

RESEARCH ARTICLE

Post cardiac surgery patients' experiences using continuous positive airway pressure (CPAP) via mask therapy to treat post-surgical atelectasis.

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ABSTRACT

Objective

Cardiac surgery procedure especially coronary artery bypass grafting (CABG) is usually associated with post-surgical atelectasis. Continuous positive airway pressure (CPAP) via mask therapy is one of the intervention treatments to re-open collapsed alveoli (atelectasis) after cardiac surgery.

This study aims to evaluate the compliance and periodicity of CPAP via mask therapy use to treat or prevent post-surgical atelectasis after CABG.

Methods

Sixty two post cardiac surgery patients who used CPAP via mask therapy every two or four hours were invited to participate in this study. All the participants used CPAP machine in the first three post- cardiac surgery days during waking hours. The participants were given a questionnaire to answer before hospital discharge. The questionnaire was composed of items about the compliance, the periodicity of CPAP therapy use and the side effects of the CPAP mask used such as pain over bridge of the nose, dry mouth, allergy or teeth and gum pain. Also, the questionnaire was linked to informal open-end question to clarify the patient's history of these illnesses before the use of CPAP therapy.

Result

Sixty two patients participated in this study from the two difference frequency group (CPAP therapy every two or four hours) with response rate approximately 85%. Twenty seven males and three females belonged to the CPAP2hr group (ages; 58 ± 6.4 years). Twenty eight males and four females were in the CPAP4hr group (ages; 57 ± 7.2 years). All the participants started to use CPAP therapy in the first post-operative day immediately after extubation from mechanical ventilation. No one from either of the groups suffered from nose bleeding, excessive sneezing, eczema or asthma either before or after therapy. More than half of the participants (60%) complained a dry mouth after the therapy. Twenty eight participants (93%) from CPAP2hrs group reported treatment compliance from CPAP machine use and 27 participants (84%) in CPAP4hrs group.

Conclusion

The result showed high acceptance rate of compliance toward CPAP therapy use especially in CPAP2hrs group.

Objective:

The present study was conducted after the two previous quantitative studies that evaluated the benefits of early use of continuous positive airway pressure (CPAP) therapy in preventing or treating atelectasis after coronary artery bypass grafting (CABC). This study aimed to evaluate the patients' compliance and periodicity about CPAP therapy. A questionnaire was prepared to gather data on the experiences of the patient's respondents before hospital discharge.

Cardiac surgery procedure especially CABG is usually associated with post-surgical atelectasis. CPAP via mask therapy is one of the intervention treatments to re-open collapsed alveoli (atelectasis) after cardiac surgery. The type of CPAP via mask therapy that was employed in this study is originally used to keep the upper airway open in obstructive sleep apnea (OSA) syndrome patient.

Several previous studies measured the compliance and periodicity of CPAP therapy used in patients with OSA^{1,2,3}. The results showed patients' compliance and acceptance rate was between 47 and 91%. However, those studies measured the compliance for long term OSA patients. The time of CPAP therapy in OSA studies was more than 6 hours per night continuously. In the present study the CPAP therapy was used for a short periods of time (half hour), which may increase the patient's compliance and acceptance rate.

McArdle and colleagues (1999)⁴ evaluated the components influencing the long term CPAP therapy use in 1, 211 long term patients. Only 4.5% of the patients refused the CPAP therapy, mostly female and current smoker. Moreover, 20% of the patients stopped the therapy after using it for a short period of time at home. The

patients' compliance acceptance rate within five years was 68%. The main components influencing the compliance acceptance rate for CPAP therapy were the number of hours use, the patient tolerance in the first three months and patient judgment of lack of benefit from CPAP therapy.

CPAP via mask therapy increases functional residual capacity (FRC) and reflexly increases the opening of upper airway (the pharynx) by generating a positive pressure in the main airway⁵. It is usually considered as first line treatment to treat the OSA syndrome patient. However, some OSA patients refuse to use CPAP via mask therapy for several reasons such as inconvenient and bulky nature of the therapy⁶, patient not well understand the therapy benefits⁷, CPAP machine noise and uncomfortable mask⁸.

