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Review Article

Sleep Disorders and Sleep Apnea: Instrumental Innovations in Polysomnographic Diagnosis and Personalized Minimally Invasive Therapies

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Abstract

OSAS diagnosis must be very accurate and performed in ENT centers specialized in the sector. It is based on the acquisition of anamnestic information, collection of anthropometric data, ENT examination, airway endoscopy, specific radiological tests and polysomnographic study. Diseases of the upper respiratory tract which contribute to sleep respiratory disorders are very widespread in industrialized societies and the economic impact is little investigated and underestimated.

Correct information, simple prevention diagnostic measures (polysomnography) and new minimally invasive high technology solutions (radiofrequency and balloon based) can change this unfortunately dramatic and underestimated reality. It would be a duty to support prevention starting from determining early diagnoses. The quality of life of a considerable number of people can be significantly improved, and sometimes some can be saved, even in this area, with a consequent, notable social saving.

The WatchPAT device, worn like a wristwatch, is an innovative home device for testing sleep apnea and nocturnal snoring that uses a new patented signal parameter PAT (Peripheral Arterial Tone). Using three points of contact with the patient's body surface (sensor on wrist, finger and sternum), WatchPAT measures 7 channels of integrated information on sleep quality.

The new, constantly evolving methods of minimally invasive surgery help in restoring the airway patency and are based on the latest generation radio frequencies-RF (Quantum Molecular Resonance), and balloon catheters both dilative (Thinvasive DRB System) and with kinetic oscillation stimulation (KOS Ozilia) spare healthy tissues, reduce mucosal inflammation and preserve the function of the respiratory mucosa.

A very innovative drug delivery system called Molecular Vaporizer-MV (Nutrintech Med Italia, Rome, Italy) which allows to obtain dry steam (transformation of a liquid solution into Gas or sublimation) has been developed and used by our research team to administrate respiratory drugs also in OSAS patients as a completely new route, obtaining very good clinical results in restoring the proper respiratory airflow.

Keywords: OSAS; Watchpat; Radiofrequency; Balloon; KOS; Molecular Vaporizer

Introduction

For some years we have been used to talking about and dealing with a very frequent and underestimated emerging pathology, which is accompanied by nocturnal snoring (snoring) with apnea, called OSAS (Obstructive Sleep Apnea Syndrome). Technically, this syndrome consists of the presence of respiratory events characterized by complete cessation (apnea) or reduction (hypopnea) of the oronasal air flow with persistence of thoraco-abdominal movements.

Recent epidemiological data confirm a prevalence of OSAS in the general Italian population of between 2.5 - 3% (therefore a problem that affects approximately 1,450,000 - 1,740,000 patients). Many millions of people in the world suffer from cardiac complications

and it is possible to state that approximately half of these patients have problems related to sleep-disordered breathing [1,2].

To underline the dimensions of the problem, let us remember how chronic snoring affects 30% of men and 10% of women aged 40, who are considered habitual snorers [2,3].

There are a series of risk factors for obstructive apnea syndrome, which should not be underestimated in case of coexistence with snoring, mainly summarized in

- Obesity
- Malformations of the rib cage (kyphoscoliosis) and upper airways
- Neuromuscular diseases (myopathies, amyotrophic lateral sclerosis, etc.)
- COPD
- Hypothyroidism
- Lesions of the trunk and spinal cord

The consequences of undiagnosed and untreated OSAS can be very serious

- Arterial hypertension
- Cardiac arrhythmias
- Stroke (cerebral stroke)
- Ischemic heart disease
- Congestive heart failure and left heart
- Chronic pulmonary hypertension and right heart
- Cheyne-Stokes breathing

Again to underline the importance of not underestimating what is a major health problem, let us remember how the cardiovascular problems connected to snoring are able to increase the risk of cerebral stroke by 4 times, the risk of hypertension by 2 times and by 3 times the risk of heart attack and cardiac arrhythmias. Increase in weight and body mass is the main cause of snoring and therefore the first rule in these cases is to lose weight [1-3].

The diagnosis must be very accurate and performed in ENT centers specialized in the sector. It is based on the acquisition of anamnestic information, collection of anthropometric data, ENT examination, airway endoscopy, specific radiological tests and polysomnographic study [4].

