Psychological Alterations After Anesthesia and Surgery

ANTON HOLE, MD

The degree and significance of postoperative mental changes caused by surgery and anesthesia are still debatable. However, after open heart surgery and after extensive surgery on elderly patients, long-lasting mental changes do occur. The susceptibility of older people to such cerebral damage may be due to preoperative marginal circulation in parts of the brain, and a small reserve of functioning neurones compared to younger patients.

[Key words: Anesthesia, general, epidural; Complications, cerebral damage; Psychological alterations; Geriatrics] Regional Anesth [Suppl] 1982;7:S141–S143.

Patients admitted to the hospital for surgical procedures often have anxiety about the operation and the outcome, and psychological alterations secondary to this are often encountered in the postoperative period.

In elderly patients, hospitalization alone often leads to mental changes, possibly due to change of environment.

Evaluation of the effect of anesthesia and surgery on psychological and mental functions is difficult, and conflicting results from clinical studies are, therefore, not surprising.

Bedford described 410 patients who “had never been the same since operation” and 18 cases of gross dementia occurring, in 1193 patients above 50 years of age, after anesthesia and surgery. These findings stimulated Simpson and co-workers to investigate the social and mental integrity of 741 patients above 65 years of age admitted to their hospital for elective surgery in one year. Of these patients, 12% were found to lead “limited” or “much limited” existences after surgery. However, except for four cases, these deteriorations were not due to organic cerebral damage and could be explained by identifiable reasons unrelated to the anesthetic procedures used.

In a recent study, we found significant mental disorders in 7 of 31 elderly patients operated on for total hip arthroplasty under general anesthesia. In contrast, 29 patients operated on for the same procedure under epidural anesthesia, showed no mental changes postoperatively (Table 1).

However, in a still unpublished study by Riis et al., investigating mental disorders in a similar population after total hip replacement, the mental disorders were transient, and there was no difference between the epidural, the general anesthesia, or the epidural/general anesthesia combined group.

The possible causes of mental disorders acquired during anesthesia and surgery are shown in Table 2. The occurrence of cerebral hypoxia is probably of major importance. Severe general hypoxia during and immediately after surgery is usually caused by anesthetic accidents or serious complications. However, less pronounced hypoxia is more likely to occur, and is, in fact, found postoperatively after different surgical procedures. Figure 1 shows the changes in PaO₂ after total hip arthroplasty. This reduction in PaO₂ does not seem alarming, but might cause cerebral dysfunction in elderly patients in whom regional cerebral blood flow prior to operation may be marginal.

The effect on brain functions of hypotension


From the Department of Anaesthesiology, University of Trondheim, Trondheim, Norway.

Address correspondence to Dr. Hole: Department of Anaesthesiology, University of Trondheim, 7000 Trondheim, Norway.

0146-521X/82/1000S/S141 $00.95 © American Society of Regional Anesthesia
to 50 mm Hg mean arterial pressure during total hip arthroplasty has been studied by Thompson and coworkers. Only one of 21 patients became disoriented during the first 24 hours after operation and all subsequently recovered. The remaining 20 patients showed no intellectual or neurologic alteration. However, Berg, Nilsson, and Vinnars found, in approximately 50% of the patients undergoing hypotensive anesthesia, a positive hexobarbitone critical flicker fusion test, indicating a diffuse cerebral injury, which persisted for more than six days. They also concluded that males were more vulnerable than females, and patients with advanced cancer were particularly vulnerable. A decrease of blood pressure to 80 mm Hg in combination with elevation of the head also increased the risk of cerebral injury.

Hyperventilation with lowering of PaCO₂ is known to cause cerebral vasoconstriction and reduced cerebral blood-flow. The dissociation of oxygen from the hemoglobin is also reduced, tending to increase the cerebral tissue hypoxia. The possible importance of these factors in causing postoperative cerebral injury has been the subject of several investigations. Allan and Morris, using the same test as Berg and coworkers, could show that, of 18 patients subjected to hyperventilation during anesthesia, 14 had positive tests for cerebral cortical dysfunction. However, these effects were of short duration, and were normalized within one to three days postoperatively.

