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Cognitive self-assessment scales in surgical settings: Acceptability and feasibility

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Pre-existing cognitive impairment is associated with poor surgical outcomes, long hospital stays, and increased morbidity and mortality. This necessitates the use of screening tools to evaluate preoperative cognitive status in elderly surgical patients. Given the growing population of older adults and increased prevalence of cognitive impairment, it is necessary to investigate whether staff-administered or self-administered cognitive screening examinations provide more sensitive information about pre-existing (preoperative) cognitive status. Self-administered Gerocognitive Screening Examination (SAGE) was developed out of the need for a cognitive self-assessment scale in the clinic. At our institution, SAGE was given to 189 elderly surgical patients to evaluate baseline cognitive status, and preliminary results are promising that self-assessment scales are both feasible and acceptable in the surgical setting.

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Introduction

Interest in human cognition and how the mind works dates back to the Stone Age, when our ancestors began studying the unique aspects of human nature that set us apart from the rest of the animal kingdom [1]. Two thousand years ago, Aristotle began his study of human memory in his treatise *On the Soul*, where he postulated that the human mind is a blank state, born without knowledge, relying on experiences to build up memories [2]. Eighteenth century English philosopher David Hartley later theorized that memories are the result of invisible motions of the nervous system [2]. Soon after, Théodule-Armand Ribot proposed Ribot's Law, which states that amnesia "has a time-gradient in that recent memories are more likely to be lost than the more remote memories" [2]. Around that time, William James and Wilhelm Wundt, the founding fathers of modern psychology, began early research into specific functions of memory, which eventually led to the origin of neuropsychology in the 1940s as a dedicated field for the study of the human mind [2]. The 1950s and 1960s subsequently came to be known as the "cognitive revolution" when influential psychologists began studying several forms of memory (short term and long term) [2].

Although several areas of the brain play a role in developing memories, the hippocampus stores short-term memory and the prefrontal cortex stores long-term memory for retrieval when needed [3]. This was confirmed in the 1950s, when scientists discovered that a lobotomy, intended to cure epilepsy, removed large portions of the hippocampus and resulted in the patient's inability to recall new experiences without changes to his long-term memory [3].

Perhaps a more fascinating fact in addition to human memory itself is the study of how memory is lost. Humans are incredibly reliant on all types of memory for the most basic daily tasks, as well as more complex activities that define the human experience [4]. Loss of memory poses many challenges to human life and is highly correlated with increased morbidity and mortality [4]. Some memory loss is normal with aging, but the elderly population is most vulnerable to pathological cognitive decline [4]. It was reported that up to 5%, 24%, and 40% of Americans aged 70–79, 80–89, and above 90 years, respectively, live with dementia [5]. Recently, under the new Enhanced Recovery After Surgery (ERAS) guidelines, there has been increased concern about pre-existing cognitive impairment and surgical outcomes, specifically postoperative cognitive decline (POCD). Given that the aging population has expanded rapidly in the past several decades, an increased number of surgical procedures are performed on elderly patients, and thus, it is important to investigate how cognitive impairment impacts surgical outcomes [6].

Pre-existing cognitive impairment (ranging from mild cognitive impairment (MCI) to advanced dementia) is associated with poorer surgical outcomes, higher resource utilization, and increased length of hospital stay and associated healthcare costs [7]. There are numerous causes of cognitive impairment: neurodegenerative, vascular, autoimmune, hepatic, and psychiatric [8–11]. For the most part, these causes have a relatively understood pathological process. Notably, surgery is established as another common and serious cause of cognitive impairment, especially in the elderly population, and it was further demonstrated that pre-existing (preoperative) cognitive impairment is a major risk factor for postoperative cognitive dysfunction [12]. Postoperative cognitive dysfunction ranges in duration and severity between procedures and patients but can ultimately have important, lasting consequences on the patient's quality of life [12]. However, the exact role of surgery in the development of postoperative cognitive impairment remains largely unknown. The etiology is seemingly a complex interplay between a patient's preoperative baseline cognition, surgical procedure, and anesthesia, thereby accentuating the need to accurately evaluate pre-existing cognitive status.

