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Relationship Between Clinical Diagnosis, Value, And Duration of Oxygen Saturation And Gas Blood Analysis With Outcomesof Acute Heart Failure Patients

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Abstract: *This paper is to determine the relationship between clinical diagnosis, oxygen saturation value and duration and blood gas analysis with outcomes of acute heart failure patients and know the suitability of oxygen saturation value using a pulseoximeter compared with oxygen value from blood gas analysis examination. An observational analytic study of 41 research samples at the Saiful Anwar Hospital GII, Indonesia,was carried out to analyze the relationship between clinical diagnosis, oxygen saturation value and duration and blood gas analysis with outcomes of acute heart failure patients. The research showed a significant association (p <0.05) between clinical diagnosis, oxygen saturation value and duration as well as blood gas analysis with outcomes of acute heart failure patients with oxygen therapy and standard medication in this study outcomes of all living patients. Interpreting a pulseoximeter oxygen saturation value more wisely means not to merely look at the value but also to pay attention to the diagnosis seen from the patients' clinical condition.*

Keywords*: heart failure, clinical diagnosis, duration, oxygen saturation, blood gas analysis*

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I. Introduction

Heart failure is one of the cardiovascular diseases significantly increased in the community; it is the main cause of decreased quality of life and sudden death. Decompensated heart failure is the most common cause of hospital admission and reentry within 60 days after discharge (Fonarow, 2007). Emergency Room is the main entry of acute heart failure patients, with the rate of entry about 80%. This causes high health costs for outpatients, hospitalization, and re-admission (Bui, 2011).Patients with acute heart failure coming to the ER will usually be hospitalized (Heidenreich, 2013). In the elderly population, survival rates from acute myocardial infarction, and based on research on treatment options for outpatients, the prevalence of heart failure is confirmed to increase over the next decade (Yancy, 2013).All patients with signs of acute and decompensated heart failure will experience hypoxia and require high-pressure oxygen using a face mask, if a spontaneous breathing is found and oxygen saturation values measured by a pulseoximeter (SpO2) is below 90%. At the time patients coming to the ER, triage will be done by measuring vital signs such as blood pressure, a pulse rate, a breath rate, and oxygen saturation. A pulseoximeter used is quite accurate when compared with a blood gas analysis. The figure 92% ofsaturation can illustrate that arterial saturation is more than 92%. However, oxygen saturation values between 88% and 92% do not necessarily indicate normal arterial saturation and may be measurably different from arterial oxygen saturation. A pulseoximeter may show much higher saturation when arterial saturation is below 80% to 90%, and therefore a pulseoximeter measurements that show normal values should be interpreted with caution (Wilson 2010, Ross, 2014). Carbon monoxide may also cause hemoglobin to form a saturation state and will cause an improper increase in saturation measurements using a pulseoximeter (Bozeman, 1997).Although clinically useful, a pulseoximeter cannot indicate the presence of partial oxygen pressures in the arterial blood, which, in combination with the total hemoglobin content, is the primary determinant of oxygen delivery to the periphery. Notably, the arterial oxygen content drops dramatically as oxygen saturation drops below 92% (Lee, 2000).

II. Method

2.1Patients

A total of 41 research samples, i.e. patients with shortness of breath belonging to triage P1 or P2 who experience acute heart failure, are measured for their oxygen saturation value by a pulseoximeter and laboratory examination of blood gas, before and after given an oxygen therapy and standard medicine.

2.2 Design

This is an analytical observational study to analyze the relationship between clinical diagnosis, the value and duration of oxygen saturation, and the blood gas analysis with outcomes of acute heart failure patients. The study also aims to determine the suitability of oxygen saturation values using a pulseoximeter compared with oxygen values from a blood gas analysis.

The study has been approved by Saiful Anwar Hospital Ethics Committee of Malang and is conducted at the Emergency Room of Saiful Anwar General Hospital Malang. Research samples include patients with chronic acute decompensated heart failure (ADHF), age above 40 years, and get standard treatment. Exclusion criteria include cardiac arrest or interruption of breath on arrival, undiagnosed previous heart failure, and failure in the interpretation of the results of thelaboratory blood-gas analysis.

2.3 Data Collection

All patients with acute heart failure coming to the ER of the hospital will go through the triage and then anamnesis is done related to when symptoms are felt, inspection awareness, blood pressure, heart rate, respiration rate, and saturation value using a pulseoximeter. Then the patients will be given treatment with the administration of oxygen, standard drugs, and laboratory examination of blood gas. After 2 (two) hours, the oxygen saturation value will be measured and a repetition of blood gas examination is done after giving the oxygen therapy and standard medicine.

