incidence of laryngeal injury and dysfunction in routine patients, or to define the mechanisms of such dysfunction. Even less work has been done to determine if variations in technique might reduce the incidence of injury/dysfunction; the article by Mencke *et al.* that is summarized above is one of the few. I would encourage interested young investigators to consider the potential value of further work in this area. A more thorough editorial concerning this issue will also be forthcoming in a few months.]

■ Effects of Intraoperative Hypothermia and Hypotension on Median Nerve Somatosensory-evoked Potentials. Kottenberg-Assenmacher *et al.* (page 1112)

To expand upon knowledge of the relationship of median nerve somatosensory evoked potentials (MN-SSEPs) amplitude and latency to hypotension and hypothermia, Kottenberg-Assenmacher *et al.* conducted a confirmatory investigation during excision of intraocular malignant melanoma in 19 healthy patients. The procedure furnished a unique opportunity for intraoperative MN-SSEP monitoring, since controlled arterial hypotension is required to reduce the risk of intraocular hemorrhage and vision loss. Study participants underwent extensive preoperative assessment to rule out unrecognized, pre-existing cerebrovascular or coronary artery disease. MN-SSEPs were recorded preoperatively, and peak-to-peak amplitudes of N20/P25 and latencies of N13 and N20 waves were determined. After baseline measurements and induction of general anesthesia with propofol/

remifentanyl, MN-SSEPs, heart rate, and arterial and central venous pressures were continuously measured throughout the procedure, as were esophageal and rectal temperatures.

Investigators evaluated evoked potential recordings, hemodynamic measurements, arterial and jugular venous blood gas tensions, lactate concentrations and oxygen saturations during two episodes of sodium nitroprusside (SNP)-evoked arterial hypotension, with and without hypothermia, in a total of 11 patients. (Eight of the original 19 patients had unresectable tumors, so they did not undergo the second set of hypotension and hypothermia episodes.) The authors found that SNP-evoked arterial hypotension with a mean nadir pressure of 40 mmHg, with or without hypothermia, did not significantly alter either MN-SSEP N20/P25 amplitude or latency. However, hypothermia alone did prolong cortical latency of N20, cervical latency of N13 and central conduction time. Hypotension with or without hypothermia did not alter SjO₂, arterial-jugular bulb oxygen concentration, or lactate concentration. The authors caution that the relatively healthy and young sample of patients (average age: 54 ± 13) participating in this investigation preclude generalizing its results to a more heterogeneous and older population.

■ Exploring the Myocardial Depressant Action of Bone Cement Component. Kim *et al.* (page 1186)

Methylmethacrylate monomer (MMA), a component of acrylic bone cements used to anchor prosthetic devices to bone during orthopedic procedures, has been documented to cause systemic hypotension and even cardiovascular collapse in some patients. To elucidate MMA's mechanisms of action on direct myocardial depression, Kim *et al.* conducted a variety of inotropic and electrophysiologic interventions on isolated rat and guinea pig right ventricular papillary muscle.

The muscle tissue was mounted horizontally in a tissue bath and superfused with modified normal Tyrode solution. The tendinous end of the papillary muscle was then attached to a force transducer. Muscles were stimulated at varying intensities to establish baseline measurements, and then exposed to increasing concentrations of MMA for 15-minute periods. Effects of MMA during various aspects of sarcoplasmic reticulum (SR) function were evaluated during rapid cooling contractures, rest-state contraction (in rat muscle), and during immersion in low

Na⁺ Tyrode solution (in guinea pig papillary muscle). In addition, the team applied whole cell patch clamp techniques to isolated myocytes to measure inward Ca²⁺ currents.

Results revealed that MMA (in concentrations of 0.5, 1.5 and 4.7 mM) caused a concentration-dependent depression of peak force and dF/dt-max to an equivalent of 70, 50 and 20% of baseline, respectively, from RS to 3 Hz stimulation rates. A concentration of 1.5 mM of MMA depressed PF of rat and guinea pig myocardium under low Na⁺ Tyrode solution by 20–30%. In modified 26 mM K⁺ Tyrode solution, 0.5 and 1.5 mM MMA caused selective and marked concentration-dependent depression of late force development without altering early force development. In patch clamp studies, MMA reduced inward Ca²⁺ in a concentration-dependent manner. The authors conclude that the direct myocardial depressant effect of MMA observed in clinical situations may be due in part to depression of Ca²⁺ influx through cardiac membrane.

■ Authors Devise New Optimization Model for PCA with Morphine and Ketamine. Svetcic *et al.* (page 1195)

While adding ketamine to morphine for intravenous patient-controlled analgesia (PCA) has been reported to be beneficial, the optimum combination is not known. Svetcic *et al.* developed a model to optimize combinations of morphine and ketamine, as well as the lockout interval, for use in PCA following lumbar spine or hip surgery. The team recruited 102 patients scheduled for such surgery, and randomly assigned them to one of 8 postoperative PCA combinations. Patients were instructed on the use of PCA on the day before surgery and subsequent to their operations. PCA pumps were installed immediately after extubation and initially programmed to deliver 1 ml bolus on demand with a maximum of 6 boluses per hour.

The aim of the optimization procedure, a modified “direct search” method, was to increase analgesic effect (verified by a lower reported pain score) by sequentially optimizing the combination of morphine concentration in PCA solution, ketamine concentration in PCA solution, and lockout interval. Each combination was tested in 6 patients; results from the initial 8 combinations (comprising a “complex”) were used to calculate the next optimization step. The next complex included the best 7 combinations of the previous complex and a new

combination generated from results of the previous complex. At the end of the optimization procedure, the team randomly selected two of the three best combinations and retested them on two additional groups also including 6 patients each.

A total of 12 PCA combination regimens with an allowed morphine and ketamine range in PCA solution of

0–2 mg/ml and a lockout interval range of 5–12 minutes were studied. The authors observed a decrease in pain scores and low incidence of side effects in the 84 patients who completed the study. The optimum procedure converged to a morphine-to-ketamine ratio of 1:1 and lockout interval of 8 minutes.

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