Prognostic significance of mean platelet volume to platelet count ratio in community-acquired pneumonia

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Prognostic significance of mean platelet volume to platelet count ratio in community-acquired pneumonia

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ABSTRACT

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Objective

This study aims to determine the association of mean platelet volume (MPV) to platelet ratio with mortality and the prognostic performance in patients with community-acquired pneumonia (CAP) in emergency department (ED).

Methods

We retrospectively reviewed the records of patients diagnosed at ED and hospitalized with CAP between January 2014 and December 2014. The MPV/platelet ratio was calculated as the MPV value divided by the platelet count on each hospital day. The clinical outcome was 28-day mortality in CAP.

Results

A total 309 eligible patients were included in this study. According to multivariate Cox proportional hazard models, higher MPV/platelet on day 1 (HR: 1.016; 95% CI: 1.005-

1.027; p=0.006) and day 2 (HR: 1.023; 95% CI: 1.012-1.034; p<0.001) were significant risk factors for 28-day mortality. Among patients with CAP, a MPV/platelet>0.051 on day 1 (HR: 3.828; 95% CI: 1.690-8.673; P=0.001) and MPV/platelet>0.064 on day 2 (HR: 3.252; 95% CI: 1.343-7.876; P=0.009) were associated with increased 28-day mortality in patients with CAP.

Conclusion

The higher MPV/platelet ratios on day 1 and day 2 are prognostic factor of 28-day mortality in patients in CAP.

Key words: community-acquired pneumonia, mean platelet volume, platelet, prognosis

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I. INTRODUCTION

Community-acquired pneumonia (CAP) is a common and important cause of morbidity and mortality in the world, and is a significant burden on healthcare resources and expense.[1-3] In a large case, ventilator care, vasopressor support, and intensive care unit (ICU) admission are needed due to respiratory failure, sepsis or septic shock.[4,5] Early diagnosis of severe CAP before it progress to multiple organ failure or circulatory failure improves patient's outcome and reduces morbidity and mortality.[4,5]

A number of severity assessment tools and biochemical/hematological markers have been used to predict severe CAP. However, there is no gold standard for the assessment of severity in CAP.[4] Some severity assessment tools such as the CURB-65 scale (Confusion, Urea >7 mmol/L, Respiratory rate ≥30 breaths per minute, Blood pressure [systolic value <90 mmHg or diastolic value ≤60 mmHg], and Age ≥65 years) and pneumonia severity index (PSI) have been developed. These scales have been extensively studied and repeatedly validated.[6-8] However, they have some limitations that may not be practical for

routine application in a busy hospital emergency department (ED).

Many biochemical/hematological markers such as the C-reactive protein (CRP), procalcitonin (PCT), interleukin-6, tumor necrosis factor (TNF)-α, and D-dimer have been studied. But, these markers are often not available in a timely and somewhat expensive.[9-11]

Platelets play an important role in thrombus formation, inflammation, and immunomodulatory process.[12-14] Some studies have reported that the presence of thrombocytopenia at admission or its development during intensive care unit (ICU) stay are associated with poor prognosis.[15-17] The mean platelet volume (MPV) is an indicator of platelet size and an accurate marker of platelet function and activity.[18,19] Over the past decade, several studies have suggested that change of MPV levels is associated with poor outcomes and increased mortality in various diseases, such as stroke, angina, acute myocardial infarction, and pulmonary embolism.[20-22] High MPV reflects the intensity of inflammation.[23] Elevated MPV is also associated with morbidity and mortality in patients with sepsis and septic shock.[24,25]

Platelet count and MPV are cost-effective and routinely measured by automated hematology analyzer in ED. Several studies showed the superiority of the MPV/platelet ratio to MPV alone as a predictor of mortality in sepsis and myocardial infarction.[26,27] To our knowledge, there is little data on prognostic value of MPV/platelet ratio in patients with CAP in emergency department ED.

Therefore, the aim of our study is to identify the association of MPV/platelet ratio with

mortality and to determine the prognostic significance of MPV/platelet ratio as a diagnostic test for CAP. We also compared the MPV/platelet ratio with the PSI and CURB-65 scale.

II. MATERIALS AND METHODS

1. Study design and population

This study was reviewed and approved by the institutional review board of Yonsei University College of Medicine, Gangnam Severance Hospital. This study was performed between January 2014 and December 2014 in a tertiary academic hospital with annual ED censuses of 85,000. Patients' records and information were anonymized and de-identified prior to analysis. We retrospectively reviewed hospital records of patients who visited our ED and were diagnosed and hospitalized with CAP.

Community-acquired pneumonia was defined as a pulmonary infiltrate on chest radiograph and symptoms consistent with pneumonia, including cough, dyspnea, fever, and/or pleuritic chest pain, none of which were acquired in a hospital or a nursing home. Patients were included if they were older than 19 years and were hospitalized with a diagnosis of CAP.

