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Mini Review

The Utilization of Telemedicine in the Field of Sleep Medicine: A Review Article

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ABSTRACT

Telemedicine (TM) is defined as "the practice of medicine using electronic communications, information technology or other means between a licensee in one location and a patient in another location, with or without an intervening healthcare provider". Its objective is to deliver medical care to patients using telecommunication technology with the aim of benefitting a patient or a population. Telemedicine can improve patients' health care experience and reduce costs of health care at the same time. In this review, we identify the way TM can be used in the diagnosis and management of sleep disorders.

Key words: Sleep medicine; Telemedicine; Continuous Positive Airway Pressure therapy; Remote monitoring

INTRODUCTION

The definition of Telemedicine (TM) is "the practice of medicine between a licensee in one location and a patient in another location, with or without an intervening healthcare provider, using electronic communications, information technology, or other methods" [1]. Its goal is to benefit a patient or a population by providing medical care to patients using telecommunication technology [2]. Telemedicine has the potential to both lower medical expenses and enhance patients' experiences receiving care [3]. The utilization of telemedicine has increased throughout the world [4] specifically during the COVID-19 pandemic [5].

There are four main models of telemedicine which are: Synchronous and asynchronous (store-and- forward) telemedicine patient encounters, Remote Patient Monitoring (RPM), and mobile health (mHealth) smartphone applications [6].

The synchronous models are live communications between the patient and the health care provider using technology with real time video and audio simulating a usual clinic encounter. Patients usually consent for such interactions. It could also be in the form of centre-to-centre or centre-to-home format [7]. The asynchronous model is more of a “store and forward” type of model such as data review and analysis remotely. This model was clearly more utilized during the COVID-19 pandemic [7].

LITERATURE REVIEW

Challenges in sleep medicine

Sleep medicine faces challenges specifically when it comes to access to care. In Saudi Arabia for example, the ratio between number of beds and 100,000 population was 0.07 in 2005 and 0.11 in 2013 which will for sure cause delays in assessment and management of patients with sleep disorders [8]. The current module of patients with sleep disorders assessment is similar in most centres. It usually starts with a clinic visit and assessment followed by investigations (in lab level-1 sleep study or level-3 home sleep apnea test). Patients diagnosed with sleep disordered breathing will proceed with Continuous Positive Airway Pressure (CPAP) titration whether in-lab or AUTOCPAP and usually this is followed by another visit to initiate CPAP. Frequent subsequent follow ups are usually needed to ensure compliance, clinical improvement and troubleshooting. From a diagnostic perspective, an in-lab Polysomnography (level-1) remains the gold standard for the diagnosis of sleep disorders, specifically

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obstructive sleep apnea [8]. Despite that, it has many disadvantages including cost, complexity, being time consuming, difficult access to sleep labs which subsequently creates long waiting lists leading to delay in diagnosis and management, difficulties in recruiting qualified staff and poor quality of sleep to name a few. Home Sleep Apnea Test (HSAT) is an alternative method utilized for the diagnosis and management of obstructive sleep apnea. It is considered more convenient for patients, reduces waiting list and access to sleep labs and help makes the diagnosis and initiation of treatment faster. It correlates well with an in-lab Polysomnography. In a randomized crossover study, a home Portable Monitoring (PM) and in-laboratory simultaneous PSG were performed on 75 patients showing that the sensitivity of home PM was 90% for the diagnosis of Obstructive Sleep Apnea (OSA) in a high-risk urban population. PM was feasible, accurate, and preferred by patients [9].

However, it also has its disadvantages such as it is limited mainly for patients with high suspicion of OSA, not for other sleep disorders other than OSA and the underestimation of the severity of OSA. In addition, a negative study will require a full in lab sleep study which will make the diagnosis process lengthy and more costly.

TM in sleep medicine

For such issues and to improve the quality of care for patients with sleep disorders, the American Academy of Sleep Medicine (AASM) recommends that, "the practice of telemedicine should aim to promote a care model in which sleep specialists, patients, primary care providers, and other members of the healthcare team aim to improve the value of healthcare delivery in a coordinated fashion" [10]. From a patient's with sleep disorders perspective, TM will create an easier and more convenient access to care with a more personalized treatment plan through the use of technology and improve feedback in timely manner. From a sleep medicine expert's perspective, TM will help managing a larger number of patients [6]. The potential benefits of TM in sleep medicine include help improve access to healthcare, reduce waiting times for medical visits or investigations and improve adherence to treatment.

The utilization of the models of telemedicine (both synchronous and asynchronous) can help in providing and delivering health care in sleep medicine [10]. This could be in the form of a telemedicine consultation rather than the usual face-to-face as the initial encounter. The same concept can be used for education and counselling after a diagnostic procedure (PSG or HSAT) or after starting CPAP therapy for example [11]. Patients diagnosed with OSA are accepting such method for CPAP follow ups and CPAP training [12].

