Comprehensive geriatric assessment increases 30-day survival in the aged acute medical inpatients

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ABSTRACT

INTRODUCTION: Age and comorbidity are associated with length of stay (LOS) and mortality. Our aim was to compare acutely ill elderly medical patients in geriatric care with general medical care, and to examine the effects of comprehensive geriatric assessment (CGA).

MATERIAL AND METHODS: In an observational study, we used data from patients aged 80+ years who had been acutely admitted to departments of medicine at Aarhus University Hospital in the period from 1 January 2009 to 31 December 2010. Age, comorbidity and LOS in the Geriatric Department (GD) were compared with those of the general medical departments (MD). A subgroup analysis was made on patients admitted during a 3.5-month period.

RESULTS: A total of 3,877 patients were hospitalized of whom 27% were admitted to the GD. The mean age of the GD patients was 86.9 years versus 85.7 ($p < 0.05$). Comorbidity was higher in the GD patients than in the MD patients ($p < 0.05$). No difference was found in LOS. GD patients were hospitalized for median seven days versus median six days in MD patients ($\beta = 1.04$ (95% confidence interval (CI): 0.98-1.10)). In the subgroup analysis (n = 496), no differences were shown in 30-day readmission (14% versus 13%) (odds ratio (OR) = 1.08 (95% CI: 0.57-2.02)). Thirty-day mortality in GD patients was lower than in MD patients (6% versus 13%) (OR = 0.40 (95% CI: 0.17-0.92)).

CONCLUSION: An acutely ill elderly patient seems to benefit from CGA in a geriatric department. Short-term mortality is reduced despite higher age and comorbidity and the length of stay or readmission rate were not increased.

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ORIGINAL ARTICLE

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Many aged medical patients admitted to hospital with an acute disease are vulnerable due to multimorbidity, functional disability and/or social problems [1]. Age and comorbidity are associated with longer hospital stay and are important predictors of mortality after acute medical admission [2-4]. Hospitalization increases the risk of delirium and nosocomial infection in the elderly medical patient [5]. Up to 50% of elderly patients experience physical impairments during hospitalization, and only half have re-established their habitual physical abilities three months after discharge [6]. It has been demonstrated that acute medical re-admissions are preventable [7]. Half of the acutely admitted medical patients are discharged the day after hospitalization [8]. The risk of re-admission is highest in elderly medical patients immediately after their discharge from hospital [1]. Additionally, almost one third of inpatient days in Danish hospitals are caused by unnecessary waiting [9].

Comprehensive geriatric assessment

Comprehensive geriatric assessment (CGA) is defined as "a multidimensional interdisciplinary diagnostic process focusing on a frail elderly person's medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and follow-up" [10].

Models of CGA have been developed in different healthcare settings and meet different needs. Several models have demonstrated their effectiveness. A recent Cochrane review concluded that CGA yields a better patient outcome than conventional care in a hospital setting [11]. There was a clear improvement in the chances that assessed patients would be alive and in their own home up to one year after an emergency hospital admission [11].

Comprehensive geriatric assessment in Denmark at Aarhus University Hospital

In Aarhus, acute medical patients are admitted at two different emergency medical wards (Tage Hansensgade and Nørrebrogade). CGA is performed only in the emergency ward at Tage Hansensgade and in the acute geriatric ward (GD) at the same location. Patient care, medical intervention and treatment, nutrition, training and social concerns are catered for by a multidisciplinary specialist team including medical, nursing and therapy staff. Members of the team meet with the patient and his or her relatives to discuss goals and plans for discharge one of the first days of hospitalization. Continuity of care is planned in cooperation with primary health care. The multidisciplinary team is responsible for establishing a relevant assessment and rehabilitation plan. Patients are primarily transferred to the Geriatric Department if they have major social problems, a low functional level and high comorbidity. Severe illness is not a

reason for refusing admission to the Geriatric Department.

