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GUEST EDITORIAL

Pre-existing cognitive impairment and post-operative cognitive dysfunction: should we be talking the same language?

Changes in cognition are known to follow anesthesia and surgery in older individuals (Evered *et al.*, 2011). Although survival *per se* was the prime outcome in the 19th and early 20th centuries for invasive procedures, a link was none-the-less observed with adverse cognitive outcomes as far back as 1887 (Savage, 1887). Historical reports of "insanity" or "weak mindedness" after anesthesia appeared within 40 years of the first anesthetic having been administered and anecdotal and retrospective reports have implicated anesthesia ever since. However, it was not until the 1970s that these observations received any sound scientific evaluation, when clinicians became aware of cognitive changes following cardiac surgery. It was assumed that the cardiopulmonary bypass (heart lung machine) must have been the main culprit because it was this factor which so greatly distinguished cardiac surgery from non-cardiac surgery (Shaw *et al.*, 1987). This long held belief entered surgical folklore and was the basis for many publications endeavoring to identify particular aspects of the heart lung machine responsible for this cognitive decline.

By the early 1980s, increasing numbers of papers were being published addressing this issue (Borowicz *et al.*, 1996), but current evidence has established that the heart lung machine and cardiac surgery have no special effect on cognitive outcome beyond the first postoperative week. Importantly, postoperative cognitive decline is not isolated to cardiac surgery, but rather occurs with similar incidence at three months following cardiac surgery, non-cardiac surgery and even procedures requiring sedation (Evered *et al.*, 2011). Consistent risk factors identified are increasing age and prior education level or IQ (Evered *et al.*, 2014). Prior cognitive impairment has also been identified as a predictor (Silbert *et al.*, 2015). Furthermore, post-operative cognitive decline has a clinical impact and is associated with an increased hospital stay (Silbert *et al.*, 2006), an increased mortality (Monk *et al.*, 2008; Evered *et al.*, 2016), and a decreased long-term quality of life (Newman *et al.*, 2001a).

Anesthesiologists and surgeons have referred to the cognitive decline which is temporally linked to anesthesia and surgery as Postoperative Cognitive Dysfunction (POCD). They have pursued this construct by creating their own definitions, classifications of decline, and research methodology. Collaborations with neuropsychologists have led to the construction of a variety of definitions and criteria for assessing the impact of anesthesia and surgery on the cognitive function of older individuals. A plethora of test batteries have been used together with a wide variety of outcome measures for decline. These included single tests reported simply as a change in a single test raw score (Saczynski *et al.*, 2012), a cognitive index of some combination of test results giving a continuous score (Newman *et al.*, 2001b), or decline from the pre-operative level of function based on several statistical methods, most commonly at that time the 20% rule or the 1 SD rule (Silbert *et al.*, 2006). More recently, control groups have been included leading to more frequent use of the reliable change index (Rasmussen *et al.*, 2001) which adjusts for both known (e.g. practice) and unknown (e.g. time) effects to determine a more reliable estimate of change over time.

POCD is an entirely objective based assessment of cognitive function, and is very conservative in its definition. In order to be classified with POCD, the most reliable data requires patients to decline by 1.96 standard deviations or more on two or more tests from a battery of eight – ten neuropsychological tests (Evered *et al.*, 2011). Unlike mild cognitive impairment (MCI) or dementia, POCD criteria does not include any assessment of function, nor any assessment of subjective decline, making this definition very different to the criteria for cognitive impairment used in the community.

In the general (non-surgical) population, investigation into cognitive decline had begun in the early 1900s, two decades after the first reports into cognitive changes following anesthesia and surgery. By the 1980s, in parallel to the work in anesthesia and surgery, research into cognitive impairment and decline in the community was progressing with similar classification and definition problems. Terms such as age associated memory impairment (AAMI) (Crook *et al.*, 1986), age associated cognitive decline (AACD) (Richards *et al.*, 1999), cognitive impairment no dementia (CIND) (Graham *et al.*, 1997), and mild cognitive decline (MCD) (Christensen *et al.*, 1995) appeared in the literature, each comprising a variety of subjective and objective criteria and, similar to the work in anesthesia and surgery, a number of different statistical methods to determine decline. It was not until 1999 when the term MCI was first used (Petersen *et al.*, 1999), becoming the accepted term for subtle cognitive impairment in the community over the last 20 years, although not without controversy.

