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Predictive Factors of Post-Discharge Mortality in the Hospitalised Elderly

Y H Ang, S F Wong, K M Chan

ABSTRACT

Aim: To study the death rate of non-institutionalised elderly after discharge from hospital, describe the causes of death and identify predictive factors of mortality.

Methods: Vital status and cause of death of patients was ascertained by linkage to the death registry 1 year post discharge. Age, sex, race, marital status, housing and class of ward (to reflect socioeconomic status), presence of carer, Elderly Cognitive Assessment Questionnaire (ECAQ) score, Barthel score, presence of depression, number of chronic illnesses and length of stay in the hospital were studied as potential predictive factors for mortality using Cox proportional hazard regression models.

Results: Death occurred in 38 out of 113 patients. The commonest causes of death were malignancy (18%) and cerebrovascular disease (18%). Barthel score and length of stay were independent significant predictive factors of mortality. Elderly with low ECAQ score, with carers and from C class wards also had higher mortality although these results were not statistically significant.

Conclusion: Post-discharge mortality is high in the elderly. We recommend that further studies be done to determine if amelioration of these predictive factors would lead to decreased mortality or improvement of quality of life.

Keywords: predictive factors, mortality, geriatric, Barthel score, length of stay

INTRODUCTION

The primary concern of the practising physician in an acute hospital setting is the treatment and stabilisation of any medical conditions that patients present with. After discharge from hospital, patients may be reviewed at the outpatient clinic and subsequently discharged from follow-up. Sometimes, patients do not turn up for the follow-up outpatient visit. Occasionally, they are readmitted to other hospitals, or even pass away at home or in other hospitals. Hence, the final outcome of patients is frequently not known to the hospital physician. Elderly patients, especially, have many medical problems and mortality rates are high. The study of mortality in the elderly, especially with regards to predictive factors, is important in prognostication. Knowing the prognosis of these frail hospitalised elderly would be helpful to doctors in the management of their medical conditions. It would also help the relatives and health care providers in the planning of long term care for the elderly.

The effects of age and sex on mortality are well known. Increased age is found to be associated with increased mortality in many studies[1-4]. Mortality rates are also higher in elderly males[3,5]. Other important predictive factors of mortality in the elderly include functional status[1,2,6-8], cognitive impairment[1,3-7,9-10], depression[11-12], presence of chronic illness[9,13-15] and self-rated health[3,7,16-17].

The aim of this study was to determine the mortality rate of non-institutionalised elderly patients discharged from our hospital, describe the causes of death, and identify predictive factors of mortality.

METHODS

The study population comprised of 113 consecutive non-institutionalised patients admitted to our department between December 1997 and January 1998. Patients who passed away on the same admission were excluded.

For each patient, the following information was obtained: age, sex, race, marital status, housing, class of ward, length of stay and the availability of a carer after discharge from hospital. The presence of medical conditions such as cerebrovascular accidents (CVA), diabetes mellitus, cardiovascular disease (ischaemic heart disease, hypertension, CCF), malignancy and depression were determined. The number of chronic illnesses (which we defined to include CVA, diabetes and cardiovascular disease) in each patient was also noted. Those patients with malignancy were discharged home after stabilisation and control of their symptoms; death was not deemed to be imminent in these patients.

The Barthel and ECAQ (Elderly Cognitive Assessment Questionnaire) scores of the patients were determined just before discharge, after treatment of their medical conditions. We used the modified Barthel Index[18] as a measure of their functional status. This index of activities of daily living (ADL) measures the severity of disability in self-care, sphincter control and mobility. The maximum score is 20, indicating independence. Nurses, physiotherapists and occupational therapists obtained the scores for each patient based on direct observation.

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The ECAQ[19] is used as an objective test of cognitive function. This 10-item questionnaire has less bias on educational status and is more suitable for elderly people in developing countries. It has a maximum score of 10 and a cut-off value of 5/6 was used to indicate the presence of cognitive impairment.

Mortality data, via linkage to the death registry, were sought from the Ministry of Home Affairs one-year after the study commenced (ie. in February 1999). Those patients who had died after discharge were identified and their causes of death determined.

