Turkish Journal of Geriatrics
2011; 14 (2) 85-94

Ş. Gülbin AYGENCEL
Neslihan DOĞAN
Başak ÜNVER-KOLUMAN
Melda AYBAR-TÜRKOĞLU

RESEARCH

AGE ALONE SHOULD NOT BE A TRIAGE CRITERION FOR INTENSIVE CARE UNIT ADMISSION

ABSTRACT

Introduction: Older age is associated with higher prevalence of chronic illness and functional impairment, contributing to an increased rate of hospitalization and admission to intensive care. The primary objectives of this study are to evaluate the rate, characteristics and outcomes of elderly patients (age ≥65) admitted to our intensive care unit (ICU), to compare the differences between old (65-79 years old) and very old (≥80) patients, and to find the factors associated with survival.

Materials and Method: Retrospective analysis of prospectively collected data from our ICU patient database was performed. Data were obtained for 780 adult admissions for ≥24 hours between April 1, 2007 and April 1, 2009.

Results: A total of 260 elderly patients (33.3%) were admitted during the study. ICU mortality for this group was 48.8%. Advanced age (≥65) was not associated with higher ICU death. Factors associated with decreased survival included greater illness severity, longer stay in the ICU, use of advanced life-support measures in the ICU (such as mechanical ventilation, central venous or arterial catheterization and vasoactive and /or inotropic drugs), and differences in some laboratory parameters. The significant differences between old and very old patients were found to be due to gender and comorbidity differences.

Conclusion: The proportion of patients aged ≥65 years old admitted to intensive care is rapidly increasing. Although these patients have more comorbidities and their severity of illness is greater when compared to younger patients, approximately half of the old patients survive to ICU discharge. Our results emphasize that age alone is not a relevant criterion for ICU admission.

Key Words: Aged; Aged, 80 and over; Length of Stay; Intensive Care Units/utilization; Mortality.

ARAŞTIRMA

YAŞ TEK BAŞINA YOĞUN BAKIM ÜNİTESİNE KABÜLDE BİR TRİAJ KRİTERİ OLMAMALIDIR

ÖZ

Giriş: İleri yaş kronik hastalık görülme sıklığında artış ve fonksiyonel bozulma ile birliktedir; bu durum hastaneye yatış ve yoğun bakıma başvuru hızında artmaya neden olur. Bu çalışmanın pimer amaçları yoğun bakım ünitemize yatan ≥65 yaş hastaların oranları, özellikleri ve sonuçlarının incelenmesi, 65-79 yaş arası ile ≥80 yaş hastaların farklılıklarının karşılaştırılması ve sağ kalıma etki eden faktörlerin bulunmasıdır.

Gereç ve Yöntem: Veriler, yoğun bakım ünitemize yatan hastalar için prospektif olarak tutulan veri tabanından retrospektif olarak elde edilmiştir. Veriler 1.Nisan.2007 ile 1.Nisan.2009 tarihleri arasında 24 saatten daha fazla yatan 780 hastadan elde edilmiştir.

Bulgular: Çalışma sürecinde toplam 260 yaşlı hasta (%33.3) yoğun bakım ünitemizde takip edilmiştir. Bu grup hasta için mortalite %48.8'dir. Altmışbeş yaş ve üstü hastalarda yoğun bakım mortalite artmamıştır. Artmış hastalık şiddeti, yoğun bakımda uzayan yatış, yoğun bakımda uygulanan ileri destek tedavileri (mekanik ventilasyon, santral venöz veya arteriyel kateter yerleştirilmesi, vazoaktif veya inotropik ilaç kullanılması) ve bazı laboratuar bulgularındaki farklılıklar azalmış sağ kalım ile ilişkili bulunmuştur. Yaşlı ve çok yaşlı hasta gruplarındaki önemli farklılıklar ise cinsiyet ve altta yatan hastalıklardan kaynaklanmaktadır.

Sonuç: Yoğun bakım ünitesine başvuran 65 yaş ve üstü hastaların toplam başvurular içindeki yüzdesi hızla artmaktadır. Bu hasta grubu genç hastalara göre daha fazla altta yatan hastalığa ve hastalık ağırlığına sahip olmasına rağmen; yaklaşık yarısı yoğun bakım ünitesinden taburcu olabilmektedir. Bizim sonuçlarımız hastaların yoğun bakıma kabulünde yaşın tek başına kullanılabilen bir kriter olmaması gerektiğini tekrar vurgulamaktadır.

Anahtar Sözcükler: Yaşlı; 80 Yaş ve Üzeri Yaşlı; Kalış Süresi; Yoğun Bakım Ünitesi/yararlanma; Mortalite.

