Lilian Jepkemboi Kigen

LONG TERM USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE CARE IN SLEEP APNEA: Literature review on common side effects and possible nursing interventions

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ABSTRACT

Department	Date	Author
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Marja-Liisa Hiironen, PhD

Sleep apnea is becoming a major health problem though it falls with the group of the most under diagnosed illnesses. Untreated sleep apnea is a risk factor for daytime sleepiness which induces impaired concentration and cardiovascular disorders such high blood pressure. Sleep apnea can by treated by administration of Continuous Positive Airway Pressure. Treatment of sleep apnea involves alleviation of the symptoms because sleep apnea is a disease that cannot be cured. As nursing progresses, the nurses have an increased responsibility in the identification of symptoms, education and management of patients who are suffering from sleep apnea. This happens both in the special and basic health care settings.

The study was carried out by conducting a literature. The data was collected by performing a literature search from databases such as Science Direct, Sage, Pubmed Centrals, American College of Chest Publications, SLEEP Journal, European Respiratory Journal and from Israel Medical Association. Seventeen articles were chosen by the researcher for the study on basis of inclusion and exclusion criteria.

The findings of the study found out the most common the side effects associated use of Continuous Positive Airway Pressure and classified them into three namely physical, problem with the equipment and psychological and socioeconomical. The study also defined nursing interventions for these side effects according to their class. The most common nursing interventions identified were use of a heated humidifier, nasal rinses or steroids and change of mask. In addition, education in combination with intervention for the side effects was highlighted in most studies as the most suitable way for nurses in management of patients undergoing Continuous Positive Airway Pressure treatment.

Keywords
Continuous Positive Airway Pressure (CPAP), Interventions, Obstructive sleep Apnea, Side effects, Treatment**.**

LIST OF ABBREVIATIONS

CPAP	Continuous Positive Airway Pressure
ESS	Epworth Sleepiness Scale
WHO	World Health Education

ABSTRACT

LIST OF ABBREVIATIONS

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1 INTRODUCTION

Sleep apnea is a breathing disorder and it occurs during sleeping. The condition is characterized by stoppage of breathing for ten seconds or longer and at least five times per hour. These episodes always come to an end when one arouses from sleep. (Black & Hawks 2005, 512-513.)

There are two types of obstructions that cause the stoppage of breathing namely apnea and hypopnea. Apnea is when an individual experiences a complete cessation of breathing for at least ten seconds whereas hypopnea is when breathing is partially stopped for at least ten seconds. (American Sleep Apnea Association.)

Treatment of sleep apnea involves getting rid of the symptoms because sleep apnea is a disease that cannot be cured. Hence, lifestyle changes such as weight loss, change of sleeping position, care of the nose and avoiding alcohol or sedatives is the first step in treatment of sleep apnea. When the case becomes severe, Continuous Positive Airway Pressure (CPAP) as a means of treatment is started. CPAP prevents the collapse of airway during sleep. In other cases of sleep apnea, corrective surgery may be performed. (Alexander, Fawcett & Runciman 2000, 791.)

The treatment of sleep is important. This is because sleep apnea has been associated to stroke which leads to premature deaths. On the other hand, stroke is a risk factor of hypertension (Yaggi, Concato, Kernan, Lichtman, Brass & Mohsenin 2005).In addition, it has been found out that even mild cases of sleep apnea have a great effect on behavioral, social and cardiovascular diseases (Olson, Moore, Mergenthaler, Gay & Staats 2003).

Interest in this topic was gained during medical nursing practical placement about internal diseases at the pulmonary outpatient clinic at the Central Hospital when the researcher had two weeks of practice with a nurse who is a specialist in sleep apnea. Working with a sleep apnea specialist nurse meant taking care of mainly sleep apnea patients and the activities included helping in identification of symptoms and management of sleep apnea. Majority of the patients already diagnosed with sleep apnea were under treatment and used CPAP machines.

Majority of the patients undergoing CPAP care often complained of the complications that arise from CPAP care for example, experiencing dry nose and mouth. Many patients stop using the CPAP machine because they do not know of way to deal with the side effects and this makes their condition worse and poses a risk to other health problems (American Sleep Apnea Association). Finding out these common side effects and possible nursing interventions are the main goals of this thesis.

The purpose of the thesis was to investigate the common side effects that develop with the use of CPAP and the possible nursing interventions. The goal of the thesis was to gather information needed for creation of a guideline for health personnel working with sleep apnea patients when intervening for the side effects that arise with long-term use of CPAP therapy. The results of this study would be beneficial to the patients who are suffering from sleep apnea. The patients as well as their relatives could be provided with more information about the disease, its treatment and that they will be more ready to tackle any of the complications that can arise when using CPAP. Hence, it improves adherence to CPAP care.

This study was carried out based on a literature review. In this study, information was gathered from previous researches about sleep apnea and continuous positive airway pressure as treatment. The most common side effects and nursing interventions were highlighted from the previous study on CPAP for treatment of sleep apnea.

2 TREATMENT OF SLEEP APNEA BY CONTINUOUS POSITIVE AIRWAY PRESSURE

2.1 Sleep apnea

Sleep apnea is a type of a breathing disorder that takes place during sleep. The breathing may partially stop or completely stop when an individual is sleeping and it can last for five seconds or more. These pauses in breathing can happen several times within an hour. On the other hand, obstructive sleep apnea is the brief periods of recurrent cessation of breathing during sleep that is caused especially by obstruction of the airway or a disturbance in the brain's respiratory center and is associated especially with excessive daytime sleepiness. (Medline Plus).

There are three types of sleep apnea namely obstructive sleep apnea, central sleep apnea and mixed sleep apnea. Obstructive sleep apnoea is caused by obstruction of the upper respiratory tract during sleep. Central sleep apnea caused by a disturbance of central respiratory control, there is no respiratory movements taking place during this type. Mixed sleep apnea is a combination of obstructive sleep apnea and central sleep apnea. (Black & Hawks 2005, 512-513.)