Health literacy is also significantly affected by cognition. Literacy is generally regarded as the ability to read and write, whereas health literacy is the ability to understand health information and follow a health care plan [13]. Federman et al. [14] demonstrated that 24.3% of older adults have inadequate health literacy and further showed that adults with abnormal cognition have poorer health literacy compared to normally cognitive adults. Additionally, deficits in cognitive function (defined as working memory and processing speed) negatively affect health outcomes to a greater degree than age, education, and race [15]. As a healthcare provider, it is important to be aware of patients' cognitive impairment when surgical/anesthesia informed consent is signed and surgical information is provided so that certain measures (power of attorney present during consenting) can be taken if necessary.

Given the consequences of cognitive impairment on patient outcomes, the American College of Surgeons and the American Geriatrics Society recommend routine use of preoperative cognitive screening examinations in elderly surgical patients [5].

Thus, it is important to identify the most efficient validated cognitive screening examinations and determine whether staff-administered or self-administered cognitive screening examinations perform better in the preoperative setting.

The origin of psychological testing dates back to Imperial China, where intelligence examinations, evaluating law and policy of the time, were part of an imperial examination [16]. In the 1800s, Francis Galton developed an intelligence examination that tested nonverbal sensory motor tests, which was later abandoned for the Binet–Simon test, created in 1905 by Alfred Binet, Victor Henri, and Theodore Simon, to test for mental retardation in children [16]. In the 18th and 19th centuries, personality tests originated from phrenology, the study of the skull, and physiognomy, estimating personality characteristics based on physical appearances [16]. By the 20th century, more modern examinations, such as the Woolworth Personality Data Sheet developed for World War I draftees, were commonplace [16]. More recently, there has been substantial interest in developing new screening examinations to evaluate cognitive decline in elderly individuals.

During the last three decades, numerous staff-administered cognitive screening examinations became readily available for clinical use. Of these, the Mini-Mental Status Examination (MMSE), Mini-Cog, and Montreal Cognitive Assessment (MoCA) are validated, widely utilized tools to assess cognitive impairment in various clinical settings.

In 1975, Folstein et al. [17] created a 10 min cognitive test (MMSE) derived from the general mental status examination for solely testing cognitive domains. MMSE is part of the larger standard cognitive battery and evaluates several domains: orientation to time and place, attention, language, calculation, recall, and repetition [18]. The MMSE is useful for following Alzheimer's disease (AD) progression and other changes in cognition with time; however, major disadvantages include an inability to detect MCI and differentiate patients with mild AD from normally cognitive patients [18]. Additionally, MMSE outcomes are largely affected by age, language, and education level [18]. MMSE relies heavily on the test administrator, who is instructed to “establish rapport and praise success” [17]. Additionally, the role of test administrator requires training for grading the examination [17].

Subsequently, Mini-Cog, a 3 min cognitive screening test, was developed to detect dementia and AD in primary care settings while removing the impact of demographic factors on outcomes [19]. Interestingly, Mini-Cog has been shown to detect cognitive impairment and Alzheimer-type dementia better than MMSE [20]. Mini-Cog also requires a test administrator to conduct the examination and involves training for grading purposes; however, time requirements for Mini-Cog are less than those for MMSE [19]. Notably, Mini-Cog is easier to administer in busy clinical settings and in multiethnic and multilingual patients [20,21].

In 1996, Nasreddine et al. created MoCA, a 10 min test to evaluate several aspects of cognition: short-term, spatial, and working memory; visuospatial function; phonemic fluency; verbal abstraction; attention; language; and orientation to time and place [22,23]. It was later found that MoCA detected MCI and mild AD with 90% and 100% sensitivity, respectively [23]. Other studies have also shown the ability of MoCA to detect MCI and mild AD [24–26]. Interestingly, because MoCA tests multiple aspects of cognition, it is useful for various types of impairment affecting different areas of the brain, such as Parkinson's disease, vascular dementia, and schizophrenia [27–29]. Similar to MMSE and Mini-Cog, MoCA requires a test administrator to explain instructions, ask questions, and provide guidance through the more difficult aspects of the test, as well as training for specific grading guidelines [23].

