RESEARCH ARTICLE / *Araştırma Makalesi*

Effect of Pneumococcal Vaccination and Other Factors on Prognosis in Patients Following with Pneumonia in Geriatric Clinic

Geriatri Kliniğinde Pnömoni Nedeniyle Takip Edilen Hastalarda Pnömokok Aşısının ve Diğer Faktörlerin Prognoza Etkisi

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Abstract

Objective — The aim of our study is to analyze the patients followed with the diagnosis of pneumonia in our geriatric clinic and discuss the effect of vaccination on prognosis by questioning the status of the vaccination before infection.

Materials and Methods — Patients who were diagnosed with pneumonia in the geriatric clinic between January 2017 and December 2017 were included in the study. Demographic data, symptoms, physical examination findings, laboratory tests and radiological examinations of the patients were recorded. Pneumococcal vaccination status before the development of pneumonia was evaluated. We classified the patients in terms of prognosis as 'good' and 'poor'. Indicators of poor prognosis were determined by the presence of septic shock findings accompanying the infection, need for intensive care or death within 30 days of onset of infection.

Results — During the one-year period, a total of 47 (25%) patients with community or hospital acquired pneumonia in 186 hospitalized patients were recorded. The rates of chest x-ray findings and auscultation suggesting pneumonia were 87% and 83 %, respectively. The presence of dyspnea (p=0.008) and mental disorder (p<0.001) were significantly predictive for poor prognosis. CURB-65 (Confusion, uremia, blood pressure, age 65) (p=0.030) and PSI (Pneumonia severity index) (p=0.013) scores were significantly higher in patients with poor prognosis. Vaccinated patients had a statistically significantly better prognosis than the non-vaccinated (p= 0.003). All the patients who died (n= 7) did not have the vaccine.

Conclusion — This study demonstrated the necessity of vaccination and its positive effect on prognosis in the geriatric population.

Keywords — Elderly; pneumonia; vaccination; prognosis

Öz

Amaç — *Çalışmamızın amacı pnömoni tanısı ile geriatri servisimizde izlenen hastaları analiz etmek ve enfeksiyon öncesi aşı durumunun sorgulanarak aşının prognoza etkisini tartışmaktır.*

Gereç ve Yöntemler — *Çalışmaya Ocak 2017- Aralık 2017 tarihleri arasında geriatri kliniğinde pnömoni nedeniyle takip edilen hastalar alındı. Hastaların demografik verileri, semptomları, fizik muayene bulguları, laboratuvar tetkikleri ve radyolojik incelemeleri kayıt altına alındı. Pnömoni gelişimi öncesinde pnömokok aşısının yapılıp yapılmadığı değerlendirildi. Hastaları prognoz yönünden 'iyi' ve 'kötü' olarak sınıflandırıldı. Kötü prognoz göstergeleri, enfeksiyona eşlik eden septik şok bulgularının varlığı, yoğun bakım ihtiyacı veya enfeksiyonun başlamasından sonraki 30 gün içinde ölüm olarak belirlendi.*

Bulgular — *Bir yıllık sürede servise yatırılan 186 hastanın 47'sinde (%25) yatışında veya yattığı sürede pnömoni saptandı. Pnömoniyi düşündüren akciğer grafisi bulgularının oranı %87 ve oskültasyon bulgularının oranı % 83 idi. Dispne (p=0,008) ve mental bozukluğun olması (p<0,001) kötü prognoz için anlamlı istatistiksel fark oluşturmaktaydı. KÜSK-65 (Konfüzyon, üremi, solunum sayısı, kan basıncı, 65 yaş üstü) (p=0,030) ve PŞİ (pnömoni şiddet indeksi) (p=0,013) skoru kötü prognozlu olanlarda anlamlı olarak daha yüksekti. Aşı olanlar olmayanlara göre istatistiksel olarak anlamlı, daha iyi prognozluydu (p=0,003). Kaybedilen 7 hasta da aşı olmamıştı.*

Sonuç — *Bu çalışma geriatrik popülasyonda, aşılamanın gerekliliğini ve prognoz üzerine olumlu etkisini göstermiştir.*

