ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Assessment of Dyspnea in Acute Heart Failure Patients with Three Scales in the Emergency Department

Acil Serviste Akut Kalp Yetmezliği Hastalarında Nefes Darlığının Üç Skala ile Değerlendirilmesi

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ABSTRACT

Aim: This study aimed to compare the three dyspnea scales (Likert, VAS, and NRS) in patients with acute heart failure (AHF) in the emergency department (ED).

Material and Methods: This study enrolled 114 patients prospectively diagnosed with AHF in the ED. We assessed the dyspnea scales for severity at admission and the 4th hour. We used the Likert scale, Visual Analogue Scale (VAS), and the Numerical Rating Scale (NRS).

Results: Sixty-five patients were women. The mean age of the patients was 72.1 ±11.7 years. 74.1% of the patients whose dyspnea was relieved were discharged. Seventy-seven of the patients were discharged from ED, while 37 were hospitalized, and 51.7% of the hospitalized patients had no improvement in dyspnea. The severity of dyspnea decreased after the treatment on each scale ($p< 0.05$). The 4th-hour scores were lower for all three scales ($p< 0.01$), but VAS and NRS scores on the 4th hour were higher in hospitalized patients than in discharged ($p< 0.01$). There was a similarly significant relationship between the admission and 4th hour of dyspnea scales ($p<0.001$).

Conclusion: Dyspnea scales are compatible with dyspnea and clinical relief in patients with AHF in the ED, whereas improvement in dyspnea is insufficient to decide whether the patient should be hospitalized or discharged.

Keywords: Emergency department, heart failure, shortness of breath, dyspnea scales

ÖZ

Amaç: Bu çalışmada, acil serviste (AS) akut kalp yetmezliği (AHF) olan hastalarda üç dispne ölçeğini (Likert, VAS ve NRS) karşılaştırmayı amaçladık.

Gereç ve Yöntemler: Acil serviste AHF tanısı konan hastalarda prospektif olarak yapılan bu çalışmaya toplam 114 hasta dahil edildi. Başvuru sırasında ve 4. saatte dispne skalaları dispne şiddeti açısından değerlendi. Likert, Visual Analog Skala (VAS) ve Sayısal Derecelendirme Ölçeği (SDÖ) kullandı.

Bulgular: Çalışmaya katılan hastaların altmış beşi kadındı. Hastaların ortalama yaşı 72.1 ±11.7 yıl idi. Nefes darlığı düzelen hastaların %74,1'i taburcu edildi. Hastaların 77'si acil servisten taburcu edilirken 37'si hastaneye yatırıldı ve yatan hastaların %51,7'sinde nefes darlığında düzelme olmadı. Her skalada tedaviden sonra dispne şiddeti azaldı ($p<0.05$). Dördüncü saat skorları her üç ölçek için düşüktü ($p<0.01$), ancak hastanede yatan hastalarda 4. saat VAS ve NRS skorları taburcu olana göre daha yüksekti ($p<0.01$). Dispne skalalarının başvuru ve 4. saatinde de benzer anlamlı doğrusal ilişki bulundu ($p<0.001$).

Sonuç: Acil serviste AKY olan hastalarda dispne skalaları nefes darlığında düzelme ve klinik rahatlama ile uyumludur, buna karşın nefes darlığındaki düzelme hastaların hastaneye yatırılması mı yoksa taburcu edilmesi mi gerektiğine karar vermek için yetersizdir.

Anahtar Kelimeler: Acil servis, kalp yetmezliği, nefes darlığı, dispne skalaları

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Introduction

The most frequent symptom of urgently hospitalized patients with acute heart failure (AHF) is dyspnea, a significant stress factor. Although dyspnea is not a symptom-specific to HF, the severity of dyspnea may vary over time (1,2). The severity of dyspnea is a relative concept for the patient and the physician (3). Despite the development of scales to measure dyspnea severity, studies have been used to measure the severity of dyspnea in asthma and chronic obstructive pulmonary disease (COPD) (4,5). Few studies on scales measure the severity of dyspnea in AHF (1,2,6). However, in several studies, VAS and Likert scales were used to measure the severity of dyspnea in the early period of ED admission (1,3).

This study aimed to compare the three dyspnea scales (Likert, VAS, and NRS) in patients with acute heart failure.

