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Preoperative Cognitive Stratification of Older Elective Surgical Patients: A Cross-Sectional Study

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Abstract

Background—Preexisting cognitive impairment is emerging as a predictor of poor postoperative outcomes in seniors. We hypothesized that preoperative cognitive screening can be performed in a busy preadmission evaluation center and that cognitive impairment is prevalent in elective geriatric surgical patients.

Methods—We approached 311 patients ≥ 65 years-old presenting for preoperative evaluation prior to elective surgery in a prospective, observational, single-center study. Forty-eight patients were ineligible and 63 declined. The remaining 200 were randomized to the Mini-Cog (N = 100) or Clock-in-the-Box [CIB; N = 100] test. Study staff administered the test in a quiet room and 2 investigators scored the tests independently. Probable cognitive impairment was defined as a Mini-Cog ≤ 2 or a CIB ≤ 5.

Results—The age of consenting patients was 73.7 ± 6.4 (mean $\pm$ SD) years. There were no significant differences between patients randomized to the Mini-Cog or CIB test in age, weight, gender, education, ASA physical status or Charlston Index. Overall, 23% of patients met criteria for probable cognitive impairment, and prevalence was virtually identical regardless of the test used; 22% screened with the Mini-Cog and 23% screened with the CIB scored as having probable cognitive impairment ($P = 1.0$ by Chi Square analysis). Both tests had good inter-rater reliability (Krippendorff's $\alpha = 0.86$ (0.72–0.93) for Mini-Cog and 1 (1-1) for CIB).

Conclusions—Preoperative cognitive screening is feasible in most geriatric elective surgical patients and reveals a substantial prevalence of probable cognitive impairment in this population.

INTRODUCTION

Nationally, approximately 1 in 3 surgical procedures is performed on a patient ≥ 65 years-old even though this demographic is a substantially smaller fraction of the population.⁽¹⁾ Older adults have a higher rate of perioperative complications and poor surgical outcomes, ^(2–5) including sustained functional decline. The premise of preoperative assessment of vital organ systems, which has been a routine part of preparation for surgery for decades, and is viewed as especially important for the elderly,^(1,6) is that identifying organ dysfunction preoperatively helps guide patient and physician decision-making and reduces complications postoperatively because the planning and execution of anesthetic, surgical, and postoperative care can be modified accordingly.

The brain, which is arguably the organ of greatest importance for informed decision-making and good functional recovery, is unique among critical organ systems in having no formal preoperative assessment. In elders about to have surgery, there are several reasons to believe it should be. First, cognitive impairment is common in this age group. In the United States, 5–10% of persons older than 65 years have dementia; if one includes mild cognitive impairment (MCI) as well as dementia, the prevalence of cognitive impairment increases to 35–50% in those older than 65 years. Second, a substantial fraction of this cognitive impairment, particularly at the MCI level, goes undetected.^(7–9) Third, age is an inadequate

surrogate for likely cognitive impairment because there is considerable heterogeneity in cognitive abilities within and across age groups. Fourth, cognitive complications such as delirium and postoperative cognitive dysfunction (are among the most common morbidities in geriatric surgical patients, affecting 20–80% and 12–15%, respectively, with preexisting cognitive impairment being a risk factor for both conditions as well as a predictor and/or modifier of postoperative outcomes.(3–5,10–12) Therefore, it seems apparent that preoperative cognitive screening of the geriatric surgical population might offer many benefits.

The problem, however, is that standard neuropsychological test batteries, and even many standard bedside screening tests like the Mini Mental Status Examination are too time consuming to be practical in a preoperative evaluation clinic, where daily visit volume is high and each patient often needs evaluation of multiple organ systems. The challenge, therefore, is to identify a cognitive assessment instrument that is brief, easily administered and scored, and has high inter-rater reliability. Several such instruments designed for use in primary care or population-based research might have utility in this setting. Accordingly, we designed a prospective observational study of elective surgical patients older than 65 years to determine 1) whether preoperative cognitive screening of older surgical patients can be performed in a busy preoperative evaluation clinic; 2) the proportion of patients older than 65 years that perform poorly on a cognitive screening test prior to surgery; and 3) whether patients older than 65 years would want cognitive screening prior to a surgical procedure. For this purpose, we randomized patients to the Mini-Cog or the Clock-in-the-Box (CIB) tests. These two cognitive assessment tools have been validated in other settings, take only a few minutes to complete,(11,13–16) and were chosen deliberately for simplicity and potential for widespread adoption.