Anahtar Kelimeler — *Yaşlı; pnömoni; aşılama; prognoz*

INTRODUCTION

The proportion of geriatric patients in population is increasing day by day and infections are about 1/3 of the primary causes of mortality. Infections are clinically less severe compared to younger patients but cause serious morbidity and mortality by affecting vital functions.[1] Reduction of protective physiological mechanisms such as cough reflex and ciliary activity in the elderly patients facilitate the lower respiratory tract infections. Pneumonia accounts for 90% of lower respiratory tract infections. The frequency of pneumonia increases exponentially with aging. While the incidence of pneumonia is 18.2% in the age group of 65 to 69 years, this rate increases up to 52.3% in the age group of 85 years and above.[2] Pneumonia is the most common cause of death due to infection.[3] Ninety percent of deaths due to pneumonia are seen in the geriatric population.[4]

Pneumonia is classified according to the place and causes of the disease such as developing in the community, developing in the hospital, related to health care, and ventilator related. This classification helps for the management and treatment of the disease. In addition to these classifications, scoring systems have been developed to determine treatment preference. Scoring systems can reduce the mortality rate by identifying vulnerable patients and avoid unnecessary hospitalizations. CURB-65 (Confusion, uremia, blood pressure, age 65) and PSI (Pneumonia Severity Index) have been developed for pneumonia cases seen in the community.[5]

Pneumococcal vaccine is recommended for all geriatric patients.[6] The main components of pneumococcal vaccines are capsule polysaccharides. The capsule is the most important virulence factor that protects pneumococci from being inactivated and killed by phagocytic cells.[7] The polysaccharide antigen in the capsule stimulates the formation of IgM antibodies specific for that serotype. These antibodies increase opsonization, phagocytosis and killing of bacteria. The aim of pneumococcal vaccination is to stimulate the immunoglobulin-G response by inducing mucosal immunity and immunological memory, as well as stimulating effective antibodies against pneumococci.[8] There are two types of vaccines used in adults to prevent pneumococcal diseases; polysaccharide pneumococcal vaccine (PPV) and pneumococcal conjugated vaccine (PCV).[9] Anyone older than sixty years old should firstly receive PCV13 and then PPV23.[6]

The aim of this study is to analyze the patients who were followed up in our geriatric clinic with the diagnosis of pneumonia according to age groups (between 65 and 84 years, older than 84 years) and prognosis (good or poor) and to discuss the effect of the vaccine on the prognosis by questioning the vaccination before infection.

MATERIALS and METHODS

This study is a descriptive and cross-sectional study. Sixty-five years and older patients who were hospitalized in our geriatric clinic between January 2017 and December 2017 with the diagnosis of pneumonia were included in the study. Demographic data, additional diseases, symptoms and physical examination findings, laboratory and radiological examinations of the patients were recorded. Pneumococcal vaccination status before the development of pneumonia and post-infection mortality rates at the 6th and 12th months were evaluated. Modified Charlson comorbidity scores for all patients; CURB-65 and PSI values were calculated for patients with community-acquired and health-care-associated pneumonia.[5,10] CRP (C-reactive protein), procalcitonin, leukocyte and neutrophil values on the day of diagnosis of pneumonia (+/- 24 hours), on the 3rd day (+/- 24 hours) and on the 7th day (+/- 24 hours) were recorded. The diagnosis of pneumonia was made by evaluating the clinical, radiological and laboratory findings of the patients in line with the recommendations of international guidelines.[11] Fever was defined as body temperature measurement over 37.7 °C.

The most important independent and dependent variables

of the study were "between 65-84 years or 84 years and older patients" and "patients with good or bad prognosis", respectively. Indicators of poor prognosis were determined as the presence of septic shock findings accompanying the infection, need for intensive care, or death within 30 days of onset of infection. Mann Whitney U test was used to compare the means of two non-parametric groups containing continuous data and determine the significant difference between them. The importance of categorical groups was examined with chi-square test. Friedman variance analysis was used for the analysis of continuous and more than two dependent nonparametric groups and then Wilcoxon signed-rank test was used for post-hoc analysis. For the evaluation of prognosis, logistic regression analysis was used. The results were evaluated at 95% confidence interval and statistical significance level was defined as p value less than 0.05. The analyzes were performed using IBM SPSS - 21 (Statistical Package for Social Sciences, Chicago, Illinois, USA). This study was approved by the Ethics Committee of Cerrahpasa Medical Faculty (Approval number 2019-186106)

