6. Rozman A, Camlek L, Marc-Malovrh M, Triller N, Kern I. Rigid versus semi-rigid thoracoscopy for the diagnosis of pleural disease: a randomized pilot study. Respirology. 2013;18:704–10.
7. Rahman NM, Ali NJ, Brown G, Chapman SJ, Davies RJO, Downer NJ, et al. Local anaesthetic thoracoscopy: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010;65 Suppl 2:ii54–60.
8. Agarwal R, Aggarwal AN, Gupta D. Diagnostic accuracy and safety of semi-rigid thoracoscopy in exudative pleural effusions: a meta-analysis. Chest. 2013;144:1857–67.
9. Khan MAI, Ambalavanan S, Thomson D, Miles J, Munavvar M. A comparison of the diagnostic yield of rigid and semirigid thoracoscopes. J Bronchol Interv Pulmonol. 2012;19:98–101.
10. Dhooria S, Singh N, Aggarwal AN, Gupta D, Agarwal R. A randomized trial comparing the diagnostic yield of rigid and semirigid thoracoscopy in undiagnosed pleural effusions. Respir Care. 2014;59:756–64.
11. Ofiara LM, Navasakulpong A, Beaudoin S, Gonzalez AV. Optimizing tissue sampling for the diagnosis, subtyping, and molecular analysis of lung cancer. Front Oncol. 2014;4:253.
12. Liu D, Lu Y, Hu Z, Wu N, Nie X, Xia Y, et al. Malignant pleural effusion supernatants are substitutes for metastatic pleural tumor tissues in EGFR mutation test in patients with advanced lung adenocarcinoma. PLoS ONE. 2014;9:e89946.
13. Bilaçeroğlu S. Molecular markers in lung cancer: role of EBUS. Curr Opin Pulm Med. 2017;23:247–53.
14. Alar T, Ozcelik C. Single-incision thoracoscopic surgery of pleural effusions for diagnosis and treatment. Surg Endosc. 2013;27:4333–6.
15. Wurps H, Schönfeld N, Bauer TT, Bock M, Duve C, Sauer R, et al. Intra-patient comparison of parietal pleural biopsies by rigid forceps, flexible forceps and cryoprobe obtained during medical thoracoscopy: a prospective series of 80 cases with pleural effusion. BMC Pulm Med. 2016;16:98.

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Telemedicine in Sleep Apnea: A Simple Approach for Nasal Pressure (CPAP) Treatment

Telemedicina en la apnea del sueño: un abordaje simple para la presión positiva continua nasal (CPAP)

Dear Editor:

Continuous positive airway pressure (CPAP) therapy is the optimal treatment for obstructive sleep apnea (OSA).[1] Nevertheless, the efficacy of CPAP depends on patient's adherence.[2] Indeed, although 4 h of treatment per night is required to achieve therapeutic effects,[2] the more hours CPAP is used the greater the benefits of treatment,[3] particularly with regard to systemic blood pressure.[4,5] When addressing the problem of CPAP compliance, several studies have reported that a good adaptation to this treatment at the beginning of its application is the key factor for long-term compliance.[6,7] Thus, patient education, follow-up and active feedback programs to provide support during the first weeks may be fundamental to increase compliance. However, the implementation of such customized programs may be expensive, as they require more resources and health staff involvement.[8] Therefore, due to the current over-burden of health care services and the cost of personalized programs, the use of telemedicine strategies may be useful. Previous studies testing telemedicine programs (web platforms, apps or videoconferences) have yielded controversial results[9] and the strategies already described have not been fully incorporated into the clinical routine. The lack of widespread application of telemedicine approaches in CPAP treatment is likely caused by their current organizational complexity, and therefore more user-friendly procedures are needed.[9] In this context, on the basis of our previous studies[10,11] we have developed a very simple and straightforward telemedicine procedure for supporting OSA patients, particularly along the first weeks of CPAP treatment.

This model for remotely managing CPAP treatment is based on three pillars: 1. To use one of the commercially available automatic-CPAP devices (Dreamstation, Respironics) which are able to remotely transmitting data on CPAP pressure, breathing flow, air leaks, compliance and residual respiratory events to a web server providing remote monitoring to the health care provider. Interestingly, such a setting also allows changing the nasal pressure applied remotely thus performing home accurate titration/re-titration. 2. To use a specially designed smartphone application, specifically an updated version of an app previously designed and tested to promote patient self-monitoring of CPAP treatment.[11] Each other day, APPnea asks the patient eight simple questions on compliance, sleep improvement, CPAP side effects and general lifestyle perception. All answers are sent to a web server and evaluated by a specialized nurse. 3. To use a voice mail available 24/24 h which is intended to collect any patient's questions or problems. Patients are encouraged to leave voice mail messages which a specialized nurse would check and, if necessary, contact the patient.