The most common symptoms of sleep apnoea include snoring when an individual is sleeping, episodes of shortness of breath during sleep, fighting sleepiness during the day or when performing daily activities, at work or while driving, falling asleep easily for example, while watching TV, frequent urination at night and morning headaches. Other symptoms include memory or learning problems and not being able to concentrate, feeling irritable, depressed, or having mood swings or personality changes and a dry throat in the mornings after waking up. (American Sleep Association 2007.)

It can also be characterized by daytime sleepiness which happens as a result of disrupts in the sleep and with the occurrence of two or more of the following symptoms; choking or gasping when one is sleeping, frequent awakening from sleep, poor concentration, feeling tired and not refreshed even after sleep with unexplained factors causing it. (De Backer 2006.)

Diagnosing of sleep apnea can be performed primarily by the use of Epworth Sleepiness Scale (ESS). ESS is a helping diagnosing tool in sleep apnea and was developed by Dr Murray Johns for assessment of daytime sleepiness. The tool contains of eight questions that tests and assess how an individual can easily fall asleep when performing some basic daily activities or when relaxing. The scale is measured on a four scale point of zero to three. (Murray 1997.)

Further diagnosis for sleep apnea is carried out by use of the polysomnography. Polysomnography is a test used for diagnosing most sleep disorders and the test records the waves in the brain, oxygen level in the blood, heart and breathing rate as well as leg and eye movements when an individual is sleeping. This test is normally carried out at home with proper instructions or at a health facility. (Mayo clinic 2009.)

According to World Health Organization (WHO 2011), sleep apnea as a condition is not a life threatening situation but the risk factors and complications such as cardiovascular and cerebrovascular diseases are the serious problems associated with sleep apnea. The disease has an effect on the quality of life due to low productivity in the society and possible motor accidents which maybe as a result of daytime sleepiness. CPAP is the most effective and commonly used form of treatment.

Use of oral appliances can be of great importance to those patients who are not able to use any form of positive airway pressure (Ballard 2008). Lifestyle changes such as weight loss play an important role in treatment of sleep apnea and studies have proofed it. However, the main challenge is the process and ways of losing weight and being able to maintain the lost weight. Sleep apnea can also be treated pharmacologically and surgically but it is not very effective (Lavie 2003, 195-211).

2.2 Continuous Positive Airway Pressure

CPAP works in such a manner that it functions as a splint that keeps the airway open throughout inspiration and expiration during sleep with help of a mild constant air pressure. The airway being able to remain open and not collapse when an individual is asleep prevents the occurrence of apnea. (Yim, Jordan & Malhotra 2006).

The administration of air is carried out by use of a CPAP machine which contains three parts namely the mask, tube and a motor. The mask connects and fits over the nose or both nose and mouth. The tube connects the mask to the machine's motor whereas the motor blows the air through the tube. The air is then passed through the mask to the airway and the constant pressure keeps the airway from collapsing. The machines are always light, small and noisy but the noise is fairly quiet and rhythmic. (National Institutes of Health 2010.)

The amount of the pressure being delivered is determined at a sleep unit or at home. Factors to be considered when determining the air pressure are body mass index, apnea-hypopnea index and neck circumference in connection to the prediction algorithm used in titration of CPAP pressure. Studies showed there is no difference between calculated CPAP and the auto-titrated CPAP (National Institutes of Health 2010.)

CPAP aids in prevention and eradication of the symptoms of sleep apnea. It is ideal for the improvement of daytime sleepiness and improves the life quality of patients suffering from sleep apnea. It reduces the occurrence of accidents due to the increased alertness and it has also been established to stabilize the levels of blood pressure. (Giles, Lasserson, Smith, White, Wright & Cates 2006.)

CPAP is the most effective form of treatment for sleep apnea but intolerance and incomplete compliance has made it difficult for efficacy. Lack of efficacy is as a result of the side effects that arise when using CPAP (Hedner, Grote & Zou 2007). Complete tolerance and compliance to the CPAP machine can be achieved when the patients use it for more than four hours in a night and there are no more symptoms of sleepiness during the day (Engleman, Kingshott, Wraith, Mackay, Deary & Douglas 1999).

Treatment of sleep apnea is important in prevention of premature all-cause mortality as shown by the Busselton study carried out by Marshall, Wong, Liu, Cullen, Knuiman & Grunstein (2008). The study found out from their community – based sample that moderate to severe sleep apnea played an important and an independent role in the increased risk of all-cause mortality because majority of the deaths reported during the study where in one way or another related to sleep apnea.

The goal for treatment of sleep apnea is to be able to remove both physiological and symptomatic problems. The goal for treatment of sleep apnea can be said to have been achieved if the symptomatic problems such as snoring and daytimes sleepiness have been completely alleviated. This applies also for the physiological problems such as breaks in sleep, apneas and hypopnea. The goal can be generally measured by an improved life quality (National Institute of Health 1995.)

Follow-up examination should be carried out to determine the success or the failure of the treatment since CPAP treatment is usually carried out at the patient's home. The follow-up examinations can be carried out through inviting the patient for an interview in the sleep apnea clinic after a certain period of time, for example, every half a year or yearly. (Lavie 2003, 236.)

Identification of the possible side effects that can occur as a result of CPAP treatment can be of great help to the nurses and health personnel working with clients suffering from sleep apnea. The nurses' awareness and early recognition of the side effects and the solutions can facilitate for early intervention, hence, prevention of further complications.

3 PATIENT'S EXPERINCES OF CPAP TREATMENT

3.1 Physical side effects

Use of CPAP has side effects that almost all the patients undergoing CPAP treatment experience at some point. The side effects are usually in relation to the pressure and mask used in CPAP care. Different patients experience different side effects but the most common side effects are nasal congestion that is blockage of the nasal passage, rhinitis which is runny nose and claustrophobia to the CPAP mask (National Sleep Foundation 2006). Other big reasons for non-compliance in CPAP care is the noise from air leakage from the mask, facial breakages and conjunctivitis (Victor 2004).

