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CLINICAL REVIEW

Comparison of positional therapy versus continuous positive airway pressure in patients with positional obstructive sleep apnea: A meta-analysis of randomized trials

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SUMMARY

Background: Obstructive sleep apnea (OSA), caused by the obstruction of the upper airway, is the most common type of sleep apnea. Continuous positive airway pressure (CPAP) and positional therapy have been shown to be effective to improve positional OSA.
Aim: To compare the effectiveness of positional therapy versus CPAP on positional OSA.
Methods: Prospective randomized trials were systematically searched from the OVID databases. The trials comparing positional therapy versus CPAP in patients with positional OSA were included. Apnea-hypopnea index (AHI), mean oxygen saturation level, arousal index, sleep efficiency, and sleep time were the outcomes of this meta-analysis.
Results: Three crossover trials were identified from Canada, New Zealand, and United States from 1999 to 2010. A total of 71 patients were randomly assigned to receive CPAP or positional therapy and the mean age of patients was 51 y. Positional therapy showed higher AHI (mean difference, MD: 4.28, 95% CI: 0.72 −7.83) and lower oxygen saturation level (MD: −1.04, 95% CI: −1.63 to −0.46) than CPAP. It showed no distinct advantage over CPAP in terms of arousal index, sleep efficiency, and total sleep time, but CPAP reduced sleep time in the supine position.
Conclusion: CPAP is superior to positional therapy in reducing the severity of sleep apnea and increasing the oxygen saturation level in patients with positional OSA.

Introduction

Obstructive sleep apnea (OSA) is the most common form of sleep apnea and is caused by the obstruction of the upper airway. The prevalence of OSA is approximately 3–7% for adult men and 2–5% for adult women in the general population,[1–3] while percentages in Hong Kong are 4.1% and 2.1%, respectively.[4,5] OSA has been identified as an independent risk factor for neurobehavioral morbidity hypertension, cardiovascular disease, and all-cause mortality.[6–8] Around half of the OSA patients have positional OSA,[9,10] which is classified as patients sleeping with at least a double of the apnea hypopnea index (AHI) in the supine position compared with the other sleeping positions. In general, the prevalence of positional OSA in the mild and moderate OSA patients is higher than that in the severe OSA patients who have AHI over 30 events/h.[9–11]

Continuous positive airway pressure (CPAP) has been shown to be effective, as it improves sleep disordered breathing, as well as sleep quality.[13,14] CPAP works like a pneumatic splint to maintain a continuous level of positive airway pressure and prevent collapsing or blockage of the airway during the sleep. Nevertheless, side effects of CPAP are reported, such as skin irritation around the nose, nasal congestion, dry nasal mucosa, and mouth leaks,[15,16] so that compliance with CPAP can be suboptimal (<50%).[17] On the other hand, it is found that the sleep apneas are more frequent and prolonged in the supine position.[18] Therefore positional therapy, which is an external intervention to prevent OSA patients from sleeping in a supine position, is more beneficial for positional OSA patients. Although the mechanisms for the positional changes in sleep-disordered breathing are not fully understood, the non-supine position appears to reduce the tendency of posterior tongue relapse and pharyngeal collapse. Some of the recent studies also showed that positional therapy is effective in preventing the patients from

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sleeping in supine position with a significant reduction in AHI.[19–21] As the prevalence of positional OSA is high in Asiatic populations,[22,23] the future demand for positional therapy is assured.

Some randomized trials have compared the efficacy of positional therapy versus CPAP in patients with positional OSA.[24–26] Although these studies showed similar conclusions for positional therapy, the results were limited by small sample size. Therefore, this meta-analysis has been conducted from all published literature with greater statistical power, in order to distinguish whether the overall benefits of positional therapy is comparable to CPAP in patients with positional OSA.

Methods

Search strategy

Prospective randomized controlled trials that compared positional therapy versus CPAP in patients with obstructive sleep apnea were the target group of studies in this meta-analysis. Literature searches with keywords related to positional therapy, positive airway pressure, and obstructive sleep apnea were performed in Ovid databases, including Medline, Embase and CINAHL. In addition, some manual searches were extended to the bibliographies of review articles. The search began from the earliest available dates in the individual databases, till the date of final literature search which was on 30th Sep 2012.

