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Nesrin ÖCAL[1]
Deniz DOĞAN[2]
Gürhan TAŞKIN[1]
Birol YILDIZ[3]
Serhat ÖZER[1]
Levent YAMANEL[1]

RESEARCH

CONTINUAL ASSESSMENT OF MORTALITY RISK FACTORS IN GERIATRIC PATIENTS HOSPITALIZED IN INTENSIVE CARE DUE TO PNEUMONIA

ABSTRACT

Introduction: The number of geriatric patients is quickly increasing. The present study has been performed to investigate the potential roles of laboratory test results on prognosis and mortality in elderly patients hospitalized in intensive care unit due to pneumonia.

Materials and Method: Prospectively collected data of patients hospitalized in intensive care due to pneumonia were retrospectively analyzed.

Results: Age and length of stay in intensive care were common mortality risk factors for geriatric and non-geriatric patients hospitalized in intensive care due to pneumonia. Moreover, anemia, hypoglycemia, hypoalbuminemia and increased levels of serum lactate dehydogenase were also in association with mortality in all patients ($p<0.001$). 'Average' values, calculated based on prospective data obtained from equal intervals of intensive care stay time, had stronger associations with mortality than the first and last test results. The association of length of stay in intensive care with mortality was more significant in geriatric patients rather than in non-geriatric adults. Additionally, correlations were stronger in geriatric patients with larger correlation ratios.

Conclusion: Age, prolonged length of stay in intensive care, anemia, hypoglycemia, hypoalbuminemia and increased levels of LDH were mortality risk factors in geriatric patients hospitalized in intensive care due to pneumonia. 'Average' value was found to be more accurate for predicting mortality risk in geriatric patients whose mean length of stay in intensive care unit is longer than non-geriatrics.

Key Words: Geriatric; Aged; Pneumonia; Critical Care; Mortality.

ARAŞTIRMA

PNÖMONİ TANISI İLE YOĞUN BAKIMDA YATAN GERİATRİK HASTALARDA MORTALİTE RİSK FAKTÖRLERİNİN SÜREĞEN DEĞERLENDİRİLMESİ

ÖZ

Giriş: Geriatrik hastaların sayısı hızla artmaktadır. Bu araştırma pnömoni tanısıyla yoğun bakım ünitesine yatırılan yaşlı hastalarda laboratuvar test sonuçlarının prognoz ve mortalite üzerine olası rollerini araştırmak için yapılmıştır.

Gereç ve Yöntem: Pnömoni nedeniyle yoğun bakımda yatan hastaların prospektif olarak toplanan verileri retrospektif olarak analiz edildi.

Bulgular: Yaş ve yoğun bakımda kalış süresi pnömoni nedeniyle yoğun bakımda yatan geriatrik ve geriatrik olmayan hastalar için ortak mortalite risk faktörü olarak saptandı. Anemi, hipoglisemi, hipoalbuminemi ve LDH artışı mortaliteyle ilişki laboratuar değerleri olarak izlendi ($p<0,001$) Yoğun bakım kalış süresi boyunca eşit aralıklarla alınan prospektif verilere dayalı hesaplanan 'ortalama' değerler, ilk ve son test sonuçlarına göre mortaliteyle daha güçlü bir ilişki göstermekteydi. Yoğun bakımda yatış süresi ile mortalite ile arasındaki ilişki geriatrik hastalarda geriatrik olmayan erişkinlere göre daha belirgindi. Ayrıca, korelasyonlar büyük korelasyon oranları ile birlikte geriatrik hastalarda daha güçlüydü.

Sonuç: Yaş, uzamış yoğun bakım yatışı, anemi, hipoglisemi, hipoalbüminemi ve LDH düzeylerinde artış pnömoni nedeniyle yoğun bakımda yatan geriatrik hastalarda mortalite risk faktörleri olarak izlenmiştir. 'Ortalama' değer, yoğun bakım kalış süreleri geriatrik olmayan hastalara göre daha uzun olan geriatrik hastalarda mortalite değerlendirilmesi için daha güvenilir bir değerlendirme olarak izlendi.

