ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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CLINICAL FINDINGS AND BLOOD GAS PARAMETERS IN PATIENTS PRESENTED WITH DYSPNEA

DİSPNE İLE GELEN HASTALARDA KLİNİK BULGULAR VE KAN GAZI PARAMETRELERİ

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Öz

Amaç
Acil servise dispne şikayet ile başvuran hastalarda, OCS-9 skoru kullanılarak klinik durumu belirlemek.

Gereç ve Yöntem
Bu çalışma, solunum sıkıntısı olan 373 hasta retrospektif olarak incelenerek gerçekleştirildi. Dispne ile başvuran hastalarda, 3 önemli kan gazı parametresi kulanılarak (pH, baz açığı, laktat seviyesi) OCS-9 değeri hesaplandı. Klinik ve kan gazı parametreleri (OCS-9 skorları), hastaların son durumları (taburcu, servis yatış, yoğun bakım yatış, ölüm) ile karşılaştırıldı.

Bulgular
Hasta klinik sonuçlandırmalarının istatistiksel karşılaştırmasında, OCS-9 skoru anlamlı olarak bulundu. Servis yatışı olan veya taburcu edilen hastaların OCS-9 skoru, yoğun bakım yatışı yapılan hastalara göre daha yüksekti. OCS-9 skorunun cut-off değeri 1 kabul edildiğinde, yoğun bakım yatış ve ölüm öngörme duyarlılığı %46.9 ve özgüllüğü %77.08 olarak bulundu.

Sonuç
OCS-9 skorunun, acil servise dispne ile başvuran hastalarda klinik sonuçları ve kısa süreli prognozu öngörmede bir yöntem olarak kullanılabileceğini düşünüyoruz.

Anahtar Kelimeler: Kan gazı; Klinik sonuç; Dispne; Acil servis; OCS-9

Abstract

Objective
To determine the effectiveness of Objective Classification Scale (OCS-9 scores) at the emergency department on the patients presenting with complaints of dyspnea.

Materials and Methods
The study was performed retrospectively on 373 patients with respiratory distress. Three important parameters of blood gas (pH, base deficit, lactate level) were used to calculate the OCS-9 value of patients who were admitted with dyspnea. Clinical parameters and blood gas parameters (OCS-9 scores) were compared with the outcome status of the patients (discharge, service stay, intensive care stay, exitus).

Results
In the differentiation of the clinical outcomes of the patients, the effectiveness of the OCS-9 value was found to be significant. OCS-9 scores of the patients who were hospitalized at a regular ward or who were

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discharged were higher than those who were hospitalized at the intensive care unit (ICU). When cut-off value for OCS-9 score was accepted as 1, its sensitivity for predicting exitus and hospitalization at an ICU was 46.9% and specificity was 77.08%.

Conclusion
We suggest that the OCS-9 score may be used as a method to help predict clinical outcomes and short term prognosis in patients presenting to the emergency room with dyspnea.

Keywords: Blood gases; Clinical outcome; Dyspnea; Emergency Department; Objective Classification Scale-9

Introduction

Dyspnea is a symptom that can be expressed in different ways depending on the sociocultural and physiological status of the patients such as dyspnea, air starvation, and difficulty in breathing (1). Dyspnea is a common symptom which significantly decreases the patients' life quality and is seen in a quarter of outpatients and in a half of the patients who admitted to tertiary hospitals (2). Previous studies have found that mild to moderate dyspnea was present in 9-13% of the population. In the United States of America, 3-4 million admissions to emergency departments occur annually (2, 3).

Acute myocardial infarction (AMI) and congestive heart failure (CHF) are the most common cardiac causes in the differential diagnosis of dyspnea, while chronic obstructive pulmonary disease (COPD), asthma, pneumonia and, pneumothorax are common causes of lung origin (4). Although dyspnea is one of the most common symptoms in emergency departments, it is very difficult to differentiate between the cardiac and extracardiac causes (5). Correct and rapid diagnosis of dyspnea by emergency physicians is necessary because it may be a symptom of potentially fatal diseases (6). The multiplicity of causes makes it difficult to create a simple algorithm to approach dyspnea. (7, 8). Diagnostic methods used to evaluate the cause of dyspnea include history, physical examination, chest radiography, electrocardiography, and laboratory evaluations (9). Arterial blood gas measurements have a great role in evaluating the pathophysiology, and mechanism of respiratory failure, in assessing the degree of compensation, and in diagnosing and monitoring acid-base status. Monitorization of blood gases and evaluation of lactate in critical patient care resulted in lower mortality compared with patients treated with standard methods. Arterial blood gas analysis is an important diagnostic procedure that can be used for the classification of patients with shortness of breath.

