Posture and Its Effect on Peripheral Oxygen Saturation, and Some Hemodynamic Parameters in Patients with Heart Failure

Kalp Yetersizliği Olan Hastalarda Postürün Periferik Oksijen Saturasyonu ve Bazı Hemodinamik Parametreler Üzerine Etkisi

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ABSTRACT Objective: The purpose of this study was to examine the effect of body positions that chosen by patients for resting on peripheral oxygen saturation, and the relationship between patients' position preferences and the some measured hemodynamic parameters in patients with heart failure. **Material and Methods:** This study was planned as quasi-experimentally. The sample included 50 adult patients with heart failure in Class III-IV according to The New York Heart Association classification. Four different positions were assigned to each patient according to randomized positioning sequence. Each patient remained 20 minutes in each assigned position and then hemodynamic parameters were measured. **Results:** The differences between values of peripheral oxygen saturation, breathing rate, and heart rate were found to be statistically significant. Peripheral oxygen saturation value was found to be 96.94%±2.03 in orthopnea; 95.96%±3.11 in the right lateral position; 95.16%±3.32 in the left lateral position; and 94.98%±3.17 supine. Besides, heart rate and breathing rate had the highest value (81.06±17.9/min-28.60±6.37/min) in orthopnea and the lowest value in the right lateral (77.48±5.20/min-26.45±5.38/min) position. We determined that patient's preferences were right lateral position. **Conclusion:** These results indicated that tissue perfusion could be affected by position changes in heart failure patients and patients' position preferences were associated with heart rate and breathing rate. It is necessary that this situation should be taken into consideration while positioning heart failure patients, and must be supported of position preferences.

Key Words: Heart failure; heart rate; hemodynamics; respiration

ÖZET Amaç: Bu çalışmada, kalp yetersizliği olan hastaların dinlenmek için seçtikleri pozisyonların periferik oksijen saturasyonu üzerine etkisinin ve ölçülen bazı hemodinamik parametreler ile hastaların pozisyon tercihleri arasındaki ilişkinin incelenmesi amaçlandı. **Gereç ve Yöntemler:** Yarı deneysel olarak planlanan çalışmada örnekleme, New York Kalp Derneği Sınıflandırma sistemine göre evre III-IV düzeyinde olan 50 kalp yetersizliği hastası alındı. Hastalara ardışık sıralaması önceden belirlenmiş dört değişik pozisyon sırayla verildi. Hastalar her bir pozisyonda 20 dakika kaldı ve sonrasında hemodinamik parametreler ölçüldü. **Bulgular:** Değişik pozisyonlarda ölçülen oksijen saturasyonu, kalp hızı ve solunum sayısı değerleri arasındaki farkın istatistiksel olarak anlamlı olduğu bulundu. Periferik oksijen saturasyonları ortopne pozisyonunda %96,94±2,03; sağ lateral pozisyonda %95,96±3,11; sol lateral pozisyonda %95,16±3,32 ve supine pozisyonunda %94,98±3,17 olarak bulundu. Bununla birlikte kalp hızı ve solunum sayısının ortopnede yüksek (81,06±17,9/dk-28,60±6,37/dk), sağ lateralde ise en düşük değerde (77,48±5,20/dk-26,45±5,38/dk) olduğu saptandı. Hasta tercihinin sağ lateral pozisyon olduğu belirlendi. **Sonuç:** Bu sonuçlar kalp yetersizliği olan hastalarda pozisyon değişikliklerinin doku perfüzyonunu etkileyebileceğini ve hastaların pozisyon seçimlerinin periferik oksijen saturasyonu düzeyinden çok kalp hızı ve solunum sayıları ile ilişkili olabileceğini göstermiştir. Bu durumun kalp yetersizliği olan hastalara pozisyon verirken dikkate alınması ve hastaların pozisyon tercihlerinin desteklenmesi önerilmektedir.

