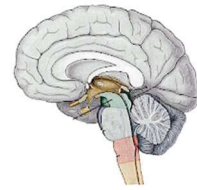


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Differences in Effectiveness Between Measuring Cuff ETT Using a Syringe and Cuff Inflator on Oxygen Saturation in Pneumonia Patients in the ICU

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ABSTRACT

Inaccuracy of ETT cuff pressure in intubated pneumonia patients will affect changes in oxygen saturation, so it is necessary to measure ETT cuff pressure using appropriate techniques. This study aims to analyze the difference in effectiveness between ETT cuff measurements using a syringe and an inflator cuff on oxygen saturation values in pneumonia patients. Comparative observational design with a cross sectional approach . There were 30 respondents using a total sampling technique, which were then distributed into 2 groups, namely the cuff inflator group and the syringe group with 15 patients each. Data were collected using observation sheets for ETT cuff measurements and oxygen saturation . The results of the Pearson statistical test analysis on ETT cuff measurements measured using a cuff inflator ($p=0.01$) and a syringe ($p=0.004$), both showed a p value <0.05 , which means there is a significant correlation with the oxygen saturation value. The results of the difference test using the independent t test for the saturation value carried out by measuring the ETT cuff using a cuff inflator using a syringe showed that $p=0.854$ (>0.05) which means there is no difference. The conclusion of this research is that there is no difference between the saturation values of respondents who were measured using the ETT cuff using a cuff inflator and using a syringe. It is recommended that nurses increase their role in observing and maintaining ETT cuff pressure within the ideal range by using a cuff inflator or using a syringe at the service point.

INTRODUCTION

Oxygen is an important component in supporting human life. Lack of oxygen can cause respiratory problems. Respiratory problems are one of the reasons why patients are often taken to the intensive care unit and require endotracheal tube (ETT) intubation. ETT intubation is a medical procedure aimed at providing artificial airway assistance to maintain adequate oxygen through monitoring oxygen saturation. Patients in the intensive care unit are monitored continuously because clinical manifestations of respiratory distress cause hypoxemia and can even progress to tissue hypoxia. The ETT has a cuff inflation system consisting of a pilot balloon and an expandable cuff. The ETT cuff is inflated via a pilot balloon to prevent O₂ leakage and minimize the risk of pulmonary aspiration. Inaccuracy in administering ETT cuff pressure

will affect changes in arterial oxygen saturation (SaO₂). ETT cuff development that is below ideal will cause suboptimal SaO₂ due to oxygen leakage through the ETT which will cause a reduction in tidal volume. Basically, the impact of a lack of oxygen saturation can result in respiratory failure which can lead to death (Hikayati, 2017; Setiyawan, 2018).

Hayati, et.al (2017) conveyed the incidence of Acute Respiratory Distress Syndrome (ARDS) in The American-European Consensus on ARDS in 2010 found between 12.6-28.0 cases/100,000 population/year and it was reported that around 40% of deaths occurred due to respiratory failure. The incidence of acute respiratory failure in adults from studies in Germany and Sweden reported that it was 77.6 -88.6 cases/100,000 population/year. Data from the Ministry of Health of the Republic of Indonesia, 2010, which fatal causes of death are based on data on the 10th ranking of Non-Communicable Diseases (PTM) in 2010, the Case Fatality Rate (CFR), the incidence of respiratory failure in hospitalized patients, is 20.98%, ranking second. Based on data from the patient registration book in the ICU of RSPAD Gatot Soebroto Puskesmas from January to December 2017, the number of patients in the ICU was 2,277 patients and as many as 807 patients (35.44%) experienced respiratory failure. On average, 189-190 patients are treated in the ICU per month. Those who experienced respiratory failure were 67-68 patients/month and 29-30 patients/month died (ICU RSPAD Gatot Soebroto, 2018). Setiyawan (2018) conveyed a similar phenomenon in the Intensive Care Unit (ICU) of Bagas Waras Regional Hospital, Klaten, that inflating the cuff in ETT intubated patients using a syringe by inflating 5 to 10 cc of air into the ETT cuff slowly until it was felt was sufficient to cause a decrease in tidal volume accompanied by a decrease in SaO₂. in patients who are ventilated with ideal inspired fraction of oxygen (FiO₂).