By contrast, the Alzheimer's Disease Cooperative Study (ADCS) established several at-home, self-administered cognitive screening examinations for an early detection of impairment in elderly individuals. Recently, there has been increased recognition of the need for improved detection of patients with AD in the preclinical phase of disease, a transitional period between normal cognition and mild AD, so that clinical intervention can begin earlier [30,31]. Currently, researchers are investigating brain scans and spinal taps for early physical markers of the disease, but this work is far from clinical use at the moment [32]. Consequently, ADCS began a 4-year longitudinal study, the Prevention Instrument (PI) Project, to identify self-administered cognitive screening tools for use at home or in the clinic [31]. Six cognitive instruments were tested: global impression of change, mail-in questionnaire, activities of daily living, four-word delayed recall, quality of life, and resource use [31].

Global impression of change is a measure of the participant and his/her study partner to reliably detect change in cognitive function through self-assessment or observation for a period of time [31,33].

Similarly, the mail-in cognitive function screening instrument (MCFSI) was created as an at-home, 14-question assessment for both participant and study partner asking about significant cognitive or functional change in the past year [31,34]. The major goal of MCFSI was to establish whether results could be used to detect early AD-related cognitive decline and determine which patients should be referred for further testing [34]. Results showed that outcomes from MCFSI correlated well with clinical measures of cognitive change [34].

Although the ADCS studied several at-home cognitive screening examinations with productive results, identifying self-administered examinations for use in the surgical setting is paramount. Cognitive status is fluid, especially in the perioperative environment; thus, it is necessary to establish self-administered cognitive examinations that can be used several times (before surgery and at specific time points following surgery) to monitor cognitive status.

In 2010, Scharre et al. created the Self-administered Gerocognitive examination (SAGE), a 12-item, self-administered examination for detecting MCI and early dementia in elderly patients [35]. SAGE developed out of the natural evolution of cognitive testing, research, and development of other screening tools. SAGE requires no equipment or personnel to administer and tests several cognitive domains: orientation to date, language, memory, executive function, visuospatial abilities, and calculations [35]. The examination is graded out of 22 possible points, with some questions being graded as correct or incorrect and other questions being graded as correct, partially correct, or incorrect [35]. SAGE was determined to have "high inter-rater and test–retest reliability and significant ability to detect cognitive impairment" [35]. Outcomes from SAGE proved comparable to MMSE in differentiating normal and MCI subjects from dementia subjects [35]. Remarkably, SAGE was able to discriminate normal subjects from MCI subjects, whereas MMSE was not [35]. Most notably, SAGE is an easy-to-use, self-assessment scale that can be provided to many patients in a variety of settings or can be used to monitor longitudinal change in cognition [35]. Thus, SAGE may prove to be extremely useful in the preoperative setting.

Staff-administered examinations (MoCA, MMSE, and Mini-Cog) are validated and widely used tools for measuring longitudinal change in cognitive function in both inpatient and outpatient settings. Nevertheless, a major limiting factor of their use is the need for staff members to conduct the examination during busy clinic schedules. Test administrators require special training and thus are likely not the most ideal for demanding surgical settings. On the other hand, self-administered cognitive screening examinations are more beneficial under time constraints and limited staff availability. Outcomes from ADCS indicate that self-administered cognitive examinations (CGIC and MCFSI) yield good results and are feasible for many elderly patients [31]. Additionally, results from the annual cognitive battery confirm that reliabilities of at-home cognitive assessment tools are comparable to clinical measurements and are sensitive for detecting longitudinal cognitive decline [31].

SAGE was developed and validated for the clinical setting and can be used successfully in preadmission surgical clinics. Because SAGE requires no special equipment or personnel for administration, it serves as a valuable tool for identifying cognitive impairment in the surgical population. Moreover, considering the time restrictions on surgical staff members, self-administered cognitive tests may prove to be a more useful and simpler method to maintain long-term contact with patients after surgery.

