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Cognitive Functioning, Retirement Status, and Age: Results from the Cognitive Changes and Retirement among Senior Surgeons Study

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Abstract

Background—Accurate assessment of cognitive functioning is an important step in understanding how to better evaluate both clinical and cognitive competence in practicing surgeons. As part of the Cognitive Changes and Retirement among Senior Surgeons study, we examined the objective cognitive functioning of senior surgeons in relation to retirement status and age.

Study Design—Computerized cognitive tasks measuring visual sustained attention, reaction time, and visual learning and memory were administered to both practicing and retired surgeons at annual meetings of the American College of Surgeons. Data from 168 senior surgeons aged 60 and older were compared with data from 126 younger surgeons aged 45 to 59, with performance below 1.5 standard deviations or more indicating a significant difference between the groups.

Results—Sixty-one percent of practicing senior surgeons performed within the range of the younger surgeons on all cognitive tasks. Seventy-eight percent of practicing senior surgeons aged 60 to 64 performed within the range of the younger surgeons on all tasks compared with 38% of practicing senior surgeons aged 70 and older. Forty-five percent of retired senior surgeons performed within the range of the younger surgeons on all tasks. No senior surgeon performed below the younger surgeons on all 3 tasks.

Conclusions—The majority of practicing senior surgeons performed at or near the level of their younger peers on all cognitive tasks, as did almost half of the retired senior surgeons. This suggests that older age does not inevitably preclude cognitive proficiency. The variability in cognitive performance across age groups and retirement status suggests the need for formal

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measures of objective cognitive functioning to help surgeons detect changes in cognitive performance and aid in their decisions to retire.

According to the American Medical Association, 18% of practicing physicians are older than age 65.[1] Although there are a number of factors that affect cognitive functioning in older physicians, older age increases the risk of cognitive impairment, which can have significant effects on clinical competence. There has been growing interest in early detection of cognitive deficits in order to reduce the prevalence of cognitive impairment and ensure competence among aging physicians.[2-4] Given that more than 20% of adults older than age 70 may have some form of cognitive impairment,[5] it is possible that there may be some physicians who fall into this category who do not self-select out of practice once cognitive deficits arise.

This issue is particularly salient in the surgical field as the average age of retirement increases for practicing surgeons.[6] Research has suggested that increasing age may be associated with reduced surgical skill and knowledge.[7-9] However, age alone does not preclude clinical competence. For example, Waljee and colleagues[9] found that surgeon age alone is not an important predictor of operative risk. They suggested that retirement considerations should not be based solely on age, particularly given the significant variability in the cognitive aging process across older adults. This highlights the need for objective ways to evaluate both clinical and cognitive competence in surgeons to aid in retirement decision-making.

We previously reported results from the Cognitive Changes and Retirement among Senior Surgeons study (CCRASS),[10,11] which showed that measures of cognitive skills, including attention, reaction time, and visual learning and memory, declined with age among surgeons. With regard to retirement decisions, we demonstrated that although perceived cognitive ability factors into decisions to retire, subjective ratings may not accurately reflect objective cognitive status and therefore may not be a good basis for retirement decisions. This study aimed to examine objective cognitive functioning in senior surgeons as it relates to retirement status and age. We report the cognitive performance of senior surgeons aged 60 years and older, who are already retired, planning for retirement within 5 years, or not considering imminent retirement.

Methods

Study design

As previously reported,[10] surgeons participating in the CCRASS study completed computerized subtests from the Cambridge Neuropsychological Test Automated Battery (CANTAB).[12] These subtests were chosen based on previous research suggesting that stress tolerance, psychomotor functioning, and visuospatial functioning were related to ratings of surgical skill.[13] The rapid visual information processing subtest (RVP) required individuals to identify 3 sequences of digits from among rapidly presented single digits, assessing visual sustained attention and stress tolerance. The outcome measure for the RVP was the probability of making a correct response, with a higher score indicating better performance. The reaction time subtest (RTI) assessed reaction time and psychomotor speed by requiring individuals to rapidly touch colored dots on a computer touchscreen. The outcome measure for the RTI was the speed of response, with a lower score indicating better performance. A paired associates learning subtest (PAL) was a measure of visuospatial learning and memory, requiring the individual to learn correct locations of visual stimuli among an increasing number of hidden locations. The outcome measure of the PAL was the total number of errors, with a lower score indicating better performance.

Surgeons also completed a survey regarding self-appraisal of surgical practice and plans for retirement, which was also reported in previous articles.[10,11] This survey assessed subjective information about surgical practice, changes in clinical practice, and changes in cognitive functioning over the past 5 years. Surgeons were also asked about their retirement status and if not retired, whether they planned to retire within the next 5 years, when they reach a predetermined age, or when they feel that their skills are deteriorating. The latter 2 groups were categorized as “no imminent plans for retirement.”

Data collection

The CCRASS study was approved by the Institutional Review Board at the University of Michigan and all participants provided informed consent. With the support of the American College of Surgeons, a booth at the annual Clinical Congress was used from 2001 to 2006 to administer the CANTAB tests and the survey. Surgeons were recruited to participate using video presentations in buses transporting attendees, announcements in the Congress newsletter, and signage. They were compensated for their participation with token novelty items (eg, stress balls). A total of 294 surgeons completed both the CANTAB and the survey.