There is some data that should make us suspect a sleep problem that needs to be investigated further with a specialist visit [4,5]:

- Excessive daytime sleepiness
- Waking up with a feeling of suffocation
- Repeated awakenings during sleep with a feeling of non-restorative sleep
- Concentration disorders with cognitive and memory disorders
- Reduction in physical, intellectual and professional performance with an increase in road and workplace accidents.
- 5 or more obstructive respiratory events per hour of sleep.

What links these pathologies and when is it best to intervene?

The objective we have set ourselves is to spread awareness that various respiratory diseases, competing with the determinism of OSAS (rhinitis, sinusitis, adenotonsillar hypertrophy, turbinates, asthma, septal deviations, polyps etc.), are often present simultaneously in the same patient and they must all be diagnosed, framed, addressed and resolved as a single "Respiratory Syndrome" [4,6]. It is necessary to avoid making the pathology chronic or ignoring even just one of its individual components: only by tackling it in all its phases (the syndrome, the diagnostic protocol, the complications and the therapies) and only by using the most modern minimally invasive therapeutic solutions, both pharmacological and surgical. it will be possible to significantly reduce the pharmacological and surgical load and achieve a rapid, complete, definitive and practically painless restoration of the patient's respiratory well-being, both children and adults, in a bloodless way without swabs and with a very rapid return to usual activities and best performance linked to correct and full oxygenation. Now that therapeutic solutions are bloodless and microinvasive, it is no longer necessary to wait or resist to intervene and recover your respiratory well-being [5,6].

We have operated on over 9,000 patients, including illustrious footballers and sports champions, voice and entertainment professionals, journalists, politicians who, thanks to the correct use of new technologies, have been able to recover their respiratory well-being, avoiding continuing to endure discomfort, pain and discomfort and invasive and demolitive interventions, which today no longer have any reason to be practiced.

Impact and social costs

Respiratory problems are more important and widespread than we think and over time can lead to serious consequences. Every-

one knows from direct experience that the perception of a stuffy nose lasting for days causes a significant reduction in physical and mental performance; this innocent symptom can evolve to cause serious cardiovascular problems. Diseases of the upper respiratory tract are very widespread in industrialized societies and the economic impact is little investigated and underestimated due to the fact that the most obvious costs seem manageable for the individual, but in society they must be multiplied by the very high number of individuals involved and the indirect costs related to them must be taken into account, broken down into drugs (expensive and to be taken continuously), hospitalizations for illness or complications, periodic absences from work or school, need for assistance from family members (for children or partner), possible contagion, errors and accidents. They are the major cause of sickness absence, the fifth cause of antibiotic prescriptions and, if one forces oneself to work or attend courses of study, they become the cause of contagion and a high percentage of dangerous and costly errors and accidents at work and at school [4-6].

Some statistical data on upper respiratory tract diseases

- Over 10 million adults affected in Italy alone (WHO, or WHO World Health Organization)
- According to CNR and WHO, rhinosinusitis is a potential "pandemic": 500 million people are affected worldwide.
- Respiratory obstruction complicated with OSAS (Obstructive Sleep Apnea Syndrome) increases the risk of cardiovascular events (hypertension, heart attack, stroke) by approximately 2 times and increases the risk of diabetes mellitus by approximately 5 times (if the patient also has metabolic syndrome);
- Sleep apnea and sleep disorders are the cause of 22% of all road accidents (Min. Healthcare);
- Estimated costs: 230 billion dollars in the United States alone, the same (projection) in Europe, 20 billion per year for Italy alone.
- Rhinitis and Allergic Rhinitis are the major cause of sickness absence, the fifth cause of antibiotic prescription
- If you force yourself to work ("presenteeism"), they become the cause of contagion and a high percentage of dangerous and expensive errors and accidents at work.

Correct information, simple prevention measures and new minimally invasive solutions can change this unfortunately dramatic and underestimated reality. It would be a duty to support prevention starting from determining early diagnoses. The quality of life of a considerable number of people can be significantly improved, and sometimes some can be saved, even in this area, with a consequent, notable social saving. Everything could be set in motion by a simple self-deliverable questionnaire (Businco-90, www.fondazioneintegria.it), easily proposed in schools, companies or sports associations. The questionnaire identifies the subjects at risk and their level, and gives indications on the tests necessary to investigate and then intervene in a targeted manner.

