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RESEARCH

CAN BARTHEL INDEX PREDICT MORTALITY IN GERIATRIC PATIENTS ADMITTED TO THE EMERGENCY DEPARTMENT WITH A HIGH FEVER?

ABSTRACT

Introduction: Physical functional capacity decreases in geriatric patients owing to age and disease. In current practice, objective parameters to evaluate physical functional capacity in geriatric patients are rarely used in departments providing acute care, such as emergency departments. In our study, we aimed to determine whether the degree of change in basal admission Barthel Index scores has a prognostic significance for patients presenting with high fever.

Materials and Method: Patients over 64 years of age without a history of or requirement for an emergency response and a tympanic membrane temperature ≥37.2°C were included. Patients were divided into 3 groups according to their change of Barthel Index scores: >30 (major), 5–30 (minor) and no change.

Results: The study population comprised 218 patients. Statistically significant differences were found among basal Barthel Index scores and those obtained at admission and 1 month later in surviving patients and between basal and admission Barthel Index scores in patients who died (p<0.001). Statistically significant difference was found in the proportion of survivors and non-survivors in patients whose change in Barthel Index score was >30 (major change) (p=0.011). No difference was found in the proportions of survivors and non-survivors in patients with minor changes and no change.

Conclusions: Fever increases physical dependency in geriatric patients. Situations that result in a serious increase in functional dependency during admission may be related to short-term mortality in geriatric patients.

Key Words: Barthel Index; Fever; Geriatric Patient; Functional Capacity; Emergency Department.

ARAŞTIRMA

BARTHEL İNDEKSİ YÜKSEK ATEŞ YAKINMASI İLE ACİL SERVİSE BAŞVURAN GERİATRİ HASTALARINDA MORTALİTEYİ ÖNGÖREBİLİR Mİ?

ÖZ

Giriş: Yaş ve hastalıklar sonucu geriatrik hastalarda fiziksel fonksiyonel kapasite azalmaktadır. Geriatrik hasta grubunda fiziksel fonksiyonel kapasiteyi objektif olarak ortaya koyabilecek ölçekler güncel pratikte acil servis gibi akut bakım sağlayan birimlerde nadir kullanılmaktadır. Bu çalışmada ateş yüksekliği ile başvuran geriatrik hastalarda bazal-başvuru Barthel İndeksi skorlarındaki değişim derecesinin ateş yüksekliği ile başvuran geriatrik hastalarda prognostik bir öneme sahip olma olasılığının test edilmesi amaçlanmıştır.

Gereç ve Yöntem: Acil müdahale gereksinimi ve travma öyküsü olmayan 64 yaş üzeri timpanik membran ateş ≥37.2°C olan hastalar çalışmaya dahil edilmiştir. Hastalar Barthel İndeks değişimi >30 (majör), 5-30 (minör) ve değişikliğin olmadığı grup olmak üzere 3 gruba ayrılmıştır.

Bulgular: Çalışma popülasyonu 218 hastadan oluşmuştur. Hastaların bazal ve başvuru Barthel İndeksi skorları karşılaştırıldığında, sağ kalan hastaların bazal, başvuru ve 1 ay sonraki Barthel İndeks'leri arasında ve mortalite gelişen hastaların bazal ve başvuru Barthel İndeks'leri arasında anlamlı farklılık saptanmıştır (p<0.001). Bazal ve başvuru Barthel İndeks değişiminin >30 (majör) olduğu durum ile mortalite arasında istatistiksel anlamlı farklılık saptanmıştır (p=0.011). Minör değişimlerde ve değişikliğin olmadığı grupta farklılık saptanmamıştır.

Sonuç: Ateş geriatrik hastaların fiziksel bağımlılıklarını artırır. Bazal duruma göre başvuru sırasında ciddi fonksiyonel bağımlılık artışına yol açan durumlar geriatrik hastalarda kısa dönem mortalite ile ilişkili olabilir.

Anahtar Sözcükler: Barthel İndeksi; Ateş; Geriatrik Hasta; Fonksiyonel Kapasite; Acil Servis.

Introduction

The expected life span of the world's population and hence the proportion of the population at 65 years of age and older has increased. Compared with the total population, the emergency department (ED) admission rate of patients aged 65 years or older is higher (1). High fever accounts for 10% of ED admissions of geriatric patients, with 70–90% of these patients requiring hospitalisation with a 10 times greater mortality risk than non-geriatric patients (2). Infectious disease frequency is greater in geriatric patients than in non-geriatric patients owing to a weakening immunity, a higher frequency of comorbid diseases, functional disability (such as weakening in swallowing and reduction in cough reflex), residence in crowded places (such as a nursing home or eventide homes) and accompanying prosthetic instruments (3). Early diagnosis of infection, quick support and antibiotic treatment are crucial in geriatric patients to prevent potentially poor outcomes (4). Nevertheless, as a result of physiological changes, findings and symptoms in geriatric patients are not always that evident, which complicates the diagnosis (5).

