Two Levels of Negative Pressure in Open Endotracheal Tube Suctioning on Physiological Indices

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ABSTRACT

Endotracheal tube suctioning is a vital component of bronchial hygiene therapy by applying negative pressure to facilitate the removal of pulmonary secretions resulting in promotion of gas exchange. Hence, the study was conducted to compare the effect of two different levels of 120mmHg and 200mmHg of negative pressure in open endotracheal tube suctioning on physiological indices. Pre-experimental research design was adopted to conduct the study with 60 samples and were allocated into experimental group I (n=30) and experimental group II (n=30). Pre-test assessment was done by assessing Oxygen saturation, respiratory rate, heart rate and mean arterial pressure for both the groups. Open endotracheal tube suctioning was done by applying negative pressure of 120 mmHg to experimental group I and 200 mmHg to experimental group II. Post-test was done immediately, 5 minutes, and 20 minutes after suctioning for both experimental groups. The results of the study reveal the significant changes in both the group however highly significant changes observed in oxygen saturation (p<0.001), respiratory rate (p<0.001), and heart rate (p<0.001) in high level negative pressure. The findings of the study concluded that 200mmHg negative pressure is safe and can be recommended for open endotracheal tube suctioning for effective oxygen saturation, respiratory rate, and heart rate.

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INTRODUCTION

Endotracheal intubation is a reliable method to keep the airway open by connecting with mechanical ventilator to permit air to pass freely to and from the lungs in order to ventilate the lungs (Şahiner, 2018). Patients on mechanical ventilation require maintenance of airway secretion clearance to maintain the patency of airway. Accumulation of secretion in the airways of patients with an endotracheal tube and mechanical ventilation will have serious consequences (American Association for Respiratory Care, 2010) such as discomfort (Chaseling et al., 2014), bronchostenosis (Guglielminotti et al., 1998), infection (Tingay et al., 2010), injury to the tracheal mucosa and haemorrhage (Maggiore et al., 2013), atelectasis (Sackner, 1976), cardiac arrhythmias and hemodynamic changes (Seymour et al., 2009; Bourgault et al., 2006). Endotracheal tube suctioning is a vital component of bronchial hygiene therapy to prevent mechanical aspiration of pulmonary secretions (Peterson and Michael, 1993). Patients on mechanical ventilator may require suctioning several times per 24 hours (Leur et al., 2003) and usually performed every 1–2 hours in
clinical practice to maintain the patency of the artificial airway (American Association for Respiratory Care, 1993). However, this needed procedure may cause serious complications like hypoxemia, bronchospasm, increased intracranial pressure, airway trauma and dysrhythmia. Ventilator associated complication are one of the major causes of morbidity and mortality especially in developing countries due to inadequate facilities for ventilator care, also ventilator complication account for the most frequent reason for prolonged stay in hospital and delay in extubation (Kulkarni and Agarwal, 2008). Signs indicating the need for suction can include: oxygen desaturation, bradycardia, audible crackles on auscultation, obvious secretions in the tube and decreased chest movement (Sakuramoto et al, 2013). The proper technique, suctioning frequency, and higher positive end expiratory pressure are risk factors for complications and can be reduced by the implementation of proper endotracheal tube suctioning guidelines (Maggiore et al., 2013). Use of inadequate pressure leads to ineffective secretion removal and excessive negative pressure results in damages to tracheal tube, causes hypoxia, and cardiac arrhythmias.

Open sterile technique of clearing the airways of patients on mechanical ventilator using suction catheter inserted into the endotracheal tube after the patient has been disconnected from the ventilator is an essential aspect of effective airway management (Kendrick, 2020). In order to facilitate the discharge of pulmonary secretion which results in promotion of gas exchange, use of negative pressure helps to bring out the secretions from the lungs. The total suction procedure from insertion to removal of catheter needs a minimum of 15 seconds with negative pressure applied continuously as the suction catheter is being withdrawn from the endotracheal tube (Manual, 2014). The general recommendation is to use negative pressure between 70 and 150 mm Hg - except when there are thick secretions, where up to 200 mm Hg can be used with the appropriate suction catheter size and suctioning technique (Hahn, 2010). Previous studies has been proven that negative pressure of 200-300 mmHg is safe and 200 mmHg negative pressure as the upmost safe pressure for endotracheal suctioning (Maggiore and Volpe, 2011; Pedersen et al., 2009).

The impact of suctioning is similar between closed and open tracheal suctioning system regarding the occurrence of ventilator associated pneumonia. It seems that consider many factors such as duration of mechanical ventilation, co-morbidities, oxygenation parameters, number of required suctioning, and the cost prior to using each type of tracheal suction system (Hamishekar et al., 2014). With an increasing demand for intensive care beds more nurses in acute and high dependency wards nurse will be expected to care competently for patients with endotracheal tubes. It is imperative that nurses are aware of the risks and are able to practice accordingly. In order to improve the discharge of airway secretion the researcher aims to identify the better level of negative pressure to be used for open endotracheal tube suctioning by comparing two levels of negative pressure (120 mmHg and 200 mmHg) on physiological indices like oxygen saturation, respiratory rate, heart rate and mean arterial pressure among mechanically ventilated patients as prevention of potential complications occurring due to negative pressure used in open endotracheal tube suctioning.

