

# Perioperative Evaluation of Brain Health



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## KEYWORDS

- Preoperative evaluation • Brain health • Cognitive dysfunction • Neurocognitive Disorders

## KEY POINTS

- The occurrence of cognitive changes in patients following anesthesia and surgery has been acknowledged for over a century.
- It is estimated that by 2050, one-fifth of the global population will be aged 65 or above, and that around 80% of older adults will reside in low-to-middle income countries.
- The cost associated with non-dementia-related PNDs has been found to be increased by almost 45% compared to individuals with dementia alone.

## INTRODUCTION

The occurrence of cognitive changes in patients following anesthesia and surgery has been acknowledged for over a century.<sup>1</sup> It is estimated that by 2030, the number of overall surgical procedures in two-thirds of the world's countries will reach over 5000 surgeries per 100,000 population.<sup>2</sup> In addition to the general rise in the global surgical needs, the population is experiencing an aging transformation, which increases the proportion of frail people whose mental health is at risk of being compromised. It is estimated that by 2050, one-fifth of the global population will be aged 65 or above, and that around of 80% of older adults will reside in low-to-middle income countries.<sup>3</sup>

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There is an emerging interest in brain health assessment initiatives in the context of a multidisciplinary and holistic team approach. Besides the reasons mentioned previously, there is a real economic burden associated with the perioperative neurocognitive disorders (PND). The cost associated with non-dementia-related PNDs has been found to be increased by almost 45% compared to individuals with dementia alone.<sup>4</sup> Even in the presence of mild cognitive impairment, the direct health care expenses were higher compared with those for individuals not suffering from any form of cognitive impairment.

To avoid the mismatch with other conditions, it is recommended to use the nomenclature of the fifth edition of the Diagnostic and Statistical Manual for Mental Disorders, for clinical purposes.<sup>1</sup> The term “perioperative neurocognitive disorders” is preferred in order to acknowledge cognitive impairment that is identified before or after surgery. This includes cognitive decline diagnosed before the operation (referred to as neurocognitive disorder), any type of acute cognitive event after surgery (known as postoperative delirium), and cognitive decline diagnosed within 30 days (delayed neurocognitive recovery) or up to 12 months (postoperative neurocognitive disorder) after the procedure.

The plausible mechanism at the basis of anesthesia and PND association might be due to ion channel membrane proteins that are both targets for anesthesia drugs and important contributors to innate immune or cognitive responses.<sup>5</sup> Some authors have even hypothesized that specific potassium channels Kv1.3, which belong to the super-family of voltage-gated potassium channels, are potential drug targets for decreasing the incidence of PND.<sup>6</sup> Certain genetic variants of the muscarinic cholinergic receptors M2 and M4 have also been linked to an impairment of the cognitive function following surgery.<sup>7</sup>

The epidemiology of PND is characterized by factors related to abnormal cognitive state. In a large retrospective cohort study of 21,666 patients 65 year old or older, out of all the cognitive screens conducted, 23.5% (5099) participants showed abnormal results. An abnormal cognitive screening was found to be linked to factors such as older age, lower body mass index, male gender, non-Caucasian race, reduced functional independence, and decreased metabolic functional capacity.<sup>8</sup>

To date, no clinical guideline with evidence-based clinical recommendations for the evaluation of brain health and its impact on PND has been produced. However, the focus is changing from delirium guidelines<sup>9–11</sup> to consensus documents with expert opinions developed by The American Society of Anesthesiology Brain Health Initiative. The pioneering consensus statement focused on the risk of PND following surgery, stating that “all patients over age 65 should be informed of the risks of PND including confusion, inattention, and memory problems after having an operation,”<sup>12</sup> was the first document that encouraged the introduction of brain health information and outcomes into the perioperative evaluation. More recently, another document from the same group discussed a total of 6 practical recommendations that can be undertaken by anesthesiologists and other perioperative clinicians to reduce the incidence of PND. A very relevant aspect is that the selection of these measures has taken into account the presence of supporting evidence from the literature, the expected impact, and the feasibility of implementation. The actions mainly focus on education, cognitive and delirium screening, non-pharmacological measures, targeted multimodal pain management, and residual use of antipsychotics. These actions should be incorporated into a custom-made anesthesia plan for each patient.<sup>13</sup> However, despite these efforts to improve perioperative brain health and the associated burden, a recent survey among anesthesiologists in the United States found that, while most of the survey participants provided anesthesia care to older adults, there was inconsistency in

following the recommended practices for the 6 specific items. The survey respondents reported low rates of screening for common geriatric syndromes like frailty, delirium, and dementia.<sup>14</sup>