The results from a 3 year longitudinal cognitive testing in surgical orthopedic patients were published in 2009 under the International Study of Postoperative Cognitive Decline (ISPOCD) [36]. The testing was conducted as a survey given to patients at specific time points following surgery to measure longitudinal changes in cognitive function, thus demonstrating that self-administered cognitive examinations might be the best way to reach patients [36].

In general, current healthcare provider opinion across several fields seems to show a desire for self-administered cognitive examinations to predict early decline in busy clinical settings. For example, Benedict et al. [37] identified a need for cognitive self-assessments in patients with Multiple Sclerosis (MS) and subsequently developed the MS Neuropsychological Screening Questionnaire (MSNQ). They concluded that MSNQ was able to detect early neuropsychological decline in patients with MS and further emphasized the need for self-administered cognitive examinations in several medical specialties [37].

Self-administered cognitive examination scales have potential to serve as a valuable adjuvant tool when evaluating elderly patients' frailty. Because frailty examinations are completely physician-administered and quite lengthy, results from self-assessment scales may provide the physician with additional information about cognition and prove to be time-effective in busy clinics.

Self-assessment scales are the standard of care for evaluating pain in elderly patients and have further proven to be a reliable pain measurement tool in cognitively impaired individuals [38,39]. These scales are also useful for the detection and management of psychiatric conditions such as anxiety and depression [40]. One of the most widely used scales in clinic and research settings, the Beck Depression Inventory (BDI), represents a historic shift toward the use of questionnaires to attempt to quantify depression [41]. Results from mental health self-assessment scales aid physicians in determining when further investigation into psychiatric conditions is warranted. Additionally, using self-assessment scales at each follow-up visit is feasible and helpful for evaluating treatment progress [40,42,43]. Moreover, several self-administered screening examinations currently in use have been shown to be accepted by patients [35,40,44].

Self-administered screening examinations could aid researchers in collecting large amounts of data, thereby minimizing anxiety of presurgery and postsurgery patient–researcher interaction. Self-assessment scales are easily distributed to many patients at once and can be collected in a timely manner [45].

Furthermore, Cook et al. [45] suggested that electronic self-assessment scales reduce the financial burden of printing forms and are even more time efficient than paper, thereby minimizing the requirement of data entry. Data from self-assessment tools can drive further research into developing additional scales for other conditions and thus may prove beneficial to both research and clinical settings.

With the advent of readily available information about dementia and increasing exposure to the consequences of cognitive decline and memory loss, elderly patients may feel compelled to test their memory outside of the doctor's office. Although patients above the age of 65 years are traditionally screened for memory impairment at their annual wellness visits, cognitive self-assessments have recently become available for use at home [32,46]. In 2014, Troyer et al. created an online self-assessment, for independent use without input from a healthcare provider, to detect normal age-related memory changes and pathological cognitive decline [46]. They concluded that this type of intervention was a valid and reliable self-assessment tool to detect cognitive changes in older adults and could be used to identify those who would benefit from further testing [46].

Conclusions

The growing population of older adults coupled with increased prevalence of cognitive impairment necessitates a comprehensive, simple screening examination to establish baseline cognitive status in surgical patients. Given the abundance of cognitive screening examnations, it is necessary to determine whether staff-administered or self-administered examinations provide more sensitive information when assessing the cognitive status.

At our institution, an ongoing study provided SAGE to 189 elderly patients (current) before surgery to evaluate baseline preoperative cognitive function. Given that SAGE was completed by a large number of surgical patients, it is promising that self-assessment tools are feasible in the preoperative setting. Moreover, preliminary results are encouraging for physicians to propose the use of self-assessment tools as a standard procedure for preoperative cognitive testing. Additional research protocols using SAGE are in the development stage to further support the importance of cognitive self-assessment in the surgical setting.

Practice points

- Assessing cognitive status before surgery can provide insight into potential risk for post-operative cognitive decline.

Research agenda

- Further research will analyze the correlation between preoperative SAGE score and postoperative cognitive dysfunction in patients older than 65 years of age.

Conflicts of interest

None.

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