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# RESEARCH ARTICLE

# EFFECT OF INCENTIVE SPIROMETER ON OXYGEN SATURATION IN PATIENT IN INTENSIVE CARE UNIT

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**ABSTRACT**

***Background:*** Previous studies have revealed that incentive spirometer has an effect on oxygen saturation, highlighted in many researches, however there is a lack of literature concerning its effect on renal failure patients in intensive care unit**.** ***Purpose of the Study:*** to find out the effect of incentive spirometer on oxygen saturation in patient in ICU. ***Subjects and Methods:*** Forty male patients with renal failure grade II were selected from intensive care unit department, El-Fayoum General Hospital and El-Fayoum university Hospital. Their mean ages 65±5.35years old, mean height 175.65±2.6 CM, mean weight 75.44±2.7 KG. They were assigned in to 2 groups: (A,B) equally in number. ***Group (A):*** Twenty patients received Incentive spirometer and traditional physiotherapy (circulatory ex, early mobilization and turning) and their routine medical treatment, ***Group (B):*** Twenty patients received traditional physiotherapy (circulatory ex, early mobilization and turning) and their routine medical treatment. They participated in a physical therapy program for two sessions per day for six days. Oxygen saturation was evaluated before and after the study. ***Results*****:** the study was showed that there was an improvement in patients in both groups but this improvement was statistically highly significant in group A .The results of this study found that, there was a statistically highly significant difference (P<0.19) in so2,% of improvement in so2 in group A and group B by 3.9% and 2.7% respectively. ***Conclusion*****:** the effect of Incentive spirometer and early mobilization is better than effect of early mobilization alone.

## INTRODUCTION

Intensive care unit is a dynamic environment where physiotherapists are an integral part of the multidisciplinary team providing various types of care, from acute respiratory interventions to rehabilitation. The ultimate goal of intensive care is quality long term, rather than short-term survival, physiotherapists play a valuable part in achieving this goal (Denehy *et al.,* 2008). Chronic kidney disease is kidney damage of 3 or more months' duration caused by structural or functional abnormalities with or without a decreased GFR. Main causes of CKD are hypertension, diabetes, glomerulonephritis (Stevens *et al.,* 2009). Stage 2 kidney disease means kidney damage and an eGFR between 60 and 89. In Stage 2 kidney disease there is mild kidney damage, and usually no symptoms. Most of the time an eGFR between 60 and 89 means the kidneys are healthy and working well. If you have Stage 2 kidney disease, this means you have other signs of kidney damage even though your eGFR is normal. Signs of kidney damage could be protein in your urine or physical damage to the kidneys (K/DOQI clinical practice guidelines for chronic kidney disease, 2002). Oxygen is carried in the blood attached to hemoglobin molecules. Oxygen saturation is a measure of how much oxygen the blood is carrying as a percentage of the maximum it could carry (Amar *et al.,* 2005). Hypoxemia is a below-normal level of oxygen in your blood, specifically in the arteries.

Hypoxemia is a sign of a problem related to breathing or circulation, and may result in various symptoms, such as shortness of breath (Renault *et al.,* 2008). A pulse oximeter is a handy medical device that uses two frequencies of light – red and infrared – to determine the percentage of hemoglobin in the blood that is saturated with oxygen, or your oxygen saturation level. When oxygen saturation is measured using a pulse oximeter, it is referred to as Sp02**.** Normal pulse oximeter readings usually range from 95 to 100 percent. Values under 90 percent are considered low (Adler *et al.,* 2009). Incentive spirometer (IS): is volumetric mechanical device that encourages patients, through visual and/or audio feeedback for the performance of reproducible, sustained maximal inspiration (Freitas *et al.,* 2007). Early mobilization leads to improvements in peripheral and respiratory muscle strength. It has also been found that early mobilization result in greater ventilation-free time compared with those that are not mobilized early (Chiang *et al.,* 2007).

## SUBJECTS AND METHODS

***Subjects:*** Forty men patients were admitted to ICU, they were participated in this study with an age range between 60 to 75 years old. They were selected from intensive care unit department, El-Fayoum General Hospital and El-Fayoum university Hospital.

***Inclusion criteria:*** Age of all patients ranged from (60-75) years.

1. Patients submitted in ICU suffering from Chronic Kidney Disease grade II GFR rate is lower than 90 milliliters(60-89), signs of kidney damage could be protein in urine or physical damage to the kidneys, albuminuria, hematuria, proteinuria and have changes in oxygen saturation.

***Exclusion criteria:*** Patients who met one of the following criteria were excluded from the study:

1. Morbid obesity.
2. Sever cardiac disorders.
3. Sever orthopedic problems (for example fractures).
4. Hepatic encephalopathy.
5. Malignant hypertension (SBP>180mmHG, DPB>110mmHG).
6. Neuromuscular diseases (e.g. myasthenia gravis).
7. Acute burn or open wound on the face**.**
8. Unable to do two minute walk test.