The present study aims to evaluate the compliance and periodicity of CPAP via mask therapy used to treat or prevent post-surgical atelectasis after CABG. It also, assesses the patients' compliance in two different frequency of CPAP therapy (CPAP therapy every two hours and every four hours). A questionnaire was used in this study to evaluate the patient compliance, periodicity and side effects of CPAP via mask therapy.

Method:

The present study was conducted in King Fahd Armed Forces Hospital in the Kingdom of Saudi Arabia from March 2010 to March 2011. All participants in the previous quantitative study (first study) who used CPAP via mask therapy every two or four hours were invited to volunteer. They were given a questionnaire to answer before discharge from the hospital. All participants had used the latest version of CPAP delivery system (ResMed VPAP III

manufactured in Milton, Australia). In addition, they used the most comfortable gel face mask available in the market. The levels of CPAP delivery pressure were set between 4 to 6 cmH₂O.

All the items in the questionnaire were explained in detail by respiratory specialist to all volunteer participants in this study. In addition, all participants signed a consent form after they read and understand all the questions. All the participants were reminded to complete the questionnaire one day before hospital discharge.

The type of questionnaire used in the study was a structured and open-ended question. The questionnaire in gathering data was modified from a valid and reliable questionnaire. It has been used by Kalan, Kenyon, Seemungal & Wedzicha, (1999)⁹ to evaluate the CPAP therapy compliance and side effect in patients with OSA. Also, the questionnaire was translated to Arabic language from English by official guaranteed translation company. Moreover, it has been used by Saudi Thoracic Society for several years with sleep apnoea patients to evaluate the CPAP therapy compliance.

The questionnaire was composed of items about the compliance and the periodicity of CPAP therapy use. It also includes questions regarding the side effects of the CPAP mask used such as pain over bridge of the nose, dry mouth, allergy or teeth and gum pain. Other questions related to side-effects and symptoms associated with CPAP therapy use such as sneezing, dizziness, running nose or sore eyes. In addition, the questionnaire was linked to informal open-end questions to clarify the patient's history of these illnesses before the use of CPAP therapy.

Result:

The purpose of the present study was to evaluate and compare the responses of compliance and periodicity of CPAP therapy use. A questionnaire was made for the participants in order to determine CPAP therapy compliance to treat or prevent atelectasis in two different frequencies (two and four hours after cardiac surgery). The questionnaire examined the physiological effects, the side effects of CPAP machine and benefits related to CPAP therapy use in different frequency of time.

Demographics:

Thirty from thirty six participants in CPAP2hr group completed and returned the questionnaire before hospital discharge. Thirty two from thirty six participants in CPAP4hr group completed and submitted the questionnaire. Some of the respondents did not complete the questionnaire for the following reasons: three patients were in a hurry to leave the hospital, four patients refused to complete the questionnaire, one patient required advanced therapy, two patients did not answer due to lack of time, despite several reminders to complete it one day before discharge.

Sixty two patients participated in this study from the two difference frequency group (CPAP therapy every two or four hours) with response rate approximately 85%. Twenty seven males and three females belonged to the CPAP2hr group (ages; 58 ± 6.4 years). Twenty eight males and four females were in the CPAP4hr group (ages; 57 ± 7.2 years). All the participants had started to use CPAP therapy in the first post-operative day immediately after extubation from mechanical ventilation.

Physiological effect:

All the participants used CPAP machine in the first three post- cardiac surgery days during waking hours (usually from 6 AM to 8 PM). CPAP2hrs group used CPAP therapy every two hours approximately eight times daily (four hours daily). Daily use of CPAP therapy in CPAP4hrs group was 50% time of CPAP2hrs group. No one from either of the groups suffered from nose bleeding, excessive sneezing, eczema or asthma either before or after therapy. One participant in each group (1/30 in CPAP2hrs group & 1/32 in CPAP4hrs) complained about nasal block before the therapy which was solved after the therapy. More than half (58%) suffered from dizziness before CPAP therapy. However, the dizziness decreased significantly in both groups, four patients from CPAP2hrs and five

patients from CPAP4hrs group (approximately 16% had post therapy dizziness).