Anahtar Kelimeler: Kalp yetersizliği; kalp hızı; hemodinami; solunum

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Heart failure (HF) is a clinical syndrome characterized by impaired ability of the heart to generate adequate cardiac output at normal filling pressures. In the past the heart failure was known as isolated pump failure. Today the heart failure is known as a complicated neuro-hormonal syndrome in which many adaptive and maladaptive mechanisms play role in its development. The epidemics of diabetes, obesity, hypertension, and coronary disease are contributing to the increasing prevalence of HF. An adequate and quality rest period in patients with HF is important with respect to the decrease in cardiac load and relaxation of the myocardium.[1-6] The positions used by HF patients contribute to the comfort of patients or negatively affect their hemodynamic parameters. Choosing the most appropriate position depends on gaining a sufficient understanding regarding the effects of positions on hemodynamic parameters and oxygenation in this patient group.

Patients with HF carry the risk of inadequate perfusion due to vascular disorders that frequently accompany low cardiac output (CO), decreased cardiac performance, and HF.[5-10] In these patients, water retention in the lower regions of the body such as the lower-extremities due to the inadequate functioning of the heart is of concern. Moreover, all compensatory mechanisms start operating pathologically just as the heart begins to fail and contributes to the failure. Of these, sympathetic activation, heart hypertrophy, and Frank-Starling Law are the most important ones.[1,5,10-15]

Many investigations have comprehensively shown that breathing difficulty and also cutaneous vasoconstriction, tachycardia, perspiration, and decrease in urine output were the cardinal symptoms of serious HF and these symptoms resulted from the increase in sympathetic nervous system activity. It was also demonstrated that plasma norepinephrine concentration also increased in patients with HF.[1,5,12-15]

Norepinephrine causes blood to reach vital organs through its inotropic effect on the myocardium and also by causing peripheral vasoconstriction during low CO. In addition, repeated stimulation of the heart with norepinephrine leads to a worse prognosis in HF patients by causing damage such as hypertrophy, ischemia, and the death of heart muscle cells.[1,12-16] This situation showed that sympathetic nervous system activation was transformed into pathological compensation in HF patients. [1,5,17-23] It has been shown that in some studies, plasma norepinephrine concentrations of patients with heart failure were determined to be lower in right lateral position compared to the other lateral position.[24-26]

Clinicians and investigators observed that HF patients usually preferred the right lateral position to other positions and the related physiological reasons then started to be investigated.[6,7] In these patients, determining the position that makes the most positive contribution to hemodynamic parameters and encouraging patients to use this position may contribute to a decrease in breathing difficulty, which is the most prevalent symptom.

Such an understanding is crucial when prescribing body positioning to enhance oxygenation in the patient in the intensive care unit and to minimize its adverse effects.[8-10] But there is not enough evidence on patient positions to reach such a conclusion. Further investigations, which will provide evidence-based data and be effective in choosing the best position, are needed in choosing the one that will provide a quality rest period. This study intends to provide results, which can be measured readily in clinical practice; depend on objective data; and can be taken into account in position selection decisions.

Since hemodynamic situations of patients with HF can be understood better by obtaining pulse oximeters which are independently used by nurses more often in recent times and provide the opportunity for making evaluations about oxygenation, heart rate, heart rhythm, and the presence of peripheral circulation, we included oxygen saturation values as well as vital findings (blood pressure, breathing rate, body temperature, and heart rate) into our study.[27-30]

The purpose of this study was to examine the effect of postures that used by patients for resting on peripheral oxygen saturation, and the relationship between patients' position preferences and the some measured hemodynamic parameters in patients with heart failure.

MATERIAL AND METHODS

This quasi-experimental study was conducted at a University Hospital in İzmir, a city located in the western Turkey. Potential subjects were all adult HF patients who were in Class III-IV according to the New York Heart Association (NYHA) classification system. Patients were stable; in terms of pulse oximeter outcomes, respiration rate, heart rate, blood pressure, peripheral oxygen saturation and consciousness during investigation. All the research data were collected by face-to-face interviews and by measurements. The sample comprised 50 patients. Consent was obtained from the ethics committee of the university, the department of cardiology, nurses, and patients. All the data were collected by the researcher.

The effects of the independent variables (positions assigned to patients) on the dependent variables (peripheral oxygen saturation [SpO_2], heart rate, breathing rate, and the most preferred position by the patient) were assessed by repeated-testing.

