Respiration

Guidelines

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Sleep Breathing Disorders in the COVID-19 Era: Italian Thoracic Society Organizational Models for a Correct Approach to Diagnosis and Treatment

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Abstract
The attenuation of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic, at least in Italy, allows a gradual resumption of diagnostic and therapeutic activities for sleep respiratory disorders. The knowledge on this new disorder is growing fast, but our experience is still limited and when a physician cannot rely on evidence-based medicine, the experience of his peers can support the decision-making and operational process of reopening sleep laboratories. The aim of this paper is to focus on the safety of patients and operators accessing hospitals and the practice of diagnosing and treating sleep-related respiratory disorders. The whole process requires a careful plan, starting with a triage preceding the access to the facility, to minimize the risk of infection. Preparation of the medical record can be performed through standard questionnaires administered over the phone or by e-mail, including an assessment of the COVID-19 risk. The home sleep test should include single-patient sensors or easy-to-sanitize material. The use of nasal cannulas is discouraged in view of the risk of the virus colonizing the internal reading chamber, since no filter has been tested and certified to be used extensively for coronavirus due to its small size. The adaptation to positive airway pressure (PAP) treatment can also be performed mainly using telemedicine procedures. In the adaptation session, the mask should be new or correctly sanitized and the PAP device, without a humidifier, should be protected by an antibacterial/antiviral filter, then sanitized and reassigned after at least 4 days since SARS-CoV-2 was detected on some surfaces up to 72 h after. Identification of pressure should preferably be performed by telemedicine. The patient should be informed of the risk of spreading the disease in the family environment through droplets and how to reduce this risk. The follow-up phase can again be performed mainly by telemedicine both for problem solving and the collection of data. Public access to hospital should be minimized and granted to patients only. Constant monitoring of institutional communications will help in implementing the necessary recommendations.

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Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has significantly limited the performance of outpatient visits, instrumental examinations, and the initiation of some non-COVID-19 therapeutic procedures. With the attenuation of the pandemic, and therefore with the diffusion of the data aimed at containing the spread of the virus, clinical activities should be resumed progressively in line with the indications of the institutions and the individual hospital facilities [1]. Pulmonology and sleep medicine departments are therefore urged to activate outpatient clinics for treating patients with sleep breathing disorders, including patients recovering from COVID-19.

In this period, telemedicine has been an important tool for the provision of services, and its contribution to the performance of health services also in overcoming the current emergency has emerged clearly [2]. Therefore, while in the acute pandemic phase all activities were discontinued and postponed, we are now in a condition of reduced prevalence of COVID-19 in the community, which enables us to resume the diagnostic and therapeutic activities for sleep breathing disorders.

These recommendations are based on a consensus of the Italian Thoracic Society (ITS-AIPO) experts and a selective literature search for reopening of sleep centers after the acute phase of the COVID-19 pandemic.

No diagnostic-therapeutic activities, whether carried out in hospital or in outpatient facilities [3], can however be resumed without taking prevention and control measures, so centers for the diagnosis and treatment of sleep breathing disorders must put in place a series of procedures to resume the activity in conditions of absolute safety for both patients and healthcare personnel [4]. Evidence-based decision-making is the ideal standard, but knowledge about this new disease is evolving rapidly, so the physician must rely on his experience [5], consensus statements, if available, and his clinical judgment when evidence is lacking [6].

Cardiorespiratory monitoring and continuous positive airway pressure (PAP) titration are essential procedures for providing services, so every center will have to review its activity in the light of the current pandemic and adapt it to the current conditions. The following recommendations are intended to represent general guidelines for the progressive resumption of diagnostic, therapeutic, and follow-up activities for patients suffering from sleep breathing disorders.

Priority should be given to services provided by telemedicine, and all remote digital activities should therefore be potentiated where possible. The services provided at the healthcare facilities, in agreement with the health departments, will entail adoption of the general precautionary measures to contain the risk of contagion for both the health personnel and the patients, by limiting access, creating separate routes, sanitizing rooms, and making sure that adequate personal protective equipment is available.

A gradual resumption of activities and a triage that allows patients with more severe forms to be managed adequately in consideration of their comorbidities, the degree of daytime sleepiness, and work activity is recommended.

These recommendations are aimed to contribute with the previous ones [7, 8] to the resumption of activities concerning sleep breathing disorders.

