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Original Article

Functional decline among elderly patients admitted for different illnesses: a cohort study

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Abstract: Background: Elderly who survive after acute insults are frequently left with intractable complications and multimorbidity. Episodes of hospitalization frequently cause physical limitations among these patients, but illness-specific estimates of functional decline are unclear. Methods: We utilized a prospectively collected cohort of elderly patients (≥ 65) admitted to the general medical wards between January 2014 and August 2014, for analysis. All participants completed questionnaires about clinical features, comorbidity profiles, and pre-morbid functional status, estimated by Barthel Index (BI) on admission. Dedicated nurse practitioners assessed BI on admission and at discharge for enrollees, and the results were analyzed according to their main admission diagnostic categories. Results: We recruited one hundred and fifty-two elderly patients (mean, 80.4 years; 51% male), among whom 55% had hypertension and 39% had diabetes. They were admitted mainly for pulmonary disorders (46%), followed by sepsis of unknown origin (11%), gastrointestinal (10%) and renal (10%) disorders, hepatobiliary (7%) and oncology disorders (7%). Elderly patients admitted for renal and pulmonary disorders had significantly lower pre-morbid BI scores, while those admitted for oncology, gastrointestinal, and neuropsychiatric disorders demonstrated more significant functional decline compared with patients admitted for other disorders (BI scores for oncology, 48.3 ± 23.6; for gastrointestinal, 48.3 ± 28.4; for neuropsychiatric, 57.5 ± 29). Conclusion: We discovered that elderly suffered from different types of illnesses might display variable degrees of functional decline on admission compared to their premorbid status. Rehabilitation programs focusing on those with neuropsychiatric disorders on admission might improve functional outcomes.

Keywords: Barthel index, elderly, functional status, geriatrics

Introduction

A lurking challenge is emerging from the horizon: the process of global aging. Increase in age is associated with anatomical and functional degeneration, the occurrence of multimorbidity, leading to a higher risk of organ injury and adverse prognoses [1, 2]. In addition to the detrimental effect on survival, advanced age also exerts negative influence on the functional outcome, another important therapeutic target in the elderly. World Health Organization (WHO) defines an individual's functional status as the ability for communication, mobility, interpersonal interactions, and self care [3]. An impairment of one's functional status is prognostically important among the elderly, as the competency for performing daily activities significantly contributes to geriatric patients' well-being and enhances their quality of life [4].

The screening and detection for functional impairment as well as frailty, a state of reduced stressor resistance and increased vulnerability toward exogenous insults, are integral components of comprehensive geriatric assessment [5, 6]. Similarly, recognizing factors influencing elderly patients' functional status is crucial for optimizing their care and for improving their prognosis. Comorbid illnesses have already been found to correlate with poorer functional status [7]. Researchers from Netherlands reported that histories of cerebrovascular accident (CVA), transient ischemic attack, and psychiatric disorders are strongly associated with impaired activities of daily liv-

ing (ADL) [8]. Another study disclosed that the number of chronic diseases, body composition, and the presence of atherosclerosis are all predictors of subsequent ADL impairment, while individual factors (gender, educational levels, and smoking) also played an important role [9]. However, the role of acute insults, that is, the precipitating events of each hospitalization, in affecting functional status is rarely investigated before.

On the other hand, the clinical significance of functional status changes upon stressor exposure is also unclear, in contrast to that of the functional status *per se*. Evidence suggests that the degree of functional status change during the hospitalization predicts post-discharge mortality better than functional status alone among older in-patients [10]. However, relatively few studies address the potential factors contributing to functional status change among geriatric in-patients. Consequently, in the current study, we attempt to investigate whether different types of acute insults, manifesting as different admission diagnoses, might confer differential impact on the functional status of the elderly being admitted.