During the study period, a total of 1735 patients were included with a diagnosis of CAP in the analysis. Of these, 921 were excluded due to younger than 19 years; 3 were excluded due to pregnant women; 54 were excluded because patients transferred from another hospital; 1 was excluded because patient transferred to another hospital during treatment; 7 were excluded because patients discharged from a hospital within the previous 10 days; 6 were excluded due to active pulmonary tuberculosis; 35 were excluded due to hematological disorder; 10 were excluded due to positive for human immunodeficiency virus (HIV); 206 were excluded because of chronically

immunosuppressed (define as immunosuppression for solid organ transplantation, postsplenectomy, receiving ≥10mg/d prednisolone or equivalent for more 30 days, treatment with other immunosuppressive agents or neutropenia [<1.0 X 10^9/L neutrophils]) status; 35 were excluded due to hospital-acquired pneumonia (HAP); 21 were excluded due to health care-associated pneumonia (HCAP); 79 were excluded due to aspiration pneumonia; 9 were excluded because of do-not-resuscitation status or hospice care cancer patients (Figure 1).

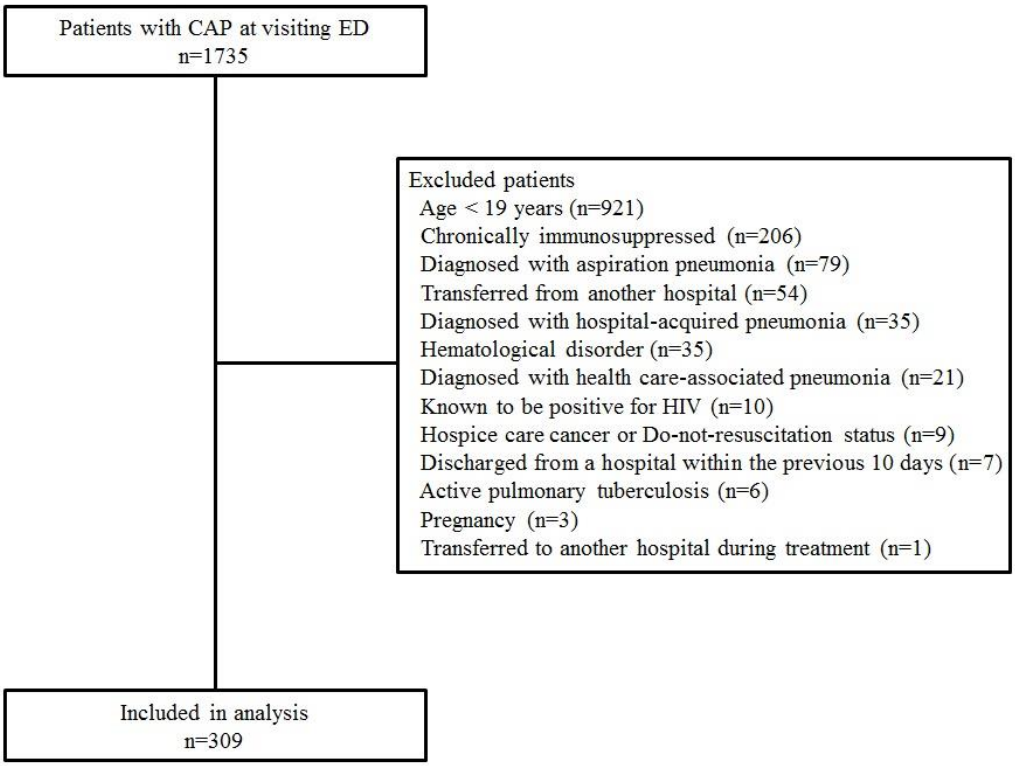

Figure 1. Flow diagram of the study patients.

2. Data collection

The following information were collected: age, sex, admission from a nursing home or another hospital, comorbid diseases (ex. lung disease, liver disease, renal disease, congestive heart failure, cerebrovascular disease, malignant disease), and medication use. Physical examination finding were recorded: mental status, pulse rate, respiratory rate, blood pressure, body temperature, and altered mentality. Laboratory data also were collected: white blood cell (WBC) count, hematocrit, red blood cell distribution width (RDW), platelet count, mean platelet volume (MPV), blood glucose, sodium, potassium, serum creatinine, blood urea nitrogen (BUN), albumin, prothrombin time (PT [international normalized ratio]), activated partial thrombin time (aPTT), arterial pH, arterial oxygen tension (P_aO_2), oxygen saturation, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). Radiologic findings were collected: pleural effusion. Patients were scored by CURB-65, PSI, and Acute Physiology And Chronic Health Evaluation (APACHE Ⅱ) on ED admission.