In contrast, Whitwam and co-workers found no cerebral changes in healthy young volunteers passively hyperventilated for two hours using the hexobarbitone critical flicker fusion test. Using psychometric tests involving memory and learning processes, Murrin and Nagarajan found a slight functional impairment in the hyperventilated group which was not statistically different from the normal ventilated group.

Table 1. Mental Changes After Total Hip Arthroplasty

<table>
<thead>
<tr>
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<th>Patients with Postoperative Mental Disorders</th>
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<tr>
<td>General anesthesia</td>
<td>31</td>
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<tr>
<td>Epidural anesthesia</td>
<td>29</td>
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Table 2. Possible Causes of Mental Disorders Acquired During Anesthesia and Surgery

<table>
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<th>Cause</th>
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<td>Cerebral hypoxia</td>
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<td>General hypoxia</td>
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<td>Hypotension</td>
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<td>Hypocarbia</td>
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<td>Microembolisation</td>
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<td>Extracorporeal circulation</td>
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<td>Thromboplastine activation</td>
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<td>Effects of anesthetic agents</td>
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<td>Unblocked surgical “stress”</td>
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Fig. 1. Change in arterial oxygen tension after total hip arthroplasty performed under either general anesthesia (n = 31) or epidural anesthesia (n = 29).

Significance of difference between the two groups: * = p < 0.025.

Significance of difference between postoperative and preoperative PaO₂ in each group: xxx = p < 0.001, xx = p < 0.01, n.s. = not significant.
During trauma, activation of the complement system takes place. Among other effects, this activation gives rise to leukocyte aggregation in the pulmonary and possibly in the cerebral capillary beds.

There is no doubt that cerebral microembolization is a problem during open heart surgery using extracorporeal circulation. Åberg \textsuperscript{11} found that 12\% of these patients had clinically obvious cerebral complications one week or more after the operation. Most of these changes were reversible, but he concluded that permanent injuries do occur, possibly caused by microembolization to the brain. Factors positively correlated to a decreased intellectual function were prolonged perfusion time and the presence of valvular calcification. Use of a micropore filter in the arterial line improved the mental functions.

During certain noncardiac operations, for instance total hip arthroplasty, release of tissue thromboplastin factors takes place, creating microemboli in the circulation. Most of these will lodge in the pulmonary capillary bed and probably not reach the brain.\textsuperscript{12} The possibility exists, however, that platelet and leukocyte aggregation in the cerebral circulation also is increased, giving rise to microembolization in the brain.

It is not surprising that cortical functions are impaired after injections of CNS depressant drugs, for instance methohexitone and diazepam.\textsuperscript{13} These effects seem to be short lasting. However, after use of inhalational anesthetic agents, more long-lasting effects on cerebral function have been demonstrated. Davidson and co-workers could demonstrate altered psychological functions in young volunteers two to eight days after exposure to halothane and, to a lesser extent, after isoflurane.\textsuperscript{14}

The authors found the symptoms severe enough to advise against intellectually demanding work for at least four days after anesthesia. This is a point well worth remembering after outpatient anesthesia with these agents.

It is generally accepted that during light general anesthesia impulses from noxious stimuli will reach the brain and set up a "stress response" reflected in metabolic and endocrine changes. It may be that these changes are of importance for psychological and mental changes postoperatively as well. In a classical study on this subject from 1921, Crile and Lower \textsuperscript{15} showed necrosis of neurons in parts of the brain after noxious stimuli to dogs under light ether anesthesia. If, at the same time, the afferent pain pathways were blocked with local anesthesia, the necrosis could not be seen. To my knowledge, these findings have neither been confirmed nor disproved by others.

Since regional anesthesia may provide some protection against cerebral insults during surgery, these techniques, especially prolonged epidural analgesia, should be recommended whenever feasible in elderly patients undergoing surgery.

**References**