Materials and methods

This study utilized a prospectively recruited cohort, consisting of elderly patients (defined according to age ≥ 65 years) enrolled from the general medical wards of National Taiwan University Hospital (NTUH) between January 2014 and August 2014. All elderly patients providing inform consent were enrolled on the day of admission, and a structured questionnaire including demographic profiles (age, sex, education, religion) and comorbidities was provided after interview [11, 12]. Each comorbidity was verified with chart abstraction. Hypertension and diabetes mellitus (DM) were defined as past or current use of antihypertensive and hypoglycemic agents (oral or parenteral). Coronary artery disease (CAD), heart failure (HF), and peripheral artery disease (PAD) were documented if the patient presented compatible symptoms, laboratory data, and image findings. Pulmonologists diagnosed obstructive pulmonary disease (COPD) based on compatible symptoms and physical examination findings, while cirrhosis was assessed with imaging. Chronic kidney disease (CKD) was defined as a baseline estimated glomerular filtration rate less than 60 mL/min/1.73 m^2, using the MDRD formula. Dementia and Parkinsonism were diagnosed by certified neurologists. The current study was conducted with adherence to the Declaration of Helsinki, and was approved by NTUH ethics committee (NO. 201306089RINA).

Admission diagnoses categorization

We divided the entire cohort according to different categories of admission diagnoses, including cardiovascular, pulmonary, hepatobiliary, gastrointestinal, renal, sepsis of unknown origin, oncology, and neuropsychiatric. The attending staffs that cared for the elderly were unaware of study design and determined the main admission diagnoses on the first day of admission. Diagnoses of cardiovascular illnesses included coronary vessel occlusion, myocardial ischemia, arrhythmia, aortic lesions, and others. Patients were diagnosed with pulmonary disorders if they manifested COPD/asthma, pneumonia, pleural lesions, respiratory failure, and others. Hepatobiliary and gastrointestinal disorders involved gastrointestinal bleeding, infection, inflammatory processes, and organ failure. Renal disorders included acute and chronic renal insufficiency, electrolyte imbalances, and infections. Oncology illnesses involved the treatment and the complication management of their underlying malignancies.

Evaluation of functional status

Barthel Index (BI) was utilized for functional status assessment in all participants on admission. BI denotes a scale with scores ranging from 0 to 100, with higher scores suggesting less dependence on assistants in multiple aspects of ADL. Subscales included feeding, dressing, bowel and bladder continence, use of toilet, stair climbing (scores 0 to 10 for each), bathing and grooming (scores 0 to 5 for each), as well as transfer and mobility (scores 0 to 15 for each). Nurse specialists unaware of study design conducted standardized interview with participants or their surrogate respondents (if inability to communicate or unresponsive) on admission and at discharge. Pre-morbid BI (one month before admission) was ascertained through structured questionnaires distributed to participants and their caregivers on admission. Recall bias was minimized with repeated counseling with participants themselves and their caregivers.

Table 1. Baseline clinical features of elderly enrollees

Clinical characteristics	Total
Demographic profiles	
Age (years)	80.4 ± 8.2
Gender (male %)	77 (51)
Education	
None	40 (26)
Elementary school	49 (32)
Junior high school	21 (14)
Senior high school	24 (16)
College and above	18 (12)
Religion	
None	46 (30)
Buddhist	60 (39)
Taoism	22 (14)
Catholic and Christianity	4 (3)
Others	20 (13)
Comorbidity profiles	
Diabetes mellitus (%)	59 (39)
Hypertension (%)	84 (55)
Coronary artery disease (%)	12 (8)
Heart failure (%)	27 (18)
Peripheral artery disease (%)	11 (7)
Chronic kidney disease (%)	34 (22)
Cirrhosis (%)	8 (5)
Obstructive pulmonary diseases (%)	17 (11)
Malignancy (%)	40 (26)
Old cerebrovascular accident (%)	33 (22)
Presence of hemiplegia (%)	5 (3)
Dementia and/or Parkinsonism (%)	21 (14)
Charlson Comorbidity Index	7.7 ± 2.4
Main admission category	
Cardiovascular (%)	8 (5)
Pulmonary (%)	70 (46)
Hepatobiliary (%)	10 (7)
Gastrointestinal (%)	15 (10)
Renal (%)	15 (10)
Sepsis of unknown origin (%)	16 (11)
Oncology (%)	10 (7)
Neuropsychiatric (%)	8 (5)

Data are expressed as mean ± standard deviation for continuous variables, and number (percentage) for categorical variables.