Anahtar Sözcükler: Geriatrik; Yaşlı; Pnömoni; Yoğun bakım; Mortalite.

Correspondance

Nesrin ÖCAL
Gulhane Military Medical Faculty, Intensive Care Department, ANKARA

Phone: 0505 504 47 15
e-mail: nesrinbaygin@yahoo.com

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[1] Gulhane Military Medical Faculty, Intensive Care Department, ANKARA
[2] Gulhane Military Medical Faculty, Chest Diseases Department, ANKARA
[3] Gulhane Military Medical Faculty, Oncology Department, ANKARA

Introduction

Average life expectancy is steadily increasing, leading to an increase in the geriatric patient population. As in many clinical areas, elderly patients constitute an important proportion of respiratory intensive care patients, attracting attention as a population of particular risk, prone to developing multiple serious comorbidities (1). Treatment, clinical follow-up and prognosis of elderly patients differ from the general population in many ways. In this regard they may require a specialized clinical approach.

Geriatric patients represent a significant segment of patients admitted to intensive care unit (ICU) in terms of prolonged hospital stay and increased mortality rates. Among dependent geriatric patients with morbidities such as Alzheimer, dementia, or neurological disorders, pneumonia, especially aspiration pneumonia, is one of the most common disorders resulting in admission to respiratory ICU (2). Swallowing disorders, weakened cough reflex, and confusion may commonly cause aspiration of food into the airways in the elderly (3). Considering the fact that aging patients are prone to developing multiple systemic comorbidities, their response to treatment and intervention is also more sophisticated than in other patients. For instance, thoracic radiological findings may emerge later and the recovery may be delayed, fluid replacement should be planned in accordance with cardiac and renal reserves and biochemical imbalances may be observed due to poor nutrition, which is a common condition in geriatric patients (2, 3). On the other hand, scoring systems developed to assess the severity of pneumonia such as pneumonia severity index (PSI) and CURB-65, only give an idea in terms of hospitalization or admission to ICU, but are not useful for clinical follow up of these patients in ICU. Nevertheless, the Acute Physiology and Chronic Health Evaluation (APACHE) II scoring system developed for intensive care is based on the first day clinical status of the patient; therefore, it can be said that its predictive value decreases in patients with prolonged ICU stay (4, 5).

The difficulty of serial clinical monitoring in elderly patients and their fragility due to clinical variables reflect the main reasons for the frequent sudden worsening and deaths. In this regard, routine laboratory assays may have an important role in the serial clinical follow-up of internal balance of the geriatric patients in ICU (6). Meanwhile, there are limited data on the predictive role of laboratory assays on the length of stay in ICU and mortality rates in geriatric patients with pneumonia in comparison with non-geriatric adult patients. We performed the present study to investigate the potential role of laboratory test results in terms of predicting prognosis and mortality in elderly patients hospitalized in ICU with pneumonia and to compare the results with non-geriatric adults.