Access to Healthcare Facilities

Before gaining access to the healthcare facility, the patient must undergo an adequate assessment of any symptoms (fever) and epidemiological criteria (contact with patients having ascertained disease) attributable to SARS-CoV-2 infection if it is not possible to carry out a swab reverse transcriptase polymerase chain reaction test first [9]. If any suspicious elements are found, the patient will not be given access to the facility and therefore to the services, but will be referred for a clinical evaluation by his general practitioner or the reference physician of the facility, which will establish whether the initial symptoms are actually present and/or there is a risk of infection, defining the most suitable pathway for the patient (e.g., imaging, blood chemistry tests, swabs). Patients who access the healthcare facilities must respect the general procedures laid down by the healthcare facilities for the optimization of routes and spaces in the waiting rooms, according to the indications of social distancing by staggering access. Clinical sense recommends maximum caution for patients and operators: more and more cases of patients testing positive for prolonged periods, even beyond the threshold of clinical recovery, are being recorded [10].

Phases of Activity

Phase 1: Preparation of the Medical Record

- The patient should preferably be approached over the phone or by another remote method for the compilation of the medical record, with particular regard to

the information useful for the triage to determine the urgency of the diagnostic examination (comorbidities, work activity, presence of excessive daytime sleepiness, predisposing factors, etc.).
- The patient can send his medical files by e-mail or fax to facilitate the doctor in drawing up the medical record.
- If the patient has been referred by another specialist (cardiologist, otolaryngologist, internist, etc.), evaluate whether to contact him to better understand the indications and timing of the exam.
- Administer questionnaires to facilitate triage.
- Assess the risk of COVID-19.

Phase 2: Performance of the Diagnostic Examination
- Postpone polysomnography and cardiorespiratory monitoring in all patients at greater risk of serious complications from COVID-19, if there is no urgency.
- Evaluate the possibility of carrying out the diagnostic tests at home, especially when there are management difficulties within the healthcare facility.
- Evaluate the option of providing an illustrative booklet with indications for self-assembly of the instrument.
- In-lab sleep study should be postponed except when this is not possible due to ascertained urgency.

Overnight Cardiorespiratory Monitoring with the Following Recommendations:

Healthcare personnel must wear personal protective equipment (visor or goggles, mask, gloves, and a nonwoven fabric lab coat cover to be changed after each patient). The patient must wear the surgical mask throughout the assembly procedure. Access should be denied to anyone accompanying the patient unless their presence is absolutely necessary, in which case they should be pre-screened as patients [4].
- *Airflow:* Disposable cannulas, depending on the manufacturer, may or may not have a built-in filter, but only of the "hydrophobic" type, which does not possess a full antibacterial/antiviral filtering capacity. The hydrophobic filter often has a filtration capacity of 0.45 μm while the coronavirus has a particle size of 0.06–0.14 μm [11]. There is therefore a risk that the virus may colonize the reading chamber downstream of the cannula and be transmitted to the next user if it cannot be sanitized. Considering that our knowledge on SARS-CoV-2 is still lacking and the mechanisms of transmission are not fully elucidated, we have considered that the lack of an antiviral filter, tested and certified to be used extensively in the field, should be considered a major point of caution. The use of nasal cannulas is therefore not recommended. The flow can be recorded by means of a thermistor or thermocouple: disposables are preferred, otherwise sanitization between one recording and another is necessary. Another method of determining the airflow is by summing the movements of the chest and abdominal wall obtained by plethysmography. Disposables are preferred.
- *Respiratory effort:* Through respiratory inductance plethysmography preferably using single-patient bands or alternatively covering the bands around the rib cage and abdomen with a "jacket" to be changed after each examination. For the recording of chest and abdominal wall movements by means of piezoelectric bands, the considerations made above are applicable. In the case of reusable bands, after each recording they must not be used for at least 4 days, since SARS-CoV-2 is more stable on plastic and stainless steel, and viable virus was detected up to 72 h after application to these surfaces, although the virus titer was greatly reduced [12].
- *Oxyhemoglobin saturation:* Recorded by a disposable sensor. If it is not for single use, the sensor must be sanitized after each use.
- *Electroencephalogram:* With electrodes to be sanitized with an alcoholic solution after each use.
- *Electrocardiogram:* Preferably with single-use electrodes. Otherwise they must be sanitized after each use.
- *Limb movements:* By means of electrodes or piezoelectric sensors. Disposable electrodes are preferred. Otherwise they must be sanitized after each use.
- *Snoring:* Using a microphone. Sanitize with an alcoholic solution after each use.
- *Body position:* Using a position sensor. Sanitize after each use.
- *Polygraph or polysomnograph:* sanitize after each use [12].

