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THE POSSIBILITIES OF OTOLARYNGOLOGYSTS FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

[1*]Avramov, T., [1]Konov, D., [1]Valcheva, S., [2]Vicheva, D., [3]Manolova, A., [4]Tafradgiiska, M., [4]Valev, D., [3]Strandzheva, M., [4]Kostadinov, D. and [1]Tchalacov, I.

[1]ENT Clinic, University Hospital "Tsaritsa Yoanna", Medical University, 8, Bjalo More str, 1508, Sofia, Bulgaria
[2]Department of Otorhinolaryngology, Medical University, Plovdiv, Bulgaria
[3]National Center for Public Health and Analysis. 15, Acad. Iv. Geshov Blvd. 1431, Sofia, Bulgaria
[4]Specialized Hospital for Active Treatment of Pulmonary Diseases "St. Sofia" Ltd, 19, Acad. Iv. Ev. Geshov Blvd. 1431, Sofia, Bulgaria

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ABSTRACT

The possibilities and the results of treatment of patients with snoring and obstructive sleep apnea, treated in the ENT Clinic, University Hospital "Tsaritsa Yoanna" for a period of three years were investigated.

Materials and methods: 22 patients with snoring and obstructive sleep apnea, treated with Laser Assisted Uvoluplasty, Radio frequent Interstitial Thermo coagulation and tracheotomy were monitored. The methodology of the study consisted of anamneses, ENT-status, blood counts, biochemistry, fibroscopy of the upper respiratory tract and for the majority of patients - polysomnography.

Results: The surgical methods of treatment indicated significant improvement of snoring in 13 patients and weakening of the main symptoms of obstructive sleep apnea. For the other 8 patients, insignificant improvements in snoring and no effect on the main symptoms of obstructive sleep apnea were observed.

Conclusion: The conducted study of sleep apnea treatment provided useful information about the opportunities concerning the management of snoring and obstructive sleep apnea, and gave some practical recommendations. The otolaryngologist was been placed in a favorable position in the treatment of snoring and obstructive sleep apnea. The interruption of the pathogenetic cascade was a crucial part, and that currently, with surgical treatment, improved the quality of life, but did not achieve complete healing.

INTRODUCATION

In nowadays' intense everyday life, various forms of sleep disturbances can be observed. One of them is the sleep apnea, which is characterized by mimicking interruptions of the airflow through the upper respiratory tract (the nose and the mouth) during sleep and also leads to decrease of the oxygen saturation of the blood. When a patient has more than ten apneic pauses per hour or more than thirty in one eight-hour sleep cycle, the sleep apnea syndrome (SAS) is apparent. Each pause (incident) must have a minimum duration of 10 seconds.

Corresponding author: Avramov, T.,
ENT Clinic, University Hospital "Tsaritsa Yoanna", Medical University, 8, Bjalo More str, 1508, Sofia, Bulgaria

When the episodes of reduction or interruption of airflow, leading to hypoxemia, sleep fragmentation and deprivation of sound sleep (deprivation), are caused by the collapse of the upper respiratory tract, then we talk about Obstructive Sleep Apnea (OSA), which is one of the three forms of the apnea syndrome (Milanova, 2008). The other two forms are central apnea and mixed apnea. It is estimated that the prevalence of OSA in the general population is 2-5%, with the frequency of 24% among middle-aged men and 9%, among women (Tsolov, 2012). It can be divided into mild, moderate and severe. Its severity is assessed by the following indices - number of apnea and hypopnea for an hour of sleep or the apnea/hypopnea index – AHI, and oxygen desaturation level. A clinically manifested OSA has a registered index of AHI>5. For the mild form, it is 5 ≤ AHI <15 per hour, for the moderate

- 15 ≤ AHI <30 per hour, and for the severe - AHI ≥30 per hour (Rangachev, 2012; Milanova, 2008; Tsolov, 2012). The so-called "narrow" regions are situated at the level of the soft palate, the mesopharynx, the tongue (its base), the jaw and the epiglottis, and cause narrowing of the airways during sleep. Based on the level of narrowing (obstruction), we observe the following mechanisms of obstruction: uvula and soft palate – anteroposterior direction and concentric, lateral pharyngeal walls – laterally and concentric, base of tongue - anterior-posterior, epiglottis - valvular and anterior-posterior. Individual constrictions are observed on one level, on multiple levels and in total. With the aim to improve the results of surgical treatment of snoring and OSA, significant attention should be paid to two areas of the pharyngeal tube: the area or the segment of the soft palate (velopharynx) and the area of the base of the tongue. The most common cause of snoring is the segment of the soft palate. Increased soft palate tonsils, macroglossia, abnormal position of the upper and lower jaw are considered as predisposed to collapse of the upper respiratory tract (URT) (Tsolov, 2012).