Prior to discharge, the need for more assistance at home and for assistive devices is identified. At discharge, the patient is escorted home by a member of the staff in one of the department's cars. On arrival, the staff member ensures that there is food in the fridge, that new prescribed medicine is available, and that the medicine at discharge is consistent with the medication record at home. In complex situations, a meeting is arranged with representatives from primary health care to bridge the gap between the sectors. The patient's relatives are invited as well. Important information is passed to the primary sector and necessary reassessments are made. Geriatric follow-up is offered within the first two weeks after discharge if community care rehabilitation is not established. In addition, X-rays or other examinations can take place on an out-patient basis after discharge.

Our aim was to examine the effects of a comprehensive geriatric assessment and intervention in the aged acute medical patients on length of hospital stay (LOS), readmission and short-term mortality in a geriatric ward compared with general medical wards.

MATERIAL AND METHODS

Design and population

This study was designed as a cross-sectional study followed by a subgroup study in a retrospective follow-up design.

In the cross-sectional study, patients aged 80 years or older were included provided that they were acutely admitted to the Departments of Medicine at Aarhus University Hospital in the period from 1 January 2009 to 31 December 2010 either via the emergency medical ward or other hospital departments or directly from home. In order to make the groups comparable, we excluded patients who were admitted to departments of neurology, cardiology, nephrology or haematology, and patients discharged directly to their homes from the emergency medical ward.

The subgroup analysis was made on patients consecutively admitted to the emergency medical ward and transferred to the geriatric or other medical departments in a randomly selected period from 1 January 2009 to 15 April 2009.

Data

Patients were identified by the Danish National Patient Registry (DNPR).

In the cross-sectional study, we grouped the identified patients by department codes into patients admitted to the Geriatric Department (GD) and patients admitted to general medical departments (MD). The diagnoses in each acute hospitalization were obtained from the DNPR according to the International Classification of Diseases, Tenth Revision (ICD-10). We calculated the patients' comorbidity burden using the Charlson Comorbidity Index (CCI). The patients' age at admission and LOS in the medical departments were calculated from DNPR data.

In the subgroup study, data were collected manually from the medical records on each patient by two researchers. Information on readmission and 30-day mortality was obtained from the DNPR and the Danish Civil Registration System, respectively. Readmission was defined as hospitalization within 30 days after discharge. Only acute readmissions were included in the 30-day readmission rate. Mortality was calculated as in-hospital mortality, 30-day and 90-day mortality after admission.

Statistical analysis

We compared the GD patients with the MD patients with regard to age, comorbidity and LOS. The mean age was analysed using Student's t-test by equal variance. Comorbidity was categorized and presented at three levels (0 = low, 1-2 = moderate, and 3 or more = high), and the non-parametric data were analyzed by Wilcoxon rank sum test. Data on LOS were not normally distributed, and a logarithmic transformation was made to permit a linear regression model with adjustment for age. Age is a potential confounder and was checked. Post-estimation was made by checking the residuals in the regression model. Using a logistic regression model, the dichotomized data on readmission and mortality were analyzed and adjusted for gender and age. Post-estima-

TABLE 1

Characteristics of all 80+ aged patients acutely admitted to the medical departments in Aarhus University Hospital (Tage-Hansens Gade and Nørrebrogade) during 2009 and 2010.

Overall, n (%)	3,877 (100.0)
Medical departments, n (%)	
Geriatric	1,040 (26.8)
Endocrinology	1,673 (43.2)
Internal medicine	551 (14.2)
Infection	304 (7.8)
Lung	191 (4.9)
Hepato-gastroenterological	118 (3.1)
Gender, n (%)	
Female	2,530 (65.3)
Male	1,347 (34.7)
Age, years, mean ± SD	86.0 ± 4.42
Comorbidity level,[a] n (%)	
Low	2,407 (62.1)
Moderate	1,348 (34.7)
High	122 (3.2)

SD = standard deviation.
a) Three levels of comorbidity defined on Charlson Comorbidity Index: scores of 0 (low), 1-2 (moderate), and 3 or more (high).

TABLE 2

Diagnosis reported at discharge in 80+ aged patients acutely admitted to the Geriatric Department or the other medical departments in Aarhus University Hospital during 2009 and 2010.