Serum MPV and platelet counts were measured on day 0 (on ED admission), day 1 (24-36 hours after ED admission), and day 2 (48-60 hours after ED admission). At ED admission, blood samples were collected immediately. MPV and platelet counts were determined by an automatic analyzer (ADVIA 2120, Siemens, Forchheim, Germany). The primary end point for this study was 28-day mortality after the ED visit.

3. Statistical analysis

Statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). Baseline characteristics and clinical data are presented as a frequency or medians (ranges) as appropriate. The chi-squared tests or Fisher's exact tests were used for categorical variables. Continuous variables were compared using Mann-Whitney U test. We estimated significant differences between groups over time using a linear mixed model and repeated measures covariance pattern with unstructured covariance within patients. Two fixed effects were included to address the survival effect for 28-day mortality (level: survival and non-survival) and time effect (time: MPV/platelet 0, 1, and 2 days after ED admission). Univariate Cox proportional analysis was conducted to identify the relationship among demographic characteristics, laboratory variables, and 28-day mortality. Multivariate Cox proportional hazard regression analysis was performed to identify independent prognostic factors associated with 28-day mortality. These results were expressed as hazard ratio (HR) and 95% confidence interval (CI).

Considering time to event, we constructed time-dependent receiver operating characteristic (ROC) curves for CURB-65, PSI, MPV/platelet on day 0, MPV/platelet on day 1, and MPV/platelet on day 2. The area under the curves (AUC) was calculated to assess the predictive values of these markers.

Kaplan–Meier analysis survival curves were performed using 28-day mortality, and the groups were compared using log-rank tests. Considering time to event, we used the Contal and O'Quigley technique for selecting the optimal cut-off values of MPV/platelet

ratio. This technique was used for dichotomization of clinical outcome variables.[28] The optimal cut-off point was selected by maximizing the HR based on time to event using more advanced statistics.[28] P-value < 0.05 was considered statistically significant.

III. RESULTS

1. Patient Characteristics

Of the 1735 patients who admitted to our ED and were diagnosed and hospitalized with CAP, we excluded 1426 patients from the analysis. The remaining 309 eligible patients were analyzed according to 28-day mortality. 27 of the 309 patients (8.7%) died during the first 28 days.

The baseline demographic and clinical characteristics of the study groups are shown in Table 1. Patients who died were older; had a higher rate of renal failure and neoplastic disease; had lower blood pressure and body temperature; had more rapid respiratory rate; and had the altered mentality. The prognostic scales (PSI and CURB-65) were higher in nonsurvivor. APACHEⅡ at ED admission were significantly different between the survivor and nonsurvivor. Patients who died were shock status and needed to hospitalize an intensive care unit (ICU). The baseline laboratory findings of the study groups are shown in Table 2. Patients who died had higher potassium, higher blood urea nitrogen, higher creatinine, lower albumin, lower hemoglobin, lower hematocrit, higher red blood cell distribution width, more prolonged prothrombin time, higher ESR, and higher CRP. There were significant differences in isolated MPV, platelet counts, and MPV/platelet ratio between the survivor and nonsurvivor.

Table 1. Baseline characteristics of the study patients

Variables	Survivor (n=282)	Nonsurvivor (n=27)	P-value
Demographic data			
Age	72 (61-78)	79 (76-83)	<0.001
Sex (male)	175 (62.06)	23 (85.19)	0.017
Female	107 (37.94)	4 (14.81)	
Comorbidity			
Liver disease	2 (0.71)	0 (0.00)	>0.999
Heart failure	9 (3.19)	2 (7.41)	0.248
Renal failure	76 (26.95)	23 (85.19)	<0.001
Lung disease	83 (29.43)	8 (29.63)	>0.999
Cerebrovascular disease	4 (1.42)	1 (3.70)	0.369
Neoplasm	19 (6.74)	6 (22.22)	0.014
Clinical data			
Systolic blood pressure	127 (108-151)	106 (89-140)	0.009
Diastolic blood pressure	70 (61-80)	58 (50-71)	0.002
Mean blood pressure	88.67 (77-102.67)	73.67 (64.33-86.67)	0.001
Heart rate	96.5 (82-109)	100 (86-113)	0.346
Body temperature	37.5 (36.7-38.2)	36.8 (36-37.9)	0.013
Respiratory rate	16 (15-20)	20 (17-24)	0.002
Altered mentality	8 (2.84)	9 (33.33)	<0.001
PSI class			<0.001
Ⅰ	15 (5.32)	0 (0)	
Ⅱ	29 (10.28)	0 (0)	
Ⅲ	69 (24.47)	1 (3.70)	
Ⅳ	82 (29.08)	11 (40.74)	
Ⅴ	27 (9.57)	13 (48.15)	
CURB-65 score			<0.001
0	58 (20.57)	0 (0)	
1	110 (39.01)	0 (0)	
2	75 (26.6)	8 (29.63)	
3	32 (11.35)	13 (48.15)	
4	5 (1.77)	6 (22.22)	
5	1 (0.35)	0 (0)	
APACHEⅡ	13 (10-17)	20 (18-23)	<0.001
Shock			<0.001
Positive	40 (14.18)	21 (77.78)	
ICU admission	9 (3.19)	12 (44.44)	<0.001