The masks used in CPAP care to deliver the air that keeps the airway open can cause skin allergy or irritation. This can happen as a result of the material used in manufacturing the mask or may be due to straps that do not fit well. Furthermore, some patients experience a dry mouth as a result of them breathing with their mouth instead of the nose. Other side effects include nose congestion, runny nose, sneezing, sinusitis and nosebleeds as a result of using the CPAP machine which can be leaking. (National Institutes of Health 2010.)

CPAP machines can cause stomach bloating and discomfort if air is inhaled. Consequently, this makes the use of CPAP machine an unpleasant experience. In some cases, CPAP machine can cause nausea and vomiting, hence a risk factor of aspiration. (Lippincott 2008.) Other common complications of CPAP are congestion and runny nose. These are as a result of nasal dryness and they may cause an infection. Other side effects are skin breakdown from air leakage from masks. Patients suffering from other lung disease can experience barotraumas as a result of excessive positive airway pressure (Yim et al. 2006).

Other most common side effects are air leakage or uncomfortable masks, nasal irritation, mouth and throat being dry and damage of the localized tissues for example, the nasal bridge. Other difficulties are experiences of practical problem with the equipment for example, difficulties adjusting the mask, pressure and leakage from mask and noise from the CPAP machine. The study reports that the named side effects have led to negative attitude towards the CPAP treatment. (Tomlinson 2007.)

3.2 Problems with the CPAP equipment

Some patients realized problem with CPAP machine in itself and not as a result of using it. The most commonly reported problem with the equipment was mask leaks that occurred as a result of the loose straps and not fitting the mask correctly. A leaking mask will lead to the above named physical side effect such as nose congestion, runny nose, sneezing, sinusitis and nosebleeds. High air pressure being administered to keep the airway open may cause side effects such as having it hard to exhale or the feeling of suffocating. (National Institutes of Health 2010.)

Some patients have difficulties sleeping with the mask; hence they end up removing it due to discomfort that it causes to them. The noise that the CPAP machine produces when in use has also be discovered to the one of the reasons some patients cannot use it even though some of the newest machines have a kind of soft and rhythmic noise that should not be a trouble to the individuals using it. (National Institutes of Health 2010.)

3.3 Psychological and social economic side effects

Some patients experience claustrophobia and as a result suffer from anxiety when using the CPAP machine (Lippincott 2008). Claustrophobia is the fear of being enclosed in some place or something and if the subject being feared cannot be avoided then it can lead to anxiety (Medline Plus).

The study carried out by(Hui, Choy, Li, Ko, Wong, Chan & Lai 2000). reported that some of patients using CPAP equipment reported to have been inconvenienced and felt embarrassed with the CPAP equipment especially when they had to use it in front of other people for example their friends or strangers and also when they were travelling.

Social economical status which is the measure of an individual's level of income, education and occupation as a factor that determines the adherence to CPAP care was studied by Platt, Field, Asch, Chen, Patel, Gupta, Roche, Gurubhagavatula, Christie & Kuna (2009). The study discovered that the individuals with lower socioeconomic status exhibited poor adherence to CPAP care compared to those who with a high socioeconomic

status. Lack of education and a realistic formulation of the disease and the risks it poses to an individual's health have been established to have an effect on CPAP adherence as reported in the study carried out by Sawyer, Canamucio, Moriarty ,Weaver, Richards & Kuna (2010).

4 NURSING INTERVENTIONS

4.1 Possible nursing interventions for physical side effects

Heated humidification has been studied to alleviate the problems such as nose congestion, runny nose, sneezing, sinusitis and nosebleeds and even made the patients more refreshed when they were awake (Randerath, Sanner, & Somers 2006). The problem of breathing with the mouth can be solved by use of both a face mask and heated humidification (Martins De Araujo, Vieira, Vasquez & Fleury 2000). A chinstrap which helps in the tight closure of the mouth has been studied to aid in the problem of mouth-leaks by minimizing arousals during sleep (Bachour 2004).

In addition, decongestants and intranasal steroids can be used for the case of runny and stuffy nose. The medications can be bought from a pharmacy with the orders from one's individual physician. Allergy testing and desensitization can also be carried out to rule out allergies. (Mickelson 2007.)

4.2 Possible nursing interventions for problems with the CPAP equipment

Introduction to the CPAP machine and performing a CPAP titration that determines the ideal fixed pressure to be used at home should be performed at the sleep clinic by specialized personnel. Demonstration to show how the CPAP machine functions should be performed at the sleep clinic by a sleep apnea specialized personnel. It should be demonstrated practically with the client in a sleeping position. (Engleman & Wild 2003.)

A suitable mask that fits should be used and be set in such a manner that the patient is comfortable and does not experience any leaks (Engleman & Wild, 2003). Some patients tend to breath with their mouth due to mask leaks and this problem can be managed by use of a full face mask. Full face masks are designed to cover both mouth and nose and there is an effective flow of air and therapy even when there is mouth leak and breathing (American Sleep Apnea Association 2011).

4.3 Possible nursing interventions for psychological and Socioeconomic side effects

The study carried out by Engleman & Wild (2003) discovered that basic educational and behavioral supports enhanced CPAP usage of patients who may otherwise stopped using it due to psychological and socio economic problems. Cognitive behavior therapy plays a major role among patients who experience claustrophobia and anxiety due to CPAP treatment.

Preparing the patient and the partners for CPAP treatment through education helps the patients to become psychologically and socially ready for the machine. The education should include medical facts about sleep apnea, complications and treatment options. CPAP as a method of treatment should be discussed and the patient is informed on what to expect when treatment commences. The patients who have lower socio economic status should be provided with CPAP machines on a loan if they are unable to afford the machine. (Engleman & Wild 2003.)

Individual support and education should be carried out for the patients with low socioeconomic status to improve the acceptance and adherence of CPAP care (Simon-Tuval, Reuveni, Greenberg-Dotan, Oksenberg, Tal & Tarasiuk 2009). Follow up visit by specialist nurse to support and evaluate the use of CPAP has been found to be highly appreciated by the patients undergoing CPAP treatment. The patients who received follow up visit by specialist nurse appreciated the support and they mentioned that the visits were cost effective because it minimized their own visits to the physician (Holmdahl, Schöllin, Alton & Nilsson 2009).