MATERIALS AND METHODS

The research approach adopted in the study was quantitative approach by using pre experimental research design. It was conducted after obtaining an authorized setting permission from Saveetha Medical College and Hospital, Chennai. A total of 60 participants who met the inclusion criteria were selected by convenience sampling technique. The inclusion criteria were the age group of 18-75 years of both male and female, on mechanical ventilator for the first 6 days, being orally intubated, hemodynamically stable, the score of 0-5 as per the Richmond agitation and sedation scale, and willing to give consent to participate in the study. Mechanically ventilated patient with history of blood coagulation disease, agitated, immune compromised, and about to wean off or extubate were excluded from the study. Participants were selected from medical intensive care unit were considered as experimental group I (n=30) and from respiratory intensive care unit were considered as experimental group II (n=30). Homogeneity was maintained between the groups. The investigator introduced herself and explained the purpose of the study to the care giver. Informed written consent was obtained from care giver and confidentiality was assured. The demographic variables were collected by using multiple choice questionnaires. Pre-test assessment was done by assessing Oxygen saturation (SpO2), respiratory rate, heart rate and mean arterial pressure for both the experimental group. Open endotracheal tube suctioning was done by using appropriate suction catheter by applying negative pressure of 120 mmHg in experimental group I and 200 mmHg in experimental group II. Patients received oxygen 100% on the ventilator for one minute before and after suctioning to prevent hypoxia. Same proce-
dure was carried out whenever patient required open endotracheal suctioning for three consecutive days. Post-test was done by assessing oxygen saturation (SpO2), respiratory rate, heart rate and mean arterial pressure immediately after suctioning, 5 minutes after suctioning and 20 minutes after suctioning for both experimental groups after using negative pressure for open endotracheal tube suctioning. Data were analysed by using descriptive and inferential statistics using SPSS statistical package. All the values were expressed as the mean ± standard deviation. The difference between two groups was compared using unpaired t-test and within the group by ANOVA (Analysis of Variance). A probability of 0.05 or less was taken as statistically significant.

RESULT

Regarding demographic variables, the present study observed that majority (43%) of the participants was in the age group of 51-70 years, 60% were male and 100% were hemodynamically stable with inotropic support in both the groups. In experimental group I, 14(46.7%) had intubated with ET tube size of 8, the size of the suction catheter used for the majority 23(76.7%) of the participants was 14fr catheter; 13(43.4%) were under assist / controlled mode of ventilation, 10(33.3%) were 0 – 2, 2 – 4 and 4 – 6 days on mechanical ventilator; and 40% were under sedated and remaining 60% were not sedated. Whereas in experimental group I, the size of the ET tube and suction catheters used for the most of the participants was 8.5 and 14fr. 12(40%) were under assist / controlled mode of ventilation, 13(43.3%) were on 2 – 4 days of mechanical ventilator, and 17(56.7%) were not sedated. Homogeneity had been maintained between the two groups as depicted in Table 1.

Table 2 shows effectiveness of low level of negative pressure (120mmHg) on physiological indices in terms of SpO2, respiratory rate, heart rate and mean arterial pressure. Pre-test and post-test mean values were compared by the paired t test. Regarding SpO2, the calculated paired t’ value of t = 7.708, t = 16.834 t= 10.071, and t=12.279 between pre-test and post-test (during suction), post-test (during suction) and post-test (5th min), post-test (5th min) and post-test (20th min) & pre-test and post-test (20th min) was found to be statistically significant at p<0.001 level which clearly infers that there was significant difference in the level of SpO2 at all the levels. With regards to respiratory rate, The calculated paired t’ value between pretest and post-tests (after suction), post-test (before suction) and post-test (5th min), post-test (5 min) and post-test (20 min) & pre-test and post-test (20 min) was not found to be statistically significant which clearly infers that there was no significant difference in the level of respiratory rate at various levels. Regarding heart rate, The calculated paired t’ value of t = 11.592 and t = 11.281 between pretest and post-test (after suction) and post-test (after suction) and post-test (5 min) was found to be statistically significant at p<0.001 level. In Mean arterial blood pressure, The calculated paired t’ value of t = 2.692 and t = 4.862 between pretest and post-test (after suction) and post-test (after suction) and post-test (5 min) was found to be statistically significant at p<0.001 level respectively which clearly infers that there was significant difference in the level of mean arterial pressure at two levels.

