

ANESTHESIOLOGY

■ Effects of Remifentanyl Studied in Critically Ill Patients Implanted with an Artificial Heart. Ouattara *et al.* (page 602)

Ouattara *et al.* report an observational study that included nine critically ill patients with congestive heart failure who were implanted with a total artificial heart while receiving short-acting general anesthesia. With the ability to modify settings on the artificial heart, and thus render the cardiac output “preload-independent,” the authors could then assess the peripheral vascular effects of remifentanyl. After inducing anesthesia with 0.3 mg/kg etomidate intravenously, increased concentrations of remifentanyl were infused in a stepwise fashion at 5-min intervals. The team monitored hemodynamic parameters, including left and right atrial pressures, systemic and pulmonary arterial pressures, and left and right cardiac indices during remifentanyl infusion and following a 12-min recovery period.

The invasive implantation procedures were performed in the nine patients under a continuous remifentanyl infusion of $1 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Remifentanyl produced a dose-dependent and significant decrease in systemic arterial pressure and vascular resistances from a concentration of $0.25 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Two of the patients who required a low dose of norepinephrine to maintain arterial pressure were excluded from the analysis of the effect of remifentanyl on pulmonary vascular resistance. In the other patients, no significant changes were observed in pulmonary vascular resistance. Because of the small sample size and the participants' end-stage congestive heart failure, extrapolation of results to the vascular effects of remifentanyl in normal patients during surgery cannot be made. In addition, the implantation of artificial hearts also modifies vascular responses to vasodilator agents. Nevertheless, the observational results suggest that systemic arterial vasorelaxation may be involved in remifentanyl-induced cardiovascular disturbances.

■ Influence of Phenytoin Use on Pharmacokinetics, Pharmacodynamics of Vecuronium Studied. Wright *et al.* (page 626)

In 22 patients scheduled to undergo supratentorial craniotomy for tumor resection, half had received phenytoin prior to surgery and half had not. Wright *et al.* analyzed blood samples obtained from both groups of patients during and after infusion of vecuronium in two separate protocols. In the first 12 patients (6 in the

phenytoin group; 6 in the control group), vecuronium was infused at $7.5 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ until first twitch response had decreased to less than 50% of control measurements. The infusion was then discontinued, and twitch tension was monitored until the twitch response was greater than 90%. Blood samples were obtained at regular intervals during this time period.

In the other 10 patients (5 phenytoin; 5 control), a larger dose of 200 $\mu\text{g}/\text{kg}$ vecuronium was infused over a 10-min period. Blood samples were drawn at intervals until 6 h after start of the infusion; urine samples were also collected at hourly intervals in these patients.

The research team used capillary gas chromatography to measure plasma concentrations of vecuronium and 3-desacetylvecuronium. They found that in patients taking phenytoin preoperatively, clearance of vecuronium was increased by 138%. The concentration of vecuronium required to depress twitch response to 50% was increased 124% in those taking phenytoin. Chronic phenytoin therapy reduces vecuronium effects, the authors believe, by mechanisms that include increased metabolism and reduced sensitivity to circulating concentrations of the neuromuscular blocking agent.

■ Two Closed-loop Anesthesia Delivery Systems Compared. Struys *et al.* (page 640)

Using a patient simulator constructed from historical data, Struys *et al.* tested two automated controllers for bispectral index (BIS)-guided propofol administration. The patient simulator was run on one computer while the controllers—one model-based and the other proportional-integral-derivative—were run on a second computer. A total of 60 virtual operations were tested, in which the patient simulator provided noxious stimuli to trigger closed-loop control actions, and provided simulated monitoring delay, among other functions. Each controller was tested using a set of 10 virtual patients undergoing fixed surgical profiles and was repeated three times with BIS targets set at 30, 50, and 70. The objective of the study was to determine which of the automated controllers could achieve the greatest percentage of time within BIS target ranges.

Median prediction error was significantly smaller for the proportional-integral-derivative controller than for the model-based controller. When simulating closed-loop control of BIS using propofol, the model-based system with effect-site control resulted in better control

of BIS compared to the standard proportional-integral-derivative controller with plasma-site control. Even under the extreme conditions introduced during the surgical simulation, the model-based controller exhibited no behavioral problems. A simulation study cannot reproduce the complications of real-life situations with actual patients; therefore, using alternate simulated patients, increasing random noise, and randomizing target levels and offset might provide a wider range of testing situations.

■ Tsui Test for Epidural Catheter Placement *via* Caudal Route in Pediatric Patients. Tsui *et al.* (page 683)

Through accessing their institution's pediatric pain service database, Tsui *et al.* conducted a review to examine the success rate and complications from continuous caudal epidurals performed between 1999 and 2002. Since 1999, the pediatric anesthesiology department has routinely used electrical epidural stimulation, also known as the Tsui test, to confirm epidural catheter tip placement when placing thoracic or lumbar epidurals *via* the caudal route in infants and children. The pediatric pain service database tracks method of epidural insertion; final level of the catheter; medication administered; and adverse effects such as respiratory depression, nausea and vomiting, sedation, urinary retention, and pruritus. Patients with a score of 3 (on a 0–3 scale) were considered to experience sedation as a side effect; requiring supplementary oxygen for reduced saturation or a respiratory rate of less than 10 defined respiratory depression. Analgesic success in each case was determined by the acute-pain attending anesthesiologist. If unsuccessful (in-

adequate analgesia with the epidural), the epidural was discontinued and pain was then managed with parenteral opioids.

During the study period, clinicians attempted placement of 289 lumbar or thoracic catheters in the pediatric patient population, all *via* the caudal approach. In five patients (aged 5 months to 1.6 yr) the catheter failed to thread to the desired level and the epidural was abandoned in the operating room. In the remaining 284 patients (median age, 0.7 yr), the overall success rate of all caudal route epidurals was 84.9%. Twenty-nine patients received supplemental morphine infusion along with a continuous epidural. There was no significant difference in adequate pain control in infants (1 day to 1 yr) compared with older children.

The most common adverse effect of the epidural was pruritus, seen in 26.1% of the patient population. Nausea and vomiting were reported in 16.9% of the patient population. In 20.8% of children without urinary catheters, urinary retention was noted. The incidence of respiratory depression was 4.2%, although the administration of naloxone was never necessary. Five epidurals were abandoned because of technical problems, which ranged from connector problems to catheter leaks and occlusions.

Placing epidural catheters *via* the caudal route may be more desirable because of less risk of spinal cord damage (typically associated with direct placement). The positioning system using the Tsui test allows the practitioner to identify catheter tip position while inserting the catheter. Thus, adjustments can be made and positioning of the catheter tip can be optimized, leading to better pain control.

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