

## Perioperative cognitive protection

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### Abstract

There is significant evidence that many older surgical patients experience at least a transient decrease in cognitive function. Although there is still equipoise regarding the degree, duration, and mechanism of cognitive dysfunction, there is a concurrent need to provide best-practice clinical evidence. The two major cognitive disorders seen after surgery are postoperative delirium and postoperative cognitive dysfunction. Delirium is a public health problem; millions of dollars are spent annually on delirium-related medical resource use and prolonged hospital stays. Postoperative cognitive dysfunction is a research construct that historically signifies decline in performance on a neuropsychiatric test or group of tests and begins days to weeks after surgery. This review focuses on the current state of information gathered by several interdisciplinary stakeholder groups. Although there is still a need for high-level evidence to guide clinical practice, there is an emerging literature that can guide practitioners.

**Key words:** cognition; delirium; perioperative period; surgery

There is significant evidence that many older surgical patients experience at least a transient decrease in cognitive function. Although there is still equipoise regarding the degree, duration, and mechanism of cognitive dysfunction, there is a need to provide best-practice clinical evidence. Under this paradigm, the ASA has recently developed a Brain Health Initiative, the goal of which is to create health policy and improve patient safety. In this review, we discuss pre-, intra-, and postoperative strategies to maintain cognitive abilities in older patients.

The two major cognitive disorders seen after surgery are postoperative delirium and postoperative cognitive dysfunction (POCD). Postoperative delirium is a clinical syndrome characterized by an acute attentional deficit that by definition waxes and wanes; motor symptoms are hyperactive or hypoactive. Generally, postoperative delirium occurs on or after postoperative day 1, and may or may not be related to emergence delirium. Delirium is a public health problem; millions of dollars are spent annually on delirium-related medical resource use and

prolonged hospital stays.<sup>1 2</sup> Delirium is also associated with long-term cognitive decline and mortality.<sup>3</sup> Postoperative cognitive dysfunction is a research construct that historically signifies some amount of decline in performance on a neuropsychiatric test or group of tests, and begins days to weeks after surgery. Up to 60% of patients after cardiac surgery and 10% of patients after general major surgery exhibit cognitive deterioration months after surgery.<sup>4</sup> The International Perioperative Neurotoxicity Group, a special interest research group of anaesthetists, neuropsychologists, and neuroscientists, has convened a panel to work toward a consensus on what defines POCD and how it relates to the current Diagnostic and Statistical Manual of Mental Disorders terminology for neurocognitive disorders. Currently, most agree that POCD begins at least 7 days after surgery and up to 1 yr after surgery. It is unclear whether POCD is heralded by delirium or related to long-term cognitive dysfunction or dementia. There is observational evidence suggesting that patients with delirium are at

**Editor's key points**

- Postoperative delirium and postoperative cognitive dysfunction are commonly seen in the elderly, but the aetiology is unclear.
- A number of perioperative factors have been implicated, but high-level evidence for causation, prevention, or treatment is lacking.

higher risk for long-term cognitive decline after both cardiac and non-cardiac surgery.<sup>5</sup> Development of delirium might play an important role in the pathophysiology of longer-term cognitive decline, as shown in Fig. 1. However, the precise contribution and mechanism for this association need to be better defined. Nevertheless, these results raise the intriguing prospect that prevention of delirium might be a strategy for prevention of cognitive decline.

This review focuses on the current state of information gathered by several interdisciplinary stakeholder groups, including the American Geriatrics Delirium Guidelines Panel and the American College of Surgeons Coalition for Quality in Geriatric Surgery. The latter is in the process of developing standards for comprehensive care for geriatric surgical patients. Both have evaluated the literature for evidence and where evidence is not present have developed expert consensus. This article expands on what is known regarding cognition and delirium as summarized by Mashour and colleagues<sup>6</sup> to emphasize implications for clinical care. Although there is still a need for additional high-level evidence to guide clinical practice, there is an emerging literature that can guide practitioners.