Table 3 reveals that the pre-test score value of physiological indices were compared with different level of post-test scores by repeated measures of ANOVA. Regarding oxygen saturation, pretest mean score was 95.80±1.32, post-test (after suction) mean score was 94.49±0.93, post-test (5 min) mean score was 97.07±0.76 and the post-test (20 min) mean score was 98.30±0.56. The calculated Repeated Measures Anova F value of F = 200.455 was found to be statistically significant at p<0.001 level. The pretest mean score of respiratory rate was 19.64±3.79, post-test (after suction) mean score was 20.49±3.04, post-test (5 min) mean score was 20.31±2.88 and the post-test (20 min) mean score was 20.22±3.16. The calculated Repeated Measures Anova F value of F = 1.684 was not found to be statistically significant. In heart rate, pre-test mean score was 77.58±11.03, post-test (after suction) mean score was 83.69±9.68, post-test (5 min) mean score was 77.16±10.38 and the post-test (20 min) mean score was 76.29±8.97. The calculated Repeated Measures Anova F value of F = 49.132 was found to be statistically significant at p<0.001 level. With regards to mean arterial pressure, the pretest mean score was 81.98±6.42, post-test (after suction) mean score was 83.10±5.76, post-test (5 min) mean score was 80.99±5.63 and the post-test (20 min) mean score was 81.04±5.72 and the calculated Repeated Measures Anova F value of F = 5.662 was found to be statistically significant at p<0.01 level. These findings clearly indicate that there was significant difference in the level of physiological indices at various levels.

Table 4 portrays the effectiveness of high level of negative pressure (200mmHg) on physiological indices in terms of SpO2, respiratory rate, heart rate and mean arterial pressure.
## Table 1: Frequency and percentage distribution of demographic variables of mechanically ventilated patients in both experimental groups I & II

| Demographic Variables | 120 mmHg Group | 200 mmHg Group | Chi-Square Value for Homogeneity |
|-----------------------|----------------|----------------|--------------------------------|
|                       | No. | %    | No. | %    |                 |
| Age in years          |     |      |     |      |                 |
| 20–35                 | 7   | 23.3 | 3   | 10.0 | \(\chi^2=8.610\), df=3 |
| 36–50                 | 4   | 13.3 | 8   | 26.7 | p = 0.035       |
| 51–70                 | 12  | 40.0 | 13  | 43.3 | NS              |
| 71–75                 | 7   | 23.3 | 6   | 20.0 |                 |
| Gender                |     |      |     |      |                 |
| Male                  | 17  | 56.7 | 18  | 60.0 | \(\chi^2=0.069\), df=1 |
| Female                | 13  | 43.3 | 12  | 40.0 | p = 0.793, N.S  |
| Size of ET Tube       |     |      |     |      |                 |
| 7.5                   | 6   | 20.0 | 11  | 36.7 | \(\chi^2=5.062\), df=2 |
| 8                     | 14  | 46.7 | 6   | 20.0 | p = 0.080, N.S  |
| 8.5                   | 10  | 33.3 | 13  | 43.3 |                 |
| Size of suction catheter |   |      |     |      |                 |
| 12 fr                 | 7   | 23.3 | 11  | 36.7 | \(\chi^2=1.270\), df=1 |
| 14 fr                 | 23  | 76.7 | 19  | 63.3 | p = 0.260, N.S  |
| Ventilator setting    |     |      |     |      |                 |
| Control ventilation   | 10  | 33.3 | 9   | 30.0 | \(\chi^2=0.343\), df=2 |
| Assist / control ventilation | 13 | 43.4 | 12 | 40.0 | p = 0.643, N.S  |
| SIMV                  | 7   | 23.3 | 9   | 30.0 |                 |
| Day on mechanical ventilator |   |      |     |      |                 |
| 0 – 2                 | 10  | 33.3 | 10  | 33.3 | \(\chi^2=0.921\), df=2 |
| 2 – 4                 | 10  | 33.3 | 13  | 43.4 | p = 0.63, N.S   |
| 4 – 6                 | 10  | 33.3 | 7   | 23.3 |                 |
| Hemodynamically stable with Inotropes |   |      |     |      |                 |
| Yes                   | 30  | 100  | 30  | 100  | -               |
| No                    | -   | -    | -   | -    |                 |
| Sedation              |     |      |     |      |                 |
| Yes                   | 12  | 40.0 | 13  | 43.3 | \(\chi^2=0.069\), df=1 |
| No                    | 18  | 60.0 | 17  | 56.7 | p = 0.793, N.S  |

\(\chi^2\) - Chi-square, d.f - degrees of freedom, N.S - Not Significant

In oxygen saturation, the calculated paired ‘t’ value of \(t = 8.800\), \(t = 19.946\), \(t = 9.602\), and \(t = 21.378\) between pre-test, post-test (after suction), post-test (5 min) & post-test (20 min) was found to be statistically significant at \(p<0.001\) level respectively which clearly infers that there was significant difference in the level of SPO2 at all levels. Regarding respiratory rate, the calculated paired ‘t’ value of \(t = 2.087\) and \(t = 2.270\) between pre-test and post-test (after suction) & pre-test and post-test (20 min) was found to be statistically significant at \(p<0.05\) level respectively which clearly infers that there was significant difference in the level of respiratory rate at two levels. The calculated paired ‘t’ value of \(t = 10.859\) and \(t = 10.573\) between pre-test and post-test (after suction) and post-test (after suction) and post-test (5 min) was found to be statistically significant at \(p<0.001\) level in heart rate. However there was no statistically significant was found in mean arterial pressure.