PSI: pneumonia severity index, CURB-65: confusion, urea, respiratory rate, blood pressure, and age ≥65 years, APACHEⅡ: acute physiology and chronic health evaluation, ICU: intensive care unit

Table 2. Laboratory findings of the study patients

Variables	Survivor (n=282)	Nonsurvivor (n=27)	P-value
Sodium	137 (133-139)	137 (132-141)	0.387
Potassium	4.3 (3.8-4.6)	4.4 (4.3-5)	0.035
Blood urea nitrogen	16 (12.2-26)	34.1 (27.5-60.3)	<0.001
Creatinine	0.86 (0.68-1.27)	1.8 (1.36-3.12)	<0.001
Glucose	131.5 (108-169)	134 (104-208)	0.846
Albumin	3.5 (3.2-3.8)	2.9 (2.5-3.2)	<0.001
Hemoglobin	12.8 (11.5-14)	11.5 (10.2-12.9)	0.004
Hematocrit	38.4 (34.3-41.8)	35.3 (31.6-38.9)	0.037
Red blood cell distribution width	13.75 (13.2-14.6)	15.3 (14.6-16.8)	<0.001
White blood cell	11745 (8090-16070)	10210 (7470-12970)	0.163
Prothrombin time (INR)	1.05 (0.98-1.14)	1.16 (1.05-1.33)	0.003
Activated partial thromboplastin time	32.25 (29.9-35.5)	32.35 (29.2-37.8)	0.700
Erythrocyte sedimentation rate	63 (40-84)	77 (58-94)	0.034
C-reactive protein	97.8 (55.8-183.3)	158.9 (85.8-251.8)	0.018
MPV0	8.1 (7.7-8.5)	8.9 (8.4-9.3)	<0.001
MPV1	8.1 (7.7-8.7)	8.8 (8.6-9.6)	<0.001
MPV2	8.3 (7.9-8.9)	8.95 (8.3-9.8)	0.002
Platelet0	218.5 (165-290)	186 (122-234)	0.008
Platelet1	207 (156-269)	151 (103-214)	0.001
Platelet2	205.5 (156-279)	153.5 (89.5-215)	0.006
MPV0/Platelet0	0.04 (0.03-0.05)	0.05 (0.04-0.07)	0.002
MPV1/Platelet1	0.04 (0.03-0.05)	0.06 (0.04-0.09)	<0.001
MPV2/Platelet2	0.04 (0.03-0.06)	0.06 (0.04-0.11)	0.005
SaO_2	94.2 (91.3-96.5)	92.1 (90.2-95.6)	0.241
pH	7.45 (7.42-7.47)	7.45 (7.39-7.48)	0.876
PaO_2	67.1 (59.4-77.3)	67 (53.9-77.5)	0.535
$PaCO_2$	29.8 (27.1-34.2)	22.9 (21.6-32.4)	0.001
HCO_3^-	20.9 (19-23.5)	16.5 (14.7-20.3)	0.001

INR: international normalized ratio, MPV: mean platelet volume

2. Trends in the mean platelet volume/platelet ratio during the first 96 hours

The linear mixed model revealed that the change in the MPV/platelet ratio between the groups (group: P<0.001) were differed significantly from day 0 to day 2 (time: P=0.068) with respect to 28-day mortality (group x time: P=0.030) (Figure 2).

