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Avoidance of the Left Lateral Decubitus Position During Sleep in Patients With Heart Failure: Relationship to Cardiac Size and Function

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OBJECTIVES We sought to determine whether patients with congestive heart failure (CHF) avoid the left lateral decubitus (LLD) position during sleep and, if so, whether this avoidance would be more pronounced in those with greater degrees of cardiomegaly.

BACKGROUND Anecdotal reports suggest that, in patients with CHF, the LLD position is associated with discomfort due to the enlarged apical heart beat and greater degree of dyspnea (trepopnea) than other positions. It has also been suggested that the LLD position is associated with increased sympathetic nervous activity.

METHODS A total of 75 patients with CHF and 75 control subjects underwent nocturnal polysomnography with monitoring of body position. Echocardiography was performed in all patients with CHF to determine left ventricular end-diastolic diameter (LVEDD). A total of 40 patients underwent cardiac catheterization from which pulmonary capillary wedge pressure (PCWP) and cardiac output (CO) were obtained.

RESULTS Patients with CHF spent significantly less time in the LLD position than in the right lateral decubitus position. No such difference was observed among control subjects. Among patients with CHF, those with larger LVEDD, higher PCWP, and lower CO spent less time in the LLD position.

CONCLUSIONS Patients with CHF avoid the LLD position spontaneously during sleep. This may be a protective strategy to avoid discomfort from the enlarged apical heart beat or further hemodynamic or autonomic compromise. (J Am Coll Cardiol 2003;41:227–30) © 2003 by the American College of Cardiology Foundation

Anecdotal reports suggest that patients with congestive heart failure (CHF) tend to avoid lying on their left sides (1,2). A number of explanations have been proposed. One is the development of dyspnea in the left lateral decubitus (LLD) position, termed "trepopnea" (1–4), which is thought to reflect elevation of pulmonary venous pressures, resulting in pulmonary edema (4). More recently, it has been reported that the LLD position is associated with higher sympathetic nervous activity in patients with CHF (5,6). Another possible explanation is an uncomfortable awareness of the enlarged heart beating against the left chest wall (3), a symptom voiced by many patients in our heart failure clinic. We, therefore, hypothesized that, during sleep, patients with CHF would spend relatively less time in the LLD than the right lateral decubitus (RLD) position. We further hypothesized that those with more dilated hearts would spend relatively less time sleeping in the LLD position than those with smaller hearts.

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METHODS

Subjects. The subjects were 75 consecutive patients with CHF, diagnosed by a cardiologist based on a history of dyspnea, and left ventricular ejection fraction <45% by radionuclide angiography (Table 1). Heart failure was due to nonischemic dilated cardiomyopathy in 39 patients, ischemic heart disease in 34, valvular heart disease in 1, and congenital heart disease in 1. Patients were clinically stable on optimal medical therapy for at least one month before participation. The control group consisted of 75 subjects with no history, symptoms, or signs of cardiovascular disease, referred for diagnostic polysomnography for suspicion of sleep apnea. They were sex- and weight-matched to the CHF group. Those with sleep apnea defined as more than 10 apneas and hypopneas per hour of sleep (apnea-hypopnea index or AHI) were excluded from the study. The protocol was approved by the local Research Ethics Board, and all subjects provided written informed consent.

Cardiac function. All patients with CHF underwent two-dimensional echocardiography from which left ventricular end-diastolic diameter (LVEDD) was determined. In addition, 40 patients underwent diagnostic cardiac catheterization in the supine position to rule out coronary artery disease. Pulmonary capillary wedge pressure (PCWP) and cardiac output (CO), measured by thermodilution, were obtained from a pulmonary artery catheter. Echocardiography and cardiac catheterizations were performed 4.2 ± 6.1

Abbreviations and Acronyms

AHI	= apnea-hypopnea index
BMI	= body mass index
CHF	= congestive heart failure
CO	= cardiac output
HR	= heart rate
LLD	= left lateral decubitus
LVEDD	= left ventricular end-diastolic diameter
PCWP	= pulmonary capillary wedge pressure
RLD	= right lateral decubitus
SaO_2	= oxyhemoglobin saturation

months and 1.4 ± 1.2 months from the time of the sleep study, respectively.

