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Positional sleep disordered breathing in patients with arrhythmia. Should we advise our patients to avoid supine position during sleep?

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ABSTRACT

Background: Sleep disordered breathing [SDB] is a well-known problem in patients with cardiovascular diseases. Around 50% of pts. with SDB present positional sleep disordered breathing [PSDB].
Aims: The aim of this study was the investigation of the frequency of PSDB in patients with different forms of arrhythmias.
Methods: We analyzed the presence of SDB in 53 pts. with diagnosed atrial fibrillation (paroxysmal or persistent), 88 pts. before ablation of ventricular ectopy and 110 pts. that had Holter monitoring due to the symptoms suggesting arrhythmia.
Results: Finally, we could collect all the data in 243 pts. – 150 men 93 women.
AHI < 15 was recorded in 136 (56%) pts., AHI > 15 in 107 (44%) pts. Moderate sleep disordered breathing was diagnosed in 59 (24%) pts. (AHI 15–30), severe sleep disordered breathing (AHI > 30) was recognized in 48 (20%) pts. In all of the analyzed groups, AHI in supine position was significantly higher than in nonsupine position. PSDB was recorded in 55% of pts. with AHI > 15 and in 29% of pts. (n = 14) with AHI > 30. Percentage of time in supine position was an independent factor related with the presence of at least moderate or severe sleep disordered breathing.
Conclusion: 1. Moderate or severe SDB is recorded in 44% of pts. with arrhythmias, almost 50% of them have positional SDB. 2. Percent of time of sleeping in supine position has an important independent impact on the presence of SDB. 3. Big studies should be conducted to verify if avoidance of sleeping in supine position may improve clinical outcome.
Condensed abstract: Sleep disordered breathing SDB is a frequent problem of pts. with cardiovascular diseases. It may influence the prognosis. Moderate or severe SDB is recorded in 44% of pts. with arrhythmias, almost 50% of them have positional SDB. Percent of time of sleeping in supine position has an important independent impact on the presence of SDB. 3. Big studies should be conducted to verify if avoidance of sleeping in supine position may improve clinical outcome.
What is new?
- The presence of positional sleep disordered breathing in pts. with arrhythmias is reported.
- Positional dependence of the disordered breathing is presented even in pts. with almost normal AHI results.

Introduction

Sleep disordered breathing [SDB] is a well-known problem in patients with cardiovascular diseases [1]. The prevalence of SDB is high (30–60%) among pts. with coronary heart disease, hypertension, heart failure [1,2]. Similar frequency is reported in patients with arrhythmias. The most investigated group are the pts. with atrial fibrillation [3–5]. Different extent of frequency was published, because of the various apnoea-hypopnea index [AHI] levels that were used as clinically important.

It is not well documented how frequent is SDB in patients with ventricular arrhythmias. Data from previous publications were rather focused on the link between SDB and increased risk of malignant arrhythmias and sudden cardiac death [6–9]. Mehra et al. reported that pts. with severe SDB more frequently had ventricular arrhythmias than pts. without SDB [10].

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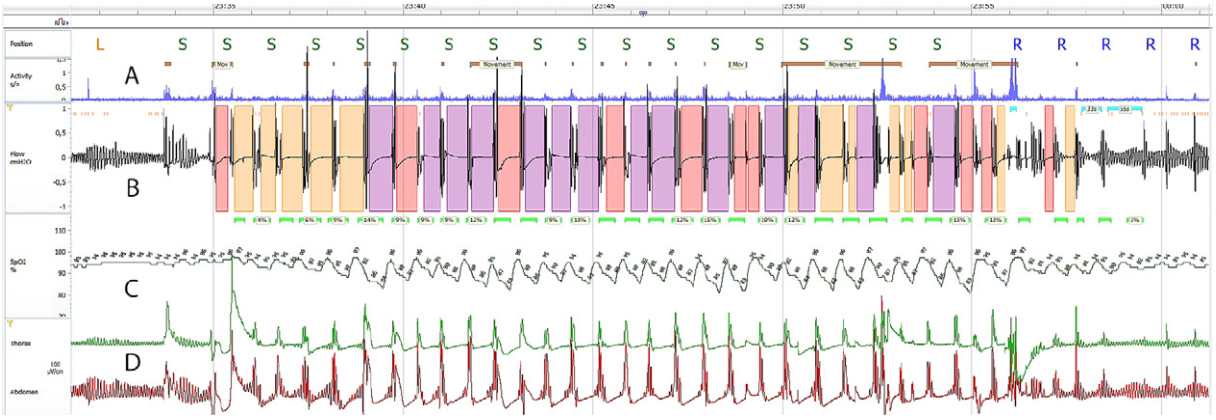