In order to eliminate the effect of the activity during positioning, five minutes elapsed. Patients threw dice to choose the rotation of positions, which would determine the sequence of four positions (supine [S], right lateral [R], and left lateral [L]: head-of-bed elevated at 30^o with one standard hospital pillow and 90^o orthopnea [O] position). As patients could not tolerate lying flat, the most appropriate choice for head-of-bed angle was thought to be 30 degrees, which was also the height commonly preferred by patients.[31] To prevent the arm, which remains under the body in lateral positions, from affecting peripheral oxygen saturation values due to a probable rapid reperfusion in the next measure, it was thought that lateral positions should not follow each other. Taken these factors into consideration, 6 rotations (6 sequences of positions) were done; namely S-L-O-R, O-R-S-L, L-S-O-R, O-L-S-R, R-O-L-S, R-S-O-L. Only one of the quadruple rotations was applied for each patient. Peripheral oxygen saturations of patients were measured by pulse oximeter (Nellcor). Patients were selected according to the classification of NHYA. The New York Heart Association (NYHA) Functional Classification (Table 1) provides a simple way of classifying the extent of heart failure. It places patients in one of four categories based on how much they are limited during physical activity; the limitations/symptoms are in regards to normal breathing and varying degrees in shortness of breath and or angina pain:

The heart rate data were obtained by both taking a pulse in the radial artery and simultaneously reading from the pulse oximeter. This procedure was done just to provide the consistency of the two results and we confirmed that the pulse oximeter worked properly. Breathing rates of patients were determined by counting breaths for one minute. Socio-demographic data and position preferences of patients were determined before the positioning process.

No inotropic intravenous medicine was given to the patients during the study. The hemoglobin values of all patients were measured and it was seen that all values were over 7 mg/dL. None of the patients had peripheral vessel disease or oedema in their hands. In order to obtain the most accurate result during determination of peripheral oxygen saturation values, the patients whose saturations

TABLE 1: New York Heart Association classification of heart failure.

	How Patient Feels During Physical Activity (Symptoms)
Class I:	No symptoms, tolerates ordinary physical activity
Class II:	Comfortable at rest; ordinary physical activity results in symptoms
Class III:	Comfortable at rest; less than ordinary physical activity results in symptoms
Class IV:	Symptoms may be present at rest; symptoms with any physical activity

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were below 70% were not included in the research. Body temperature, blood pressure, breathing rate, and initial heart rate values were assessed in order to determine whether the patients were hemodynamically stable or not. The oxygen therapy was not applied to any patient during the study. While measurements were being taken, all patients were within normal ranges regarding these values. To take measurements, a pulse probe was placed on the index finger first and attention was paid to whether the probe had moved or not, the index finger was at the same level with the heart or not, and there had been a light directly shining on the probe or not just before reading the value. All procedures were performed between 2-6 pm due to the relationships of the cardiac autonomic nervous activity with circadian rhythm in patients with heart failure.[32] Thus, all patients had an equal opportunity to be active during the day. At the same time, patients were in the same condition with regard to a full stomach compressing the diaphragm after a meal. They all had had lunch.

Severe palpitations, severe respiratory distress, severe decrease in oxygen saturation could be developed but no complication occurred in patients as a result of the procedures. Some patients left the study because they were not able to tolerate staying in the left lateral position for 20 minutes. No change was made in the treatment period of patients during the data collection process. Informed consent received from all patients. The data obtained after each position were recorded on the data collection form.

The number of patients included in the sample was fifty. Twenty-two patiens were excluded due to not meet inclusion criteria of the study. Post Hoc Analyses were used in order to calculate the sample power and it was determined that the sample power was at α=0.05 level and approximately 90%. Repeated measures analysis of variance was used in order to determine the effect of positions on dependent variables. In further analysis, paired sample t test with Bonferroni correction was used. The differences between the most preferred positions by patients were assessed by Kruskal-Wallis test was used in order to determine the relationship between the position preferences of patients and hemodynamic parameters. The Statistical Package for Social Sciences program (SPSS 17.0) was used for data analyses.