Action-diagnosis[a]	Geriatric department, % (n = 1,040)	General medical departments, % (n = 2,837)	Relative risk ratio (95% CI)
Enteritis and gastritis	0.5	2.1	0.23 (0.09-0.59)*
Sepsis	4.6	5.5	0.87 (0.68-1.12)
Other infections e.g. tuberculosis, sexually transmitted diseases	3.0	4.0	0.79 (0.58-1.09)
Cancer	4.0	1.3	2.00 (1.61-2.48)*
Anaemia	4.4	3.9	1.09 (0.84-1.40)
Metabolic disorder and endocrine diseases	1.2	1.8	0.75 (0.46-1.23)
Diabetes	0.6	1.5	0.46 (0.22-0.98)*
Electrolyte disorder, e.g. dehydration	8.9	5.4	1.44 (1.22-1.71)*
Delirium	2.1	2.3	0.93 (0.65-1.34)
Disease of the nervous system	2.1	0.9	1.72 (1.26-2.36)*
Hypertension	2.5	1.9	1.23 (0.90-1.70)
Pneumonia	29.0	31.3	0.92 (0.82-1.03)
Chronic obstructive pulmonary disease	3.9	3.5	1.10 (0.85-1.43)
Other lung diseases	2.7	6.0	0.51 (0.36-0.72)*
Diseases of the digestive system	2.2	2.8	0.83 (0.58-1.19)
Disease of the muscle, bone or connective tissue	2.1	2.0	1.04 (0.73-1.49)
Diseases of the kidneys	1.8	1.5	1.16 (0.80-1.70)
Cystitis	14.0	3.9	2.30 (2.04-2.60)*
Diseases of the genitourinary system	1.3	3.9	0.41 (0.25-0.68)*
Symptoms and abnormal findings[b]	2.9	7.9	0.43 (0.30-0.60)*
Injury and poisoning	4.6	2.1	1.69 (1.36-2.10)*
Other disease (incidence < 1%) e.g. diseases of the skin, arthritis, benign tumour and malnutrition	1.6	4.5	0.42 (0.27-0.66)*

CI = confidence interval.
a) The diagnosis that caused the hospitalization. Diagnosis classification is based on a Danish version of WHO's "International Statistical Classification of Diseases and Related Health Problems (ICD-10)".
b) The majority of the symptoms and findings are: dizziness, urine-retention, fall, fever, pain, high sedimentation rate, fainting and death.
*) $p < 0.05$.

tion was performed by a receiver operating characteristics ROC curve. Analyses were performed using Stata version 11.

Trial registration: Clinicaltrials.gov - id: CGA-GD-2011.

RESULTS

Patient characteristics

We identified 3,877 elderly patients who were acutely admitted to the medical departments during 2009 and 2010. Approximately two thirds of all the patients were females. Their mean age was 86 years. At least one severe disease, according to the CCI, was present in 38% of the patients (**Table 1**). The most frequent cause of the acute admission was pneumonia (**Table 2**).

Geriatric versus general medical care

Nearly one third of the patients (n = 1,040) were admitted at the GD and received CGA. The mean age of the GD patients was 86.9 years (standard deviation (SD) 4.41), and the mean age of the MD patients was 85.7 years (SD 4.38). A Student's t-test by equal variance showed that the GD patients were older than the MD patients (difference = 1.24 years (95% confidence interval (CI): 0.92-1.55); $p < 0.001$).