As a result of age and disease, functional capacity in geriatric patients decreases. Knowing the basal functional state of geriatric patients before they visit the ED is important. Objective parameters and tests that determine functional capacity in geriatric patients objectively are well known and used particularly by nursing homes and current geriatric clinics; however, in the acute care setting, such as EDs, they are rarely used despite the increasing number of admissions (6, 7). Therefore, in our study, we used the Barthel Index (BI) to evaluate the physical condition of patients admitted to the ED with a condition, such as high fever, that affects general functional capacity. Furthermore, we aimed to determine whether the difference between basal and admission BI scores had a prognostic importance in geriatric patients admitted with a high fever and to measure functional status.

Materials and Method

Study Design and Setting

This prospective, observational, single-centre, cross-sectional study was conducted at the ED of the Ege University Hospital in İzmir, Turkey. Data were collected from consecutive geriatric patients (age > 64 years) who were admitted to the ED with fever between 22 September 2012 and 31 March 2013. The hospital has 2000 beds, and the annual number of ED patient visits are approximately 120,000 per year. Upon approval from the local ethics committees (Reference number 12-8/26), this study was conducted according to the Principles of the Declaration of Helsinki; written informed consent was obtained from every patient or patient representative who participated in the study.

Definition of Barthel Index

Barthel Index (Table 1) comprises 10 items that are related to activities of daily living and morbidity. Feeding, transfers between wheelchair and bed, grooming, bathing, walking,

Table 1— Barthel Index

Bowels	0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent
Bladder	0 = incontinent, or catheterised and unable to manage 5 = occasional accident 10 = continent
Grooming	0 = needs help with personal care 5 = independent face/hair/teeth/shaving (implements provided)
Toilet Use	0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)
Feeding	0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent
Mobility (On Level Surfaces)	0 = immobile or <45 metres 5 = wheelchair independent, including corners, >45 metres 10 = walks with help of one person (verbal or physical) >45 metres 15 = independent (but may use any aid; for example, stick) >45 metres
Transfers (Bed To Chair And Back)	0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent
Stairs	0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent
Bathing	0 = dependent 5 = independent
Dressing	0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)

climbing up and going down stairs and urinary and faecal incontinence are evaluated. Scoring is based on whether or not the person gets help while performing these activities. According to total scores possible, the groups are as follows: 0–20, totally dependent; 21–61, severely dependent; 62–90, moderately dependent, 91–99, slightly dependent; 100, fully independent (8).

Definition of Fever in Geriatric Patients

In the guidelines issued by the Infectious Diseases Society of America regarding evaluation of fever and infection in patients requiring care, a single oral measurement of >37.8°C, repeated oral measurements of ≥37.2°C, a rectal temperature of ≥37.5°C, or a rise in body basal temperature of >1.1°C are all considered as fever in geriatric patients (9). Recently, the use of tympanic membrane temperature measurement is increasing owing to its convenience. Most health centres choose infrared tympanic membrane thermometers. Despite the scanty clinical information about the reliability of tympanic membrane thermometers in geriatric patients, most studies show that tympanic membrane thermometers yield readings similar to oral thermometers when compared with rectal thermometers (10). Therefore, because of its hygiene and ease of use, we decided to use tympanic membrane thermometers in our study and determined the fever threshold to be ≥37.2°C in repeated measurements.

Selection of Participants and Data Collection

Patients older than 64 years of age with no history of or requirement for an emergency response and a tympanic membrane temperature ≥37.2°C were included in this study. Patients' age, sex, vital parameters, final diagnosis, laboratory findings (leukocytes and C-reactive protein), ED treatments (antibiotics, vasopressor agents, blood products) and hospitalisation time periods were recorded. According to information provided by either patients or their relatives, the BI values of the time period before admission to the ED were calculated and recorded as basal BI values. The Barthel Index values of the patients at the time of admission were also recorded. Surviving patients discharged from the hospital were followed up 1 month later, and based on the information given either by patients or their relatives, Barthel Index values were calculated and recorded as 1-month BI values. The Barthel Index information was acquired from the patients who were responsive or, if not, from the relatives responsible for taking care of them. Through telephone conversations, at the same time, the mortality of the patients was also clarified. In the course of relating the difference between basal and admission BI (¢BI) values with mortality, being inspired by the study of Rozzini and colleagues, patients were divided into the following according to ¢BI: >30 (major), 5–30 (minor) and no difference (11). Nevertheless, patients who had a basal BI <30 were not included in the ¢BI analysis during the calculation of BI differences, because the calculation of functional capacity change (¢BI) in patients accepted as bedridden might give misleading results since the major ¢BI threshold was determined to be >30 points.