5 PURPOSE AND RESEARCH PROBLEMS

The main purpose of this study was to investigate the common side effects that appeared when CPAP was used and the possible nursing interventions. The objective of this thesis was to highlight the most common side effects that arise with long term use of CPAP machines and their possible nursing interventions. Hence, this material would be useful for the patient's education especially for the nurses that are taking care of patients suffering from sleep apnea and are undergoing CPAP treatment. The material would be beneficial to the patients and their relatives as the information will enable them to tackle the side effects that develop from using CPAP. Therefore, they may be able to lead normal and productive lives.

There were two research questions in this study:

1. What were the common side effects that arise with the long term use of CPAP care?
2. What were the possible nursing interventions for the side effects that arise with the long term use of CPAP care?

6 METHODOLOGY

6.1 Literature review

A literature review is method used in research project or a thesis and its main use is to summarize and put into context what has already been studied before. It means putting together several studies that have been carried out on a particular subject, systematically reviewing them and finally, summarizing them. (Parahoo 2006, 121.)

The importance of conducting a literature review is that the main intention is to summarize the several literature available about one topic. This makes it easier for the reader as they do not have to read each of the report included in the literature review. It is also particularly important in the social and health care field as there are numerous amount of literature available about one topic and thus, a review makes it simple to gather the most recent and developed ideas about the practice without having to read all the numerous reports.(Aveyard 2007, 6.)

Conducting a literature review has a particular process just like any other research paper. Firstly, there has to be a formulation of the research question, aim, objective or the hypotheses. This is followed by definition of terms or concepts. Then the inclusion and exclusion criterion is drawn up so as to define boundaries of the review. (Parahoo 2006, 136-138). Searching relevant materials from the databases available for example, CINAHL, EBSCO, and OVID is the next step in conducting a literature review. The retrieved articles that meet the inclusion are reviewed and finally appraisal of evidence is performed to rule out the unwanted studies since all studies may not be valid and reliable. (Parahoo 2006, 138-140.)

The next step will be synthesizing the findings from the selected studies to collate and summarize the data that have been collected from the primary studies. The last part of the literature review concludes and makes recommendations in accordance to the research question. The conclusion should be based on the findings of the studies selected for the literature review. (Parahoo 2006, 141-142.)

6.2 Literature search

Literature search can be defined as the process whereby scientific databases are used to identify and retrieve materials from research reports or articles with the aim of finding and analyzing information related to the study that is being carried out. The aim can also include suggestions for future studies and drawing up guidelines that can be used in clinical practices. (Burns & Grove 2009, 93-94.)

The collection of the data was done by performing a literature search on the school's library computerized databases such as CINAHL, OVID, EBRARY, SAGE, Science Direct, Terveysportti, Academic search Elite and PUBMED. The inclusive and exclusive criterion was applied in the data collection process. The literature search was limited to the articles published between the years 2001 to the current date and if they articles were in full text. The limit also included articles written and published in English language and if the content of the study was relevant to the purpose of this study. The excluded data were those published in other languages, published before the year 2001 and with no relevance to the current study. Table 1 below shows the inclusive and exclusive criteria used. The database search was performed by using the keywords and following inclusive and exclusive criteria shown in table 2.

TABLE 1. Inclusive and exclusive criteria used in this study.

Inclusion criteria	**Exclusion criteria**
Articles published from the year 2001 up to date	Articles published before 2001
Articles published in English language	Articles published in other languages other than English language
Studies in full text	Studies not in full text
The study is relevant to the purpose of this particular study	The study is not relevant to the purpose of this particular study

TABLE 2. Results of database searches.

Keywords	**Databases**						
	CINAHL	OVID	SAGE	Science Direct	The Cochrane Library	Academic search Elite	PUBMED
"Sleep apnea"	936	300	557	165	15	1182	1858
"Sleep apnea" AND treatment	185	211	495	125	14	943	1032
"Sleep apnea" AND treatment AND CPAP	17	38	52	62	7	35	330
"Sleep apnea" AND treatment AND CPAP AND "Side effects"	1	9	15	12	1	1	10
"Sleep apnea" AND treatment AND CPAP AND "Side effects" AND Interventions	0	9	11	8	5	1	1

6.3 Data selection

Seventeen articles were selected. The search from the databases as shown in Table 2 resulted in six articles that were selected for this study. One article from was retrieved from SAGE and seven articles from SCIENCE DIRECT after searching the titles and abstracts of the studies. In addition, other resources were searched by assessing the reference list of the already retrieved articles in order to find out other reports relevant to the study.

The manual search was carried out in basis of the title of the article from PUBMED. The searches from PUBMED resulted in eleven articles that had links to the articles in full texts from other sites. Two articles were retrieved from American College of Chest Publications, four articles from Pubmed Central, one article from SLEEP Journal, one article from European Respiratory Journal and one from Israel Medical Association.

6.4 Data analysis

The purpose of conducting data is analysis is primarily to decrease the number of collected data, organize it and develop a meaningful evidence based data. The type of data analysis is determined by the research objectives, questions or hypotheses. It can be divided into qualitative or quantitative data analysis. (Burns & Grove 2007, 41-42.)

The data gathered was analyzed by use of content analysis. Content analysis is a technique that is mostly used when conducting a historical research. Content analysis involves the use of words, phrases or sentences and in the data content is presented as text. The particular characteristics of the content to be analyzed should first be defined in advance and finally, a guide for indentifying and recording them is developed. (Burns & Grove 2009, 528).

It is important when analyzing the data to read through the materials chosen and then, decide on the data to be accepted or rejected. Data analysis can be a challenge when interesting data is found but it does not have a relation to the subject at hand and the researcher finds it difficult to reject it. Data that does not agree on each other should be interpreted and explained deeply for the reader, for example, when two primary sources of information display varying opinion on one topic. (Burns & Grove 2009, 528.)