METHODS

This prospective observational study was approved by the Partners Human Research Committee, also known as the Partners Institutional Review Board. Between June 16, 2013 and July 31, 2013, study staff members approached 311 patients 65 years and older who presented for preoperative evaluation at the Weiner Center for Preoperative Evaluation at the Brigham and Women's Hospital to obtain written informed consent for study participation. All eligible patients were identified from the Weiner Center for Preoperative Evaluation tracking system on the day before surgery. Exclusion criteria included a prior diagnosis of dementia noted on the patient chart or reported to the investigator by the patient or a surrogate; planned postoperative intensive care unit stay; history of stroke or brain tumor; uncorrected vision or hearing impairment (unable to see pictures or read or hear instructions); limited use of the dominant hand (limited ability to draw); and/or inability to speak, read or understand English. From those that consented and enrolled, we gathered information from the medical record about age, weight, gender, highest level of education, ASA functional status, Charlson Comorbidity Index (not corrected for age), Metabolic Equivalent of Task, planned admission type (same day admission vs. day surgery), and the presence of an advanced directive.

Patients enrolled in the study were asked to complete a survey about their perceptions of preoperative cognitive screening (Table 1). They were then randomized to cognitive assessment with either the Mini-Cog (N = 100) or the Clock-in-the-Box (CIB N = 100) test. Both tests are brief and were designed for primary care but have been used in surgical settings, involve clock drawing, have minimal education and cultural/language bias, and are validated in community samples against standardized cognitive measures. (13–22) Study staff administered the test in a quiet examination room in the clinic. The Mini-Cog involves a 3-item recall test for memory and a clock drawing test that serves as a distractor; it tests visuospatial representation, recall, and executive function and has a sensitivity and specificity for the detection of dementia of 0.91 and 0.86, respectively.(11,13,14,22,23) The CIB also involves a clock drawing test but includes no formal item recall; instead, it tests working memory and planning/organization.(16,19) The CIB also correlates with other tests of cognitive function.(16,19) Both tests take just 2–4 minutes to complete. Two trained, blinded investigators scored each test independently; a third investigator scored the test in the event of a disagreement to determine the final score. Investigators were trained to grade the tests by reviewing information easily accessed via the internet (www.alz.org/documents_custom/Mini-Cog.pdf for the Mini-Cog; <http://www.heartbrain.com/cib/> for the CIB) and scored the tests accordingly, with the Mini-Cog graded on a 0–5 scale and the CIB on a 0–8 scale. We defined probable cognitive impairment as a score ≥ 2 on the Mini-Cog or ≥ 5 on the CIB based on published validity data.(13,16) Finally, answers from the nursing intake form filled out on the day of surgery to 3 binary questions related to nervous system function were recorded (alert and oriented $\times 7$, speech clear and understandable, and follows commands) for each patient.

Univariate analysis was performed to compare the baseline characteristics of patients randomized to the two cognitive assessment instruments with the Wilcoxon Rank Sum Test for ordinal variables and Chi-square or Fisher's exact test for categorical variables. "Krippendorff's alpha (KA) were calculated using "kripp.alpha" function in "irr" package in R software (<https://cran.r-project.org/web/packages/irr/irr.pdf>) to evaluate the agreement between the two initial raters for each of the two cognitive tests. The confidence intervals of KA were calculated using a bootstrapping method by random sampling the data points with replacement.

We used a modified Poisson regression to examine the association between the potential predictors and Mini-Cog and CIB scores on a risk ratio (RR) scale. For all analyses, a two-sided P-value of ≤ 0.05 was considered statistically significant. All statistical analyses were performed with SPSS version 22 (IBM SPSS Statistics) and SAS 9.3 (SAS Institute, NC).

RESULTS

Of the 311 patients approached, 48 (15%) were ineligible due to language, hearing or visual impairment or a known cognitive deficit. Of the remaining 263 eligible patients, 63 did not want to participate in the study, for a recruitment rate of 76% (Figure 1). The mean age of the 200 consenting patients was 73.7 ± 6.4 (mean $\pm$ SD) years. After completion of the patient survey, two patients randomized to the Mini-Cog test asked to be removed from the study and were not included in the analysis. The randomization was successful: there were

no significant differences between patients randomized to the Mini-Cog or CIB in age, weight, gender, Metabolic Equivalent of Task (a marker of functional activity level), Charlson Comorbidity Index, ASA Physical Status, highest education level achieved, presence of an advanced directive, or admission type (Table 2). Similarly, none of these variables was a risk factors for a low score on the Mini-Cog (Table 3) although advanced age was a risk factor of a low score on the CIB (Table 4).