To clarify the causes of snoring and OSA, we should mention some characteristics of the regulation of breathing during wakefulness and sleep. During wakefulness, our breathing is regulated metabolically and volitionally, while during sleep the regulation is regulated only metabolically. During sleep, weakening of the neuromuscular activity of the URT is observable, which is caused by the physiological decrease of the dilators tonus. When considering apnea, lack of muscle contraction is observable, while in hypopnea, there is insufficient contraction. A critical weakened motor response of the muscles of URT leads to collapse, and hence, to subsequent obstruction, and this effect is more pronounced in patients with the above anatomical features. Snoring and excessive daytime sleepiness are the main symptoms of OSA. Furthermore, the symptoms can be divided into daytime and nighttime symptoms. Daytime symptoms are the increased daytime sleepiness, morning headaches, dry mouth upon awakening, irritability even changes in the personality, depression, decreased sexual drive, impaired concentration, problems in the family and at work, gaining weight and high blood pressure. Nighttime symptoms are loud, often intermittent snoring, heavy breathing and episodes of suffocation, nocturnal enuresis (nocturia), grunting during sleep accompanied by choking after which the patient wakes because of the respiratory effort.

The main reason that causes patients to seek assistance from an ENT specialist is snoring (information from patient's relatives is received for its severity) and attacks of suffocation in which the patient awakens. Habitual snoring is a major symptom of sleep apnea syndrome (SAS). Observations suggest that approximately 20% of males and 5% of women, aged 30 – 35, do snore. At age 60, snoring is observed in 60% of men and 40% of women. For adults, the male/female ratio is 2:1, whereas for children, the ratio is 1: 1. Loud, habitual snoring is a family matter and therefore, the condition has also a medico-social aspect (Tsolov, 2012). OSA treatment is performed by both surgical and non-surgical methods. The non-surgical treatment is carried out mainly through CPAP (continuous positive airway pressure) and BIPAP (two-stage positive pressure – Bi-level Positive Airway Pressure). Through it, constant or two-stage positive pressure passes through a nasal mask, and thus, URT is maintained open and the occurrence of apnoic and hypopnoic episodes is prevented (Milanova, 2005). The surgical treatment includes: uvulopalatopharyngoplasty (UPPP), Laser Assisted Uvoluplasty (LAUP); Cautery Assisted Palatinal Stiffering Operation (CAPSO), Coblation Assisted Upper Airway Procedure (CAUP); radiofrequency tissue volume reduction (RFTVR), element of which is Radio frequent Assisted Uvuloplasty (RAUP); Mandibular myotomy; Mandibular/ maxillary Advancement Surgery (MMA); Hyoidopexy and Tracheotomy (Milkov *et al*., 2008; Nedev *et al*., 2008; Milkov *et al*., 2009). Snoring is most successfully treated surgically, as the target object of influence is that part of the upper respiratory tract which is causing the snoring.

MATERIALS AND METHODS

In the period 2010-2013 in the ENT Clinic of the University Hospital „Tsaritsa Yoanna" were operated and followed 22 patients with snoring and OSA (19 men and 3 women), the mean age was 48.32 ± 11,14 years. The used diagnostic methods were anamneses, ENT-status, blood counts, leukogram, ionogram, biochemistry, X-rays of the paranasal cavities, fibroscopy of the upper respiratory tract, for 17 of the patients - polysomnography and for 5 of the patients - screening polygraph. Based on the self-reported data for height and weight the levels of overweight and obesity were assessed. The following surgical techniques were used:

LAUP - During this technique, part of the uvula and the surrounding soft tissues is removed. This part was originally used for the treatment of snoring, and later in the treatment of sleep apnea.

RFITT – During this technique, radio frequency generator is used to contract and reduce the soft tissue of the airways and to reduce the level of snoring. As a result of the thermal effects, the tissue in depth is shrinking and the mucosa, which covers the tissue, remains unaffected.