Material and Methods:

Study design

This prospective observational study aimed to investigate the dyspnea scales in patients with AHF who applied to Mersin University Research and Practice Hospital ED between 01.08.2015 - 01.08.2016. The study was approved by the Mersin University Medical Faculty Ethics Committee on 25.06.2015 (Approval no. 2015/211). The informed consent form was obtained from all patients. Patients who wanted to leave the study and died in the emergency room were excluded from the study. When the Likert, VAS, and NRS dyspnea severity scales were applied, it was estimated that a 0.30 difference between the admission and 4th hours was considered clinically significant.

A case form was used to record all the parameters for this study. Emergency medicine physician assistants (EMPA) were informed about this case form and the research. Standardization was provided to collect and record data, and the EMPAs collected all data. Reasons for dyspnea included pneumonia, sepsis, renal failure, and spontaneous/traumatic pneumothorax excluded. In addition, patients with non-invasive positive pressure ventilation, patients with invasive ventilation, patients with positive inotropic agents, patients with altered consciousness, decreased visual acuity, and physical abnormalities that prevent their scoring were excluded.

Demographic and clinical parameters

Age, gender, vital signs on admission (systolic and diastolic blood pressures (SBP and DBP), heart rate (HR), heart rhythm, pulse oximetry (SpO2), and respiratory rate (RR)), ECG, laboratory tests on admission (complete blood count, renal function tests, liver function tests, electrolytes, and blood sugar) were recorded.

Patients were assessed for dyspnea with dyspnea scales (VAS, NRS, 5-point Likert) at the admission and the 4th hour. Vital signs of patients, blood gases, cardiac enzyme [conventional troponin (Tn-T)], and NT-proBNP were monitored during the admission and 4th hours. Adequate standard AHF therapy (positioning, O2, iv diuretic, vasodilator therapy) was given to patients.

Use of dyspnea scales (Likert, VAS, and NRS)

Patients in this study were asked to grade dyspnea with three scales (VAS, NRS, and Likert scales) at admission and the 4th hour after appropriate standard treatment.

Likert scale: A 5-point Likert scale is 1 point refers to the absence of dyspnea; 2,3,4,5 points defined mild, medium, serious, and severe dyspnea, respectively (1)

VAS scale: On this scale, the straight line representing 100 mm was divided into ten equal parts with 1 cm intervals and 0 to 10. The patients were informed: "Show me the level of breathlessness on the ruler: 0 indicates no breathing disturbance, 10 indicates the worst breathing that you can imagine," The patients were asked to rate their shortness of breath (7).

NRS scale: It was stated that a number should express the severity of dyspnea from 0 to 10. It was noted that 0 defined that the patient did not have shortness of breath, and 10 represented the worst shortness of breath that the patient could imagine (8).

After HF treatment, the severity and state of dyspnea (improved and not improved) were evaluated. The severity of dyspnea was compared between the admission and 4th hours. Improvement of dyspnea was defined according to the Likert scale. Those who regressed to severity 1 and 2 were noted as " improved," whereas those 3, 4, and 5 were defined as "not improved." In VAS scales, for dyspnea improvement, 50 points and over were described as "not improved, <50 points were noted as "improved," whereas 5 points and over on the NRS scale was defined as ''not-improved" and <5 points were stated as ''improved".

Statistical Analysis

The normality of continuous variables was tested with the Shapiro Wilk test. Student t-test and Mann Whitney U test were used for differences between two groups of continuous variables. Paired t-test and Wilcoxon Signed Rank tests were used for differences between admission and 4th-hour measurements. Mean and standard deviation values for normal distributions as the descriptive statistics and minimum, maximum, median, and 25-75% values for the data with no normal distribution were calculated. The relationship between continuous measurements, Pearson and Spearman correlation coefficients was calculated. Differences between categorical variables and groups were tested with Pearson chi-square and Exact chi-square tests. Numerical and percentage values are given as descriptive statistics, and statistical significance was taken as $p < 0.05$. Statistical analyses were done using SPSS 21 software demo (SPSS Inc., NY, USA).

Results

A total of 114 AHF patients aged 18 years and older who came to the ED with shortness of breath were included in the study.

