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Original Article

Early Geriatric Evaluation and Management Services Reduced In-Hospital Mortality Risk among Frail Oldest-Old Patients

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ABSTRACT

Background/Purpose: Geriatric evaluation and management (GEM)-based intervention has been a well-established approach for frail older patients, but whether delayed GEM introduction during the hospital course jeopardizes clinical outcomes remained unclear.

Methods: Data of all patients admitted to the GEM unit (GEMU) of Taipei Veterans General Hospital via the emergency department (ED) from January of 2015 to January of 2019 were obtained for study. Patients were categorized into early and delayed GEM two groups. Demographic characteristics and results of functional assessments were used for analysis. All patients were followed by telephone at the first and sixth month after GEMU discharges. Mortality and functional declines during the follow-up period were used as main outcome indicators for this study.

Results: Overall, data of 194 patients (median (interquartile range,IQR) age: 91 (87-94) years, 72.2% males) were obtained for analysis and their baseline characteristics were similar between groups. Delayed GEM group (n=32, median (IQR) age: 91.0 (87.5-95.5) years, 75% males) had significantly lower Barthel Index (median (IQR): 0 (0-28) v.s. 25 (0-65), *P*=0.015) than early GEM group (n=162, median (IQR) age: 91.0 (87.0-94.0) years, 71.6% males), and higher risk for pressure sore (Braden Scale, median (IQR): 13 (12-16) v.s. 15 (13-18), *P*=0.01). GEM services successfully secure patients in both groups from in-hospital functional declines. Besides, the delayed GEM group had a significantly higher in-hospital mortality rate than the early GEM group (15.6% v.s. 4.9%, *P*=0.027).

Conclusion: Frail elderly patients with acute conditions receiving early GEM services had significantly lower in-hospital mortality risk than delayed GEM group. Further intervention study is needed to establish optimal service model for frail oldest-old patients.

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1. INTRODUCTION

Population aging is a global issue that poses a great variety of challenges to all countries, and Taiwan is no exception.[1] As one of the most rapidly aging countries, Taiwan is expected to take 8 years to become a super-aged society from an aged society that the percentage of people aged 65 years and older will exceed 20% by 2026.[2] As people age, the health characteristics may gradually change that older adults reported to have multiple chronic conditions with gradually declined physical and/or cognitive function.[3-5] These comorbid multiple complex conditions further complicate healthcare needs and related outcomes of older adults.[6] Previous studies have shown that older patients were associated with higher outpatient visits, hospitalizations with longer hospital stay.[7,8] To cope with the multiple complex care needs for older people, several specific service models have been developed and validated.[9-12] The most famous and successful model is the comprehensive geriatric assessment (CGA)-based intervention so called geriatric evaluation and management (GEM).[12-14] The efficacy of CGA-based intervention or GEM has been widely validated,[15,16] but the implementation of these effective service models in acute general hospitals was not widely accepted internationally.

Currently, acute general hospitals may provide these services in specific units, such as acute care for elders (ACE) unit or geriatric evaluation and management unit (GEMU), or the inpatient consultation geriatric team model.[17-19] Despite that specifically designed care units and inpatient consultation teams may differ in clinical outcomes, early implementation of GEM process may play an important role to secure the quality of care for the frail older patients.[20] However, in most acute general hospitals, patients were often admitted via the emergency department (ED) and the triage and decision of ED physicians may greatly change the outcomes of frail older patients.[21,22] Traditionally, ED physicians admit patients based on their illness and treatment needs, but those judgements were usually based on organ disease instead of functional needs. Moreover, timely provision of GEM for frail older patients with multiple complex needs may be the essential approach for patient outcome.[20,23,24] However, GEM services and GEMU beds may not be available for patients visited ED, and these patients in need may be transfer to other medical wards or transitional care units. Hence, this study aimed to compare the clinical outcomes of frail oldest old patients visiting ED with acute conditions receiving timely or delayed GEM services, so to optimize the strategy to improve quality of care for senior patients.

2. METHODS

2.1. Study Design and Participants

This is a retrospective cohort study of all patients admitted to the GEMU of Taipei Veterans General Hospital via ED from January of 2015 to January of 2019. Data of hospitalization and results of CGA were obtained for study. All patients met the following criteria and were allocated to GEMU by ED physicians: (1) aged 75 years and older, (2) present with functional impairment or disability, and (3) having multiple comorbid conditions instead of single acute condition. When the GEMU bed is available, patients would be admitted directly to GEMU via ED, and patients may be admitted to the transitional care unit if GEMU bed is unavailable. The transitional care unit was supported by hospitalists and patients would be transferred to GEMU when GEMU beds available. Hence, in this study, patients were classified into (1) early GEM group: admitted to GEMU directly via ED, and (2) delayed GEM group: admitted to GEMU via the transitional care unit. In an elderly-friendly environment, GEMU provided CGA for elderly patients at the same time of treatment of their diseases. Patients in GEMU received different dimension of care offered by multi-disciplinary team, inclusive of nutritional intervention, medication adjustment, physical, occupational, and speech therapy, aiming to reduce the possibility of functional decline or disability after admission. This study was approved by the Institutional Review Board of Taipei Veterans General Hospital (IRB-TPEVGH No.: 2020-09-011AC).

