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Role of physical activity in mortality prediction in elderly hospice patients

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The prediction of life-expectancy in terminally ill patients is important both for medical and social reasons but it is widely recognized as being inaccurate. The aim of this study was to investigate the mortality predictors and indicators of life extension among elderly patients in a hospice service center. In order to determine the mortality predictors, we investigated the relationship between patients' cognitive status using the Korean-Mini Mental State Examination & Global Deterioration Scale (K-MMSE & GDS), the patient's physical function using the instrumental Activities of Daily Living (ADL) score, and the patient's blood component values. The subjects included 43 men and 57 women with a mean age of 82.4±8.4 years, and a mean nursing period of 11.1±12.2 months. These terminally ill patients were enrolled in a cross-sectional study. All data were collected from paper and electronic charts, and patient interviews. A simple correlation analysis was performed to determine the relationship between the variables and to satisfy the normal distribution ($P<0.01$). The results revealed that the time of death negatively correlated with ADL score ($r=-0.273$, $P=0.006$). However, the K-MMSE & GDS, and the values of blood component such as albumin, gamma-glutamic transpeptidase, blood urea nitrogen, and creatinine were not correlated with the time of death. Consequently, the ADL score might be an important predictor of mortality and life extension in elderly patients. Therefore, in order to improve ADL score, physical exercise and overall fitness may be potential non-pharmacologic methods useful in preventing mortality in elderly people.

Keywords: Physical activity, Activities of Daily Living, Death predictor, Elderly, Hospice patients

INTRODUCTION

The elderly population has become an important group that increasingly requires special attention with respect to health and social issues. The health of the elderly proceeds on a continuum that begins with the development of symptoms associated with biological changes, and continues to disease onset, functional loss and disability, and ultimately, terminal status and death (Rizzuto and Fratiglioni, 2014). Functional decline in the health of the elderly is associated with increased risk of mortality in terminally ill patients. Hospice care offers a highly humane and cost-effective pathway for end-of-life care (Kang et al., 2012). The purpose of hospice care is not to cure the illness, but to prolong the life expectancy of the patients. Hospice care caters to the psychological and social needs of the elderly in maintaining their quality of life, and their ability to cope with death and bereavement. This care consists of comprehensive protection service programs (Kil, 2004). However, despite the higher quality of life and better pain management that has been observed in hospice patients (Wallston et al., 1988), there is a concern that hospice care might be associated with shortened survival time (Saito et al., 2011). The prediction of life-expectancy for terminal care patients is important both for medical and social reasons, but it is widely recognized as being inaccurate. Life expectancy prediction has both emotional and practical importance for patients, family and medical staff. Patients and their families are able to request the exact information, but the ability of the medical or nursing staff to predict the end-stage of a patient's life is inadequate (Addington-Hall et al., 1990). Nevertheless, it is necessary to find a predictor of mortality in order to anticipate the life expectancy of the elderly. There are

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various approaches to increasing the life expectancy of the elderly once death predictors are considered. Predictors of death in the elderly are several and diverse, such as age, loneliness (Perissinotto et al., 2012), Activities of Daily Living (ADL) (Katz et al., 1963; Matzen et al., 2012; Wlodarczyk et al., 2004), recognition (Hirsch et al., 2012), quality of life (Wlodarczyk et al., 2004), physical activity (Jalayondeja et al., 2016), blood albumin (Menon et al., 2005; Sudfeld et al., 2013), and blood transfusion (Chazot et al., 2014). In this study, we investigated the predictors of mortality in elderly individuals, aiming to find ways to help prolong life expectancy. This study is based on data obtained from elderly hospice patients. The analysis of this data provides a meaningful way to explore the health and longevity of the elderly.

MATERIALS AND METHODS

Participants

One hundred elderly patients (57% male, 43% female) who used a hospice services center in South Korea were enrolled in the study. The researchers gathered objective data on inpatient hospice patients over a period of 3 years. Since the purpose of hospice treatment is not the improvement of health or cure, no special effort was made to extend life (Table 1).