İletişim *(Correspondance)*

Gülbin AYGENCEL
Gazi Üniversitesi Tıp Fakültesi
İç Hastalıkları Anabilim Dalı ANKARA

Tlf: 0312 202 42 16
e-posta: aygencel@hotmail.com

Geliş Tarihi: 21/08/2009
(Received)

Kabul Tarihi: 09/11/2009
(Accepted)

Gazi Üniversitesi Tıp Fakültesi
İç Hastalıkları Anabilim Dalı ANKARA

INTRODUCTION

The elderly population has increased significantly in developed countries and is expected to grow more as a consequence of increased life expectancy. Older patients are more demanding in terms of health resources than the younger ones. Older age is associated with an increased prevalence of chronic illness and functional impairment. As a result, the rate of hospitalization for acute illness among older persons is likely to increase. Similarly, the demand for critical care services and admissions to ICUs will also dramatically rise (1).

There are significant worldwide geographic variations in the number of elderly patients admitted to ICUs. The United States has the highest percentage of ICU patients ≥65 years of age (42-48%). In other parts of the world, including Asia, the proportion of elderly patients admitted to ICUs is lower. This may be the result of a possible exclusion of elderly from ICUs in Asian countries due to a shortage in ICU beds (2).

Age alone is an important prognostic factor in elderly patients admitted to intensive care units, but it is not as important as illness severity. However, age seems to remain an important independent triage criterion for ICU admission (3).

Our primary objectives in this study are to evaluate the clinical characteristics, outcomes and factors associated with survival for old patients (≥65 years old) admitted to our medical ICU and to compare the management and outcomes of patients aged 80 years or older with those of patients aged between 65 and 79 over a two-year period.

MATERIALS AND METHOD

This study was performed in the Gazi University Hospital, a 900-bed tertiary university hospital, located in Ankara, Turkey. The hospital provides care to all general surgical and medical conditions. The ICU is a nine-bed medical unit admitting on a nonelective basis, 400 adult patients per year. Patients were admitted after an evaluation by a physician intensivist. We had no specific admission criteria.

This retrospective study was performed between April 1, 2007 and April 1, 2009. All consecutive patients aged ≥65 years old in our unit were included in the study. Informed consent was obtained from all participants or their healthcare proxy. The data were extracted from our ICU database. This database was prospectively managed and comprehensively describes patient stays. For each patient, we collected (a) prehospitalization attributes (age, gender, presence of comorbidities), (b) admission data (including reason for ICU admission, severity of illness on admission according to Acute Physiology and Chronic Health Evaluation-APACHE II –scoring system, source of admission), (c) advanced life support measures taken during the ICU stay (mechanical ventilation, central venous catheterization, arterial catheterization, inotropic and/or vasoactive drug use, and/or dialysis), (d) physiological data (including some laboratory examinations), (e) ICU outcome, and (f) duration of ICU stay.

Statistical Analysis

Analysis was performed using the SPSS 11.5 computer program. Normally distributed or almost-normally distributed variables were reported as means with standard deviations and were compared by Student's t test. Non-normally distributed continuous data were reported as medians with interquartile ranges and were compared by the Mann-Whitney U test. Categorical data were reported as proportions and were compared using the chi-square test, Pearson or Fischer's exact test (as appropriate). Multivariable logistic regression analysis was used to evaluate for factors associated with ICU mortality for the cohort aged ≥65 years. Differences were considered statistically significant when $p<0.05$.

RESULTS

Over a two-year period, 780 patients were admitted to our ICU. Ranging from 17 to 107, mean age of the patients was 61.89±18.26 years. Fifty-six point two percent (56.2 %) of all patients were males. Forty-eight point two percent (48.2%) of the patients died during their stay in the ICU. The mean length of ICU stay for all inpatients was 8.61±12.12 days (median: 5 days; minimum: 1 day; maximum: 102 days).

Thirty-three point three percent (33.3%) of the inpatients were 65 years old and over. This group was included in the study. In the study group, there were 131 women (50.4%) and 129 men (49.6%). While 161 patients (61.9%) were in the 65-79 age group, 99 patients (38.1%) were 80 years old and over. APACHE II score of the patients in the study group was 22.46±8.0 (22; 7-53). Hospitalization period of these patients in the ICU was 11.15±14.09 (7; 2-100) days. Causes of inpatient admission to the ICU are shown in Table 1 and their comorbidities are shown in Table 2.

Majority of the patients admitted to intensive care unit were from the emergency service (58.1%) and the internal medicine clinics (30.8%).

Mechanical ventilation was used for 58.8% of the patients. While invasive mechanical ventilation was used for 125

Table 1— Causes of ICU Admission For Inpatients Aged 65 Years and Over

Causes of Admission to ICU	n (%)
Sepsis	91 (35%)
Respiratory causes	81 (31.2%)
Gastrointestinal causes	28 (10.8%)
Postresuscitation	13 (5%)
Renal causes	13 (5%)
Metabolic causes	13 (5%)
Neurological causes	10 (3.8%)
Postoperative	7 (2.7%)
Cardiovascular	3 (%1.2)
Intoxication	1 (0.4%)
Total	260 (100%)

Table 2— Comorbidities of ICU Inpatients Aged 65 Years and Over

Comorbidities	n (%)
Cardiovascular diseases	126 (48.5%)
Endocrinological diseases	89 (34.2%)
Neurological diseases	63 (24.2%)
Renal diseases	69 (26.5%)
Respiratory diseases	41 (15.8%)
Oncologic diseases	42 (16.2%)
Hematological diseases	28 (10.8%)
Gastrointestinal diseases	29 (11.2%)
Chronic infectious disease	11 (4.2%)
No-comorbidities	11 (4.2%)
Romatological diseases	8 (3.1%)

patients (48.1%), non-invasive mechanical ventilation was applied for 90 patients (34.6%). Seventy-two percent (72%) of the patients were extubated on the first trial; whereas 35 patients required more than one trial.

