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Preoperative impairment is associated with a higher postdischarge level of care

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Abstract

Background—Although preoperative risk factors have been shown to lead to postdischarge institutionalization, an association between preoperative risk factors, preoperative level of required care, and discharge to higher levels of care has not previously been demonstrated.

Materials and methods—Using an institutional American College of Surgeons National Surgical Quality Improvement Program database, a retrospective review of elderly patients undergoing nonemergent inpatient general surgery procedures was performed with the goal of identifying preoperative risk factors that indicated the need for a higher level of care on hospital discharge. Univariate and multivariate analyses were performed on the patient population.

Results—Over a 4-y period, 585 patients (29%) within the database were aged ≥ 65 y. In this population, 12% of patients required discharge to a higher level of care compared with their preoperative origin. In patients aged ≥ 65 y, impaired cognition, decreased functional capacity, advanced age (> 79 y), high American Society of Anesthesiologists class, and long hospital length of stay were found in univariate analysis to be associated with postoperative discharge to a higher level of care, although all of these variables except decreased functional capacity were also associated with a higher discharge level of care in multivariate analysis.

Conclusions—Cognitive and functional capacity scoring can be used as simple ways to indicate discharge to a higher level of care for older adults. Preoperative counseling in high-risk older adults needs to include the likelihood for discharge to a higher level of care, so that a possible referral to social work can be placed during discharge planning.

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Keywords

Preoperative geriatric assessment; Surgical outcomes; Cognitive function; Multidisciplinary team; Discharge destination

1. Introduction

As the number of older adults (aged ≥ 65 y) in the United States is anticipated to increase to 71 million by 2030, the focus on medical management of this population grows as well [1]. Older adults have surgery four times more often than the rest of the population, making care for elderly surgical patients of prime importance [2]. Recent studies have attempted to characterize elderly patients preoperatively to predict surgical outcomes [2–9]. However, there is still a need to identify preoperative measures that are not only effective but are also efficient and practical to implement.

Previous studies of elderly patients used the Comprehensive Geriatric Assessment (CGA), a tool that has been proven to predict both mortality and disability [2,3,5,6,10]. One CGA model found to correlate with poor outcomes is composed of eight domains: Katz Index of Independence in Activities of Daily Living (ADL), Lawton Instrumental Activities of Daily Living Scale (IADL), cognition, depression, fall risk, nutrition, polypharmacy, and social support [5]. Although the CGA provides a comprehensive assessment of an elderly patient, because of its many categories, it may be perceived as too cumbersome, and therefore not performed.

Previous studies have also connected preoperative variables with hospital discharge destination in elderly patients [5,9]. Discharge to a skilled nursing facility in older adults hospitalized for heart failure has been shown to result in higher 30-d and 1-y mortalities and higher rates of 30-d and 1-y rehospitalization than those patients discharged home [11]. These studies focused on specific discharge locations or examined discharge destination without considering the origin of each patient. A patient who comes to a hospital from an institution and is discharged back to the same institution is not the same as a patient who lives at home initially and is discharged to an institution after their hospital course. Therefore, patients discharged to an institution after a surgical procedure need to be considered in separate groups based on their place of origin, or the level of care they were receiving before their operation.

The purpose of this study was to use validated preoperative measurements from the proposed CGA model to create a high-risk profile for older patients regarding discharge level of care in the context of multiple discharge destinations after general surgery. In addition, this study aimed to incorporate patient origin into the determination of discharge level of care. The hypothesis is that patients with poor scores in the measured variables were more likely to be discharged to a higher level of care.

2. Materials and methods

After obtaining institutional review board approval, a retrospective review of the prospectively maintained American College of Surgeons National Surgical Quality

Improvement Program (ACS-NSQIP) database of an academic tertiary referral center was performed. Nonemergent general surgery operations between 2008 and 2012 were identified. Further inclusion criteria were adult patients (aged ≥ 18 y) who underwent a general surgery procedure after the institution of an electronic medical record (EMR) in 2008. Exclusion criteria included patients with an unknown hospital discharge destination and patients who expired while still in the hospital. These patients were excluded because they could not be accurately classified into a discharge level of care. Demographic information was recorded and compared between those aged <65 and ≥ 65 y. Since an association between older patients and discharge to a higher level of care was determined in this initial comparison between patient groups, all further analyses focused on the older adult population. All recorded variables were obtained from the ACS-NSQIP database or from the associated institutional EMR. All continuous variables were split into quartiles to ensure that enough patients would be present in each group during analysis, and so that the first or fourth quartile could be used as a high-risk group when no standard high-risk group was previously established in the literature. Unknown values for each variable were included in a separate category to be considered as a distinct group during statistical analyses.