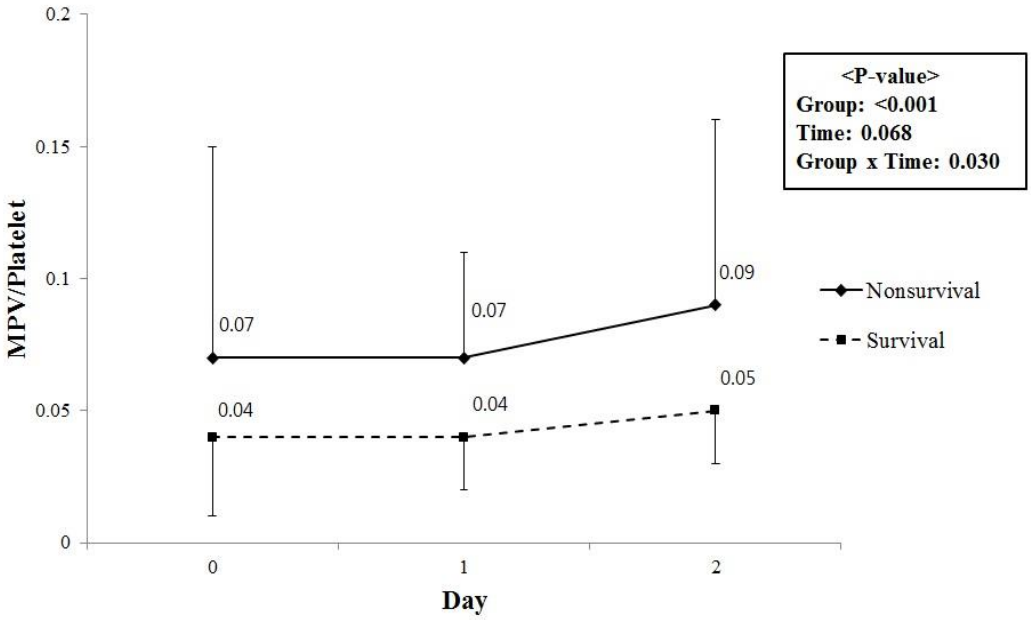

Figure 2. The linear mixed model for mean platelet volume/platelet ratio. The changes in MPV/platelet ratio across time between survivors and nonsurvivor, according to 28-day mortality.

3. Prognostic factors for 28-day mortality

The univariate Cox proportional analysis showed that MPV values, Platelet counts, and MPV/platelet ratios were useful prognostic factors for 28-day mortality (Table 3). We performed multivariate Cox proportional hazard regression analysis to identify the effect of MPV values and MPV/platelet ratios on 28-day mortality in patients with CAP. However, the multivariate Cox proportional analysis showed that MPV values were not associated with independent prognostic factors for 28-day mortality (data not shown). The multivariate Cox proportional analysis showed that higher MPV/platelet ratio on day 1 (HR: 1.016; 95% CI: 1.005-1.027; p=0.006) and on day 2 (HR: 1.023; 95% CI: 1.012-1.034; p<0.001) were useful prognostic factors for 28-day mortality (Table 4). In time-dependent ROC curves analysis for 28-day mortality, the predictive value of MPV/Platelet ratio was not inferior to those of CURB-65 and PSI. The AUCs of CURB-65 and PSI were 0.722 (95% CI: 0.630-0.830) and 0.719 (95% CI: 0.575-0.839). The AUCs of MPV/platelet on day 0, MPV/platelet on day 1, and MPV/platelet on day 2 were 0.714 (95% CI: 0.612-0.831), 0.719 (95% CI: 0.624-0.83), and 0.694 (95% CI: 0.602-0.811) (Figure 3).

Kaplan-Meier survival curves were performed for 28-day mortality based on the MPV/platelet ratio on day 1 and 2, and log-rank tests indicated that the MPV/platelet ratios were independent prognostic factors in patients with CAP. The optimal MPV/Platelet ratio on day 1 was 0.051 (p=0.001) and on day 2 was 0.064 (p=0.005) for 28-day mortality. Further analysis of these cut-off values using Contal and O'Quigley

technique demonstrated that MPV/platelet>0.051 on day 1 (HR: 3.828; 95% CI: 1.690-8.673; P=0.001) was associated with an increased risk for 28-day mortality. In addition, a MPV/platelet>0.064 on day 2 (HR: 3.252; 95% CI: 1.343-7.876; P=0.009) revealed a strong association with 28-day mortality in patients with CAP (Figure 4).

Table 3. Univariate Cox proportional analysis for 28-day mortality

Variables	HR (95% CI)	P-value
Age	1.054 (1.013-1.097)	0.010
Sex (female)	1	
Male	2.639 (0.910-7.647)	0.074
Liver disease	1.772 (0.099-31.770)	0.698
Heart failure	2.401 (0.568-10.15)	0.234
Renal failure	9.730 (3.356-28.210)	<0.001
Lung disease	0.921 (0.403-2.106)	0.846
Cerebrovascular disease	3.598 (0.483-26.780)	0.211
Neoplasm	3.198 (1.289-7.936)	0.012
Systolic blood pressure	0.984 (0.971-0.996)	0.012
Heart rate	1.006 (0.989-1.024)	0.476
Body temperature	0.628 (0.445-0.888)	0.008
Respiratory rate	1.05 (0.987-1.117)	0.125
Altered mentality	5.719 (2.504-13.06)	<0.001
Sodium	1.078 (1.010-1.150)	0.024
Potassium	1.317 (0.782-2.220)	0.301
Blood urea nitrogen	1.028 (1.016-1.039)	<0.001
Glucose	1.000 (0.996-1.004)	0.992
Albumin	0.259 (0.132-0.511)	<0.001
Hematocrit	0.957 (0.903-1.015)	0.143
White blood cell	0.939 (0.878-1.003)	0.063
Prothrombin time (INR)	0.928 (0.544-1.583)	0.783
Activated partial thromboplastin time	1.005 (0.953-1.060)	0.854
Erythrocyte sedimentation rate	1.007 (0.994-1.020)	0.313
C-reactive protein	1.002 (0.998-1.005)	0.304
MPV0	1.958 (1.430-2.680)	<0.001
MPV1	1.896 (1.401-2.567)	<0.001
MPV2	1.462 (1.112-1.923)	0.007
Platelet0	0.994 (0.989-0.998)	0.006
Platelet1	0.991 (0.985-0.997)	0.002
Platelet2	0.992 (0.986-0.998)	0.012
MPV0/Platelet0	1.005 (1.002-1.009)	0.006
MPV1/Platelet1	1.021 (1.012-1.030)	<0.001
MPV2/Platelet2	1.020 (1.012-1.027)	<0.001
SaO_2	0.982 (0.927-1.041)	0.547
PaO_2	0.995 (0.979-1.012)	0.587
APACHE Ⅱ	1.168 (1.100-1.240)	<0.001