During the intensive care unit stay, tracheostomy was performed in 16 patients (6.2%) due to prolonged mechanical ventilation. In 162 patients (62.3%), a central venous catheter was placed for hemodynamic monitorization or renal replacement therapy. Catheter complications developed in 20 patients (12.34%). The most frequent complication was catheter-related infection. In 175 patients (67.3%), arterial catheter was placed for invasive arterial blood pressure monitorization or arterial blood gas analysis. The most frequent complication of arterial catheterization was ischemia and it was observed in 7 patients (4%). None of the ischemia complications resulted in gangrene or necrosis.

Renal function tests were found abnormal in 143 patients (55%) on admission, and renal functions improved in 32 patients during ICU stay. Renal replacement therapy (continuous or intermittent hemodialysis) was required in 101 patients (38.8%). On admission, liver enzymes were elevated in 77 patients (29.6%) and at follow up liver function tests improved in 28 patients.

Five patients developed ARDS during their stay in the ICU.

On admission, infection was determined in 226 (86.9%) patients. The most frequent type of infection was pneumonia (63.1%) and urinary tract infection (25.4%). During ICU stay, infection developed in 83 patients (31.9%). Most common infection was ventilator-associated pneumonia (25.8%).

Gastrointestinal bleeding was observed in 22 patients (8.5%) on admission. Although prophylaxis with PPI was performed for all patients, bleeding in gastrointestinal system persisted in 17 patients (6.5%) during the stay.

Food intake of patients who could receive oral nutrition was observed, and some patients were supported with oral enteral products. Enteral (47.7%) and/or parenteral (60%) nutrition was initiated for patients who were unable to maintain an adequate food intake.

On admission sepsis was present in 55 patients (21.2%), and 60 patients (23.1%) developed sepsis during their stay. Sepsis was observed both on admission and the during the stay in 33 patients (12.7%). Vasopressor and/or inotropic drugs were administered to 151 patients (58.1%).

In our ICU protocol, red blood cell transfusion is performed when the hemoglobin level is below 7-8 g/dL for patients aged ≥65 years. If the patient is in septic shock or has acute or chronic cardiovascular disease, target hemoglobin level is 9-10 g/dL. Replacement of blood and blood products was performed in 153 patients (58.8%) during their stays according this protocol. 129 patients (49.6%) required red blood cell transfusions and 36 patients (13.8%) required platelet transfusions.

During the ICU stay, additional procedures were performed on 69 patients (26.5%). As mentioned above, the most frequent procedure was tracheostomy (6.2%). Other procedures performed include gastrostomy, thoracentesis, paracentesis, lumbar puncture, bone marrow biopsy, and insertion of a chest tube.

153 patients (58.8%) went through additional diagnostic investigations during their stay in the ICU. Abdominal USG was performed in 71 patients, abdominal CT in 9 patients, thorax USG in 8 patients, thorax CT in 22 patients, cranial

Table 3— Some Laboratory Parameters On Admission and Discharge of ICU Inpatients Aged 65 Years and Over

Parameters	On Admission	On Discharge	p
Hemoglobin (g/dL)	10.58±2.36 (10.3; 4-19)	9.73±1.97 (9.6; 3-18.6)	**<0.0001**
Leukocytes (/mm³)	14014.09±17739.29 (11150; 220-256000)	13799.48±17333.82 (10600; 82-231000)	0.799
Platelets (/mm³)	189471.35±155577.37 (173500; 1410-1840000)	164212.96±138949.12 (138500; 9230-1350000)	**<0.0001**
hsCRP (mg/dL)	12.3±9.1 (11; 0.3-31)	11.82±9.07 (10.4; 0.2-30)	0.399
BUN (mg/dL)	51.34±29.85 (46; 6-196)	44.42±28.78 (35; 3-145)	**0.001**
Creatinine (mg/dL)	2.38±1.88 (1.75; 0.4-14)	2.24±1.77 (1.6; 0.4-11.8)	0.096
Sodium (mEq/L)	138.11±7.75 (138; 97-170)	139.1±5.52 (139; 124-155)	0.05
Potassium (mEq/L)	4.11±0.88 (4; 2-7)	4.03±0.81 (3.9; 2.4-7.7)	0.260
AST (IU/L)	115.92±308.56 (33; 5-3863)	104.1±344.36 (29; 4-4220)	**0.049**
ALT (IU/L)	94.44±272.17 (25; 1-3242)	76.1±223.73 (20; 1-1645)	**0.003**
Albumin (g/dL)	3.06±0.66 (3; 1.4-5.3)	2.77±0.66 (2.8; 1.3-4.7)	**<0.0001**
Total bilirubine (mg/dL)	1.72±2.78 (0.9; 0.2-23)	1.74±3.27 (1; 0.2-26)	0.815
Calcium	8.054±1.1 (8; 5-16)	7.81±0.87 (7.9; 5.3-10.7)	**0.001**
Phosphorus	3.83±1.52 (3.5; 1-9)	3.78±1.81 (3.45: 0.7-12.9)	0.668