Materials and Method

The present study is a retrospective analysis of prospectively collected data of patients with pneumonia hospitalized in ICU between September 1, 2014 and September 1, 2015. Data on age, gender, diagnosis, radiological findings, comorbidities, length of ICU stay, survival times, status of the patient at hospital discharge and laboratory assays were retrieved. Variables were assessed in the groups of patients stratified by age (non-geriatric adult patients,<65 years; geriatric patients,≥65 years [young–elderly,65–74 years;middle–elderly,75–84 years; oldest–elderly,≥85 years]). Patients who died in ICU were defined as "death group" and the patients who were discharged from ICU were defined as "survival group". Laboratory assays included complete blood count and routine biochemistry results. White blood cell (WBC), hemoglobin (Hgb), platelet (Plt) and absolute eosinophil (#eosinophil) counts were evaluated along with serum lactate dehydrogenase (LDH), serum albumin, and serum glucose levels. Laboratory test results were analyzed in serial intervals divided into certain periods according to length of ICU stay. For patients who were inpatients for less than 5 days, laboratory results were recorded for each day, and the 'average' value was calculated. For patients who were inpatients for at least 5 days, ICU stay time was divided into four equal intervals from the first day to the last day. Laboratory results for each interval were recorded, and the 'average' value was determined. For example, for a patient hospitalized for 20 days, the test results of the 0^{th}, 5^{th}, 10^{th}, 15^{th}, and 20^{th} days were determined, and eventually the 'average' value was calculated. Thus, the 'average' value, representing the changes in laboratory test results of the patients for the entire ICU stay, was obtained for each parameter.

Relationships between investigated parameters were evaluated statistically. SPSS software (SPSS Inc, Chicago, IL) was used for statistical evaluation. Frequencies and percentages for discrete data, and means ± standard deviations for continuous variables were used for descriptive statistics. The Mann–Whitney U test was used for comparing differences between groups. Probability (p) values less than 0.05 were considered statistically significant.

RESULTS

Data of 186 patients (82 females, 104 males) were recorded and assessed. The mean age of the patients was 63.7±20.5 (20-89) years. While 72 (39%) of the patients were non-geriatric adult patients (ages between 18 and 65 years), 114 patients (61%) were geriatric cases (age ≥ 65). A total of 37 of the geriatric patients (32.45%) were young-elderly, 55 (48.24%) were middle-elderly, and 22 (19.29%) were oldest-elderly cases. The overall mortality rate was 41.9%, being 38.8% in non-geriatric adults and 43.8% in geriatric cases (43.2% in early-elderly cases, 38.1% in middle-elderly cases, and 59.1% in oldest-elderly cases). The mortality rate was higher in geriatric patients and significantly higher in oldest-elderly patients. While overall mean ICU stay time was 23.15±22.20 (2-93) days, 19.61±19.47 days in non-geriatric adults, and 25.38±23.58 days in geriatric patients (21.32±18.32 days in early-elderly cases, 26.43±25.62 days in middle-elderly cases, and 30.88±26.83 days in oldest-elderly cases). The mean values of all detected parameters for all groups are summarized in Table 1. There was no significant difference between groups except for the mean 'average' Plt value, which was significantly higher in middle-elderly and oldest-elderly cases (Table 1).

When we compared the data of survival group with death group in all patient groups and sub-groups, we observed significant differences that are accounted for in the following.

All Cases

While the mean age of the survival groups was 59.42±20.98, the mean age was 68.07±17.04 in the death group. The mean length of stay in ICU was 16.23±14.75 days in survival group and 32.29±26.86 days in death group (p<0.001). The mean age and the mean length of stay in ICU were significantly higher in death group (p=0.01). Among the mean laboratory test results for the first day; values for WBC, Hgb, #eosinophil, serum glucose and albumin were significantly low, and the mean serum LDH level was significantly higher in death group (p=0.028, p<0.001, p=0.002, p<0.001, p<0.001, and p=0.009 respectively). Among the mean labo-

Table 1— Mean 'Average' Values ± Standard Deviations of All Parameters for All Patient Groups.