Statistical Analysis

Demographic data are presented as percentages, averages and standard deviations. The normal distribution of data was determined using the Kolmogorov-Smirnov test. The Mann–Whitney U test was used for comparisons of independent data that did not demonstrate a normal distribution, including ordinal data. Changes in basal, admission and 1-month BI values were evaluated using the Friedman test in patients who survived for 1 month and those who died. Comparisons between two groups were performed using the Wilcoxon test and evaluated using the Bonferroni correction. A total type-1 error level of 5% was used for statistical significance. SPSS version 16.0 was used for statistical analysis.

RESULTS

Baseline Characteristics

In total, 226 patients were included; eight patients were excluded because they were not available for the phone survey, leaving a study population of 218 patients. Of the surviving patients (n=181), 72.9% (n=132) were 65–79 years of age and 27.1% (n=49) were ≥80 years of age. Of the patients who died (n=37), 64.8% (n=24) were 65–79 years of age and 35.2% (n=13) were ≥80 years of age. Patients who survived were most frequently diagnosed with pneumonia (23.2%), urinary tract infection (21.5) and non-focal fever (17.7%). In patients who died, the most common diagnoses were pneumonia (32.5%), a non-infectious condition (18.9%) and non-focal fever (16.2%). The main characteristics of the study groups are given in Table 2.

Main Findings

We found significant differences between basal, admission and 1-month BI scores of surviving patients and between basal and admission BI scores of non-survivors (Table 3). The

Table 2— Baseline Characteristics of the Study Groups

Demographic Findings	Survivors (n=181)	Non-survivors (n=37)	p
Sex (male), n (%)	90 (49.7%)	20 (54.1%)	0.632
Age, years	74.8 (65–96)	75.1 (65–90)	0.880
Vital Findings, mean±sd			
Temperature (C°)	38.3±0.6	38.1±0.5	0.080
Systolic blood pressure (mmHg)	135±25	127±27	0.073
Diastolic blood pressure (mmHg)	72±15	74±16	0.292
Pulse (bpm)	104±19	105±25	0.886
Saturation O_2%	94±5	91±7	0.015
Laboratory Findings (Associated with Infection), mean±sd			
White blood cell count, /µL	11466±6542	13573±9775	0.394
C-reactive protein level	10±9	14.1±10	0.017
Emergency Department Treatment Efforts, n (%)			
Blood product use	13 (7.2)	3 (8.1)	0.739
Antibiotics therapy	46 (25.4)	7 (18.9)	0.529
Vasopressor agent use	4 (2.2)	11 (29.7)	<0.001
Secondary Outcomes, mean±sd			
Hospital Length of Stay (hours)	98±144	546±2368	0.014

Table 3— Barthel Index Scores in Survivors and Non-survivors

	Mean±sd	p
Survivors		
BI Basal Score	87.5(±24.7)	**<0.001**
BI Admission Score	73.2(±30.7)	
BI 1-month Score	85.1(±26.8)	
Non-survivors		
BI Basal Score	60.8(±37.5)	**<0.001**
BI Admission	31.7(±28.0)	

Table 4— Overall Change in Barthel Index Scores

	Survivors (n=181)	Non-survivors (n=37)	p
Admission–basal BI score	14.3(±17.0)	29.1(±23.2)	<0.001

fact that the BI scores of surviving patients who were discharged reached the same average value at 1 month as their basal BI scores drew attention. Although we observed a statistically significant difference among basal, admission and 1-month values ($p<0.001$); no difference was found between basal and 1-month values in survivors ($p=0.035$) (Table 3).

Furthermore, the difference between basal and admission BI values was greater in non-survivors (Table 4).

We found a statistically significant difference in the proportion of survivors and non-survivors in patients whose change in BI score was >30 (major change) ($p=0.011$). No difference was found in the proportions of survivors and non-survivors in patients with minor changes and no change (Table 5).

Discussion

The Barthel Index is a frequently used scale that was developed to analyse the activities of daily living of geriatric patients. Identification of a patient's basal level by measuring activities of daily life enables determination of possible declines, which may be predictive for depression, dementia, falling, incontinence, vision problems and other diseases (12).

During ED admissions, it is difficult for a clinician to determine the level of functional dependence of a geriatric patient with a high fever. Therefore, we used the BI, which is an objective means for evaluating a patient's functional physical state, in a geriatric subpopulation admitted to an ED with high fever and possible infection. We determined that high fever increases the vulnerability of geriatric patients, and therefore, the patients experience an increased dependency du-

Table 5—Difference Between Basal and Admission Barthel Index Scores in Survivors and Non-survivors

Change in Barthel Index Score*	Survivors (n=172), n (%)	Non-survivors (n=26), n (%)	p
>30 (Major change)	35 (20.3%)	15 (57.7%)	0.011
5–30 (Minor change)	56 (32.5%)	10 (38.5%)	0.086
No Change	81 (47.2%)	1 (3.8%)	1.000

*Patients whose Basal Barthel Index Score was <30 were not included in the analysis (n = 20).

ring admission compared with their basal situation. Furthermore, in addition to the relation between basal and admission physical situations with lower BI values, the change in BI during admission compared with the basal situation showed a greater decline in non-survivors compared with that of survivors.