CT in 60 patients, EEG in 25 patients, cranial MRI in eight patients, endoscopy in 32 patients, bronchoscopy in two patients, angiography in three patients, scintigraphy in three patients, Doppler USG in 27 patients, and echocardiography in 28 patients.

Some laboratory values for inpatients 65 years old and over on admission to and discharge from ICU are shown in Table 3.

Some laboratory parameters significantly changed from admission to discharge in elderly ICU patients. Platelet counts, hemoglobin and albumin levels were adversely affected from admission to discharge.

Ultimately, 61 patients (23.5%) were discharged, 71 patients (27.3%) were transferred to related units, 127 patients (48.8%) died, and 1 patient (0.4%) was transferred to another hospital. In short, 133 patients (51.2%) were identified as survivors and 127 patients (48.8%) as nonsurvivors.

Patients were categorized in two groups in terms of their age (patients aged between 65-79 years and patients aged 80 years and over). We evaluated whether the two groups were significantly different with regard to continuous variables (age, length of stay, laboratory parameters, etc.) and categorical variables (intubation rate, comorbidities, existing infections, etc.). The only significantly different continuous variable between the age groups was BUN value on admission of patients. BUN value on admission in patients aged 80 years and over was higher (p=0.036). The continuous variables compared between the age groups are shown in the table below (Table 4).

In comparison of categorical variables, sex (p=0.002), presence of comorbidities for cardiovascular diseases (p=0.005), presence of oncologic diseases (p=0.05), presence of neurological diseases (p=0.011), presence of hematological diseases (p=0.033), presence of febrile neutropenia on admission (p=0.033), platelet transfusions (p=0.05), performing paracentesis (p=0.026), insertion of percutaneous transhepatic cholangiography (PTC) (p=0.02), placement of catheter with angiographic technique (p=0.038), and thorax CT scans performed (p=0.025) were significantly different between the age groups.

In addition, the number of female patients in the group aged 80 years and over was significantly higher. In the same group, presence of comorbidities for cardiovascular diseases and presence of neurological diseases were also significantly higher. In the 65 to 79 year-old-patient group, presence of comorbidities for oncologic and hematological diseases were higher. Therefore, in this age group, febrile neutropenia was more frequent and platelet transfusions and thorax CT scans were performed more often. Due to the conservative approach in patients aged 80 years or over, PTC insertion and permanent catheter insertion with angiographic technique for chronic renal replacement therapy was applied more often due to structural changes in anatomy, problems such as atherosclerosis or decreased survival expectancy.

Table 4— Continuous Variables Compared Between Patients Aged 65 to 79 Years and Patients Aged 80 Years and Over