	All Patients			Geriatric Patients			
	Geriatric Patients	Non-geriatric Patients	p	Early-elderly	Middle-elderly	Oldest-elderly	p
Mortality rate	43.8%	38.8%	NS	43.2%	38.1%	59.1%	NS
Days	25.38 ± 23.58	19.61 ± 19.47	NS	21.32 ± 18.32	26.43 ± 25.62	30.88 ± 26.83	NS
WBC (x 103/μL)	10072.31 ± 2933.41	9940.83 ± 2623.15	NS	10399.46 ± 3143.23	9799.81 ± 2651.00	10208.51 ± 3633.27	NS
Hgb (g/dL)	11.34 ± 1.72	11.64 ± 1.66	NS	11.43 ± 1.61	11.35 ± 1.89	11.12 ± 1.62	NS
Plt (x 103/μL)	309826.61 ± 79883.89	287668.05 ± 63623.54	NS	290813.51 ± 93604.91	319638.18 ± 74620.13	321574.07 ± 64243.77	0.01
#eos. (x 103/μL)	142.07 ± 77.79	150.11 ± 57.84	NS	151.83 ± 72.58	136.79 ± 82.210	133.66 ± 69.55	NS
Glucose (mg/dL)	145.39 ± 36.24	144.69 ± 39.09	NS	143.51 ± 43.93	149.55 ± 34.73	143.90 ± 29.84	NS
Albumin (g/L)	2.57 ± 0.43	2.57 ± 0.39	NS	2.62 ± 0.52	2.62 ± 0.41	2.57 ± 0.39	NS
LDH (U/L)	339.12 ± 176.03	346.84 ± 171.53	NS	325.85 ± 155.48	321.06 ± 176.26	141.84 ± 319.56	NS

Days: number of days of ICU stay, WBC: white blood cell, Hgb: hemoglobin, Plt: platelet, #eos. : #eosinophil count, LDH: lactate dehydrogenase, NS: non-significant.

Table 2— Comparison of the Mean Values ± Standard Deviations of Ages, Length of Stay in ICU and Mean Values ± Standard Deviations of First, Last and 'Average' Results of Detected Parameters Between Survival and Death Groups in All Patients.

		Survival Group	Death Group	p
Age		59.42 ± 20.98	68.07 ± 17.04	0.008
Days		16.23 ±14.75	32.29 ± 26.86	<0.001
First day results	WBC (x 10^3/μL)	12178.70 ± 4799.35	10132.05 ± 4318.50	0.028
	Hgb (g/dL)	12.39 ± 1.84	10.94 ± 1.45	<0.001
	Plt (x 10^3/μL)	242287.03 ± 55552.62	233076 ± 72300.55	NS
	#eos. (x 10^3/μL)	132.22 ± 59.42	109.87 ± 66	0.002
	Glucose (mg/dL)	243.07 ± 66.75	109.55 ± 22.74	<0.001
	Albumin (g/L)	2.83 ± 0.57	2.44 ± 0.3	<0.001
	LDH (U/L)	304.50 ± 139.1	417.51 ± 231.76	0.009
Last day results	WBC (x 10^3/μL)	7718.51 ± 2730.38	9725.64 ± 7902.74	NS
	Hgb (g/dL)	12.59 ± 2.03	9.87 ± 1.31	<0.001
	Plt (x 10^3/μL)	305879.62 ±80804.21	309269.23 ± 91074.77	NS
	#eos. (x 10^3/μL)	163.61 ± 112.56	182.05 ± 161.11	NS
	Glucose (mg/dL)	131.53 ± 57.58	117.69 ± 37.14	NS
	Albumin (g/L)	2.73 ± 0.44	2.52 ± 0.29	<0.001
	LDH (U/L)	359.77 ± 155.02	502.18 ± 375.91	NS
'Average' results	WBC (x 10^3/μL)	10236.32 ± 3016.23	9723.84 ± 2487.14	NS
	Hgb (g/dL)	12.43 ± 1.44	10.11 ± 0.94	<0.001
	Plt (x 10^3/μL)	301195.67 ± 65131.59	301323.07 ± 86510.00	NS
	#eos. (x 10^3/μL)	149.87 ± 67.38	143.17 ± 72.45	NS
	Glucose (mg/dL)	165.21 ± 40.36	123.00 ± 18.23	<0.001
	Albumin (g/L)	2.80 ± 0.42	2.32 ± 0.19	<0.001
	LDH (U/L)	272.08 ± 86.10	411.33 ± 210.19	0.001