Likewise, there were no statistically significant differences in the response to the patient survey between those randomized to the Mini-Cog or the CIB and the survey indicated patients supported cognitive screening (Table 5).

The Mini-Cog and CIB were, as expected, simple to administer. The prevalence of poor performance based on our prespecified cutoffs was virtually identical in this population regardless of the test used; 22% screened with the Mini-Cog and 23% screened with the CIB scored as having cognitive impairment ($P=1.0$ by Chi Square analysis). In contrast, impairment was nearly always missed on the standard nursing intake interview; all but one patient with a Mini-Cog or CIB score below our cutoff was judged to be intact (99% false negative rate for unstructured interaction). Finally, agreement between the raters was good for both the Mini-Cog and CIB, with Krippendorff's alpha of 0.86 (0.73–0.93) and 1 (1-1), respectively.

DISCUSSION

This study demonstrates that preoperative cognitive screening can be performed in a busy preadmission testing center and is accepted by most older adults. Moreover, the data show that many geriatric elective surgical patients do poorly on cognitive screening tests preoperatively. Specifically, 23% of patients ≥ 65 years-old scored in a range that suggests probable cognitive impairment. Our cutoffs were selected to identify with reasonable sensitivity and specificity the level of impairment of individuals who might present for a memory evaluation with MCI or dementia.(13,16) Thus, many if not most of these individuals are likely to have meaningful impairment, although a far more extensive evaluation would be required to make a formal diagnosis. These results are consistent with the reported prevalence of cognitive impairment among community-dwelling elders (9) as well as those in clinical settings (e.g., patients ≥ 65 years presenting to an emergency department or having elective surgery with planned admission to the intensive care unit (11,24,25)). We enrolled a diverse group of geriatric elective surgical patients and executed the tests during the visit to the preoperative evaluation clinic, so our results are probably generalizable to a broad group of older patients without known dementia presenting for elective noncardiac, non-neurosurgical surgery.

Previous work in primary care shows clinically relevant cognitive impairment, as defined by a formal neurological/neuropsychological/geriatric evaluation, is missed in 27–82% of affected patients during unstructured clinical interaction and that a brief, structured cognitive assessment tool identifies such impairment better than spontaneous detection by a patient's own primary care physician.(26–29) Likewise, only one of our patients with low cognitive scores was judged by the intake nurse to be cognitively impaired although on the screening

tests 23% scored in a range that suggests probable cognitive impairment (patients with a chart diagnosis of dementia were excluded from the study). While we do not have a “gold standard” and are aware that some of those identified as probably impaired are likely to be normal, our findings that the prevalence of probable impairment in this cohort is similar to that of other community and clinically based studies and that impairment is seldom noted by medical staff strongly suggest that current preoperative evaluation practices are insufficient. As such, cognitive impairment will continue to go undetected and unappreciated in geriatric surgical patients without structured cognitive screening.

The Mini-Cog and CIB tests were easy to administer and detected a similar prevalence of low scoring persons in this population. This is not surprising because the tests are similar in several respects. Both tests are brief and were designed and tested for primary care but have been used in surgical settings.(14,16–20) Both involve clock drawing, but the Mini-Cog adds a 3-item recall component. In the Mini-Cog, the clock is drawn free-style whereas in the CIB the patient is directed to place the clock in one of four differently colored boxes. Both have minimal education and cultural/language bias. Performance on these brief tests predicts performance on validated standardized cognitive measures,(13,15,16,21,22) although this relationship has not been studied when the screening tests are administered in a surgical setting. Both tests have good reported inter-rater reliability,(16,21) as well as good reliability in our hands. Although the inter-rater reliability of scoring was similar, the CIB was subjectively judged to require more time and be more difficult to score despite significant training.