Several operative and diagnostic factors were considered in the sample population to identify impact on discharge level of care. General surgery subspecialty, operative approach (laparoscopic *versus* open), and the absence or presence of malignancy were the three factors chosen for this study. Surgical subspecialty and/or type of procedure performed was classified into six categories based on Current Procedural Terminology codes and *International Classification of Diseases, Ninth Revision* codes as follows: intestinal and/or colorectal, hepatobiliary and/or splenic, gastroesophageal, hernia, other intra-abdominal, other nonabdominal. The origins and discharge destinations of the patients were compared with respect to these explanatory variables.

Because a complete CGA is not performed at our institution, components of the CGA model that are assessed by floor nurses on admission were specifically selected for this study. These components included measures for functional capacity and cognition, which were consistently documented in the medical record. Functional capacity was assessed using two tests: ADL and the IADL, which were both performed according to the standard protocol [12,13]. ADLs were scored based on standard scoring for the examination with a scale of 0–6 (6 being normal), whereas the scores that fell within the first quartile of all recorded scores (<2) were considered a high-risk group [13]. IADLs were recorded based on the institutional scoring system with a scale of 0–16 (16 being normal), whereas the scores that fell within the first quartile of all recorded scores (<8) were considered a high-risk group. The institutional IADL scoring for each activity is as follows: 0 = completely unable; 1 = with some help; and 2 = without help. Cognition was assessed using the standard test at our institution, the abbreviated Mini Mental State Examination (MMSE). The abbreviated MMSE was performed and scored according to customary protocol and scale (0–21) [14,15]. Cognitive impairment is defined as a score ≤ 14 [14]. Cognitive and functional capacity scores were recorded and compared against age quartiles to determine if there was any difference in scores among the age groups.

Age was assessed at the time of the operation and any age within the fourth quartile of all older patients (aged ≥ 79 y) was grouped into a variable of interest. The American Society of Anesthesiologists physical status classification system (ASA class) was assessed at the time of the operation, and scores ≥ 3 were considered high risk based on the ASA class definitions [16]. Body mass index was assessed at the time of the operation, and patients were divided into the standard categories (<18.5 is underweight, 18.5–25 is normal, 25–30 is overweight, and >30 is obese) [1]. Hospital length of stay (LOS) was measured from the admission date to the discharge date and was recorded as whole number of days. Any LOS within the fourth quartile of all older patients (≥ 9 d) was grouped into a variable of interest.

The primary outcome variable was the discharge level of care for each patient. Origins and discharge destinations for all patients were collected from the EMR to determine if patients transitioned to a different level of care compared with their place of origin. Three categories were recorded for origins and discharge destinations: home, chronic care, and acute care. Home was defined as a living residence that did not qualify as a medical support facility of any kind. This group included patients with home self-care and patients with home health services. Chronic care was defined as a skilled facility, unskilled facility, or rehabilitation center. Acute care was defined as a hospital inpatient facility or outside emergency department. Level of care was ranked among the three categories with acute care being the highest level of care and home being the lowest level of care. Patients who started at a lower level of care and transitioned to a higher level of care were grouped into a higher level of care category, whereas all other patients were grouped into an equal or lower level of care category.

A secondary outcome of interest was the presence of 30-d complications as defined by ACS-NSQIP guidelines. Patients with one or more complications were considered to have a poor outcome. Another secondary outcome of interest was the presence or absence of 30-d readmission. Both secondary outcomes were considered with respect to patients who were aged ≥ 65 y.

Statistical analyses were performed using IBM SPSS Statistics version 20 (SPSS Inc, Chicago, IL). Discrete variables were expressed as counts and percentages. Chi-square was used for univariate analyses. A chi-square P value <0.1 was used to select variables for multivariate analyses. Binary logistic regression models were used to evaluate the associations between demographic, cognitive, and functional capacity risks and discharge level of care, hospital readmissions, and postoperative complications. A P value ≤ 0.05 was considered statistically significant. Bivariate correlations were evaluated to identify variables that demonstrated significant collinearity with other independent variables, to omit collinear variables from the final multivariable logistic regression models.