Sleep studies. Polysomnography was performed with scoring of sleep stages and movement arousals, and measurement of tidal volume, heart rate (HR), and mean oxyhemoglobin saturation (SaO_2) using standard techniques and equipment described for our laboratory (7). Apneas were defined by the absence of a tidal volume excursion for at least 10 s, whereas hypopneas were defined as a 50% or greater reduction in tidal volume from the baseline value for at least 10 s. Body position was scored as LLD, RLD, or supine by visual inspection by a sleep technician every 15 min and whenever a change in pattern of the polysomnographic tracings occurred consistent with movement of the subject. Scoring and interpretation of sleep studies were performed by technicians unaware of the results of the subjects' cardiac function tests.

Data analyses. The percentage of time spent in each sleeping position was expressed as time in position/total sleep period time × 100, following which the percentage of time spent in the LLD and RLD positions were compared in both the CHF and control groups. Patients with CHF were divided dichotomously into groups above and below the median value for LVEDD. Comparisons of sleeping position times were then made between the resulting groups. A similar analysis was performed for PCWP, CO, age, body mass index (BMI), and AHI. Data are presented as mean ± SD for normally distributed data and median (25th, 75th percentile) for nonnormally distributed data.

Table 1. Demographic Data

	CHF Patients	Controls	p Value
Age (yrs)	55.0 ± 12.1	43.9 ± 13.8	< 0.05
Male:female (n)	59:16	59:16	NS
Body mass index (kg/m^2)	29.5 ± 5.4	29.1 ± 5.7	NS
Apnea-hypopnea index (no/hr)	13.9 (7.9, 28.5)	4.9 (2.9, 6.7)	< 0.001
Left ventricular ejection fraction (%)	24 ± 11.5	—	—
New York Heart Association (class)	2.5 ± 0.6	—	—

Normally distributed data are presented as mean ± SD, and nonnormally distributed data as median (25th, 75th percentile).
CHF = congestive heart failure.

Normality was assessed by the Kolmogorov-Smirnov test. In all cases, sleeping position times were nonnormally distributed. The Mann-Whitney rank sum test was used for nonnormally distributed unpaired data. The paired *t* test and the Wilcoxon signed rank test were performed for normally and nonnormally distributed paired data, respectively. The statistical software used was Sigmastat 2.03 (SPSS Inc.). Results were considered significant at $p < 0.05$.

RESULTS

There were no significant differences in sex distribution or BMI between patients with CHF and control subjects (Table 1). Patients with CHF were older and had more sleep apnea than control subjects. The prevalence of sleep apnea in the CHF patients was 64%, similar to that previously reported (7).

Patients with CHF spent a significantly smaller percentage of sleep period time in the LLD position than the RLD position (Fig. 1). In contrast, there was no significant difference between the percentage of time spent by control subjects in the two decubitus positions.

In patients with CHF, a significantly smaller percentage of the sleep period time was spent in the LLD position by those with higher LVEDD than those with lower LVEDD (Fig. 2). Similarly, CHF patients with higher PCWP and lower CO spent less time in the LLD position than those

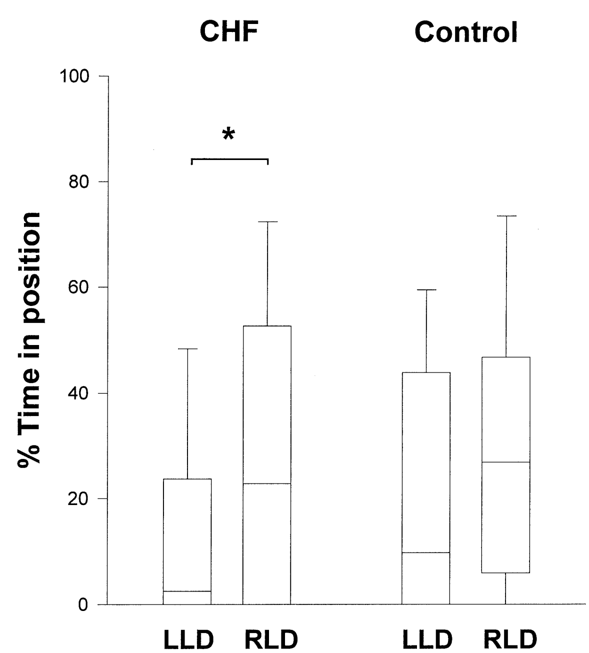

Figure 1. Percentage of time spent in the left lateral decubitus (LLD) and right lateral decubitus (RLD) positions among patients with congestive heart failure (CHF) and controls. Patients with CHF spent a significantly smaller percentage of sleep period time in the LLD position than the RLD position; 2.5% (0, 23.7) versus 22.8% (0, 52.7), respectively. No significant difference was observed among controls. Data are nonnormally distributed as indicated by **box plots. Error bars** = the 10th and 90th percentiles; **horizontal lines** = the median; **rectangular boxes** = 25th and 75th percentiles. *$p < 0.05$.