Cox proportional hazard regression was used to study the age and sex adjusted effect of various potential predictive factors for mortality. Forward stepwise regression using Cox proportional hazard models was used to determine a set of independent predictive factors for mortality. Potential predictive factors studied were age, sex, race, marital status, housing and class of ward to reflect socioeconomic status, presence of carer, ECAQ score, Barthel score, presence of depression, number of chronic illnesses and length of stay in the hospital. Polychotomous nominal exposure variables were fitted using indicator variables. The log likelihood ratio test was used for model testing. A p-value of 0.05 was accepted for conventional statistical significance. Kaplan-Meier survival curves were plotted and log-rank tests were performed for the following factors: Barthel score, length of stay, ECAQ score and presence of carer.

RESULTS

The mean age of the patients was 82 years and the median age was 81 years. The demographic profile, lengths of stay, number of chronic illness, ECAQ and Barthel scores of the patients are shown in Table I. A large proportion (75 %) of patients would have 1 main day-time carer after discharge, 20% would have no carer.

The prevalence of the following conditions among the patients was: new cerebrovascular accident (CVA), 11%; old CVA, 15%; depression, 10%; diabetes mellitus, 22%; cardiovascular disease, 40%; malignancy, 4%.

Thirty-eight (34%) patients (16 males and 22 females) have died after one year. The death rates for male and female are 363 and 385 per one thousand person years respectively.

The causes of death are shown in Table II. The commonest causes of death were malignancy and cerebrovascular disease, followed by pneumonia and ischaemic heart disease. Pneumonia is the commonest cause of death among our male patients, followed by malignancy, ischaemic heart disease and cerebrovascular disease (same death rates). The commonest causes in our female patients are malignancy and cerebrovascular disease. Only one female died from pneumonia.

The results of the predictive factors of mortality studied (adjusted for age and sex) are shown in Table III. Barthel score and length of stay were found to be significant predictive factors of mortality (Table III). In addition, although not statistically significant, increased mortality appears to be associated with ECAQ score of 5 or less (HR 1.7, CI 0.88 – 3.4), class of ward (A or B1 class: HR 0.26, CI 0.04 – 2.0; B2 class: HR 0.67, CI 0.32 – 1.4; C class: reference), and the presence of a carer (HR 1.9, CI 0.76 – 5.0). Further analysis showed that there is a positive association between the presence of a carer and low Barthel score (Fig 1). After adjusting for Barthel score, the relative risk of mortality among patients with carers decreased from 1.9 to 1.27. Age, sex, race, marital status, housing, number of chronic illnesses and presence of depression did not predict mortality in our study.

The independent predictive factors found on multivariate analysis are Barthel score (p = 0.009) and length of stay (p = 0.04), as shown in Table IV.

Kaplan Meier survival curves showing the effect of Barthel score, length of stay, ECAQ score and presence of carer on mortality are shown in Fig 2.

Table I – Demographic profile, lengths of stay, number of chronic illness, ECAQ and Barthel scores of the Elderly

	Numbers	Percent
Sex		
Male	50	44
Female	63	56
Race		
Chinese	91	81
Malay	16	14
Indian	6	5
Marital status		
Single	1	1
Married	36	32
Widowed	74	66
Divorced	2	2
Housing		
Private/HUDC	8	7
1 – 3 Room HDB	53	47
4 – 5 Room/Executive HDB	2	2
Class		
A/B1	8	7
B2	36	32
C	69	61
Length of stay		
1 – 7 days	57	50
8 – 14 days	35	31
15 or more days	21	19
ECAQ score		
5 or less	59	52
6 or more	54	48
Barthel score		
20	36	32
16 – 19	24	21
11 – 15	12	11
6 – 10	15	13
0 – 5	26	23
No. of chronic illness		
0 chronic illness	67	59
1 chronic illness	29	26
2 chronic illness	13	11
3 chronic illness	4	4

DISCUSSION

In Singapore, the male and female age-specific death rates for those aged 70 and over in 1997 are 61.4 and 50.2 per thousand residents respectively[20]. Our death rates of 363 and 385 per thousand respectively for

Table II – Causes of death in male and female patients

Cause of death	Numbers		Total	Percent
	Male	Female		
1. Malignancy	3	4	7	18
2. Cerebrovascular disease	3	4	7	18
3. Pneumonia	4	1	5	13
4. Ischaemic heart disease, including AMI	3	2	5	13
5. Chronic Obstructive Pulmonary Disease (COPD)	2	0	2	5
6. Heart failure	0	2	2	5
7. Hypertensive heart disease	0	2	2	5
8. Others*	1	7	8*	21
Total			38	100

* Include one death each from asthma, chronic pulmonary heart disease, diabetes mellitus, urinary tract infection, chronic renal failure, chronic liver disease, subarachnoid haemorrhage and systemic lupus erythematosis (SLE).

