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THE EFFECT OF EXPIRATORY MANUAL RIB CAGE COMPRESSION BEFORE SUCTIONING ON BLOOD OXYGEN SATURATION IN PATIENTS

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Abstract:

Introduction: *One of the most common ways put into practice to the clearance of the airway of patients who are under mechanical ventilation is applying suctioning into trachea. Some physiotherapeutic procedures including rib cage compression parallel to exhale and prior to suctioning can facilitate the egression of discharges. The present study aimed to determine the effect of rib cage compression during the exhale before suctioning on O2 saturation changes in patients receiving mechanical ventilation.*

Methodology: *The research is a clinical trial study. The sample involved 55 patients who received mechanical ventilation hospitalized in special sections of health centers at Golestan and Emam-Khomeini hospitals in Ahvaz. The patients were divided into control and intervention groups by convenience sampling as paying attention to random involvement criteria. Blood oxygen saturation, within 5 minutes before and 15 and 25 minutes after suctioning were measured for intervention group using rib cage compression technique and the data were analyzed by independent t-test, and paired t-test as well as repeated measures design.*

Findings: *The level of oxygen saturation increased by the trachea suctioning through rib cage compression technique and it is statistically meaningful at $p< 0.05$.*

Conclusion: *With respect to the improvement of blood oxygen saturation in intervention group, the technique is recommended for intubed patients.*

Keywords: *Suctioning, compressing the rib cage, O2saturation, mechanical ventilation*

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INTRODUCTION:

Being watchful to airway and keeping it open for proper breathing have been the priority in intensive care units. The initial attempts to maintain the airway have targeted facilitating the natural breathing of the patients and using no artificial airway [1]. The lower respiratory track in human is kept sterile through natural defense mechanisms such as coughing, clearing away phlegm, and cleaning the mucus. Tracheal intubation and mechanical ventilation are two factors that cause disorder either in this natural mechanism or decrease or absence of cough reflex leading to bronchial hyperactivity and device related pneumonia [2, 3]. The emergence of device-based pneumonia in patients admitted in intensive care units varies from 10 to 70 percent [2]. Collapse and atelectasis can be named the other side effects of mucus plug that can reduce the oxygenation and extend the hospitalization period of patients [6]. Therefore, the suctioning of tracheal intubation should be necessarily done to block the accumulation of mucus in the lung, to improve oxygenation, and to prevent some adverse effects like lumbar atelectasis [8, 7].

Despite having numerous advantages, suctioning has some undesirable effects and it can induce hemodynamic changes by increasing or decreasing blood pressure, stimulating the vague nerve, reducing the heart rate, and lowering the level of saturated oxygen [9, 11]. The sudden hemodynamic changes can result in vascular damages, bleeding, retina damage, and brain related effects [12]. The rate of decrease in saturated oxygen has been reported to be 46.8% after endotracheal suctioning, 31.6% for hemorrhage, 24.1% for blood pressure changes, and 10.1% for heart rate changes [10]. One of the factors that can make endotracheal suctioning more effective and hence aid the discharge of more mucus is carrying out chest physiotherapy before suctioning [14, 13]. Physiotherapy makes up one of the elemental acts of multipurpose nursing care in intensive care units. To run physiotherapy some equipment and manual techniques are applied to decrease the lung mucus and unblock the collapsed areas [15]. Physiotherapy can be done by different ways some of which are hyperinflation, chest wall vibration, and rib cage compression during the exhalation [16].

The expiratory rib cage compression involve a manual compression applied at the lower part of the chest at the time of inhalation and releasing the hands at the end of exaltation to move the expiratory secretions, facilitate the active inspiration and enhance the alveolar ventilation [17, 18]. This technique increases the forced expiratory volume by about 30%, gives rest to exhalation muscles, and prevents lung collapse. The technique, moreover, is considered to be an unaggressive approach for patients [19].

A study by Guimara˜es et al. in Brazil revealed that using expiratory rib cage compression during the exhalation increases the clearance of secretions by 34.4% than that of regular technique [20]. Berti et al. [2012] carried out a study in Brazil on 20 patients under mechanical ventilation. The results showed the shortening of time of admittance of patients who received expiratory rib cage compression with manual hyperinflation in intensive care unit [21]. Shirvani et al. [2013] did a study on expiratory rib cage compression before endotracheal suctioning in Zanjan. The results displayed an increase of oxygen in arterial blood and systolic blood pressure in minutes 15 and 25 in comparison to minute 5 after suctioning in patients received expiratory rib cage compression. Regarding the drop of blood pressure in these patients because of ventilation with positive pressure, the results were beneficial for the patients [22]. Similarly, the results of a study carried out by Yousefnia et al. displayed no statistical meaningful difference between endotracheal suctioning with or without compression of rib cage [23].