Statistical analysis

Analyses were performed using the SPSS Release for Windows, Version 17.0. Because we were interested in the cognitive performance of senior surgeons, the 294 surgeons were divided into 2 age groups: younger surgeons below the age of 60 (n = 126) and senior surgeons aged 60 and older (n = 168). Although the cognitive performance of this senior surgeon group was of primary interest in our studies, the normative data for older adults on the CANTAB are limited by insufficient sample sizes in the standardization groups. Therefore, we used the raw scores of the younger surgeon group to establish the normative reference group for the senior surgeon group. Z-scores were calculated for each senior surgeon for each of the 3 variables of interest (RVP, RTI, PAL) using the mean scores and standard deviations from the younger surgeon group. The z-score represents the number of standard deviations that a raw score deviated from the mean score of the younger reference group. Z-scores were calculated so that a higher z-score indicated better performance. A z-score of below −1.5 (ie, greater than 1.5 standard deviations below the younger group score) was considered significantly below the performance of the younger surgeon group. Demographic information and cognitive scores for the younger and senior surgeon groups are displayed in Table 1.

Results

Demographic and clinical practice information

Data from 168 senior surgeons aged 60 and above are reported in this study. Data from 126 younger surgeons aged 45 to 59 are also included for comparison purposes. Of the senior surgeons, 36% were already retired, 33% were planning to retire within the next 5 years, and 30% did not have imminent retirement plans. A 1-way analysis of variance showed that age differed by retirement decisions ($F[2,165]$ 10.94, $p < 0.001$). Retired senior surgeons were the oldest group (mean 70.25 years; SD 5.55; range 60 to 84 years), with equivalent ages among senior surgeons who planned to retire within 5 years (mean 65.95 years; SD 5.09; range 60 to 86 years) and senior surgeons with no imminent retirement plans (mean 66.37 years; SD 5.78; range, 60 to 81 years).

Objective cognitive performance and retirement status

One-way analysis of variance showed that the senior surgeons performed significantly below the younger surgeons on the RVP ($F [1,293]$, 15.24, $p < 0.001$), the RTI ($F [1,293]$, 22.03, $p < 0.001$), and the PAL ($F [1,293]$, 35.82, $p < 0.001$). Of the 168 senior surgeons, 3 senior surgeons (2%) performed below the younger surgeons on the RTI. Fifty-five senior surgeons (32%) performed below the younger surgeons on the PAL and 32 senior surgeons (18%) performed below the younger surgeons on the RVP.

Table 2 presents mean z-scores for each of the 3 cognitive variables (PAL, RTI, and RVP) across retirement statuses. Table 3 displays the distribution of senior surgeons according to retirement status and the number of tests (0 to 3) in which they performed significantly below the younger surgeons. Across all senior surgeons, 55% of surgeons performed within the range of the younger surgeons on all 3 cognitive tasks. No senior surgeon performed significantly below the younger surgeons on all 3 tasks, although 9% of senior surgeons performed below the younger surgeons on 2 tasks. Forty-nine percent of practicing senior surgeons with no imminent plans to retire performed within the range of the younger surgeons on all 3 tasks, compared with 72% of practicing senior surgeons planning to retire within the next 5 years. Forty-five percent of retired of surgeons performed within the range of the younger surgeons on all 3 tasks.

We also examined the effect of age on cognitive performance among the 108 practicing senior surgeons. Age was negatively correlated with z-scores on the PAL ($r = -0.29$, $p = 0.002$), the RVP ($r = -0.25$, $p = 0.01$), and the RTI ($r = -0.19$, $p = 0.05$). Table 4 shows the distribution of practicing senior surgeons according to age group and the number of tests (0 to 3) in which they performed below the younger surgeons. The percentage of senior surgeons performing below the younger surgeon group on at least 1 task increased with age, from 22% in the youngest age group (aged 60 to 64) to 78% in the oldest age group (aged 75 years and over). Among the older groups of practicing surgeons (aged 70 and above), 38% of practicing senior surgeons performed within the range of the younger surgeons on all 3 measures.

Discussion

This study examined the cognitive functioning of senior surgeons aged 60 and older in relation to retirement status and age. When compared with younger surgeons, senior surgeons as a group performed significantly below the younger surgeons on tasks of attention, reaction time, and visual learning and memory. However, when comparing the individual performance of senior surgeons to younger surgeons, more than half of the senior surgeons (55%) performed within the range of the younger surgeons on all 3 tasks. No senior surgeon performed significantly below the younger surgeons on all 3 tasks. So, the majority of senior surgeons are performing within normal limits when compared with their younger counterparts.

There was variability in cognitive performance across tasks, age, and retirement status. A task of visual learning and memory was most difficult for senior surgeons, with one-third of the senior surgeons performing below the younger surgeons on the PAL. In contrast, only 3 of the 168 surgeons performed below the younger surgeons on the RTI, suggesting that psychomotor speed may be less affected by age in this group.