Of the 32 participants in CPAP4hrs group 11 suffered from dry nose after the therapy while 13 participants suffered from it in CPAP2hrs. One third of the participants (33%) in both groups complained about dry mouth before CPAP therapy. However, more than half of the participants (60%) complained a dry mouth after the therapy. In addition, some participants reported reduction in mucus 31% in CPAP2hrs group and 14% in CPAP4hrs after the therapy as compared to pre-therapy complained. One patient suffered from pain over bridge of nose in CPAP2hrs group after therapy while no one complained of it in CPAP4hrs group. The summary of physiological effect relating to CPAP therapy every two hours or every four groups is shown in figures 1 and 2 respectively.

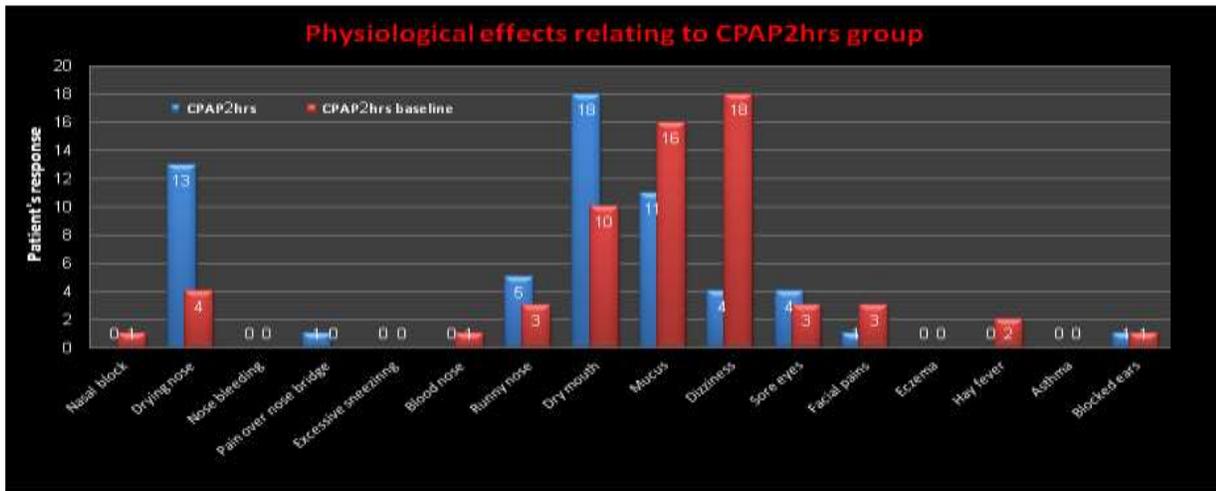


Figure 1. Physiological effects relating to CPAP therapy every two hours.