More important than whether preoperative cognitive screening is practical is whether it is useful. Here the evidence is mostly circumstantial.(10) Cognitive impairment is a risk factor for adverse life events and hospitalization,(27,30–32) so cognitive screening may change the cost-benefit calculus of surgery by helping identify those least likely to benefit from the procedure. Failure to recognize the problem could lead to suboptimal outcomes in a surgical setting if patients cannot recall what is expected of them pre- or postoperatively in terms of medication regimens, activity restrictions, wound care, and rehabilitation, and one cannot rely on routine clinical interactions to detect cognitive impairment or even frank dementia. (14,23,27–29) Poor preoperative cognitive function may predispose to the subtle and long-lasting executive dysfunction that many seniors experience postoperatively, because the persistent changes are independent of the specific anesthetic or surgical procedure.(33–35) Finally, recent evidence indicates poor cognitive status increases complication risk, undermines the chance of a good outcome, and adds to the cost of care. In-hospital delirium is a prime example; it occurs in 15–80% of older surgical patients, contributes to poor outcomes, and is more common in those with baseline cognitive impairment.(36–39) Likewise, preexisting cognitive impairment is strongly associated with serious non-cognitive morbidity and mortality in hospitalized seniors and those having major elective surgery. (11,12,25,40–42) Therefore, one can conceptualize cognitive impairment as a form of brain failure that, like heart failure, arises from multiple causes but may lead independently to poor outcomes. However, whether cognition-specific information can be used to improve geriatric surgical outcomes is unknown but the feasibility of preoperative cognitive screening might stimulate work to address that question. In addition, cognitive screening with a short test such as the Mini-Cog or CIB might be an appealing alternative to the 45

min NIH Cognitive Toolbox (<http://www.nihtoolbox.org/Pages/default.aspx>) for pragmatic clinical trials investigating ways to improve cognitive outcomes of surgery such as by multicomponent geriatric consultation or Bispectral Index-guided anesthetic management. (43)

This study has several important limitations. One is that neither the Mini-Cog nor the CIB can diagnose dementia or MCI. However, we did not choose them for that purpose, because our objective was to identify a cognitive screening tool that could be implemented in a high-throughput presurgical evaluation clinic. Our data show that both the Mini-Cog and the CIB have good inter-rater reliability and are inexpensive, brief, require minimal training, and demand no special personnel or technology. Still, we cannot exclude the possibility that other brief instruments could work as well or better in the presurgical setting.(14,26,27,44–47) As screening instruments, the Mini-Cog and CIB will inevitably yield false positives and negatives. Someone falsely labeled as impaired may elect to forgo elective surgery for fear of having cognitive impairment afterward but those who proceed will likely just receive increased vigilance (e.g., geriatric consultation, more careful monitoring during anesthesia, joint discharge instructions), and those with undetected impairment will be no worse off than our patients are currently. Along these lines, our survey data indicate subjects found cognitive screening prior to surgery acceptable but we did not consult an expert in survey design so cannot exclude the possibility of bias in the survey questions. Another issue is that the stress of being in the preoperative evaluation center could confound performance of seniors on the cognitive screening tests. However, few things are as stressful as surgery and hospitalization. Testing in a busy environment may therefore reveal more about the likely response to surgery and hospitalization than testing done in the quiet, controlled, artificial confines of neuropsychology lab. Perhaps the main limitation is that this study provides no evidence for the clinical utility of screening with the Mini-Cog or CIB test preoperatively. This is a critical issue because cognitive screening requires time and can be troubling to older adults. (48,49) However, emerging evidence linking poor cognition with medical-surgical and functional morbidity in seniors (11,20,41,50,51) provides ample reason to study the question further.

The science of cognition as a perioperative risk factor for the geriatric patient is in its infancy, but interest is growing. The American College of Surgeons and the American Geriatrics Society recently published joint guidelines recommending preoperative cognitive assessment of seniors with a screening tool such as the Mini-Cog.¹ Data showing that targeting poor performers for special attention before, during, and after surgery improves surgical outcomes are lacking but our study provides evidence that cognitive screening is practical in a preoperative evaluation center and that a substantial percentage of seniors screen positive. This suggests that in elective geriatric surgical patients preoperative cognitive impairment is prevalent but largely undetected.