Parameters	Age Between 65 and 79 Years (n=161)	Age ≥80 years (n=99)	p
APACHE II score	22.48±8.41 (22; 7-53)	22.41±7.30 (22; 7-42)	0.797
Duration of ICU stay (day)	11.46±14.74 (7; 2-100)	10.65±13.01 (7; 2-90)	0.810
Hemoglobin on admission	10.54±2.49 (10; 5.4-18.5)	10.66±2.15 (10.5; 4.1-15.6)	0.413
Leukocytes on admission	14511.07±21828.46 (11200; 220-256000)	13205.86±7257.13 (11100; 2010-48000)	0.345
Platelets on admission	181026.4±127089.87 (165000; 1410-628000)	203205.05±193107.52 (176000; 19900-1840000)	0.277
HsCRP on admission	12.77±9.43 (11.1; 0.3-30)	11.65±8.54 (9.8; 0.3-31)	0.486
BUN on admission	49.28±31.49 (42; 6-196)	54.68±26.8 (49; 9-125)	**0.036**
Creatinine on admission	2.41±2.02 (1.6; 0.4-14)	2.32±1.64 (1.8; 0.4-8.6)	0.744
Sodium on admission	137.64±7.59 (137; 116-170)	138.87±7.99 (138; 97-165)	0.052
Potassium on admission	4.15±0.83 (4.1; 2.3-7.0)	4.05±0.96 (3.9; 2.2-7.3)	0.22
AST on admission	113.93±357.34 (32; 5-3863)	119.15±207.7 (36; 5-1119)	0.396
ALT on admission	90.76±315.04 (22; 6-3242)	100.42±183.51 (30; 1-790)	0.088
Albumin on admission	3.1±0.71 (3.1; 1.4-5.3)	2.99±0.57 (3; 1.7-4.7)	0.331
Total bilirubin on admission	1.73±2.78 (0.9; 0.2-21)	1.69±2.78 (0.9; 0.2-23)	0.623
Calcium on admission	8.1±1.12 (8.1; 5.2-16)	7.97±1.06 (8; 5.5-12.4)	0.205
Phosphorus on admission	3.83±1.57 (3.5; 1-8.8)	3.82±1.45 (3.5; 1.2-7.7)	0.833
Hemoglobin on discharge	9.75±2.08 (9.5; 5-18.6)	9,7±1.81 (10; 3-13.4)	0.387
Leukocytes on discharge	14249.57±21202.87 (9790; 82-231000)	13067.53±7695.72 (10800; 255-40900)	0.142
Platelets on discharge	158034.78±124416.81 (127000; 13500-628000)	174260.3±154000 (164000; 9230-1350000)	0.259
HsCRP on discharge	11.79±9.11 (10.56; 0.2-30)	11.88±9.06 (10.26; 0.2-30)	0.957
BUN on discharge	42.80±28.31 (34; 3-125)	47.05±29.5 (38; 7-145)	0.205
Creatinine on discharge	2.34±1.98 (1.6; 0.4-11.8)	2.1±1.35 (1.6; 0.4-6.1)	0.953
Sodium on discharge	139.17±5.48 (139; 124-155)	138.98±5.61 (138; 125-153)	0.94
Potassium on discharge	4.08±0.82 (3.9; 2.4-7.7)	3.97±0.8 (3.8; 2.6-6.9)	0.235
AST on discharge	119.61±420.78 (28; 4-4220)	78.9±152.64 (29; 6-913)	0.473
ALT on discharge	81.16±243.28 (21; 1-1645)	67.86±188.57 (19; 1-1149)	0.497
Albumin on discharge	2.78±0.67 (2.8; 1.3-4.7)	2.75±0.65 (2.7; 1.3-4.4)	0.936
Total bilirubin on discharge	1.78±3.42 (1; 0.2-26)	1.68±3.03 (0.9; 0.2-25)	0.981
Calcium on discharge	7.82±0.87 (7.9; 5.5-10.7)	7.81±0.88 (7.9; 5.3-10.7)	0.927
Phosphorus on discharge	3.91±2.01 (3.5; 0.7-12.9)	3.58±1.4 (3.4; 0.7-7.3)	0.429

Patients who were 65 years old and over were then divided into two groups as those who survived (survivors) and those who died (nonsurvivors), and continuous and categorical variables were compared. The continuous variables, significantly different between survivors and nonsurvivors were APACHE II score, duration of stay in the intensive care unit, number of intubations, number of catheters placed and artlines opened, values for hsCRP, BUN, creatinine, AST, albumin and phosphorus on admission, and values for hemoglobin, leukocytes, platelets, hsCRP, BUN, creatinine, potassium, AST, total bilirubine, calcium, phosphorus, albumin on discharge. Significantly different values identified are shown in the table below (Table 5).

The APACHE II score of the survivors was lower and their duration of stay in the intensive care unit was shorter compared to the nonsurvivors. Survivors were less exposed to invasive procedures (intubation, catheter placement, etc.). Laboratory values of the survivors on admission and on discharge

Table 5— Different Continuous Variables in ICU Inpatients Aged 65 Years and Over Who Survived and Who Died