The data gathered during this thesis process was read through and divided into two sections. The first section dealt with side effects which were divided into physical, problem with CPAP equipment, psychological and socio economical whereas the second section related to possible nursing interventions for the identified side effects.

7 FINDINGS

7.1 The most common side effects

Patients suffering from sleep apnea and undergoing CPAP treatment experienced upper air symptoms such as nasal congestion, dry nose or throat, sore throat and bleeding nose because of inspiring dry air from the CPAP machine (Mador, Krauza, Pervez, Pierce and Braun. 2005; Neill, Wai, Bannan, Beasley, Weatherall & Campbell 2003 ; Broström, Nilsen, Johansson, Albers, Wiberg, Svanborg & Fridlund 2008). Nasal congestion, rhinorrhea and sneezing were the highest reported side effects by the patients in the study carried out by Ryan, Doherty, Nolan & McNicholas (2009).

Adverse effects such as nasal congestion, mask leaks, mask dislodging during sleep and claustrophobia were reported by patients using nasal CPAP treatment for sleep apnea. Dry eyes and conjunctivitis have also been reported side effects due to use of masks that do not fit well. Tightening of the head gear to prevent mask leaks has been indentified to cause breaking of the skin and it even causes inflammation of the skin in some cases. (Khanna & Kline 2003; Broström et al 2008). The study carried out by Baltzan, Elkho & Wolkove (2007) identified that mouth leak, nasal congestion and unconscious removal of the mask during sleep as the major side effects reported by patient. Unconscious removal was also reported by Broström et al. (2008).

CPAP related adverse effects found in most of the patients were, nasal problems including dry nose, nasal drip and nasal congestion. Present in one patient was nose bleeding that required hospitalization. Other side effects included marks on the face, eye irritation due to the leakages of the mask as well as noise produced by the machine. (Amfilochiou, Tsara, Kolilekas, Gizopolou, Maniou, Bouros & Polychronopoulos 2009.)

Negative attitude towards the adherence to CPAP treatment were reported. This was due to the experiences of practical problem with the equipment for example, difficulties adjusting the mask, intolerable pressure, air leaks from the mask and the noise created by the machine when it is being used. Difficulty in changing sleeping position was also one of the

problems that patients experienced. Some patients found it cumbersome to carry around the CPAP machine if they required to travel (Broström et al. 2010; Broström et al. 2008.)

Socioeconomic status combines a number of variables such occupation, education, income, wealth, and place of residence has been studied in connection to CPAP use. The study found out that low Socioeconomic status was a barrier to efficient and long term use of CPAP therapy. (Simon-Tuval et al. 2009). Claustrophobia has been established to be one of the side effects. Many patients stop using the CPAP machine due to the fear of being in an isolated place. (Broström et al. 2010; Chasens, Pack, Maislin, Dinges, & Weaver 2005).

Patients experienced negative psychological effects towards the CPAP treatment due to the side effects that arise with CPAP treatment. In addition to the side effects, patients were psychologically affected by the fact that they were independent on CPAP machine for the rest of their lives. Furthermore, the study found out that most patients were embarrassed when they used the CPAP machine in front of strangers. Lack of support and encouragement from health personnel, family or spouse were revealed to affect the patient psychologically. (Broström et al. 2010; Broström et al. 2008). The CPAP machine was also viewed as unsexy and uncomfortable especially for the young couples whose sexual health was active (Broström et al. 2008).

7.2 Nursing interventions

Heated humidification as used in nasal CPAP has been proven to reduce sleepiness and improve the quality of life of patients under CPAP therapy as shown by the study carried out by Neill et al. (2003). Complains of upper airway symptoms such as dry nose, mouth and throat has been studied to be eliminated by employing use of heated humidified nasal CPAP. A face mask has been studied to eliminate the problem of mouth leaks. (Mador et al. 2005; Ryan et al. 2009; Neill et al. 2003).

The claustrophobic feelings and air leaks have been alleviated by use of a nasal pillow in CPAP therapy. Air leaks occur when using a normal nasal mask and it causes eye soreness and discomfort to the patient. An alternate mask of the correct size and fits well assists in

managing the problem of air leaks or uncomfortable mask (Masie & Hart 2003; Ballard, Gay & Strollo 2007.)

Use of nasal rinse kits or topical nasal corticosteroids and in this case use of fluticasone was found out to treat nasal congestion. Some patients experienced sneezing which ceased after a few minutes of application but it was expected as the producing company had listed it as a mild side effect of fluticasone. (Kiely, Nolan, & McNicholas 2004; Ryan et al. 2009.)

In addition, education and counseling should be emphasized. The patient should be taught and be made aware of the possible complications such as neurocognitive and cardiovascular problems that arise due to untreated sleep apnea. A suggestion for trial for an alternative form of pressure therapy for example, flexible bi-level positive airway pressure should be offered to those patients who cannot tolerate the CPAP device despite all the interventions. (Ballard et al. 2007.)

Involving the spouse at all the stages for instance, when conveying information and education during diagnosis before initiation of treatment and also during the follow up visits to the sleep clinic has been studied to improve CPAP treatment (Broström et al. 2008). Loaning a CPAP machine to the patients with a low socioeconomic status has been established as an intervention for low CPAP use. This was indicated by a study carried out in a sleep laboratory in Israel. The findings of the study concluded that despite the severity of the disease, majority of patients could not be treated because they could not afford a CPAP machine (Tzischinsky, Shahrabani & Peled 2011).

Cognitive behavioral therapy carried out together with interventions for the adverse effects associated with CPAP has been studied to enhance the acceptance and adherence to CPAP treatment. The patients who received cognitive behavioral therapy were found out to be more self confident at the end of the study. Feelings of embarrassment or anxiety diminished after they were more familiar and knowledgeable about CPAP treatment. They also appreciated and realized the social support they received from health care personnel and family or spouse. Cognitive behavioral therapy increased the daily use of CPAP treatment which is the main goal of the therapy. (Richards, Bartlett, Wong, Malouff & Grunstein 2007.)