Table III – Predictive factors of mortality, adjusted for age and sex

Factor	HR	95% CI	p value
Age			0.71
65 – 79	1.12	0.59, 2.2	
80 – 99	reference		
Sex			0.86
Male	reference		
Female	1.06	0.56, 2.0	
Race			0.95
Chinese	0.97	0.41, 2.3	
Malay or Indian	reference		
Marital status			0.87
Married	1.07	0.49, 2.3	
Widowed	reference		
Class of ward			0.20
A or B1	0.26	0.035, 2.0	
B2	0.67	0.32, 1.4	
C	reference		
Housing			0.77
1 – 3 room HDB	1.10	0.57, 2.1	
4 – 5 room HDB, Executive	reference		
ECAQ			0.11
5 or less	1.7	0.88, 3.4	
6 or more	reference		
Barthel score			0.003
20	reference		
16 – 19	1.5	0.50, 4.8	
11 – 15	3.4	1.1, 11.0	
6 – 10	1.6	0.50, 5.9	
0 – 5	5.3	2.1, 13.7	
Carer			0.14
Present	1.9	0.76, 5.0	
Absent	reference		
Length of stay			0.02
1 – 7 days	reference		
8 – 14 days	1.5	0.68, 3.2	
15 or more days	3.2	1.4, 6.9	
Depression			0.83
No	0.89	0.31, 2.5	
Yes	reference		
No. of chronic illness			0.69
0 chronic illness	reference		
1 chronic illness	0.73	0.33, 1.63	
2 chronic illness	1.4	0.53, 3.7	
3 chronic illness	0.64	0.08, 4.9	

male and female patients are much higher than these national figures, reflecting the higher mortality among elderly who have been hospitalised before.

There are well known age and sex differences in mortality. Death rates increase with age and males have higher death rates than females. In our study, no significant age and sex differences in mortality were found. This may be explained by the fact that our study group of elderly patients is a selected group of hospitalised patients, in whom other factors (such as severity of medical illness and functional disability) may play a more important role in determining mortality.

The Barthel score, a measure of functional ability, is a significant predictive factor of mortality found in our study. Campbell et al[1] followed up on an age stratified sample of 535 elderly living in the community (New Zealand) and found functional disability to be a predictive factor of mortality, even after controlling for age. Scott et al[2] studied a sample of community-dwelling elderly in the United States and found that increasing score on a ten-item ADL-LADL (activities of daily living-instrumental activities of daily living) scale was predictive of mortality. Narain et al[8] also studied acutely hospitalised elderly patients and found decreased functional status to be associated with an increase in 6-month mortality. Functional disability is also found to be a predictor of mortality in institutionalised elderly[7,21]. We would like to recommend that further studies be carried out to determine if efforts aimed at preventing disability would lead to reduced mortality.

Length of stay in the hospital is the second significant predictive factor of mortality found in our study. In multivariate analysis, together with Barthel score, length of stay emerged as a significant predictive factor, indicating that its effect on mortality is independent of any association with Barthel score. Length of stay may be a proxy for other factors, such as severity of the underlying medical conditions and psychosocial factors, which play a part in prolonging hospital stay. Winograd et al[22] studied hospitalised elderly and showed that frailty is associated with increased length of stay as well as mortality at one year. Librero et al[14] in Spain also found a positive correlation between co-morbidities, length of stay and in-hospital mortality.