Improper cuff development will cause underinflation or overinflation (Hikayati, 2017). Direct stimulation of the tracheal mucosa can cause hemodynamic changes during ETT intubation. Expanding the ETT cuff after intubation will cause a cough reflex due to the mechanism of pressing the ETT cuff. Receptors around the surface of the trachea are very sensitive so that when the cough response occurs it can cause hemodynamic changes, increased intraocular and intracranial pressure, myocardial ischemia and bronchospasm. The emergence of a cough reflex during cuff expansion causes pressure on the trachea area. As a result, arterial and venous blood flow to the trachea is obstructed, resulting in hypoxemia. Hypoxemia causes O₂ needs to not be met adequately, pO₂ decreases and pCO₂ increases so that the workload of the lungs and heart increases. The work of breathing is normally carried out by the respiratory muscles with 2-3% O₂ consumption. Respiration works efficiently with O₂ consumption of 10% and 90% will be used if the need for O₂ increases. In pathological conditions, the suppression of tracheal arterial and venous blood flow due to cuff expansion causes serious ventilation disorders so that the workload of the lungs and heart increases. Arterial and venous blood flow in the trachea is obstructed due to underinflation or overinflation which can cause hypoxemia as evidenced by a decrease in oxygen saturation (Hikayati, 2017; Setiyawan, 2018).

Considering that the impact is very fatal, it is necessary to fill the cuff ett in a measured manner. Based on previous journal references, it is stated that the ETT cuff can inflate a pilot balloon using an inflator cuff or syringe to prevent O₂ leaks and minimize the risk of pulmonary aspiration (Hikayati, 2017; Setiyawan, 2018).

At RSSA, filling the ETT cuff using a cuff inflator is only carried out in the ICU room due to limited equipment, while in other rooms such equipment is not available, so measurements are not carried out. This means that health workers cannot ensure the accuracy and effectiveness of ETT installation on

the patient's oxygen saturation levels. One other method of filling the ETT cuff that is applied at RSSA, specifically in the ICU room, is by using a syringe as a substitute for the inflator cuff. The effectiveness of using a syringe to fill the ETT cuff on patient oxygen saturation will be carried out in further scientific studies through this research by comparing it with the cuff inflator method. If it is known that the comparison between the syringe method and the cuff inflator method is proven to be equally effective for oxygen saturation, then this could be a solution to the limited cuff inflator facilities in health services.

Based on the above phenomena, researchers are interested in conducting research with the title "The difference in effectiveness between measuring the ETT cuff using a syringe and a cuff inflator on oxygen saturation values in pneumonia patients in the RSSA Malang ICU".

METHODS

The research design used in this research is a non-experimental correlational research design (relationship/association) with a cross sectional approach . This research was conducted in May 2021 at RSSA Malang. The samples in this study were all pneumonia patients in the RSSA Malang ICU who had an ETT installed and 15 respondents measured the ETT cuff with a cuff inflator and 15 respondents measured using a syringe. The Cuff Inflator data collection tool is a tool used to measure and control the pressure of the balloon/cuff on the ETT, with the measurement results in the form of pressure in units of cmH₂O. The syringe is a tool used to measure and control the volume of air in the balloon/cuff on the ETT with the results Measurement in the form of volume using cc units. A tool used to measure how much percentage of oxygen the hemoglobin in the patient's arterial blood is able to carry . . Statistical tests to test the comparability between measuring oxygen saturation using an inflator cuff and a syringe were analyzed using the independent t test with the confidence interval (CI) used being 95%.

RESULTS AND DISCUSSION

The results of descriptive analysis of ETT cuff measurement data and oxygen saturation values are as follows:

Table 1. Descriptive Analysis of Cuff ETT Measurement Data and Oxygen Saturation Values In the ICU Room at Dr. Saiful Anwar Mala ng .