TABLE 3. Side effects and interventions.

SIDE EFFECTS	INTERVENTIONS
Physical	- nasal rinse kits or topical nasal corticosteroids, heated humidifier, and mask that fits properly
- nasal congestion, runny nose, sneezing, sinusitis, and nosebleeds	
- allergy or skin breakdown	- different type, size, shape and material of mask
- dry nose, mouth or throat, sore throat and bleeding nose	- Heated humidifier
- dry eyes and conjunctivitis	- Nasal pillow
- Mouth leaks	- Nasal pillow, correct size of mask, Face mask
Problem with Equipment	- chin strap and mask that fits well
- difficulties adjusting the mask	
- intolerable pressure	- change of machine
- air leaks	- Adjust mask, find a different size or type of mask
- noise	- Changing machine, putting machine in a different room
- difficulty in changing sleeping position	- Nasal pillow
- cumbersome to carry when travelling	- Education
Psychological and Socioeconomic	- Nasal pillow, cognitive behavior therapy
- Claustrophobia	
- Anxiety and embarrassment	- Cognitive behavioral therapy
- low Socioeconomic status	- Loaning a CPAP machine and Education
- lack of support from health personnel, family or spouse	- Support from health personnel and involvement of spouse/ family

8 DISCUSSIONS

8.1 Discussion of findings and conclusion

The main purpose of the study was to investigate the side effects that occur when undergoing CPAP therapy for patients with sleep apnea and possible interventions for these side effects. The findings of the study suggested that side effects could be divided into three; physical side effects, problem with the CPAP equipment and psychological and socioeconomic difficulties. Most of the studies explored the side effects and interventions for those side effects in the same study.

The most reported side effects were airway symptoms such as dry nose & mouth, sore throat (Amfilochiou et al. 2009; Khanna & Kline 2003; Neil et al. 2003)., nasal congestion, rhinorrhea and sneezing (Khanna & Kline 2003; Ryan et al. 2009 ;). Irritated eyes due to mask leaks were also found out as one of the side effects of CPAP therapy. (Amfilochiou et al. 2009; Broström et al. 2010).

Problems with CPAP equipments such as intolerance to high pressure and difficulties adjusting the mask were reported in the study carried out by Broström et al. (2010 & 2009). Noise produced by the CPAP machine has also been reported to have a negative effect on CPAP therapy treatment. (Amfilochiou et al. 2009; Broström et al. 2010 & 2009). Mouth leak has also been stated as a side effect that can be corrected by use of a chinstrap. The chinstrap has been established to cause snoring in some cases despite it being able to keep the mouth closed which has as a result prevents mouth leaks and hence, diminishes arousal during sleep. (Bachour, Hurmerinta & Maasilta 2004).

A study was performed to compare the automatic CPAP equipment versus the constant CPAP equipment. The automatic CPAP machine is designed in a way that the device is able to auto adjust the amount of pressure being delivered whereas the constant CPAP equipment has a fixed pressure being delivered all the time. The study found out that there was no difference in the efficacy of both the machines but the automatic CPAP equipment was associated with lower leakages hence, preferred more over the constant CPAP

equipment by sleep apnea patients. (Galetke, Anduleit, Richter, Stieglitz & Randerath 2006.)

The studies carried out by Ballard et al. 2007; Mador et al. 2005; Neill et al. 2003; Richards et al. 2007;Ryan et al. 2009; agreed that upper airway symptoms such as dry nose, mouth or throat ,nasal congestion, rhinorrhea and sneezing can be corrected by addition of a heated humidifier in CPAP therapy. The study by Kiely et al. (2004); Ballard et al. (2007) found out that intranasal corticosteroids and nasal saline can be used as an intervention for nasal congestion. On the other hand, the study carried out by Ryan et al. (2009) disagreed that nasal steroids have had an improved effect if used with patients experiencing nasal congestions during CPAP therapy.

Claustrophobia which is a fear of a closed surrounding or feeling trapped in a closed space was also reported as a negative effect to a successful CPAP therapy (Chasens et al. 2005; Massie & Hart 2003; Broström et al. 2008). Claustrophobia can be treated by use of nasal pillows (Massie & Hart 2003), and cognitive behavioral therapy has also been studied to improve the claustrophobic feeling. (Richards et al. 2007).

Lack of support from next of kin or healthcare personnel was also established as a consequence to low CPAP usage. (Broström et al. 2010). Tzischinsky et al. (2011) & Simon-Tuval et al. (2009) reported low socioeconomic status which includes, low income, low level of education and poor living conditions as a characteristic for poor CPAP therapy acceptance. Lending of CPAP machines or loaning and support from medical personnel, family or spouse were the suggested interventions for the patients with low socioeconomic status.

Cognitive behavioral therapy, standard interventions for side effects in addition to support from family and next of kin were studied to improve CPAP therapy treatment. (Richard et al. 2009). Education about the sleep apnea, its consequences and the benefits of CPAP treatment were studied to improve CPAP therapy adherence. Patients were willing to undergo treatment when they had information on the severity of the disease and benefits of treatment. (Ballard et al. 2007; Tzischinsky et al. 2011; Simon-Tuval et al. 2009; Golay, Girard, Grandin, Métrailler, Victorion, Lebas, Ybarra & Rochat 2006; Broström et al. 2008 & 2009).

The Cochrane review carried out by Smith, Nadig & Lasserson (2009) agreed that cognitive behavioral therapy and continuous support and motivation increased the usage of nightly CPAP use but on the other hand, they were not able to prove the effects on the symptoms and daily life activities.

Sleep apnea is becoming a major health problem though it falls under the group of most of the under diagnosed illnesses. As nursing progresses, the nurses acquire an increased responsibility and key role in the diagnosis, education and management of patients who are suffering from sleep apnea. This is practiced both in the specialized and primary health care settings (Tomlinson 2007.)

Nurses' sufficient knowledge on the signs and symptoms of sleep apnea can aid in the early diagnosis of sleep apnea in the primary health care settings. Moreover, the patients and their relatives' active participation in self assessment have been discovered to facilitate early identification of symptoms of sleep apnea in the primary health care settings (Broström et al. 2008.)