Cognitive impairment has been found to be an important predictor of mortality in many studies. Liu et al[9], in their study of more than two thousand Framingham Heart Study participants, found poor cognitive function to be associated with an increased risk of death even after adjusting for the confounding effects of age, education and illness. Kelman et al[3] found both mild and severe cognitive impairment as measured by the MMSE (Mini-Mental State Exam)

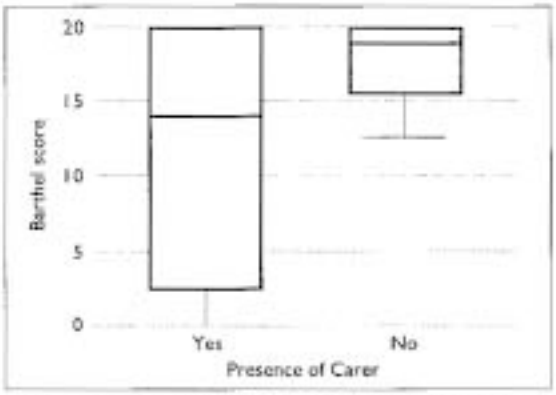

Fig 1 – Boxplot showing association between Barthel score and presence of carer.

Table IV – Multivariate analysis showing independent predictive factors of mortality

Factor	HR	95% CI	p value
Barthel score			0.009
20	reference		
16 – 19	1.6	0.5, 5.0	
11 – 15	4.0	1.3, 12.6	
6 – 10	1.6	0.5, 5.8	
0 – 5	4.5	1.7, 11.8	
Length of stay			0.04
1 – 7 days	reference		
8 – 14 days	1.2	0.52, 2.6	
15 or more days	2.8	1.3, 6.3	

to be predictive of death and suggested that early detection of dementia and attention to associated health problems might improve quality of life and perhaps increase survival. Our study found that those patients with a low ECAQ score, which indicates the presence of cognitive impairment, had higher mortality (Fig 2), although the result did not reach statistical significance.

Our study found that patients who had carers had higher mortality (Fig 2). This is partly mediated through the effect of Barthel score as shown by the reduction in the hazard ratio after adjustment for Barthel score. As a comparison, Kelman et al[3] found the receipt of formal and informal social support to be a significant predictive factor of mortality in both univariate and multivariate Cox proportional hazard models.

Studies on depression in the elderly as a predictive factor of mortality has yielded controversial results. A recent study on elderly depressed Finns[11] showed that depression, as determined by the DSM III criteria, was not predictive of death when other factors known to influence survival such as age, education, smoking, functional abilities and somatic illnesses were taken into account. Bruce and Leaf[12], however, found that the odds of dying were four times higher for individuals with affective disorders, especially major depression, even after age, sex and physical health were controlled for. Our study did not find depression to be a predictor of mortality. However, it is limited by its small numbers, especially as only 11 patients had depression.

Marital status, race and housing did not influence mortality in our study. However, class of ward appeared to predict mortality, although this result was not statistically significant. We present class of ward to be an indicator of socioeconomic status, although patients of high socioeconomic status may opt to stay in subsidised wards. This result could be a chance finding, but our numbers may be too small to show statistical significance even if the association is real. A study done in Norway[23] did not find marital status and socioeconomic status as measured by education and occupation, to be significant factors of mortality. In contrast, Kelman et al[3] found increased mortality