Shock		
Positive	9.277 (3.696-23.280)	<0.001
ICU admission	5.734 (2.607-12.620)	<0.001

INR: international normalized ratio, MPV: mean platelet volume,

APACHEⅡ: acute physiology and chronic health evaluation, ICU: intensive care unit

Table 4. Multivariate Cox proportional analysis for 28-day mortality

	Demographic data + MPV0/Platelet0		Demographic data + MPV1/Platelet1		Demographic data + MPV2/Platelet2	
Variables	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
Albumin	0.342 (0.157-0.746)	0.007	0.375 (0.168-0.837)	0.017	0.795 (0.314-2.009)	0.627
Age	1.023 (0.980-1.068)	0.295	1.012 (0.970-1.056)	0.588	1.008 (0.963-1.055)	0.739
Blood urea nitrogen	1.015 (1.001-1.029)	0.034	1.007 (0.991-1.024)	0.384	1.016 (0.994-1.038)	0.167
Systolic blood pressure	0.991 (0.977-1.005)	0.196	0.989 (0.976-1.003)	0.137	0.988 (0.973-1.004)	0.137
Altered mentality	1.903 (0.571-6.340)	0.295	1.283 (0.371-4.439)	0.694	0.166 (0.030-0.925)	0.041
MPV0/Platelet0	1.002 (0.996-1.007)	0.543				
MPV1/Platelet1			1.016 (1.005-1.027)	0.006		
MPV2/Platelet2					1.023 (1.012-1.034)	<0.001

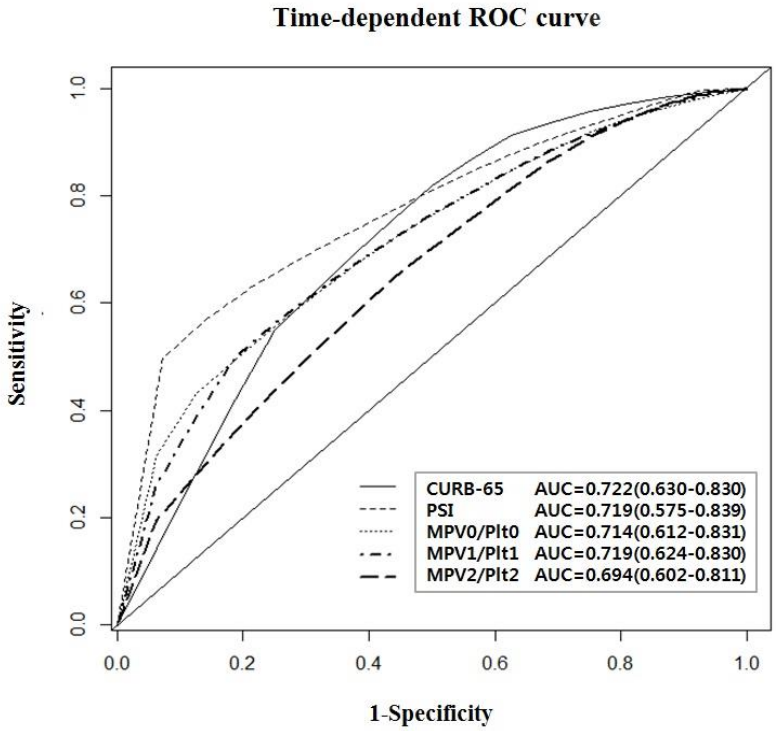

Figure 3. Time-dependent receiver operating characteristic (ROC) curves of CURB-65, PSI, and Mean platelet volume /platelet ratio for 28-day mortality.