Days: number of days of ICU stay, WBC: white blood cell, Hgb: hemoglobin, Plt: platelet, #eos. : #eosinophil count, LDH: lactate dehydrogenase, NS: non-significant.

ratory test results pertaining to the last day of the ICU stay; the mean Hgb and serum albumin levels were significantly lower in death group (p<0.001 for both). Among the means of 'average' values of detected parameters; the mean 'average' Hgb, serum glucose and albumin levels were significantly lower and the mean 'average' LDH level was significantly higher in the death group (p<0.001, p<0.001, p<0.001 and p=0.001 respectively) (Table 2).

Non-geriatric Adults

The mean length of stay in ICU was significantly higher in the death group (p=0.002). The mean 'average' values of Hgb, serum glucose and albumin were significantly lower in the death group (p<0.001 for all of the three parameters) (Table 3).

Geriatric Patients

The mean length of stay in ICU was significantly higher in death group (p<0.001). The mean 'average' values of Hgb, serum glucose and albumin were significantly lower in the death group (p<0.001 for all of these three parameters) (Table 3). Length of stay in ICU was found to be a more significant risk factor of mortality in geriatric patients than in non-geriatric adults.

Young-elderly Patients

The mean length of stay in ICU was significantly higher in the death group (p=0.006). The mean 'average' values of Hgb, serum glucose and albumin were significantly lower in the death group (p<0.001, p<0.001 and p=0.001) (Table 4).

Middle-elderly Patients

The mean length of stay in ICU was significantly higher in the death group (p=0.003). The mean 'average' values of Hgb, serum glucose and albumin were significantly lower in the death group (p<0.001, p=0.001, p<0.001) (Table 4).

Oldest-elderly Patients

The mean 'average' values of Hgb, serum glucose and albumin were significantly lower in the death group (p=0.002,

Table 3— Comparison of the Mean 'Average' Values ± Standard Deviations Between Survival and Death Groups in Geriatric and Non-geriatric Groups.

	Geriatric Patients			Non-Geriatric Patients		
	Survival Group	Death Group	p	Survival Group	Death Group	p
Days	17.42 ± 15.35	35.58 ± 28.11	<0.001	14.50 ± 13.83	27.64 ± 24.23	0.002
WBC (x 10^3/µL)	10423.30 ± 3012.95	9622.40 ± 2793.64	NS	9963.63 ± 3034.78	9905.00 ± 1850.55	NS
Hgb (g/dL)	12.37 ± 1.43	10.01 ± 0.98	<0.001	12.51 ± 1.46	10.28 ± 0.83	<0.001
Plt (x 10^3/µL)	307791.14 ± 75505.56	312432.00 ± 85872.35	NS	291602.27 ±45213.98	281485.71 ± 85580.48	NS
#eos.(x 10^3/µL)	148.49 ± 78.08	133.87 ± 77.41	NS	143.95 ± 55.98	159.78 ± 60.40	NS
Glucose (mg/dL)	161.85 ± 38.22	124.32 ± 18.54	<0.001	159.99 ± 41.34	120.64 ± 17.74	<0.001
Albumin (g/L)	2.76 ± 0.47	2.34 ± 0.21	<0.001	2.74 ± 0.40	2.29 ± 0.16	<0.001
LDH (U/L)	302.00 ± 138.42	386.64 ± 206.69	NS	310.27 ± 129.72	404.30 ± 212.06	NS

Days: number of days of ICU stay, WBC: white blood cell, Hgb: hemoglobin, Plt: platelet, #eos. : #eosinophil count, LDH: lactate dehydrogenase, NS: non-significant.

Table 4— Comparison of the Mean 'Average' Values ± Standard Deviations Between Survival and Death Groups in Sub-groups of Geriatric Patients.