Table 5 depicts the comparison of pre-test mean score with the different level of posttest mean score by repeated measures of ANOVA. The pre-test mean score of SPO2 was 95.84±1.03, post-test (after suction) mean score was 93.79±1.04, post-test (5 min) mean score was 97.58±0.82 and the post-test (20 min) mean score was 98.88±0.45. The calculated Repeated Measures Anova F value of \(F = 318.983\)
### Table 2: Determine the effectiveness of low level Negative Pressure (120mmHg) on Physiological indices among Experimental Group I

| Physiological Indices               | Mean   | SD     | Paired 't' test |
|-------------------------------------|--------|--------|-----------------|
| **SPO2 (Oxygen Saturation)**        |        |        |                 |
| Pre-test                            | 95.80  | 1.32   | t = 7.078       |
| Post-test (During suction)          | 94.49  | 0.93   | P = 0.0001, S*** |
| Post-test (During suction)          | 94.49  | 0.93   | t = 16.834      |
| Post Test (5th Minute)              | 97.07  | 0.78   | P = 0.0001, S*** |
| Post Test (5th Minute)              | 97.07  | 0.78   | t = 10.071      |
| Post Test (20th Minute)             | 98.30  | 0.56   | P = 0.0001, S*** |
| Pre-test                            | 95.80  | 1.32   | t = 12.279      |
| Post Test (20th Minute)             | 98.30  | 0.56   | P = 0.0001, S*** |
| **Respiratory Rate**                |        |        |                 |
| Pre-test                            | 19.64  | 3.79   | t = 1.874       |
| Post-test (During suction)          | 20.49  | 3.04   | P = 0.071, NS   |
| Post-test (During suction)          | 20.49  | 3.04   | t = 1.132       |
| Post Test (5th Minute)              | 20.31  | 2.88   | P = 0.267, NS   |
| Post Test (5th Minute)              | 20.31  | 2.88   | t = 0.346       |
| Post Test (20th Minute)             | 20.22  | 3.16   | P = 0.732, NS   |
| Pre-test                            | 19.64  | 3.79   | t = 0.931       |
| Post Test (20th Minute)             | 20.22  | 3.16   | P = 0.360, NS   |
| **Heart rate**                      |        |        |                 |
| Pre-test                            | 77.58  | 11.03  | t = 11.592      |
| Post-test (During suction)          | 83.69  | 9.68   | P = 0.0001, S*** |
| Post-test (During suction)          | 83.69  | 9.68   | t = 11.281      |
| Post Test (5th Minute)              | 77.16  | 10.38  | P = 0.0001, S*** |
| Post Test (5th Minute)              | 77.16  | 10.38  | t = 1.028       |
| Post Test (20th Minute)             | 76.29  | 6.97   | P = 0.312, NS   |
| Pre-test                            | 77.58  | 11.03  | t = 1.591       |
| Post Test (20th Minute)             | 76.29  | 6.97   | P = 0.122, NS   |
| **Mean Arterial Pressure**          |        |        |                 |
| Pre-test                            | 81.98  | 6.42   | t = 2.692       |
| Post-test (During suction)          | 83.10  | 5.76   | P = 0.012, S*   |
| Post-test (During suction)          | 83.10  | 5.76   | t = 4.863       |
| Post Test (5th Minute)              | 80.99  | 5.63   | P = 0.0001, S*** |
| Post Test (5th Minute)              | 80.99  | 5.63   | t = 0.073       |
| Post Test (20th Minute)             | 81.04  | 5.72   | P = 0.943, NS   |
| Pre-test                            | 81.98  | 6.42   | t = 1.298       |
| Post Test (20th Minute)             | 81.04  | 5.72   | P = 0.204, NS   |

*p<0.05, ***p<0.001, S – Significant, N.S – Not Significant
Table 3: Comparison of pre-test and post-test score of Physiological indices among Experimental Group I (Low Negative Pressure –120mmHg)

| Physiological Indices | Mean  | SD   | Repeated Measures ANOVA |
|-----------------------|-------|------|-------------------------|
| SPO2 (Oxygen Saturation) |       |      |                         |
| Pre-test              | 95.80 | 1.32 | F = 200.455             |
| Post-test (During suction) | 94.49 | 0.93 | P = 0.0001              |
| Post Test (5th Minute) | 97.07 | 0.76 | S***                    |
| Post Test (20th Minute) | 98.30 | 0.56 |                         |
| Respiratory Rate      |       |      |                         |
| Pre-test              | 19.64 | 3.79 | F = 1.684               |
| Post-test (During suction) | 20.49 | 3.04 | P = 0.203              |
| Post Test (5th Minute) | 20.31 | 2.88 | N.S                     |
| Post Test (20th Minute) | 20.22 | 3.16 |                         |
| Heart Rate            |       |      |                         |
| Pre-test              | 77.58 | 11.03| F = 49.132              |
| Post-test (During suction) | 83.69 | 9.68 | P = 0.0001              |
| Post Test (5th Minute) | 77.16 | 10.38| S***                    |
| Post Test (20th Minute) | 76.29 | 8.97 |                         |
| Mean Arterial Pressure|       |      |                         |
| Pre-test              | 81.98 | 6.42 | F = 5.662               |
| Post-test (During suction) | 83.10 | 5.76 | P = 0.004              |
| Post Test (5th Minute) | 80.99 | 5.63 | S**                     |
| Post Test (20th Minute) | 81.04 | 5.72 |                         |