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References

1. Chow WB, Rosenthal RA, Merkow RP, Ko CY, Esnaola NF. American College of Surgeons National Surgical Quality Improvement P, American Geriatrics S. Optimal preoperative assessment of the geriatric surgical patient: a best practices guideline from the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatrics Society. *J Am Coll Surg*. 2012; 215:453–466. [PubMed: 22917646]
2. Cram P, Lu X, Kates SL, Singh JA, Li Y, Wolf BR. Total knee arthroplasty volume, utilization, and outcomes among Medicare beneficiaries, 1991–2010. *JAMA*. 2012; 308:1227–1236. [PubMed: 23011713]
3. Finlayson E, Wang L, Landefeld CS, Dudley RA. Major abdominal surgery in nursing home residents: a national study. *Ann Surg*. 2011; 254:921–926. [PubMed: 22020197]
4. Finlayson E, Zhao S, Boscardin WJ, Fries BE, Landefeld CS, Dudley RA. Functional status after colon cancer surgery in elderly nursing home residents. *J Am Geriatr Soc*. 2012; 60:967–973. [PubMed: 22428583]
5. Gajdos C, Kile D, Hawn MT, Finlayson E, Henderson WG, Robinson TN. Advancing age and 30-day adverse outcomes after nonemergent general surgeries. *J Am Geriatr Soc*. 2013; 61:1608–1614. [PubMed: 23927841]
6. Barbour CM. Preoperative evaluation. *Anesthesiology*. 1958; 19:275–278. [PubMed: 13521380]
7. Gauthier S, Reisberg B, Zaudig M, Petersen RC, Ritchie K, Broich K, Belleville S, Brodaty H, Bennett D, Chertkow H, Cummings JL, de Leon M, Feldman H, Ganguli M, Hampel H, Scheltens P, Tierney MC, Whitehouse P, Winblad B. International Psychogeriatric Association Expert Conference on mild cognitive i. Mild cognitive impairment. *Lancet*. 2006; 367:1262–1270. [PubMed: 16631882]
8. Petersen RC. Clinical practice. Mild cognitive impairment. *N Engl J Med*. 2011; 364:2227–2234. [PubMed: 21651394]
9. Plassman BL, Langa KM, Fisher GG, Heeringa SG, Weir DR, Ofstedal MB, Burke JR, Hurd MD, Potter GG, Rodgers WL, Steffens DC, McArdle JJ, Willis RJ, Wallace RB. Prevalence of cognitive impairment without dementia in the United States. *Ann Intern Med*. 2008; 148:427–434. [PubMed: 18347351]
10. Crosby G, Culley DJ, Hyman BT. Preoperative cognitive assessment of the elderly surgical patient: a call for action. *Anesthesiology*. 2011; 114:1265–1268. [PubMed: 21490501]
11. Robinson TN, Wu DS, Pointer LF, Dunn CL, Moss M. Preoperative cognitive dysfunction is related to adverse postoperative outcomes in the elderly. *J Am Coll Surg*. 2012; 215:12–17. [PubMed: 22626912]
12. Oresanya LB, Lyons WL, Finlayson E. Preoperative assessment of the older patient: a narrative review. *JAMA*. 2014; 311:2110–2120. [PubMed: 24867014]
13. Borson S, Scanlan JM, Chen P, Ganguli M. The Mini-Cog as a screen for dementia: validation in a population-based sample. *J Am Geriatr Soc*. 2003; 51:1451–1454. [PubMed: 14511167]
14. Borson S, Scanlan JM, Watanabe J, Tu SP, Lessig M. Improving identification of cognitive impairment in primary care. *Int J Geriatr Psychiatry*. 2006; 21:349–355. [PubMed: 16534774]
15. McCarten JR, Anderson P, Kuskowski MA, McPherson SE, Borson S, Dysken MW. Finding dementia in primary care: the results of a clinical demonstration project. *J Am Geriatr Soc*. 2012; 60:210–217. [PubMed: 22332672]
16. Chester JG, Grande LJ, Milberg WP, McGlinchey RE, Lipsitz LA, Rudolph JL. Cognitive screening in community-dwelling elders: performance on the clock-in-the-box. *Am J Med*. 2011; 124:662–669. [PubMed: 21592451]
17. Borson S, Scanlan J, Hummel J, Gibbs K, Lessig M, Zuhr E. Implementing routine cognitive screening of older adults in primary care: process and impact on physician behavior. *J Gen Intern Med*. 2007; 22:811–817. [PubMed: 17447100]
18. Borson S, Frank L, Bayley PJ, Boustani M, Dean M, Lin PJ, McCarten JR, Morris JC, Salmon DP, Schmitt FA, Stefanacci RG, Mendiondo MS, Peschin S, Hall EJ, Fillit H, Ashford JW. Improving dementia care: the role of screening and detection of cognitive impairment. *Alzheimers Dement*. 2013; 9:151–159. [PubMed: 23375564]