The present study was carried out to determine the effects of expiratory rib cage compression before suctioning on the rate of percentage changes in saturated blood oxygen in patient under mechanical ventilation. The rationale behind the study was to some factors, first, the importance and necessity of applying suctioning in patients under mechanical ventilation in different hours of a day. Second, noting the impossibility of regular presence of physiotherapist in intensive care unit, and taking into account the American Association of Respiratory care guidelines that have specified the presence of no particular specialist group for chest physiotherapy in patients under mechanical ventilation and have regarded the duty of nurses' knowledge and skills in chest physiotherapy. Third, the use of vibration physiotherapy for chest physiotherapy in Iran's hospitals by nurses and physiotherapists and not applying other approaches like compression of rib cage during exhalation. And finally, the patients under mechanical ventilation generally encounter the reduction of returning arterial blood to the heart because of ventilation by positive pressure.

MATERIALS AND METHOD:

Fifty-five patients qualified to be included in the study according to the defined criteria. Inclusion criteria include patients aged 18 to 65; having endotracheal tube for for at least 24 hours; table hemodynamic status [i.e., arterial blood pressure above 100 mmhg, heart rate of less than 110 beats per minute]; lack of chest tube; no chest surgery or injuries; no rib fractures; no skin grafts and reconstructive surgery of the chest; no pregnancy and obesity [body mass index >30]. Exclusion criteria were mucolytic and muscle paralysis drugs, start, stop or change the bronchodilator medications during the study, extubation during study period, using paralyze anesthesia (23).

The patients were divided randomly into intervention and control groups. In intervention group, patients received the routine suctioning with expiratory rib cage compression three times a day, while, the control group received routine suctioning without rib cage compression. Then 5 minutes before and 15, 25 minutes after intervention, O2 saturation was measured. In RCC, during expiration both hands very slightly were used to squeeze the rib cage.

Table1: Fifty-five patients were assessed by mechanical ventilation for at least 24 hours

group	GCS		Height		weight		ETT size		**ventilation** Duration	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
intervention	9.44	0.5	178.7	6.1	80.92	7.25	7.92	0.18	2.07	0.266
control	9.32	0.47	176	7.48	79.03	8.03	7.89	0.20	3.69	0.781

Table 2: The comparison of O2 saturation mean 5 minute before intervention with 15 and 25 minute after that in both group

time		**5,15 min**	**P value**	**5,25 min**	**pvalue**	**15,25min**	**pvalue**
group	**intervention**	**-0.63**	**0.00**	**-0.778**	**0.002**	**-0.148**	**0.327**
	control	**-0.5**	**0.308**	**-0.429**	**0.443**	**0.071**	**0.764**

RESULTS:

Fifty-five patients were assessed by mechanical ventilation for at least 24 hours. [27 patients were in intervention group and the rest was in control group]. Data are are given in table 1. Additionally, data were tested for normality and homogeneity of variance [Levene test] and they were displayed normal. In this study, significant differences between the two method of suction with and without RCC were detected. RCC increased the amount of O2 saturation in 15,25 minutes after tracheal suctioning. [Tables 2].

DISCUSSION:

This study demonstrated that manual rib cage compression improves the mean of O2 saturation. These results are in line with Shirvani and et al's study that demonstrated the benefits of RCC in ventilated patients [22]. Conversely, the study did not find agreement with Yousefnia Darzi and et al.'s study. They showed RCC did not improve O2 saturation in ventilated patients. It seems in Yousefnia darzi study, the duration of hospitalization rolled a key factor [23]. The mean of hospitalization period was 6 days. Consequently, based on Lopen's study after 19 to 56 hours of ventilation approximately 55% of diafragma is been atrophy and tidal volume is decreased then O2 saturation decline.

Unoki's study demonstrated the RCC did not improve gas exchange, secretion clearance and O2 saturation. The remarkable point in the present study was hyper oxygenation before suctioning which was not done in Unoki's study [24].

CONCLUSION:

The study demonstrated that the manual expiratory rib cage compression improves the oxygen condition in ventilated patients. The routine suctioning with rib cage compression in patients under mechanical ventilation is recommended. However, the effects on the long term outcomes on patients are unknown.

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