Memory during Anesthesia

To the Editor—In their recent article on memory during anesthesia,¹ Cork et al. mention, but do not detail, data that appear in conflict with their own conclusions. They note that three patients remembered specific words from the list presented during anesthesia. These patients were excluded from the study, presumably to test implicit memory in the absence of explicit recall. Of the remaining patients (who showed no free recall of list items), more than a third (9 of 25) “reported vague, dreamlike recollections of other intraoperative events.” We are not told how closely these experiences corresponded to actual intraoperative events. However, the word “recollections” suggests that the authors believe them to be true, explicit memories. Indeed, the authors remark, “The use of a pure nitrous oxide/opioid technique without

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**Table 1. Perioperative Changes in Ventilator Settings and Values of Arterial Blood Gas Analysis**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Immediate Postnatal</th>
<th>Preoperative NICU</th>
<th>Preoperative OR</th>
<th>Before Lobectomy</th>
<th>Postoperative OR</th>
<th>4 Days Postoperatively</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_{\text{aO}_2} (mmHg)</td>
<td>91</td>
<td>118</td>
<td>62</td>
<td>20</td>
<td>18</td>
<td>63</td>
</tr>
<tr>
<td>P_{\text{aCO}_2} (mmHg)</td>
<td>81</td>
<td>35</td>
<td>7.11</td>
<td>7.45</td>
<td>7.54</td>
<td>7.45</td>
</tr>
<tr>
<td>pH</td>
<td>6.95</td>
<td>7.37</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

NICU = neonatal intensive care unit; OR = operating room; HFOV = high-frequency oscillatory ventilation; P_{\text{aw}} = mean airway pressure. 

Examination, was transported to our hospital after the premature rupture of the membranes at 33 weeks of gestation. Consequently, a 1806-g male neonate was delivered vaginally in the lying-in room. Apgar scores at 1 and 5 min were 4 and 6, respectively. Immediately after birth, his trachea was intubated, and he was transported to the neonatal intensive care unit (NICU) for ventilatory management. He suffered from severe hypoxia despite manual ventilation during transport. His lungs were then ventilated with high-frequency oscillation (HFOV) (Hummingbird BMO-20N) at the frequency of 15 Hz and mean airway pressure of 17 cm H_{2}O. This ventilation improved his arterial blood gases (table 1). The diagnosis of CGAM was confirmed using chest roentgenogram, which revealed fine cystic masses in the left lung with a mediastinal shift to the right. Poor oxygenation and hypotension caused by compression of the heart and lung by the cyst led to an emergency left lower lobectomy. As the ventilator had no battery, manual ventilation had to be performed during transfer from the NICU to the operating theater. Interruption of HFOV led to severe hypoxemia on arrival in the operating room. Resumption of HFOV rapidly improved oxygenation considerably. HFOV at gradually reduced ventilator settings was continued during anesthesia. The lower lobe of his left lung was occupied by a solid lesion, resulting in compression and collapse of the upper lobe. The lobectomy improved the gas exchange by releasing compression of the remaining lobe. During return to the NICU, manual ventilation was not associated with decreased oxygenation. The patient was successfully separated from HFOV 4 days after operation. Thereafter, ventilation could be controlled using continuous positive airway pressure. On postoperative day 15, his trachea was extubated with no complication. 

Nakano et al. have recommended fetal anesthesia during elective cesarean delivery and prompt use of HFOV for neonates without prior mask ventilation,¹ because spontaneous respiration immediately after birth and conventional ventilation increase the risk of hypoxemia in neonates by enlarging and rupturing lung cysts. Our inability to ventilate the lungs with HFOV during transfer to the operating room suggests that cesarean section or vaginal delivery in the operating room would have been beneficial compared with delivery in the lying-in room in the obstetric ward. Our report supports the use of HFOV as described by Nakano et al.¹ and suggests that this technique might be useful in the perioperative period for other neonatal cystic lung lesions such as congenital lobar emphysema,⁵ if conventional ventilation is inadequate.

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In Reply—In our previous research, we showed a dissociation between explicit and implicit memory in surgical patients who experienced adequate anesthesia with isoflurane.* The purpose of our most recent study was to determine whether a similar dissociation could be observed with other anesthetic regimes. For this purpose, we restricted our analysis to those patients who, like the vast majority of surgical patients, showed no explicit memory whatsoever for any aspect of their surgical experience, including the words presented on the audiotape, as measured by a test of free recall. We were somewhat surprised to find that some of our patients anesthetized with sufentanil/nitrous oxide displayed hints of explicit memory for surgical events; but our protocol, which was designed to provide a replication of our isoflurane study (in which no such hints were apparent), required that these patients be eliminated from statistical analysis. To repeat our findings: with isoflurane, implicit memory was spared to some degree in patients for whom explicit memory was abolished entirely; however, when sufentanil abolished explicit memory, it also abolished implicit memory. This direct comparison, removed from our paper at the request of the Editor to avoid publication repetition, is documented elsewhere.6

Unfortunately, we have no way of gauging the accuracy of these particular patients' "vague, dreamlike" reports. For the most part, they were generic thoughts and images that could pertain to any surgical procedure; perhaps it was inaccurate to refer to them as "recollections," but they were made in response to a question about memory, so to be conservative, we characterized them as such. (We hasten to add that all of these patients were adequately anesthetized according to standard clinical criteria, none of them reported anything more than a fleeting impression, and none of them found their recollections—if indeed that is what they were—to be disturbing in any way.)

As we noted in our paper, we suspect that the occurrence of these apparent recollections was due to our elimination of benzodiazepine premedication—again, following the procedure used in our isoflurane study. Certainly there was nothing remarkable about the patients' illnesses or the progress of their surgeries. The fact that isoflurane without benzodiazepine abolishes explicit memory reliably, but sufentanil administered under the same circumstances does not always do so, is a finding of some theoretical and practical interest, but further research is required to define it more precisely. In any event, nothing in our research justifies the speculation that "patients remember what is important to them," as suggested by Doering: presumably the details of surgical procedures are important to all patients who undergo them, regardless of the anesthetic agents employed; yet most patients remember nothing at all.

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Partially Paralyzed: A Personal Experience

To the Editor—I was one of the volunteers partially paralyzed to a T1–T1 ratio of 0.2 with atracurium in the study reported by Sharpe et al.1 During the first phase of this study, I was lying supine. While in that position, I found it difficult to lift my limbs off the bed. All attempts to do so failed in midcourse. Although my tongue was lying limp in my throat, I was not choking. Difficult phonation was not due to inability to breathe but to not being able to lift my lips off my teeth, so that I could only lip. I could not focus my eyes, but I did not have diplopia.

At the end of the study, I was turned on to my right side. In that position, I could move my arms freely and kick my legs with ease, as long as I confned all movements to the plane of the bed. I could purse my lips again, and my speech cleared. My vision improved also, particularly


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