The mean age of the patients was 72.1 ±11.7 years. 57% (n=65) of the patients participating in the study were women. 32.5% (n=37) of the patients were hospitalized.

Time course of clinical features and dyspnea scales

The heart rate (HR) at the admission was 89.84 ±21.53 for patients discharged; 93.27 ±19.37 for hospitalized patients. HR at 4th hours was 80.19 ±14.65 in the patients discharged and 89.68 ±16.94 in the hospitalized patients. HR values were significantly lower in patients discharged at the admission and 4th hours than in hospitalized patients ($p = 0.0039$ and $p = 0.001$).

Parameters	At admission	4th hour	p
	Median [% 25-75]	Median [% 25-75]	
Likert	5 [4-5]	2 [1-3]	<0.001
VAS	90 [80-100]	30 [0-50]	<0.001
NRS	9 [8-10]	3 [0-5]	<0.001
RR /minute	26 [24-30]	23.5 [20-25]	<0.001
SpO_2 (%)	90 [85-94]	94 [90-96]	<0.001
Tn-T (ng/mL)	0.028 [0.02-0.054]	0.03 [0.02-0.08]	0.002
NT-proBNP (pg/mL)	3160 [1327.75-8780]	4070.5 [1452.5-9928]	<0.001
pH	7.40 [7.35-7.43]	7.41 [7.37-7.45]	0.001
BE (mmol/L)	-0.7 [-3.9-2.3]	0.55 [-2.2-2.33]	0.002
	Mean ± SD	Mean ± SD	
SBP (mmHg)	150.94 ± 30.81	128.78 ± 19.71	<0.001
DBP (mmHg)	87.99 ± 20.27	75.30 ± 13.45	<0.001
HR /minute	90.96 ± 20.83	83.27 ± 15.99	<0.001
PO_2 (mmHg)	63.05 ± 11.80	70.68 ± 12.06	<0.001
PCO_2 (mmHg)	38.28 ± 8.13	37.46 ± 6.53	0.204
HCO_3 (mmol/L)	23.12 ± 4.23	23.61 ± 3.75	0.146
SaO_2 (%)	89.40 ± 6.13	93.43 ± 3.54	<0.001

Data are presented as median ([% 25-75 percent]) or Mean ±SD
Abbreviations: RR: respiratory rate, SPO_2: pulse oximetry, Tn-T: Troponin T: pro-BNP: pro-brain natriuretic peptide, VAS: Visual analog scale, NRS: numerical assessment scale, BE: Base excess, SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate, PO_2: partial pressure of oxygen, PCO_2: partial pressure of carbon dioxide, HCO_3: bicarbonate: SaO_2: oxygen saturation

Table 1. Distribution of dyspnea scales and clinical parameters at admission and 4th hour

SaO2 mean values at the admission were 90.94 ±5.17 for patients discharged and 86.21 ±6.80 for inpatients; the mean values at 4th hours were 94,24 ±2,84 in patients with discharge; 91,73 ±4,23 in hospitalized patients. SaO2 value was lower in hospitalized patients at admission and 4th hours (p = 0.001 and p = 0.002) (Table 1). pH, base excess (BE), partial oxygen pressure (PO2), and oxygen saturation (SaO2), SpO2, Tn-T, and NT-proBNP were higher at the 4th hour than at the admission (p values < 0,05). RR, Likert, VAS, NRS, SBP, DBP, and HR parameters were lower at the 4th hour (p values < 0,05).

The changes in the clinical parameters of the patients for time are shown in Table 1.

Dispne scales, state of dyspnea, and clinical features related to hospital admission and discharge

The median values for VAS and NRS at the 4th hour were significantly higher in hospitalized patients. According to this, for the Likert scale, VAS, and NRS, both the discharged and hospitalized patients had lower scores in the 4th hour, and this decrease was statistically significant (p <0.001) (Table 2).

Each scale was evaluated by itself and others to determine if the patient's dyspnea had improved. According to the Likert scale, 71.1% (n = 81) of the patients improved their dyspnea. For VAS and NRS scales, the improvement in dyspnea was 74.6% (n = 85) (Table 3).