The actual clinical feasibility and usefulness of the described approach was tested in a pilot study. First, we assessed the remote titration procedure and patient compliance. Twenty patients (AHI 54.7 ± 22.00 events/h, BMI 30.9 ± 6.0 kg/m^2, Epworth 9.8 ± 5.0 and age 60.2 ± 9.0 years; m ± SE) were subjected to home CPAP titration, which was carried out along 5 consecutive nights and was supported through APPnea and the voice mail. Home titration was compared with in-hospital full polysomnography (PSG) titration (crossover protocol), with the result that no significant differences were found in the fixed recommended nasal pressure (8.95 ± 1.57 and 8.55 ± 1.32 cm H_2O for in-hospital PSG and remote home titration, respectively ($p = 0.389$). The performance of the telemedicine approach was also tested in terms of CPAP compliance after 3-months of treatment. To this end, the group of patients within the telemedicine procedure was compared with a group of 60 patients (matched 1:3 by AHI and age) who conventionally followed-up at the hospital during the same year period. No significant differences in compliance were found between the telemedicine group (6.4 ± 2.6 h/night) and the control group (5.9 ± 1.8 h/night) ($p = 0.691$). Taking into account the work hours employed by the involved sleep technician, nurse and physician and the use of devices and consumable materials, our analysis found that telematic approach was less expensive since the in-hospital PSG titration incurred in a 60% higher cost.

In addition to considering cost evaluation, assessment the patient's perspective is fundamental when testing a new clinical management approach. A first question that arises when trying to introduce the use of new technologies to a group of patients who are potentially not be familiar with them (in this case the use of

Apps) is to what extend OSA patients (most of them in an age segment not belonging to the digital generation) are prone to accept and perform the internet tools. In this connection it is worth noting that we carried out a preliminary test by asking 10 patients with limited knowledge of the use of Internet and mobile applications to test the APPnea tool at home, with the result that 9 of them we able to use it correctly, thus demonstrating the feasibility of telemedicine approach and confirming published reports on the ability of digitally illiterate patients to learn on the basic use of health applications.[12] Of particular importance is the patient's opinion on the use of telemedicine on sleep apnea management. To this end, using a focus group methodology we asked 14 OSA patients under CPAP treatment that had experienced both the in-hospital and the telemedicine approaches to talk freely about their experience when distributed into two focus groups (8 and 6 patients). The interviews highlighted the importance of: (1) flexibility of the consultations, (2) savings on work hours and trips to the hospital, and (3) chance to follow the progress of the therapy especially with regard to the residual AHI. Most patients reported that, according to their actual practical experience, the telemedicine approach was an innovative and straightforward way of controlling their treatment. Our experience after working with the patient's focus group confirmed our initial opinion that patient's opinion is of capital importance when designing future clinical procedures studies aimed at personalized treatment.

The simple telemedicine procedure we propose is feasible even in patients with limited knowledge of Internet or mobile applications and it reduces costs with patient satisfaction. However, bearing in mind that this telemedicine procedure does not replace the whole care of patients, especially in the more complex ones, it seems reasonable that telemedicine is progressively included in the clinical management programs for patients with sleep breathing disorders. Large follow-up and multicenter studies are needed to support these very promising results.

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References

1. Sullivan CE, Issa FG, Berthon-Jones M, Eves L. Reversal of obstructive sleep apnoea by continuous positive airway pressure applied through the nares. Lancet. 1981;318:862–5.
2. Wozniak DR, Lasserson TJ, Smith I. Educational, supportive and behavioral interventions to improve usage of continuous positive airway pressure machines in adults with obstructive sleep apnoea. Cochrane Database Syst Rev. 2014;1:CD007736.
3. Weaver TE, Maislin G, Dinges DF, Bloxam T, George CF, Greenberg H, et al. Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. Sleep. 2007;30:711–9.
4. Barbé F, Durán-Cantolla J, Capote F, de la Peña M, Chiner E, Msa JF, et al., Spanish Sleep and Breathing Group. Long-term effect of continuous positive airway pressure in hypertensive patients with sleep apnea. Am J Respir Crit Care Med. 2010;181:718–26.
5. Martínez-García MA, Capote F, Campos-Rodríguez F, Lloberes P, Díaz de Atauri MJ, Somoza M, et al. Effect of CPAP on blood pressure in patients with obstructive sleep apnea and resistant hypertension: the HIPARCO randomized clinical trial. JAMA. 2013;310:2407–15.
6. Luyster FS, Strollo PJ Jr, Thunström E, Pekere Y. Long-term use of continuous positive airway pressure therapy in coronary artery disease patients with nonsleepy obstructive sleep apnea. Clin Cardiol. 2017;40:1297–302.
7. Chai-Coetzer CL, Luo YM, Antic NA, Zhang XL, Chen BY, He QY, et al. Predictors of long-term adherence to continuous positive airway pressure therapy in patients with obstructive sleep apnea and cardiovascular disease in the SAVE study. Sleep. 2013;36:1929–37.
8. Bakker JP, Wang R, Weng J, Aloia MS, Toth C, Morrical MG, et al. Motivational enhancement for increasing adherence to CPAP: a randomized controlled trial. Chest. 2016;150:337–45.
9. Farré R, Navajas D, Montserrat JM. Telemedicine: a key tool for improving CPAP adherence in sleep apnea patients? Am J Respir Crit Care Med. 2018;197:12–4.
10. Isetta V, Negrín MA, Monasterio C, Masa JF, Feu N, Álvarez A, et al. A Bayesian cost-effectiveness analysis of a telemedicine-based strategy for the management of sleep apnoea: a multicentre randomised controlled trial. Thorax. 2015;70:1054–61.
11. Isetta V, Torres M, González K, Ruiz C, Dalmases M, Embid C, et al. A New mHealth application to support treatment of sleep apnoea patients. J Telemed Telecare. 2017;23:14–8.
12. Lind L, Karlsson D. Telehealth for "the digital illiterate" – elderly heart failure patient's experiences. Stud Health Technol Inform. 2014;205:353–7.

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