Group	Variable	Mean	elementary school
Cuff Inflator	O2 saturation	96.40	1,844
	ETT Cuff Value	29.67	0.724
Syringe	O2 saturation	96.27	2,089
	ETT Cuff Value	7.96	0.091

The results of the bivariate analysis of ETT cuff measurements using the Cuff Inflator on the respondents' oxygen saturation values are shown as follows:

Table 2. Results of Bivariate Analysis of Cuff ETT Measurements Using a Cuff Inflator on Oxygen Saturation Values In the ICU Room at Dr. Saiful Anwar Malang .

Hypothesis testing	Number of Samples	Value (R)	Value (p)
Pearson test	15	0.642	0.010

Based on table 2, it is known that hypothesis testing shows a p value = 0.010 (<0.05) which means it shows a significant correlation in measuring the ETT cuff using the Inflator cuff on the oxygen saturation value in the ICU Room at Dr. Hospital. Saiful Anwar Malang.

Table 3. Results of Bivariate Analysis of ETT Cuff Measurements Using a Syringe on Oxygen Saturation Values In the ICU Room at Dr. Saiful Anwar Malang.

Hypothesis testing	Number of Samples	Value (R)	Value (p)
Pearson test	15	0.700	0.004

Based on table 3, it is known that hypothesis testing shows a p value = 0.004 (<0.05) which means it shows a significant correlation in measuring the ETT cuff using a syringe on the oxygen saturation value in the ICU Room at Dr. Hospital. Saiful Anwar Malang.

Table 4. Results of Oxygen Saturation Normality Test Analysis on ETT Cuff Measurements Using a Syringe Using a Cuff Inflator.

Group	Value (p)
Oxygen Saturation with Cuff Inflator measurements	0.235
Oxygen Saturation with Syringe measurements	0.187

Based on table 4, it is known that the two groups were proven to have a normal distribution through the normality test with Shapiro Wilk with the results of each p value >0.05.

Hypothesis testing regarding the difference in the effectiveness of oxygen saturation measurements between Cuff ETT measurements using a syringe and using a cuff inflator was carried out using an independent t test with the consideration that both groups met the requirements and were proven to have a normal distribution.

Table 5. Results of Bivariate Analysis of Differences in Oxygen Saturation Between ETT Cuff Measurements Using a Syringe and a Cuff Inflator In the ICU Room at Dr. Saiful Anwar Malang.

Hypothesis testing	Value (t)	Value (p)
Independent t test	0.185	0.854

Based on table 5, it is known that hypothesis testing shows a p value of 0.854 (>0.05), which means there is no difference in saturation values between respondents who were measured using an ETT cuff using a cuff inflator and those who were measured using a syringe in the ICU Room at Dr. RSUD. Saiful Anwar Malang.

ETT Cuff Measurement Using a Syringe for Oxygen Saturation

In this study, ETT cuff measurements were carried out using two techniques, namely using a cuff inflator and using a syringe. The first technique is to take measurements using a 10 cc syringe which is used to measure and control the volume of air in the balloon/cuff on the ETT with the measurement results in the form of volume using cc units. Next, a statistical analysis was carried out regarding the correlation with oxygen saturation.

The results of the bivariate analysis of measuring the ETT cuff using a syringe on the respondent's oxygen saturation value according to table 4 show that hypothesis testing shows a significant correlation in measuring the ETT cuff using a syringe on the oxygen saturation value in the ICU Room at Dr. Hospital.

Saiful Anwar Malang. The results of this study show that measurements using a syringe can still be applied, which is supported by similar research from Bulamba (2017) and research by Gilliland (2015), showing that assessments using a syringe are stated to be equivalent to measurements of various inflation techniques used by anesthesiologists.

