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Clinical case of treatment of obstructive sleep apnea/hypopnea syndrome in patient with bronchial asthma

Key words: *obstructive sleep apnea/hypopnea syndrome, bronchial asthma, polysomnography, continuous positive airway pressure*

A respiratory disorder during sleep is a group of pathological conditions that are important and socially significant problem of modern medicine. Obstructive sleep apnea/hypopnea is one of the most common disorder (hereinafter – SOAHS). SOAHS defined as a combination of excessive daytime sleepiness and breathing disorders during sleep, resulting intermittent, repetitive episodes of the upper airways collapse. Apnea is a complete descending of the upper airways of a 10-second or longer cessation of ventilation. Hypopnea is a partial narrowing by 50 percent or more of the upper airway with a 10-second or longer ventilation decrease. Episodes of apnea/hypopnea considered obstructive if the respiratory effort remains. In the absence of respiratory effort, apnea/hypopnea episodes considered as central [1].

According to the Wisconsin Sleep Cohort study (Wisconsin Sleep Cohort Study, 2003) SOAHS prevalence in the general population is 10–12 %, and it affects up to 24 % of the population in the middle age group (30 to 60). More than 40 % of patients with SOAHS have combined pathology: coronary heart disease (CHD), hypertension (AH), chronic obstructive pulmonary disease (COPD), asthma (BA) [6].

The pharyngeal muscle tone is reduced during sleep in patients with SOAHS that leads to narrowing of the upper airways, their partial or complete decrease and pulmonary ventilation stop. Hypoxemia and hypercapnia leads to compensatory activation of sympathetic-adrenal system and the formation of enhanced respiratory effort to restore the airway. These points lead to a transition to a more superficial stage of sleep or full awakening of the patient; reoxygenation takes place after the blood ventilation restoring. Then the patient goes to sleep again, muscular hypotonia occurs, abnormal circle closes. These phenomena can be repeated hundreds of times a night, resulting in a disruption of sleep patterns, the development of daytime sleepiness, as well as circulatory and hemodynamic disorders, oxidative stress, systemic inflammation syndrome [2].

SOAHS significantly reduces the duration and reduces the quality of life of patients. Excessive daytime sleepiness, cognitive and neurotic disorders, nocturnal snoring, sexual disorders cause social and individual conflicts. Patients with SOAHS constitute group of high-risk relative to transport and industrial injuries

Risk factors of SOAHS are: anatomical and functional abnormalities such as: reducing the caliber of the upper airways, genetic predisposition, smoking, obesity, male gender, females in postmenopause, old age [4].

Somatic effects of SOAHS are not less significant: cardiovascular (hypertension, coronary heart disease, circulatory failure, arrhythmias, stroke) and severe metabolic disturbances (insulin and leptin resistance, diabetes type II, obesity) [2].

Combining SOAHS and bronchial asthma (BA) in one patient mutually aggravating course of nosology. The frequency of SOAHS in asthma is about 18–20 %. Even a healthy person during sleep has ventilation and respiratory sensitivity to stimuli reduction. As for the patients with asthma, these phenomena lead to dramatic consequences of hypoxia and hypercapnia, pulmonary hypertension, high risk

of nocturnal death. The severity of the combined pathology caused by the inability to adequately resaturation after apnea in asthma, in contrast to the healthy lung and insufficient ventilation response due to weakness of the respiratory muscles and inhibition of respiratory drive [5].

Polysomnography is a recognized standard diagnostic of SOAHS, in which sleep and the nature of the patient's breathing, the parameters of the heart and blood oxygenation, the movements of the lower extremities are simultaneously recorded.

Polysomnography is performed in a specially equipped sleep laboratory by the constant presence of a laboratory assistant that monitors the adequacy of the technical examination and the patient's behavior with the following interpretation of results by the doctors with knowledge of Sleep Medicine [11].

SOAHS should be defined as a condition in which AGI ≥ 15 episodes per hour or a value of AGI is from 5 to 14 episodes per hour documented daytime sleepiness, impaired consciousness or mood, history of hypertension, coronary heart disease, acute disorders of cerebral circulation [7].

Non-invasive ventilation support is the most effective way to treat SOAHS. According to the experts of the American Academy of Sleep Medicine, positive airways pressure (PAP) is the therapy of choice for all forms of SOAHS and should be offered to every patient with SOAHS [3].