RESULTS

SAMPLE DESCRIPTION

Patients were in the age range of 50-85 years with a mean 70.86. The sample was made up of 56% female and 44% male individuals. Of HF patients 38% were in class III and 62% were in class IV. Duration of the disease changes between 12 and 72 months with a mean 31.34±14.31. Of HF patients 48% also had coronary artery disease (CAD), 40% had diabetes mellitus (DM), 62% were with hypertension (HT), and 18% were with chronic obstructive pulmonary disease (COPD) (Table 2).

Peripheral oxygen saturation was detected as 96.94%±2.03 in orthopnea, 95.96%±3.11 in right lateral, 95.16%±3.32 in left lateral, and 94.98%±3.17 in supine. The differences between saturations, which were measured during the different positions that were assigned to patients, were found to be statistically significant as a result of univariate analysis of variance in repeated measures (one-way ANOVA) ($p<0.05$). Further analyses of Bonferroni correction were made in order to find out which group was the source of difference. However, the differences between all the results that were obtained after each position were found to be statistically significant ($p<0.05$).

TABLE 2: Sample characteristics (n=50).

Characteristics	Groups	Number	Percent
Age (Mean) (year)	70.86 (50-85)	50	100
Gender	Male	22	44
	Female	28	56
HF Class	Class III.	19	38
	Class IV	31	62
Duration of disease (month) $\bar{X}$±SD	31.34±14.31 (min-max: 12-72)		
Additional diagnoses of patients	CAD	24	48
	DM	20	40
	HT	31	62
	COPD	9	18

Breathing rates of patients were determined as 28.60±6.37 in orthopnea, 29.05±6.31 in left lateral, 27.95±6.01 in supine, and 26.45±5.38 in right lateral position. The difference between breathing rates in different positions of patients was found to be statistically significant. Further analyses that were conducted in order to determine the group causing the difference showed that the breathing rate measured in one position was different from the breathing rates in other positions ($p<0.05$).

The heart rates were recorded as 81.06±17.9/min in orthopnea, 80.06±17.6/min in left lateral, 79.24±16.3/min in supine, and 77.48±15.2/ min in right lateral. It was found that the heart rate data showed a significant difference depending on patients' positions. In further analysis, it was found that the difference was caused by heart rate values in orthopnea and right lateral ($p<0.05$) however, the difference between supine and left lateral position was not statistically significant ($p>0.05$) (Table 3).

The large majority of patients (66%) preferred the right lateral position. Of the patients who participated in the study, it was determined that 20% preferred the supine position, 12% preferred the left lateral position, and 2% preferred the orthopnea position (Table 3). As a result of Kruskal-Wallis variance analysis, the difference among the preferred positions of most by patients was statistically significant ($p<0.05$).

DISCUSSION

The positions used by patients with HF may cause hemodynamic changes, which affect breathing functions of patients and cause breathing difficulty. Some of these changes are the changes in pulmonary pressures, CO, heart rate, and breathing rate.[6-10,33] In relevant studies concerning the patient with HF, it was stated that differences were observed in these variables depending on patient position and there was an increase in pulmonary pressures, heart rate, and breathing rate and a decrease in cardiac output particularly in the left lateral position.[6,7] However, in most of these studies, patients were mechanically ventilated and were receiving oxygen support.[6-10,33] In our study patients were stable, no mechanical ventilation was used, there was no oxygen support, and no treatment such as treatment with dopamine or dobutamine that would affect cardiac performance was given to patients. Thus, we may claim that this study presents objective data reflecting changes that will occur in the oxygenation of patients depending on their position.

Heart rate, breathing rate, and peripheral oxygen saturation values examined in this study showed statistically significant differences associated with the positions.