Parametres	Survivors (n=133)	Nonsurvivors (n=127)	p
Age	76.37±6.76 (75; 65-94)	77.71±7.71 (77; 65-95)	0.155
APACHE II score	19.4±6.73 (19; 7-39)	25.66±7.98 (25; 8-53)	**<0.001**
Duration of ICU stay (days)	8.46±7.79 (7; 2-55)	13.97±18.13 (9; 2-100)	0.018
Number of intubation	0 (0-2)	1 (0-4)	**<0.001**
Number of catheter insertion	0 (0-3)	1 (0-4)	**<0.001**
Number of artline insertion	0 (0-2)	1 (0-4)	**<0.001**
HsCRP on admission	9.95±8.3 (7.63; 0.3-30)	14.75±9.23 (14; 0.5-31)	**<0.001**
BUN on admission	48.33±31.11 (42;6-196)	54.49±28.26 (49;8-186)	**0.022**
Creatinine on admission	2.26±2.08 (1.4; 0.5-14)	2.5±1.65 (2.1; 0.4-9)	**0.018**
AST on admission	113.73±380.96 (29; 6-3863)	118.21±208.97 (40; 5-1119)	**0.02**
Albumin on admission	3.18±0.7 (3.1; 2-5)	2.93±0.6 (3; 1-5)	**0.003**
Phosphorus on admission	3.65±1.45 (3.4; 1-9)	4.02±1.56 (3.7; 1-8)	**0.043**
Hemoglobin on discharge	10.32±1.83 (10.2; 5-15)	9.13±1.95 (9.2; 3-19)	**<0.001**
Leukocytes on discharge	10197.22±5380.44 (9320; 1980-30900)	17571.94±23648.38 (12800; 82-231000)	**<0.001**
Platelets on discharge	191874.44±117516.6 (170000;16800-612000)	135244.65±153509.2 (97100; 9230-435000)	**<0.001**
HsCRP on discharge	7.67±7.06 (5.7; 0.2-30)	16.23±8.88 (17; 0.2-30)	**<0.001**
BUN on discharge	33.11±21.85 (27;3-105)	56.27±30.42 (49;6-145)	**<0.001**
Creatinine on discharge	1.76±1.73 (1.1; 0.4-12)	2.76±1.66 (2.4; 0.5-10)	**<0.001**
Potassium on discharge	3.89±0.65 (3.8; 3-6)	4.18±0.92 (4; 2-8)	**0.016**
AST on discharge	51.51±143.4 (25; 6-1210)	159.18±465.02 (34; 4-4220)	**<0.001**
Total bilirubin on discharge	1.23±2.1 (0.8; 0.2-22)	2.3±4.1 (1; 0.3-26)	**<0.001**
Calcium on discharge	8.13±0.8 (8.1; 6-11)	7.5±0.84 (7.5; 5-10)	**<0.001**
Albumin on discharge	3.06±0.61 (3; 2-5)	2.47±0.56 (2.4; 1-4)	**<0.001**
Phosphorus on discharge	3.34±1.28 (3.2; 0.7-10)	4.24±2.14 (4.24; 0.9-13)	**<0.001**

were closer to the normal values when compared to those of the nonsurvivors.

Survivors and nonsurvivors were also different in terms of categorical variables. Significant differences were observed in application of mechanical ventilation, extubation, re-intubation, tracheostomy, central venous and arterial catheterization. There were significant differences in changes in renal function tests on admission and ICU stay, in application of renal replacement therapy, in infections present on admission and those developed during intensive care unit stay, in application of nutritional support treatment, vasopressor therapy, replacement of blood and blood products, and additional investigations (Table 6).

An important finding is that, in the surviving 65 years old and over intensive care inpatient group, mechanical ventilation and invasive procedures were less frequently performed, number of infections developed was lower, lesser blood and blood product replacements were performed and vasopressors were used less frequently. As these patients could receive oral nutrition, less nutritional support was provided.

When logistic regression analysis was performed to identify the factors independently associated with mortality in ICU; APACHE II score, ventilator-associated pneumonia, parenteral nutrition, sepsis/septic shock and hsCRP on discharge were found to be significantly associated with ICU mortality (Table 7).

Discussion

Treatment in the ICU is costly. In certain parts of the world, elderly patients admission to ICUs have a lower priority. This is due to uncertainty of the costs and benefits of

Table 6— Categorical Variables Showing Differences Between ICU Survivors and Nonsurvivors Aged 65 Years and Over

Parameters	Survivors (133) (n, %)	Nonsurvivors (127) (n,%)	p
Intubation	20 (15%)	104 (81.9%)	**<0.0001**
Applying mechanical ventilation	44 (33.1%)	109 (85.8%)	**<0.0001**
Performing invasive mechanical ventilation	20 (15%)	105 (82.7%)	**<0.0001**
Re-intubation	2 (1.5%)	34 (26.8%)	**<0.0001**
Tracheostomy	1 (0.8%)	15 (11.8%)	**<0.0001**
Central venous catheter placement	50 (37.6%)	112 (88.2%)	**<0.0001**
Arterial catheterization	60 (45.1%)	116 (91.3%)	**<0.0001**
Abnormality in renal functions on admission	62 (46.6%)	81 (63.8%)	**0.006**
Performing renal replacement therapy	35 (26.3%)	66 (52%)	**<0.0001**
Presence of infection on admission	106 (79.7%)	120 (94.5%)	**<0.0001**
Presence of pulmonary infection on admission	64 (48.1%)	100 (78.7%)	**<0.0001**
Infection development in the ICU	14 (10.5%)	69 (54.3%)	**<0.0001**
Urinary tract infection development in the ICU	4 (3%)	19 (15%)	**<0.001**
Ventilator-associated pneumonia development in the ICU	7 (5.3%)	60 (47.2%)	**<0.0001**
Blood/catheter infection development in the ICU	2 (1.5%)	11 (8.7%)	**0.009**
Providing oral nutrition	103 (77.4%)	14 (11%)	**<0.0001**
Providing enteral nutrition	39 (29.3%)	85 (66.9%)	**<0.0001**
Providing parenteral nutrition	60 (45.1%)	96 (75.6%)	**<0.0001**
Presence of sepsis/septic shock	39 (29.4%)	109 (85.8%)	**<0.0001**
Administration of vasopressors/inotropes	40 (30.1%)	111 (87.4%)	**<0.0001**
Replacement of blood and blood products	58 (43.6%)	95 (74.8%)	**<0.0001**
Erythrocyte replacement	49 (36.8%)	80 (63%)	**<0.0001**
Platelet replacement	8 (6%)	28 (22%)	**<0.0001**
Albumin replacement	6 (4.5%)	19 (15%)	**0.006**
Performing paracentesis in ICU	8 (6%)	0 (0%)	**0.007**
Cranial CT scan in ICU	22 (16.5%)	38 (29.9%)	**0.012**