Korean-Mini Mental State Examination & Global Deterioration Scale

We discovered a death extension index through a basic medical examination and through observation of patient records. All data were obtained from paper and electronic charts, and patient interviews. Trained research nurses entered the data with standardized definitions and coding practices. We examined the relationship between patients' cognitive status using the Korean-Mini Mental State Examination & Global Deterioration Scale (K-MMSE & GDS) (Wlodarczyk et al., 2004). The composition of the K-MMSE was a total of 30 points, with 10 points for orientation (time and place), 3 points for memory registration, 5 points for attention concentration and calculation, 3 points for memorial remarks, and 9 points for language and space-time. The GDS consists of 1 point for 'no cognitive impairment' to 7 points for 'late severe cognitive impairment'.

Table 1. Physical characteristics of the subjects (n = 100)

Characteristic	Value
Sex	1.57 ± 0.50
Men:women	43 (43):57 (57)
Age (yr)	82.44 ± 8.43
Nursing period (mo)	11.06 ± 12.16
Cause of death	2.22 ± 1.62
Respiratory failure	48 (48)
Hematosepsis	26 (26)
Acute myocardial infarction	3 (3)
Pneumonia	10 (10)
Cardiogenic shock or septic shock	5 (5)
Other	8 (8)
Kind of death	1.00 ± 0.00
Illness death	
Violent death	
Other	

Values are presented as mean ± standard deviation or number (%).

Activities of Daily Living

We examined the relationship between patients' physical functional status using the instrumental ADL score (Katz et al., 1963). Measurements of ADL performance include dressing, brushing one's teeth, bathing and hygiene related activities, eating, postural changes, movement, and using the toilet. The allotment of scores were as follows: 1 point for the fulfillment of the criteria 'complete independence' to 5 points for 'requirement of full support or inability to complete the task.'

Blood component

Blood components are total protein, albumin, aspartate transaminase (serum glutamic oxaloacetic transaminase), alanine transaminase (serum glutamic-pyruvic transaminase), gamma-glutamic transpeptidase (r-GTP), blood urea nitrogen (BUN), creatinine, sodium, potassium, chloride, glucose, hemoglobin, hamatocrit, red blood cell, white blood cell, platelet.

Statistical analyses

Three years of objective data on inpatient hospice patients were obtained. Simple correlation analysis and 2 variables all satisfy the normal distribution ($P < 0.01$). Statistical analyses were performed using IBM SPSS Statistics ver. 24.0 (IBM Co., Armonk, NY, USA).

RESULTS

K- MMSE & GDS

MMSE total score is an average of 6.48 ± 6.68 points out of 30 points. GDS total score is an average of 5.68 ± 1.46 points out of 7 points. Cognitive ability (K-MMSE & GDS) components are not correlated with time of death (Table 2).