**Subjects were selected and divided randomly into two equal groups**

**Group (A): Study group:** Twenty patients received Incentive spirometer and traditional physiotherapy (circulatory ex, early mobilization and turning) and their routine medical treatment for two sessions per day for six days.

**Group (B): Control group:** Twenty patients received traditional physiotherapy (circulatory ex, early mobilization and turning) and their routine medical treatment for two sessions per day for six days.

## MATERIALS AND METHODS

**(A) Equipment for evaluation:**

a. **Pulse Oximeter**: (model Bmo310). A non invasive method allowing the monitoring of the oxygenation of patients hemoglobin**.**
b. **Body weight and height scale:** It was used to measure the subject's weight and height to calculate the BMI.
c. **Two minutes walk Test:** To measure the endurance. It asses walking distance over two minutes and their walking capacity.

**(B)Equipment for treatment:**

**Incentive spirometer: (Eiffestrabe 80 20537 Hamburg German)** Incentive spirometers emphasize sustained maximal inspiration (inspiration to total lung capacity for the longest possible time). Incentive spirometry is performed using devices which provide visual cues to the patients that the desired volume has been achieved.

**III-Procedures of the study**

**(A)Evaluative Procedures**

**(1) Pulse Oximeter:** After cleaning the patient's fingertip by acetone and alcohol to decrease skin resistance. The sensor of pulse oximeter was placed on a thin part of the patient right thumb and a light containing both red and infrared wavelengths passed from one side to the other. Pulseoximeter is connected to the monitor.

**(2) Evaluation of ambulation by two minutes walk Test:**

**Two Minutes Walk Test Instructions:**

**General Information**: Individual walks without assistance for two minutes and the distance is measured, start timing when the individual is instructed to "Go", stop timing at 2 minutes, assistive devices can be used but should be kept consistent and documented from test to test, if physical assistance is required to walk, this should not be performeda measuring wheel is helpful to determine distance walked and should be performed at the fastest speed possible.

**Patient Instructions:** Cover as much ground as possible over two minutes. Walk continuously if possible, but do not be concerned if you need to slow down or stop to rest. The goal is to feel at the end of the test that more ground could not have been covered in the 2 minutes.

**3) Evaluation of Body Mass Index:** Body Mass Index equals body weight in kilograms on height in meter squared.

**(B)Treatment Procedures:**

**(1)For study group:**
**Patients in this group were engaged in treatment session include:** Incentive spirometer, traditional physiotherapy (circulatory ex, early mobilization and turning) and their routine medical treatment.

**2) Forcontrol group:**

**Patients in this group were engaged in treatment session include:**

Traditional physiotherapy (circulatory ex, early mobilization and turning) and their routinemedical treatment.

1-Operating Incentive Spirometer:

- Sit on the edge of your bed if possible, or sit up as far as you can in bed.
- Hold the incentive spirometer in an upright position.
- Place the mouthpiece in your mouth and seal your lips tightly around it.
- Breathe in slowly and as deeply as possible. Notice the yellow piston rising toward the top of the column. The yellow indicator should reach the blue outlined area.
- Hold your breath as long as possible. Then exhale slowly and allow the piston to fall to the bottom of the column.
- Rest for a few seconds and repeat steps one to five at least 10 times every hour.
- Position the yellow indicator on the left side of the spirometer to show your best effort. Use the indicator as a goal to work toward during each slow deep breath.
- After each set of 10 deep breaths, cough to be sure your lungs are clear. If you have an incision, support your incision when coughing by placing a pillow firmly against it.
- Once you are able to get out of bed safely, take frequent walks and practice the cough.

**2**-Early mobilization consist of: passive and active turning and moving in bed, active assisted and active exercises, pedal cycles in bed, tilt table, sitting at the edge of the bed, standing (with the assistance of the physiotherapist and with or without the help of standing or walking aids), transfers from bed to chair, chair-based exercises, and walking.
**3-**Circulatory exercises done for both sides of patient body as passive movement or active for wrist, elbow, shoulder, hip, knee. Ankle joints.

**Statistical analysis:** Data would be statistically analyzed and treated before and after the treatment for two groups through:

1) Descriptive statistics: the mean, standard deviation and percentage (qualitative variables).
2) Inferential statistics: by using t-test (test for difference).

## RESULTS

Purpose of the study was to determine the effect of Incentive spirometer on oxygen saturation in patients in renal patients grade II intensive care unit.

**Patients characteristic:** Comparing the general characteristics of the patients of both groups revealed that there was no significance difference between both groups in the mean age, weight, height pre study (p>0.05) Table (1).