When the correlations of the parameters observed at the 4th hour with NT-proBNP and dyspnea scales were examined, there was a linear relationship between SS and NT-proBNP and Likert scale measurements; and between HR and Likert, VAS, and NRS dyspnea scales. There is a linear relationship between NT-proBNP and NRS, between Tn-T and NT-proBNP, between VAS and NRS, and between Likert and VAS and NRS (Table 4).

Discussion

In this study, in patients with AHF in the ED, we found that using these scales successfully evaluated the improvement of dyspnea in patients. Still, it was not enough to decide whether patients should be discharged or hospitalized.

Scales for measuring the severity of dyspnea have been developed to evaluate this subjective complaint more objectively. Because a single dyspnea scale cannot reflect the severity of dyspnea, it is recommended that several dyspnea scales be used together (1). The timing of assessing the severity of dyspnea is essential, and earlier treatment has been associated with a further reduction in the severity of dyspnea (2,6,9).

Early enrollment can lead to difficulty expressing patients' severity of dyspnea in severe respiratory distress. Mebazaa and colleagues (2) assessed the effects of early standard care in patients with AHF-induced dyspnea with dyspnea scales (5-point Likert, 7-point Likert, and VAS) at 1 and 6 hours. According to this study, the 5-point Likert scale scored 2 for dyspnea on admission and 5 for VAS. In the 6-hour Likert score, fewer patients reported severe and very severe dyspnea, and VAS scores were regressed to 3.5. In our study, the median value of the Likert scale was 5, the VAS median value was 90, and the NRS median value was 9. After treatment, the Likert score at the 4th hour had a median value of 2, the VAS score was 30, and the NRS score regressed to 3. According to Likert, VAS, and NRS scales, it was observed that most of the patients had very severe breathing difficulty at the time of admission, while the shortness of breath mainly was decreased at 4 hours after in the ED.

Past studies have shown that VAS better captures changes in respiratory distress according to the Likert-type scales (2,10,11). In Pang et al.'s (1) research, the improvement in dyspnea according to both VAS and 5-point Likert was associated with baseline severity of dyspnea. Allen et al. (11), with the 7-Likert and VAS scales, the progress of dyspnea was observed daily during AHF patients' hospitalization period. This study included patients with AHF, as in our study. According to the same study, in the measurements of the Likert scale, statistically significant

Scales	Hospitalized			Discharge		
	At admission	4th hour	p	At admission	4th hour	p
Likert	5 [4-5]	2 [2-3]	<0.001	5 [4-5]	2 [1-2]	**<0.001**
VAS	100 [80-100]	40 [10-70]	<0.001	90 [70-100]	20 [0-40]	**<0.001**
NRS	10 [8-10]	4 [1.5-7]	<0.001	9 [7-10]	2 [0-4]	**<0.001**

Data are presented as median ([% 25-75 percent]). NRS: Numerical Rating Scale, VAS: Visual Analog Scale

Table 2. Dyspnea scales between admission and 4th hour among discharged and hospitalized patients

improvement was detected at the beginning (admission and 2nd day). On the contrary, according to VAS, more improvement in dyspnea was observed day by day, and this improvement was statistically significant between days 2 and 7 (11).

In a prospective cohort study by Placido et al. (12), which examined the ED patients who complained of shortness of breath with or without AHF, the median severity of dyspnea severity score at admission was the same for both VAS and NRS. The correlation between NRS and VAS scores was similar (r = 0.810) in patients without AHF (r = 0.788)(12). In our results, the median values for both VAS and NRS were the same in AHF patients. And we found VAS and NRS dyspnea scales are compatible in evaluating the severity of dyspnea.

According to our hypothesis, there was an increase in SpO2, PO2, SaO2, pH, and BE levels and decreased RR, SBP, DBP, HR, Likert, VAS, and NRS levels after treatment of our patients. Our findings are consistent with our hypothesis.

A large study found that initial fatigue and dyspnea levels were associated with cardiovascular death or the length of stay in an HF-related hospital (13). In our research, hospitalized patients' VAS and NRS 4th hour values are higher than discharged patients. Our study shows that 78% of those discharged improved dyspnea, and 74% of those whose dyspnea improved were discharged.

In a prospective observational ten-year cohort study by Llorens et al. (14), the rate of discharge of 13971 ED patients was 24.9%. In our results, 67.5% of the patients were discharged from ED. Several reasons may cause the big difference, such as the data collection time, patient number, and clinical characteristics (15).