Table 2. Descriptive statistics and correlation

		K-MMSE	GDS	ADLs	Total_ protein	Albumin	AST	ALT	r-GTP	BUN	Creatinine	Sodium	Potassium	Chloride	Glucose	Hb	Hct	RBC	WBC	Platelet	TD (mo)
K-MMSE	Pearson Correlation	1	-0.797**	-0.595**	0.053	0.103	-0.044	-0.057	0.249*	0.047	0.238*	-0.038	0.138	0.042	0.005	-0.071	0.174	-0.096	-0.022	0.017	0.056
	Sig.	-	0.000	0.000	0.602	0.308	0.662	0.571	0.012	0.640	0.017	0.704	0.172	0.676	0.959	0.485	0.084	0.343	0.825	0.869	0.578
GDS	Pearson Correlation	-0.797**	1	0.586**	-0.199*	-0.148	0.045	0.058	-0.201*	-0.132	-0.288**	-0.055	-0.128	-0.117	0.094	0.028	-0.185	0.126	0.049	-0.026	-0.017
	Sig.	0.000	-	0.000	0.047	0.141	0.659	0.568	0.045	0.190	0.004	0.589	0.205	0.248	0.350	0.780	0.066	0.213	0.631	0.798	0.866
ADLs	Pearson Correlation	-0.595**	0.586**	1	-0.191	-0.235*	0.039	0.033	-0.197*	-0.242*	-0.367**	-0.166	0.008	-0.189	-0.022	-0.015	-0.002	0.032	-0.024	0.076	-0.273**
	Sig.	0.000	0.000	-	0.057	0.019	0.701	0.747	0.050	0.015	0.000	0.099	0.934	0.060	0.825	0.885	0.986	0.751	0.809	0.454	0.006
Total_ protein	Pearson Correlation	0.053	-0.199*	-0.191	1	0.715**	-0.045	-0.071	0.097	0.073	0.140	-0.026	0.326**	0.043	-0.218*	0.335**	0.029	0.234*	-0.167	0.173	0.131
	Sig.	0.602	0.047	0.057	-	0.000	0.659	0.486	0.338	0.471	0.165	0.795	0.001	0.671	0.029	0.001	0.775	0.019	0.096	0.085	0.193
Albumin	Pearson Correlation	0.103	-0.148	-0.235*	0.715**	1	-0.032	-0.044	-0.037	0.124	0.124	0.010	0.223*	0.081	-0.224*	0.434**	-0.007	0.349**	-0.166	0.011	0.158
	Sig.	0.308	0.141	0.019	0.000	-	0.749	0.666	0.712	0.217	0.221	0.925	0.026	0.420	0.025	0.000	0.944	0.000	0.098	0.911	0.117
AST	Pearson Correlation	-0.044	0.045	0.039	-0.045	-0.032	1	0.993**	0.220*	-0.010	-0.042	0.030	0.066	-0.005	-0.061	0.083	-0.003	0.077	-0.031	-0.084	-0.062
	Sig.	0.662	0.659	0.701	0.659	0.749	-	0.000	0.028	0.924	0.681	0.765	0.511	0.960	0.548	0.413	0.975	0.449	0.760	0.408	0.542
ALT	Pearson Correlation	-0.057	0.058	0.033	-0.071	-0.044	0.993**	1	0.211*	0.002	-0.051	0.068	0.019	0.013	-0.044	0.088	-0.019	0.081	-0.028	-0.087	-0.040
	Sig.	0.571	0.568	0.747	0.486	0.666	0.000	-	0.036	0.985	0.613	0.501	0.849	0.896	0.667	0.381	0.852	0.421	0.783	0.387	0.691
r-GTP	Pearson Correlation	0.249*	-0.201*	-0.197*	0.097	-0.037	0.220*	0.211*	1	0.109	0.160	-0.149	0.109	-0.152	-0.106	-0.122	-0.027	-0.041	0.204*	0.214*	0.037
	Sig.	0.012	0.045	0.050	0.338	0.712	0.028	0.036	-	0.279	0.112	0.139	0.281	0.131	0.294	0.227	0.792	0.684	0.042	0.032	0.718
BUN	Pearson Correlation	0.047	-0.132	-0.242*	0.073	0.124	-0.010	0.002	0.109	1	0.644**	0.254*	0.087	0.195	0.056	0.023	0.163	-0.007	0.269**	-0.234*	-0.022
	Sig.	0.640	0.190	0.015	0.471	0.217	0.924	0.985	0.279	-	0.000	0.011	0.387	0.052	0.582	0.819	0.105	0.941	0.007	0.019	0.831
Creatinine	Pearson Correlation	0.238*	-0.288**	-0.367**	0.140	0.124	-0.042	-0.051	0.160	0.644**	1	0.088	0.162	0.142	-0.099	-0.023	0.372**	-0.041	0.188	-0.124	-0.009
	Sig.	0.017	0.004	0.000	0.165	0.221	0.681	0.613	0.112	0.000	-	0.382	0.108	0.159	0.327	0.818	0.000	0.687	0.061	0.219	0.931