In previous studies, preferred position of the patient with HF to sleep were examined by measurement of sleep time of spent in each position and determined that all the patients lay a long time in right lateral position than other positions.[24,25,32]

It was detected that breathing rate and heart rate had the highest value in orthopnea position in addition to high oxygen saturation obtained in this position. Likewise, Yokoi and Aoki determined

TABLE 3: Effects of positions on peripheral oxygen saturation, heart rate, and breathing rate (n=50).*

	Positions†					
	Orthopnea	Right Lateral	Left Lateral	Supine		
Variables	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	$\bar{X}$±SD	F	p
SpO_2 (peripheral oxygene saturation)	96.94±2.03	95.96±3.11	95.16±3.32	94.98±3.17	25.3	<0.05
Breathing rate	28.60±6.37	26.45±5.38	29.05±6.31	27.95±6.01	4.95	<0.05
Heart rate	81.06±17.9	77.48±5.2	80.06±17.6	79.24±16.3	4.95	<0.05
**Preferences Number(Percent)	1 (2%)	33 (66%)	6 (12%)	10 (20%)	X2=49.0	<0.05

*Data were evaluated by analysis of variance in repeated measurements

†Results are shown in mean±standard deviation forms.

**Data (were) evaluated with Kruskal Wallis Variance Analysis.

that no change occurred in positions below 45 degrees whereas there was an increase in sympathetic activity in lying positions of 45 degrees and over.[34] In our research, the detected increase in breathing rate and heart rate in orthopnea position may be thought to develop as a result of sympathetic activation. It might cause an increase in peripheral oxygen saturation naturally and besides, it might cause the need of the heart for oxygen to increase and palpitations to be experienced. Only 2% of patients preferred this position, perhaps as a result of this situation.

Another explanation for high peripheral oxygen saturation values in orthopnea position is also expressed in the study of Manning et al. In this study Forced Vital Capacity (FVC) and forced expiratory volume in one second (FEV_1) were higher in sitting positions than in lying positions.[35] The Fowler's position can be used in emergency situations where it is impossible to position the subject in a supine or seated position avoiding wasting time in positioning the patient's body. In such situations, this could also reduce the patients' risk and the time in formulating a diagnosis and implementing a specific therapy.[26]

The finding of the lowest breathing rate and heart rate together with the second highest value of peripheral oxygen saturation in the right lateral position directs our attention to this position. In our study, majority of our patients preferred right lateral position. It is understood from this result that the positions, which heart rate and breathing rates are lower, are preferred by the patients.

The correlation between patient preferences and hemodynamic values is remarkable both in our study and also in the studies conducted by Leung et al., and Fujita et al.[6,7] Although patients were unaware of these processes relating to cardiac function, they spent more time in right lateral position which cardiac output was higher and pulmonary pressures were lower, than left lateral position even during sleep as demonstrated in Leung's study.[6] In the study of Leung et al., no difference was observed in healthy individuals, who constituted the control group, regarding the position preference.[6,7] The authors concluded that avoidance of patients with HF from left lateral positions spontaneously might be a protective strategy.

Leung et al. stated that in the right lateral position low breathing rate and heart rate develop due to parasympathetic system activation and sympathetic system suppression.[6] Reduction of breathing rate decreases the energy needed for the act of breathing, which becomes a serious effort for HF patients. Moreover, a low heart rate contributes positively to hemodynamic parameters by reducing the energy need of the heart and also decreasing palpitations. A decrease in the heart rate also prolongs the diastole time, which is the resting period.[1-6,11,14,15] The high peripheral oxygen saturation level, breathing rate and heart rate were determined in orthopnea position. However, it was detected that breathing rate and heart rate had the lowest value in the right lateral position in addition to second highest oxygen saturation value obtained in this position. This case brought out the question of how this saturation came about. Moreover, an increase in lung volume and capacity that contributes to this increase in saturation in the right lateral position was not mentioned. This situation may be explained by the facilitation of gas exchange depending on the cardiac output increase and the decrease in pulmonary pressures. Leung et al. stated that left ventricule diastole end diameter and pulmonary capillary wedge pressure (PCWP) was low and cardiac output was high in the right lateral position.[6] These results have the characteristic of explaining the high saturation values in the right lateral position.

According to Leung et al., the large veins of the heart (vena cava inferior and superior) are twisted because of hypertrophic heart weight and the external pressure of the mediastinal organs on the heart in the right lateral position.[6] This situation, which causes a decrease in pulmonary pressure and congestion by preventing venous return, would actually cause a cardiac output reduction in a healthy individual. Yet, a decrease in excessively increased venous return in HF patients due to such a reason perhaps pulls pulmonary pressures and congestion towards normal values.

