THIS MONTH IN
ANESTHESIOLOGY®

274 Performance of Noninvasive Airway Occlusion Maneuvers to Assess Lung Stress and Diaphragm Effort in Mechanically Ventilated Critically Ill Patients

Monitoring and controlling lung stress and diaphragm effort has been hypothesized to limit lung and diaphragm injury in mechanically ventilated critically ill patients. The reference methods to assess lung stress and diaphragm effort are esophageal and gastric manometry to calculate the transpulmonary pressure and transdiaphragmatic pressure. The hypothesis that occluded inspiratory airway pressure (Pocc) and drop in airway pressure in the first 100 ms of an occluded inspiration (P0.1) correlate with lung stress and diaphragm effort and that both parameters would perform well in identifying patients with extremes of lung stress and diaphragm effort was tested in a secondary analysis of data from two clinical trials, a 39-patient primary cohort and a 13-patient validation cohort. Although Pocc and P0.1 could not be used to calculate the exact values of diaphragm effort and lung stress in the preceding hour in mechanically ventilated critically ill patients, they had good to excellent diagnostic performance in identifying extremes of lung stress and diaphragm effort, with Pocc outperforming P0.1 in detecting patients with high diaphragm effort. *See the accompanying Editorial on **page 235**.* *(Summary: M. J. Avram. Image: A. Johnson, Vivo Visuals Studio.)*

289 Mechanical Power Ratio and Respiratory Treatment Escalation in COVID-19 Pneumonia: A Secondary Analysis of a Prospectively Enrolled Cohort

Tidal volume, minute ventilation, and esophageal pressure measurements help inform diagnosis of patients with acute respiratory failure and monitor their response to therapeutic intervention. Mechanical power quantifies the amount of energy transferred to the respiratory system during mechanical ventilation, and the mechanical power ratio is the ratio between it and the expected baseline mechanical power. The hypothesis that the mechanical power ratio can identify spontaneously breathing patients with higher risk of respiratory failure was tested in a secondary analysis of data from patients with COVID-19 pneumonia. Forty-seven patients were supported with continuous positive airway pressure until transfer to the ward, and 64 underwent treatment escalation to noninvasive or invasive mechanical ventilation. Although the tidal volume was similar in both groups, patients undergoing treatment escalation had higher respiratory rate, minute ventilation, tidal pleural pressure, and mechanical power and lower arterial oxygen tension/fractional inspired oxygen tension. Mechanical power, mechanical power ratio, and pressure-rate index were variables most strongly associated with the need for respiratory treatment escalation. *See the accompanying Editorial on **page 238**.* *(Summary: M. J. Avram. Image: Generated by the author (of the accompanying Editorial) using DALL•E 2 natural language to image generation AI system.)*

299 Predicting Intensive Care Delirium with Machine Learning: Model Development and External Validation

The hypothesis that variables routinely acquired during intensive care would be associated with the probability of delirium onset was tested by developing and validating two models for the prediction of delirium in the intensive care unit (ICU): an early prediction model to identify delirium onset at any time during intensive care using data available early in the ICU stay and a dynamic model to predict the onset of delirium 0 to 12 h in the future. The prediction models were trained and tested using a large multicenter database and externally validated on two large single-center databases. The early prediction model performed better than the modified reference model and calibrated well in a contemporary dataset. The dynamic model had higher discrimination than the reference model and similar or better discrimination compared to published models. Both models generally validated well on the external datasets. Features involving Glasgow Coma Scores, Richmond Agitation Sedation Scale, age, mechanical ventilation, and overall acuity were important in prediction. Length of ICU stay before delirium onset and time of day were important predictors for the dynamic model. *(Summary: M. J. Avram. Image: Adobe Stock.)*

241 Comparison of Contralateral Acceleromyography and Electromyography for Posttetanic Count Measurement

Deep neuromuscular blockade during anesthesia for laparoscopic or robotic surgeries may offer several advantages in terms of patient outcomes and physician surgical experience. Posttetanic count can be used to identify intense neuromuscular block (posttetanic count equal to 0) and deep neuromuscular block (posttetanic count greater than or equal to 1 and train-of-four count equal to 0) and estimate the time to recovery. The agreement of posttetanic counts monitored in contralateral arms by acceleromyography and electromyography was determined in 36 patients given 0.6 mg/kg rocuronium after induction of anesthesia and calibration of the monitors, with additional doses of 0.3 mg/kg if required. Seventy-three percent of 226 pairs of acceleromyography and electromyography posttetanic count measurements indicated the same neuromuscular blockade status (intense or deep block). Of 184 pairs of posttetanic counts of 15 or less, 42 (23%) acceleromyography posttetanic counts were equal to electromyography posttetanic counts, 93 (50%) were more than electromyography counts, and 49 (27%) were less than electromyography counts. *(Summary: M. J. Avram. Image: J. P. Rathmell.)*