### Preoperative risk stratification

Recent studies suggest that preoperative patient-level factors are equally or more important than intraoperative anaesthetic management.<sup>7-8</sup> Several risk factors for postoperative delirium and cognitive decline consistently emerge in observational studies: increasing age, low baseline cognitive status, and low level of education.<sup>9-12</sup> These factors contribute to individual brain and cognitive reserve, which might provide protection from short- and long-term cognitive changes, including dementia.<sup>13-14</sup>

The American Geriatrics Society has partnered with the American College of Surgeons to develop an optimal preoperative assessment for geriatric patients that incorporates measures of cognition and risk factors for delirium.<sup>15</sup> However, this important information has not yet become a routine part of

preoperative testing. Cognitive impairment is probably more common among patients presenting for surgery than generally assumed, with one study showing a 22% prevalence of amnesic mild cognitive impairment in patients presenting for elective hip replacement.<sup>16-17</sup> Although formal neurocognitive testing can be time consuming, even a brief assessment can add important information, with the goal of counselling patients on perioperative risk and implementing targeted strategies to prevent postoperative cognitive change.<sup>18</sup>

Beyond basic epidemiology, there are several validated risk models to predict delirium, as shown in Table 1. In cardiac surgery, Rudolph and colleagues<sup>12</sup> found that four risk factors (low Mini-Mental State Examination, history of stroke, low albumin, and depression) were highly predictive of postoperative delirium, and age also appeared to be important. In non-cardiac surgery, Marcantonio and colleagues<sup>9</sup> developed a risk model with the following independent predictors of delirium: age  $\geq 70$  yr, alcohol abuse, cognitive impairment, physical impairment, abnormal electrolytes, and type of surgery (aortic aneurysm and thoracic).

There are fewer validated risk models for postoperative cognitive decline, although several large cohort studies have examined risk factors. In the ISPOCD study of 1218 patients undergoing non-cardiac surgery, only age was an independent risk factor for cognitive dysfunction 3 months after surgery.<sup>10</sup> Likewise, in a study of 1064 patients undergoing major non-cardiac surgery, independent risk factors for cognitive decline at 3 months after surgery were increasing age, lower education, history of stroke, and cognitive dysfunction at hospital discharge.<sup>11</sup>

Several models have been developed specifically to predict global risk for postoperative complications in older adults, although these models are not specifically focused on risk for delirium and cognitive decline. The Comprehensive Geriatric Assessment is an established multidomain method for evaluating and optimizing older adults, and information on the Comprehensive Geriatric Assessment has been shown to correlate with postoperative complications, including delirium.<sup>19-21</sup> Frailty is a validated geriatric syndrome that characterizes the phenotype of extreme vulnerability.<sup>22</sup> Frailty before surgery has consistently been associated with increased postoperative complications, institutionalization, and mortality, in addition to postoperative delirium.<sup>23-26</sup>

As our understanding of the pathogenesis of cognitive decline after surgery improves, there is hope that more precise characterization of underlying risk will be possible. Potential markers of high-risk patients include intracerebral amyloid- $\beta$  (A $\beta$ ) deposition, genotypes with an elevated risk of dementia, and high tau/A $\beta$  ratio in the cerebrospinal fluid. Furthermore, several cohort studies of hospitalized patients have shown that critical illness is associated with long-term cognitive decline and structural changes on brain magnetic resonance imaging.<sup>27-29</sup> Patients with these characteristics are expected to be at high risk for cognitive decline after surgery, but further work needs to be done in order to provide better definition of risk profiles and develop strategies targeted to these patients.

### Preoperative optimization

Optimizing patients before surgery is an attractive concept with intrinsic face value for both patients and clinicians, but the literature supporting preoperative optimization to improve cognitive outcomes is sparse. Nevertheless, it is the authors' opinion that multidisciplinary efforts to improve perioperative

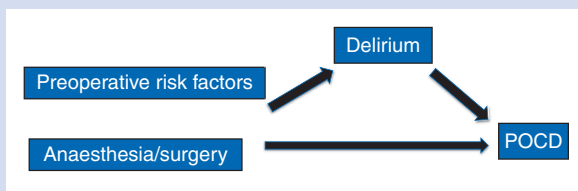


Fig 1 Relationship between delirium, postoperative cognitive dysfunction (POCD) and anaesthesia/surgery

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