The reduced efficiency we have talked about, combined with therapies, which are sometimes ineffective, affects young people's academic performance. The resulting reduced attention and school attendance will limit the possibility of full assimilation of the courses, gaps in understanding will be created which could also lead to falling out of love with a more complex subject or with entire studies.

Furthermore, all activities in closed environments with reduced air exchange, whether for play, school or work, bring with them some specific risks for the upper respiratory tract areas. The winter with cold climate and more frequent rains, as well as the variable spring or summer with strong temperature variations, do not help, nor does the wind that democratically accompanies all the seasons. It happens that those with "sensitive mucous membranes" easily experience inflammatory or infectious episodes which, if neglected, can become recurrent to the point of becoming chronic.

Our first muscular act at birth is breathing and our main fuel is oxygen: putting less of it into the lungs is like having less wind in the sails or using petrol with less octane. Respiratory problems such as stuffy nose, adenoids, hypertrophic turbinates, tonsillitis, asthma, as well as the mere presence of mucus, etc. they reduce the flow of oxygen and put noble organs such as the heart and brain in a non-ideal condition, "under strain", therefore they can reduce or impair not only physical performance but also and above all intellectual performance. A minimal reduction in respiratory flows can make the difference and compromise a class assignment, a job interview, an exam, slow down a decision, make one less lucid, less concentrated and less resistant, less efficient.

All activities, even those carried out outdoors, will be affected and closed environments, not always with adequate air exchange, will become ideal for human-to-human contagion: a severe test for the ability to properly ventilate the ear and nose which will make

ear infections, sinusitis and rhinitis possible. , inflammation, hyperproduction of mucus, which stagnates causing pain, malaise, dizziness, nausea and other symptoms that are sometimes highly disabling.

Why taking this risk or, worse, give up when a little prevention, a proper medical visit, an early clinical diagnosis and the right therapy are enough to enjoy the enormous benefits given by the restoration of correct air flow and excellent oxygenation: recovery and overall improvement of psychophysical performance (attention, concentration, clarity, efficiency, feeling of well-being, etc.) and reduction of cardiovascular overload.

Fortunately, progress in this research field has brought important innovations. We are living in a period of overwhelming development where information is unable to keep up with evolution, even in Otolaryngology. There is a lack of widespread awareness of the development process of respiratory syndrome, because it is very long: it lasts years, often presents with apparently negligible, apparently transitory problems, with easily bearable disorders. The associated dangers are not known and, above all, many doctors are not yet up to date on the simplicity and speed of the solutions that progress itself has offered us in the last ten years. An evolution comparable only to the IT one, rapid and complex to follow: in a few years we have gone from demolishing and painful solutions of nasal obstructions to the painless vaporization of only excess non-functional cells; new tools have already made it possible to solve problems that had no solution a few years ago. Today a simple balloon (hemodynamic angioplasty-derived balloon) through the natural opening channels, widens and restores normal respiratory flows at the level of the sinuses and Eustachian tube and goodbye to sinusitis, goodbye to stagnation of purulent mucus, goodbye to the inability to compensate and to shooting pains in the ear during outdoor sports, and in water, when traveling by plane and during underwater activity. Goodbye scars, bleeding and tampons. In just a few years we have gone from solutions that can be defined as 1.0 to the 3.3 era, that is, the third version of the third generation of new tools and new procedures and protocols. We are at the 3.3 procedures when most have only managed to implement 1.3, or 2.0, considering what is now widely experimented, documented and published as experimental or completely new. It is our duty to try to speed up the information process for doctors and patients, to prevent chronic conditions and avoid unnecessary suffering. Above all, this is why the Integria Foundation was founded, which promotes and disseminates information and training on these topics (www.fondazioneintegria.it).