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249 Respiratory Effects of Biased Ligand Oliceridine in Older Volunteers: A Pharmacokinetic–Pharmacodynamic Comparison with Morphine

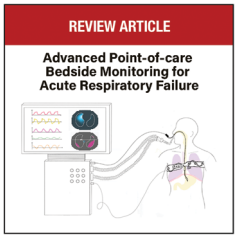
After μ-opioid receptor activation, oliceridine selectively engages the G protein–coupled signaling pathway, which is associated with analgesia, and has reduced engagement of the β-arrestin pathway, which is associated with adverse effects such as respiratory depression. In healthy young males, oliceridine had a higher probability of providing analgesia than producing respiratory depression over the clinically relevant concentration range, while morphine had a higher probability of producing respiratory depression than providing analgesia. Older and somewhat obese individuals of both sexes may be more vulnerable to opioid-induced respiratory depression than younger individuals. The hypothesis that oliceridine and morphine differ in their pharmacodynamic behavior, measured as effect on ventilation at an extrapolated end-tidal P_{CO_2} of 55 mmHg ($\dot{V}_E$55), was tested in a four-arm, double-blind, randomized crossover study of 18 male and female volunteers aged 56 to 87 yr. The effect-site oliceridine concentration causing a 50% depression of $\dot{V}_E$55 was 39% higher than that of morphine. The onset and offset of the respiratory effect of oliceridine was five times faster than that of morphine. *(Summary: M. J. Avram. Image: Adobe Stock.)*

264 Extended-age Out-of-sample Validation of Risk Stratification Index 3.0 Models Using Commercial All-payer Claims

The Risk Stratification Index (RSI) 3.0 is a well-validated and calibrated suite of predictive algorithms that uses diagnostic, procedural, and demographic information available at the time of admission to predict health outcomes during hospitalization and after discharge. The RSI 3.0 models were developed and out-of-sample validated in Medicare fee-for-service patients who were mostly at least 65 yr old. The performance of seven RSI 3.0 models developed in Medicare patients and applied to younger and healthier 2017 Utah (55,109 admissions from 40,710 subjects) and Oregon (21,213 admissions from 16,951 subjects) state populations were compared to those of the out-of-sample Medicare validation analysis to determine how well the RSI 3.0 models perform when applied to out-of-sample younger and healthier adult populations. The models included in the analysis were selected to demonstrate performance of predictors for clinically and economically meaningful outcomes spanning a broad range of incidences. Performance measures for all endpoints exceeded prespecified minimum acceptable performance standards and were similar to or better than those obtained on the Medicare population. *(Summary: M. J. Avram. Image: Thinkstock Images.)*

312 Multidisciplinary Pain Management: A Tale of Two Outcomes (Classic Paper Revisited)

The Multidisciplinary Pain Clinic started at the University of Washington by John J. Bonica, M.D., in 1960 evolved over the years, becoming the Pain Center in 1978. John D. Loeser, M.D., the author of this Classic Paper Revisited article, became director of the Pain Center in 1982 where he and Wilbert Fordyce, Ph.D., designed and implemented a 3-week inpatient treatment program for patients with chronic intractable pain, labeled "the structured program," which became a model for chronic pain treatment not only in the United States but also throughout the world. It has been the model for a wide network of Scandinavian pain treatment programs that provide universal access to multidisciplinary care for acute, chronic, and cancer-related pain to this day. Although pain programs were developed in many institutions in the United States, without government support few survived the economic health care chaos in the United States. The Classic Paper, published in 1999 in *Acta Anaesthesiologica Scandinavica*, provides an analysis of developments in chronic pain management in both the United States and the Nordic countries. *(Summary: M. J. Avram. Image: J. P. Rathmell.)*



317 Advanced Point-of-care Bedside Monitoring for Acute Respiratory Failure (Review Article)

Advanced point-of-care respiratory monitoring tools may provide insights on pathologic changes in the respiratory system produced by underlying disease in patients with acute respiratory failure and support clinicians in providing mechanical ventilation while protecting the lungs and respiratory muscles. Such monitoring is focused on assessing lung aeration and morphology, lung recruitment and overdistention, ventilation–perfusion distribution, inspiratory effort, respiratory drive, respiratory muscles contraction, and patient–ventilator asynchrony. Advanced respiratory monitoring involves several noninvasive or minimally invasive technologies, safely applicable at the bedside, to conduct an in-depth evaluation of the lung and respiratory muscles. The present review provides an updated description of those tools, including assessment of esophageal pressure, assessment of electrical activity of the diaphragm, electrical impedance tomography, and ultrasound of the lung and respiratory muscles. *(Summary: M. J. Avram. Image: From original article.)*