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EDITORIAL

Perioperative cognitive evaluation and training: the use of digital games for assessment and prevention of cognitive decline after major non-cardiac surgery

Cognitive dysfunction after major surgery is highly prevalent and may occur in the form of Postoperative Delirium (POD) or as Postoperative Cognitive Dysfunction (POCD). Both short- and long-term cognitive decline after surgery represent a major public health concern, as patients continue to age, and associated complications are highly morbid. Cognitive decline may occur after any type of surgery and it is currently defined as a reduction in cognitive performance detected by a combination of multiple neuropsychological tests.[1] Notably, POCD may compromise a wide range of cognitive functions, including attention, concentration, information processing and memory with potential long-term consequences and poor clinical outcomes.[2]

The incidence of both short- and long-term cognitive decline after surgery varies depending on the studied population and diagnostic criteria. Importantly, POD is present in up to 50% among older patients undergoing major surgery and is considered the most frequent postoperative complication in elderly patients.[3] Moreover, POCD is experienced by nearly 40% of older patients at discharge and in more than 10% at 3 months after surgery of those undergoing non-cardiac procedures.[4-6] In cardiac surgery, the incidence of POD varies between 10% to 30% and long-term cognitive changes may occur in up to 60% of cardiac patients.[7] In fact, the conflicting incidence rates of POCD in previous studies are largely dependent on the variation of statistical methods, changes in neuropsychological tools and the lack of consistent diagnostic criteria.

Previous evidence has indicated that strengthening cognitive reserve may be a potential strategy for reducing the risk of cognitive impairment after surgery.[8] Low preoperative cognitive performance is associated with both postoperative delirium and long-term cognitive decline,[9] and surgical patients who adhere to cognitively stimulating activities before surgery demonstrate a reduced incidence and severity of cognitive dysfunction.[10] Considering that there is limited evidence in this field and the challenges involved in this area, studies addressing new neuropsychological tools to evaluate cognition and potential interventions on cognitive training before surgery are urgently warranted.

In this issue of the Brazilian Journal of Anesthesiology, two interesting studies provide new insights into the potential benefits of digital games in the area of cognitive evaluation and training before and after non-cardiac surgery.[11,12] Authors in both studies applied the MentalPlus® test, which is a digital game developed to assess and stimulate some key neuropsychological functions. The test takes approximately 25 minutes to be completed, addressing short- and long-term memory, selective and alternating attention, inhibitory control, and visual perception. Both studies addressed the same set of patients in two different strategies, focused on the comparison with traditional paper tests and in the accuracy in detecting cognitive dysfunction after non-cardiac surgery.

Firstly, Goulart and colleagues[11] performed an interesting comparison between the new digital game MentalPlus® and a standard battery of neuropsychological tests in order to assess cognitive functions before and after surgery. In this study, a control evaluation was composed by conventional and previously validated neuropsychological tools, including Telephone Interview Cognitive Status (TICS), Visual Verbal Learning Test (VVLT), Brief Visuospatial Memory Test Revised (BVMTR), Stroop Test, and Trail Making Test (TMT). Interestingly, this study has demonstrated moderate to strong correlation between the digital game MentalPlus® and standardized tests for evaluating short-term memory and visual perception.

In a second study, Lucatelli and colleagues[12] used the digital game MentalPlus® as a neuropsychological test to assess POCD in non-cardiac surgery patients. By using a robust statistical analysis with a generalized linear mixed model, authors have evaluated 60 patients and detected a significant reduction in the test performance after surgery in all phases of the digital test, except for the visual perception

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domain. Notably, this study has shown that the digital game MentalPlus® is accurate to detect cognitive decline after surgery.

The incidence of POCD typically depends on the neuropsychological test battery applied to patients. Therefore, continuous improvement in neuropsychological testing instruments may increase our understanding and ability to detect postoperative cognitive decline. In general, the measurements may be performed with a "paper and pencil" test battery or with a computerized or digital test battery. Although those studies[11,12] are somewhat preliminary, we may notice that the completion of this digital test seems to be faster and easier to understand than conventional tests on paper, features that are quite attractive especially in elderly patients and in the early postoperative period.

Although some controversy still remains, the potential of digital games for the detection of cognitive decline in elderly patients has been clearly demonstrated in previous research.[13,14] Additionally, there is some evidence indicating that computerized tests are suitable for measuring cognitive change after both cardiac and non-cardiac surgery and may detect cognitive dysfunction in a greater proportion of patients than conventional neuropsychological tests.[15,16] Therefore, such a promising performance in the assessment of cognitive disorders in different scenarios encourages further research to eventually introduce this technique for the clinical diagnosis of cognitive impairment after surgery.

Considering the numerous risk factors for brain injury after surgery, it is possible that some loss of cognitive reserve is unavoidable after major procedures.[17] Nevertheless, cognitive reserve is considered a potentially modifiable and primary protective factor against the development of POD and POCD, and there is ongoing debate on the potential strategies that could be used in order to improve it perioperatively.[18] An approach that focuses on building and reinforcing cognitive reserve, especially in the most vulnerable domains, may allow better tolerance to bran injury, providing some sort of "cognitive preco
nditioning" before and after surgery. More recently, plenty of software programs designed to improve cognitive reserve in elderly patients have been released, displaying some promising results.[19-21] Some of these digital programs have been already investigated in clinical studies and systematic reviews, both in healthy older adults and patients exhibiting cognitive decline.[21] Some digital programs are named as follows: BrainGymmer®, BrainHQ®, CogMed®, CogniFit®, Dakim®, Lumosity®, and MyBrainTrainer®.[21] Although previous data indicate that short-term brain training with digital tests can lead to sustained improvements on attention, memory, general cognition, and brain processing speed,[19-21] the overall available evidence is still limited to support a large-scale implementation of those programs and it is unclear whether these benefits are purely a training effect, or if they are due to an actual improvement in cognitive reserve. Notably, this field of research is still in its beginning and further investigation is necessary to provide more substantial evidence regarding the effectiveness of this rapidly growing business.[21]

It is noteworthy to emphasize that both studies display some relevant limitations. Firstly, both studies are somewhat underpowered and preliminary, displaying a small sample size. Additionally, timing of postoperative evaluations is not well-defined and based on patient's clinical status after surgery. A relatively short-term follow-up was used in both studies, especially considering protocols that evaluate cognitive dysfunction after surgery. Most importantly, the adherence to the digital tool was relatively low, since the number of dropouts in the postoperative period was quite large. For instance, more than 45% of patients refused to participate in the study in the postoperative period, significantly impairing the feasibility of the new technique. Of note, this is a relevant problem for the traditional battery of "paper and pencil" neuropsychological tests and strategies to increase adherence to both paper and digital tools should be implemented in future research.

In summary, there is growing evidence regarding new methods with potential to detect and assess cognitive dysfunction following cardiac and non-cardiac surgery. In this issue of the Brazilian Journal of Anesthesiology, we can observe that digital games similar to MentalPlus® could be considered consistent alternatives for assessment of cognitive function perioperatively. They may reduce assessment time, offer simple and reliable results, are easy to understand, are usually enjoyable and self-explanatory to patients. Finally, and most interestingly, it is really tempting to propose their additional investigation for cognitive training before and after surgery in future research.

Conflicts of interest

The authors declare no conflicts of interest.

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