Limitations

There are many restrictions in this study. First of all, it is single-centered, and the number of patients is small. In addition, the absence of data on the drug use history of HF is also a limitation. Assessment of dyspnea status at the 4th hour after treatment in patients referred to the ED with shortness of breath may not be a sufficient response to treatment. The lack of physical examination findings of the patients enrolled in the study and the lack of medical treatment data (need for intravenous diuretics or intravenous nitrates) they received had led us not to determine the factors that affected the state of dyspnea thoroughly. The fact that patients do not have hospitalization and mortality data within 30 days decreases the power of this study. Since the patient defines the severity of dyspnea, these scales alone may be misleading in determining the significance of dyspnea medically.

Conclusion

As a result, evaluation of improvement in dyspnea in AHF patients who present with shortness of breath in ED by dyspnea severity scaled is compatible with the clinical relief of the patient. The use of dyspnea scales in patients with AHF who have complaints of shortness of breath in the ED may guide physicians in evaluating the general condition of patients.

Scales	Status	n (%)	Discharge n (%)	Hospitalized n (%)	p
Likert	**Not improved**	33 (28.9)	17 (22.1)	16 (43.2)	**0.020**
	Improved	81 (71.1)	60 (77.9)	21 (56.8)	
VAS	**Not improved**	29 (25.4)	14 (18.2)	15 (40.5)	**0.010**
	Improved	85 (74.6)	63 (81.8)	22 (59.5)	
NRS	**Not improved**	29 (25.4)	14 (18.2)	15 (40.5)	**0.010**
	Improved	85 (74.6)	63 (81.8)	22 (59.5)	

NRS: Numerical Assessment Scale, VAS: visual analog scale

Table 3. Dyspnea status to hospitalization and discharge according to dyspnea scales

Correlation of parameters measured at admission with dyspnea scales				
Parameters		**Likert**	**VAS**	**NRS**
Likert	r		0.833	0.833
	p		<0.001	<0.001
VAS	r			1.000
	p			<0.001
SBP (mmHg)	r	0.205	0.144	0.144
	p	0.028	0.127	0.127
DBP (mmHg)	r	0.264	0.170	0.170
	p	0.005	0.070	0.070
RR/minute	r	0.254	0.209	0.209
	p	0.006	0.026	0.026
HR/minute	r	0.131	0.081	0.081
	p	0.165	0.391	0.391
SpO_2 (%)	r	-0.166	-0.219	-0.219
	p	0.077	0.019	0.019
Tn-T (ng/mL)	r	0.059	0.095	0.095
	p	0.532	0.315	0.315
NT-proBNP (pg/mL)	r	0.245	0.167	0.167
	p	0.009	0.076	0.076
Correlation of parameters measured at 4th hour with dyspnea scales				
Likert	r		0.893	0.89
	p		<0.001	<0.001
VAS	r			0.997
	P			<0.001
SBP (mmHg)	r	0.017	0.013	0.015
	p	0.855	0.891	0.876
DBP (mmHg)	r	0.117	0.109	0.109
	p	0.217	0.249	0.25
RR/minute[a]	r	0.258	0.16	0.159
	p	0.005	0.09	0.092
HR/minute[a]	r	0.195	0.206	0.201
	p	0.038	0.028	0.032
SpO2 (%)	r	-0.07	-0.071	-0.074
	p	0.46	0.452	0.436
Tn-T (ng/mL)	r	0.169	0.266	0.273
	p	0.073	0.004	0.003
NT-proBNP (pg/mL)	r	0.15	0.181	0.187
	p	0.11	0.054	0.046

Abbreviations: RR: respiratory rate, SpO_2: pulse oximetry, Tn-T: Troponin T: PRO-BNP: pro-brain natriuretic peptide, VAS, Visual analog scale, SBP: systolic blood pressure; NRS: numerical assessment scale, DBP: diastolic blood pressure; HR: heart rate, r: correlation coefficient

Table 4. Correlations of the parameters measured at admission and 4th hour with dyspnea scales

However, assessment with dyspnea scales alone is insufficient to decide whether the patient should be hospitalized or discharged. Therefore, AHF patients should be hospitalized according to their clinical characteristics, other findings of congestion, and comorbidities, together with the severity of dyspnea.

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