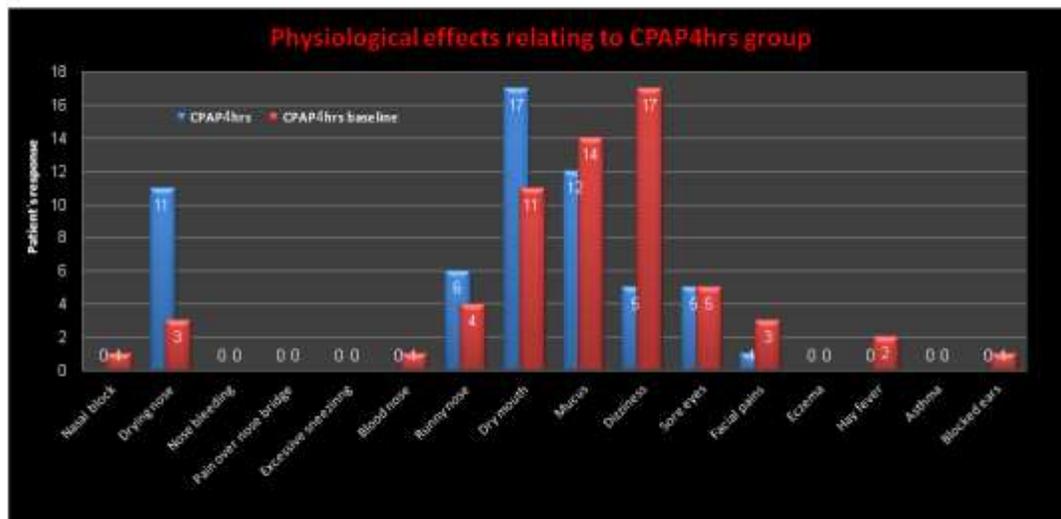


Figure 2. Physiological effects relating to CPAP therapy every four hours.

Two participants (7%) from CPAP2hrs group complained about the noise of the machine while four participants in CPAP4hrs group were irritated by the noise. More than half of the participants (53%) in both groups complained that the mask was uncomfortable. Five participants (17%) reported air leak from face mask in CPAP2hrs group and eight participants (25%) in CPAP4hrs. However, the complaints about breakdown of skin over nose (i.e. Pressure sore) in CPAP4hrs group were marginally less than CPAP2hrs (15% in CPAP4hrs and 16% in CPAP2hrs).

Almost all, 28, participants (93%) from CPAP2hrs group reported treatment benefit from CPAP machine use and 27 participants (84%) in CPAP4hrs group. The result showed high acceptance rate of compliance toward CPAP therapy use especially in CPAP2hrs group. The summary of the participants' responses in CPAP machine side effects and benefits for CPAP2hrs group is shown in figure 3 and CPAP4hrs group in figure 4.