Objective evaluation of the severity of dyspnea is an important milestone in emergency departments, and parameters of arterial blood gases are used for describing correctly the severity of dyspnea. For objective evaluation of dyspnea, pH, base excess (BE), and lactate levels could be used for calculating OCS-9 scores.

The purpose of this study was to predict clinical outcomes and short term prognosis in patients presenting to the emergency room with dyspnea by using OCS-score.

Materials And Methods

Study Design

This retrospective study was performed on 373 patients who admitted to a university emergency clinic giving tertiary level healthcare between January 2015 and August 2017 with dyspnea. After approval by the ethics committee, the data were obtained from the hospital automation system.(Manisa Celal Bayar University School of Medicine Ethics Commitee 11/8/2017 / 20.478.486) No consent form was obtained from the patients due to retrospective nature of the study. Research and publication ethics were followed in this study. Patients' files were screened and blood gas parameters were evaluated. Socio-demographic characteristics of the patients like age and sex, comorbid diseases and outcome status (discharge, service stay, intensive care stay, exitus) were determined. Physical examination and clinical findings of the first visit (saturation, number of breathing, pulse, arterial blood pressure) were recorded. The cases were defined as severe dyspnea in the presence of at least one of the clinical findings together with the presence of one of the findings of the physical examination showing severe dyspnea (Table 1).

Objective Classification Scale (OCS)-9 which assesses three important parameters (pH, base deficit, lactate level) was used for blood gas analysis (Figure 1). The highest score is 9 and the severity of dyspnea increases with an increasing score.

Clinical parameters and blood gas parameters (OCS-

9 scores) were compared with the outcomes of the patients (discharge, hospitalization at a ward, hospitalization at intensive care unit, exitus). The associations between the outcomes and OCS-9 scores were evaluated.

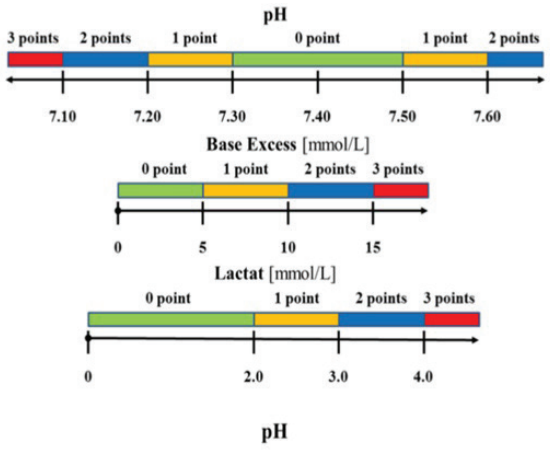

Figure 1
Objective Classification Scale (OCS) -9

Statistical Analysis

Data were evaluated using SPSS 22 (Statistical Package for the Social Sciences),IBM, USA. The power analysis of the OCS-9 score in the design of a significant difference analysis between severe patients in intensive care unit / exitus and groups of discharged patients was made with GPower 3.1.9.2. As a result of the pilot application, the effect size was determined as 0.31. It was determined that the total number of cases with 80% power and 0.05 error margin should be included in the study in a total of 356 cases, of which 236 were in the mild group and were 120 in the severe group.

Descriptive statistics for the continuous variables (characteristics) were presented as mean, standard deviation (SD), while count and percent for the categorical variables. Normal distribution of parameters was tested with the Kolmogorov Smirnov test. The Mann-Whitney U test was used for the analytical statistics when independent two groups were compared, and Kruskal-Wallis test was used when more than two independent groups were compared while the parametric test assumptions were not met. Chi square test and Fischer's Exact test were used when dicotom data were compared. ROC analysis was performed for estimation of OCS-9 score on intensive care unit admission and exitus. ROC curve was used to present the relationship between both sensitivity and specificity.