III. Data Analysis

Statistical significance is assessed using a 95% confidence level. The value of the clinical diagnosis, the value and duration of oxygen saturation as well as the analysis of blood gases with the outcomes before and after the standard oxygen therapy and standard medicine are presented in the form of mean±SD values, maximum-minimum values.

IV. Results

Table 1. Frequency Distribution of Patients by **Sex**

Sex	**n**	**%**
Male	25	61
Female	16	39
Total	41	100

Table 1 shows the population consists of 25 male (61%) and 16 female (39%).

Table 2. Frequency Distribution of Patients Based on the Clinical Diagnosis

Classification of NYHA	**n**	**%**
Class 1	0	0
Class 2	18	43.9
Class 3	20	48.8
Class 4	3	7.3
Total	41	100

The table above shows patients coming to the ER with acute heart failure using. The Framingham diagnostic criteria are used to classify patients with chronic heart failure based on the New York Heart Association, i.e. the New York Association Functional Classes (NYHA), Class 1 to 4. The table illustrates that patients coming to the ER with shortness of breath according to the NYHA classification are mostly from Class 3 as many as 20 people (48.8%) and the least are from Class 4 with the most severe complaints of 3 people (7.3%).

Table 3. Distribution of Saturation and PaO2 before and after the Standard Therapy

Variable	**n(41)**	**%**
Saturation before the oxygen delivery and the standard therapy		
Good	23	56.1
Medium	17	41.5
Poor	1	2.4
Saturation afterthe oxygen delivery and the standard therapy		
Good	40	97.6
Medium	1	2.4

Poor	0	0

PaO2 BGA before the oxygen delivery and the standard therapy

Good	21	51.2
Medium	15	36.6
Poor	5	12.2
PaO2 BGA afterthe oxygen delivery and the standard therapy		
Good	39	95.1
Medium	2	4.9
Poor	0	0

Note:

Oxygen saturation measured with a pulse oximeter (%): Good = 93-100, Medium = 75-92, Poor<75 PaO2 measured by blood gas analysis (mmHg): Good => 80, Medium = 60-80, Poor<6The table showed that 41 patients came with shortness of breath and had a history of heart failure—most othem were classified into NYHA Class 3 as many as 20 patients (48.8%) and into Class 4 as many as 3 patients (7.3%). When they came, the oxygen saturation value measured using a pulseoximeter triage was more at 93 to 100% (56.1%).Then at the same time, laboratory examination of blood gas was taken and showed the value of the partial pressure of oxygen (PaO2) mostly was good (> 80 mmHg) as much as 51.2%After resuscitation by the oxygen delivery and standard medicineadministration, the patients' condition improved as evidenced by an increase in oxygen saturation value and the measured partial oxygen pressure value in the blood gas analysisAfter receiving treatment, patients belonging to the good category (saturation 93-100%) were as many as 40 people. As for the measurement of partial oxygen pressure value in the blood gas analysis, after patients given the oxygen therapy and standard medicine, also showed the good category (PaO2> 80mmHg) as many as 39 people (95.1%).

Table 4. Differences in Oxygen Saturation Values Measured by A pulseOximeter and the Oxygen Partial Pressure by the Blood Gas Analysis, and Time

Clinical Characteristics	x ± SD	Median (min-max)	p
Saturation 1	91.15 ± 7.6	93 (55-98)	
			0.000
Saturation 2	98.54 ± 1.7	99 (92-100)	
BGA1	78.52 ± 18.0	81 (21-111)	
			0.000
BGA2	131.94 ± 41.5	123 (61-259)	
Ratio Sat1-BGA1	1.20 ± .23	1.15 (0.87-1.88)	
			0.000
Ratio Sat2-BGA2	.8085 ± .23	0.8 (0.39-1.51)	
Duration Sat1-Sat2	8.07 ± 10.3	4 (2-55)	
			0.000
Duration BGA1-BGA2	188.00 ± 102.6	141 (60-526)	
Delta Saturation	7.39 ± 6.9	5 (2-39)*	-
Delta BGA	53.43 ± 38.3	45 (0.9-178)*	-

Note:

1. Saturation 1: the oxygen saturation value is me asured when the patient arrives by using a pulse oximeter
2. Saturation2: the oxygen saturation value is measured after the patient has received the oxygen therapy and standard drug
3. BGA1: the value of partial oxygen pressure before the patient gets the oxygen therapy and standard drug
4. BGA2: the value of partial oxygen pressure after the patient receives the oxygen therapy and standard drug

*No analysis is done because the units are different (delta saturation uses% whereas delta BGA uses mmHG)

The table illustrates a significant difference in patients with acute heart failure when they first come with shortness of breath before and after the oxygen therapy and standard medicine.