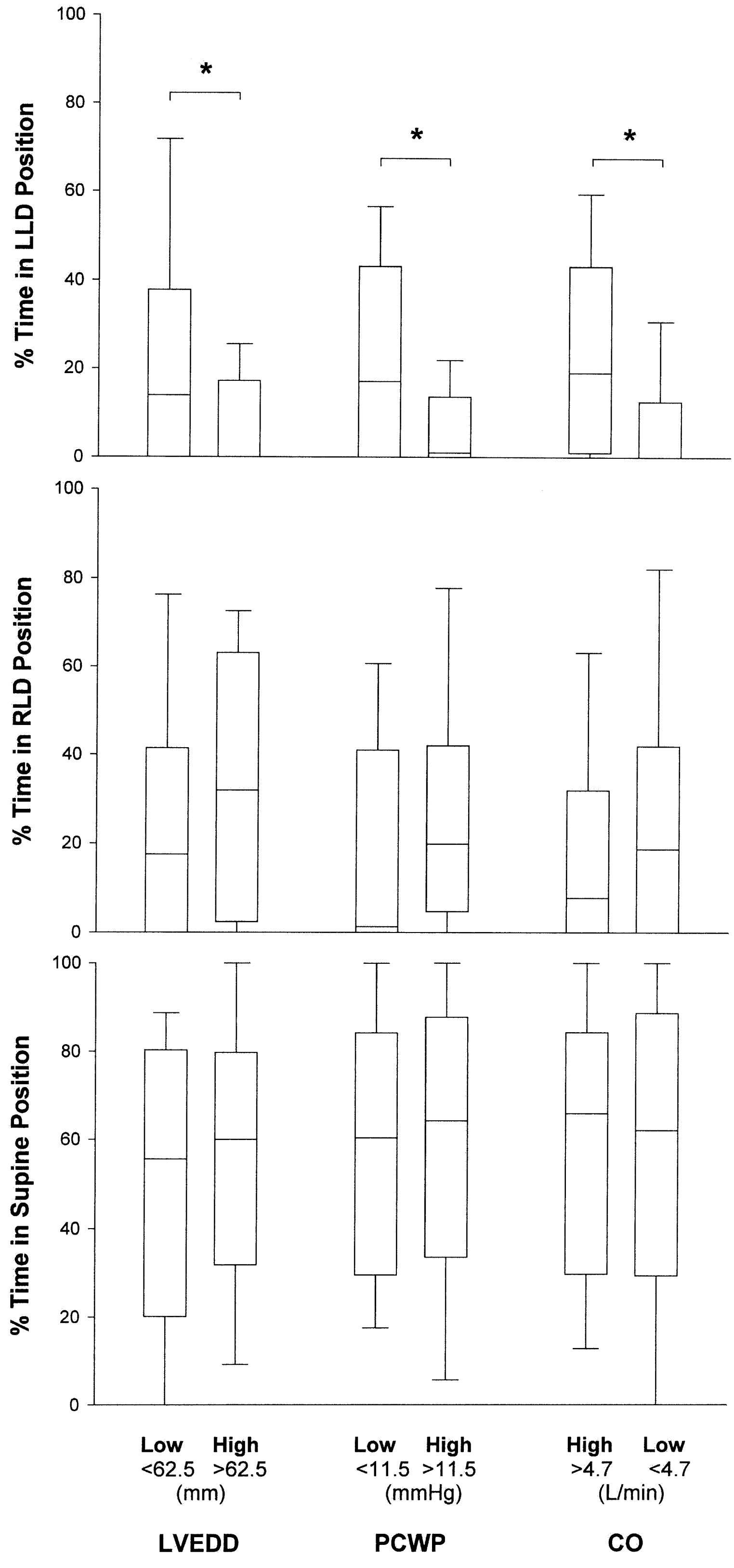

Figure 2. Comparison of the percentage of time spent in the left lateral decubitus (LLD), right lateral decubitus (RLD), and supine positions compared between patients with congestive heart failure divided dichotomously into those above and below the median values for left ventricular end-diastolic diameter (LVEDD) (62.5 mm), pulmonary capillary wedge pressure (PCWP) (11.5 mm Hg), and cardiac output (CO) (4.7 l/min). Mean (± SD) values above and below these medians were: LVEDD, 72.5 ± 6.5 vs. 57.2 ± 3.8 mm; PCWP, 19.8 ± 6 vs. 6.8 ± 3.1 mm Hg; and CO, 5.7 ± 0.8 vs. 3.8 ± 0.7 l/min. Patients with larger LVEDD, higher PCWP, and lower CO spent less time in the LLD position. No significant differences were found in time spent in the RLD or supine positions based on these dichotomous divisions. Data are nonnormally distributed (see Fig. 2.) *$p < 0.05$.

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with lower PCWP and higher CO. However, no significant differences were observed in the percentage of time spent in the RLD or supine positions based on LVEDD, PCWP, and CO (Fig. 2). The proportion of sleep time spent in the LLD position did not differ significantly based on age, BMI, or AHI.

Among 19 patients with CHF who slept for some portion of the night in both LLD and RLD positions, the two positions were not associated with any significant differences in HR (76.0 ± 12.8 vs. 75.1 ± 11.0 beats/min, respectively), mean SaO_2 (95.1 ± 2.5% vs. 95.4 ± 1.5%), AHI (12.9 [6.4, 31.5] vs. 11.7 [2.9, 24.2] per hour), or frequency of arousals (13.4 ± 7.9 vs. 19.0 ± 12.9 per hour). Nevertheless, these patients still spent a significantly smaller proportion of the sleep period time in the LLD than the RLD position (20.1 ± 9.9% vs. 42.2 ± 20.3%, $p < 0.05$).

DISCUSSION

Our study has given rise to two novel observations. First, in a group of 75 patients with CHF, we found a highly significant tendency to avoid sleeping on the left side. In contrast, this was not the case in the 75 control subjects. Second, and most importantly, we found that avoidance of the LLD position among patients with CHF is related to the degree of cardiomegaly and cardiac dysfunction.