Statistical analysis

Statistical analyses were performed using SPSS 18.0 software (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed with means ± standard deviations and compared with an independent *t*-test. Categorical variables were expressed as event numbers with percentages and compared with a Chi-square test. Comparison between groups with different main admission diagnoses was conducted with one-way Analysis of Variance (ANOVA). In all analyses, a two-sided *P*-value less than 0.05 was considered statistically significant.

Results

The clinical characteristics of the participants

We enrolled one hundred and fifty-two elderly patients during the study period (**Table 1**), consisting predominantly of octogenarians (mean age, 80.4 years) with a near equal distribution of both gender. One-third of participants received elementary school education, while one-fourth did not receive any formal education. Most enrollees were Buddhists (39%), followed by no religious belief (30%), and Taoism (14%).

About half of the participants had comorbid hypertension (55%), followed by DM (39%) and a history of malignancy (26%). Less than one-fourth had CKD, a past history of CVA, dementia, Parkinsonism, and HF. Very few had comorbid CAD, PAD, and cirrhosis. The prevailing admission diagnoses among the participants were pulmonary disorders (45%), while gastrointestinal and renal disorders were the second most common diagnoses (10%). Neuropsychiatric and cardiovascular disorders were the least common admission diagnoses (5%).

Functional status of the current cohort

The mean pre-morbid BI scores of the entire cohort before their admission were 49.7 ± 41.7, with highest scores (better functional status) among elderly admitted for oncologic and hepatobiliary diseases (**Table 2**). Elderly patients with renal (39.1 ± 45) and pulmonary (36.9 ± 39.5) disorders on admission manifested significantly lower pre-morbid BI compared with those of the other groups ($P < 0.01$). On admission, significant impairment of functional status were observed among most participants; elderly admitted for oncology, gastrointestinal, and neuropsychiatric disorders exhibited more severe functional decline compared with those

Table 2. Functional status, assessed by Barthel index scores, and its change at admission according to admission diagnosis categories

Barthel index scores	Cardiovascular	Pulmonary	Hepatobiliary	Gastro-intestinal	Renal	Sepsis of unknown origin	Oncologic	Neuropsychiatric	*P* value
Pre-morbid status	79.1 ± 39.6	36.9 ± 39.5	87 ± 16	62 ± 33.5	39.1 ± 45	47.2 ± 41.7	92.5 ± 9.6	80 ± 36.7	< 0.01
On admission	58.1 ± 31.3	35.3 ± 33.8	58 ± 35.3	40 ± 29.1	29.3 ± 25.9	50 ± 26.9	46 ± 32.1	28.8 ± 25.5	0.1
Feeding	6.7 ± 4.1	4.4 ± 4.1	5 ± 4.3	4.6 ± 4	4.2 ± 3.4	7.9 ± 2.6	3.3 ± 2.6	3.1 ± 3.7	0.09
Bathing	0.8 ± 2	0.9 ± 2	1.7 ± 2.5	0.8 ± 1.9	0.8 ± 2.8	0.4 ± 1.4	0 ± 0	1.3 ± 3.5	0.88
Grooming	1.7 ± 2.6	1.3 ± 2.2	1.7 ± 2.5	0.8 ± 1.9	0.4 ± 1.4	2.1 ± 2.6	0 ± 0	0.6 ± 1.8	0.37
Dressing	5.8 ± 3.8	3.6 ± 3.8	5 ± 4.3	4.6 ± 4	3.9 ± 3	5.8 ± 2.9	3.3 ± 2.6	2.5 ± 3.8	0.38
Bowel continence	8.3 ± 4.1	6.2 ± 4.2	7.8 ± 4.4	5.8 ± 3.6	5.8 ± 4.9	9.2 ± 1.9	7.5 ± 4.2	5.6 ± 5	0.3
Bladder continence	8.3 ± 4.1	6.2 ± 4.3	7.8 ± 4.4	5 ± 3.7	3.5 ± 4.7	8.8 ± 2.3	7.5 ± 4.2	6.3 ± 5.2	0.06
Toilet use	5.8 ± 3.8	4.1 ± 3.8	6.1 ± 4.2	3.3 ± 3.3	3.9 ± 3	6.3 ± 3.1	3.3 ± 2.6	1.9 ± 2.6	0.09
Transfer (bed-to-chair)	8.3 ± 6.8	5.7 ± 5.8	8.9 ± 5.5	5 ± 5.6	4.6 ± 4.3	8.3 ± 5	5 ± 5.5	3.8 ± 5.2	0.29
Mobility (on level surface)	6.7 ± 7.5	5.2 ± 5.8	6.7 ± 5	4.6 ± 6.2	3.1 ± 4.8	7.1 ± 4.5	5 ± 5.5	2.5 ± 4.6	0.52
Stair climbing	4.2 ± 4.9	2.3 ± 3	4.4 ± 3.9	2.5 ± 3.4	1.2 ± 2.2	3.8 ± 2.3	2.5 ± 2.7	1.3 ± 2.3	0.13
Δ *(pre-morbid - admission)*	31 ± 42	0.6 ± 30	23.8 ± 26.3	48.3 ± 28.4	13.5 ± 39.1	1.7 ± 31.7	48.3 ± 23.6	57.5 ± 29	< 0.01
At discharge	52.5 ± 34.8	38.6 ± 37.4	48.5 ± 37.3	46 ± 36.8	25 ± 27.4	35.3 ± 38.3	33.5 ± 32.9	45 ± 35.1	0.63
Δ *(discharge - admission)*	-5.6 ± 25.7	3.3 ± 21.5	-9.5 ± 29.9	6 ± 33.1	-3.2 ± 26.3	-16.9 ± 33.9	-12.5 ± 47.7	16.3 ± 17.3	0.11