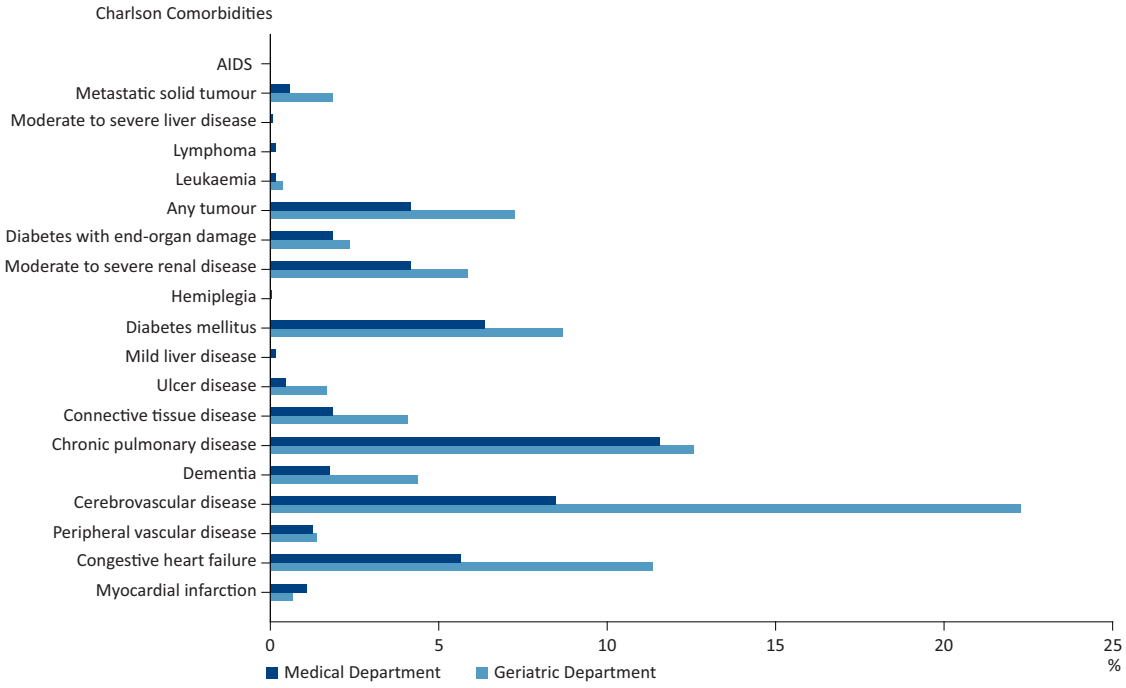
Comorbidity was higher among GD patients (**Figure 1**). In GD patients, 48% had a low level of comorbidity versus 65% among MD patients. 48% of GD patients had a moderate comorbidity level versus 32% of MD patients, and 4.4% a high comorbidity level versus 2.9% in MD patients ($p < 0.05$).

With regard to the cause of hospitalization, the majority of the diagnostic categories were equally distributed in the groups, but more GD than MD patients were hospitalized due to cystitis, cancer, electrolyte disorder, injury and drug poisoning. Correspondingly, in the MD patients, more hospitalizations were caused by gastritis, diabetes, lung and genitourinary diseases, symptoms and abnormal findings than in the GD patients (Table 2).

The LOS in the GD patients was median seven days (interquartile range: 4-10) and 7.7 mean days (SD 5.6). In the MD patients, the LOS was median six days (interquartile range: 3-11) and mean 8.4 days (SD 12.2). No

FIGURE 1

Incidence of comorbidity burden at admission, measured by Charlson Comorbidity Index in medical patients acutely admitted at Geriatric Department or at the general medical departments at Aarhus University Hospital.



difference was found in an unadjusted regression model (β = 0.91 (95% CI: 0.79-1.04)). When adjusted for age, still no difference was found (β = 1.04 (95% CI: 0.98-1.10)). There was no interaction between the LOS and age (95% CI: 0.99-1.06).

Readmission and mortality

In the subgroup analysis, 13% of the patients from the cross-sectional study were included. A total of 496 patients were admitted through the emergency medical ward and transferred either to the GD (22%) or to the MD (78%) during the first 3.5 months of 2009.

No differences were shown in the rates of 30-day acute readmission. The adjusted odds ratio was 1.08 (95% CI: 0.57-2.02). No interactions were found between readmission and gender and age, respectively. In GD patients, the 30-day mortality rate was lower than in the MD patients; when adjusted for age and gender, the odds ratio was 0.40 (95% CI: 0.17-0.91) (**Table 3**). Age was associated with 30-day mortality, and testing the association revealed no interaction (p = 0.40).

TABLE 3

Subgroup analysis of mortality in all 80+ aged patients acutely admitted through the emergency medical ward at Aarhus University Hospital from January 1 to April 15, 2009.

	Geriatric department, n (%) (N = 109)	General medical departments, n (%) (N = 387)	Adjusted[a] odds ratio (95% CI)
In-hospital mortality (%)	3 (2.8)	34 (8.8)	0.25 (0.07-0.83)*
30-day mortality (%)	7 (6.4)	50 (12.9)	0.40 (0.17-0.91)*
90-day mortality (%)	24 (22.0)	86 (22.2)	0.87 (0.51-1.47)

CI = confidence interval.
a) Adjustment of age and gender in a logistic regression model; *) p < 0.05.