	Early-Elderly			Middle-Elderly			Oldest-Elderly		
	Survival Group	Death Group	p	Survival Group	Death Group	p	Survival Group	Death Group	p
Days	14.00 ± 7.63	30.93 ± 23.54	0.006	18.23 ± 16.79	39.71 ± 31.74	0.003	18.57 ± 19.32	38.72 ± 28.74	NS
WBC (x 10^3/µL)	10534.28 ± 3172.77	10222.50 ±3198.58	NS	9978.52 ± 2601.71	9510.47 ±2768.42	NS	12116.19 ±4429.47	8994.54 ±2549.58	NS
Hgb (g/dL)	12.42 ± 1.23	10.12 ± 1.01	<0.001	12.33 ± 1.60	9.75 ± 1.04	<0.001	12.52 ± 1.54	10.22 ± 0.88	0.002
Plt (x 10^3/µL)	295900 ±80113.64	284137.50 ±111297.60	NS	315008.82 ±75232.59	327133.3 ±74831.2	NS	311904.76 ±70878.6	327727.2 ±62409.7	NS
#eos. (x 10^3/µL)	162.09 ± 77.82	138.37 ± 65.02	NS	133.82 ± 75.56	141.59 ± 93.73	NS	165.42 ± 69.96	113.45 ± 64.27	NS
Glucose (mg/dL)	166.28 ± 44.43	113.62 ± 17.92	<0.001	162.06 ± 36.96	129.3 ± 17.5	0.001	166.28 ± 33.85	129.65 ± 15.89	0.46
Albumin (g/L)	2.87 ± 0.54	2.30 ± 0.22	0.001	2.78 ± 0.44	2.35 ± 0.17	<0.001	2.85 ± 0.40	2.39 ± 0.27	0.008
LDH (U/L)	292.77 ± 114.48	369.26 ± 192.35	NS	272.58 ± 101.23	399.56 ±237.72	NS	330.46 ± 92.29	312.63 ± 170.16	NS

Days: number of days of ICU stay, WBC: white blood cell, Hgb: hemoglobin, Plt: platelet, #eos. : #eosinophil count, LDH: lactate dehydrogenase, NS: non-significant.

p=0.046 and p=0.008). On the other hand, the mean length of stay in ICU was higher in the death group, but this difference was not statistically significant (p=0.07) (Table 4).

The p values and correlation ratios for correlations between age, length of stay in ICU and 'average' values of detected parameters are given in Table 5. Statistically significant positive correlations were observed between age and Plt, Hgb and serum glucose, Hgb and serum albumin, serum glucose and serum albumin, serum glucose and serum LDH, whereas statistically significant negative correlations were observed between Hgb and length of stay in ICU in both geriatric and non-geriatric patients. Additional correlations were observed in geriatric patients; as follows: Statistically significant positive correlations were observed between WBC and #eosinophil count, WBC and serum LDH, #eosinophil count and serum albumin, whereas a statistically significant negative correlation was observed between serum albumin and length of stay in ICU (Table 5).

Hence, we identified that age and length of stay in ICU were common mortality risk factors for all cases hospitalized in ICU due to pneumonia. Anemia, hypoglycemia, hypoalbuminemia and increased levels of LDH were laboratory risk factors of mortality in all groups. The association between the length of stay in ICU with mortality was more significant in geriatric patients than in non-geriatric adults. Additionally, the correlations were stronger in geriatric patients with larger correlation ratios.