Tracheotomy was the only possible treatment of obstructive sleep apnea until the beginning of 80s. Statistical analysis was performed using SPSS software (version 17, SPSS statistical package, Inc, Chicago, IL, USA) with the level of significance $P < 0.05$. The study complies with the ethical principles of the Declaration of Helsinki and is conducted following the approval of the Ethical Committee in University Hospital "Tsaritsa Yoanna".

RESULTS

Depending on the surgical technique, the patients were divided into three groups:

Group I– LAUP (n= 12); Group II – RFITT (n= 9); Group III - tracheotomy (n= 1). There were no significant differences in the age structure of the 3 groups of patients - $P>0.05$ (Table 1). The majority of the patients (81.8%) were identified with obesity – I degree (n=9), II degree (n=5), III degree (n=3) и IV degree (n=1). Normal weight was established for 4 of the

patients, aged 29 - 43. The average number of performed surgical procedures is 2,45 ± 0.6, as in Group I - 2.42 ± 0.51, in Group II - 2.67 ± 0.50 in Group III - 1.

Table 1. Age structure of the monitored group

Surgical methods	N	Mean	Std. Deviation	Minimum	Maximum
Laup	11	47,27	13,062	29	68
RFITT	10	48,40	9,264	37	64
Tracheotomy	1	59,00	.	59	59
Total	22	48,32	11,137	29	68

Patients from groups LAUP и RFITT were operated under local anesthesia and the tracheotomy patient - under general anesthesia. For all of the patients from Group I and Group II at the first stage were performed corrections of the patency of nasal passages; for 7 of the cases - with septoplasty and the remaining 14 –the volume of the nasal mucosa of the lower nasal shells was reduced. No complications were observed in patients treated with the surgical methods in question. Prior to the intervention, all of these patients suffered from mild OSA (AHI from 5 to 15). Furthermore, it has to be underlined that before the treatment in the clinic, the duration of their complaints was 1-3 years. After the surgical procedure a reduction of the snoring intensity was reported in 13 patients (7 treated with LAUP and 6 with RFITT). Based on data provided by the patients' relatives, significant declining of excessive daytime sleepiness is observed. It has to be mentioned that following a diet, prescribed by a doctor, the patients also reduce their weight with 4.5-7.0 kg.

In the other 8 patients, we observed significant improvement of snoring and no effect on excessive daytime sleepiness. Five of these patients had mild form of OSA, and three – moderate with duration of complaints before the treatment of 4-7 years. All of patients had a history of cardiovascular diseases, and 4 of them had diabetes mellitus type II. The target for the patient that required tracheotomy was to ensure patency of the airways because of the seriousness of the accompanying cardiovascular diseases. Her height was 1.65 cm, weight - 150 kg (BMI=55.5) and AHI>30/hour, so LAUP and RFITT interventions were not applicable. Despite the intensive resuscitative measures, the patient made exitus letalis on the 5th day after the tracheotomy, showing progressive cardiovascular failure against high blood sugar, poorly responsive to the ongoing insulin therapy. Different studies demonstrate that metabolic-vascular complications develop in about fifteen years, but, however, this patient's medical history showed that these complications had developed for about nine years and resulted in fatal outcome.

DISCUSSION

As in other studies, our results show that probably the biochemical and cellular effector-receptor defects that interrupt the activation of the cascade of enzymatic reactions underlie OSA and the metabolic syndrome, which is observed in more than 80% of our patients (Milanova, 2008). Thus our patients, who have reduced their weight after a diet, the surgery led to improvements of some of the main symptoms – snoring and excessive daytime sleepiness. We believe that the best results of surgical treatment can be obtained when AHI ≤30 / hour and BMI ≤32. It is suggested that the components of the metabolic syndrome not only trigger the disease progression, but are also developed as a result of the disease, leading to the creation of a vicious cycle (Wolk and Somers, 2007; Leung and Bradley, 2001). The cells of the striated muscles are the primary users of glucose in the body; some patients no longer absorb sufficient amount of glucose from the blood. Reduced consumption leads to hyperglycemia following the increase release of insulin by the β-cells of the pancreas. Hyperinsulinemia results in normalization of the glucose levels in the blood, but also increases weight and fat stores, mainly in the abdominal and gluteal region. It is assumed that an increase in body weight of 10 kg, doubles the risk of OSA (Milanova, 2008). Transmitting hormones from these adipocyte depots activates the sympathetic nervous system, resulting in increased blood pressure, and from these depots are released more free fatty acids and pro-inflammatory factors, inflammatory mediators (TNF-α, IL-6, IL- 8, etc.), vasoactive substances, components of the renin-angiotensin-aldosterone system. Increased cytokine levels in a concrete TNF-α may lead to insulin resistance (Zavaroni *et al*., 1999).