The results were evaluated with a 95% confidence interval and $p<0.05$ significance level.

Results

A total of 373 patients were included in this study. Among them 124 (33.3%) were females and 249 (66.8%) were males. The mean age of the patients was 68.2±15.03. The mean systolic blood pressure was 125.9±26.05 mmHg, and the mean diastolic blood pressure was 77.4±14.9 mmHg. The mean pulse rate

Table 1 First Visit Physical Examination Findings

Clinical Parameters	Present	Absent
	Presence of any of the following;	Absence of these findings
Use accessory respiratory muscles	Is he/she using accessory respiratory muscles?	
Orthopnea	Is he/she orthopneic?	
Tripod-fishmouth appearance	Is there a tripod-fishmouth appearance?	
Cyanosis	Is he/she cyanotic?	
Conciousness	Is he/she unconscious?	
SpO_2	Saturation at admission <90	Saturation at admission≥90
Number of breathing	Number of breathing≥24	Number of breathing<24
Heart rate	<60 or >100	Normal
Tension	Systolic <90 or >130	Systolic 90-130
	Diastolic <60 or >90	Diastolic between 60-90

was 100.5±18.5 pulse/minute, body temperature was 37.1±1.6 °C, respiration rate was (RR) 24.2±7.3, and oxygen saturation was 89.7±6.6%. Severe dyspnea was detected in 137 (36.7%) patients. Demographic features and the first visit clinical findings of the patients are shown in Table 2.

Comorbidity was present in 175 patients (46.9%). The most common accompanying disease was hypertension (23.9%), which was followed by COPD (22.5%). The mean OCS-9 score and clinical parameters of the patients who had or didn't have comorbidity were compared. Age, SBP, DBP, pH, PCO2, HCO3, and base deficit values were significantly different according to the presence of comorbidity (Mann-Whitney U $p<0.05$; Ki-Kare $p<0.05$; Fisher's Exact $p<0.05$). The mean age, SBP, DBP, PCO2, and base deficit scores of the patients with comorbidity were higher and SpO2, pH, PO2, HCO3, and lactate levels were lower than those without comorbidity. No difference could be found in OCS-9 scores according to the presence of comorbidity ($p=0.9$).

The mean pH of the blood gases of the patients was 7.4±0.1, base deficit was 0.36±5.6, and the mean lactate was 1.99±1.6.

Distribution of the patients according to the OCS-9 classification is shown in Table 3.

In our study, statistically significant differences were detected between patients who had or who didn't have severe dyspnea at first visit according to respiratory rate, SpO2, pH, PO2, PCO2, HCO3, base deficit, and lactate (Mann-Whitney U, $p<0,05$). Statistically significant differences were detected in both groups according to OCS-9 scores (Mann-Whitney U, $p<0.05$) (Table 4).

When we grouped the patient outcomes as discharged, hospitalized at a ward, or hospitalized at an ICU, statistically significant difference was detected according to OCS-9 scale ($p<0.001$) (Table 5). The mean OCS-9 score of the patients who were discharged or hospitalized at a ward was significantly lower than that of the patients who were hospitalized at an ICU.

In our study, patients whose outcomes were exitus or hospitalization at an ICU were classified as severe patients and patients who were discharged or hospitalized at a regular ward were classified as mild patients. In the differentiation of the clinical outcomes of the patients, the effectiveness of the OCS-9 value was found to be significant (The areas under the ROC curves

Table 2 Demographic and Clinical Features of the Patients

		(n) Mean±SD
Age		(373) 68.2±15.03
SBP (systolic blood pressure)		(373) 125.9±26.05
DBP (diastolic blood pressure)		(373) 77.4±14.9
Pulse rate		(373) 100.5±18.5
Body temperature		(373) 37.1±1.6
Breath rate		(373) 24.2±7.3
SpO_2		(373) 89.7±6.6
		N
Gender	**Female**	124
	Male	249
Severe dyspnea	**Absent**	236
	Present	137

(AUC) (Figure 2). When OCS-9 cut-off value was taken as 1, the sensitivity for the prediction of exitus and hospitalization at an ICU was 46.9% and the specificity was 77.08%. Comparisons of SBP, DBP, pulse, and breath rate according to this cut-off score were statistically significant (Mann-Whitney U, p<0.05). SBP and DBP were higher and pulse and breath rates were lower in patients with OCS-9<1.