RESULTS

During the one-year period, a total of 47 (25%) patients with pneumonia in 186 hospitalized patients were recorded. Nineteen (40%) of these patient were community-acquired pneumonia (CAP); 7 (15%) had health-care-associated pneumonia (HCAP); 21 (45%) were hospital-acquired pneumonia (HAP). The median age was 83 (range, 65-104), thirty (64%) of the cases were male and 17 (36%) were female. When the patients were evaluated according to age groups, 26 (55%) patients were found in the 65-84 age group and 21 (45%) were detected in group over 84 years. When the patients were evaluated according to age groups; diabetes incidence and male to female ratio in the 65-84 age group; in the over 84 years of age group, the rate of dementia was statistically significantly high (p=0.024; p=0.007; p=0.007 respectively). Demographic data, accompanying diseases and pneumonia types of patients according to age groups are given in Table 1.

Table 1. Demographic Data, Accompanying Diseases and Pneumonia Types of Patients According to Age Groups

	Total (n, %)	65-84 age (n)	>84 age (n)	P
Number of patients	47	26	21 (45)	
Age (year) mean ± standard deviation	82,72±9,48	76,19±6,24	90,81±5,82	
Male / Female	30(64)/ 17(36)	21 / 5	9/ 12	
Hypertension	36 (76)	21	15	0,505
Diabetes mellitus	22 (46)	16	6	**0,024**
COPD	17 (36)	11	6	0,330
Hearth failure	12 (25)	8	4	0,360
Cerebrovascular diseases	7 (15)	3	4	0,684
Chronic renal failure	21 (44)	13	8	0,414
Malignancy	8 (17)	4	4	1,000
Demantia	15 (32)	4	11	**0,007**
Community acquired pneumonia	19 (40)	10	9	0,760
Hospital acquired pneumonia	21 (44)	12	9	0,821
Health care associated pneumonia	7 (15)	4	3	1,000
Ventilator associated pneumonia	3 (6)	1	2	0,579

COPD: Chronic obstructive pulmonary disease

Cough (72%) and dyspnea (61%) were the two most common symptoms. The rates of chest x-ray findings and auscultation suggesting pneumonia were 87% and 83 %, respectively. Pleural effusion was seen in 17 (36%) patients. Sixty-one percent of the patients with signs of auscultation were bilateral. There was no reproduction in all blood cultures (n = 33) taken. When evaluated according to obtaining sputum culture; sputum culture could be obtained from 10 (38%) patients in the 65-84 age group and 2 (9%) patients in the over 84 years age group and it was found statistically significantly higher in 65-84 age group (p = 0.024). Sputum culture was positive in 6 of 12 patients. Three patients had pseudomonas and one each patient had acinetobacter, escherichia coli and serratia growth. The symptoms, clinical and radiological findings of patients according to age groups are given in Table 2.

Table 2. Symptoms, Clinical and Radiological Findings of Patients According to Age Groups

	Total(n, %)	65-84 age (n)	>84 age (n)	p
Cough	34 (72)	20	14	0,435
Sputum	27 (57)	14	13	0,579
Dyspnea	29 (61)	17	12	0,563
Mental disorder	13 (28)	8	5	0,596
Fever	21 (45)	13	8	0,414
Hypothermia	1 (2)	1	0	1,000
Hemoptysis	1 (2)	0	1	0,447
Auscultation findings	39 (83)	23	16	0,440
Pulmonary radiography signs	41 (87)	24	17	0,386
Pleural effusion	17 (36)	10	7	0,716
Sputum extractability	12 (25)	10	2	**0,025**