In the comparison of oxygen saturation values measured by a pulse oximeterwhen patients first arrive at the ER and have not received the oxygen therapy or standard medicine, it turns out to have a meaningful relationship meaning there is indeed an increase in the oxygen saturation value after the oxygen delivery. Likewise, the

increase in the value of the partial pressure oxygen on the gas blood analysis after the administration of oxygen and standard medicine also happens.

The ratio of the oxygen saturation value and the oxygen partial pressure of blood gas analysis also showed a significant relationship with the p-value < 0.05 with the ratio after the oxygen therapy and standard drugs. For the duration, it appears that the time required to increase the oxygen saturation value by means of the pulse oximeter is much faster when compared to the time required for the blood gas analysis to determine the increase in the oxygen partial pressure.

Table 5. Relationship of Clinical Diagnosis with Saturation andPaO2 BGA before and after oxygen delivery and standard therapy

Clinical Diagnosis	Before Therapy						After Therapy					
	Saturation 1			BGA1			Saturation 2			BGA2		
	1	2	3	1	2	3	1	2	3	1	2	3
4	1	1	1			3	3			2	1	
3	10	10		9	10	1	20			20		
2	12	6		12	5	1	17	1		17	1	
Total	23	17	1	21	15	5	40	1		39	2	

Table 6. Suitability of Oxygen Saturation Measured using a Pulse Oximeter and the Oxygen Partial Pressure based on the Blood Gas Analysis before the Standard Therapy

Suitability of Saturation 1& BGA1	**N (41)**	**%**	**p**
Good – Good	16	**39,0**	
Medium – Medium	9	**22,0**	**0.157**
Poor – Poor	1	**2,4**	
Good – Medium	6	**14,6**	
Good – Poor	1	**2,4**	
Medium – Good	5	**12,2**	
Medium – Poor	3	**7,3**	

Note:

1. Saturation1: oxygen saturation value measured with a pulse oximeter before treatment: Good = 93-100, Medium = 75-92, Poor = <75
2. BGA1: partial oxygen pressure value before patients get the oxygen therapy and standard medicine: Good => 80, Medium = 60-80, Poor <60

In the table, there is a correspondence between the oxygen saturation value and the BGA value before the patient receives the oxygen therapy and standard medicine (p> 0.05). It is proven that the suitability is 63.4% and the most patients are in a good category. Nevertheless, there is 1 (one) patient belonging to the good category in the oxygen saturation assessment, then it turns out that the oxygen partial pressure value is in the poor category, and so it is necessary to see the patient's clinical condition (see table below).

Note:

1. Saturation1: oxygen saturation value measured with a pulse oximeter (%) before treatment: Good = 93-100, Medium = 75-92, Poor = <75
2. BGA1: partial oxygen pressure value before patients get the oxygen therapy and standard medicine: Good => 80, Medium = 60-80, Poor <60
3. Clinical diagnosis (based on the NYHA classification): Class 1 = no shortness of breath in the regular physical activity, Class 2 = minimum shortness of breath in the regular physical activity, Class 3 = significant shortness of breath in the regular physical activity, Class 4 = shortness of breath at rest

The table indicates that patients with a Class 4clinical diagnosis before receiving the oxygen therapy and standard medicine have the oxygen saturation in the good category (93-100%) based on the pulse oximeter, but the oxygen partial pressure value in the blood gas analysis actually shows the poor category (<60 mmHg). The partial oxygen pressure value from the blood gas analysis is more appropriate to the patients' clinical condition when they first come to the ER because the patients are in an NYHA Class 4 clinical diagnosis.It is therefore important to look at the condition of the patients in accordance with the clinical diagnosis, not only based on the oxygen saturation value alone, as it is derived from the result of blood gas analysis that patients have a poor category of the oxygen partial pressure value.