In 1935, Dock (8) proposed that patients with CHF might avoid the LLD position due to the uncomfortable sensation of the apex beat. Our data support this proposition by demonstrating that patients with a greater degree of left ventricular dilation spend less time in the LLD position. Patients with higher PCWP also had a more pronounced tendency to avoid the LLD position. Wood et al. (4) reported anecdotally that the LLD position is associated in some individuals with paroxysmal nocturnal dyspnea, suggesting that it might raise pulmonary venous pressure by an, as yet, undetermined mechanism. Movement of the heart due to gravity might distort the pulmonary veins and impede venous return from the lungs. Compression of the enlarged left ventricle against the lateral chest wall might also impair diastolic filling. Echocardiographic Doppler studies have shown that the LLD position leads to mitral flow pattern changes compatible with increased left ventricular preload (9,10).

It has been reported in patients with CHF that the LLD position is associated with higher sympathetic nervous activity than the RLD position (5,6). The authors of this study speculated that sympathetic activity is increased in the LLD position due to lower CO. Alternatively, increased sympathetic activity in the LLD position might also arise from effects of increased PCWP (11) or simply be a manifestation of the uncomfortable sensation of the apex beat.

It has long been recognized that pleural effusions in the setting of chronic CHF are predominantly right-sided (12), but the reason remains unclear. Our findings may shed light on this issue. Because edema accumulates in dependent areas, previous authors have speculated that it might be because patients with CHF spend more time in the RLD position during sleep (3,8). We now confirm that speculation in a large group of patients with CHF. Therefore, it is likely that the predominant accumulation of fluid in the right pleural space in patients with CHF is at least partly attributable to sleeping position.

In summary, the present study demonstrates that patients with CHF tend to avoid the LLD position during sleep, and that this avoidance is related to the degrees of left ventricular dilation, elevated filling pressure, and reduction in CO. These observations are in keeping with the concept that the LLD position may exert deleterious effects on left ventricular filling pressure, CO, or cardiovascular autonomic function (5,9,10) and that avoiding it may be a protective strategy. In addition, discomfort arising from perception of the enlarged apical beat against the left chest wall may promote avoidance of the LLD position (3).

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