3. Results

A total of 3369 nonemergent, inpatient general surgery patients were identified in the ACS-NSQIP database from 2008–2012. After exclusions, the sample size included a total of 2015 patients: 585 patients (29%) who were aged ≥ 65 y on the day of their operation and 1430 patients (71%) who were aged <65 y on the day of their operation. Initial analysis showed an

association between patients aged ≥ 65 y and discharge to a higher level of care (Table 1). In addition, both groups of patients were different in regards to race, body mass index, ASA class, LOS, origin, destination, but had a similar gender distribution (Table 1).

Patients aged ≥ 65 y ($n = 585$) were selected for further analysis. The median age of the elderly population was 73.3 y and the population ranged from 65–97 y. An overwhelming majority of the population was Caucasian (94%) and 54% of patients were female. An ASA class of 3 was present in 55% of patients, whereas a hospital LOS that was ≥ 9 d was seen in 28% of the population. For preoperative origin, 92% of patients came from a home residence, 3% of patients came from a place of chronic care, and 5% of patients came from a place of acute care. For postoperative destination, 83% of patients were discharged to a home residence, 15% patients were discharged to a chronic care setting, and 2% of patients were discharged to an acute care setting.

In regards to cognitive function, 22 patients (4%) scored ≤ 14 on the MMSE, indicating low cognitive function. For functional capacity, 138 patients (24%) scored ≤ 2 on the ADL and 157 patients (27%) scored ≤ 8 on the IADL. There was no clinical significance between the age quartiles of the elderly adults for the MMSE scores, ADL scores, or IADL scores, indicating that variation in advanced age impact these scores.

Univariate analysis revealed an association between older age, higher ASA class, longer LOS, lower MMSE score, and lower IADL score with discharge to a higher level of care (Table 2). However, an association between general surgery subspecialty, operative approach, or presence of malignancy and a higher level of care was not found (Table 2). In the multivariate model, lower MMSE score, older age, higher ASA class, and longer LOS were all correlated with discharge to a higher level of care (Table 3).

For secondary outcomes, longer LOS ($P < 0.001$), non-Caucasian race ($P < 0.04$) and higher ASA class ($P < 0.01$) were associated with one or more postoperative complications in the univariate model. Similarly, longer LOS ($P < 0.001$), non-Caucasian race ($P < 0.05$), and higher ASA class ($P < 0.04$) were associated with 30-d readmissions. In multivariate analysis, longer LOS correlated with both postoperative complications (odds ratio, 5.490; 95% confidence interval, 3.643–8.273, $P < 0.001$) and 30-d readmissions (odds ratio, 3.449; 95% confidence interval, 2.003–5.941, $P < 0.001$).

4. Discussion

This study adds to previous efforts of identifying validated preoperative measurements that predispose elderly patients for poor surgical outcomes [2–9]. This was accomplished by using components of the CGA, a widely recognized tool for screening older adults at risk of adverse postoperative effects [2,3,5,6,10]. This study aimed to show the association between certain components of the CGA and hospital discharge level of care.

In this study, discharge to a higher level care was found to be associated with numerous preoperative risk factors including low MMSE score, low IADL score, advanced age, high ASA class, and long LOS. Based on these results, it is evident that elderly patients with characteristics such as impaired cognition and decreased functional capacity are more likely

to be discharged to places of higher care than those without these characteristics. In addition, older patients who have longer hospital LOS are more likely to have at least one postoperative complication, which is expected because patients with postoperative complications would invariably need a longer hospital admission to resolve these issues. Older adult patients were also more likely to be readmitted to the hospital within 30 d when they had a longer hospital LOS.

Although IADL score was found to be associated with discharge to a higher level of care in univariate analysis, ADL score was not. This discrepancy may be explained by the definitions of ADL and IADL. ADL measures independence in basic activities, such as eating a meal without help, whereas the IADL measures independence in more complex activities, such as planning and preparing meals without help [17]. Complex activities require a higher level cognition and IADL activities are likely to fall below previous levels if these abilities become mildly impaired. In contrast, ADL activities remain unimpaired until a certain level of cognitive impairment has been reached [18]. The results of this study indicate that the inability to perform more complex tasks is associated with discharge to a higher level of care, whereas varying levels of independence in basic tasks are less likely to affect discharge level of care, meaning that the mechanism behind cognitive impairment and poor outcomes is not fully understood, and further exploration into this topic is needed.