2.2. Functional Assessment

When admitted to GEMU, all patients would receive the first CGA in the first 72 hours of admissions to GEMU, and a follow-up CGA was performed before hospital discharge. The CGA performed in the GEMU was conducted by trained case managers.[25,26] Demographic characteristics, including past and personal medical history, socioeconomic status, educational level, medication history, current medication list and others were collected for this study. Besides, case managers performed various functional assessments for all patients, including cumulative illness rating scale for geriatrics (CIRS-G),[27] Barthel index,[28] instrumental activities of daily living (IADL),[29] mini-mental state examination (MMSE),[30] geriatric depression scale-5 (GDS-5), [31] mini-nutritional assessment – short form (MNA-SF),[32] STRATIFY fall risk assessment tool,[33] Braden scale,[34] 6-meter walking speed, timed up-and-go test,[35] and handgrip strength.[36,37] The case managers would provide the CGA information for team members to make a care plan separately after the evaluation. All patients were followed by case managers by telephone at the first and sixth month after GEMU discharges. Survival status and declines in Barthel index during the follow-up period were assessed and were the major outcome indicators for this study.

2.3. Statistical Analysis

In this study, all continuous variables were expressed as median and interquartile range and the categorical variables were expressed as numbers (percentage). Comparisons between continuous variables were done by student's *t*-test or Mann-Whiney U test when appropriate. Comparisons between categorical data was done by the chi-square ($\chi 2$) test or Fisher exact test when appropriate. Multivariate logistic regression was used to evaluate the association between mortality status and timing of GEM services. The mortality status included in-hospital mortality and 6-month mortality after discharge. A *P*-value (two-tailed) of $p < 0.05$ was deemed statistically significant. All statistical analysis was performed by the commercial statistical software (SPSS 22.0, IBM, USA).

3. RESULTS

Table 1 summarized the demographic characteristics of all study participants that data of 194 patients (median (IQR) age: 91 (87-94) years, 72.2% males) were obtained for analysis. Baseline characteristics between groups were similar, which reflected the consistency of the GEMU evaluated by ED physicians. Among all patients, 32 were admitted to GEMU after he transitional care units, i.e. delayed GEM group (median (IQR) age: 91.0 (87.5-95.5) years, 75% males), and they had significantly lower Barthel index (median (IQR): 0 (0-28) v.s. 25 (0-65), *P*=0.015) than early GEM group (*n*=162, median (IQR) age: 91.0 (87.0-94.0) years, 71.6% males), and higher risk for pressure sore (Braden scale, median (IQR): 13 (12-16) v.s. 15 (13-18), *P*=0.01) (Table 2). For all patients, functional status were improved with GEM services, however, the delayed GEM group had a significantly higher in-hospital mortality rate than the early GEM group (15.6% v.s. 4.9%, *P*=0.027). Adjusted for confounding factors, the delayed GEM group was a risk factor of in-hospital mortality (OR=3.572, 95%CI 0.924-13.801, *P*= 0.065). In addition, patients with disability (Barthel

Table 1. Basic characteristics of frail elderly patients admitted to the GEMU of an acute hospital

Data show number (%) or median (interquartile range, IQR)	At admission (n=194)	At dscharge (n=181)	*P*-value
Demographic characteristics			
Age (years)	91 (87-94)	-	-
Sex (male, %)	140 (72.2)	-	-
Smoking, n (%)	14 (7.2)	-	-
Drinking, n (%)	7 (3.6)	-	-
Education years	9 (6-16)	-	-
Body mass index (kg/m^2)	20.86 (18.60-23.02)	-	-
Institutional care, n (%)	60 (30.9)	-	-
Married, n (%)	82 (42.3)	-	-
Mortality status			
In-hospital Mortality, n (%)	13 (6.7)	-	-
Mortality at 1st month of discharge, n (%)	5 (2.6)	-	-
Mortality at 6th month of discharge, n (%)	21 (10.8)	-	-
Functional Assessment			
MMSE	14.5 (9-21)	-	-
CIRS-G	1.75 (1.5-2)	-	-
BI	20 (0-55)	20 (0-57.5)	0.311
Disability (BI ≤40), n (%)	119 (65.7)	117 (64.6)	0.158
IADL	0 (0-1)	0 (0-1)	0.858
GDS-5	2 (1-3)	2 (1-3)	<0.001
MNA-SF	6 (4-8)	6 (4-8)	0.570
STRATIFY	2 (1-2)	1 (1-2)	0.021
Braden scale	15 (13-18)	15 (13-19)	<0.001
Slowness or unable to walk, n (%)	122 (67.4)	123 (68)	0.828
Low hand grip strength, n (%)	59 (32.6)	70 (38.7)	0.004
Physical frailty (CHS ≥3), n (%)	180 (92.8)	179 (92.3)	0.481
Malnutrition (MNA-SF ≤7), n (%)	119 (65.7)	123 (68)	0.207
Drug number	6 (4-9)	8 (6-10)	<0.001
EuroQol-VAS Score	60 (40-80)	60 (50-80)	0.203