Prevention

We can prevent: a gust of wind and the health effects can manifest themselves both immediately and slowly, causing the cause and effect relationship that binds them to be lost. The respiratory system has two functions that are of significant importance for young students and athletes as well as for those who work: that of air conditioning which regulates the temperature of the air before it reaches the lungs and that of filtering the air from particles. If you study or play sports with a stuffy nose, especially in winter in the cold in closed environments with stagnant and heavy air or worse in polluted areas and/or full of allergens, you will not be able to use them, with the possibility of thermal shock and cardiovascular fatigue or other damage precisely at the moment of maximum aerobic or cerebral activity. Maximum attention must be paid to any sign of chronicity of the neglected symptom. The close recurrence of episodes of otitis, for example, signals a malfunctioning of the Eustachian tube which can lead to chronic secretory catarrhal otitis (tympanic catarrhs in children are too often unrecognized or mistaken for harmless and transient dulling or redness of the membrane of the ear!) with permanent hearing reduction. Even a simple blow on the nose in the classroom or during physical activity can deviate the nasal septum and permanently reduce the flow rate of the respiratory flow, without necessarily causing aesthetic damage, especially in children. A few days of discomfort or soreness and then you get used to it and it is first neglected and then forgotten. But oxygenation will never be the same again. A minimal inflammation, perhaps due to a cold, will be enough to cause the closure of first one nostril and soon the other too. Dizziness, tinnitus, breathlessness, asthma, hypertension may appear. Performance disappears, one is slower and more confused, mentally and physically, less precise, less lucid, less resistant and with fatigue and lack of results one loses pleasure and the ability to be passionate about what one does or what one does. she studies. Healthy curiosity, the desire to understand, the thirst for knowledge slip into the fulfillment of a simple duty, no longer compelling, no longer satisfying, without participation. If this persists, an insurmountable gap is created, people fall out of love, only do what is indispensable and their academic and intellectual performance generally suffers. You breathe worse and worse and by consuming fewer calories you also gain weight, then you start to snore. Even in the very young, sleep apnea and sleep disorders appear. It is non-

restorative sleep that is responsible for 22% of road accidents and all their consequences in adults!!! If the symptoms are neglected, a very slow deterioration of the noble organs, the heart and the brain, begins, which due to reduced oxygenation continually work under stress to the point of risk of failing. At a young age the first simple respiratory symptoms begin and at 45/50 years of age one finds oneself with heart disease, hypertension, overweight and, perhaps, one blames stress without reconnecting to the first cause [4-6]. We must break this vicious circle. It is a duty to activate, especially towards young people, every behavior that can lead to early diagnoses, organize screening, inform and prevent, prevent, prevent. The specialist questionnaires developed and disseminated by Fondazione Integria for the self-assessment of global respiratory function and in particular related to OSAS are available free of charge and can certainly represent a first concrete intervention.

Associated symptoms

Some symptoms can warn us and these signals should not be underestimated: occlusion of one or both nostrils, alternating opening and closing of a nasal cavity, also linked to the change in the side on which one lies in bed, nasal secretion during training and meals , temperature variations, sneezing, itching, perception of non-restorative sleep, concentration and neurocognitive disorders, metabolic disorders, morning foggy mind, decrease in psychophysical performance, bad breath, headache, insomnia, ear muffling, irritability, anxiety. If they last for more than two or three weeks and are repeated several times a year, a specialist visit or at least a self-assessment with one of the questionnaires that Fondazione Integria makes available on its website is urgently needed.

To improve the respiratory level, it may be useful to combine prevention with a light diet rich in substances that favor the elimination of liquids (mildly diuretic), generally small and frequent meals that do not increase the blood flow to the digestive system. Where necessary, natural physiological solutions or sprays for nasal washes can be used. If we have already gone further and the symptoms and the results of the questionnaire suggest it, a recommendable ENT specialist visit would be necessary in a practice equipped for the execution of all the necessary specialist tests, the comparative evaluation of the functional outcomes and, if necessary, an in-depth evaluation endoscopic examination of respiratory function, up to the most modern microinvasive endoscopic treatments.

Diagnostic test

The main diagnostic test is represented by polysomnography, which, through a multi-channel computerized instrument connected to the patient for the duration of one night, allows for a precise diagnosis of the snoring by carrying out the analysis of sleep parameters (duration of apneas, possible cardiovascular damage , and so on). The polysomnography device traditionally used in home diagnostics for cardiorespiratory sleep disorders is a recorder (which may resemble cardiac Holter) equipped with amplifiers and multiple sensors dedicated to the measurement of signals applied to respiratory and cardiac physiology. The small instrument is easily fixed to the patient's chest via an elastic band and allows you to monitor all advanced cardiorespiratory and neurological channels. Once the instrument is worn, the patient can move in absolute freedom while resting in bed. A dedicated software performs the analysis of the recorded parameters to study the nature and severity of the relationship between breathing disorders during sleep and cardiac dysfunction. Alongside this test we now have the WatchPat available, a modern sleep study methodology performed through a device similar to a wristwatch, which has revolutionized by integrating traditional polysomnography with new clinical data on the state of the patient with OSAS.