The results from this study can be interpreted in light of what is known about postoperative outcomes in older adults. Impaired cognition and decreased functional capacity have been shown to predict poor outcomes after surgery in older patients [3,5]. Robinson *et al.* [8] found that impaired preoperative cognition correlates with longer hospital LOS, higher rates of discharge to institutional care facilities, higher rates of 6-mo mortality, increased incidence of postoperative complications, and increased incidence of postoperative delirium in elderly patients undergoing an elective procedure. Allen *et al.* determined that longer LOS in elderly patients correlates with discharge to a higher level of care [11]. Schneider *et al.* [19] discovered that longer LOS and postoperative complications are associated with readmissions in elderly patients after colorectal surgery. This study found that some of these previously measured variables, LOS, impaired cognition, and decreased functional capacity result in discharge to a higher level of care.

Although higher ASA class and advanced age were shown to be associated with discharge level of care, they are less specific indicators for this outcome because of their known predictive value. ASA class is used to assess physical state before surgery and does not aim to measure operative risk [3]. Age by itself does not increase surgical risk. Instead, factors that are associated with aging such as disease and deterioration of the body, which influence ASA class, increase the risk of adverse surgical outcomes [5].

This study had several strengths. There was a relatively large sample size considering the use of an institutional database with a limited patient age group and ACS-NSQIP data paired with data from the EMR. Because of the nature of the ACS-NSQIP capture system, selection bias was reduced in this study as surgical cases are chosen at random to obtain a 20% overall sample. This study also differs from previous studies because patient origin was considered in addition to discharge destination. Origin was deemed to be essential because a change in

the level of care for any patient signifies a change in the level of independence or functionality for a patient. This manifests itself in various lifestyle changes. In addition, patients who are discharged to higher levels of care are at a greater risk for readmission and mortality [11].

This study also had several limitations. The lack of well-established high-risk cutoff values for many of the variables resulted in defining the first or fourth quartile as a high-risk group and comparing it against the other three quartiles. Because of the establishment of the EMR in 2008, the group sizes were limited because of a lack of recorded measurements before this time. All patients were taken from a single academic, tertiary referral center serving a largely rural catchment area, so the ability to extrapolate these findings to a greater population is limited. The lack of racial diversity at the referral center also makes these results less applicable to other patient populations. All patients who were discharged to a home residence were treated as one group, despite varying levels of care within the home. Some patients were discharged home with a health service included in their care, whereas others were discharged home with self-care, but these categories were not distinguished within the ACS-NSQIP database. A future study could investigate discharge to various levels of care by differentiating home care. Selection bias is a concern in this study as only 22 cognitively impaired patients (4%) underwent a general surgery procedure. The authors were unable to determine if this is because of patient self-selection or surgeon preference. Robinson *et al.* [8] have described increased postoperative problems that are likely to be encountered in patients who show preoperative cognitive impairment. This information may contribute to the lack of cognitively impaired patients undergoing general surgery procedures by impacting operative planning and the patient consent process.

Despite these limitations, the results of this study are important for determining preoperative risk in older adults. The results of this study show that simple indicators such as MMSE and the IADL values concerning for decreased cognitive or functional capacity are associated with increased risk for discharge to a higher level of care. Administration of these simple tests takes less time than conducting a full CGA and can be important in determining preoperative and postoperative management. To further validate the use of MMSE or IADL as a means to predict an increased likelihood that a patient will require a higher level of care at the time of hospital discharge compared with the baseline preadmission level of care, a prospective study using these measures is warranted. Future studies, which capture data regarding the level of home health services provided both pre- and post-operatively, would also further differentiate between patient populations.

As institutions develop their own CGA models, cognitive status and functional assessment are critical components that should be included. Operating on individuals with low cognitive or functional capacity scores can be done if the correct system is in place to anticipate future problems. With proper preoperative management and clear expectations regarding the outcomes of surgery, elderly patients and their families can be aware of future possibilities and plan their decisions accordingly.

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Table 1

Patient characteristics based on age.