Sleep recordings in a tele-monitoring setting can be utilized with the goal of obtaining good quality sleep recordings outside the sleep lab ensuring recordings are quickly available for analysis, using TM for data transmission and maintaining the quality of unattended polygraphy/PSG (performed at home or in a virtual hospital) by intermittent or continuous remote supervision of recording. In a randomized crossover trial, which included 99 patients with suspected OSAS, Home unattended Polysomnography Tele-monitored Polysomnography (T-PSG) by a Sleep Laboratory and were done on 2 consecutive nights, according to a randomized order. H-PSG and T-PSG did not differ in terms of sleep and respiratory indexes in the 65 patients in whom both recordings were legible. H-PSG and T-PSG were concordant in 58 of 65 patients using a 10-event-per-hour apnea-hypopnea index cutoff value for the diagnosis of OSAS [13,14].

In another study by Borsini, et al. [15], where technicians were trained on respiratory polygraphies which are self-administered with raw data transmission through intranet for scoring. 499 respiratory polygraphies were done and analysed leading to diagnosis of mild OSA in 167 patients (33%), moderate OSA in 110 (22%) patients and severe OSA in 86 patients (17%). 191 patients (39%) were eventually started on CPAP therapy. Only 20 studies (4%) had to be repeated as they were ultimately considered not accurate with other promising studies showing the feasibility of such diagnostic methods. Tele-monitored CPAP titration for patients with OSA can be integrated in the process of sleep medicine care delivery. There is a reasonable concordance between pressures needed to alleviate airway obstructions in both tele-monitored CPAP titration and attended CPAP titration polysomnography [14].

OSA and CPAP compliance

Obstructive Sleep Apnea (OSA) is defined by "the occurrence of daytime sleepiness, loud snoring, witnessed breathing interruptions, or awakenings due to gasping or choking in the presence of at least 5 obstructive respiratory events (apneas, hypopneas or respiratory effort related arousals) per hour of sleep. The presence of 15 or more obstructive respiratory events per hour of sleep in the absence of sleep related symptoms is also sufficient for the diagnosis of OSA due to the greater association of this severity of obstruction with important consequences such as increased cardiovascular disease risk" as per the American academy of sleep medicine [9]. It increases the risk for metabolic diseases and cardiovascular diseases by two to three folds [16].

The prevalence is reported to be around 17% of women and 34% of men in the USA [9]. In Saudi Arabia, 33% of Saudi men and 39% of Saudi women are at risk of OSA [17,18]. Another study estimates that at least 8.8% (12.8% in men and 5.1% in women) was calculated for the overall prevalence of OSA. Similarly, the overall estimated prevalence of Obstructive Sleep Apnea Syndrome (OSAS) and Clinically diagnosed OSA Syndrome (COSAS) was 2.8% (4.0% in men and 1.8% in women) and 8.5% (12.4% in men and 4.8% in women), respectively [19].

Positive Airway Pressure (PAP) remains the recommended treatment for OSA patients with excessive daytime sleepiness, impaired sleep-related quality of life and comorbid hypertension [20]. However, compliance to PAP therapy is big challenge when managing patients with obstructive sleep apnea. Adherence is defined as the use during of PAP for at least 4 h per night-1 and for >70% of nights [21]. Compliance with CPAP therapy is between 30 to 60% [22] with physical discomfort from wearing

the CPAP apparatus, financial burden, and psychological stress as common causes for non-compliance [23].

TM and CPAP compliance

In a study where 45 patients diagnosed with OSA were randomized to receive clinic care through telemedicine or the conventional way after the initiation of CPAP therapy in the first 2 months, patients who received care and follow ups through telemedicine had a better compliance than those who were followed through the usual clinical care (average 4.1 ± 1.8 hours per night in comparison to 2.8 ± 2.2 hours per night (P=0.07)) [24].

A non-blinded, single center, randomized controlled trial by Fox et al. [25], where patients were randomized to use either AUTOCPAP (standard care) or an AUTOCPAP device which transmits information to a website. Information from the device (such as leak, apnea-hypopnea index and compliance) were analysed and appropriate actions were taken to correct them. There was a significant better compliance among the group of patients managed through telemedicine in comparison to the AUTOCPAP group (191 min per day *vs.* 105 min per day; mean difference=87 min, 95% Confidence Interval (CI): 25-148 min, P=0.006) [25].

It's worth mentioning that compliance to CPAP therapy through tele-monitoring was enforced in the first couple of months of starting CPAP which is usually an important period in OSA management with CPAP [24,26] and can be done through different methods (such as smart phones) which also can improve compliance [27]. The ability of earlier intervention is another advantage of telemedicine CPAP compliance monitoring [28].

CONCLUSION

Sleep Medicine faces many challenges when it comes to access to care, diagnostic modalities, initiating treatment and continuous management. The integration of new technologies in the field is becoming a necessity with out of center assessment and management through telemedicine being more needed with evidence showing its benefits to achieve such goals. Further research would be needed.

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