The majority of practicing senior surgeons (61%) performed within the range of the younger surgeons on all 3 tasks, with only 7 of the 108 practicing senior surgeons performing significantly below the younger surgeons on more than 1 task. We also examined the effects of age on cognitive functioning among practicing senior surgeons. Not surprisingly, age was negatively correlated with cognitive performance. Similarly, the proportion of practicing senior surgeons who performed below the younger surgeons on at least 1 cognitive measure increased with age. However, even in the older age groups (senior surgeons ages 70 and older), more than one-third of the surgeons performed within the range of the younger surgeons on all tasks. So even in the oldest age groups, a number of practicing senior surgeons continue to show cognitive competence, suggesting that age alone is not a sufficient predictor of cognitive performance.

With regard to retirement decisions, there was variability in cognitive functioning across practicing senior surgeons planning for imminent retirement, practicing senior surgeons with no plans for imminent retirement, and retired senior surgeons. Approximately half of practicing senior surgeons with no imminent plans to retire performed within the range of the younger surgeons on all tasks. Almost three-quarters of senior surgeons who planned to retire within 5 years performed within the range of the younger surgeons on all tasks, suggesting that a large number of currently practicing senior surgeons will likely retire with intact cognitive abilities. Consistent with this, almost half of retired senior surgeons demonstrated intact cognitive functioning. There are many factors that affect the decision to retire or stay in practice, which can include financial incentives, geographic factors, health issues, and family demands. However, it may be that some retired surgeons would have chosen to stay in practice if they had objective evidence of their intact cognitive abilities.

In sum, the majority of senior surgeons performed at or near the level of younger surgeons on measures of reaction time, attention, and visual learning and memory. However, there was significant variability among senior surgeons, suggesting that age alone cannot predict

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cognitive competence, particularly when making important decisions such as when to retire from practice. Although there are many factors to consider when deciding to retire, perceived cognitive decline plays an important role even though it may not be an accurate reflection of true abilities.[10] Therefore, our data continue to support the development of formal measures of cognitive functioning to detect changes in cognitive performance that may affect surgical skill. Accurate assessment of objective cognitive functioning can provide very useful information to aid a senior surgeon in deciding whether to retire, continue in practice, or modify his or her practice. Future research could examine other domains of cognitive functioning that are also likely associated with surgical skill, such as fine motor coordination, processing speed, and visuospatial judgment. In addition, although the small number of female surgeons in our sample precluded an examination of gender effects on cognitive functioning, this would be an interesting focus for future studies, particularly as the number of women in the surgical field grows.

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Abbreviations and Acronyms

CANTAB	Cambridge Neuropsychological Test Automated Battery
CCRASS	Cognitive Changes and Retirement among Senior Surgeons

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PAL	paired associates learning
RTI	reaction time
RVP	rapid visual information processing

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Table 1

Demographic Information and Raw Cognitive Scores for Younger and Senior Surgeons

Variable	Younger surgeons	Senior surgeons
n	126	168
Age range, y	45–59	60–86
Age mean (SD)	53.17 (4.26)	67.61 (5.78)
Gender, n	21 F, 105 M	2 F, 166 M
PAL total errors, n (SD)	17.02 (11.03)	32.75 (28.14)
RVP probability of a hit, (SD)	0.73 (0.16)	0.65 (0.18)
RTI reaction time	339.63 (36.80)	365.86 (52.16)

PAL, paired associates learning (visual memory); RTI, reaction time; RVP, rapid visual information processing (visual sustained attention).

Table 2
Z-Scores on Cognitive Tasks Across Retirement Statuses for Senior Surgeons

	Retirement decision			
Task	**No imminent plans**	**Retire within 5 years**	**Retired**	**Total**
PAL	−1.50 (2.63)	−0.80 (1.83)	−1.95 (2.95)	−1.43 (2.55)
RVP	−0.41(1.12)	−0.26 (0.98)	−0.75 (1.20)	−0.48 (1.12)
RTI	−0.62 (1.50)	−0.63 (1.47)	−0.86 (1.31)	−0.71 (1.42)

Scores are given as means (SD).

PAL, paired associates learning (visual memory); RTI, reaction time; RVP, rapid visual information processing (visual sustained attention).

Table 3

Number and Percentage of Senior Surgeons Who Performed Significantly Below the Younger Surgeon Group on Cognitive Tests across Retirement Decisions

	Retirement decision						
	No imminent plans		Retire within 5 years		Retired		
Number of tests	n	%	n	%	n	%	Total, n
0	25	49	41	72	27	45	93
1	20	39	15	26	25	42	60
2	6	12	1	2	8	13	15
3	0		0		0		0
Total	51	100	57	100	60	100	168

Table 4

Number and Percentage of Practicing Senior Surgeons Who Performed Significantly Below the Younger Surgeon Group on Cognitive Tests across Age Groups

	Age group, y								
	60–64		65–69		70–74		75+		
Number of tests	n	%	n	%	n	%	n	%	Total
0	43	78	14	48	7	47	2	22	66
1	10	18	11	38	7	47	7	78	35
2	2	4	4	14	1	6	0		7
3	0		0		0		0		0
Total	55	100	29	100	15	100	9	100	108