admitted for other disorders (the decrease of BI scores for oncology, gastrointestinal, and neuropsychiatric diagnoses, 48.3 ± 23.6, 48.3 ± 28.4, 57.5 ± 29; $P < 0.01$ compared to the others). Elderly admitted for pulmonary disorders manifested relatively insignificant functional decline on their admission (BI scores decrease, 0.6 ± 30). No significant differences were observed for the admission BI scores between participants of different admission categories ($P = 0.1$), and the subscales of BI scores were also similar among those of different admission categories.

On the other hand, groups with different admission diagnoses exhibited diverse trajectories of functional status changes; not all participants demonstrated functional improvement after hospitalization. On average, further functional decline was observed after hospitalization in elderly with admission diagnoses of cardiovascular, hepatobiliary, oncology, and sepsis of unknown etiology, although between-group differences were not observed ($P = 0.11$).

Discussion

In the current study, we observed that elderly patients admitted for different illnesses exhibited strikingly diverse pre-morbid functional status. Elderly admitted for oncology and hepatobiliary disorders had significantly better ADLs before admission, while those admitted for pulmonary and renal disorders were already functionally impaired before their hospitalization. Furthermore, those admitted mainly with gastrointestinal, oncology, and neuropsychiatric diagnoses exhibited a more severe functional decline compared to elderly patients admitted for other types of disorders.