Sleep apnea can by treated by administration of CPAP. Studies have shown that successful treatment has led to decrease in otherwise risk factors of untreated sleep apnea which are as a result of sudden drops in blood oxygen levels. These complications include daytime sleepiness which causes impaired concentration, neuropsychological dysfunction and cardiovascular disorders such high blood pressure. (WHO 2011.)

Provision of simple interventions at the beginning of CPAP treatment which includes education about sleep apnea and treatment, frequent telephone follow-up for advice and troubleshooting and clinical visits to a sleep physician has been established to improve clinical attendance by sleep apnea patients. Clinical attendance paves way for early recognition of any difficulties or problems and hence, solutions can be sought early enough before complications occur or alternative treatment can be suggested. (Lewis, Bartle, Watkins, Seale & Ebden 2006.)

Extensive education and empowering the patient's knowledge about CPAP therapy has been improvements in treatment with CPAP (Golay et al. 2006). Identification of the possible side effects that can occur as a result of CPAP treatment can be of great help to

the nurses and health personnel working with clients suffering from sleep apnea. The nurses and health personnel familiarity with the side effects and the solutions can assist in early recognition and facilitation of the possible interventions thus, prevention of further complications (Broström et al. 2008).

8.2 Reliability and the research method

Validity and reliability of a literature review can be measured by using information acquired from a primary source. A primary source can be defined as a firsthand experience as narrated by an individual being studied whereas a secondary source is from a previously read and summarized primary source for example, books. The primary source content used in the development of the research should be from a scientific and evidence based database. (Burns & Grove 2007, 537-538.)

As concerning reliability, the data used in the thesis was the most current and up to date. This was achieved by limiting the date of publication to at least last ten years. The school's library database was used when searching for the material. The data bases used were WILEY ONLINE LIBRAY, PUBMED, SCIENCE DIRECT and SAGE. The data used was available in full text and were free of charge.

The materials used for the data were chosen by following the inclusion and exclusion criteria method. Besides that, the relativity of the article to the research problems was also considered by the researcher. Literature review articles were avoided and hence, they were not used in the findings of the study. The results of the studies found were compared against each other and grouped accordingly. The researcher also mentioned results from the studies that disagreed.

8.3 Ethical consideration

Ethics are observed at each and particular stage of a research project and this includes even the choice of the research topic, selection of the research method and in the end the publication of the results (Parahoo 2006, 111). The content from the primary source should be presented honestly without any distortion of the perceived information in favor of one's research questions. Original authors should be acknowledged by use of referencing (Burns & Grove 2007, 112-113).

The researcher observed the ethics code by rewarding credit to the original authors of the materials used in conducting the research. This was achieved by referring to the authors of the material used in every case and by also compiling a list of references without omitting any data source used whether primary or secondary. The research plan was formulated by the researcher and it was approved by the Central Ostrobothnua University of Applied Sciences before this research was carried out.

8.4 Limitations and recommendations

The main goal for conducting the study was to gather information for developing a guideline that can be used by nurses taking care of patients suffering from sleep apnea. Hence, use of studies that were carried out on a nurse's perspective would have been suitable for the study but the researcher encountered problems while searching for the data. Adequate articles carried by nurses and could answer to the research problems were not able to be retrieved for this study.

The researcher finally used articles that were performed by medical doctors because of the difficulty in acquiring the articles based on nurses' perspective. The articles used were chosen because they answered the research problems even though they were carried out from a doctor's point of view. As a result, the findings of the study were not exclusively based on the studies carried out by nurses but they also included those accomplished by medical doctors.

Further studies are highly recommended to be carried out to in the future and the study should ensure the data material examined be based on studies explored exclusively by nurses. Thus, the results of the findings based on the nurse's point of view and suggestions or findings will be easy to be implemented by the fellow nurses. The number of study subject should be larger and sufficient to ensure generalization and conclusion based on a reliable population. This is because one of the studies used in this research involved a single case even though it was carried out on a nurse's perspective. The results of the single study case cannot be reliable or generalized even though it answered to the research problems.

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Author/s and year	Purpose/ Problem	Type of Research	Design	Target group	Results
Amfilochiou, A., Tsara, V., Kolilekas, L., Gizopolou, E., Maniou, C., Bouros, D. and Polychronopoulos, V. 2009.	Determinants of continuous positive airway pressure compliance in a group of Greek patients with obstructive sleep apnea.	Qualitative study	Interview	Ninety eight Sleep apnea patients	CPAP related adverse effects reported were, -Nasal problems that included dry nose, nasal drip and nasal congestion. -nose bleeding -marks on the face, eye irritation due to mask leaks - noise
Ballard, R.D., Gay, P.C. & Strollo, P.J. 2007.	Interventions to improve compliance in sleep apnea patients previously non-compliant with continuous positive airway pressure.	Quantitative study	Interview and Monitoring	Two hundred and four Sleep apnea patients	-Mask refitting, heated humidification, use of nasal saline rinses or corticosteroids together with education and support improve CPAP use.
Baltzan, M.A., Elkholi, O. & Wolkove, N. 2007.	Evidence of interrelated side effects with reduced compliance in patients treated with nasal continuous positive airway pressure.	Prospective exploratory and subsequent validation study	Questionnaires	Sleep apnea patients	-Side effects reported were mouth leak, nasal congestion and unconscious removal of mask during sleep