We classified the patients in terms of prognosis as 'good' and 'poor'. There was no significant difference in prognosis in the 65-84 and over 84 years of age groups (p = 0.436). When the mortality was evaluated from the date of hospitalization; 7 patients in the first month, 17 patients in six months and 24 patients in 12 months died. After pneumonia, the 12-month mortality was significantly higher in the over 84 years of age group than in the 65-84 years of age group (p= 0.007). The presence of dyspnea and mental disorder were significantly predictive for poor prognosis (p=0.008; p<0.001). When pneumonia was classified according to the place and causes of the disease (community, hospital, health care, aspiration), there was no significant difference in prognosis. CURB-65 and PSI scores were significantly higher in those with poor prognosis (p=0.030; p=0.013). When the number of comorbidity and modified Charlson comorbidity index score were evaluated in terms of prognosis, no significant difference was found (p=0.865; p=0.700). Evaluation of prognosis according to risc factors is given in Table 3. While 18 (38%) of the patients were previously vaccinated for pneumonia, 29 (62%) were not.

Table 3. Evaluation of Prognosis According to Risc Factors

	Good (n, %)	Poor (n,%)	p
Age 65-84 **Age >84**	20 (77) 14 (67)	6 (23) 7 (33)	0,435
6 months mortality **Age 65-84** **Age >84**	 19 (73) 10 (50)	 7 (27) 10 (50)	0,108
12 months mortality **Age 65-84** **Age >84**	 17(65) 5 (25)	 9(35) 15 (75)	**0,007**
COPD with/ without	14 (82) 20 (66)	3 (18) 10 (34)	0,321
Hearth failure with/ without	6 (50) 28(80)	6 (50) 7 (20)	0,065
Chronic renal failure with/ without	13 (62) 21 (81)	8 (38) 5 (19)	0,197
Dyspnea with/ without	17 (59) 17 (95)	12 (41) 1 (5)	**0,008**
Mental disorder with/ without	4 (31) 30 (88)	9 (69) 4 (12)	**<0,001**
Fever with/ without	17 (81) 17 (65)	4 (19) 9 (35)	0,236
Acute renal failure with/ without	6 (55) 28 (78)	5 (45) 8 (22)	0,246
Community acquired pneumonia with/ without	15 (79) 19 (68)	4 (21) 9 (32)	0,515
Hospital acquired pneumonia with/ without	13 (62) 21 (81)	8 (38) 5 (19)	0,151
Health care associated pneumonia with/ without	6 (86) 28 (70)	1 (14) 12 (30)	0,655
Ventilator associated pneumonia with/ without	1 (33) 33 (75)	2 (67) 11 (25)	0,181
Single antibiotic usage **Multiple antibiotic usage**	25 (73) 9 (69)	9 (27) 4 (31)	1,000
Vaccination status positive/negative	17 (94) 15 (52)	1 (6) 14 (48)	**0,003**
Number of comorbidities	2,65±1,34	2,85±1,72	0,865
Modified Charlson comorbidity index score *	7,71±2,30	8,38±3,17	0,700
CURB-65 score*	1,71±0,71	3,00±1,41	**0,030**
PSI score*	114,05±25,29	164,60±42,03	**0,013**

* Mean ± standard deviation
COPD: Chronic obstructive pulmonary disease; CURB-65: Confusion, uremia, blood pressure, age 65; PSI: Pneumonia Severity Index

All the vaccinated patients had received PCV13 and three of them also had PPV23 vaccine one year after the administration of PCV13. Ninety-four percent of those who had the vaccination and only 52% of those who did not have vaccination had good prognosis. Vaccinated patients had a statistically significantly better prognosis than those without vaccination (p=0.003). All 7 patients who were

deceased, did not receive the vaccine. It is summarized in Figure 1.

