ANESTHESIOLOGY NEWS

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CLINICAL ANESTHESIOLOGY

ISSUE: 12/2007 | VOLUME: 33:12

Study Ties Anesthesia Awareness to Speech Comprehension

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Why do a small percentage of patients recall some or all of what transpired during surgery under general anesthesia, yet for others those hours are a total blank? Why do some patients diagnosed as minimally conscious or in a vegetative state show signs of brain activity, as if they are able to comprehend complex speech?

Answers to these questions—more similar than they may at first seem—are being teased out through research into the relationship between speech comprehension and varying states of conscious awareness. The results of these studies will surely be grist for neuroscientists. But the findings may also prove significant for clinicians, according to experts who said the work could eventually help guide the giving of instructions after surgery to patients with low residual blood concentrations of anesthetics and assist the discharge patients without formal clinical supervision following ambulatory surgery under general anesthesia.

Researchers in England administered propofol to 12 healthy volunteer anesthetists (nine men, three women) to achieve graded sedation. Using functional magnetic resonance imaging, they assessed neural correlates of language comprehension at reduced levels of awareness. They found that once deeply sedated, the volunteers showed no response to conversational speech despite the fact that their temporal—but not frontal—responses remained largely intact.

Even relatively low levels of sedation appear to affect higher-level processes involved in computing the meaning of sentences and encoding them into memory, the researchers found, whereas lower-level perceptual processing of speech remains intact. “These results support the view that anesthesia is a behavioral and neural continuum rather than a discrete event,” the scientists reported in a recent issue of the *Proceedings of the National Academy of Sciences* (2007;104:16032-16037).

The study was conducted by researchers at the Medical Research Council’s Cognition and Brain Sciences Unit, the Impaired Consciousness Research Group and the Division of Anesthesia at the University of Cambridge in England. It is part of an ongoing program funded by the Royal College of Anaesthetists.

The volunteers were scanned before and during sedation with propofol. Responses to sentences and nonspeech noises were assessed at three levels of awareness: fully awake, lightly sedated and heavily sedated (although not as deeply as with general anesthesia). Even at light levels of sedation, the researchers saw no activity in brain areas normally used to comprehend sentences containing ambiguous words, such as “bark” or “rain” and “reign.”

“Even though lightly sedated volunteers can hold a simple conversation, albeit with more hesitant spoken responses, they do not show the same neural correlate of ambiguity resolution that we see in awake, healthy volunteers or in certain [vegetative] patients,” said Matthew H. Davis, PhD, a cognitive neuroscientist at the research council and the study’s lead author. “To me, the disappearance of this neural correlate of ambiguity resolution during light sedation is surprising—especially since other brain responses to speech, in the comparison of speech and noise, remain apparent during light sedation.”

Additional studies already underway are looking at other higher-level cognitive processes, such as the ability to produce a behavioral response to a spoken instruction or to make simple decisions, he

said.

Although much research has been done on anesthetic awareness, such as the B-Aware Study (*Lancet* 2004;363:1757-1763), the reported incidence of the phenomenon has depended on patients remembering the events.

“We hypothesized that patients may experience awareness without encoding memories of events,” said David K. Menon, MD, PhD, professor of anesthesia at Cambridge and one of the authors of the *Lancet* paper. If so, Dr. Menon said, recall of events might underestimate the true incidence of awareness.

“Our research shows that a high level of awareness is required to comprehend sentences containing ambiguous words like rain or reign,” Dr. Menon said. “Brain-injured patients that show an additional response to these sentences are therefore likely to be at a high level of awareness.”

Nicholas D. Schiff, MD, associate professor of neurology and neuroscience and director of the Laboratory of Cognitive Neuromodulation at Weill Medical College of Cornell University in New York City, called Dr. Davis’ study “important” work that “adds weight to the passive language paradigms employed by [Martin] Coleman et al., in their recent study of brain-injured patients [*Brain* 2007;130:2494-2507]. I think it is particularly nice in suggesting several next steps for assessment of levels of overt and covert responsiveness in human subjects.”