In previous studies, the position preferred by the patients with HF to sleep were examined with measurement of sleep time spent in each position and determined that all the patients lay for a long time in right lateral position than other positions.[24,25,32]

Two studies that pulse measurement done at different positions in patients with HF were reached. In these studies, there were no difference in heart rate between right-lateral position which the patient spent most time and other positions (left lateral and supine) during the night.[6,32]

Nineteen patients in the study of Leung et al, and eight patients in the Miyamoto's study were examined for pulse values.[6,25] In our study fifty patient were examined. The differences between values measured in four positions were statistically significant. Lowest values of heart rate and respiration were recorded in the right lateral position.

The reason for low levels of saturation and high breathing rates and high heart rates in the left lateral position can be explained by the same studies that we mentioned concerning the right lateral position.[6,7] In the left lateral position, changes that have adverse effects when compared to right lateral position were observed. According to Leung et al., the left ventricle end diastolic diameter was large and cardiac output was low in the left lateral position.[6] In addition, HF patients clearly hear the apex sound in the left lateral position because the hypertrophic heart leans towards the sternum in this position and this situation causes patients to worry about palpitations. This position was not preferred by majority of patients, perhaps due to this reason. Breathing rate and heart rate increase caused by sympathetic system activation stimulates the act of breathing and also causes cardiac function to worsen by increasing the need of the heart for oxygen as well as not being able to provide adequate oxygenation.

In the supine position however, breathing rate and heart rate values seem to be lower when compared to the left lateral position. In the supine position, breathing rate with the value of 27.95/min±6.01 had the second lowest value and heart rate with a value of 79.24±16.3 again was the second lowest. In addition, peripheral oxygen saturation was also at the lowest level. The supine position, where the negative effects of sympathetic activation are not seen as in the left lateral and orthopnea, was found to be the most preferred position by HF patients (%20) after the right lateral position despite low saturation.

Here, this question comes to mind: why do patients prefer the supine position to the left lateral position although they had lower saturation values in this position than in the left lateral position? This question can again be answered by the processes of sympathetic activation. Firstly, a lower breathing rate and heart rate in the supine position than in the left lateral position may cause this position to be preferred. The correlation between patients' preferred positions and breathing rates and heart rates rather than peripheral oxygen saturation is in fact understandable. The normal value of peripheral oxygen saturation is in the range of 95-100%. We obtained similar results in our group from each of the four positions. The majority of the saturation values of the individuals were within normal limits. Patients are unaware of this situation unless oxygen saturation falls below 90%.[36] When they become aware after a certain time, they compensate for this by increasing their breathing rate. Yet, the increase in breathing rate and heart rate is a situation immediately recognized by patients. It appears that patients respond more naturally to changes in heart rates and breathing rates than to slight differences in saturation levels.

In this study, we will mention another point that may trigger sympathetic activation in the orthopnea position. Greater consumption of oxygen may occur in the orthopnea and lateral positions when compared to the supine position and this consumption increase may trigger the sympathetic system. For example, in the orthopnea position an increase in the need for energy for several reasons such as keeping the body straight and raising the head and neck and maintaining them in balance may trigger sympathetic activation. The statement of Yokoi and Aoki concerning a high heart rate depending on sympathetic activation at 45 degrees or more appears to be an important clue at this point.[34] In the supine position, patients have the lowest need for energy in relation to positioning and maintaining the position. This may be the explanation for the fact that patients feel more comfortable in this position than in the left lateral position despite the lowest saturation.

Another reason for patients' preference for this position over the left lateral position is that they do not experience any negative effects like hearing the apex sound, which appears in the left lateral position.

There is a necessity to examine factors like cardiac output, pulmonary pressures, breathing rate, heart rate, venous return, and hemodilution that occurred due to venous return, all of which affect tissue oxygenation and other parameters that reflect the results of these factors, to be able to assess the effect of positions on tissue oxygenation in this patient population. Yet, the number of studies examining this issue is limited.