19. Grande LJ, Rudolph JL, Milberg WP, Barber CE, McGlinchey RE. Detecting cognitive impairment in individuals at risk for cardiovascular disease: the •Clock-in-the-Box• screening test. *Int J Geriatr Psychiatry*. 2011; 26:969–975. [PubMed: 21845599]
20. Harrington MB, Kraft M, Grande LJ, Rudolph JL. Independent association between preoperative cognitive status and discharge location after cardiac surgery. *Am J Crit Care*. 2011; 20:129–137. [PubMed: 21362717]
21. Borson S, Scanlan J, Brush M, Vitaliano P, Dokmak A. The mini-cog: a cognitive 'vital signs' measure for dementia screening in multi-lingual elderly. *Int J Geriatr Psychiatry*. 2000; 15:1021–1027. [PubMed: 11113982]
22. Tsoi KK, Chan JY, Hirai HW, Wong SY, Kwok TC. Cognitive Tests to Detect Dementia: A Systematic Review and Meta-analysis. *JAMA Intern Med*. 2015; 175:1450–1458. [PubMed: 26052687]
23. McCarten JR, Anderson P, Kuskowski MA, McPherson SE, Borson S. Screening for cognitive impairment in an elderly veteran population: acceptability and results using different versions of the Mini-Cog. *J Am Geriatr Soc*. 2011; 59:309–313. [PubMed: 21314650]
24. Carpenter CR, Bassett ER, Fischer GM, Shirshekan J, Galvin JE, Morris JC. Four sensitive screening tools to detect cognitive dysfunction in geriatric emergency department patients: brief Alzheimer's Screen, Short Blessed Test, Ottawa 3DY, and the caregiver-completed AD8. *Acad Emerg Med*. 2011; 18:374–384. [PubMed: 21496140]
25. Evered LA, Silbert BS, Scott DA, Maruff P, Ames D, Choong PF. Preexisting cognitive impairment and mild cognitive impairment in subjects presenting for total hip joint replacement. *Anesthesiology*. 2011; 114:1297–1304. [PubMed: 21502855]
26. Cordell CB, Borson S, Boustani M, Chodosh J, Reuben D, Verghese J, Thies W, Fried LB. Medicare Detection of Cognitive Impairment W. Alzheimer's Association recommendations for operationalizing the detection of cognitive impairment during the Medicare Annual Wellness Visit in a primary care setting. *Alzheimers Dement*. 2013; 9:141–150. [PubMed: 23265826]
27. Callahan CM, Hendrie HC, Tierney WM. Documentation and evaluation of cognitive impairment in elderly primary care patients. *Ann Intern Med*. 1995; 122:422–429. [PubMed: 7856990]
28. Chodosh J, Petitti DB, Elliott M, Hays RD, Crooks VC, Reuben DB, Galen Buckwalter J, Wenger N. Physician recognition of cognitive impairment: evaluating the need for improvement. *J Am Geriatr Soc*. 2004; 52:1051–1059. [PubMed: 15209641]
29. van den Dungen P, van Marwijk HW, van der Horst HE, Moll van Charante EP, Macneil Vroomen J, van de Ven PM, van Hout HP. The accuracy of family physicians' dementia diagnoses at different stages of dementia: a systematic review. *Int J Geriatr Psychiatry*. 2012; 27:342–354. [PubMed: 21626568]
30. Schupf N, Tang MX, Albert SM, Costa R, Andrews H, Lee JH, Mayeux R. Decline in cognitive and functional skills increases mortality risk in nondemented elderly. *Neurology*. 2005; 65:1218–1226. [PubMed: 16247048]
31. Phelan EA, Borson S, Grothaus L, Balch S, Larson EB. Association of incident dementia with hospitalizations. *JAMA*. 2012; 307:165–172. [PubMed: 22235087]
32. Toot S, Devine M, Akporobaro A, Orrell M. Causes of hospital admission for people with dementia: a systematic review and meta-analysis. *J Am Med Dir Assoc*. 2013; 14:463–470. [PubMed: 23510826]
33. Silbert BS, Evered LA, Scott DA. Incidence of postoperative cognitive dysfunction after general or spinal anaesthesia for extracorporeal shock wave lithotripsy. *Br J Anaesth*. 2014; 113:784–791. [PubMed: 24972789]
34. Selnes OA, Grega MA, Bailey MM, Pham LD, Zeger SL, Baumgartner WA, McKhann GM. Cognition 6 years after surgical or medical therapy for coronary artery disease. *Ann Neurol*. 2008; 63:581–590. [PubMed: 18481292]
35. Price CC, Garvan CW, Monk TG. Type and severity of cognitive decline in older adults after noncardiac surgery. *Anesthesiology*. 2008; 108:8–17. [PubMed: 18156877]
36. Fong TG, Jones RN, Shi P, Marcantonio ER, Yap L, Rudolph JL, Yang FM, Kiely DK, Inouye SK. Delirium accelerates cognitive decline in Alzheimer disease. *Neurology*. 2009; 72:1570–1575. [PubMed: 19414723]