Inclusion & exclusion criteria

All randomized trials were included if they met the following criteria: i) all patients were diagnosed with positional OSA, i.e., at least a double AHI in supine position compared with non-supine position; ii) patients were randomized to compare positional therapy with CPAP; iii) the positional device was used as an external intervention to prevent patients from supine sleep, iv) sleep monitoring was conducted at night time; and v) at least one of the following outcomes was reported: AHI, mean oxygen saturation, total sleep time, sleep efficiency, or arousal index. Trials were excluded if i) patients had other medical conditions that may interfere with sleep, such as chronic respiratory disorder, heart failure, or uncontrolled allergies; ii) no ethics approval or patient consent was reported; or iii) the trials were not written in English.

Data extraction

Two investigators (SCH, HWH) independently assessed the titles and abstracts of all generated papers for relevancy, and extracted the data into a standardized data extraction form. The data extraction form was used to record the demographic data, including names of the first author, year of publication, study location, number of participants, mean age of patients, and also the study outcomes. Consensus decisions were made by the two reviewers, regarding the inclusion of studies and data extraction. When discrepancies were found, the third investigator (KKT) would make the definitive decision for trial eligibility and data extraction.

Study outcomes

The primary outcome of this study was AHI, which is used to assess the severity of sleep apnea based on the average number of apnea and hypopnea occurring in an hour of sleep. Apnea and hypopnea are respectively defined as a complete and partial obstruction of airway for more than 10 s with oxygen desaturation. AHI was measured by overnight polysomnography or a portable recording device.

The secondary outcomes were mean oxygen saturation level, arousal index, sleep efficiency, total sleep time, sleep time proportion in supine position, and preference on the intervention. Mean oxygen saturation level is the average of oxygen saturation during sleep. Arousal index is the average number of arousals in an hour during sleep. Sleep efficiency is the total recorded sleep time divided by the total time in bed expressed in percentage. Total sleep time is the total number of hours in sleep measured by a machine, such as polysomnograph, within the recorded period. Sleep time proportion in supine position is the percentage of time spent in supine position during sleep divided by the total sleep time. Preference of intervention is the percentage of patients preferring the positional therapy or CPAP.

Risk of bias and study quality

Potential sources of bias were assessed by using the Cochrane's guideline.[27] The risk of bias guideline basically evaluated the adequate sequence generation, subject allocation and concealment, blinding of patients and outcome assessment, outcome data completely addressed, selective outcome reporting, and other biases. The quality of each eligible trial was also assessed by the guideline of critical appraisal for randomized controlled trial.[28] The quality criteria were designed in a 8-point scale with reference to the questions in the guideline for study methodology, including: 1) methods of patient allocation, 2) randomization procedures with concealed allocation, 3) mechanism used to implement the random allocation sequence, such as computer-generated allocation, 4) eligibility criteria for patients and settings for data collection, 5) interventions for each group with sufficient details, 6) pre-specified primary and secondary outcome measures, 7) estimation of required sample size, and 8) methods of blinding. Some of these quality parameters were included in the risk of bias evaluation, such as the adequate sequence generation, subject allocation and concealment, and blinding methods.

Statistical analysis

Meta-analyses were performed with Review Manager (Copenhagen).[29] Relative risk (RR) and mean difference (MD) with 95% confidence interval (CI) were used to evaluate the dichotomous and continuous outcomes, respectively. Standard derivation of the mean was estimated by the 95% CI or the reported standard error. When median and range were reported as the only outcomes, sample mean and standard deviation were approximately estimated.[30] Statistical heterogeneity among the trials was assessed, and P-value <0.1 was considered as statistically significant. Heterogeneity was assessed with I^2, which describes the percentage of total variation across studies caused by the heterogeneity rather than chance alone. High values of I^2 show an increasing heterogeneity. A Mantel–Haenszel fixed-effects model was used for significant homogeneous trials; and otherwise, random-effects model was applied.[31] Forest plots were used to present the combined results graphically.

Results

Literature search

The initial search identified total 771 abstracts from published studies or conference papers (Fig. 1). All abstracts were evaluated and 18 studies were found to be relevant. Fifteen studies were excluded for the following reasons: compared different sleeping