Sodium	Pearson Correlation	-0.038	-0.055	-0.166	-0.026	0.010	0.030	0.068	-0.149	0.254*	0.088	1	-0.277**	0.815**	-0.027	0.171	-0.116	0.142	-0.027	-0.160	0.153
	Sig.	0.704	0.589	0.099	0.795	0.925	0.765	0.501	0.139	0.011	0.382	-	0.005	0.000	0.787	0.090	0.252	0.158	0.791	0.112	0.130
Potassium	Pearson Correlation	0.138	-0.128	0.008	0.326**	0.223*	0.066	0.019	0.109	0.087	0.162	-0.277**	1	0.021	-0.223*	0.136	0.424**	0.062	-0.052	0.097	0.024
	Sig.	0.172	0.205	0.934	0.001	0.026	0.511	0.849	0.281	0.387	0.108	0.005	-	0.838	0.026	0.177	0.000	0.541	0.605	0.338	0.812
Chloride	Pearson Correlation	0.042	-0.117	-0.189	0.043	0.081	-0.005	0.013	-0.152	0.195	0.142	0.815**	0.021	1	-0.104	0.075	-0.046	0.029	-0.108	-0.171	0.114
	Sig.	0.676	0.248	0.060	0.671	0.420	0.960	0.896	0.131	0.052	0.159	0.000	0.838	-	0.304	0.457	0.649	0.773	0.284	0.089	0.258
Glucose	Pearson Correlation	0.005	0.094	-0.022	-0.218*	-0.224*	-0.061	-0.044	-0.106	0.056	-0.099	-0.027	-0.223*	-0.104	1	-0.167	-0.051	-0.100	0.293**	-0.080	-0.027
	Sig.	0.959	0.350	0.825	0.029	0.025	0.548	0.667	0.294	0.582	0.327	0.787	0.026	0.304	-	0.097	0.618	0.321	0.003	0.431	0.793
Hb	Pearson Correlation	-0.071	0.028	-0.015	0.335*	0.434*	0.083	0.088	-0.122	0.023	-0.023	0.171	0.136	0.075	-0.167	1	-0.044	0.849**	0.006	0.003	0.021
	Sig.	0.485	0.780	0.885	0.001	0.000	0.413	0.381	0.227	0.819	0.818	0.090	0.177	0.457	0.097	-	0.665	0.000	0.955	0.973	0.837
Hct	Pearson Correlation	0.174	-0.185	-0.002	0.029	-0.007	-0.003	-0.019	-0.027	0.163	0.372**	-0.116	0.424**	-0.046	-0.051	-0.044	1	-0.064	-0.027	0.064	-0.001
	Sig.	0.084	0.066	0.986	0.775	0.944	0.975	0.852	0.792	0.105	0.000	0.252	0.000	0.649	0.618	0.665	-	0.524	0.788	0.530	0.991
RBC	Pearson Correlation	-0.096	0.126	0.032	0.234*	0.349**	0.077	0.081	-0.041	-0.007	-0.041	0.142	0.062	0.029	-0.100	0.849**	-0.064	1	0.140	0.268**	-0.036
	Sig.	0.343	0.213	0.751	0.019	0.000	0.449	0.421	0.684	0.941	0.687	0.158	0.541	0.773	0.321	0.000	0.524	-	0.164	0.007	0.722
WBC	Pearson Correlation	-0.022	0.049	-0.024	-0.167	-0.166	-0.031	-0.028	0.204*	0.269**	0.188	-0.027	-0.052	-0.108	0.293**	0.006	-0.027	0.140	1	0.141	0.053
	Sig.	0.825	0.631	0.809	0.096	0.098	0.760	0.783	0.042	0.007	0.061	0.791	0.605	0.284	0.003	0.955	0.788	0.164	-	0.161	0.602
Platelet	Pearson Correlation	0.017	-0.026	0.076	0.173	0.011	-0.084	-0.087	0.214*	-0.234*	-0.124	-0.160	0.097	-0.171	-0.080	0.003	0.064	0.268**	0.141	1	0.000
	Sig.	0.869	0.798	0.454	0.085	0.911	0.408	0.387	0.032	0.019	0.219	0.112	0.338	0.089	0.431	0.973	0.530	0.007	0.161	-	0.996
TD (mo)	Pearson Correlation	0.056	-0.017	-0.273**	0.131	0.158	-0.062	-0.040	0.037	-0.022	-0.009	0.153	0.024	0.114	-0.027	0.021	-0.001	-0.036	0.053	0.000	1
	Sig.	0.578	0.866	0.006	0.193	0.117	0.542	0.691	0.718	0.831	0.931	0.130	0.812	0.258	0.793	0.837	0.991	0.722	0.602	0.996	-
	Mean± SD	6.48± 6.69	5.68± 1.46	46.91± 5.57	5.98 ±0.91	3.02 ±0.59	49.8± 163.70	35.42± 121.05	56.79± 144.02	13.30± 11.07	0.71 ± 0.43	137.97± 7.44	4.24± 1.36	97.98± 7.97	138.14± 97.68	10.85± 2.07	61.11± 280.28	3.57± 0.77	8.59± 4.20	249.21± 114.62	2.05± 2.19