**p<0.01, ***p<0.001, S–Significant, N.S – Not Significant

was found to be statistically significant at p<0.001 level. In respiratory rate, the pre-test mean score was 18.65±3.49, post-test (after suction) mean score was 19.42±3.23, post-test (5 min) mean score was 19.30±3.12 and the post-test (20 min) mean score was 19.63±3.40. The calculated Repeated Measures Anova F value of F = 3.956 was found to be statistically significant at p<0.05 level. The pre-test mean score of heart rate was 78.32±9.79, post-test (after suction) mean score was 84.06±8.80, post-test (5 min) mean score was 77.32±8.93 and the post-test (20 min) mean score was 76.55±7.78. The calculated Repeated Measures Anova F value of F=38.204 was found to be statistically significant at p<0.001 level. There was no statistical significant difference was not found in mean arterial pressure.

Table 6 shows the comparison of pre-test, post-test score of immediately after suction, 5 minutes and 30 minutes after suction on physiological indices between the experimental group I (120mmHg) and II (200 mmHg). Regarding oxygen saturation, The calculated unpaired ‘t’ test value of t = 2.738, t = 2.478 and t = 4.321 was found to be statistically significant at p<0.05, p<0.05 and p<0.001 level respectively which clearly infers that there was significant difference in the SPO2 between the group at pre-test, post-test (after suction) and post-test (5 min).

In the respiratory rate, the calculated unpaired ‘t’ test value of t = 1.050, t = 1.318, t = 1.302 and t = 0.695 was not found to be statistically significant which clearly infers that there was no significant difference between the group. The calculated unpaired ‘t’ test value of t = 0.276, t = 0.154, t = 0.067 and t = 0.121 was not found to be statistically significant which clearly infers that there was no significant difference in the heart rate between the groups. Similarly there was no significant difference was observed in the mean arterial pressure between the group.

**DISCUSSION**

The most important goals in the care of the mechanically ventilated patients are to prevent airway obstruction and keeping it open which is achieved through airway suctioning. Brenda et, 2006, stated that the majority of patients (68.5%) experienced an immediate drop in dynamic compliance following endotracheal suctioning, and increased in 31.5% of patients after the procedure. The review article by Pedersen et al, 2009, who suggested the one of the major evidence based recommendation during suctioning are using the lowest possible suction
Table 4: Determine the effectiveness of high level Negative Pressure (200mmHg) on Physiological indices among Experimental Group II

| Physiological Indices                  | Mean   | SD   | Paired 't' test |
|----------------------------------------|--------|------|-----------------|
| **SPO2 (Oxygen Saturation)**           |        |      |                 |
| Pre-test                               | 95.84  | 1.03 | t=8.800         |
| Post-test (During suction)             | 93.79  | 1.04 | P = 0.0001, S***|
| Post-test (During suction)             | 93.79  | 1.04 | t=19.946        |
| Post Test (5th Minute)                 | 97.58  | 0.82 | P = 0.0001, S***|
| Post Test (5th Minute)                 | 97.58  | 0.82 | t=9.602         |
| Post Test (20th Minute)                | 98.88  | 0.45 | P = 0.0001, S***|
| Pre-test                               | 95.84  | 1.03 | t=21.378        |
| Post Test (20th Minute)                | 98.88  | 0.45 | P = 0.0001, S***|
| **Respiratory Rate**                   |        |      |                 |
| Pre-test                               | 18.65  | 3.49 | t=2.087         |
| Post-test (During suction)             | 19.42  | 3.23 | P = 0.046, S*   |
| Post-test (During suction)             | 19.42  | 3.23 | t=0.778         |
| Post Test (5th Minute)                 | 19.30  | 3.12 | P = 0.443, NS   |
| Post Test (5th Minute)                 | 19.30  | 3.12 | t=1.950         |
| Post Test (20th Minute)                | 19.63  | 3.40 | P = 0.061, NS   |
| Pre-test                               | 18.65  | 3.49 | t=2.270         |
| Post Test (20th Minute)                | 19.63  | 3.40 | P = 0.031, S*   |
| **Heart rate**                         |        |      |                 |
| Pre-test                               | 78.32  | 9.79 | t=10.859        |
| Post-test (During suction)             | 84.06  | 8.80 | P = 0.0001, S***|
| Post-test (During suction)             | 84.06  | 8.80 | t=10.573        |
| Post Test (5th Minute)                 | 77.32  | 8.93 | P = 0.0001, S***|
| Post Test (5th Minute)                 | 77.32  | 8.93 | t=0.850         |
| Post Test (20th Minute)                | 76.55  | 7.78 | P = 0.402, NS   |
| Pre-test                               | 78.32  | 9.79 | t=1.775         |
| Post Test (20th Minute)                | 76.55  | 7.78 | P = 0.086, NS   |
| **Mean Arterial Pressure**             |        |      |                 |
| Pre-test                               | 80.88  | 7.38 | t=1.639         |
| Post-test (During suction)             | 81.45  | 7.46 | P = 0.112, NS   |
| Post-test (During suction)             | 81.45  | 7.46 | t=1.810         |
| Post Test (5th Minute)                 | 80.42  | 6.67 | P = 0.081, NS   |
| Post Test (5th Minute)                 | 80.42  | 6.67 | t=0.944         |
| Post Test (20th Minute)                | 79.88  | 6.66 | P = 0.353, NS   |
| Pre-test                               | 80.88  | 7.38 | t=1.419         |
| Post Test (20th Minute)                | 79.88  | 6.66 | P = 0.167, NS   |