Fig. 1. Example of the part of polygraphic examination (30 min). From the top: A – position and activity (L - left, R - right, S – supine), B – nasal flow (during supine position interruptions lasting 30–40 s), C – oxygen saturation (desaturations 6–15%), D – thorax and abdomen movements (during supine position typical for obstructive/mixed sleep apnea). This is examination in pts. with PSDB – overall AHI 30, AHI in supine position 90, AHI in nonsupine position 12. Supine position - 30% of time.

Majority of pts. with diagnosed SDB have obstructive sleep apnea [OSA], around 50% of them present positional sleep disordered breathing [PSDB] [11]. In these cases SDB are observed only or more frequently in supine position. Such diagnosis has important therapeutic implications.

It has not been reported yet how frequent is PSDB in patients with arrhythmias. The aim of this study was the investigation of the frequency of PSDB in patients with different forms of arrhythmias.

Methods

We analyzed the presence of SDB in three groups of consecutive patients. Group A – 53 patients with diagnosed paroxysmal/persistent atrial fibrillation (patients before ablation). Group B – 88 patients with ventricular arrhythmias considered for ablation. Group C – 110 patients with symptoms suggesting arrhythmias who underwent diagnostic Holter monitoring. Inclusion criteria:

1. Documented atrial fibrillation (Group A)
2. Documented increased number (>5000/day) of ventricular ectopy (Group B)
3. Symptoms suggesting arrhythmia (Group C)
4. Age > 18 yers.

We excluded the patients with previously diagnosed any form of SDB (it was <10 pts). We wanted to present data based on pts. without diagnosed SDB to show how frequent was this problem in such population.

Basic demographic data – age, gender, BMI were collected.

Polygraphy

We used Nox T3 portable respiratory sleep monitor. This device was reported as clinically comparable with classical polysomnography [12,13].

The following data were recorded: saturation (pulse oximetry), nasal flow (nasal canula), thorax and abdomen movements (belts – inductance pletysmography), pulse (pulse oximetry), ecg (one chanel), body position and activity, snoring (microphone).

After recording data were transferred to PC computer, verified by trained physician and the final report was generated.

The following parameters were taken into account in our study:

- AHI.
- mean O2 saturation.
- % of time with O2 saturation < 90%.
- % of time in supine position.

We analyzed overall results and obtained in supine and non-supine position.

Example of the part of polygraphic examination is in Fig. 1. (See Fig. 2.)

According to AHI results first we analyzed the presence of normal or mild SDB (AHI < 15), moderate SDB (AHI 15–30) and severe SDB (AHI > 30).

Positional sleep disordered breathing was defined according to criteria proposed by Bignold [14] as: AHI > 15, AHIsupine/AHInonsupine >2 and AHI nonsupine<15, >20 min of sleep in supine and nonsupine positions.

In the group of pts. with AHI 5–15, we looked for the presence of AHIsup >15 and AHIsup/AHInsup>2. This group we named as moderate positional SDB [MPSDB].

Finally, we had four group of pts.:

Group 1 – AHI <15 and AHIsup<15.

Group 2 – AHI > 15 and AHI nsup >15 (any values of AHIsup).

