

Postoperative cognitive dysfunction

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(Parts of the presentation have been previously published as Deiner, S and Silverstein J Postoperative Delirium and Cognitive Dysfunction Br. J Anesth 2009 103 Suppl 1)

Postoperative cognitive dysfunction (POCD) is difficult to define. Broadly, POCD refers to deterioration in cognition temporally associated with surgery. While the diagnosis of delirium requires a detection of symptoms, the diagnosis of POCD requires preoperative neuropsychological testing (baseline) and a determination that defines how much of a decline is called cognitive dysfunction. The spectrum of abilities referred to as cognition is diverse, including learning and memory, verbal abilities, perception, attention, executive functions and abstract thinking. It is possible to have a decrement in one area without a deficit in another. Self reporting of cognitive symptoms have been shown to correlate poorly with objective testing, so valid pre and postoperative testing is essential to the diagnosis of POCD⁽¹⁾. Many elderly patients may have preexisting mild cognitive impairment that has gone undiagnosed.

Unfortunately, there has not been a standard methodology used in the multiple studies within the POCD literature⁽²⁾. Selection of neuropsychological test instruments and the amount of change considered to be significant, timing of testing, inclusion and exclusion criterion have all varied⁽³⁾. Furthermore, the batteries used, while relevant, have had floor effects and have not incorporated batteries that are somewhat different than those employed by dementia researchers. Hence it is difficult to define the presence and therefore incidence of POCD or to clearly understand the relationship between POCD and other dementing illnesses. Some commonly used testing instruments include the Logical Memory Test, the CERAD word list memory, the Boston Naming test, Category Fluency test, Digit Span Test, Trail making test, Digit symbol substitution test. Interestingly, POCD test batteries tend to be a compilation of tests which have shown differences among subjects in previous studies of POCD. The domains that were

most sensitive include: verbal learning and working memory, episodic memory, processing speed, and set shifting.

The method of scoring the testing batteries and determining how much dysfunction is clinically significant remains an open subject. One method is the percentage change method i.e. $\frac{\text{postoperative score} - \text{preoperative score}}{\text{preoperative score}}$. Averaging across groups is discouraged, because while some patients will decline, others may improve over time and this difference may be masked. Another method defines a number of standard deviations outside of which a score will be called a decline. However, this method may be flawed for patients with low baseline scores (floor effect). By necessity, the absolute magnitude of the change required for significance will vary between studies since the norm is determined from the preoperative baseline test scores. Finally, some studies have used percent change (e.g. 20%) to define decline. The limitation of this method is that the baseline low scoring patients require a smaller change in their raw score to meet POCD criterion.

The timing of testing is important as well. It is possible that patients who undergo baseline testing on the morning of their procedure may not score as well as patients tested days prior, secondary to preprocedural anxiety. Postoperatively, patients who are testing shortly after surgery may test worse than those who are tested weeks to months later possibly due to pain, residual drugs, and health status. However, long term follow up and testing is confounded by attrition- i.e. patients who experience the greatest decline are the least likely to follow up with their postoperative cognitive testing and drop out of the study. This may be a significant cause for underestimating the true incidence of POCD. Additionally, there may be significant variability between testing sessions which may be due to learning, examiner bias etc⁽⁴⁾. However, although variability in neuropsychological test data contributes to a

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low consistency between postoperative test sessions, the differences detected suggest that this does not fully explain the detection of cognitive dysfunction after major surgery. It is clear that deterioration is not random variation between testing sessions.

The current literature is also diverse with respect to inclusion and exclusion criterion of patients with mild cognitive impairment. Mild cognitive impairment (MCI) is described as the prodromal state a heterogeneous group of conditions including Alzheimer's dementia, cerebral vascular disease, and other dementia. Most of the major studies have excluded this group due to limitations of the test battery. This is true even though this group may be the most significant risk for POCD by virtue of having less cognitive reserve. By not differentiating this patient population it is possible that the incidence of cognitive decline has been «washed out» by the larger sample.

Similar to delirium literature, more has been described regarding risk factors and associations for POCD than the mechanism itself. Advancing age has been found as a risk factor for POCD, though minor declines have been described in younger patients as well⁽⁵⁾. Preoperative cognitive and

physical impairment, and cognitive impairment during hospitalization correlates with poorer postoperative outcomes at 2 and 12 months⁽⁶⁾. However the epsilon-4 allele of the ApoE gene which is strongly associated with the development of Alzheimer's disease is not associated with the development of POCD⁽¹⁾. Postoperative delirium has also been associated with early postoperative dysfunction (at 7 days), however the association with long term cognitive function is less clear⁽⁷⁾. There may indeed be an association between POD and POCD, but the relationship has yet to be elucidated. The ISPOCD1 study did not find that the patients who developed delirium were the same patients who developed POCD. Most studies have focused on either POD or POCD, in the future studies designed to evaluate this patient population for both and examine their association may enhance our understanding of this issue.

PREVENTION AND TREATMENT

Prevention and treatment of postoperative cognitive decline is still undefined. It is unclear if delirium prevention strategies affect long term cognitive outcomes.

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