*p<0.05, ***p<0.001, S –Significant, N.S – Not Significant
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Table 5: Comparison of pre-test and post-test score of Physiological indices among Experimental Group II (High Negative Pressure –200mmHg)

| Physiological Indices | Mean  | SD   | Repeated Measures ANOVA |
|-----------------------|-------|------|-------------------------|
| SPO2 (Oxygen Saturation) |       |      |                         |
| Pre-test              | 95.84 | 1.03 | F = 318.983             |
| Post-test (During suction) | 93.79 | 1.04 | P = 0.0001              |
| Post Test (5th Minute)  | 97.58 | 0.82 | S***                    |
| Post Test (20th Minute) | 98.88 | 0.45 |                         |
| Respiratory Rate       |       |      |                         |
| Pre-test              | 18.65 | 3.49 | F = 3.956               |
| Post-test (During suction) | 19.42 | 3.23 | P = 0.035               |
| Post Test (5th Minute)  | 19.30 | 3.12 | S*                      |
| Post Test (20th Minute) | 19.63 | 3.40 |                         |
| Heart Rate            |       |      |                         |
| Pre-test              | 78.32 | 9.79 | F = 38.204              |
| Post-test (During suction) | 84.06 | 8.80 | P = 0.0001              |
| Post Test (5th Minute)  | 77.32 | 8.93 | S***                    |
| Post Test (20th Minute) | 76.55 | 7.78 |                         |
| Mean Arterial Pressure |       |      |                         |
| Pre-test              | 80.88 | 7.38 | F = 2.498               |
| Post-test (During suction) | 81.45 | 7.46 | P = 0.086               |
| Post Test (5th Minute)  | 80.42 | 6.67 | NS                      |
| Post Test (20th Minute) | 79.88 | 6.66 |                         |

*p<0.05, ***p<0.001, S – Significant, NS – Not Significant

...pressure. Hence the present study intensively analyse the high and low level of negative pressure in open endotracheal tube suctioning on oxygen saturation, respiratory rate, heart rate and mean arterial pressure among mechanically ventilated patients in intensive care unit. The finding of the present study reveals the highly significant improvement in Spo2 in experimental group I (120 mmHg) and II (200 mmHg) at all levels. Considering the respiratory rate, there was no significant changes in applying negative pressure with 120mmHg whereas it shows changes in applying negative pressure with 200mmHg when comparing pre-test mean score with post-test mean score of during suctioning and 20 minutes after suctioning. Repeated Measures ANOVA reveals the highly significant changes in SPO2, heart rate, and mean arterial pressure within experimental group I whereas within experimental group II, highly significant changes was found in SPO2 and heart rate. When compared the effectiveness two level of negative pressure on physiological indices mentioned above by independent t test which shows significant difference only in oxygen saturation (p<0.001) whereas no difference was found in respiratory rate, heart rate, and mean arterial pressure. This finding is in line with previous study by Yousefi et al. (2014) who proved that detrimental effect of endotracheal tube suctioning on arterial oxygen saturation and hear rate and also concluded that suctioning with negative pressure of 200 mmHg is considered to be a low-risk procedure compared to suctioning with negative pressure of 100 mmHg (Yousefi et al., 2014). Similarly another study supported the present study findings by Etemadifar et al. (2008) observed that the maximum changes of blood pressure and heart rate (increase) and arterial oxygen saturation (decrease) occurs during suctioning and maximum changes of blood pressure and heart rate (decrease) and arterial oxygen saturation (increase) occurs 3 minutes after suctioning (Etemadifar et al., 2008). The present study findings also revealed that the post-test mean level of heart rate is higher than the pre-test mean level which proved that there is a significant increase in heart rate during suctioning and 5 minutes after applying negative pressure suctioning of both 120mmHg and 200mmHg. It also found that there was decline in the heart rate within clinical range in 20 minutes of suctioning and it does not show significant changes in mean arterial pressure in both experimental group I and II. It is contrast with the findings of Yazdannik et al. (2013) who reported...
Table 6: Comparison of post-test (during suction), post-test (5th Min) and post-test (20th Min) of Physiological indices between Experimental Group I (Low Negative Pressure – 120mmHg) & Experimental Group II (High Negative Pressure – 200mmHg)