WATCHPAT: An innovative simple, accurate, reliable polysomnographic test

Alongside the traditional polysomnographic examination, performed with cumbersome and unnatural equipment which sometimes hindered sleep at home and made the patient's sleep study unreliable, an innovative diagnostic tool has recently been developed for the in-depth and accurate study of Sleep and Sleep Apnea, the WatchPAT [4].

This device, worn like a wristwatch, is an innovative home device for testing sleep apnea and nocturnal snoring that uses a new patented signal parameter PAT (Peripheral Arterial Tone). Using three points of contact with the patient's body surface (sensor on wrist, finger and sternum), WatchPAT measures 7 channels of integrated information on sleep quality: PAT signal, heart rate, oximetry, actigraphy, body position, snoring and movement of the chest.

After the conclusion of the study at the end of the sleep period, all the data collected and in particular some new parameters useful for reliably distinguishing any possible pathology even in its initial

stage are downloaded and evaluated with accurate software. The Sleep Study performed with WatcPat distinguishes central apnea events from obstructive apnea events and detects, in addition to the sleep stages, the AHI, RDI and ODI indices based on the actual sleep period according to an advanced patented algorithm that differentiates the result from previous polysomnography devices (True Sleep Time). Both the AHI and RDI identified with the WatchPAT have been clinically validated by international scientific studies. In fact, the PAT signal is currently a measure approved by the AASM HSAT Clinical Practice Guidelines for the diagnosis of adults suffering from OSA.

The characteristics of the sleep test carried out with WatchPat can be summarized as follows

- Simple: three points of contact for excellent patient compliance
- Clinically reliable with a success rate of 98%.
- Identification of actual sleep period to obtain a more accurate AHI index
- Comprehensive sleep architecture for accurate overall diagnosis
- Ability to diagnose central apnea (CSA) thanks to the Central+ module
- Effective and Reliable with a complete analytical report for rapid diagnosis and timely treatment
- zzzPAT software with advanced automatic algorithm for scoring respiratory events
- CloudPATTM cloud-based IT solution for fast and reliable sleep diagnosis and secure transfer of patient data

Clinical parameters evaluated by WatchPAT

- AHI Apnea/hypopnea index
- AHIc Central apnea/hypopnea index
- RDI Respiratory disturbance index
- ODI Oxygen desaturation index
- Waking/Sleeping with actual sleep period
- REM/Deep/Light sleep stages with complete sleep architecture
- Body position indices
- Snoring
- Heart rate
- Chest movement
- Pulse oximetry
- Actigraphy

Sleep architecture

With WatchPAT the complete Sleep Architecture provides information on the quality of sleep in all its phases, including sleep efficiency, sleep latency and REM latency. It also offers the unique advantage of detecting REM-associated sleep apnea by identifying the AHI in REM and non-REM sleep. The in-depth analysis of sleep architecture allows for better knowledge of the patient's actual nocturnal pattern and a reliable parameter for following the evolution of the disorder over time until complete recovery and improvement in the quality of sleep and life.

True sleep time

WatchPAT, integrating the data collected with precise dedicated software, uses an advanced actigraph to distinguish the periods of wakefulness from those of sleep and therefore calculate the actual sleep period (True Sleep Time); it also uses the amplitude of the PAT signal and the heart rate to differentiate REM periods from non-REM ones and precisely identify the Sleep Architecture (light, deep, REM). WatchPAT calculates the AHI and RDI by considering the patient's actual sleep period rather than the recording time, as is the case with most traditional polysomnography devices currently on the market. The actual sleep period calculated with the innovative WatchPAT system reduces the risk of incorrect diagnoses and classifications, as happens for 20% of polysomnographic exams performed with previous instrumentation that use the total recording time.