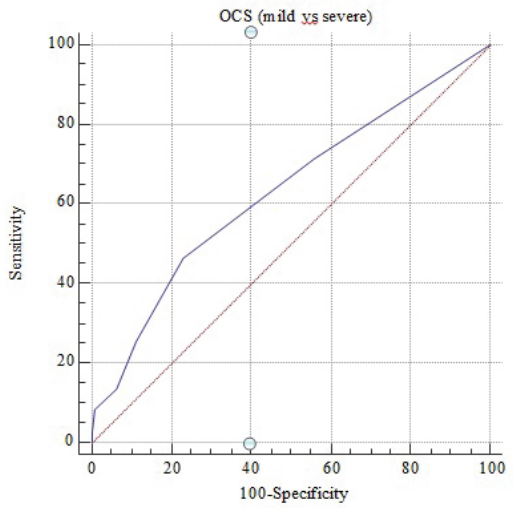

Figure 2
OCS-9 ROC Analysis

There were weak positive correlations between OCS-9 scores and pulse and breath rates and weak negative correlations between OCS-9 score and SpO2 (Spearman's rho p<0.05). OCS-9 scores increased with increasing breath rate and pulse rate and decreased with increasing SpO2.

The presence of comorbidity was statistically significantly different between patients who were discharged or hospitalized at a ward and the patients who were hospitalized at ICU (p=0.007). 71.4% of the patients without comorbidity were mildly ill (discharged or hospitalized at a ward) while this ratio was 58.1% in patients with comorbidity. Severe dyspnea (exitus, hospitalization at intensive care unit) was found in 41.9% of the patients with comorbidity and in 28.6% of the patients without comorbidity.

No statistically significant difference could be found in OCS-9 scores after the categorization of the patients according to risk groups (<50 years, 50-70 years, and >70 years) but there were significant differences between age groups and severe dyspnea (present-absent), comorbidity (present-absent), or final outcomes. (Fisher's-Exact p<0.05) In the presence of comorbidity, the severity of dyspnea and hospitalization of the patients increased. (Table 6).

Post-Hoc binary comparisons revealed significant differences between patients who were hospitalized at a

Table 3 Patient distribution according to OCS-9 classification

		Patients	%
pH	<7.10	1	0.3
	7.10 – 7.20	5	1.3
	7.20 – 7.30	19	5.1
	7.30 – 7.40	61	16.4
	7.40 – 7.50	221	59.2
	7.50 – 7.60	63	16.9
	>7.60	3	0.8
Base	0 – 5	258	69.2
	5 – 10	82	22.0
	10 - 15	27	7.2
	>15	6	1.6
Lactate	0 – 2	254	68.1
	2 – 3	65	17.4
	3 – 4	23	6.2
	>4	31	8.3

Table 4 Comparison of OCS-9 Scores According to the Severity of Dyspnea

Severe dyspnea	Severe Dyspnea Negative (n) Mean±SD Med. (Min-Max)	Severe Dyspnea Positive (n) Mean±SD Med. (Min-Max)	p
OCS-9 Score	(236) 1,02±1,3 1 (0-8)	(137) 1,59±1,5 1 (0-6)	**<0.001**[1]

[1]Mann-Whitney U p<**0.001**

Table 5 Comparison of OCS-9 According to the Decision for Hospitalization or Discharge

	Ward (n) Mean±SD Med ((Min-Max)	ICU (n) Mean±SD Med (Min-Max)	Discharge (n) Mean±SD Med (Min-Max)	p
OCS-9	(183) 0,99±1,2 1 (0-5)	(132) 1,69±1,7 1 (0-8)	(57) 0,9±1,1 1 (0-5)	**<0.001**[1]

Kruskall Wallis H test[1]