| Physiological Indices | Experimental Group I (120 mmHg Group) | Experimental Group II (200 mmHg) | Unpaired ‘t’ test |
|-----------------------|---------------------------------------|---------------------------------|------------------|
|                       | Mean | SD | Mean | SD | t  | P     | S   |
| SPO2 (Oxygen Saturation) |      |    |      |    |     |       |      |
| Post-test (During suction) | 94.49 | 0.93 | 93.79 | 1.04 | 2.738 | 0.008, S* |
| Post Test (5th Minute) | 97.07 | 0.78 | 97.58 | 0.82 | 2.478 | 0.016, S* |
| Post Test (20th Minute) | 98.30 | 0.56 | 98.88 | 0.45 | 4.321 | 0.0001, S*** |
| Respiratory Rate |      |    |      |    |     |       |      |
| Post-test (During suction) | 20.49 | 3.04 | 19.42 | 3.23 | 1.318 | 0.193, NS |
| Post Test (5th Minute) | 20.31 | 2.88 | 19.30 | 3.12 | 1.302 | 0.198, NS |
| Post Test (20th Minute) | 20.22 | 3.16 | 19.63 | 3.40 | 0.695 | 0.490, NS |
| Heart Rate |      |    |      |    |     |       |      |
| Post-test (During suction) | 83.69 | 9.68 | 84.06 | 8.80 | 0.154 | 0.878, NS |
| Post Test (5th Minute) | 77.16 | 10.38 | 77.32 | 8.93 | 0.067 | 0.947, NS |
| Post Test (20th Minute) | 76.29 | 8.97 | 76.55 | 7.78 | 0.121 | 0.904, NS |
| Mean Arterial Pressure |      |    |      |    |     |       |      |
| Post-test (During suction) | 83.10 | 5.76 | 81.45 | 7.46 | 0.959 | 0.342, NS |
| Post Test (5th Minute) | 80.99 | 5.63 | 80.42 | 6.67 | 0.359 | 0.721, NS |
| Post Test (20th Minute) | 81.04 | 5.72 | 79.88 | 6.66 | 0.721 | 0.474, NS |

*p<0.05, ***p<0.001, S – Significant, NS – Not Significant

that 200 mmHg has no detrimental effect on cardiorespiratory function (Yazdannik et al., 2013). In another study by Elmelegy and Ahmed (2016) found that open and closed suction were effective methods on heart rate and arterial blood oxygen saturation stability, where the closed suction method causes less change in patient’s vital signs than open one (Elmelegy and Ahmed, 2016). The current study is limited to measure the amount of secretions and also did not observe the complications related to suctioning. In another study by Lee et al. (2001) who found that open suctioning was found to result in higher hear rate, mean arterial pressure and lower SpO2 compared to closed suctioning and also concluded that that open suctioning results in more adverse changes in cardiorespiratory parameters compared to closed suctioning (Lee et al., 2001). Lasocki et al. (2006) who concluded that negative pressure of 200 mmHg prevents gas exchange deterioration but seems less efficient than open endotracheal suctioning for removal of secretions and also increasing negative pressure more than 200 mmHg improves endotracheal suctioning efficiency and causes deleterious effects on gas exchange which is consistent with present study (Lasocki et al., 2006). There are limited studies to support the present study findings hence further study can be conducted with analysing the other parameters such as inspiratory and expiratory dynamic airway resistance, mechanical expired tidal volume, spontaneous expired tidal volume, total minute volume, FiO2, and electro cardiogram with
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deep and shallow suctioning methods and different negative pressure on open endotracheal suctioning.

CONCLUSIONS

This findings of present study concluded that both the levels of negative pressure causes significant changes in the oxygen saturation and heart rate without observing the complications related to suctioning. However the high level negative pressure of 200 mmHg is safe and can be recommended for open endotracheal tube suctioning in intensive care unit among mechanically ventilated patients for effective oxygen saturation, respiratory rate, and heart rate.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

REFERENCES

American Association for Respiratory Care 1993. AARC clinical practice guideline. Endotracheal suctioning of mechanically ventilated adults and children with artificial airways. American Association for Respiratory Care. Respiratory Care, 38(5):500–504.

American Association for Respiratory Care 2010. AARC Clinical Practice Guidelines. Endotracheal suctioning of mechanically ventilated patients with artificial airways 2010. Respiratory Care, 55(6):758–764.

Bourgault, A. M., Brown, C. A., Hains, S. M. J., Parlow, J. L. 2006. Effects of Endotracheal Tube Suctioning on Arterial Oxygen Tension and Heart Rate Variability. Biological Research For Nursing, 7(4):268–278.

Chaseling, W., Bayliss, S. L., Rose, K., Armstrong, L., Boyle, M., Caldwell, J. 2014. Suctioning an Adult ICU patient with an artificial airway. Agency for Clinical Innovation NSW Government Version 2 Chatswood. pages 33–33, NSW, Australia.