Note: MMSE, Mini-mental state examination; CIRS-G, Cumulative illness rating Scale for geriatrics; BI, Barthel index; IADL, Instrumental activities of daily living; GDS-5, Geriatric depression scale-5; MNA-SF, Mini-nutritional assessment–short form; STRATIFY, St. Thomas's risk assessment tool in falling elderly inpatients; EuroQol-VAS Score, European quality of life-VAS.

Table 2. Comparisons between early GEM group and delayed GEM group

Data show number (%) or median (interquartile range, IQR)	Early GEM Group	Delayed GEM Group	*P*-value
At admission	**n=162**	**n=32**	
Demographic characteristics			
Age (years)	91.0 (87.0-94.0)	91.0 (87.5-95.5)	0.807
Sex (male, %)	116 (71.6)	24 (75)	0.695
Body mass index (kg/m^2)	20.70 (18.60-22.96)	21.45 (18.68-23.88)	0.613
Smoking, n (%)	10 (6.2)	4 (12.5)	0.186
Drinking, n (%)	7 (2.5)	0 (0)	0.237
Education years	9.0 (6.0-16.0)	7.5 (6.0-16.0)	0.618
Institutional care, n (%)	47 (29)	13 (40.6)	0.227
Married, n (%)	69 (42.6)	13 (40.6)	0.837
CIRS-G	1.75 (1.50-2.00)	1.71 (1.33, 2.00)	0.763
Delayed days	-	5 (4-6)	-
Functional Assessment			
MMSE	15 (9-21)	14 (10-25)	0.331
BI	25 (0-65)	0 (0-28)	0.015
Disability (BI ≤40), n (%)	102 (63)	28 (87.5)	0.007
IADL	0 (0-1)	0 (0-0)	0.285
GDS-5	2 (1-3)	2 (1-4)	0.817
MNA-SF	6.0 (3.0-8.0)	7.0 (4.5-8.0)	0.245
STRATIFY	2 (1-2)	1 (1-2)	0.257
Braden scale	15 (13-18)	13 (12-16)	0.010
High pressure sore risk (Braden scale <16), n (%)	94 (58)	22 (68.8)	0.258
Slowness or unable to walk, n (%)	111 (68.5)	23 (71.9)	0.707
Low Handgrip Strength, n (%)	51 (31.5)	17 (53.1)	0.019
Physical frailty (CHS ≥3), n (%)	151 (93.2)	29 (90.6)	0.606
Malnutrition (MNA-SF ≤7), n (%)	112 (69.1)	18 (56.3)	0.157
Drug number	6.0 (4.0-9.0)	6.0 (3.0-8.5)	0.475
EuroQol-VAS score	60.0 (38.5-80.0)	80.0 (50.0-90.0)	0.164
High fall risk (STRATIFY ≥2), n (%)	84 (51.9)	14 (43.8)	0.402
At discharge	**n=154**	**n=27**	
Functional Assessment			
BI	25 (0-65)	0 (0-40)	0.177
Disability (BI ≤40), n(%)	95 (61.7)	22 (81.5)	0.047
IADL	0 (0-1)	0 (0-0)	0.477
GDS-5	2 (1-3)	2 (1-3)	0.764
MNA-SF	6 (4-8)	6 (5-8)	0.412
STRATIFY	1 (1-2)	1 (1-2)	0.369
Braden Scale	15 (13-19)	14 (13-17)	0.172
High pressure sore risk (Braden Scale <16), n(%)	84 (54.5)	18 (66.7)	0.241
Slowness or unable to walk, n(%)	102 (66.2)	21 (77.8)	0.236
Low Handgrip Strength, n(%)	56 (36.4)	14 (51.9)	0.127
Physical frailty (CHS ≥3), n(%)	143 (92.9)	23 (85.2)	0.182
Malnutrition (MNA-SF ≤7), n(%)	105 (68.2)	18 (66.7)	0.876
Drug number	8 (6-10)	7 (6-12)	0.637
EuroQol-VAS Score	62.5 (50.0-80.0)	60.0 (55.0-90.0)	0.937
High fall risk (STRATIFY ≥2), n(%)	76 (49.4)	12 (44.4)	0.638
Mortality			
In-hospital Mortality, n(%)	8 (4.9)	5 (15.6)	0.027
Mortality at 6th month after discharge, n(%)	18 (11.7)	3 (11.1)	0.931