Table 5— The p Values and Correlation Ratios for Correlations Between Age, Length of Stay in ICU and 'Average' Values of Detected Parameters in All Groups and Sub-groups

		Correlation	r	p	Correlation	r	p
All patients		age ~ days	0.157	<0.05	Hgb ~ days	-0.428	<0.01
		age ~ Plt	0.198	<0.01	#eos. ~ albumin	0.207	<0.01
		WBC ~ #eos.	0.363	<0.01	glucose ~ albumin	0.503	<0.01
		WBC ~ LDH	0.168	<0.05	glucose ~ LDH	0.271	<0.01
		WBC ~ days	0.143	<0.05	albumin ~ LDH	-0.143	<0.05
		Hgb ~ glucose	0.461	<0.01	albumin ~ days	-0.219	<0.01
		Hgb ~ albumin	0.500	<0.01			
Non-geriatrics		age ~ Plt	0.936	<0.01	Hgb ~ days	-0.429	<0.01
		WBC ~ days	0.266	<0.01	glucose ~ albumin	0.485	<0.01
		Hgb ~ glucose	0.487	<0.01	glucose ~ LDH	0.228	<0.05
		Hgb ~ albumin	0.543	<0.01			
Geriatrics		age ~ Plt	0.252	<0.01	Hgb ~ days	-0.424	<0.01
		WBC ~ #eos.	0.391	<0.01	#eos. ~ albumin	0.206	<0.05
		WBC ~ LDH	0.37	<0.05	glucose ~ albumin	0.509	<0.01
		Hgb ~ glucose	0.458	<0.01	glucose ~ LDH	0.321	<0.01
		Hgb ~ albumin	0.535	<0.01	albumin ~ days	-0.276	<0.01
Geriatric patients	early-elderly	age ~ Plt	-0.563	<0.01	Hgb ~ days	-0.538	<0.01
		WBC ~ #eos.	0.352	<0.05	glucose ~ albumin	0.379	<0.05
		Hgb ~ glucose	0.466	<0.01	glucose ~ LDH	0.338	<0.05
		Hgb ~ albumin	0.551	<0.01	albumin ~ days	-0.610	<0.01
	middle-elderly	age ~ Plt	0.598	<0.01	Hgb ~ days	-0.376	<0.01
		WBC ~ #eos.	0.454	<0.01	#eos. ~ LDH	-0.316	<0.01
		Hgb ~ glucose	0.501	<0.01	glucose ~ albumin	0.615	<0.01
		Hgb ~ albumin	0.534	<0.01	glucose ~ LDH	0.289	<0.05
	oldest-elderly	age ~ Plt	-0.555	<0.01	glucose ~ LDH	0.454	<0.01
		Hgb ~ #eos.	0.456	<0.01	albumin ~ LDH	0.538	<0.01
		Hgb ~ albumin	0.481	<0.01			

Days: number of days of ICU stay, WBC: white blood cell, Hgb: hemoglobin, Plt: platelet, #eos. : #eosinophil count, LDH: lactate dehydrogenase, r: correlation ratio.

Discussion

Average life expectancy is gradually increasing. According to estimates, by 2050 the number of the world population aged over 80 years will be doubled (7). While senility is a life period accompanied by a reduction in cardiopulmonary and renal reserves and severe comorbidities, the mean age of the patients hospitalized in ICU are increasing day by day as expected. Due to the frequency of progressive multiple organ failure, elderly patients constitute a particular group at risk in respiratory ICUs (5, 6). During the aging process, several respiratory deteriorations occur in the structure of the lung parenchyma, respiratory muscle functions, central regulation of breathing and natural defense mechanisms of the respiratory tract. All these deteriorations in the respiratory system of the geriatric population, result in pneumonia, especially aspiration pneumonia, being a frequent and severe clinical entity (6, 8). This is why pneumonia in the geriatric population represents a large proportion of the ICU patient population.