The types of devices that create a positive pressure in the airways:

1. CPAP is a delivery of fixed pressure in the airway of the patient during the night (CPAP - continuous positive airway pressure. CPAP devices have a unit that generates an air stream that is directed to the patient's airway through a mask. Created positive pressure prevents the descending upper respiratory tract.

2. BiPAP (bi-level positive airway pressure) is a delivery of a higher IPAP (inspiratory positive airway pressure) during inhalation and a lower EPAP (expiratory positive airway pressure) during exhalation in the respiratory tract of the patient. BiPAP therapy is used in patients with a combination of SOAHS and severe course of COPD hypoventilation syndrome, as well as poor tolerance of CPAP therapy by the patient.

3. AutoCPAP is a mode with automatic change of pressure for the airway maintenance depending on the patient's needs. AutoCPAP facilitates initial treatment titration pressure and improves patient adherence to therapy.

4. ASV is adaptive servo-ventilator which provides steady minute volume ventilation maintenance in patients with heart failure and central sleep apnea [8, 10].

Here is a clinical case of our own observations (work carried out by the state budget).

Patient, D. 1953 year of birth (50 years) admitted to hospital with complaints of daytime sleepiness and fatigue, headache, disturbed nocturnal sleep with frequent awakenings, dry mouth upon awakening, dry cough, shortness of breath at rest, aggravated by exertion. There were also short of falling asleep while performing repetitive work and driving. Relatives of patients concerned about his loud snoring and pauses in breathing during sleep. By the Epworth Sleepiness Scale, the daytime sleepiness of the patient was rated as severe (22 points) at a normal rate of 10 points. He considers himself a patient for 4 years, when the snoring, sleep disturbance, fatigue and daytime sleepiness appeared. Also, the patient complained of attacks of breathlessness about 1–2 times a week in the afternoon and 3-4 times a month at night, morning stiffness in the chest (asthma control test (ACT) – 22 points), episodes of high blood pressure and pain in the heart area.

Patient does not smoke and have never smoked. From anamnesis suffers from asthma for 23 years. Diagnosis: Asthma, persistent, III stage severity, partially controlled, f. remission. Coronary heart disease (CHD), hypertension (AH) stage II, atherosclerotic cardio since 2006. Takes basic therapy of asthma: Seretide 50/500 mcg 2 times a day, 2 inspiration of Salbutamol to stop asthma symptoms if stated as necessary. Regarding hypertension, patient receives treatment: Enalapril – 20 mg daily, Preductal – 75 mg daily throughout the year.

Objectively, the general condition is satisfactory. Anthropometric data indicate a high risk of developing SOAHS: height – 183 cm, weight – 123 kg, body mass index – 36.7 kg/cm2, neck circumference - 43 cm. On examination, the general condition is satisfactory, heart rate – 70 per min., BH – 20 per min., blood pressure – 155/90 mmHg.

On radiographs of the lungs – symptoms of chronic bronchitis, the ECG – sinus rhythm and signs of right heart overload.

According rynomanometria – nasal breathing is not broken. Ultrasound of the abdomen shows the signs of liver fatty infiltration, gallbladder cholesterosis, chronic cholecystitis.

According to the spirogram and «flow-volume» curve analysis of forced expiratory and total body plethysmography on the «Master Screen PFT», device of «Cardinal Health" Company (Germany), FEV1 was 56.7 %, reversible bronchial obstruction – 12.8 %.

Support of overlap (membrane) was surveyed to determine the strength of respiratory muscles (PImax and PEmax) and neural respiratory drive (P0, 1). The study was conducted on the «MasterScreen-PFT» device of «Cardinal Health» Company. There was a decrease strength of respiratory muscles (both PImax (60 %) and Pemax (82 %)), a slight increase in neural respiratory drive (156 %), which confirms the severity of the disease.

The patient was conducted daily monitoring of ECG (EC-2H, Labtech), blood pressure (ABMP04, Meditech). The values of blood pressure averaged 155/92 mmHg, maximum blood pressure is 170/100 mmHg., increased levels of daily index (DI – 25 %) at a rate of 10–20 % (reflects the level of blood pressure reduction at night), the index of time (Hldx – 60 %) at a rate of 15–20 % (indicating the number of measuring blood pressure that exceeds normal indicators). Holter monitoring recorded lower overall heart rate variability (SDNN – 90 ms) at a rate of 96-162ms, indicating increased activity of the sympathetic division of the autonomic nervous system (ANS), especially at night, the presence of supraventricular extrasystoles (SVEs) – 500 per day, at a rate of up to 100, ventricular extrasystoles (VEs) – 130 per day, at a rate of up to 100. Average daily heart rate was 88 per minute.