Note: MMSE, Mini-mental state examination; CIRS-G, Cumulative illness rating scale for geriatrics; BI, Barthel index; IADL, Instrumental activities of daily living; GDS-5, Geriatric depression scale-5; MNA-SF, Mini-nutritional assessment–short form; STRATIFY, St. Thomas's risk assessment tool in falling elderly inpatients; EuroQol-VAS score, European quality of life-VAS.

Table 3. Independent associated factors of mortality status

	Odds ratio	95% confidence interval	*P*-palue
In-hospital			
Age	3.052	0.769-12.104	0.112
Sex (Male)	0.58	0.161-2.084	0.404
Delayed GEM Group	3.572	0.924-13.801	0.065
CIRS-G	3.23	0.964-10.822	0.057
Disability at admission (BI ≤40)	0.619	0.086-4.431	0.633
Malnutrition at admission (MNA-SF ≤7)	2.498	0.436-14.31	0.304
High Pressure sore risk at admission (Braden scale <16)	3.358	0.45-25.04	0.237
Six-month after discharge			
Age	0.588	0.215-1.609	0.301
Sex (Male)	4.127	0.855-19.92	0.078
Delayed GEM Group	0.774	0.798-3.035	0.714
CIRS-G	1.618	0.586-4.462	0.353
Disability at discharge (BI ≤40)	6.534	1.097-38.934	0.039
Malnutrition at discharge (MNA-SF ≤7)	0.59	0.157-2.217	0.434
High pressure sore risk at discharge (Braden scale <16)	1.051	0.277-3.987	0.942

The in-hospital variables adjusted in the regression models were age, gender, group, cumulative illness rating scale for geriatrics (CIRS-G), disability at admission, malnutrition at admission and high pressure sore risk at admission. *Statistically significant odds ratio (*P*-value <0.05). The six-month after discharge variables adjusted in the regression models were age, gender, group, cumulative illness rating scale for geriatrics (CIRS-G), disability at discharge, malnutrition at discharge and high pressure sore risk at discharge. *Statistically significant odds ratio (*P*-value <0.05).

index ≤40) at discharge was a risk factor of six-month mortality after discharge (OR=6.534, 95%CI 1.097-38.934, *P*=0.039) (Table 3).

4. DISCUSSION

Hospitalists may play multiple roles in modern healthcare systems and frail older patients surely posed certain challenges. In this study, hospitalists responsible for the transitional care units were established to reduce ED congestion, and patients admitted to the transitional care units were those have been clinically studied by ED physicians. All patients included in this study were those who were assigned to GEMU by ED physicians, and were admitted to the transitional care units due to the lack of GEMU beds. When the GEMU beds were available, these patients were transferred to GEMU from the transitional care units. In the present study, we found that frail elderly patients with acute conditions receiving early GEM services had significantly lower in-hospital mortality risk than those receiving delayed GEM services. Consequently, older patients with acute conditions might receive GEM services as soon as possible at emergency department admission to reduce the mortality.

Previous studies have reported that disability is associated with all-cause mortality risk in elderly population.[3,4,38,39] Patients with better physical function usually have low mortality rate. In the present study, patients without disability (Barthel index >40) at discharge was significantly associated with lower risk for 6-month mortality after GEMU discharge. Physical function at discharge played a strong factor on long-term survival.[40] Therefore, the improvement of the physical function before discharge could be an important role to reduce the mortality rate of elderly patients.

There are some limitations to the present study. First, the study population was much older than the general elderly population in Taiwan. This group of people may be more disability. It can lead to higher mortality risk. Second, most of the patients of delayed GEM group in the study were disability or in bedridden status. This population may have no progress possibility or may lead to higher mortality risk.

Third, the population of delayed GEM group was small.

In conclusions, GEM services provided good effects to frail elderly patients with acute conditions. Although the delayed GEM group had a significantly higher in-hospital mortality rate than the early GEM group. Further intervention study is needed to establish the most optimal service model for frail oldest-old patients.

CONFLICTS OF INTEREST

All authors have declared that no support from any organization for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years and no other relationships or activities that could appear to have influenced the submitted work.

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