Phase 3: Initiation of PAP Therapy

In order to reduce the number of patient visits to the hospital, the diagnostic study report with any therapeutic indications should be sent by e-mail. If PAP therapy is to be initiated, a session for adaptation to PAP and identification of the appropriate mask can be scheduled where possible. We recommend that:
- Continuous PAP titration be postponed and reprogrammed (unless it is performed in a negative pressure room) except in the case of an emergency.

- Access be denied to anyone accompanying the patient unless their presence is absolutely necessary, in which case they should be pre-screened like patients.
- At centers that have the possibility of sterilizing the material used, the most suitable mask be chosen directly on the patient before making the prescription. If this is not possible, the choice will be made empirically on the basis of the operator's experience according to the morphological characteristics of the patient's face, though a modification may be necessary during titration if the patient reports any problems.
- Priority be given to PAP titration at home by telemedicine using the PAP mask assigned to the patient where possible. If this is not possible, apply an antibacterial/antiviral filter (99.99%) and proceed subsequently to sanitize the instrument to be reassigned after at least 4 days. Consider using a device to contain dispersion in the environment from the exhalation system [13]. Before applying an antibacterial/antiviral filter, evaluate its impact on the pressure actually delivered to the patient since, on average, the flow resistance provided by the filters corresponds to about 2 cm H_2O, so the pressure delivered by the device may not correspond to that recorded at the mask. If heat and moisture exchangers are used, resistance will vary with the progressive saturation of the filter. Identification of the pressure by telemedicine must be carried out by downloading and interpreting the data, not just considering the automatic indication of the 90th–95th percentile. Once the best operating pressure has been identified, it should preferably be confirmed through cardiorespiratory monitoring. If it is to be adapted to use in the hospital environment, the humidifier, a source of airborne contamination, must not be used, and disposable tubes should preferably be used [10, 11]. Viruses survived well at a relative humidity <33% and at 100%, whereas their viability was reduced at intermediate values [14]. Evaporation kinetics play a role in modulating the survival of microorganisms in droplets [15]. The humidifier can be used at home in patients who are already being treated or in those who begin adaptation immediately in their family environment, providing, however, the necessary information regarding the risk, even if marginal, of spreading an infection to others who sleep in the same environment [16].
- Institutional public health communications be monitored to warn the patients of any increases in the number of cases present in their community. Today's coronavirus outlook is a matter of concern and it is difficult to forecast the future of its diffusion. In many European countries, the precautions are stepping up and down quickly, sometimes with regional differences. We opted for a change in our practice that could offer most protection to our patients even in the worse scenario, offering proper instrumental support to clinical diagnosis of sleep breathing disorders whenever the general health authority rules allow performing sleep studies. The maintenance of this setting in the phases of remission protects our patients from occasional and unpredictable contacts with a carrier of the virus.

Phase 4: Follow-Up

- Give priority to telemedicine in monitoring the efficacy and adherence data [17, 18].
- If telemedicine cannot be used, resume the appointments at the facility for patients who are not at a high risk of contracting COVID-19.
- Call the patient over the phone to discuss any problems, help him to solve them, and give him motivational support in using the PAP mask.

Recommendations

- Draw up a plan for resuming activities.
- Ensure workplace safety.
- Establish safety measures for patients.
- Resume providing services gradually.
- Implement a remote triage program.
- Use telemedicine as much as possible.
- Screen patients before they visit outpatient facilities (check that they have no symptoms of COVID-19).
- Restrict access to patients only.
- Limit as much as possible the use of instruments with a risk of contamination.
- Consider the medicolegal implications.

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Statement of Ethics

The Italian version of the document is published on the ITS-AIPO website and available at www.aiponet.it/editoria/aipo-ricerche-edizioni/prodotti-editoriali/127-documenti-covid-19/2492-i-disturbi-respiratori-nel-sonno-in-epoca-covid-19-modelli-organizzativi-per-un-corretto-approccio-alla-diagnosi-e-cura.html.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Author Contributions

All authors contributed substantially to the writing of the manuscript and reviewed and approved the final version. The accuracy and integrity of any part of it have been appropriately investigated and resolved. G. Insalaco coordinated the working group.

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