When evaluating patients with neurocognitive disorders or cognitive dysfunction preoperatively, several important aspects should be considered to ensure an unproblematic perioperative course and discharge. The cognitive dimensions that can be assessed are either global or domain-specific. Specific domains include verbal memory, non-verbal memory, working memory, processing speed, executive functions, attention, visuospatial skills, and global cognition and language.<sup>15</sup> However, it has also been observed that there is a high degree of heterogeneity in the studies, which assess only some of these dimensions, thus complicating the application of the results to different surgeries. Moreover, the degree of surgical complexity may be another factor influencing the occurrence of PND.<sup>16</sup>

These dimensions help health care professionals assess the patient's cognitive status and identify potential risks associated with anesthesia and surgery. The authors review the most important dimensions to consider.

## **BRAIN HEALTH TOOLKIT**

### ***Cognitive Function***

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Evaluate the patient's cognitive abilities, including memory, attention, language, executive functions (planning, decision-making, problem-solving), and visuospatial skills. This can be done through neuropsychological testing and cognitive screening tools. According to Decker and colleagues,<sup>17</sup> who screened 1803 clinic patients scheduled for inpatient surgery for cognitive function, up to 21% of adults had results consistent with cognitive impairment and this number rose to 36% in patients over 85 years of age. They also found that in up to half of the cases, staff were unable to detect PNDs.

### ***Comorbidities***

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Identifying any co-existing medical conditions that may impact brain health, such as diabetes, hypertension, cardiovascular disease, or history of cerebrovascular accidents, is another pillar during the examination. These conditions can affect the brain's vascular health and cognitive function, thus, putting patients at risk of cognitive impairment in the perioperative period. Postoperative delirium is linked to a disruption in the blood-brain barrier.<sup>18</sup> This disruption is not constant and is connected to both neuroinflammation and increase in lactate levels. Moreover, in patients with cardiovascular risk factors undergoing non-cardiac surgery, there might be a 10% occurrence of covert stroke (a stroke without obvious symptoms) as detected by MRI after the surgery.<sup>19</sup> The role of postoperative neuroinflammation pathways and underlying mechanisms in immune-to-brain signaling after peripheral surgery are now being studied to characterize the weight of intercurrent comorbidities during surgery.<sup>20</sup>

### ***Severity of Neurocognitive Disorder***

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Assess the severity of any existing neurocognitive disorder, such as Alzheimer's disease, dementia, or mild cognitive impairment. Understanding the level of impairment will help determine the patient's ability to cope with anesthesia and surgery. Individuals who have existing difficulties in one or more areas of cognitive functioning are considered to suffer from a baseline cognitive impairment. This impairment can be categorized as either mild (referred to as mild cognitive impairment) or more severe (known as dementia), depending on the extent of the difficulties.<sup>21</sup>

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**Medications**

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Review the patient's current medications, including any drugs that may affect cognitive function or interact with anesthesia. Some medications can cause cognitive side effects or alter the response to anesthesia. Same issue applies to potential withdrawal symptoms from substances such as alcohol or benzodiazepines. Pharmacologic agents increasing the risk of PND are benzodiazepines and anticholinergic medications, while the use of dexmedetomidine, non-steroidal anti-inflammatory drugs, and acetaminophen is found to have beneficial effects in preventing PND.<sup>21</sup> Additionally, an adequate pain management regimen after surgery is paramount to the prevention of cognitive impairment that can lead to any form of PND, including the evaluation of basal conditions such as preoperative pain thresholds that leave patients at a higher risk of experiencing postoperative pain.<sup>22</sup>

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**Nutritional Status**

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There is increasing evidence that shows a connection between diet and cognitive functions. Thus, it is important to assess the patient's nutritional status to ensure they are well-nourished before surgery. Proper nutrition is vital for brain health and recovery from surgical procedures. Adherence to the Mediterranean diet or the Dietary Approach to Stop Hypertension (DASH) was associated with decreased cognitive impairment in some studies.<sup>23</sup>

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**Sleep Quality**

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Evaluating the patient's sleep patterns and quality of sleep might help to identify concerns and guide interventions to decrease the incidence of PND. Poor sleep hygiene can negatively impact cognitive function and increase the risk of cognitive complications after surgery.<sup>24</sup>