In the biochemical blood analysis increased levels of total cholesterol to 5.8 mmol/L (normal 5.2 mmol/L), triglycerides up to 2.3 mmol/L (normal 1.8 mmol/L), were detected, other parameters, general blood and urine tests without pathology.

Patients underwent polysomnography (PSG), the results of which revealed significant changes in the PSG: index of apnea/hypopnea (IAH) – 22/h, apnea index 9/h, average nocturnal saturation 84.2 %, minimum saturation 72.4 %, desaturation index 25.8/h. Patient diagnosed – SOAHS, moderate severity [1].

Taking into account the average degree of sleep disorders and concomitant asthma and hypertension, the patient was recommended an auxiliary ventilation therapy using SPAP.

First night of CPAP therapy was conducted in a laboratory to determine the level of sleep pressure treatment, efficiency control and tolerability of treatment. After the first night with the CPAP device patient noticed a good sleep and feeling of rest. As a result, the polysomnography study, while sleeping with CPAP device, revealed normalization of disturbed sleep parameters: an index decrease of apnea/hypopnea (IAH) from 22/h. to 10/h., apnea index from 9/h. to 4/h., average nocturnal saturation from 84.2 % to 91.5 %, the lowest saturation from 72.4 % to 88 %, the index of desaturation from 25.8/h. to 6.8/h., therefore this mode of ventilation support is recognized as appropriate for the patient.

After 10 days the patient improved significantly: decreased fatigue disappeared daytime sleepiness, episodes of falling asleep while driving, snoring, and headaches. Decreased dyspnea, disappeared cough and dry mouth. The general condition of the patient is satisfactory. Heart rate 64 per minute., blood pressure 140/85 mmHg., RR 19 per minute. Due to Epworth Sleepiness Scale the level of daytime sleepiness in patients decreased from 22 points to 9 points.

Dynamics of PSG continued to improve after 10 sessions of CPAP treatment.

Compared with the results of the first PSG, a reduction in respiratory distress index to 7/h was found as well as apnea index to 3/h, desaturation index to 6.2 % overnight.

The patient is recommended to keep basic medical asthma treatment and carry CPAP therapy on a regular basis.

After 10 sessions of CPAP therapy, a positive dynamics of asthma symptoms is observed: fewer attacks of breathlessness, reduced cough (ACT 18 points).

The FDD dynamics before and after treatment are presented in Table 2.

There was a decrease in general resistance of airway (Rtot) from 109 % to 80 %, from 94.8 % to 72.4 % of residual volume (RV) and from 82.7 % to 71, 9 % of intrathoracic gas volume (ITGV), increase of total lung capacity (VC) from 86.4 % to 90.7 %, increase of FEV_1 values from 66.7 % to 78.1 %, and FVC from 87.3 % to 94.2 %, inspiratory capacity (IC) from 93.8% to 97.7 % and the flow rate at the level of small bronchi (FEF_{25}, L/s) of 49,3 to 64,5 (FEF_{50}, L/s) from 34,3 to 46,2, (FEF_{75}, L/s) from 20,9 to 31,4. Improved ratio of FEV_1/ FVC from 61.67 % to 66.84 %.

While conducting repeated daily monitoring BP and ECG an average daily blood pressure decreased and made 130/88 mmHg., maximum blood pressure recorded per day was 150/90 mmHg, and average heart rate was 73 beats / min. The level of DI – 18 %, Hldx – 30 %, SDNN – 110 ms, SE – 150 /day, st – 50 /day also decreased indicating a normalization of blood pressure, a significant reduction of blood pressure at night, the function of the autonomic nervous system improvement (increased parasympathetic ANS activity at

Table. 1

Dynamics of PSG before and after treatment

Indicators	Before treatment	After the first night of therapy	After 10 days
Index of desaturation, / h	25,8	6,8	6,2
Basal SpO_2 during sleep, %	87,5	92,6	95,6
Average level of SpO_2 during desaturation, %	84,2	91,5	92,5
Longest desaturation, sec.	54	22	18
Minimum level of SpO_2 during desaturation, %	72,4	88	89,2
Basal heart rate during sleep, /min	70	68	66
Index of respiratory disorders /h	22	10	7
Index of apnea /h	9	4	3
Index of hypopnea /h	13	6	4
The total number of apnea /night, including:	230	18	12
- obstructive	177	10	8
- mixed	33	6	2
- central	20	2	2