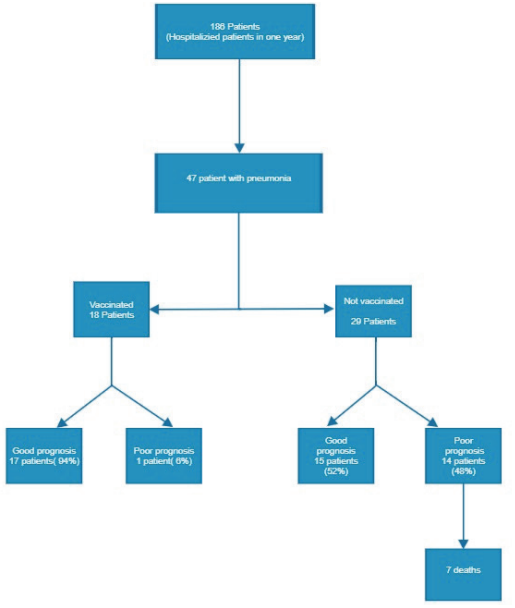

Figure 1. Vacination, prognosis and mortality status

In the Friedman analysis, the first day of diagnosis and treatment of pneumonia cases were evaluated as day 0 th. The changes in laboratory parameters on 0th, 3th and 7th days were statistically significant for the leukocyte and neutrophil counts, the levels of CRP and procalcitonin (p= 0,006; p< 0,001; p< 0,001; p< 0,001, respectively). On the other hand, the leukocyte and neutrophil counts on 0th day; the CRP and procalcitonin measurements on day 7th made a significant difference. When these 4 parameters were compared according to age groups, no significant difference was found for the 0th, 3th and 7th days. Statistical analysis, mean and median values of these dependent parameters according to age groups 0th, 3th and 7th days are summarized in Table 4.

In univariate regression analysis; dyspnea, vaccination for pneumonia, mental disorder, CURB-65 and PSI parameters were found to be associated with poor prognosis.

Table 4. Analysis of laboratory parameters by age groups on day 0th, day 3 th and day 7 th

		Day 0		Day 3		Day 7	
Age		**65-84**	**>84**	**65-84**	**>84**	**65-84**	**>84**
WBC*	**Mean ± sd**	8503 ±4938	9414 ±5004	8741 ±4467	8085 ± 4414	7771 ±3240	8210 ±3930
	Median	7950	8600	7850	7500	7800	7500
	p	0,615		0,517		0,835	
Friedman p 0,006		Group making significant difference on day 0					
CRP*	**Mean ± sd**	79,4 ±71,6	71,8 ±67,9	75,4 ±68,2	65,8 ±61,3	28,7 ±26,0	57,5 ±79,0
	Median	50	53	58	48	24,5	36
	p	0,708		0,532		0,199	
Friedman p<0,001		Group making significant difference on day 7					
PRC*	**Mean ± sd**	1,01 ±1,92	1,19 ±3,21	1,02 ±1,65	0,82 ±1,46	0,56 ±0,83	0,31 ±0,47
	Median	0,41	0,18	0,22	0,14	0,27	0,15
	p	0,313		0,392		0,340	
Friedman p<0,001		Group making significant difference on day 7					
NEU*	**Mean ± sd**	6892 ±4552	7076 ±4958	6433 ±4134	5705 ±4288	5342 ±3127	5827 ±4025
	Median	5950	6300	4900	4600	4600	4900
	p	0,889		0,370		0,917	
Friedman p<0,001		Group making significant difference on day 0					

*WBC: white blood cell; CRP: C reactive protein; PRC: procalcitonine; NEU: neutrophile

There was no relationship between fever, modified Charlson comorbidity index and number of comorbidities and poor prognosis. Table 5 shows the odds ratio (OR), confidence intervals (CI) and p values of these parameters.

Table 5. Univariate Regression Analysis for Poor Prognosis

	OR	Cl	P
Dyspnea	0,08	0,01-0,71	**0,023**
Vaccination status	16,0	1,82-140,54	**0,012**
Mental Disorder	16,87	3,49-81,38	**<0,001**
CURB-65	4,60	1,02-20,69	**0,047**
PSI	1,05	1,00-1,09	**0,022**
Modified Charlson comorbidity index	1,10	0,86-1,42	0,415
Number of comorbidities	1,10	0,70-1,72	0,670
Fever	0,44	0,11-1,72	0,241

*OR: odds ratio, CI: confidence intervals
CURB-65: Confusion, uremia, blood pressure, age 65; PSI: Pneumonia Severity Index

DISCUSSION

In geriatric patients, symptoms and signs are less commonly seen than in young people and this causes delays in diagnosis. At the same time, due to the weakness of its compensatory mechanisms, organ failure develops more easily. The effect of vaccine on prognosis is important in this study which refers on patients with pneumonia, the foremost cause of geriatric death. This study demonstrated the need for vaccination and specific assessments for the elderly population.