Variable	<65 y	65 y	P value
Number	1430 (71.0)	585 (29.0)	
Gender			0.99
Female	778 (54.4)	318 (54.4)	
Male	652 (45.6)	267 (45.6)	
Race *			<0.01
Caucasian	1281 (89.6)	548 (93.7)	
Non-Caucasian	143 (10.0)	33 (5.6)	
BMI [†]			<0.001
<18.5	44 (3.1)	9 (1.5)	
18.5–25	403 (28.2)	171 (29.2)	
25–30	373 (26.1)	198 (33.9)	
>30	610 (42.6)	207 (35.4)	
ASA class [‡]			<0.001
3	417 (29.2)	320 (54.7)	
LOS			<0.001
9 d	236 (16.5)	161 (27.5)	
Origin			<0.001
Home	1374 (96.1)	540 (92.3)	
Chronic care	12 (0.8)	19 (3.3)	
Acute care	44 (3.1)	26 (4.4)	
Destination			<0.001
Home	1382 (96.6)	488 (83.4)	
Chronic care	37 (2.6)	86 (14.7)	
Acute care	11 (0.8)	11 (1.9)	
Discharge level of care			<0.001
Equal/lower level of care	1403 (98.1)	513 (87.7)	
Higher level of care	27 (1.9)	72 (12.3)	

Data are presented as number (percent).

Bold *P*-values indicate statistical significance.

* Ten patients had unknown race.

[†] Normal body mass index (BMI) range is 18.5–25.[‡] Normal ASA class is 1.

Table 2

Elderly patient and operative characteristics based on discharge level of care.

Patient characteristic	Equal/lower level of care	Higher level of care	P value
Number	513 (87.7)	72 (12.3)	
Age (y)			<0.001
79	104 (20.3)	41 (56.9)	
Gender			0.47
Female	276 (53.8)	42 (58.3)	
Male	237 (46.2)	30 (41.7)	
Race *			0.25
Caucasian	482 (94.0)	65 (90.3)	
Non-Caucasian	27 (5.3)	7 (9.7)	
BMI [†]			0.37
<18.5	7 (1.3)	2 (2.8)	
18.5–25	145 (28.3)	26 (36.1)	
25–30	178 (34.7)	20 (27.8)	
>30	183 (35.7)	24 (33.3)	
ASA class [‡]			<0.001
3	265 (51.7)	55 (76.4)	
LOS			<0.001
9 d	114 (22.2)	47 (65.3)	
MMSE score [§]			<0.001
14	13 (2.5)	9 (12.5)	
>14	475 (92.6)	62 (86.1)	
ADL score			0.35
<2	118 (23.0)	20 (27.8)	
2	384 (74.9)	49 (68.1)	
IADL score [¶]			0.01
<8	128 (25.0)	29 (40.3)	
8	372 (72.5)	40 (55.6)	
General surgery subspecialty			0.55
Intestinal/colorectal	236 (46.0)	36 (50.0)	
Hepatobiliary/splenic	135 (26.3)	22 (30.6)	
Gastroesophageal	31 (6.1)	1 (1.4)	
Hernia	54 (10.5)	5 (6.9)	
Other intra-abdominal	19 (3.7)	3 (4.2)	
Other nonabdominal	38 (7.4)	5 (6.9)	
Operative approach			0.38
Open	344 (67.1)	52 (72.2)	
Laparoscopic	169 (32.9)	20 (27.8)	
Presence of malignancy			0.55

Patient characteristic	Equal/lower level of care	Higher level of care	<i>P</i> value
Yes	202 (39.4)	31 (43.1)	
No	311 (60.6)	41 (56.9)	

Data are presented as number (percent).

Bold *P*-values indicate statistical significance.

* Four patients had unknown race.

[†] Normal BMI range is 18.5–25.

[‡] Normal ASA class is 1.

[§] Twenty-six patients had unknown scores. Normal MMSE score is >14.

^{||} Fourteen patients had unknown scores. Normal ADL score is 6.

[¶] Sixteen patients had unknown scores. Normal IADL score is 16.

Table 3

Multivariate analysis for risk of discharge to a higher level of care in elderly patients.

Variable	OR	CI (95%)	P value
MMSE score [*] (> 14)	4.760	1.721–13.165	0.003
IADL score [†] (<8)	1.737	0.977–3.089	0.06
Advanced age (> 79 y)	4.424	2.534–7.724	<0.001
ASA class [‡] (> 3)	1.895	1.010–3.555	0.046
LOS (> 9 d)	5.477	3.105–9.663	<0.001

Bold *P*-values indicate statistical significance.^{*} Normal MMSE score is >14.[†] Normal IADL score is 16.[‡] Normal ASA class is 1.