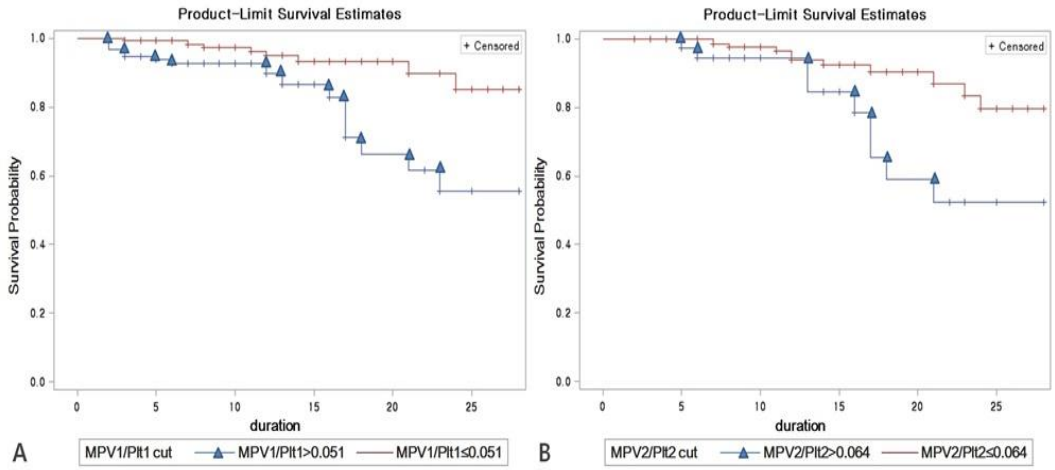

Figure 4. Mean platelet volume/platelet ratio as a predictor of 28-day mortality. To assess the prognostic value of the MPV/platelet ratio, we used the Contal and O'Quigley technique based on the log-rank test. Optimal cut-off points for MPV/Platelet ratio were >0.051 (HR: 3.828; 95% CI: 1.690-8.673; P=0.001) on day 1 (A) and >0.064 (HR: 3.252; 95% CI: 1.343-7.876; P=0.009) on day 2 (B).

IV. DISCUSSION

CAP is one of the most common and important cause of morbidity and mortality in the world.[1] Because of the frequent occurrence of complications such as sepsis or septic shock, it is very important to assess the severity and predict the accurate prognosis in patients with CAP.[4] Some severity assessment tools such as PSI and CURB-65 score have been developed and validated to decide site of care.[6-8] However, they have some limitations concerning their use in routine clinical practice in ED. Many biochemical/hematological markers such as CRP, procalcitonin, interleukin-6, TNF-α, and D-dimer have been investigated in association with clinical outcome in patients with CAP. But, they could not be used easily in ED and somewhat expensive.[9-11]

It is known that platelet play a pivotal role in the pathogenesis of inflammatory and infectious diseases.[12,13] MPV is an indicator of platelet size and index of platelet activation status.[18,19] Changes of MPV have been reported in several inflammatory and infectious diseases.[19-25,29] An elevated MPV shows a positive correlation with the intensity of systemic inflammation and association with mortality in sepsis and septic shock.[23,24] Total platelet count is inversely associated with MPV.[14,24] Thrombocytopenia is well recognized as a poor prognostic factor in critically ill patients.[17] MPV and platelet count are readily available in routine practice and cost-effective, and could be used as serial measurements in patient with CAP.[30]

In our study, platelet count was found to be significantly lower in the non-survival group on 0, 1, and 2 days after ED admission. MPV was found to be significantly higher

in the non-survivors on 0, 1, and 2 days after ED admission. Azab et al. demonstrated that high MPV with low platelet count reflects increased activity and aggregation of platelet. And the authors suggested the superiority of MPV/platelet ratio to MPV alone as a prognostic factor in non-ST elevation myocardial infarction.[26] Similarly, inverse association between MPV and platelet count act as a predictor of early mortality in CAP. In this study, the multivariate Cox proportional analysis showed that higher MPV/platelet ratio on day 1 (HR: 1.016; 95% CI: 1.005-1.027; p=0.006) and on day 2 (HR: 1.023; 95% CI: 1.012-1.034; p<0.001) were useful prognostic factors for 28-day mortality in CAP. However, the multivariate Cox proportional analysis revealed that MPV values were not associated with independent predictor for 28-day mortality. So, the MPV/platelet ratio could be a predictor of early mortality in CAP.

In ED, most physicians require easy, simple, rapid, and serially measurable predictors to determine the severity of CAP. MPV/platelet ratio is calculated easily and quickly from blood test results and requires the consideration of fewer variables than the prediction rules such as CURB-65 and PSI. In our study, the accuracy of MPV/platelet ratio for predicting the severity of CAP was not inferior to that of CURB-65 and PSI.

This study demonstrated that the MPV/platelet ratio was an independent predictor of 28-day mortality in patients with CAP. To our knowledge, this study is the first to identify the association of MPV/platelet ratio with early mortality and the superiority of MPV/platelet ratio to MPV alone as a predictor for early mortality in CAP. In this study, the MPV/platelet ratios on day 1 and on day 2 were useful predictor for 28-day mortality.

Therefore, our study suggests that patients with high MPV/platelet ratio should be carefully monitored because of the close association with early mortality.