DISCUSSION

We found that elderly patients acutely admitted to the Geriatric Department were older and had a higher comorbidity burden than patients admitted to the general medicine departments. It appeared that some patient selection by health care professionals took place at admission. The frailest patients according to comorbidity were directly admitted to or transferred to the GD. Although the geriatric patients were older and more burdened with comorbidity, results from the subgroup analysis showed that the GD could keep a rate of acute readmissions equal to that of the MD, and CGA seemed to lower short-term mortality. Several studies have demonstrated that elderly medical patients do better when hospitalized in a geriatric ward than in other medical departments [12, 13].

The diagnoses causing hospitalizations in the geriatric departments may not be the same across the country. Cultural variations and different geriatric settings most likely create diversity between patient populations. In Aarhus University Hospital, the aged patient who is admitted to the Geriatric Department is as acutely ill as a patient admitted to the remaining med-

ical departments. The high 90-day mortality rate found in the patients hospitalized at the general medical departments was equal to the rate found in a previous study regarding aged patients in the medical departments at Aarhus University Hospital, Nørrebrogade [4]. Likewise, we found the same 30-day mortality rate of 13% as they found in the patients from the general MDs [4]. However, in our study, we found that among the patients transferred to the GD, only 6% died within 30 days.

CGA in Denmark exists in several versions. In this study's version, we examined CGA as a complete solution spanning several aspects of CGA based on knowledge from the internationally validated geriatric intervention and assessment studies. Nevertheless, in our version, it is not obvious which parts of the assessments are the most effective. One of the geriatric interventions is the follow-home arrangement. A recent Danish cost-benefit analysis of a follow-home arrangement in the primary home care sector reported a total gain of 366 Euro per patient, and both patient and primary home care staff were very satisfied [14]. But no economic analysis of the hospital-based follow-home arrangement has been made in Denmark, and it would be an obvious candidate for further investigation. International studies demonstrate a positive effect on the number of re-admissions from hospital-based follow-home arrangements [15-17]. A Cochrane review showed that geriatric intervention, including early discharge planning and supported discharge, improves health care efficacy [18]. Other studies have shown a reduction in LOS as well as readmission, and mortality [17, 19].

Based on the present study and several validated studies in this field, we cautiously recommend in-hospital CGA as performed in Aarhus combined with supported discharge to elderly acute medical patients. To further improve the effect of CGA in the acutely ill elderly medical patients, the concept: "Early discharge-hospital at home" is the most recent initiative to reduce the length of hospital stay and to increase the elderly medical patients' satisfaction [15, 20]. CGA at home requires more attention to the frail elderly population and should be examined and performed in a clinical randomized design conducted with a view to preventing readmission and lowering mortality.

This cross-sectional study is based on a large population. Limitations must be considered when data are collected retrospectively from the DNPR. It would have been obvious to adjust for other relevant parameters, e.g. functional ability, but they could not be obtained from the DNPR. Furthermore, it is possible that the information on IDC-10 codes was insufficient when codes were registered only for the present hospitalization. To improve the validity, comorbidity might have been recorded retrospectively for several years to include diagnoses from former contacts with the health care system. However, in the analysis potentially missing diagnoses are distributed equally in both groups. In the subgroup, the analyses are made on a smaller dataset and limitations must be considered. Adjustment of the estimates was only performed for gender and age, but may have been performed according to comorbidities.

Multidisciplinary conference at the Emergency Medical Ward. The elderly medical patient is referred either to the Geriatric Department or to one of the other medical departments in the hospital.

In conclusion, acutely ill elderly patients seem to benefit from CGA in the context of a geriatric in-hospital intervention followed by a follow-home arrangement. Short-term mortality was reduced despite a higher age and higher comorbidity and the length of hospital stay or the readmission rate were not increased.

Ethics

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article. No funding was provided. The study was approved by the Danish Data Protection Agency and was registered in www.clinicaltrials.gov by the Unique Protocol ID: CGA-GD-2011.

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