Lewis, et al. (2013) stated that monitoring cuff pressure is very important. In general, the endotracheal tube cuff has two functions: (1) the cuff pressure functions to ensure an airtight space to maintain the efficiency of ventilation support; (2) protect the lower airway from aspiration of secretions and blood. Uncontrolled cuff pressure can increase the risk of tracheal injury such as ischemia of the tracheal mucosa, tracheitis, tracheomalacia and tracheal stenosis (Lizy, et.al. 2015: Vincent, et.al. 2017). Meanwhile, low cuff pressure predisposes to ventilator acquired pneumonia and poor ventilation due to leaks which affect oxygen saturation levels in the body (Pavlista, et.al. 2016: Vincent, et.al. 2017).

Continuous monitoring keeps pressure on cuff in intubated patients is very important for nurses and currently this activity has become a routine activity that is required to be carried out in the unit maintenance intensively with Standard Operating Procedures (SOP) that have been legalized by health service agencies. Conditions in health services found the phenomenon that the availability of equipment that meets standards (using a cuff inflator) for taking measurements is not always available. This then created a dilemma for the nurses on duty, so they took the initiative to look for references for alternatives to replace the standard equipment, one of which was to use a 10cc syringe.

Data from the results of this study show that the measurement results have a correlation with oxygen saturation in patients. A high oxygen saturation value in a patient is followed by a cuff pressure measurement value via a syringe with a high volume in cc units. This shows that the lower the value of the syringe volume in the ETT cuff, this indicates an indication of leakage or a reduction in cuff pressure, thereby affecting the patient's oxygen saturation which also decreases. The conclusion that can be drawn is that measurements using a syringe as a substitute for a cuff inflator as a standard tool in health care conditions can still be applied for routine monitoring if it is linked to the oxygen saturation value indicator.

ETT Cuff Measurement Using a Cuff Inflator on Oxygen Saturation

In this study, the ETT cuff was also measured using a cuff inflator. The Cuff Inflator is a tool used to measure and control the pressure of the balloon/cuff on the ETT with the measurement results in the form of pressure in units of cmH₂O. Next, a statistical analysis is carried out regarding its correlation with oxygen saturation.

The results of the bivariate analysis of ETT cuff measurements using the Inflator cuff on the respondent's oxygen saturation value according to table 5.4 show that hypothesis testing shows a significant correlation in the ETT cuff measurement using the Inflator cuff on the oxygen saturation value in the ICU Room at Dr. Hospital. Saiful Anwar Malang.

According to the researcher, this is in line with the research of Hikayati (2017), with the results of his study suggesting that it is best to develop the ETT cuff using a cuff inflator to be able to inflate the cuff at an ideal pressure of around 25-35 cmH₂O. Inaccuracy in administering ETT cuff pressure will affect changes in arterial oxygen saturation (SaO₂). ETT cuff development that is below ideal will cause suboptimal SaO₂ due to oxygen leakage through the ETT which will cause a reduction in tidal volume. Basically, the impact of a lack of oxygen saturation can result in respiratory failure which can lead to death (Hikayati, 2017; Setiyawan, 2018).

High cuff volume with low pressure can stabilize and attach the ET tube to the tracheal wall and prevent air leakage from the vent. Insufficient cuff pressure can interfere with this function, but excessive cuff pressure can cause tracheal damage. The cuff pressure exerted on the tracheal mucosa by the ETT cuff must be as low as possible to avoid cessation of blood flow to the tracheal mucosa and must be high enough to prevent leakage and microaspiration of fluid into the lungs. The recommended pressure to maintain ideal cuff pressure using a cuff inflator from several references is in the range of 20 to 30 cm H₂O (Pavlisa, et.al. 2016; Ajjapa & Naz, 2017). The same thing was also stated by Athiraman, et.al. (2015), the maximum cuff inflation pressure is 20-30 cm H₂O so that capillary perfusion can be adequate. Safe cuff pressure ranges between 20 and 30 cmH₂O or 15 and 22 mmHg.

Measuring the ETT cuff using a cuff inflator in health services is a routine nurse activity that is standardized and legal on the basis of implementation in accordance with Standard Operating Procedures (SOP). In daily implementation at the service, the measurement results obtained were relatively stable, with the values in this study being in the range of 28 to 30 cm H₂O. Good data in this study was also followed by good saturation values with an average oxygen saturation value, namely 96.40. Apart from being based on standardized tools and SOPs, of course this condition can also be supported by several other factors that can have an influence, such as a stable position, fully controlled patient movements and transfers, as well as ventilator modes that are set appropriately according to the patient's needs.