Table 6 Comparison of OCS-9, Dyspnea Status, Comorbidity and Outcome Parameters by Age

Age		<50 (n) Mean±SD Median (Min-Max)		50-70 (n) Mean±SD Median (Min-Max)		>70 (n) Mean±SD Median (Min-Max)		p
OCS-9 Score		(44) 0,86±1,2 0 (0-5)		(140) 1,37±1,5 1 (0-8)		(189) 1,2±1,4 1 (0-6)		0.086[1]
		<50 N (%)		**50-70 N (%)**		**>70 N (%)**		**p**
Severe dyspnea	**No**	35	79.5	89	63.6	112	59.3	**0.042***
	Yes	9	20.5	51	36.4	77	40.7	
Comorbidity	**No**	39	88.6	63	45.0	73	38.6	**<0.001***
	Yes	5	11.4	77	55.0	116	61.4	
Result	**Discharge+ hospitalization at ward**	35	79.5	92	65.7	113	59.8	**0.044***
	Exitus+ Intensive care unit	9	20.5	48	34.3	76	40.2	

Kruskal Wallis p[1], Fisher'sExact p*

Table 7 Post-hoc binary comparisons

Post-Hoc Binary Comparisons	Ward vs. Intensive Care Unit	Ward vs. Discharge	Discharge vs. Intensive Care Unit
Age	0.007	0.218	0.371
SBP	0.018	0.214	0.013
DBP	0.003	0.173	0.004
Pulse rate	0.001	0.139	0.001
Respiration rate	<0.001	0.038	<0.001
SpO_2	<0.001	0.238	<0.001
pH	<0.001	0.374	<0.001
PO_2	<0.001	0.105	<0.001
HCO_3	0.022	0.509	0.028
Laktat	0.027	0.258	0.008

Mann-Whitney U p

ward or at an ICU according to age, DBP, pulse rate, breath rate, SpO2 and pH (Mann-Whitney U, p<0.016, Bonferroni correction). Significant differences were detected between discharged patients and patients hospitalized at an ICU according to SBP, DBP, pulse rate, respiration rate, SpO2, pH, PO2, and lactate (Mann-Whitney U-p<0,016 Bonferroni correction) (Table 7).

Discussion

Dyspnea is one of the most serious and frequent causes of patients coming to the emergency department. (10). It is a serious symptom seen in half of the patients admitted to tertiary health care facilities and in one-fourth of the outpatients (2). Most of the patients with respiratory distress admit to emergency services. Therefore, emergency department physicians have an important place and responsibility in the initial evaluation and treatment of critical patients. The prognosis of patients who are transferred to an intensive care unit (ICU) from the emergency department is better than patients who are transferred to an ICU after hospitalization at a ward (11). Timely transfer to an ICU is dependent on effective triage.

There are various cardiopulmonary and non-cardiopulmonary pathologies causing dyspnea. In the emergency department, scoring systems are needed to predict the severity of patient's situation, to make a diagnosis, to measure diagnostic and therapeutic efforts, to perform triage and to make a treatment choice. The clinical scales used in the evaluation of dyspnea aim to determine the severity of respiratory insufficiency (12). It is emphasized in the literature that measurement of the degree of dyspnea as well as determining the cause of dyspnea are important (13, 14, 15). The use of these scales in clinical practice ensures the correct definition of dyspnea severity. This plays important roles in the accurate diagnosis of the disease and in the planning of both medical treatment and pulmonary rehabilitation practices.

Visual Analog Scale (VAS), Oxygen Consumption Diagram (OCD), Modified Borg Scale (MBS), Verbal Rating Scales (VRS), Basal Dyspnea Index (BDI)/ Transitory Dyspnea Index (TDI), and Medical Research Council Scale (MRCS) are used as dyspnea scales in clinical practice. In this study, we evaluated the effectiveness of OCS-9 score to determine the clinical severity of patients who present to emergency department with dyspnea. We used three important parameters in blood gas (pH, base deficiency, and lactate level) to calculate OCS-9 scores of the patients who presented with dyspnea.

Especially pH shifts are a sign of a serious disease underlying dyspnea (16). Base deficit is a valuable indicator of metabolic compensation (17, 18). Lactate level shows mainly anaerobic metabolism. They are guiding parameters in determining the severity of dyspnea.

