Title: High flow nasal cannula compared to continuous positive airway pressure in the treatment of obstructive sleep apnea

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NCT number: NCT03843372

Document date: June 08, 2020

Materials and Methods

This work was approved by the institutional review board of Chang Gung Memorial Hospital (201601844B0C101), and all subjects signed informed consent forms in accordance with the amended Declaration of Helsinki. Subjects who were diagnosed with OSAHS via standard polysomnography (PSG) were recruited in the sleep center of Chang Gung Memorial Hospital. The definition of OSAHS was an AHI greater than 5 times per hour (times/hr). Patients with central sleep apnea, hypoventilation syndrome, chronic obstructive airway disease, an unstable hemodynamic state, who were younger than 18 years old, with an Eastern Cooperative Oncology Group Performance Status higher than grade 2, who experienced intolerance to HFNC or CPAP, and pregnant women were excluded. In addition, patients who recently underwent surgery or used an oral appliance were also excluded.

Study Protocols

This was a prospective crossover study. All of the participants were randomized into two groups for minimized first night effects. All of them would receive one-night HFNC therapy and another night for CPAP titration under PSG monitoring. The duration between these two treatments was approximately one week apart. The first group underwent CPAP titration on the first night and HFNC titration on the second night. Conversely, the second group was subjected to HFNC on the first night and CPAP titration on the second night. All of the participants were asked and recorded their side effects following completion of an HFNC or CPAP.

Polysomnography and scoring methods

Standard overnight PSG included recording electroencephalography, bilateral electroculograms, submental electromyogram, electrocardiography, nasal pressure, oronasal thermistor, oximetry, chest, and abdominal movement (inductance plethysmography), body position, sound intensity, and bilateral tibia electromyogram. All signal results for each night were collected and digitized on a computerized PSG system (Embla N7000, USA; Compumedics, Australia). Sleep stages and respiratory events were scored according to the American Academy of Sleep Medicine (AASM, Version 2.4; 2017) scoring manual.

CPAP titration

All patients underwent a nasal CPAP titration study in the sleep laboratory for an entire night. During the CPAP titration study, manual CPAP titration was conducted to determine the optimal CPAP level required. A CPAP interface was individually fitted from a wide range of interfaces to maximize comfort and minimize leaks. The preparation of the patients was accomplished by a trained PSG technician who supervised the study. All of the participants used a CPAP mask and machine (System one, Philip Respironic, US) throughout the study. Preparation of the patients was accomplished the technician who supervised the study and corrected the mask position and fitting initially. All of the patients were started at a low pressure (4 cm H2O) initially, and then the pressure was manually increased after the patients went to sleep. The pressure sensor was used to evaluate apneas, hypopneas, and flow limitations. The optimal CPAP pressure was determined to be the pressure that could eliminate apnea, hypopnea, desaturation, and snoring in a supine position or when possible in REM sleep [18].

High flow titration

All participants underwent high flow titration in the sleep laboratory for an entire night. An air compressor (AIRVOTM2, Fisher &Paykel Healthcare, Auckland, New Zealand) delivered the airflow via nasal cannula (Optiflow). A heating tube (900PT500) and humidifier kept the temperature at 34–37oC and absolute humidity of 44mg/L. The initial flow rate was set as 20L/min. After the patients fell asleep, the flow rate was increased by 10L/min up to a maximum of 60L/min to try to eliminate apneas, hypopneas, and desaturation in the supine position or REM sleep. This principle was similar to the CPAP titration; however, RIP signals were used to distinguish the respiratory events. If the participants become awake or complain that the flow rate was too high or uncomfortable, the flow rate would be decreased 10 L/min until they could return to sleep. When the subject fell asleep again, the flow rate would be increased again to try and discover the optimal flow rate that could maintain sleep and achieve a favorable AHI reduction. The flow rate that could maintain sleep, plus the best AHI was defined as the optimal flow rate. Once the optimal flow rate was determined, the subjects were allowed to sleep at that flow rate for the rest of the night.

Statistical analysis

The most of respiratory event and sleep quality parameters were not normal distribution. Therefore, the carry over effect of CPAP and HFNC were evaluated by Wilcoxon rank sum test. The AHI, desaturation index, sleep efficiency, and total sleep time between CPAP titration, and HFNC were also compared with the Wilcoxon rank sum test. The side effects of HFNC and CPAP were compared with the chi-square test and Fisher's exact probability test. A p-value < 0.05 was considered statistically significant. Statistical evaluations were performed using the SPSS 16.0 Software (SPSS Inc., Chicago, Ill). Data were presented as median ± interquartile range (IQR). P-values < 0.05 were considered to be statistically significant.