Correlation is significant at the 0.01 level (2-tailed).

K-MMSE Korean-Mini Mental State Examination; GDS, Global Deterioration Scale; ADL, Activities of Daily Living; AST, aspartate transaminase; ALT, alanine transaminase; r-GTP, gamma-glutamic transpeptidase; BUN, blood urea nitrogen; Hb, hemoglobin; Hct, hematocrit; RBC, red blood cell; WBC, white blood cell; TD, time of death; SD, standard deviation.

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Activities of Daily Living

ADL total score is an average of 46.91±5.57 points out of 50 points. The physical function status (ADL) is correlated with time of death in elderly hospice patient (r= -0.273, P=0.006) (Table 2).

Blood component

Blood component are not correlated with time of death (Table 2).

DISCUSSION

Hospice care patients receive basic medical care and observation without special rehabilitation programs to extend life. In this study, there was consistent decrease in the KMMSE & GDS with respect to the time of death, but ADL score was even more affected to the time of death. The risk of death varied in proportion to the scores ranging from low-risk (ADL score 0–1) to high-risk (ADL score 5) groups. Factors such as increasing age, dementia, stroke, and congestive heart failure were associated with higher ADL scores. Physiological measurements, such as low systolic blood pressure and high white blood cell count, were also associated with a higher ADL score (Sood et al., 2011). This suggests that the ADL score on admission captures the effect of both the acute illness and more chronic conditions, and, further, it provides a comprehensive measure of health. Therefore, ADL score is an important a predictor of mortality in the elderly. Obtaining an ADL functional score on admission was simple and easy to perform. Although the ADL score may have overestimated functionality it was strongly predictive of outcomes. This suggests that assessment of ADL score may have a potential role in decision making for the clinical management of frail elderly inpatients (Matzen et al., 2012).

ADL score was associated with blood component values in the present study. As time of death neared, ADL score decreased, and BUN, r-GTP, creatinine rose sharply. Rowe and Kahn (1997) suggested that successful aging has 3 constituent components: avoiding disease and disability, maintaining high cognitive and physical function, and engagement with life. High physical function is a crucial factor for successful aging. Measures of functional performance and physical fitness are important, simple, and objective observations of physical function in elderly. Therefore, physical activity, including exercise is needed to achieve a good ADL score. ADL have proven to be effective in improving the postprandial serum glucose in type 2 diabetic patients, but endurance exercise intensity was even more effective in improving blood sugar homeostasis than daily ADL (van Dijk et al., 2013). Long-term football exercise and strength training helped to effectively maintain the ADL score, develop muscle strength, and prevent functional decline in elderly men (Sundstrup et al., 2016). Fisher et al. (2016) suggested that early mobilization, physical therapy, walking programs, and other approaches may improve mobility in the elderly and potentially reduce hospitalization. Physical exercise and dietary measures are currently the only known ways of slowing the aging process (Le Gall and Ardaillou, 2009). Gremeaux et al. (2012) demonstrated mechanisms that underlie the positive effects of exercise on the aging process. Regular physical activity is associated with a 30% reduction in the risk of cardiovascular mortality in subjects with cardiovascular disease (Nocon et al., 2008). This risk reduction corresponds to 1–2 years of additional life attributable to adequate exercise when compared to individuals who engage in little or no physical activity (Franco et al., 2005). However, the study of exercise intensity for the elderly can be divided into various segments. Xue et al. (2012) suggested that physical activity does not have to be vigorous to be beneficial and that the gain may be the greatest among women who reported the lowest levels of activity. In contrast, Samitz et al. (2011) demonstrated that larger training volume (exercise duration×intensity) is associated with greater reduction in mortality. For a given training volume, engaging in physical activities of a higher intensity provides additional benefit.

According to the statement of the hospital staff, this improvement was related to a correction in dehydration, improved chewing ability, and a drug regimen, among other interventions. As the patient neared death, all functional abilities declined at various rates. Until death, cognitive ability (K-MMSE & GDS) did not decrease as much, but physical functional status and ADL score decreased, and blood component values worsened. In conclusion, ADL scores might be seen as indicators for the delaying of death. Thus, when providing care to those confronted with terminal illness it is important to increase the ADL score. The method to achieve this is to increase physical activity. Consequently, in order to improve ADL score, physical exercise and improved fitness are potential nonpharmacologic means to prevent mortality in the elderly. Using objective data, the present study confirmed some of the clinical reports of medical and nursing staff working in the hospice field; however, further study is needed to construct a model that enables prediction of life-expectancy on the basis of the objective parameters.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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