Table 7— Logistic Regression Analysis to Identify Factors Independently Associated With Mortality in The ICU
(CI: confidence interval, VAP: ventilator-associated pneumonia)

Parameters	Odds ratio for mortality	95% CI	p
APACHE II score	1.1	(1.01-1.23)	**0.028**
VAP	11.53	(2.22-59.9)	**0.004**
Parenteral nutrition	5.26	(1.62-17.16)	**0.006**
Sepsis/septic shock	19.73	(3.74-103.95)	**<0.001**
hsCRP on discharge	1.1	(1.03-1.17)	**0.003**

treating elderly patients in such units. Critically ill elderly patients who are not admitted to the ICU receive suboptimal care in the general wards. Thus, it is important to know the outcomes of treating these elderly patients in ICUs in order to make a rational decision and to provide reliable information to clinicians, patients and their families (1,4).

Our study was conducted to examine the characteristics of and the survival in elderly patients (≥65 years old) hospitalized in the ICU. Although this is a small study conducted in a single center, we believe that it is relevant in terms of determining the percentage of elderly patients in a medical ICU in Turkey, elderly patients' survival rates, and the factors affecting their survival.

Elderly patients (aged ≥65 years old) currently represent 42-52% of ICU admissions and almost 60% of all ICU stays in developed countries (5). In our study, over a two-year peri-

od 33.3% (260) of 780 inpatients were 65 years old and over. Prior estimations for ICU admission rates of patients aged ≥80 years old were ranging between 3% to 16.5% (6). In our study, the ICU admission rate of patients aged 80 years and over was 12.7% (99). Both results are similar to the values in the literature. This study is also of great value in showing the importance of ICU and health care service use of the aging population in Turkey.

Aging is associated with decreased cardiopulmonary and renal reserve and with a high rate of comorbidities, increasing the risk of progressive organ failure in the elderly.

According to several studies, severity of illness and age are important factors for determining ICU survival. Age and functional status before ICU admission are the major determinants of survival on discharge and at 6 and 12 months after ICU discharge (7). Age alone should not be used to triage ICU patients; the decision to admit an elderly patient to an ICU should be based on comorbidities, severity of illness, prehospital functional status, and preferences with regard to life sustaining treatment (8). In our study, only 11 patients (4.2%) had no comorbidities. Most of the patients experienced additional illnesses and problems, particularly cardiovascular, neurological, endocrinological and renal problems. The functional status of the patients before ICU admission was unknown as no data on patient status was gathered. The majority of the patients was hospitalized due to vital problems such as septic or respiratory problems. In 58.8% (153) of the patients, mechanical ventilation was applied. Moreover, 58.1% (151) of the patients were administered vasopressor and/or inotropic drugs.

The SAPS and APACHE II scores provided a good assessment for mortality and severity of illness in different studies performed in a population solely consisting of elderly patients. SAPS provided a better linear relationship with mortality rate. The severely ill elderly patients had a gloomy prognosis when their SAPS was >20 or APACHE II score was >30 (9). In our study, the APACHE II score was used to determine the severity and mortality of the illness. The APACHE II score of all patients in the ICU was 17.22±5.44 (19; 3-61); while the APACHE II score of patients in the study group was 22.46±8.0 (22; 7-53). The difference between the scores was significant ($p<0.05$). While 11 patients (24.4%) out of 45 with an APACHE II score ≥30 survived, 122 patients (56.7%) out of 215 with an APACHE II score <30 survived. The difference was significant ($p<0.0001$).

In the literature review, inhospital mortality of the critically ill elderly varied from 20% to 50% in the ICUs. This great variation results from the heterogeneity of elderly patients as well as from the selection criteria of individual ICUs (10,11). Our results indicate that half of the patients (51.2%) were discharged alive from the ICU.