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**Delirium Risk**

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Delirium is a frequent and severe complication that occurs after surgery and can lead to a decline in cognitive and physical abilities in older individuals. Therefore, we need to assess the patient's risk of developing postoperative delirium, a state of acute confusion and cognitive dysfunction that can occur after surgery, particularly in older adults. In patients scheduled for cardiac surgery,<sup>25</sup> delirium or PND in the prehabilitation group have decreased, however, this difference was not statistically significant. The total number of hours required and the type of exercises appropriate for cognitive prehabilitation remain to be determined, as does the question of whether the benefit would also be achieved in patients who perform them under supervision or in a self-directed format.<sup>26</sup>

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**Functional Status**

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Consider the patient's functional abilities and activities of daily living. Impairments in daily functioning may affect the patient's ability to cope with postoperative recovery and rehabilitation.<sup>24</sup>

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**Social Support and Family Environment**

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Evaluate the patient's social support system and living situation. Adequate support and care at home can play a crucial role in the patient's recovery and overall well-being although the exact nature of the association between social activities, social networks, and social relationships with cognitive functioning status remains unclear.<sup>27</sup>

## **Emotional Health**

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Assess the patient's emotional well-being and history of mental health conditions. Anxiety and depression can impact cognition and influence the patient's response to surgery. Innovative approaches during the induction of anesthesia can help to minimize anxiety without significant side effects.<sup>28</sup>

All these items should be incorporated in a tailor-made anesthesia plan. There are a large number of devices available that allow titration of anesthetic drugs according to the characteristics of each patient and the type of surgery. Specifically, a recent meta-analysis found that the monitoring with intraoperative electroencephalography or/and regional cerebral oxygen saturation could decrease the risk of PND.<sup>29</sup> The avoidance of "too deep" general anesthesia,<sup>30</sup> the minimization of opioids, and the use of regional anesthesia wherever possible might aid to promote a healthy surgical environment for the brain. Although there is controversy as some evidence suggests that the type of anesthesia appears to be unrelated to PND. Despite of this, different anesthesia techniques may be preferred for patients with cognitive impairment. It is unlikely that anesthesia or surgery alone is the sole cause of PND.<sup>31</sup>

## **FUTURE DEVELOPMENTS**

Establishing an interprofessional perioperative brain health initiative<sup>17</sup> may help in creating a new clinical pathway within the preoperative consultations. Comprehensive brain health assessment should be integrated as part of all organ-based evaluations, and especially among patients at increased risk of developing PND. Careful individual patient screening is necessary to reduce complications and comorbidities, which, in addition to a worsened quality of life, carry a high associated financial cost.

The implementation of cognitive prehabilitation programs to reduce the impact of PND as part of the brain health initiative may be an effective intervention to reduce the incidence of delirium or/and PND<sup>32</sup> in frail patients requiring surgery. Initiatives that promote patient wellbeing and highlight the patient's preferences and needs are values that enhance patient care and could help care givers to mitigate burnout by creating meaningful context and human connection.<sup>33</sup>

Future advances might deepen the knowledge in the subjective pain experience since recent research indicates that we can enhance our comprehension of pain management by examining subjective pain from the perspective of predictive coding. It is possible that the brain continues to utilize active inference even when a person is under deep sedation or general anesthesia.<sup>34</sup> The growing volume of data produced in this process has resulted in the emergence of techniques associated with artificial intelligence and computer-aided diagnosis software.<sup>35</sup> These methods are specifically designed to aid and enhance the diagnosis and treatment of pain,<sup>36</sup> including postoperative pain.<sup>37</sup>

## **SUMMARY**

The screening of perioperative neurocognitive disorders should be incorporated into the perioperative evaluation in patients at risk undergoing surgery. The authors advocate for the implementation of multidisciplinary teams and expert anesthesiologists-led anesthesia to envision a pre-defined anesthesia plan based on the patient's cognitive status and medical history. Cognitive prehabilitation initiatives that promote brain training in the elderly have the ability to reduce the occurrence of comorbidities along the surgical journey.

## CLINICS CARE POINTS

- Increasing surgical requirements combined with an aging population puts the spotlight on perioperative brain health surveillance.
- The assessment of perioperative brain health is currently not well defined, so the authors propose a set of minimum standards that cover almost all relevant items for cognitive baseline assessment.
- A tailored anesthetic plan according to the conditions identified during the preoperative consultation, together with prehabilitation interventions, may help reduce the incidence of perioperative cognitive impairment or reduce its severity if it occurs.

## CONFLICTS OF INTEREST

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