The PAT signal

The patented PAT Signal non-invasively detects changes in pulsatile arterial volume at the fingertip. The attenuation of the PAT signal and the accelerated pulsations reflect the sympathetic activation which represents a clear clinically validated sign of the autonomic arousals and micro-awakenings observed in sleep disorders. With additional support for oxygen desaturation and re-saturation parameters, the patented algorithm accurately classifies sleep disturbance events into AHI, RDI and ODI to provide the clinician with an overall patient assessment that is unique among available diagnostic tools for sleep tests.

The zzzPAT software

The zzzPAT software uses an advanced algorithm for the automatic scoring of respiratory events and the identification of sleep stages. Once the study has been downloaded, an analytical report is generated and analyzed by the Specialist to describe the Sleep

Architecture, sleep effectiveness, sleep latency and apnea events relating to the REM and non-REM phase. Thanks to the flexibility of the zzzPAT software, it is also possible for the Doctor to manually score one or more suspicious events or an entire study.

Soft surgery for miniinvasive approach to OSAS

The new, constantly evolving methods of minimally invasive surgery that we have introduced for some years also in Otolaryngology, based on the latest generation radio frequencies-RF (Quantum Molecular Resonance, Telea, Sandrigo-Vicenza, Italy) and balloon catheters both dilative (Thinvasive DRB System, Eustakius, Como, Italy) and with kinetic oscillation stimulation (KOS Ozilia, Kista, Sweden) spare healthy tissues, reduce mucosal inflammation and preserve the function of the mucosa with rapid restoration of normal daily activities [7-11]. The soft surgery treatments most frequently necessary for this purpose are both resurfacing and insertion techniques RF-based, which allow an effective and painless reduction of tissue volume, and more specifically Uvulo-palatoplasty, the elimination of obstructions from septal deviations, hypertrophies of the inferior and middle Turbinates and of the tongue base, nasal polyps, tonsils and adenoids and the reduction of prolapses of the palatine velum and the uvula which are too elongated due to the metabolic disorders and chronicity of the disease. It will also be possible, using these minimally invasive methods associated with each other, to practice free nutrition in the postoperative period and not only fluid feeding as it is almost mandatory after traditional surgery.

After careful and advanced diagnostic analyses, we use the microinvasive methods above described which, through HR-cameras connected to fiber optic endoscopes, avoiding external incisions and stitches, allow the best treatment of all those respiratory and nasal obstructions from deviations of the nasal septum, hypertrophy of the turbinates , nasal polyps, adenoids and prolapses of the palatine velum and uvula, which together are the main causes of nocturnal snoring and sleep apnea. These operations are also almost always performed in Day Surgery approach, well tolerated by adults and children, not very painful, not bloody and with rapid restoration of normal activities.

It is important to communicate to patients, but also to colleagues who have not yet explored these issues in depth, why these interventions can fully be defined as microinvasive, and how this explains such a rapid recovery.

Medical therapies, with new molecules for local nasal and oral use, together with modern nasal and sublingual anti-allergic vaccines complete the therapeutic framework in order to alleviate those small discomforts linked to nasal secretion and rhinitis, as pre- and post- radiofrequency and dilatative treatments.

A very innovative drug delivery system called Molecular Vaporizer-MV (Nutrintech Med Italia, Rome, Italy) has been developed and used by our research team to administrate respiratory drugs also in OSAS patients as a completely new route [12,13].

The MV device we patented allows to obtain dry steam (transformation of a liquid solution into Gas or sublimation) both hot and at a lower temperature than hot steaming, using two synergistic vaporization systems (absolutely innovative principle), one at low temperature through the application of an ultrasonic vibrating ceramic at the bottom of the metal container (double chamber) of the solution containing the active principle which allows to vaporize, through the release of mechanical vibratory energy at an adjustable frequency which allows to reach the molecular size (or of molecular aggregates) of the active principle and a second through an induction heater applied to it reservoir (principle of the two energies synergic).

The MV application is suitable for any cavity present in the body, for example through the pharynx, larynx, lung alveoli and through the nasal and paranasal cavities. The respiratory administration is very interesting especially for OSAS pulmonary comorbidities as while the alveolar area is always neglected before MV development, since all the drugs delivered by traditional aerosol currently in use are not able to reach the pulmonary alveoli but stop at the proximal bronchial level; the intranasal way is more used to deliver drugs via nasal spray, but with MV the active principles gain the advantages in reaching the entire cavities included paranasal sinuses having the active principle in the form of a molecular aggregate thus increasing the possibility of delivery with a consequent reduction of the drug dose and obtaining maximum biocompatibility.