**Table 1. Descriptive statistics for both groups**

| Group | | Age (yr.) | Weight (Kg) | Height (Cm) | BMI |
|---|---|---|---|---|---|
| Study Group | Mean± S.D. Max. Min. | 65± 5.35 75 60 | 75.44± 2.7 79 70 | 175.65 ± 2.6 177 170 | 24.45± 1.6 25.21 24.21 |
| Control Group | Mean± S.D Max. Min. | 63.8± 4.12 75 61 | 74.66± 2.8 77 70 | 174.57± 2.83 177 170 | 24.51±2.1 24.85 24.24 |
| Significance | | p>0.05** | p>0.05** | p>0.05** | |

*= significant; SD: standard deviation
**=non significant; P value: probability value; Cm: centimeter; Kg: kilogram;
Yr: years Level of significance at p<0.05.

**Results of Oxygen Saturation of both group's pre and post study:** Results revealed Statistical significant improvement in Oxygen Saturation in study group compared to control group.

**Table 3. Statistical analysis of mean values of SO2 between two groups (A,B)**

| | $SaO_2$ | | | |
|---|---|---|---|---|
| | Pre | | Post | |
| | A | B | A | B |
| Mean±SD | 92.7 ±2.5 | 92.3±2.3 | 97±1.9 | 95.2±1.39 |
| Mean difference | 1.1 | | 2.9 | |
| t-value | 1.23 | | 3.5 | |
| p-value | 0.19 | | 0.0001 | |
| S | NS | | S | |

*Sd: standard deviation, P: probability, S: significant, NS: non-significant

## DISCUSSION

Purpose of the study was to determine the effect of Incentive spirometer on oxygen saturation in renal patients grade II intensive care unit. Oxygen Saturation was recorded before, after the treatment session in intensive care unit (two sessions per day for six days). The data obtained in the current study indicated that there was statistical difference in Oxygen Saturation that showed improvement in patients in both control and study group but this improvement was more in the study group. Data from this study suggested that adding of IS to early mobilization offer extra benefits than using early mobilization only, this may be attributed to the effect of IS in improvement of oxygenation status and lung volumes which is comparable to the effect of early mobilization only. The specific training of respiratory muscles may be a useful alternative for patients with chronic kidney disease because the conditioning and strengthening of respiratory muscles can delay the complications of loss of muscle mass. Its achievement may result in effects like phenotype modification of the respiratory muscles, increased respiratory muscle strength and endurance (Norrenberg and Vincent, 2008). It was found that there was low number of findings suggest that Incentive spirometer can provide strengthening of respiratory muscles, improving functional capacity and lung function in chronic renal failure patients on dialysis (Zanni *et al.,* 2010). The improvement of Oxygen Saturation after using early mobilization and Incentive spirometer was due to improvement of oxygenation as following: in early mobilization may be due to improve ventilation –perfusion ratio, coughing functional residual capacity and lung compliance, and also in using incentive spirometer improvement may be due to biofeedback and encouraging to breath to inspiratory lung capacity which may lead to prevent atelectasis and reduce hypoxemia (Morris, 2007). Waissman (2009) reported that incentive spirometer Increase transpulmonary pressure and inspiratory volumes, improve inspiratory muscles performance, and re-establish or simulate the normal pattern of pulmonary hyperinflation. Respiratory muscle training by incentive spirometer enhances lung expansion and inspiratory muscle strength; increases production of surfactant which leads to reducing surface tension, increasing lung compliance, decreasing the work of breathing and better aeration of the alveoli. The improvement of total lung and thoracic compliance may be contributed to increase partial arterial pressure of oxygen ($PaO_2$) and arterial oxygen saturation ($SaO_2$) (Canet *et al.,* 2010). The result of the current study was also supported by Schweickert (2009) who found that incentive spirometer can be used as a preventive measure to reduce pulmonary complications, incentive spirometer can improve peak expiratory mouth pressure (PEMP), Peak inspiratory mouth pressure (PIMP) and cough peak expiratory flow rate (CPEFR) by increasing strength of innervated muscles and thus can improve cough capability, inspiratory capacity, endurance and perceived dyspnea, and so helps in decreasing pulmonary complications. Maximal inspiratory breathing exercises or incentive spirometer when used in addition to early mobilization offers therapeutic advantage over early mobilization alone in returning airflow, lung volumes toward normal values (Warner, 2010) Incentive spirometer is superior to routine pulmonary physical therapy, intermittent positive pressure breathing and deep breathing exercises, so that IS has become common therapy (Duggan and Kavanagh, 2010).

### Conclusion

So, the data from this study suggested that Incentive spirometer can improve oxygen saturation in renal patient grade II in intensive care unit.

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