Group 3 – PSDB (as described above).

Group 4 – MPSDB (as described above).

The study protocol was approved by the Ethics Committee Institute of Cardiology Warsaw. All patients signed written consent to the scientific treatment of their clinical data in an anonymous form.

Statistical analysis

Statistical analysis was performed with SPSS standard version 11.0.1. Continuous variables were presented as mean, SD, minimum-maximum and categorical variables as counts and percentages. According to data distribution t-Student or Wilcoxon test were used for data

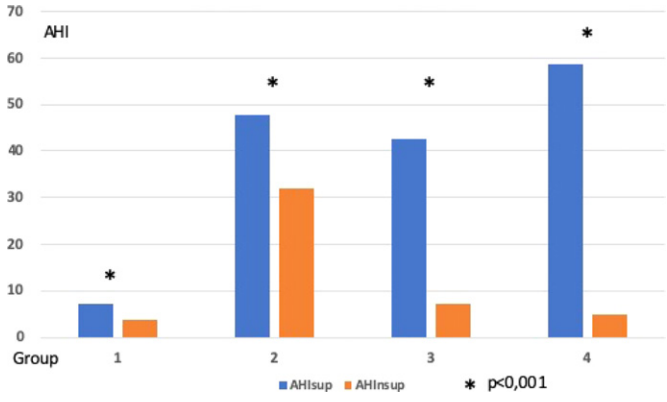

Fig. 2. Comparison of AHI in supine and nonsupine position in Group 1 (AHI < 15 and AHIsup<15), Group 2 (AHI > 15 and AHI nsup >15), Group 3 (PSDB), Group 4 (MPSDB).

Table 1
Results in all patients. Comparison of results supine vs nonsupine.

Parameter	Mean ± SD	Min-max
Age	55,5 ± 15,5	17–86
BMI	28,4 ± 4,7	18,3–46,5
AHI	17,5 ± 15,7	0,1–88,8
MeanO2	92,3 ± 2,0	84,2–96,7
%of time O2 < 90%	9,6 ± 15,6	0–98
AHIsup	27,3 ± 21,6*	0,2–95
menO2sup	92,7 ± 2,1*	88,4–98,6
% of time sup O2 < 90%	11,8 ± 17,1*	0–98
% of time in sup position	47,2 ± 27,6	0–100
AHInsup	9,5 ± 12,9	0,2–94,9
meanO2nsup	93,1 ± 2,0	84,3–96,8
%of time nsup O2 < 90%	6,7 ± 15,2	0–98

* $p < 0{,}001$ results in supine position vs nonsupine position.

comparison. Categorical data were compared with Chi^2 test. We use logistic multivariate analysis to define the factors related with the presence of sleep disordered breathing (backward elimination, the $p > 0{,}1$ as a border for elimination).

Results

Finally, we could collect all the data in 243 pts. – 150 men 93 women.

In 8 pts. polygraphy was not successful (4 men and 4 women). Most of the recordings were done in ambulatory pts. Results of all pts. are presented in Table 1. We also compared results - supine vs nonsupine position. Results of analyzed parameters obtained in supine position were significantly worse than in nonsupine position. Mean AHI in supine position was almost three times higher than in nonsupine position.

AHI < 15 was recorded in 136 (56%)pts., AHI > 15 in 107 (44%)pts. Moderate sleep disordered breathing was diagnosed in 59 (24%) pts. (AHI 15–30), severe sleep disordered breathing (AHI > 30) was recognized in 48 (20%) of pts.

Majority of pts. with AHI > 15 had obstructive sleep apnea – 77 pts., hypoventilation had 17 pts. and central or mixed apnea 13 pts. In pts. with severe SDB, 41 had obstructive apnea and 7 central or mixed.

Analysis of positional sleep disordered breathing

When we analyzed the presence of PSDB we found the following results:

Group 1 – pts. without significant SDB - (AHI < 15 and AHIsup<15) – 102 pts. (42%).