Broström, A., Nilsen, P., Johansson, P., Ulander, M., Strömberg, A., Svanborg, E. & Fridlund, B. 2010.	Putative facilitators and barriers for adherence to CPAP treatment in patients with obstructive sleep apnea syndrome.	A qualitative content analysis	In-depth interviews.	Twenty three purposively selected patients	-Practical problem with the equipment for example difficulties adjusting the mask, pressure and leakage from mask and noise. -Side effects such as blocked nose, dry throat and mouth not being able to exhale and eyes getting irritated -Insufficient support from spouse and healthcare personnel
Broström, A., Strömberg, A., Ulander, M., Fridlund, B., Mårtensson, J. & Svanborg, E. 2009.	Perceived informational needs, side-effects and their consequences on adherence—A comparison between CPAP treated patients with OSAS and healthcare personnel.	A cross-sectional descriptive design	Questionnaires	350 CPAP treated OSAS patients from 3 Swedish hospitals and 105 healthcare personnel from 26 Swedish hospitals.	-common side effects perceived by both nurses and patient were blocked-up nose, mask leaks, dry throat and uncomfortable pressure of the mask - Education concerning matter such symptoms, the pathophysiological process, side-effects and intervention must be emphasized.
Broström, A., Nilsen, P., Johansson, P., Albers, J., Wiberg, J., Svanborg, E. & Fridlund, B.2008.	6-month CPAP-treatment in a young male patient with severe obstructive sleep apnoea syndrome	A case study from the couple's perspective.	Interview	33-year old male patient and his female partner	claustrophobia - Disturbing and unsexy -embarrassment to put on in front of others - noise - difficulties adapting the mask - air-leaks -dry throat, stuffy nose - change of mask and use of a humidifier eliminates the problems with the equipment -patient education and involving of spouse in all matter regarding sleep apnea and treatment and intervention o

					side effects improves CPAP adherence
Chasens, E.R., Pack, A.I., Maislin, G., Dinges, D.F. & Weaver, T.E. 2005.	Claustrophobia and adherence to CPAP treatment.	Prospective study	Secondary analysis of data	One hundred and fifty three sleep apnea patients	Claustrophobia established as a side effect to using CPAP
Golay, A., Girard, A., Grandin, S., Métrailler, J.C., Victorion, M., Lebas, P., Ybarra, J.& Rochat, T. 2006.	A new educational program for patients suffering from sleep apnea syndrome. Patient Education and Counseling.	Psycho-Educational methodology	Discussions	Thirty five OSAS patients	- Education plays a major role in improvement of CPAP use
Khanna, R. & Kline, L.R. 2003.	A prospective 8 week trial of nasal interfaces vs. a novel oral interface (Oracle) for treatment of obstructive sleep apnea hypopnea	Prospective study	Questionnaires	Thirty eight OSAS patients	Adverse effects due to CPAP reported were -nasal congestion -air leaks -mouth, nose and throat dryness

	syndrome.				
Kiely, J.L., Nolan, P. & McNicholas, W.T. 2004	Intranasal corticosteroid therapy for obstructive sleep apnoea in patients with co-existing rhinitis.	Qualitative study	Randomised, placebo controlled crossover design.	Twenty three patients (Thirteen apnoeic and ten a non-apnoeic)	Intranasal corticosteroids can be used as an intervention for nasal congestion.
Mador, M.J., Krauza, M., Pervez, A., Pierce, D. and Braun, M. 2005.	Effect of Heated Humidification on Compliance and Quality of Life in Patients With Sleep Apnea Using Nasal Continuous Positive Airway Pressure.	Qualitative study	Randomized controlled trial.	Ninety eight patients with obstructive sleep apnea who had not received nasal CPAP previously	CPAP side effects such as dry nose, mouth and throat were improved in the heated humidification group.
Massie, C.A. & Hart, R.W.2003.	Clinical Outcomes Related to Interface Type in Patients With Obstructive Sleep Apnea/Hypopnea Syndrome Who Are Using Continuous Positive Airway Pressure.	Qualitative study	Randomized, cross-over	Thirty nine patients with OSAHS (mean age, 48.7 years), in whom CPAP was a novel treatment	Nasal pillows are more effective for patients with claustrophobic feelings and have a less side effects

Neill, A.M. , Wai, H.S., Bannan, S.P.T. ,Beasley, C.R. Weatherall, M. & Campbell, A.J. 2003	Humidified nasal continuous positive airway pressure in obstructive sleep apnoea.	Qualitative study	A randomised crossover design	Thirty seven sleep apnea patients	-Use of a heated humidifier improves quality of life reduces upper airway symptoms such as dry nose, mouth and throat.
Richards, D., Bartlett, D., Wong, K., Malouff, J. &Grunstein, R. 2007.	Increased adherence to CPAP with a Cognitive Behavioural Treatment Intervention: a randomised trial.	Qualitative study	A randomized controlled trial	One hundred individuals (96 men), ranging in age from 32 to 81 years, diagnosed with OSA.	Cognitive behavioral therapy, standard intervention for side effects, family/ spouse and health care personnel support improve use of CPAP therapy
Ryan, S., Doherty, L.S., Nolan, G.M. & McNicholas, W.T. 2009.	Effects of heated humidification and topical steroids on compliance, nasal symptoms, and quality of life in patients with obstructive sleep apnea syndrome using nasal continuous positive airway pressure.	Quantitative study	Randomised control trial/ Questionnaires	125 patients with the established diagnosis of OSAS	Most reported side effects were nasal congestion, rhinorrhea, and sneezing. Use of heated humidification but not topical steroids improved these side effects.

Simon-Tuval, T., Reuveni, H., Greenberg-Dotan, S., Oksenberg, A., Tal, A. & Tarasiuk, A. 2009**.**	Low Socioeconomic Status Is a Risk Factor for CPAP Acceptance Among Adult OSAS Patients Requiring Treatment**.**	Cross-sectional study	Experimental Design	162 consecutive newly diagnosed adult OSAS patients who required CPAP underwent attendant titration and a 2-week adaptation period.	Low socio economic status was classified as a risk for poor CPAP therapy acceptance. Education, counseling and support were identified as interventions.
Tzischinsky, O., Shahrabani, S. & Peled, R. 2011.	Factors Affecting the Decision to be treated with Continuous Positive Airway Pressure for Obstructive Sleep Apnea Syndrome	Descriptive study	Questionnaires and telephone interview	Eighty three sleep apnea patients	Low-income and lack of knowledge about sleep apnea has a negative effect on CPAP therapy. Loaning of CPAP machines and education patient improves the treatment of sleep apnea