Comparison of the endotracheal tube suctioning with and without normal saline solution on heart rate and oxygen saturation

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Abstract
Aims: Pre-suctioning normal saline instillation into the trachea is a traditional nursing intervention. In this line, the present study has been carried out to "evaluate the effect of endotracheal suctioning with and without normal saline solution on heart rate and oxygen saturation".

Methods: This semi-experimental study with crossover design was conducted on 50 trauma patients admitted to critical care unit of Shahid Bahonar Hospital of Kerman in 2010. For each patient, suctioning was performed once without and once with 5ml normal saline solution. Heart rate and oxygen saturation were measured and recorded at one, two and five minutes before and after suctioning by standard monitoring apparatus. Data were analyzed by SPSS17 statistical software using independent and paired t-tests.

Results: Heart rate was increased in both groups after the suctioning; however, it was slightly more in group receiving normal saline but not statistically significant. Negative changes in oxygen saturation were higher in saline group compared to the other (p<0.05).

Conclusion: Normal saline instillation prior to suctioning will be accompanied by reduced oxygen saturation, and it is recommended that more suitable approaches, such as moisturizing the inhaled gas, be used for diluting secretions to minimize the related side effects.

Key words: Tracheal suctioning; Heart rate; Oxygen saturation; Normal saline

Introduction
Airway care and keeping it open for proper breathing has always been a top priority, especially in critical care units. Although, early attempts to restore the airway are to preserve normal respiration without the use of artificial airways [1], they will be required when the person is not normally able to maintain the open airway. Endotracheal tube is one of these artificial airways, preventing the glottic closure and disabling the person to use natural airway-cleaning mechanisms, such as cough; on the other hand, the presence of a foreign body (the endotracheal tube) leads to increased production of pulmonary secretions, and endotracheal tube suctioning will be necessary for removing discharges and maintaining the airway [2, 3, 4]. Pre-suctioning normal saline (NS) instillation into the trachea is a traditional nursing intervention [5] which has become part of the ward's routine in a large number of intensive care units [6]. Prior to suctioning, nurses usually instill three to ten ml of NS into the endotracheal tube [5]; this is performed with specific objectives, among which diluting viscous fluids [8], stimulating the cough reflex [6], lubricating the suction catheter [5], and facilitating secretion clearance [9] can be mentioned. In a study by Ridling et al., it has been shown that pre-suctioning NS instillation can contribute to more reduction in oxygen saturation in comparison with suctioning without normal saline solution [6].

A research in South Korea by Ji et al. revealed that intra-suctioning NS instillation eventuates in greater decrement in oxygen saturation following the suctioning [5]. Although members of the healthcare team believe that NS instillation brings about secretion dilution, researches have not yet demonstrated this effect. In vitro instillation of 5 and 10 ml of normal solution on lung secretions and vigorous shaking showed no combination between the two in any way [8], as the outer layer of secretions are strongly hydrophobic [9]; hence, NS cannot be certainly combined with pulmonary discharges inside the lung. Instillation of normal solution not only does not augment secretion clearance, but also can even be harmful [8]. Intra-suctioning NS instillation may cause symptoms such as post-suctioning asthma [11], as well as increased risk of respiratory infection [12]. Most studies have suggested that routine use of NS solution
Comparison of the endotracheal tube suctioning with and without normal saline solution during endotracheal tube suctioning should not be performed [13]; however, this is routinely implemented in critical care units of our country. In this regard, the present study has been carried out to investigate the effect of endotracheal tube suctioning with and without normal saline solution on heart rate and oxygen saturation among critical care unit patients, so that the results can be applied for educational and therapeutic purposes.

Methods
This semi-experimental study was conducted with crossover design after being approved by Ethics Committee of Kerman University of Medical Sciences in Shahid Bahonar Hospital of this city in 2010. In the present research, two methods of endotracheal tube suctioning, one with normal saline solution and the other without NS instillation, have been compared. For each fifty patients participated, both procedures were applied, and the study samples were considered as their own control as well. The research sample size was determined based on previous studies and also sample size determining-formula. Inclusion criteria included hospitalization in critical care units for at least 24 hours, having the endotracheal tube, no history of cardio-pulmonary diseases, and the age range of 18 to 45 years.

After selecting the participants, suctioning was performed once without and once with 5ml normal saline solution for each patient; so as, in suctioning without NS instillation, 100% oxygen was first given to patients by the ventilator for one minute, and they were then weaned from the device and suctioned for 10 to 15 minutes (depending on patient's needs). Afterwards, patients were ventilated one more time with 100% oxygen for one minute. In suctioning with normal saline solution, all the steps were similar to that mentioned before, and the difference was only in 5ml instillation of sterile normal saline solution into the patient's endotracheal tube before suctioning. The time interval between the two suctioning procedures was two hours for each participant, and in cases of patients' need to be suctioned in less than this specified time, they would be excluded from the study.