Elmelegy, O. E. A., Ahmed, R. E. 2016. Effect of Open versus Closed Endotracheal Suctioning System on Vital Signs among Mechanically Ventilated Patients in ICU. IOSR Journal of Nursing and Health Science, 5(6):91–100.

Etemadifar, S. H., Nemati, S. H., Aslani, Y., Alian, H. A. M. 2008. Effects of intratracheal suctioning on hemodynamic parameters and arterial oxygen. Iran Journal of Nursing, 21(54):31–39.

Guglielminotti, J., Desmonts, J.-M., Dureuil, B. 1998. Effects of Tracheal Suctioning on Respiratory Resistances in Mechanically Ventilated Patients. Chest, 113(5):1335–1338.

Hahn, M. 2010. 10 considerations for endotracheal suctioning. RT Magazine, Clinical Therapy Device.

Hamilshekar, H., Shadvar, K., Taghizadeh, M., Golzari, S. E., Mojtahedzadeh, M., Soleimanpour, H., Mahmodpoor, A. 2014. Ventilator-Associated Pneumonia in Patients Admitted to Intensive Care Units, Using Open or Closed Endotracheal Suctioning. Anesthesiology and Pain Medicine, 4(5):4–4.

Kendrick, A. 2020. The development of this nursing guideline was coordinated by Allison Kendrick, Clinical Nurse Educator, Nursing Education, and approved by the Nursing Clinical Effectiveness Committee.

Kulkarni, A. P., Agarwal, V. 2008. Extubation failure in intensive care unit: Predictors and management. Indian Journal of Critical Care Medicine, 12(1):1–9.

Lasocki, S., Lu, Q., Sartorius, A., Fouillat, D., Remerand, F., Rouby, J.-J. 2006. Open and Closed-circuit Endotracheal Suctioning in Acute Lung Injury. Anesthesiology, 104(1):39–47.

Lee, C. K., Ng, K. S., Tan, S. G., Ang, R. 2001. Effect of different endotracheal suctioning systems on cardiorespiratory parameters of ventilated patients. Annals of the Academy of Medicine, Singapore, 30(3):239–244.

Leur, J. P. V., Zwaveling, J. H., GLoef, B., Schans, C. P. V. D. 2003. Endotracheal suctioning versus minimally invasive airway suctioning in intubated patients: a prospective randomized con-trolled trial. Intensive Care Medicine, 29.

Maggiore, S. M., Lellouche, F., Pignataro, C., Girou, E., Maitre, B., Richard, J.-C. M., Lemaire, F., Brun-Buisson, C., Brochard, L. 2013. Decreasing the Adverse Effects of Endotracheal Suctioning During Mechanical Ventilation by Changing Practice. Respiratory Care, 58:1588–1597.

Maggiore, S. M., Volpe, C. 2011. Endotracheal suctioning in hypoxemic patients. Réanimation, 20(1):12–18.

Manual, I. C. 2014. Suctioning an Adult ICU Patient with an Artificial Airway: A Clinical Practice Guide- line. pages 1–39.

Pedersen, C. M., Rosendahl-Nielsen, M., Hjermind, J., Egerod, I. 2009. Endotracheal suctioning of the adult intubated patient—What is the evidence? Peterson, Michael, W. 1993. Problems in Respiratory Care. Complications of Mechanical Ventila-
tion. Critical Care, 21(11):1810.

Sackner, M. A. 1976. Letter: Tracheobronchial suction catheters. Chest, 70(2).

Şahiner, Y. 2018. Indications for Endotracheal Intubation. Tracheal Intubation.

Sakuramoto, H., Shimojo, N., Jesmin, S., Unoki, T., Kamiyama, J., Oki, M., Miya, K., Kawano, S., Mizutani, T. 2013. Repeated open endotracheal suctioning causes gradual desaturation but does not exacerbate lung injury compared to closed endotracheal suctioning in a rabbit model of ARDS. BMC Anesthesiology, 13(1).

Seymour, C. W., Cross, B. J., Cooke, C. R., Gallop, R. L., Fuchs, B. D. 2009. Physiologic impact of closed-system endotracheal suctioning in spontaneously breathing patients receiving mechanical ventilation. Respiratory Care, 54(3):367–374.

Tingay, D. G., Copnell, B., Grant, C. A., Dargaville, P. A., Dunster, K. R., Schibler, A. 2010. The effect of endotracheal suction on regional tidal ventilation and end-expiratory lung volume. Intensive Care Medicine, 36(5):888–896.

Yazdannik, A. R., Haghighat, S., Saghaei, M., Eghbali, M. 2013. Comparing two levels of closed system suction pressure in ICU patients: Evaluating the relative safety of higher values of suction pressure. Iranian Journal of Nursing and Midwifery Research, 18(2):117–122.

Yousefi, H., Vahdatnejad, J., Yazdannik, A. R. 2014. Comparison of the effects of two levels of negative pressure in open endotracheal tube suction on the physiological indices among patients in intensive care units. Iranian Journal of Nursing and Midwifery Research, (5):473–477.