Thus, a second vicious cycle is created - insulin resistance is increased in both the muscle cells and in the liver provoking a new increase in the production of insulin. High circulating insulin levels in insulin-resistant patients trigger through the link receptor-effector, the activation of the insulin-like growth factor. This leads to the swelling and proliferation of soft tissue in the neck area, reflecting the formation of the so-called "narrow" regions in the area of the pharynx (Rangachev, 2012). Up to a certain time, the pancreas maintains the balance in the body by hyperinsulinism. Gradually, the β-cells of the pancreas become exhausted, and impaired glucose tolerance is observed, which is considered as a pre-diabetic state of hyperglycemia. Hyperinsulinism has pronounced atherogenic effect, which manifests in dyslipidemia leading to deposition of atheromatous substance and proliferation of smooth muscle cells in the vessel wall (Ramnathan and Revati, 2006). Additionally, the inflammatory mediators, the vasoactive factors and other substances enhance atherosclerosis by a generalized inflammatory process that can be objectified by elevated levels of C-reactive protein. These changes result in formation of plaques in the walls of cerebral and coronary vessels, leading to vascular rigidity and narrowing of the vascular lumen.

Moreover, increased vascular resistance, loading of the left ventricle, venoconstruction and increased right ventricle preload, increased myocardial contractility, tachycardia and arrhythmia are also observable. As a consequence of this, we can consider the left ventricular hypertrophy, myocardial changes and the increased risk of ischemic heart disease (Wolk and Somers, 2007; Leung and Bradley, 2001). At the same time, we can detect changes in the blood, which can be formulated as pro-trombogenic condition. These changes are included in the viscosity, the increased levels of fibrinogen, factor VII and von Willebrand factor (Zavaroni *et al*., 1999). Its, in turn, cause coronary, cerebral and peripheral ischemia, hypertension, leading to increased susceptibility to accidents and mortality in patients with AHI>20/hour as opposed to those with AHI<20/hour (Marin *et al*. 2012; Redline *et al*., 2010; Riha *et al*., 2008). This was the case with the tracheotomy patient, who died on the 5th day after the intervention.

CONCLUSION

The obtained results and the various operative approaches provide useful information about the possibilities in the treatment of snoring and obstructive sleep apnea. The otorhinolaryngology specialist is placed in a relatively favorable position in the treatment of snoring, but not in that of the obstructive sleep apnea. The operational techniques lead to improvement in patients' complaints (primary snoring and quality of life), but not to complete healing. In our opinion, the division of apnea syndrome into three types in not accurate. Probably, these are the three different stages of the disease progression. We believe that the guiding element in the treatment of OSA remains the discovery of the cause of the damage of the metabolic regulation of breathing during sleep and the interruption of the connections between the components in the cascade of the metabolic syndrome, and hence, the reduction of swelling and proliferation of soft tissue in the neck area. We assume that the correct approach is to influence sleep deprivation at an early stage and thereby stop the progression of multiorgan pathology. The treatment of OSA should be carried out by a multidisciplinary team - neurologists, cardiologists, pulmonologists, endocrinologists and otorhinolaryngology specialist.

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List alphabetical abbreviations

1. AHI - Apnoe Hypopnoa Index
2. BIPAP - Bi level Positive Airway Pressure
3. BMI - Body Mass Index
4. CAPSO - Cautery Assisted Palatinal Stiffering Operation
5. CAUP - Coblation Assisted Upper Airway Procedure
6. CPAP - Continuous Positive Airway Pressure
7. IL - interleukin
8. LAUP - Laser Assisted Uvoluplasty
9. OSA - Obstructive Sleep Apnea
10. RAUP - Radiofrequent Assisted Uvoluplasty
11. RFITT - Radiofrequent Interstitial Thermocoagulation
12. SAS - Sleep Apnea Syndrome
13. TNF - Tumor Necrosis Factor
14. UPPP – Uvulopalatopharyngoplasty
15. URT - Upper Respiratory Tract

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