Table 7. Suitability of Oxygen Saturation Measured using a Pulse Oximeter and the Oxygen Partial Pressure based on the Blood Gas Analysis after the Standard Therapy

Suitability Saturation 2 & BGA2	**N (41)**	**%**	**p**
Good – Good	39	**95,1**	
Medium – Medium	1	**2,4**	**0.317**
Poor – Poor	0	**0**	
Good – Medium	1	**2,4**	
Good – Poor	0	**0**	
Medium – Good	0	**0**	
Medium – Poor	0	**0**	

Note:

1. Saturation1: oxygen saturation value measured with a pulse oximeter before treatment: Good = 93-100, Medium = 75-92, Poor = <75
2. BGA1: partial oxygen pressure value before patients get the oxygen therapy and standard medicine: Good => 80, Medium = 60-80, Poor <60There appears to be suitability between the oxygen saturation value and the BGA value after patients received the oxygen therapy and standard medicine (p> 0.05). It has been proven that the appropriate value is 97.5%, in accordance with the 2 (two) categories of good and medium.

III. ,Discussion And Limitation

This study is according to the inclusion criteria in the ER of Syaiful Anwar General Hospital Malang since November 2017. The subjects consisted of 41 people. They were examined on their oxygen saturation value using a pulse oximeter, the blood gas analysis before and after the oxygen delivery and standard therapy, and the time for the administration of measuring the oxygen saturation value. The outcomes, when the patients were given the oxygen and alive, showed a significant change in the oxygen saturation value as measured by a pulse oximeter and the oxygen partial pressure based on the blood gas analysis in acute heart failure patients before receiving the oxygen therapy and standard medicine.The clinical diagnose on patients who come with shortness of breath using the New York Heart Association classification showed that patients coming were mostly in Class 2 and 3, while those in Class 4 with the most severe complaints were only 3 people. Despite the many variations in classification of patients coming to the ER with acute heart failure, after receiving the oxygen therapy and standard medicine, all patients were alive—meaning 100% live outcomes. Data analysis confirmed that with resuscitation, the patients' condition was improved as evidenced by an increase in the oxygen saturation value and the oxygen partial pressure value.In the subsequent analysis, the data showed a significant relationship, where the probability value (p-value) was smaller than the 0.05 significance value indicating a significant relationship between the oxygen saturation value before and after the standard therapy. Similarly, the relationship of the oxygen partial pressure value based on the blood gas analysis before and after treatment also indicates a significant relationship**.**Data analysis shows suitability between the oxygen saturation value and the oxygen partial pressure value based on the blood gas analysis when patients arrive at the ER. This means that the oxygen saturation value measured by the pulse oximeter is appropriate with the oxygen partial pressure in the blood gas analysis—and this means that the pulse oximeter can be used as a substitute in determining the oxygen value in the blood. After getting the oxygen therapy and standarddrug, most patients were in a good category and the suitability is 63.4%. Nevertheless, there is 1 (one) patient belonging to the good category in the oxygen saturation assessment, then it turns out that the oxygen partial pressure value is in the poor category, and so it is necessary to see the patient's clinical condition.The data analysis shows patients coming with a Class 4 clinical diagnosis before receiving the oxygen therapy and standard medicine, and the measured oxygen saturation values using the pulse oximeter was in the good category (93-100%), yet the oxygen partial pressure value in the blood gas analysis was poor (<60 mmHg). In this case, the oxygen partial pressure value based on the blood gas analysis is more appropriate to the patients' clinical condition because patients were in the Class 4 of NYHA clinical diagnosis. It is always important to look at the clinical diagnosis of the patients, not only examining them based on the oxygen saturation value alone, because it is shown from the blood gas analysis that the patients had a poor oxygen partial pressure value.The next table shows suitability between oxygen saturation value and BGA value after patients get the oxygen therapy and standard medicine (p> 0.05). The suitability is 97.5%, in accordance with the two categories of good and medium.

The results are based on statistical tests done, but some limitations are still found, including the following:

1. The number of samples is small.
2. The number of samples is not the same for each class of NYHA classification of clinical diagnosis of acute heart failure.

IV. Conclusion

1. There Is A Significant Relationship Between The Clinical Diagnosis, the value, and duration of oxygen saturation as well as the blood gas analysis with outcomes of acute heart failure patients treated withthe oxygen therapy and standard medicine; in this study, all patients are alive.
2. There is a significant relationship between the oxygen saturation value measured using a pulse oximeter when compared to the oxygen value in the blood gas analysis examination.
3. We must interpret the oxygen saturation values, measured using the pulse oximeter, more wisely, which means we must not merely looking at the value alone but still having to pay attention to the diagnosis seen from the patients' clinical condition.

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