In 2011, the National Institute of Aging and the Alzheimer's Association (NIA-AA) published three sets of guidelines to define and classify preclinical, prodromal, and clinical MCI and dementia with both clinical and research criteria (Jack *et al.*, 2011). These guidelines included recommendations for predicting the progression from normal function to MCI and dementia and factored in biomarkers, although for research use only. These terms have become accepted parlance for cognitive disorders both clinically and socially in the community.

The recent release of the diagnostic and statistical manual for mental disorders, 5th edition (DSM-5) (APA, 2013) has brought the DSM definitions more into line with the NIA-AA definitions. Although the definitions and classifications are not identical, the two now have some ability to be used interchangeably. The DSM-5 section on neurocognitive disorders (NCD) offers cut-points to be interpreted relative to normative or control data, defining mild NCD and major NCD, with mild NCD mapping closely to MCI and major NCD mapping closely to dementia.

Thus, although collaborations between neuropsychologists, anesthesiologists, and surgeons have been undertaken since the 1980s when research investigating POCD began to flourish, the link to other cognitive disorders was not made until very recently. Thus, the cognitive disorders associated temporally with anesthesia and surgery remained in isolation of cognitive decline in the community. It remains curious why a cognitive assessment made in association with a hospitalization should be considered any differently to a diagnosis made as part of the routine healthcare of an individual. The similarities between cognitive impairment associated with the perioperative period and that observed in community dwelling individuals are multiple and include both subtle and more severe impairment, the group at risk share similar characteristics (aged 65 years or more and low education), and attribution includes objective decline which is assessed using similar tests. Indeed, the primary difference is the temporal association with surgery and anesthesia.

Furthermore, despite the advances in criteria and definition of cognitive impairment in the community leading to common use both clinically and for research of MCI and dementia, the criteria and definition of POCD have remained static since the late 1980s, still have no consensus definition and include variable criteria (often determined purely by logistics or tests which are not suitable to assess subtle decline, even to the current day (e.g. MMSE)) (Saczynski *et al.*, 2012).

Research has confirmed that elderly patients are susceptible to cognitive decline following anesthesia and surgery; that this cognitive decline has to date been termed POCD in the anesthesia and surgical literature; POCD is identified by the administration of neuropsychological tests – it is often too subtle to be picked up from subjective impressions; POCD is identifiable for at least 3 months (Evered *et al.*, 2011) (and even as long as 7.5 years) (Evered *et al.*, 2016) and is associated with adverse clinical outcomes; POCD is inconsistently defined and measured, in part because of a lack of formal classification or definition; and POCD shares common factors with other geriatric cognitive conditions.

It is time, then, to recommend terminology for the cognitive impairment associated with anesthesia and surgery which is consistent with other medical disciplines including neurology, psychiatry, and gerontology. This should align the cognitive impairment observed preoperatively which has been termed "pre-existing cognitive impairment," and the cognitive decline which occurs in the postoperative period which has been termed POCD, with the criteria and definitions currently accepted by the medical disciplines attending to these conditions in the community. Namely, we should align the definition and criteria for perioperative cognitive disorders with the definition and criteria of DSM-5 and NIA-AA criteria in order to allow the perioperative period to be considered as part of the overall healthcare management of older individuals undergoing surgery and anesthesia. Achieving this will allow identification of at-risk patients in the pre-operative period, facilitate inter-disciplinary research and communication, allow development of preventive measures, encourage diagnosis and referral and in doing so will ensure more appropriate healthcare management, improved outcomes, hopefully leading to reduced mortality, and improved long-term cognitive function for older individuals undergoing anesthesia and surgery.

Conflict of interest

None.

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