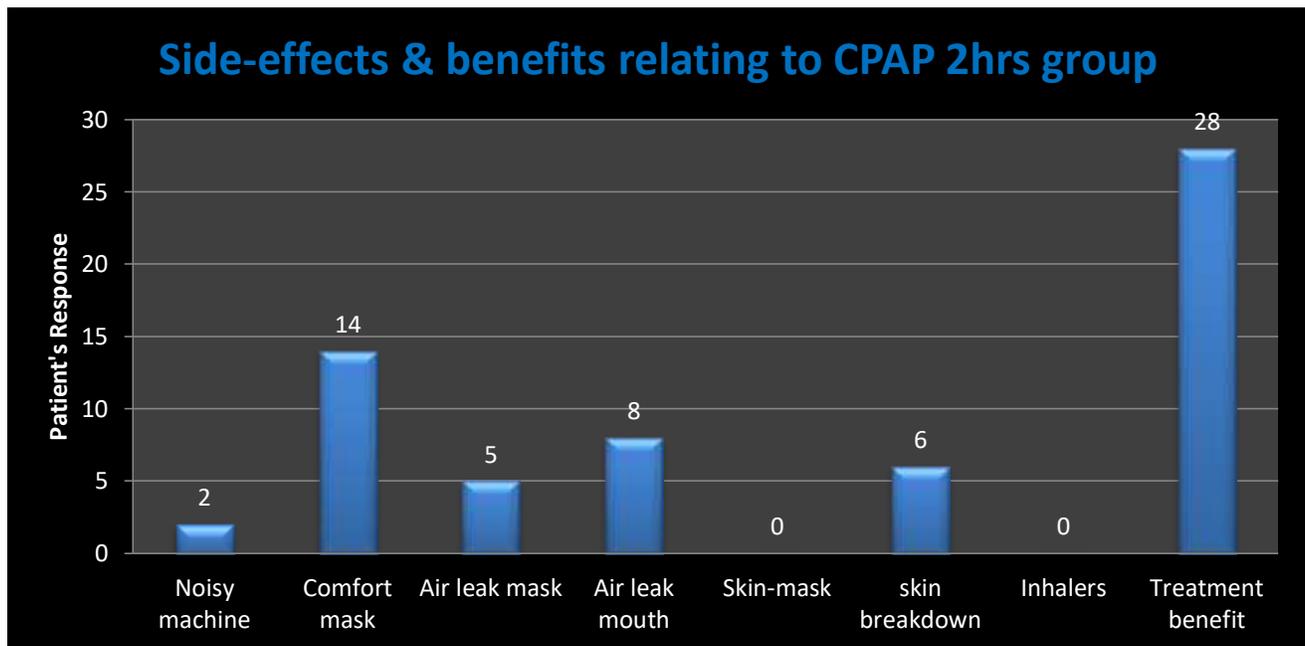


Figure 2. CPAP machine side-effects and benefits relating to CPAP therapy every two hours

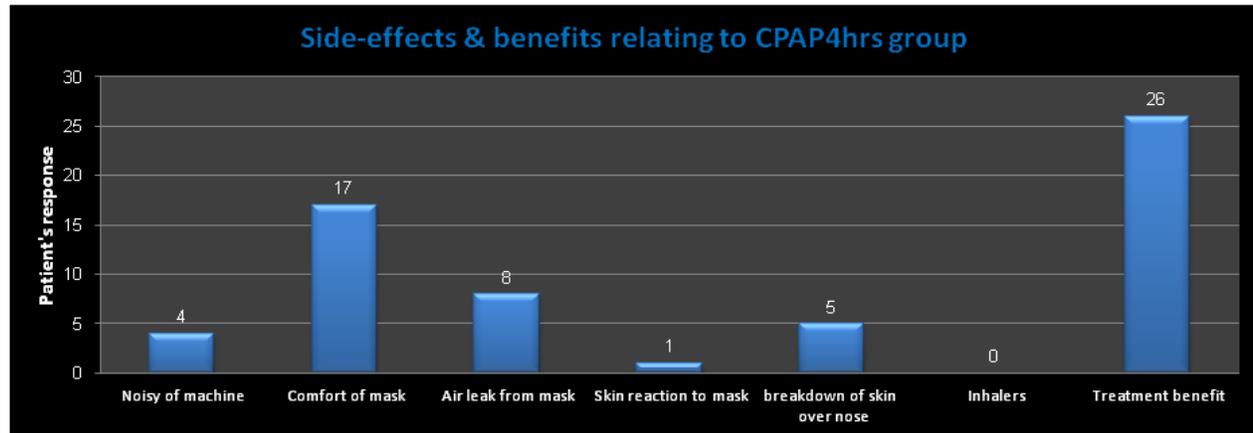


Figure 3. CPAP machine side-effects and benefits relating to CPAP therapy every four hours.

Discussion:

This is the first study that evaluates the compliance and periodicity of the use of CPAP therapy to treat or prevent atelectasis after cardiac surgery. It also examines the side effects and symptoms relating to CPAP device use. The results showed high acceptance rate of CPAP therapy use in both groups in most of the responses. However, CPAP therapy applied for half hour every two hours had a better acceptance rate than CPAP therapy use every four hours (93% and 84% respectively).

The high compliance of CPAP therapy use found in the present study agreed with the previous studies of (McArdle et al. 1999; Kakkar & Berry, 2007)^{4,10}. This was also supported by the previous study (Montserrat, et al., 2001; Weaver et al. 2007)^{11,12} that found out the increase of

time in using CPAP therapy was associated with the increase in compliance rate. There was high incidence of dry mouth and nose in the present study because there was no humidification system use in CPAP machine. The heated or cold humidity would likely lead to a decrease in the side effects of dry nose or mouth during the CPAP use and potentially better compliance.