Increasing number of older adults survived through their protracted course of cancer, and functional limitation has been recognized as an important sequel [13]. Functional impairment can occur during the initial presentation of cancer, during courses of chemotherapy or radiotherapy, and after treatment completion [14]. A US nationwide study disclosed that cancer survivors were 2 to 3 times more likely to have functional limitation than those without cancer [14]. Data from Surveillance, Epidemiology, and End Results (SEER) cancer registry similarly identified that the presence of cancer in older adults could cause significant decline in physical function irrespective of cancer types, while the presence of additional comorbid illnesses confers a 10% to 15% higher risk of further functional decline [15, 16]. Pain, sleep disturbance, depression, and cancer-related fatigue are the predominant contributors toward functional impairment among cancer-bearing elderly [17, 18]. Among this symptom cluster, fatigue is the most common symptom reported by oncology patients (prominent in over one-third) during and after therapy [19]. In the current study, most elderly patients admitted for oncology disorders mostly received management for the status of disease progression (loco-regional invasion) and for treatment-related complications; only 10% cases were admitted for work-up and treatment outlining of newly diagnosed malignancies. Although we did not measure the symptom severity of pain, depression, or fatigue in this cohort, we did find that elderly admitted for oncology disorders had significantly higher Charlson comorbidity index than the others (the former vs. the latter, 9.5 vs. 7.6; $P = 0.01$). We presumed that most elderly we recruited are physically unlimited pre-morbidly, but they are prone to sustain more severe function decline, probably due to their multi-morbidity and potentially cancer-related symptomatology. This is reasonable since older adults eligible for curative therapies of cancer are frequently more robust compared with those unable to undergo such treatment [20]. Moreover, this reminds us that treatments against malignancies and their complications might be stressful for the elderly, potentially leading to severe functional limitation.

The main illnesses among those admitted for gastrointestinal disorder in this study included gastrointestinal bleeding (46.7%) and bowel obstruction (33.3%). Prior experiences suggested that elderly developing acute gastrointestinal bleeding often had limitations in their functional status, presumably due to strict fasting and nutritional insufficiency [21]. Anemia resulting from gastrointestinal bleeding also correlates negatively with functional status in the elderly [22]. In addition, intestinal obstruction also compromises functional independence physically in a study using self-report instruments [23]. Consequently, the compound effects of anemia, the sources of gastrointestinal bleeding, and the resultant malnutrition could impair the ADL of elderly in-

patients more severely than those admitted for other disorders.

Neuropsychiatric disorders might have a significant impact on an elderly's functional independence as well. In a community-based study, older participants seldom had neuropsychiatric diagnoses, but those with such diseases manifested a nearly 5-fold higher risk of physical limitation [7]. Indeed, cognitive disturbance introduced by dementia, Parkinsonism, and other neurologic abnormalities affecting postural balance or muscular strength creates unavoidable barrier regarding ADL independence. Furthermore, neurologic disorders (dementia and Parkinsonism) as well as psychiatric illnesses such as depression, commonly co-exist and might worsen the functional status of individuals with advanced age [24]. In the current study, we discovered that those admitted mainly for neuropsychiatric disorders had more prominent functional decline compared to those for other disorders (**Table 2**). Among our enrollees, 50% were admitted for acute stroke, 75% of whom developed their first-ever stroke episodes. This is compatible with reports suggesting that admission for acute stroke of the first time confers significant deterioration in functional status, but recoverable with subsequent rehabilitation programs [25].

Elderly patients admitted for pulmonary or renal disorders were more likely to be functionally limited than the others before current admission (**Table 2**). CKD patients tend to have poorer functional status compared to those without, while the presence of COPD is associated with variable degrees of physical activity restriction [26, 27]. We found that elderly admitted with pulmonary diagnoses had significantly older age ($P < 0.01$) and were more likely to have COPD ($P = 0.03$) as well as old cerebrovascular accident ($P < 0.01$). However, no significant difference in demographic profiles and comorbidity distributions was observed between elderly admitted for renal disorders and those for non-renal disorders, except a borderline higher percentage of malignancy among the former ($P = 0.06$). Other un-discovered features affecting functional status of these elderly with CKD might exist and await further evaluation.

Limitation

Our study has its strengths and limitations. This study is one of the few reports that addressed the impact of different types of acute insults on the functional status of elderly in-patients. However, the current study is also limited by its case number and its single center nature. The applicability of our findings outside this clinical scenario might need more consideration.

Conclusion

Elderly patients are prone to develop medical complications owing to their comorbidities and organ degenerations. We found that elderly patients admitted for different illnesses exhibit a diverse degree of functional decline. In particular, those mainly admitted for oncology, gastrointestinal, and neuropsychiatric illnesses had significantly more severe functional decline compared to those admitted for other disorders. Interventions directed at patients with these diagnoses could be considered in order to improve patient morbidity and potentially, their survival.

Disclosure of conflict of interest

None.

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