According to different studies, certain factors determine mortality in elderly patients on admission or during ICU stay. The mortality rate of elderly patients who received CPR before admission and those with a newly diagnosed or incurable malignancy was 100% (12). Among patients > 65 years of age in Knaus et al.'s study, those with one organ system failure had a hospital mortality rate of 60%. For patients with two organ system failures, the mortality rate increased to 90%. Among patients who had three or more organ system failures, the mortality rate was 100% (13). Patients who had been mechanically ventilated also had a high mortality rate. In one of the studies, risk factors for higher hospital mortality were determined as: a diagnosis of acute respiratory failure on admission, an APACHE II score ≥25, need for mechanical ventilation and inotropes, and development of complications during ICU stay (particularly acute renal failure) (14). In some studies, a significantly higher mortality rate was reported for people ≥85 years of age (15). However, in the current study no significant difference was found between the 65-79 year old group and the 80 years old and over group in terms of mortality ($p=0.252$). According to our study, a higher APACHE II score, ventilator-associated pneumonia, parenteral nutrition, sepsis/septic shock and higher hsCRP value on discharge were associated with a higher ICU mortality.

In our study, the differences between old (65-79 years old) and very old (≥80 years old) patients, and the differences between the survivors and nonsurvivors were examined.

The differences between very old (≥80 years old) and old (65-79 years old) patients can be listed as follows: (1) The number of female patients in the group aged 80 years and over was significantly higher. However, in some studies in the literature, it was noted that the number of male patients in this age group was higher (2). In patients aged 80 years and over, comorbidities for cardiovascular diseases and presence of neurological diseases were significantly higher, while in patients aged between 65 and 79 years comorbidities for oncological and hematological diseases were higher. Therefore, in this age group, febrile neutropenia was more frequent and platelet transfusions and thorax CT scan was performed more often (3). In the group aged 80 years and over, more conservative approaches were used. For instance, PTC was preferred over ERCP in biliary diseases.

The differences between the survivors and nonsurvivors can be listed as follows: (1) APACHE II score of the survivors

was lower and their length of stay in the intensive care unit was shorter compared to the nonsurvivors (2). Invasive procedures (intubation, catheter placement, etc.) were performed less on the survivors (3). Laboratory parameters on admission and discharge of the survivors were closer to normal values compared to those of the nonsurvivors (4). Mechanical ventilation support was less frequently used for the survivors (5). Number of infections developed in the survivors during their stay in the ICU was lower (6).

In some prior studies, when compared with younger subgroups, older patients had greater odds of death in the ICU and the hospital after covariate adjustment including comorbid diseases and severity of illness (16). De Rooij et al. found that age was independently associated with lower short-term survival in older patients admitted to the ICU that was not attributable to older patients' receiving less intensive therapy (17). Moreover, patients aged ≥80 years had the highest 6-month mortality rates when compared with other age strata. Boumendil et al. found that very old patients had comparably greater ICU and hospital adjusted odds of death (6). On the other hand, Boumendil et al. conducted a matched cohort study of over 6,000 patients comparing those aged 65-79 years and those aged ≥80 years old and found that fewer very old patients received mechanical ventilation or renal replacement therapy; vasopressor, tube feeding, and major surgical interventions were withheld compared with younger patients (6).

In our study, we found no difference between the groups in terms of mortality when the necessary treatment was applied at necessary times on all age groups. Mortality rates for all inpatients, ≥65 year old patients and ≥80 year old patients, during a period of two years in our ICU, were found 48.2%, 48.8% and 53.5% respectively. The difference was not statistically significant.

Our study and prior available data suggest, however, that chronological age alone is probably insufficient to discriminate triage decisions on ICU admission. Rather, age probably represents an additive factor when coupled with fragility, physiologic reserve, burden of comorbid illness, primary diagnosis, and illness severity. Prehospital disposition and/or functional status was shown in numerous investigations to predict worse clinical outcome. This constellation of clinical factors probably has important bearing not only on short-term survival but also on long-term survival, neurocognitive performance, functional autonomy, and quality of life. Accordingly, very old patients developing critical illness-who are characterized by a low burden of comorbid disease, good functional status, and no measurable frailty-are likely to benefit from ICU support (18,19).

Worldwide medical expenditures on intensive care and the percentage of the elderly population are dramatically increasing. There is a possibility that in the future, elderly patients will not receive intensive care treatment if restrictions on health care resources are introduced. Throughout the literature, concerns are expressed regarding the existence of bias against admitting elderly patients to intensive care units (20, 21). Cost benefit analysis is important in the evaluation of intensive care treatment for the elderly patients (22). Therefore, we are planning to conduct a prospective cost benefit analysis study for elderly patients admitted to ICU.

The present study has a number of limitations. The sample size was small and limits the generalizability of our findings. Additionally, our study represents the practice at only one institution. To the extent that practice patterns are different, our results may not be generalizable to other institutions. As a tertiary center, our ICU receives referrals of complicated medical cases with high levels of severity of illness. This might suggest the possibility of selection bias due to case-mix accounting for some of our findings. Despite its limitations, however, we are convinced that this particular study will lead to other studies on costs and outcomes of treating elderly patients in the ICU.

As a conclusion, this study has shown that severity of acute illness is an important predictor of mortality after ICU admission. Age by itself is not a significant predictor. Therefore, age should not be used as a unique predictor for triage of ICU stay. In conclusion, additional prospective investigations are urgently needed to better predict and improve clinical outcomes of elderly patients requiring ICU support.

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