While PSI and CURB-65 represent the most common scoring systems in the assessment of the severity of pneumonia, they have not been considered ideal for predicting ICU admission and mortality rates. PSI and CURB-65 are useful for decisions to whether the patient must be treated in home or at hospital and to determine the need for ICU admission (9). PSI can estimate the severity of the diseases lower especially in the young cases without comorbidities other than respiratory failure. CURB-65, although easier, scores the severity lower in elderly patients with multiple comorbidities. The predictive values of both pneumonia severity scoring systems are low in terms of mortality in intensive care (10). On the other hand, the APACHE II scoring system is based on the clinical state of the patient on the first day of ICU admission; therefore, it can be said that its predictive value decreases in elderly patients with prolonged ICU stay, in whom clinical status and laboratory findings may rapidly alter. APACHE II scoring does also not include commonly used biomarkers such as serum albumin and serum LDH (11). While these known scoring systems only rely on daily evaluation of the clinical status, their predictive value may not be accurate for patients with prolonged ICU stay (10, 11). From this point, easier, quicker and continual assessment methods are still needed in risk assessment of geriatric patients with regard to prognosis and mortality. Serial laboratory findings may be suggested in this regard. In the present study, 'average' values which were determined based on serial laboratory test results, were found to be more reliable and useful especially in terms of serum LDH.

In the previous literature, some studies on risk factors affecting mortality in elderly patients are available. Low albumin levels and elevated creatinine levels were reported to be associated with mortality in geriatric in-patients (12-14). Ponzetto et al (13) studied risk factors affecting mortality in hospitalized patients aged ≥70 years. They observed that serum albumin levels of 3.0–3.4 g/dL, fibrinogen levels ≥452mg/dL and creatinine levels of 1.5–3mg/dL and >3mg/dL are independent risk factors of mortality in elderly patients. Sousa et al (14) investigated data from geriatric in-patients immediately upon hospital admission and reported that low serum albumin and WBC counts are correlated with mortality. In another study, WBC and lymphocyte counts, ESR, CRP, insulin-like growth factor, triiodothyronine, serum albumin, iron, total cholesterol and LDL cholesterol were found to be associated with mortality in elderly patients (15). Red blood cell distribution width (RDW) and serum vitamin B12 levels were also demonstrated to be associated with mortality in hospitalized elderly patients (16-18). Hypoglycemia is known to be a serious clinical state in intensive care, particularly so in geriatric patients. In the study by Kagansky et al (19) study, performed on geriatric patients, mortality rates were reported to be two times higher for hypoglycemic cases than for non-hypoglycemic cases. In the present study, anemia, hypoglycemia, hypoalbuminemia and altitude levels of serum LDH were laboratory risk factors of mortality in all patient groups hospitalized in ICU due to pneumonia. We also identified significantly positive correlations between age and Plt, Hgb and serum glucose, Hgb and serum albumin, serum glucose and serum albumin, serum glucose and serum LDH, and a significant negative correlation between Hgb and length of stay in ICU in both geriatric and non-geriatric patients.

In several previous studies, age and length of stay in ICU were also reported as mortality risk factors for ICU patients (20-22). We confirmed that age and length of stay in ICU were common mortality risk factors for all cases hospitalized in ICU due to pneumonia. The association between length of stay in ICU with mortality was more significant in geriatric patients than in non-geriatric adults according to our results. Mortality rate was higher in geriatric patients and significantly higher in the oldest-elderly patients. The mean ICU stay time was also longer in geriatric patients.

In this study, we performed a distinct evaluation of laboratory findings which gives us the opportunity of performing prolonged assessment of the results. We think that the 'average' values of the laboratory data, calculated based on the data obtained from equal intervals, may represent the overall alterations in test results obtained during the ICU stay time of

patients. Our results indicate that 'average' values had stronger associations with mortality than the first and last test results. Therefore, this assessment should be accepted more accurate for mortality assessment of geriatric patients whose ICU stay times are longer than for non-geriatrics.

As a conclusion; we report that age, prolonged length of stay in ICU, anemia, hypoglycemia, hypoalbuminemia and increased levels of LDH were risk factors for mortality in geriatric patients hospitalized in ICU due to pneumonia. Considering the fact that the number of the geriatric patients is steadily increasing, it is necessary to well define the prognostic markers and mortality risk factors for elderly patients. The retrospective design is a limitation of our study and prospective studies are required to improve these findings.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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