We found no adequate ED studies that define the prognosis of serious infection in geriatric patients. Because an important portion of the present data is formed by the research which has been carried out in adult and geriatric heterogeneous populations, the applications of findings to geriatric patients are less valid (13). Developing prognostic scoring scales for geriatric patients is crucial because the number of people in this age group has increased along with the frequency of admissions secondary to fever and infection (14).

In this patient group, alterations in physiological parameters are scrutinised in studies carried out in order to predict the potentially poor prognoses. Chung and colleagues stated that to evaluate 30-day mortality, the following parameters defined as Geriatric Fever Scoring can be used: leucocytosis (≥12.000/mm^3), serious coma (Glasgow Coma Score ≤8) and thrombocytopenia (≤150.000/mm^3) (15). Caterino and colleagues identified the following independent determinants of 28-day mortality in geriatric patients admitted to the ED for infection: respiration rate > 20/min or hypoxemia, heart rate ≥120 beats/min, systolic blood pressure < 90 mmHg or lactate ≥4 despite fluid therapy, the presence of concomitant terminal disease and thrombocyte count < 150,000/mm^3 (16).

Nonetheless, some studies have found that the functional situations of patients should also be taken into consideration, together with evaluation of comorbidities and physiological measurements, in order to predict patient outcomes such as mortality (17). Rozzini and colleagues reported that in a geriatrics department, a distorted functional status as a result of acute disease has clinical importance and should be evaluated together with negative prognostic factors (11). Alarcón and colleagues emphasise that moderate and high BI values in patients staying in a geriatrics unit increases in-hospital mortality, hospitalisation period and readmissions after discharge (18). Narain and colleagues found that distortions in functional physical state as a result of acute disease were related to 6-month mortality in geriatric patients (19). Covinsky and colleagues stated that evaluation of activities of daily living provides more information than routine physiological measurements and comorbidities evaluations, which are used to determine prognosis; hence, these functional evaluations should be used together with other data (20). Leung and colleagues, showed that walking with or without help as a physical activity is an independent determining factor of the duration a hospital stay (21).

In contrast to these studies, given that there are limited numbers of studies on the topic, Caterino and colleagues, in a study of geriatric patients with suspicion of infection who were admitted to the ED, investigated the relationship between functional state and complicated clinical situations such as hospital mortality, need of intensive care, deterioration in clinical situation of the septic patients within 48 hours, and concluded that although functional state does not predict complicated clinical situations, critical factors such as immunosuppression, systolic blood pressure, pulse, metabolic acidosis, serious sepsis and septic shock have important prognostic value for these patients (22). However, in this study, primarily the level of activities of daily living during admission to the ED was taken into consideration, and overall change in level of activity of daily living was calculated. Nonetheless, the point stressed in Rozzini's and our study was that basal and admision BI change can predict mortality and deterioration (11), (23).

In a study conducted by Meurer and colleagues, an increase was detected in the 90-day mortality risk of geriatric patients who had serious infection potential and were admitted to the ED. In survivor patients, temporary distortions in functional state were observed, and their daily physical activity situation in the pre-morbid period was reported to have no de-

tectable influence on 90-day mortality risk (24). Moreover, in our research, after treating and removing the cause of fever, the survivors gained their previous functional capacities back within 1 month. That indicates, physical functional capacity may return to basal levels again after the cause of the fever is identified (for example, the pathogens or bacteria that cause pneumonia or urinary tract infections) and appropriately treated.

First admission points to the healthcare of patients complains fever at geriatric age groups are usually the ED's. In addition, a distinct reduction in functional capacity occurring in geriatric patients with a high fever may mislead clinicians in their evaluation of patients. Especially the fact that emergency medicine physicians are capable of measuring the functional loss between basal and admission can be an important parameter both in predicting mortality and evaluating response to treatment. The fact that there are significant differences between basal BI scores and admission BI scores indicate that these values can be used in the prognosis of patients similar to physiological and laboratory data. For this reason, we believe that BI can be used as an objective evaluation tool by ED physicians for predicting mortality in geriatric patients. A limitation of our research is that we did not evaluate the effects of the cognitive and psychological states of patients on their prognosis.

In conclusion, fever increases the physical dependency of geriatric patients. A functional scoring test such as BI for prognostic purposes can be used during evaluations of geriatric patients admitted to ED with a high fever. Situations causing a serious increase in functional dependency during admission compared with a patient's basal situation can be related to short-term mortality in geriatric patients.

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