MV is a device that transforms a liquid solution into a gas consisting of molecular aggregates not contained as usual in droplets. Since there are no droplets, there is not even the colloidal layer that keeps the droplets in a spherical form and that limits the passage of the active ingredients present in the solution through the protein channels found in the cell membranes that have the walls of the

mucous membranes. In conclusion MV is clearly not an aerosol and is use in combination with other innovative technologies for the treatement of sleep respiratory disorders will represent a crucial support to reach an integrated and personalized approach to OSAS.

What we hope for and what is the challenge taken up daily in our clinics is an ever-increasing awareness and diffusion of possible systemic complications linked to poor breathing, especially at night. If this condition is accompanied by apnea, it represents a real alert on our desktop that should not be underestimated or trivialized, as often happens, mistakenly relegating it to a mere element of annoyance for the partner during sleep or correlating it to occasional irregular and abundant evening meals; the otolaryngologist is therefore in the privileged position but also with great responsibility compared to other sleep disorder specialists, to propose innovative alternative integrated solutions above mentioned to nocturnal mechanical ventilation (CPAP) and above all to intercept OSAS in its earliest stages with the aid of ENT diagnostics carried out in the routine approach to all respiratory syndromes, when the damage is still reversible and has less impact on the patient's overall health.

Conclusion

Nowaday innovative technologies are the best, more precise and less invasive options to personalize the treatments and improve the clinical benefits for a such complex syndrome as OSAS and is crucial to be updated and use all these diagnostic and therapeutic tools in a comprehensive approach.

Bibliography

1. Patel SR. "Obstructive Sleep Apnea". *Annals of Internal Medicine* 171.11 (2019): ITC81-ITC96.

2. Gottlieb DJ and Punjabi NM. "Diagnosis and Management of Obstructive Sleep Apnea: A Review". *JAMA* 323.14 (2020): 1389-1400.

3. Lévy P., *et al*. "Obstructive sleep apnoea syndrome". *Nature Reviews Disease Primers* 1 (2015): 15015.

4. Di Rienzo Businco L., *et al*. "Diagnosi completa e terapia risolutiva contestuale delle sindromi ostruttive ed infiammatorie naso-sinusali-tubariche in adulti e bambini". *EAI eds* (2019).

5. Di Rienzo Businco L., *et al*. "Upper airway respiratory syndrome and its impact on sports performance: an often-overlooked issue". *The Journal of Sports Medicine and Physical Fitness* 62.8 (2022): 1134-1135.

6. Di Rienzo Businco L., *et al*. "Respiratory syndrome: a new nosological entity with a high social impact". *Minerva Medica* 108.4 (2017): 383-384.

7. Di Rienzo Businco L., *et al*. "Turbinoplasty with quantic molecular resonance in the treatment of persistent moderate-severe allergic rhinitis: Comparative analysis of efficacy". *American Journal of Rhinology and Allergy* 28.2 (2014): 164-168.

8. Di Rienzo Businco L., *et al*. "Innovative Mini-invasive treatments with new devices for upper respiratory flogosis: Thinvasive protocols with high technology balloons and quantum molecular resonance". *Annals of Clinical Otolaryngology* 6.2 (2021): 1053-1059.

9. Pavaci S., *et al*. "New frontiers in balloon sinuplasty". *Journal of Otolaryngology and Rhinology Research* 5 (2022): 1-3.

10. Di Rienzo Businco L., *et al*. "First Report on Shockwave Tubodilation Technique for Eustachian Tube Dysfunction". *Archives of Otorhinolaryngology-Head and Neck Surgery* 6.1 (2022).

11. Tortorella F., *et al*. "Effectiveness of KOS treatment in patients with on allergic rhinitis refractory to conventional medical therapies". *The American Journal of Surgery* 4.2 (2022): 104-109

12. Di Rienzo Businco L., *et al*. "Effectiveness of Kinetic Oscillation Stimulation treatment in persistent moderate-severe allergic rhinitis compared to medical therapy". *Journal of Otolaryngology Research and Reports* 2 (2023): 11-15.

13. Brandimarte B., *et al*. "Nebulization of pharmacological solutions with an innovative medical device based on microvaporization". *Heliyon* 3 (2023): 100-108.