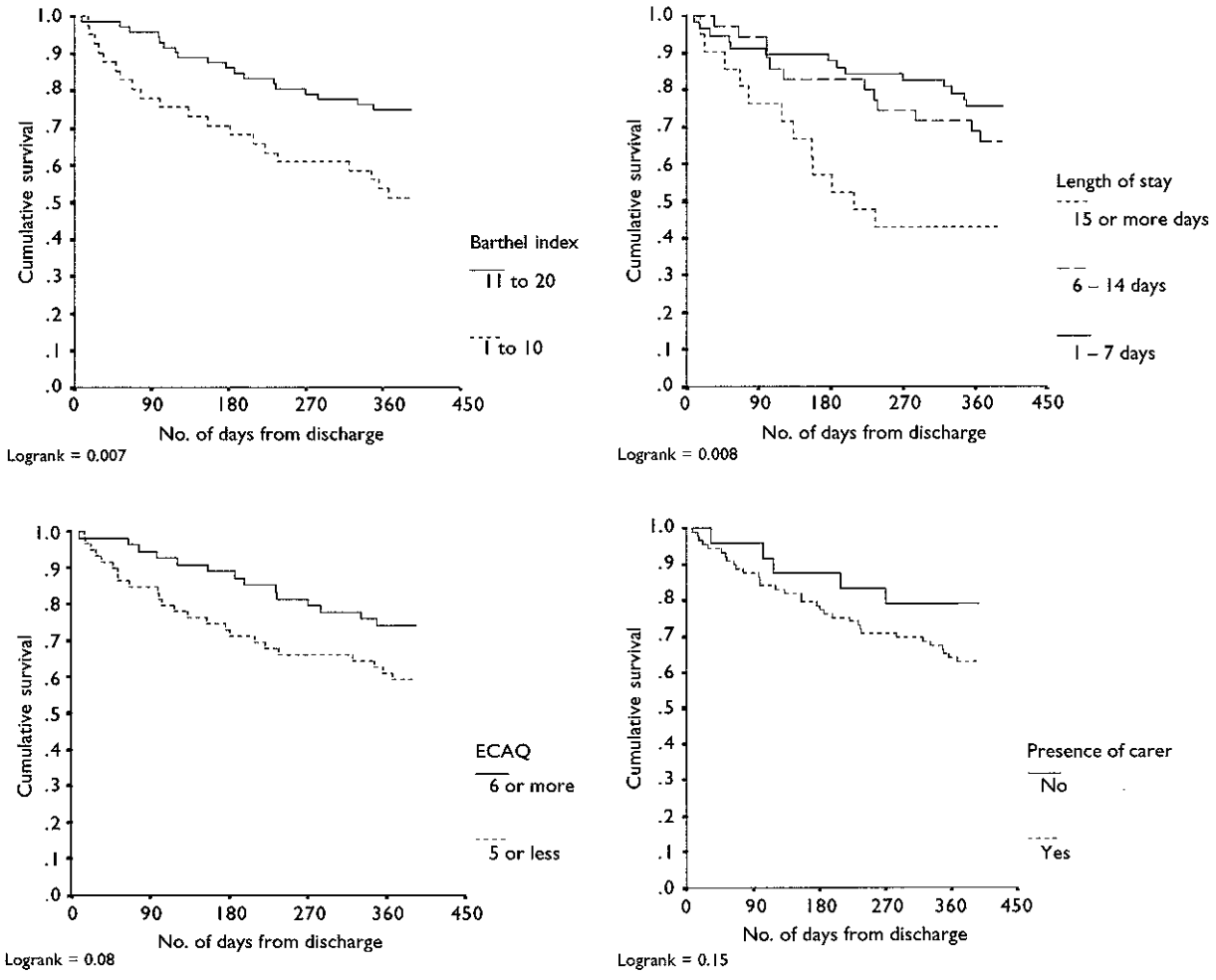

Fig 2 – Kaplan Meier survival curves showing the effects of Barthel score, length of stay, ECAQ score and presence of carer on mortality.

among individuals with low income as well as those who are not married.

The number of chronic illnesses is not predictive of mortality in our study. Librero et al[14] found that chronic comorbidity was associated with greater in-hospital mortality. Aevarsson et al[15] found that 7-year mortality was increased by the number of physical disorders (include myocardial infarction, congestive heart failure, hypertension, diabetes mellitus, cerebrovascular disorders) in the very elderly male and female individuals aged 85 years. These very old elderly include both people living in the community as well as institutions. It may be that severity of illnesses also contributes to increased mortality, in addition to the number of illnesses. In our hospitalised patients, severity of illnesses would be expected to play a more important role.

Our study has a few important limitations. This is a hospital-based study and its results should not be extrapolated to the community or national population. We excluded nursing home patients from this study, as we believe that they are a unique group of elderly who have to be studied separately. The reasons being that they have different socio-demographic characteristics, are generally more frail as well as physically and mentally more disabled. Predictive factors of mortality have been found to be different in these patients[16].

Many studies done in western countries have found self-rated health to be an important predictor of mortality[3-17]. These are supported by two other studies carried out among Chinese subjects in Hong Kong and Taipei[7,16]. We did not look into this factor in our study.

CONCLUSION

Post-discharge mortality is high in the hospitalised elderly. The most commonest causes of death were malignancy (18%) and cerebrovascular disease (18%). We have found that the most important predictive factors of mortality at one year in our cohort of elderly patients are Barthel score and length of stay in the hospital. These are reflective of the patients' underlying functional status, and possibly severity of medical illnesses and psychosocial factors. Patients with cognitive impairment and those who had carers were found to have higher mortality. We recommend that further studies be done to determine if amelioration of some of these factors would lead to decreased mortality or improvement of quality of life.

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