However, this study has several limitations. First, this study was a retrospective study based on a small population of patients was enrolled from a single medical center. Therefore, this study is inherently susceptible to certain biases associated with a single center study. Second, we could not investigate the previous use of anti-platelet agents and NSAIDs, which are known to affect MVP.[23] Third, this study suggested that high MPV/platelet ratio in acute phase of CAP was associated with 28-day mortality. However, we could not assess long-term clinical outcomes in patients with CAP. In addition, we could not study the association between MPV/platelet ratio and long-term clinical outcomes with CAP. Prospective multicenter studies are needed to validate the usefulness of the MPV/platelet ratio as a prognostic factor in patients with CAP.

V. CONCLUSION

Our study shows that the MPV/platelet ratios on day 1 and on day 2 were useful prognostic factor for 28-day mortality in patients with CAP. Patients with elevated MPV/platelet ratio should be closely monitored. Additional studies should be conducted to confirm the effectiveness of the MPV/platelet ratio as a predictor in CAP.

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ABSTRACT(IN KOREAN)

지역사회획득폐렴 환자의 예후예측 인자로서의 평균 혈소판 용적/혈소판 수 비의 유용성

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서론

지역사회획득폐렴은 응급진료센터 경유 입원의 주요한 질환으로서 전세계적으로 사망률과 이환율에서 주요한 원인이다. 이에 지역사회획득폐렴의 중증도 판단 및 예후의 예측이 질병의 치료에 있어서 중요하다. 본 연구에서는 응급진료센터에 내원하여 지역사회획득폐렴으로 진단된 성인 환자에서 평균 혈소판 용적/혈소판 수 비와 사망률과의 연관성을 분석하고, 환자의 예후를 예측하는데 유용한지 알아보고자 하였다.

방법

2014년 1월부터 2014년 12월까지 세브란스병원 응급진료센터에 내원한 성인 환자 중 지역사회획득폐렴으로 진단된 환자들을 대상으로 하였다. 대상환자들의 의무기록과 검사 결과를 후향적으로 검토하였다. 평균 혈소판 용적/혈

소판 수 비는 응급진료센터 내원 당시 (Day 0), 내원 1일 후 (Day 1), 그리고 내원 2일 후 (Day 2)에 정맥을 통해 채취된 혈액을 통해서 얻어진 평균 혈소판 용적과 혈소판 수를 이용하였다. 연구의 일차적인 결과는 응급진료센터 내원 후 28일 이내 사망으로 정하였다. 통계기법으로 Univariate Cox proportional analysis, Multivariate Cox proportional regression analysis, Kaplan-Meier analysis survival curve, Contal and O'Quigley technique을 이용하였다.

결과

본 연구 기간 동안에 지역사회획득폐렴으로 내원하여 연구에 포함된 환자는 총 309명이었다. 평균 혈소판 용적/혈소판 수 비는 Day 0, 1, 2에서 생존군과 사망군 간에 의미 있는 차이를 보였다. Multivariate Cox proportional regression analysis을 시행한 결과 내원 1일 후 (Day 1) 평균 혈소판 용적/혈소판 수 비 (HR: 1.016; 95% CI: 1.005-1.027; p=0.006), 내원 2일 후 (Day 2) 평균 혈소판 용적/혈소판 수 비 (HR: 1.023; 95% CI: 1.012-1.034; p<0.001)가 28일 이내 사망률과 독립적인 상관관계를 보였다. 평균 혈소판 용적/혈소판 수 비가 CURB-65 및 PSI와 비교하여 28일 사망률을 예측하는 지표로서 효용성이 있는 지를 확인하기 위해서 Time-dependent receiver operating characteristic curve 분석을 수행하였으며, CURB-65 및 PSI와 비

교하여 예후 예측 지표로서 열등하지 않음을 알 수 있었다. Contal and O'Quigley technique을 이용하여 평균 혈소판 용적/혈소판 수 비에 대한 최적의 결정점을 구하였으며 내원 1일, 2일 후 평균 혈소판 용적/혈소판 수 비가 각각 0.051보다 클 때 (HR: 3.828; 95% CI: 1.690-8.673; P=0.001), 0.064보다 클 때 (HR: 3.252; 95% CI: 1.343-7.876; P=0.009) 이하인 환자에 비해서 28일 이내 사망률이 높았다.

결론

본 연구의 결과 응급의료센터에 내원하는 지역사회획득폐렴 환자에서 증가된 평균 혈소판 용적/혈소판 수 비는 28일 사망률을 예측하는 지표로서 효용성이 있다. 지역사회획득폐렴 환자에서 내원 1일, 2일 후 측정된 평균 혈소판 용적/혈소판 수 증가 시 환자의 치료 방향 결정 및 환자의 예후를 향상시키는 데 도움을 줄 수 있을 것이다.

핵심 되는 말: 지역사회획득폐렴, 평균 혈소판 용적, 혈소판, 예후 인자