In the study of 101 geriatric patients with community-acquired pneumonia by Riquelme et al., the two most common symptoms were dyspnea (71%) and cough (67%), similar to our study.[12] The rate of mental disorder (27%) was also similar to our study.[12] In a study with 1474 patients, fever and pleuritic pain were less and mental disorder was more common in the group over 80 years old than in the young group.[13] This suggests that mental disorder may become more important than fever as a symptom in pneumonia in the geriatric population. When the symptoms, signs and radiological findings were eveluated in our study, there was no statistically significant difference between 65-84 and over 84 years of age group except 'sputum extractability'. One of the reasons why we receive less sputum in the over 84 years of age group than in the between 65-84 age group may be the decrease in ciliary activity with aging. In our study, 57% of patients identified sputum as a symptom, 43% of them gave appropriate samples and 50% of appropriate samples were found to be causal. In an article on community-acquired pneumonia, similar to our study, 61% of 97 patients described sputum, while 45% were able to give appropriate samples, and 51% of appropriate samples were found to be causative.[14] In studies, the detection rate of causative agent in sputum is between 21-63%.[15]

Mortality rate, which is changing between 1-5% in outpatient community-acquired pneumonia cases, can increase to 12% in hospitalized patients or with risk factors and up to 40% in cases requiring intensive care.[11,16] Özmen et al. divided the patients who had pneumonia into two groups as between 75-84 and over 84 years old. There was found no significant difference between these two groups in terms of prognosis in accordance with our study. Also the mortality rate was 11% similar to our study (%15).[17] In our study, we think that the mortality rate was slightly higher because in adition to community-acquired pneumonia, there were cases of hospital acquired, health care associated and ventilator-associated pneumonia, and eleven of our patients had intensive care requirement during hospitalization.

Kaplan et al. found a 1-year mortality rate of 40% in geriatric patients with community-acquired pneumonia.[18] In our study, one-year mortality rate was 51%. CURB-65 and PSI scores were significantly higher for poor prognosis; there was no statistically significant difference between the number of comorbidity and modified Charlson comorbidity index score with good prognosis. In addition, univariate regression analysis showed that CURB-65 and PSI were associated with poor prognosis, whereas modified Charl-

son comorbidity index score and number of comorbidity were not associated with poor prognosis. These findings revealed that CURB-65 and PSI index are superior to the number of comorbidities and the modified Charlson comorbidity index in predicting prognosis for pneumonia especially in the elderly patients. The CURB-65 and PSI tests can easily be used in clinical practise due to their similar efficacy.[19] In the CAPNETZ study that was studied with 1349 patients over 65 years of age, mortality was higher in patients with a high CURB-65 score, similar to our study.[20] No statistically significant difference was found between fever and poor prognosis and no correlation was found in univariate regression analysis, also. The reasons why fever is less common in the geriatric population compared to young people are thought to be the decrease in the production of endogenous pyrogens, hypothalamic changes and changes in brown fat tissue.[21]

While 94% of the 18 vaccinated patients had a good prognosis, only 52% of 29 non-vaccinated patients had a good prognosis. In the literature, there is no randomized placebo-controlled efficacy study performed with PPV23 in the population over 65 years old.[22] Looking at randomized controlled studies on PPV23, it turns out that there is a protective effect against invasive lung disease in the elderly population.[22] In randomized controlled trials with PCV13, it reduces the risk of all-cause pneumonia, invasive pulmonary disease and pneumococcal pneumonia.[23]

Limitation

Our study had several limitations. First, it was conducted in a single centre. Second, our sample size was low. The reason for this is that only patients hospitalized in the geriatric service were included in the study.

CONCLUSION

Dyspnea and mental disorder of elderly patients should be not overlooked due to assosciation with poor prognosis in the geriatric population with pneumonia. It is important to calculate at at least one of the CURB-65 and PSI scores in geriatric patients, as it will give an idea in terms of prognosis. Most importantly, this study demonstrated the necessity of vaccination and its positive effect on prognosis in the geriatric population.

This study was approved by the Ethics Committee of Cerrahpasa Medical Faculty (Approval number 2019-186106).

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