According to the study of Massie and colleagues (1999)¹³, the use of a humidity system with CPAP therapy significantly ($p=0.001$) decreased the frequent complaint of dry mouth or nose. Also, the use of humidification system with CPAP via mask therapy has been recommended as standard of practice to reduce dry mouth and nose¹⁴. However, the improvement of the compliance associated with humidification use still not clear according to the study^{10,15}. The present study found out that more than 60% of

the participants in both group complained of dry nose or mouth that agreed with the earlier study reported that 65% of patients complained also with dry nose or mouth ¹⁶.

The types of mask use with CPAP therapy is usually associated with better patient compliance. The present study used the most comfortable gel face mask available in the market. The result showed that more than half complained about an uncomfortable mask in both groups. However, the present study disagreed with another earlier study ¹⁷ which recommended the use of nasal mask. Due to several reasons, the nasal mask increase the air leak of mouth by 50%, allergy to the face ¹⁸ and the mouth leak associated with lower compliance ^{19,20}.

Compliance or adherence studies usually concentrate on pharmaceutical not mechanical therapy such as CPAP therapy. However, the improvement of CPAP technology using smart card, which can save and report data (such as CPAP hours use and the level of CPAP pressure). This can make the CPAP therapy adherence measurement better than medication measurement ²¹.

Several factors relate to predictors of CPAP therapy use compliance;

First factor, the type of mask (full face, oral, nasal or nasal pillows mask) used with CPAP therapy ²². The present study used the most comfortable face gel mask to improve the patient adherence for CPAP therapy.

Second factor, patient's characteristics (such as age and sex) may not influence the CPAP therapy compliance. However, the acceptance of CPAP therapy by different ethnic groups is still not clear. Several studies reported non-white patients (for example, African Americans) had

lower acceptance for CPAP therapy than American whites ^{23,24,25}. The present study evaluated the acceptance of CPAP therapy in Saudi patients and found a high acceptance rate. However, the CPAP therapy was used for a short period of time and there was no comparison for other ethnicities. For the above reasons, the acceptance of CPAP therapy by different gender and ethnicity requires further future research to determine the extent of these factors.

Third factor, the severity of disease as reported in several studies may influence the CPAP therapy adherence ^{23,26}. For example, in OSA patients, there is increase in the day time sleepiness associated with long use of CPAP therapy ²⁷. However, the severity of day time sleepiness reduces the effectiveness of this factor to CPAP therapy become less ²⁸. Other studies ^{29,30} result showed the nasal resistance or obstruction significantly (more than 50%) influence the initial acceptance of CPAP therapy. The present study investigated the CPAP therapy acceptance in post-operative cardiac patients which may not influence the CPAP therapy adherence as much as with patients with OSA.

Fourth factor, even with the use of advanced CPAP technology and the most comfortable mask there were still some patients' reporting side effects of CPAP therapy. Several studies ^{31,32} reported more than 50% side effect of CPAP therapy user. However, there was no evidence that prevents the use of CPAP therapy due to the side effects reported by patient. The present study used all elements (such as advance CPAP system technology and comfortable mask) to avoid or minimize the side effects of CPAP therapy use. However, all treatments provided to patients showed that there will be a few side effects.

Fifth factor, the type of method used to introduce the CPAP therapy. The clear explanation and pre-use demonstration of CPAP devices to respondents will lead to increase the patient compliance of CPAP therapy³³. In the present study, the investigator explained the CPAP therapy in detail in simple terms to all participants before the cardiac surgery. Also, the participants were allowed to experience the CPAP therapy before the cardiac surgery under the supervision of the researcher.

Limitation

One of the most frequent side effect with CPAP therapy use was dry mouth and nose, due to the CPAP devices used in this study does not have

humidification system. This study used the most comfortable gel mask available in the local market. However, still a lot of the participants complained about the mask not comfortable to them. The use of high comfortable modern mask may resolve this problem.

Conclusion:

Post-CABG patient accepting rate about the CPAP via mask therapy use was very high and CPAP every two hours more preferable to them. Resolution of the usual side effect of CPAP therapy use such as dry mouth and uncomfortable mask may increase the compliance rate in the future.

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