Table 2
Dynamics of FDD results before and after treatment

Indicators	Before treatment		After 10 days of traetment	
	absolute value	% of a must	abso-lute value	% of a must
R tot, kPa*s/L	0,33	109,6	0,24	80,0
IC, L	4,19	93,8	4,36	97,7
ITGV, L	3,19	82,7	2,77	71,9
RV, L	2,13	94,8	1,63	72,4
TLC, L	7,38	86,8	7,13	83,9
VC MAX, L	5,24	86,4	5,50	90,7
FEV_1, L	3,12	66,7	3,65	78,1
FVC, L	5,06	87,3	5,46	94,2
FEV_1/ FVC, %	61,67		66,84	
FEF 25, L/s	4,42	49,3	5,78	64,5
FEF 50, L/s	1,97	34,3	2,65	46,2
FEF 75, L/s	0,56	20,9	0,83	31,4
PEF, L/s	5,79	56,1	9,65	93,6
MMEF 75/25, L/s	1,53	32,6	2,17	46,2

Table 3
Dynamics of blood pressure and ECG before and after treatment

Indicators	Before treatment	After 10 days of traetment
	% of a must	% of a must
BP mmHg average per day and night	155/92	130/88
BP mmHg average per night	145/85	120/80
BP mmHg maximum per day and night	170/100	150/90
BP mmHg maxi-mum per night	160/95	135/85
DI %	25	18
Hldx % per night	40	15
Hldx % per day	60	30
SDNN мс	90	110
VE per day	150	50
SVE per day	500	150
VE % per night	70	30
SVE % per night	65	40

night), reducing arrhythmias. An objective review did not revealed the pathology.

The dynamics of blood pressure and ECG before and after treatment are presented in Table 3.

Thus, CPAP therapy is a prerequisite for the full normalization of respiratory disturbances during sleep due to collapse of the upper airways and makes it easier for course of asthma, improving functional performance and reduces the incidence of heart disease and the risk of life-dangerous arrhythmias. And the majority of chronic diseases requires continuous basic therapy and SOAHS treatment involving CPAP therapy equipment or modifications nightly (or almost every night at least three times a week), consistently with regular doctor's advice.

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КЛИНИЧЕСКИЙ СЛУЧАЙ ЛЕЧЕНИЯ СИНДРОМА ОБСТРУКТИВНОГО АПНОЭ/ГИПОПНОЭ СНА У БОЛЬНОГО С БРОНХИАЛЬНОЙ АСТМОЙ

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Резюме

Синдром обструктивного апноэ/гипопноэ сна (СОАГС) – актуальная проблема здравоохранения. На сегодняшний день

представленная выше патология недостаточно изучена и как следствие – слабодиагностируемая. В материалах статьи изложена клиническая картина, особенности диагностики и лечения СОАГС, используя полисомнографию и CPAP-терапию, на примере собственного наблюдения авторов. Изложенный авторами материал позволяет повысить уровень осведомленности врачей в вопросах диагностики и лечения СОАГС у больных бронхиальной астмой.

Ключевые слова: *дыхательные расстройства во время сна, синдром обструктивного апноэ/гипопноэ сна, бронхиальная астма, CPAP-терапия*

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CLINICAL CASE OF TREATMENT OF OBSTRUCTIVE SLEEP APNEA/HYPOPNEA SYNDROME IN PATIENT WITH BRONCHIAL ASTHMA

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Summary

Obstructive sleep apnea/hypopnea syndrome is an actual problem of public health. Described above pathology is not well studied yet and therefore poorly diagnosed. Clinical features, diagnostic and treatment of sleep apnea/hypopnea syndrome using polysomnography (PSG) and continuous positive airway pressure (CPAP) were expounded in the article regarding the authors' observations. Materials, outlined by the authors, allow to increase doctors' awareness in the diagnosis and treatment field.

Key words: *sleep-disordered bretahing, obstructive sleep apnea/hypopnea syndrome, bronchial asthma, continuous positive airway pressure.*

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