Group 2 – pts. with significant SDB not positional (AHI > 15 and AHI nsup >15) – 48 pts. (20%).

Group 3 – pts. with PSDB – 59 (24%).

Group 4 – pts. with MPSDB – 34 (14%).

Positional SDB was recorded in 55% of pts. with AHI > 15 and in 29% of pts. (n = 14) with AHI > 30. In Table 2 we present the comparison of results among groups 1–4.

Patients without significant SDB (Group 1) were significantly younger, with lower BMI and lower snore index. Proportion - female/male presented slightly higher number of females. This was in contrast with group 2, 3 and 4. In all groups (even in group 1) results in supine position were worse than in nonsupine position. Special attention should be paid on group 4. These pts. had the highest AHIsup while they spent significantly less time in supine position than the rest of the patients.

Comparison of results in three groups of patients with arrhythmia

Finally, we collected data in 51 pts. with atrial fibrillation (Group A), 86 pts. with frequent ventricular ectopy (Group B) and in 106 pts. with symptoms suggesting arrhythmia. In Table 3 we compared results in these three groups.

The lowest incidence of SDB was observed in pts. with frequent ventricular ectopy (34%), but this pts. had the lowest mean age, the lowest BMI and the lowest snore index. The worst results we observed in pts. from Group A – pts. with atrial fibrillation (54%). High frequency of AHI > 15 (48%) was also noted in pts. with symptoms suggesting arrhythmia.

PSDB was observed in 29% pts. with AF, 22% pts. with Vebs, 2 and 24% pts. with arrhythmic symptoms. In general more than 50% pts. with AHI > 15 had PSDB - 59/107.

Analysis of factors related with the presence of sleep disordered breathing – multivariate logit regression analysis

We analyzed the factors related with the presence of at least moderate SDB (AHI > 15) and severe SDB (AHI > 30) we used stepwise logit multivariate analysis with backward elimination ($p < 0{,}1$ as the border of inclusion). We included following parameters: age, gender, BMI, diagnosis (Group A, B or C), snore index and % of time in supine position.

Results of multivariate analysis are presented in Tables 4 and 5. Percentage of time in supine position was an independent factor related with the presence of at least moderate or severe sleep disordered breathing.

Discussion

Sleep disordered breathing is a common problem in cardiovascular patients [1,2]. In pts. with arrhythmias we have strong data reporting this problem in pts. with atrial fibrillation [3,4]. The same in our study

Table 2
Comparison of results. Group 1 (AHI < 15 and AHIsup<15), Group 2 (AHI > 15 and AHI nsup >15), Group 3 (PSDB), Group 4 (MPSDB).