In our study, when we compared OCS-9 score and clinical parameters of patients according to comorbid diseases (yes/no), we found statistically significant

differences in terms of age, SBP, DBP, pH, PCO2, HCO3, and base deficit. The mean age, SBP, DBP, pCO2, pH, and base deficit values of the patients with comorbidity were higher than the patients without comorbidity while their mean SpO2, pH, PO2, HCO3, and lactate levels were lower. In patients who have shortness of breath, change in breath pattern and underlying pathophysiological mechanisms may disturb arterial blood gas parameters while comorbidities, especially cardiac pathologies, are predicted to affect this change. Burri et al evaluated the effect of arterial blood gas in patients who presented with acute dyspnea and found that the presence of 2 or more reasons as causes of dyspnea together with low pH predicted 12 month mortality (19).

Dyspnea can be expressed as the patients' feelings of breathing discomfort. It is a subjective symptom and changes from patient to patient. OCS-9 score is an objective system to evaluate patient status.(20)

Gondos et al calculated OCS-9 and OCS-13 scores in their study with 350 patients. They demonstrated a strong relationship between the initial clinical findings of the patients and OCS-9 scores. They evaluated dyspnea with the Dyspnea Severity Score (DSS) and found significant relationships with OCS-9 in all parameters (20). Burri et al evaluated functional parameters in patients with acute dyspnea using the NHYA classification and couldn't find a significant relationship between the pH value and dyspnea evaluation (19). The findings we have found with OCS-9 score supported the results of Gondos et al study. Gondos showed that respiratory pathologies are the most common causes of dyspnea at first admission. Again, the follow up demonstrated that pulmonary problems were more common (20). In our patient group, COPD was in the first place and cardiac causes were second in the rank. The proportion of patients with no known diagnosis was 48%. The presence of a high proportion of undiagnosed patients at presentation may have partially affected the results of our study. Nevertheless, the findings suggest that OCS-9 score can be used as an early assessment parameter in patients with pulmonary disease.

Comparison of patients with bad outcomes (exitus and hospitalization at ICU) and good outcomes (discharge and hospitalization at a ward) according to OCS-9 cut-off value revealed significant results. When OCS-9 cut-off value was accepted as "1", its sensitivity for the prediction of exitus and intensive care unit stay was 46.9% and its specificity was 77.08%. Gondos et al took cut-off value for OCS-9 as 4 and found 89% specificity and 64% sensitivity for dyspnea evaluation. When they took the cut-off value as 8, they found sensitivity as 100% and specificity as 99% and they suggested 4 as the appropriate cut-off value. In accordance with our study, they reported that the OCS-9 score was important for early follow-up treatment (20). We found that our OCS-9 score parameters were not enough to take the cut-off value as 4. This result was a limitation of our study.

Similarly, OCS-9 value was significant when we compared patients according to their outcomes as exitus, hospitalization at ICU, hospitalization at ward or discharge. In their observational study, Burri et al investigated the value of arterial blood gas analysis in 530 patients who admitted to the emergency department with dyspnea and found that patients with low pH values were more commonly hospitalized at ICU. At the same time, they found high hospital mortality and 30-day and 12-month mortalities (19). Similarly, there was a significant difference in pH between the patients admitted to the intensive care unit and the patients admitted to the service.

When oxygen saturation was assessed with post-hoc analysis a significant difference was found between patients who were hospitalized at an ICU or at a regular hospital ward. A study by Guryay et al demonstrated that ICU requirement increased in patients whose oxygen saturation is lower than 88% (21).

The rate of comorbidity, the severity of dyspnea, and the rate of hospitalization of the patients increased with increasing age. These data suggest that OCS-9 score may be used as a parameter that provides early data to illustrate the clinical course of patients over 50 years of age.

Limitations

The main limitation of our study was distribution of patient groups. Definition of cardiac or pulmonary causes and according to more spesific diseases would be more effective for comparison of outcomes.

In conclusion, we suggest that the OCS-9 score may be used as a method to help predict clinical outcomes and short term prognosis in patients presenting to the emergency room with dyspnea.

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