The suctioning apparatus applied was the same for all subjects, for whom the device pressure was set to 80 to 120 mmHg; the same pressure was used in both suctioning approach for each participant, and the suction catheter was about half of the endotracheal tube diameter.

Parameters investigated were respectively measured and recorded while suctioning and also at one, two, and five minutes before and after the suctioning by standard monitoring apparatus. Data were analyzed by SPSS17 statistical software and compared within and between the two groups using descriptive and inferential statistical tests, as well as paired and independent t-tests.

Table 1. The mean difference of oxygen saturation between the two groups before and after suctioning with and without normal saline solution in the study patients

<table>
<thead>
<tr>
<th>Times recorded for oxygen saturation</th>
<th>The group with normal saline before suctioning</th>
<th>The group without normal saline before suctioning</th>
<th>(p&lt;0.05) between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minute 5 0.6</td>
<td>- 0.020</td>
<td>Minute 5</td>
<td>0.2008</td>
</tr>
<tr>
<td>Minute 2 - 0.28</td>
<td>0.031</td>
<td></td>
<td>+ 0.12</td>
</tr>
<tr>
<td>Minute 1 - 0.7</td>
<td>0.008</td>
<td></td>
<td>- 1.37</td>
</tr>
</tbody>
</table>

Table 2. The mean difference in heart rate between the two groups before and after suctioning with and without normal saline solution in the study patients

<table>
<thead>
<tr>
<th>Times recorded for heart rate</th>
<th>The group with normal saline before suctioning</th>
<th>The group without normal saline before suctioning</th>
<th>(p&lt;0.05) between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minute 5</td>
<td>3.34</td>
<td>2.68</td>
<td>0.512</td>
</tr>
<tr>
<td>Minute 2</td>
<td>7.82</td>
<td>6.26</td>
<td>0.426</td>
</tr>
<tr>
<td>Minute 1</td>
<td>12.98</td>
<td>11.98</td>
<td>0.654</td>
</tr>
</tbody>
</table>
Results
Among the study participants, 38 (76%) were male and 12 (24%) were female. The mean age of patients was 30.7 years, ranging from 18 to 45 years old. Negative alteration of oxygen saturation was more remarkable in the group receiving normal saline solution than the other group (Table 1). Heart rate was increased in both groups, on which the difference was slightly more in the group with normal saline solution than the other, but not statistically significant (Table 2).

Discussion
The study results demonstrated that endotracheal tube suctioning with 5ml normal saline instillation contributes to further lowering in the percentage of oxygen saturation compared to suctioning without NS instillation; this finding is in accordance with Ridling et al. investigation [6]. Likewise, in Ji et al. study, it has been found out that changes toward reducing the percentage of oxygen saturation enhance with NS instillation. Similarly, in Akerman survey on 40 patients in critical care units, greater decrement in oxygen saturation has been observed in those receiving intra-suctioning NS instillation than the others [14]. The results achieved in the present study are also compatible with Akerman research in terms of oxygen saturation percentage. For the explanation of further decline in oxygen saturation following 5ml NS instillation, it can be stated that only 10.7% to 18.7% of the normal saline instilled is discharged through the suctioning and the rest remain in the tracheal tube and respiratory system, diminishing the tube diameter which, per se, leads to further resistance in the airway to airflow and more difficulties in patient breathing, as he/she needs to strive to have the current respiratory volume [11]; this can reduce the oxygen available for lungs to gas exchange and eventually decrease hemoglobin saturation with oxygen.

The study results also elucidated elevated heart rate in both groups following endotracheal tube suctioning. Although the increase was slightly more in NS-receiving group than the other, the difference was not statistically significant; this finding is in agreement with the results obtained by Shorten et al. and Akerman et al., and it seems that heart rate does not significantly differ in suctioning with normal saline solution and that without NS instillation.

Conclusion
The results of the present research and other studies in this field demonstrate that normal saline instillation before endotracheal suctioning can be accompanied by complications such as decreased hemoglobin saturation with oxygen, and more appropriate approaches including moisturizing the inhaled gas are, therefore, recommended for diluting secretions to minimize post-suctioning complications. In this study, due to special nature of trauma intensive care unit, no possibility was available to investigate the respective cases more than five minutes before and after suctioning, and it is suggested that the project be studied over greater time intervals in critical care units, in which the facilities are more provided to the researchers.

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References
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