Parameter	Group 1 (n = 102)	Group 2 (n = 48)	Group 3 (n = 59)	Group 4 (n = 34)	Statistics
Age	47,2 ± 16,2	64,3 ± 11,3	60,7 ± 11,9	58,7 ± 11,9	$p < 0{,}001$ 1 vs 2,3,4; $p < 0{,}05$ 2 vs 4
Gender F/M	56/46	12/36	16/43	9/25	$p < 0{,}001$
BMI	26,5 ± 4,1	30,9 ± 4,6	29,3 ± 3,7	29,7 ± 5,1	$p < 0{,}001$ 1 vs 2,3,4
AHI	5,0 ± 3,8	39,7 ± 14,5	24,5 ± 8,9	11,1 ± 2,2	$p < 0{,}001$ 1 vs 2,3,4; 2vs3; 2 vs 4; 3 vs 4
meanO2	94 ± 2	91,8 ± 2,0	92,4 ± 1,6	92,3 ± 1,6	$p < 0{,}001$ 1 vs 2,3,4;
%time O2 < 90%	3,9 ± 9,1	19,7 ± 21	10,9 ± 14	9,5 ± 17	$p < 0{,}001$ 1 vs 2,3,4; $p < 0{,}05$ 2 vs 3 $p < 0{,}01$ 2 vs 4
AHIsup	7,1 ± 5,5*	47,9 ± 16,8*	42,5 ± 16*	58,8 ± 11,9*	$p < 0{,}001$ 1 vs 2,3,4; $p < 0{,}01$ 2 vs 4, 3 vs 4
meanO2sup	93,4 ± 2,1*	91,9 ± 1,8	92 ± 1,8*	92,1 ± 1,5#	$p < 0{,}001$ 1 vs 2,3,4;
%time O2 < 90%sup	4,9 ± 11,9*	21,0 ± 20,5#	15,5 ± 16,2*	12,1 ± 18#	$p < 0{,}001$ 1 vs 2,3,4; $p < 0{,}05$ 2 vs 3
AHIns	3,7 ± 4,3	32,1 ± 17,8	7,3 ± 4,0	4,8 ± 2,6	$p < 0{,}01$ 2 vs 3, 2 vs 4, 3 vs 4
meanO2ns	94,1 ± 1,8	92,1 ± 2,4	92,7 ± 1,5	92,4 ± 1,6	$p < 0{,}001$ 1 vs 2,3,4;
%time O2 < 90%ns	2,5 ± 7,5	16,5 ± 22,9	5,7 ± 13	8,0 ± 17,5	$p < 0{,}001$ 1 vs 2,3,4; $p < 0{,}01$ 2 vs 3
% time in SP	50,4 ± 26	47,8 ± 35	51,2 ± 22	29,6 ± 17,6	$p < 0{,}01$ 1 vs 4, 2 vs 4, 3 vs 4

\# $p < 0{,}05$ supine vs nonsupine.
* $p < 0{,}01$ supine vs nonsupine.

Table 3
Comparison of results in three groups of pts. with arrhythmia.

	Group A AF (n = 51)	Group B Vebs (n = 86)	Group C Diag (n = 106)	Statistics
Age	59,6 ± 15,5	53,8 ± 16,3	54,9 ± 15,4	AvsB 0,03; BvsC NS AvsC NS
male/female	38/13	45/41	67/39	
AHI	20,1 ± 16,1	13,8 ± 13,3	19,2 ± 17,1	AvsB 0,02; BvsC 0,02 AvsC NS
AHIsup	32,6 ± 18,9*	22,9 ± 21,3*	28,5 ± 22,6*	AvsB 0,007; BvsC NS AvsC NS
AHInsup	11,5 ± 15,0	6,5 ± 8,7	11,0 ± 14,4	AvsB 0,04; BvsC 0,01 AvsC NS
PSDB				
Group 1 (AHI < 15 and AHIsup<15)	12 (24%)	45 (52%)	45 (42%)	$p = 0,02$
Group 2 (AHI > 15 and AHI nsup >15)	13 (25%)	10 (12%)	25 (24%)	
Group 3 (PSDB)	15 (29%)	19 (22%)	25 (24%)	
Group 4 (MPSDB)	11 (22%)	12 (14%)	11 (10%)	

* $p < 0,01$ supine vs nonsupine.

– SDB was more severe in pts. with the history of paroxysmal or permanent atrial fibrillation comparing to those with other forms of arrhythmia. Never in the past had any publication pointed the importance of sleep position in SDB in patients with different forms of arrhythmia. This is for our knowledge the first publication that analyses the presence of positional sleep disordered breathing in these patients. We clearly documented that sleep breathing parameters achieved worse results when patients slept in supine position. Even the patients with AHI < 15 had significantly higher AHI values in supine than non-supine position. Supine position favors upper airway obstruction and is an important factor that determines the presence of obstructive sleep apnea [15]. In the previous study of 200 consecutive pts. with suspected obstructive sleep apnea [OSA] Di-Tullio et al. reported that 54% of pts. with OSA had positional form of SDB [16].

Positional SDB were reported in heart failure patients. Pinna et al. documented positional sleep apnoea in 76% pts. with obstructive sleep apnoea and in 53 of those with central sleep apnoea [17].