37. Rudolph JL, Marcantonio ER. Review articles: postoperative delirium: acute change with long-term implications. *Anesth Analg*. 2011; 112:1202–1211. [PubMed: 21474660]
38. Saczynski JS, Marcantonio ER, Quach L, Fong TG, Gross A, Inouye SK, Jones RN. Cognitive trajectories after postoperative delirium. *N Engl J Med*. 2012; 367:30–39. [PubMed: 22762316]
39. Rudolph JL, Inouye SK, Jones RN, Yang FM, Fong TG, Levkoff SE, Marcantonio ER. Delirium: an independent predictor of functional decline after cardiac surgery. *J Am Geriatr Soc*. 2010; 58:643–649. [PubMed: 20345866]
40. Deschodt M, Braes T, Flamaing J, Detroyer E, Broos P, Haentjens P, Boonen S, Milisen K. Preventing delirium in older adults with recent hip fracture through multidisciplinary geriatric consultation. *J Am Geriatr Soc*. 2012; 60:733–739. [PubMed: 22429099]
41. Watkin L, Blanchard MR, Tookman A, Sampson EL. Prospective cohort study of adverse events in older people admitted to the acute general hospital: risk factors and the impact of dementia. *Int J Geriatr Psychiatry*. 2012; 27:76–82. [PubMed: 21360591]
42. Silbert BS, Scott DA, Evered LA, Lewis MS, Maruff PT. Preexisting cognitive impairment in patients scheduled for elective coronary artery bypass graft surgery. *Anesth Analg*. 2007; 104:1023–1028. [PubMed: 17456647]
43. Moyce Z, Rodseth RN, Biccard BM. The efficacy of peri-operative interventions to decrease postoperative delirium in non-cardiac surgery: a systematic review and meta-analysis. *Anaesthesia*. 2014; 69:259–269. [PubMed: 24382294]
44. Weuve J, Kang JH, Manson JE, Breteler MM, Ware JH, Grodstein F. Physical activity, including walking, and cognitive function in older women. *JAMA*. 2004; 292:1454–1461. [PubMed: 15383516]
45. Amariglio RE, Townsend MK, Grodstein F, Sperling RA, Rentz DM. Specific subjective memory complaints in older persons may indicate poor cognitive function. *J Am Geriatr Soc*. 2011; 59:1612–1617. [PubMed: 21919893]
46. Robinson TN, Wu DS, Sauaia A, Dunn CL, Stevens-Lapsley JE, Moss M, Stieglmann GV, Gajdos C, Cleveland JC Jr, Inouye SK. Slower walking speed forecasts increased postoperative morbidity and 1-year mortality across surgical specialties. *Ann Surg*. 2013; 258:582–588. [PubMed: 23979272]
47. Long LS, Wolpaw JT, Leung JM. Sensitivity and specificity of the animal fluency test for predicting postoperative delirium. *Can J Anaesth*. 2015; 62:603–608. [PubMed: 25537737]
48. Boustani M, Perkins AJ, Fox C, Unverzagt F, Austrom MG, Fultz B, Hui S, Callahan CM, Hendrie HC. Who refuses the diagnostic assessment for dementia in primary care? *Int J Geriatr Psychiatry*. 2006; 21:556–563. [PubMed: 16783796]
49. Brayne C, Fox C, Boustani M. Dementia screening in primary care: is it time? *JAMA*. 2007; 298:2409–2411. [PubMed: 18042918]
50. Millar K, Asbury AJ, Murray GD. Pre-existing cognitive impairment as a factor influencing outcome after cardiac surgery. *Br J Anaesth*. 2001; 86:63–67. [PubMed: 11575412]
51. Smith PJ, Attix DK, Weldon BC, Greene NH, Monk TG. Executive function and depression as independent risk factors for postoperative delirium. *Anesthesiology*. 2009; 110:781–787. [PubMed: 19326492]

Figure 1.
Consort recruitment diagram.