CONCLUSION

Our sample reflects HF patients who were stable hemodynamically, in Class III-IV according to the NYHA classification. Whereas there were statistically significant differences between all our dependent variables, it is worth noting that our results can also be supported by other studies. The most important limitation of this study is that it examined a restricted number of variables. Besides this, the comments related to the variables measured by other researchers, but unmeasured by us in this study have been mentioned in the discussion part. As mentioned before, there is a need to examine the factors that affect tissue oxygenation and the changed hemodynamic values as a result of these factors. Despite these important limitations, we think that this study importantly contributed to the selection of position in patients with heart failure. These results indicate that position preferences of patients should certainly be taken into consideration and the right lateral position with a head-of-bed angle of 30 degrees is the most appropriate position for HF patients.

REFERENCES

1. Soylu K, Şah M, Dursun İ. [Neurohormonal activation in heart failure]. Turkiye Klinikleri J Cardiovasc Sci 2006;18(3):211-21.
2. Ateşal S, Şenocak H, Alp N, Yiğitoğlu R, Karakelleoğlu Ş. [Relationships between plasma atrial natriuretic peptide levels and some hemodynamic parameters in patients with chronic left heart failure]. Turkiye Klinikleri J Cardiology 1992;5(4):244-8.
3. Salcedo EE, Moloo J, Quaife R, Wolfel E. Imaging heart failure in 2010. Curr Cardiovasc Imaging Rep 2010;3(5):303-16.
4. Welstand J, Carson A, Rutherford P. Living with heart failure: an integrative review. Int J Nurs Stud 2009;46(10):1374-85.
5. Brashers VL, McCance KL. Structure and function of the cardiovascular and lymphatic systems. In: McCance KL, Huether SE, Brashers VL, Rote NS, eds. Pathophysiology the Biologic Basis for Disease in Adults and Children. 6th ed. Maryland Heights, Missouri: Mosby Elsevier; 2010. p.1091-209.
6. Leung RS, Bowman ME, Parker JD, Newton GE, Bradley TD. Avoidance of the left lateral decubitus position during sleep in patients with heart failure: relationship to cardiac size and function. J Am Coll Cardiol 2003;41(2):227-30.
7. Fujita M, Miyamoto S, Tambara K, Budgell B. Trepopnea in patients with chronic heart failure. Int J Cardiol 2002;84(2-3):115-8.
8. Jones AY, Dean E. Body position change and its effect on hemodynamic and metabolic status. Heart Lung 2004;33(5):281-90.
9. Olson TP, Frantz RP, Snyder EM, O'Malley KA, Beck KC, Johnson BD. Effects of acute changes in pulmonary wedge pressure on periodic breathing at rest in heart failure patients. Am Heart J 2007;153(1):104.e1-7.
10. Banasik JL, Emerson RJ. Effect of lateral positions on tissue oxygenation in the critically ill. Heart Lung 2001;30(4):269-76.
11. Huffstutler SY. Assessment of the cardiovascular system. In: Monahan DF, Sands JK, Neigbors M, Marek JF, Green CJ, eds. Phipps' Medical-Surgical Nursing Health and Illness Perspectives Europe, Middle East and African Edition. 8th ed. Louis, Missouri: Mosby Elsevier; 2008. p.713-895.
12. Ammon S. Managing patients with heart failure. Am J Nurs 2002;101(12):33-9.
13. Bither CJ, Apple S. Home management of the failing heart. Inotropic therapy in the outpatient setting. Am J Nurs 2001;101(12):41-5.
14. Baig MK, Mahon N, McKenna WJ, Caforio AL, Bonow RO, Francis GS, et al. The pathophysiology of advanced heart failure. Heart Lung 1999;28(2):87-101.
15. Calerlock J, Clark AP. Heart failure: Pathophysiologic mechanisms. Am J Nurs 2002; 101(12):26-33.
16. Lainscak M, Anker SD. Prognostic factors in chronic heart failure. A review of serum biomarkers, metabolic changes, symptoms, and scoring systems. Herz 2009;34(2):141-7.
17. Gheorghiade M, Cody RJ, Francis GS, McKenna WJ, Young JB, Bonow RO. Current medical therapy for advanced heart failure. Heart Lung 2000;29(1):16-32.
18. Meghani SH, Becker D. Beta-blockers: a new therapy in congestive heart failure. Am J Crit Care 2001;10(6):417-27;quiz 428-9.