Our study confirms the importance of sleeping position on the presence of SDB. In multivariate analysis we showed that longer time in supine position had independent impact on the presence of moderate or severe SDB.

We think that very interesting observation of our study is the group of 34 patients with slight SDB-AHI [5–15] who evidently presents positional sleep disordered breathing. These pts. spent less time in supine position than other pts. but this time was enough to express the problem. We may suspect that if they sleep longer in supine position, they might have more pronounced SDB – simply PSDB.

CPAP therapy is the first line mode of treatment of OSA. This kind of therapy improved the recurrence of atrial fibrillation after cardioversion in the study conducted by Kanagala et al. [18] – 82 vs 42%. Significant decrease (compared to baseline) in atrial and ventricular ectopy in patients with atrial fibrillation and OSA at 3 and 6 months of CPAP treatment was recently reported by Abumuamar et al. [19]. The use of CPAP therapy was associated with the lower risk of incidence of heart failure in pts. older than 60 yrs. in big observational Danish population study [20]. On the other hand - we know that the patient compliance to CPAP is not high [21].

The significant frequency of PSDB should raise the question about the sense of specific therapy. Positional therapy in pts. with recognized PSDB has been used for many years [22–27]. Different solutions were implemented starting from simple “tennis ball” in the back to more sophisticated devices. Positional therapy is not so frequently used as “gold standard” CPAP therapy. The positive potential of positional therapy was even commented as “undervalued” [24]. Reported results are generally positive showing the significant decrease of AHI or % of time with O2 < 90%. One study presented worse results of positional therapy in comparison with CPAP but it used old “tennis ball” technique [25]. Compliance of positional therapy was not always high [26]. We think that patients with documented PSDB at first should be informed how sleeping position has important impact on their breathing parameters. We should present them the potential solutions and results of this behavioral therapy should be verified.

When we look at our and previously reported data presenting worse breathing parameters in supine position in most of the patients, we think that we can ask the question - if we in general should advise our patients as a prevention of SDB to avoid sleeping in supine position? Big data are necessary to document if such simple solution may decrease the number of pts. with SDB and what is more important - may influence the clinical outcome and prognosis.

Study limitation

Our study has limitations that we want to express. We tried to include consecutive pts. but having 2 polygraphic devices it was not always possible. However, the frequency of SDB was comparable with previous studies in pts. with cardiovascular diseases. We did not use polisomnography as the diagnostic tool. Polygraphy was previously reported as an almost equal tool and enabled us to record data in ambulatory pts. As an advantage, polygraphy is easier and cheaper. We had no comparison of results of the same patients sleeping all the night in nonsupine position. The number of patients in subgroup analyses was not big but the results of statistical analyses with the level of significance mostly below 0,01 was suggestive.

Conclusions

1. Moderate or severe SDB is recorded in 44% of pts. with arrhythmias, almost 50% of them have positional SDB.
2. Percent of time of sleeping in supine position has an important independent impact on the presence of SDB.
3. Big studies should be conducted to verify if avoidance of sleeping in supine position may improve clinical outcome.

Table 4
Factors related with the presence of moderate SDB - multivariate analysis.

Parameter	Odds ratio (CI)	p=
Gender (male)	4,3 (2,1–9,1)	0,0001
BMI	1,1 (1,02–1,2)	0,017
Age	1,06 (1,03–1,08)	0,0001
Snore	1,05 (1,03–1,08)	0,0001
% of Time in SP	1,02 (1,01–1,04)	0,001

Table 5
Factors related with the presence of severe SDB – multivariate analysis.

Parameter	Odds ratio (CI)	p=
Gender (male)	5,3 (1,97–14,7)	0,001
Age	1,07 (1,04–1,11)	0,0001
Snore	1,07 (1,04–1,1)	0,0001
% of Time in SP	1,03 (1,02–1,05)	0,0001

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