Table 1**Sample Patient Survey**

Do you believe that a short memory test should be performed before having a surgical procedure? ____Yes ____No (Choose one)
If a memory test could help predict surgical outcomes would you want memory testing performed on you? ____Yes ____No (Choose one)
If the results of your memory test suggested memory problems would you want to know about the result of that test? ____Yes ____No (Choose one)
If the memory test suggested possible memory problems would you want to be referred to a memory specialist? ____Yes ____No (Choose one)

Table 2

Baseline Demographics

Variable	CIB (N=100)	Mini-Cog (N=98)	P Value
Age (years)	73.6. $\pm$ 6.4	73.9 $\pm$ 5.9	0.76
Weight (kg)	77.6 $\pm$ 19.1	80.0 $\pm$ 21.1	0.41
Gender, n (%)			0.89
. Female	50 (50%)	50 (50%)	
. Male	50 (51%)	48 (49%)	
Metabolic Equivalent of Task	4.4 $\pm$ 1.2	4.7 $\pm$ 1.7	0.16
Charlson Comorbidity Index	2.4 $\pm$ 1.7	2.3 $\pm$ 1.9	0.73
ASA Physical Status, n (%)			0.71
. II	35 (36%)	38 (40%)	
. III	61 (62%)	55 (59%)	
. VI	2 (2%)	1 (1%)	
Highest Level of Education, n (%)			0.88
. College Graduate	47 (53%)	47 (51%)	
. High School Graduate	19 (22%)	24 (26%)	
. Some College	20 (23%)	19 (20%)	
. Some High School	2 (2%)	3 (3%)	
Advanced Directive, n (%)			0.33
. No	20 (20%)	25 (26%)	
. Yes	80 (80%)	72 (74%)	
Admit type, n (%)			0.67
. Outpatient	38 (39%)	34 (36%)	
. Same day admission	60 (61%)	61 (64%)	

Table 3

Predictors of Mini-Cog Score

	Risk ratio	p-value
Age		
Continuous	1.06 (0.99 to 1.13)	0.075
Weight		
Continuous	0.99 (0.96 to 1.01)	0.199
Gender		
Male	Reference	-
Female	0.8 (0.35 to 1.85)	0.602
Highest level of education		
Non college grad	Reference	-
College grad	0.68 (0.29 to 1.59)	0.369
Charlson Comorbidity Index		
Continuous	1.02 (0.82 to 1.26)	0.884
ASA		
<3	Reference	-
>=3	1.4 (0.55 to 3.57)	0.485
Advanced Directive		
Yes	Reference	-
No	1.99 (0.85 to 4.66)	0.112
METS		
Continuous	0.84 (0.63 to 1.12)	0.235

Table 4

Predictors of Clock-in-the Box Score

	Risk ratio	p-value
Age		
Continuous	1.12 (1.03 to 1.21)	0.009
Weight		
Continuous	0.97 (0.94 to 1.01)	0.139
Gender		
Male	Reference	-
Female	1.43 (0.45 to 4.5)	0.542
Highest level of education		
Non college grad	Reference	-
College grad	0.35 (0.09 to 1.32)	0.12
Charlson Comorbidity Index		
Continuous	1.14 (0.84 to 1.55)	0.388
ASA		
2	Reference	-
3	1.29 (0.39 to 4.28)	0.679
Advanced Directive		
Yes	Reference	-
No	1.37 (0.37 to 5.05)	0.638
METS		
Continuous	0.69 (0.43 to 1.12)	0.133

Table 5

Patient Responses to Survey Questions and Mini-Cog Score

Question	Total Group % Yes	Mini-Cog % Yes	CIB % Yes	P value
Do you believe that a short memory test should be performed before having a surgical procedure?	143/182 (78.6%)	71/80 (79.8%)	71/90 (78.9%)	0.985
If a memory test could help predict surgical outcomes would you want memory testing performed on you?	184/194 (94.8%)	92/95 (96.8%)	90/96 (93.8%)	0.648
If the results of your memory test suggested memory problems would you want to know about the result of that test?	185/196 (94.4%)	93/98 (94.9%)	90/95 (94.7%)	1.000
If the memory test suggested possible memory problems would you want to be referred to a memory specialist?	157/196 (81.4%)	75/95 (78.9%)	80/95 (84.2%)	0.502