19. O'Connor CM, Gattis WA, Swedberg K. Current and novel pharmacologic approaches in advanced heart failure. Heart Lung 1999; 28(4):227-42.

20. Özcebe Oİ, Oto MA. [Treatment of hearth failure]. Türk İlaç ve Tedavi Derg 1990; 3(4):501-11.

21. Sorrentino MJ. Drug therapy for congestive heart failure. Appropriate choices can prolong life. Postgrad Med 1997;101(1):83-6, 89-90, 93-4.

22. Strömberg A, Broström A, Dahlström U, Fridlund B. Factors influencing patient compliance with therapeutic regimens in chronic heart failure: A critical incident technique analysis. Heart Lung 1999;28(5):334-41.

23. Wenger NK. Women, heart failure, and heart failure therapies. Circulation 2002;105(13): 1526-8.

24. Fujita M, Miyamoto S, Sekiguchi H, Eiho S, Sasayama S. Effects of posture on sympathetic nervous modulation in patients with chronic heart failure. Lancet 2000;356(9244): 1822-3.

25. Miyamoto S, Fujita M, Sekiguchi H, Okano Y, Nagaya N, Ueda K, et al. Effects of posture on cardiac autonomic nervous activity in patients with congestive heart failure. J Am Coll Cardiol 2001;37(7):1788-93.

26. Miyamoto S, Tambara K, Tamaki S, Nagaya N, Hasegawa K, Nohara R, et al. Effects of right lateral decubitus position on plasma norepinephrine and plasma atrial natriuretic peptide levels in patients with chronic congestive heart failure. Am J Cardiol 2002;89(2):240-2.

27. Jensen LA, Onyskiw JE, Prasad NG. Meta-analysis of arterial oxygen saturation monitoring by pulse oximetry in adults. Heart Lung 1998;27(6):387-408.

28. Dicle A, Başpınar S, Oto Ö. [Investigate the compliance between pulse oximetry measurements and arterial blood gas analysis results during the separation of open-heart surgery patients from ventilator]. Ulusal Cerrahi Kongresi, Cerrahi Hemşireliği Seksiyonu. İstanbul: Türk Cerrahi ve Ameliyathane Hemşireleri Derneği; 1994. p.13-4.

29. Hakverdioğlu G. [Use of pulse oximeter in evaluation of the oxygen saturation]. Journal of Cumhuriyet University School of Nursing 2007;11(3):45-9.

30. Cicolini G, Gagliardi G, Ballone E. Effect of Fowler's body position on blood pressure measurement. J Clin Nurs 2010;19(23-24): 3581-3.

31. Bridges EJ, Woods SL, Brengelmann GL, Mitchell P, Laurent-Bopp D. Effect of the 30 degree lateral recumbent position on pulmonary artery and pulmonary artery wedge pressures in critically ill adult cardiac surgery patients. Am J Crit Care 2000;9(4):262-75.

32. Miyamoto S, Fujita M, Tambara K, Sekiguchi H, Eiho S, Hasegawa K, et al. Circadian variation of cardiac autonomic nervous activity is well preserved in patients with mild to moderate chronic heart failure: effect of patient position. Int J Cardiol 2004;93(2-3):247-52.

33. Banasik JL, Emerson RJ. Effect of lateral position on arterial and venous blood gases in postoperative cardiac surgery patients. Am J Crit Care 1996;5(2):121-6.

34. Yokoi Y, Aoki K. Relationship between blood pressure and heart-rate variability during graded head-up tilt. Acta Physiol Scand 1999;165(2):155-61.

35. Manning F, Dean E, Ross J, Abboud RT. Effects of side lying on lung function in older individuals. Phys Ther 1999;79(5):456-66.

36. Parshall MB, Welsh JD, Brockopp DY, Heiser RM, Schooler MP, Cassidy KB. Dyspnea duration, distress, and intensity in emergency department visits for heart failure. Heart Lung 2001;30(1):47-56.