The conclusion from the discussions above is that measuring the ETT cuff using a cuff inflator is a standardized activity and must be carried out by the nurse on duty in order to maintain oxygen saturation in optimal conditions.

Differences in the Effectiveness of Measuring the ETT Cuff Using a Cuff Inflator with a Syringe on Oxygen Saturation Values

Based on table 5 it is known that hypothesis testing shows that there is no significant difference between the saturation values of respondents who were measured using the ETT cuff using a cuff inflator and those who were measured using a syringe in the ICU Room at Dr. RSUD. Saiful Anwar Malang.

This research is in line with the results of Bulamba's research that measuring the cuff ETT method using a 5-10 cc air syringe is equivalent to using a cuff inflator at a pressure of 25 - 30 cmH₂O so that both methods can be used (Bulamba, 2017). This shows that these two techniques can still be used in providing services to patients who use ETT so that they can function optimally and avoid complications.

Measuring cuff pressure in intubated patients is very important. Until now there is still no definite and acceptable standard for the frequency of monitoring ETT cuff pressure, and there is also no standard regarding the measurement techniques and strategies used as a reference in daily care (Letvin, 2018). In general, the aim of routine ETT cuff pressure measurements is to maintain and maintain ETT cuff pressure in the ideal range of 20-30 cm H₂O, thereby minimizing the risk of air leaks which impact oxygen saturation.

The results of this study illustrate that the lower the measurement value both using a syringe and with an inflator cuff, the lower the oxygen saturation value. The results of measuring the ETT cuff using a cuff inflator or syringe at a low value can indicate an indication of a leak, which has an impact on the effectiveness of the oxygen coming in and out so that the results of the oxygen saturation also get a low value.

It is important for intensive care nurses to have the skills, analytical abilities and responsibility to provide care to patients who require close and continuous supervision. Nurses play a role in observing and

maintaining cuff pressure within the ideal range. The nurse's responsibilities for patients who have an ETT installed include maintaining proper cuff inflation to prevent or minimize injury to the trachea as well as changes in oxygen saturation in the patient's body.

The limitations of standardized measurement tools (cuff inflators) in health services have initiated nurses to look for alternative measurements using a 10cc syringe in order to fulfill the nurse's responsibility to maintain ETT cuff pressure in ideal conditions. Through this research, it was found that these two techniques were equally correlated with oxygen saturation values. The research data shows that oxygen saturation values are good when measured with a syringe and with a cuff inflator, and is proven by the results of different tests which show that no differences were found so that these two techniques can still be used. However, this does not rule out the possibility that the good condition of the patients in this study could also be influenced by other factors, especially the ventilator mode. The uniformity of the ventilator mode in this study has not yet been controlled, making it possible for different patients to receive different modes. Apart from that, the position and transfer of the patient also has an influence on the condition of the ETT cuff pressure and has an impact on saturation. However, the position and transfer of patients at the research site can be well controlled, namely the bedrest position with minimal ROM by keeping the ETT cuff patent, while patient transfers are still carried out using a CT scan and some patients undergo hemodialysis in the hemodialysis unit.

The conclusion from this discussion is that not all health services have a standardized ETT cuff measuring device (cuff inflator) so the alternative of using a 10 cc syringe is still applied to ensure the ETT cuff pressure is within the ideal range, which is then expected to have an impact on the patient's optimal oxygen saturation value.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study showed that there was no significant difference between the saturation values of respondents who had ETT cuff measurements using a cuff inflator and those measured using a syringe in the ICU Room at Dr. RSUD. Saiful Anwar Malang. Nurses can increase their role in observing and maintaining cuff pressure within the ideal range by using a cuff inflator if available, and using a 10 cc syringe if a cuff inflator is not available at the service location.

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