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Knowledge Assessment of Routine Normal Saline Instillation for Endotracheal Suctioning Among the Respiratory Therapists Working in Intensive Care Units

Ebad Ur Rehman[1], Areeba Nazir[2], Ali Hussain[3], Rizwan Ullah[4], Shah Fahad*[5]

[1,2,3,5] Department of Emergency Care Technology/ Respiratory Therapy and Intensive Care Technology, Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan

[4] Department of Radiology, Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan. rizwan.ipms@kmu.edu.pk

Corresponding Author, Shah Fahad, Email: shahfahad.ipms@kmu.edu.pk

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Abstract

Endotracheal suctioning (ETS) is a routine procedure in intensive care units (ICUs) to remove airway secretions in intubated patients. Normal saline instillation (NSI) is still widely practiced, although studies report potential adverse effects such as oxygen desaturation, hemodynamic instability, and increased risk of ventilator-associated pneumonia (VAP). Despite this, NSI continues to be used by respiratory therapists (RTs) in many ICUs, including those in Peshawar, Pakistan. A cross-sectional study was conducted in ICUs of tertiary care hospitals in Peshawar. Thirty respiratory therapists were recruited using a convenience sampling technique. Data were collected through a structured questionnaire and analyzed with SPSS version 22. The study excluded RT trainees and other healthcare professionals to ensure accuracy. Most RTs reported instilling 1–3 ml of normal saline during suctioning, primarily to loosen thick secretions or when clinically indicated, rather than routinely. While 60% stated that NSI did not result in severe complications, adverse effects were reported, including oxygen desaturation, tachycardia, hypertension, increased intracranial pressure (ICP), VAP, bronchospasm, airway irritation, and bleeding. NSI was considered contraindicated in patients with severe airway bleeding. Indicators prompting NSI included excessive secretions and elevated peak inspiratory pressures. Although NSI may facilitate secretion clearance, it can adversely affect patient outcomes and should not be performed routinely. If required, only small volumes (1–3 ml) should be used, and special caution is needed in patients with airway bleeding. Evidence-based suctioning practices are recommended to optimize patient safety and outcomes.

Keywords: Endotracheal Suctioning, Normal Saline Instillation, Mechanical Ventilation, Intensive Care Unit, Ventilator-Associated Pneumonia.

Introduction

The Intensive Care Unit (ICU) is a specialized hospital department that provides comprehensive care to patients with severe, life-threatening conditions. Critically ill individuals admitted to the ICU often present with acute respiratory distress syndrome (ARDS), septic shock, multi-organ failure, or other emergencies requiring continuous monitoring and advanced interventions (1). ICU care is delivered by a multidisciplinary team that includes physicians, nurses, respiratory

therapists, physiotherapists, nutritionists, and pharmacists. Each member plays a vital role in ensuring patient survival and recovery. Nurses, in particular, contribute significantly by administering fluids and medications prescribed by physicians, monitoring vital signs such as blood pressure, heart rate, and oxygen saturation, and identifying early changes in patient condition. They also provide comfort and basic care, including repositioning patients, maintaining hygiene, and ensuring overall well-being (2). Respiratory therapists are integral members of the ICU team, primarily responsible for managing patients with compromised respiratory function. Their responsibilities include maintaining airway patency, removing secretions and obstructions, administering respiratory medications, and operating mechanical ventilators to ensure adequate oxygenation and ventilation. They adjust ventilator settings based on arterial blood gas (ABG) analysis to maintain normal blood pH levels between 7.35 and 7.45 (3). In addition, respiratory therapists perform pulmonary function testing, oxygen therapy, bronchoscopy assistance, and arterial blood gas sampling. They are also trained in airway management techniques such as intubation, airway clearance, and inhaler administration (4) and (5). Mechanical ventilation (MV) is one of the most essential life-support techniques employed in ICUs. A ventilator assists or fully supports breathing in patients who cannot breathe independently, either due to severe illness or during surgical procedures. It provides oxygen, facilitates carbon dioxide removal, and applies positive pressure to prevent alveolar collapse. Ventilator settings are tailored according to the clinical status and needs of each patient (6). Mechanical ventilation may be delivered non-invasively, through face masks using CPAP or BiPAP, or invasively, via an endotracheal tube (ETT) or tracheostomy. Indications for invasive ventilation include respiratory failure, low Glasgow Coma Scale (GCS) scores, head injury, stroke, spinal cord injury, ARDS, pneumonia, sepsis, or cardiac arrest (6) and (7). Intubated patients are unable to clear secretions due to impaired ciliary function and the presence of an artificial airway. Accumulated secretions, if not removed, can lead to airway obstruction, impaired oxygenation, and an increased risk of ventilator-associated pneumonia (VAP). Respiratory secretions are normally composed of mucus from sub-mucosal glands, goblet cells, and epithelial cells, influenced by autonomic neural regulation. Under normal conditions, mucus is cleared by coughing, airflow, and ciliary movement. However, in intubated patients, these mechanisms are compromised, making suctioning a critical intervention (8), (9) and (10). Endotracheal suctioning (ETS) is the most widely used procedure in ICUs for the removal of accumulated secretions in patients with artificial airways. It is performed in both pediatric and adult patients who cannot clear secretions due to absent cough reflexes, sedation, or neurological impairment. ETS is performed either by the closed method—where the ventilator remains connected—or by the open method—where the patient is disconnected from the ventilator and a sterile catheter is inserted (11) and (12). One practice often observed during ETS is the instillation of normal saline (NSI) prior to suctioning. Although some clinicians believe NSI helps loosen secretions, evidence from studies conducted outside Pakistan has shown mixed or negative results. While some reports suggest NSI may not provide benefits, others highlight potential adverse effects, including oxygen desaturation, altered pH, increased intracranial pressure, and airway irritation. Despite this, respiratory therapists in Peshawar, Pakistan, continue to practice NSI during suctioning. This study was therefore conducted to assess the knowledge and perceptions of respiratory therapists regarding the routine use of normal saline instillation during endotracheal suctioning in ICUs in Peshawar, Pakistan.

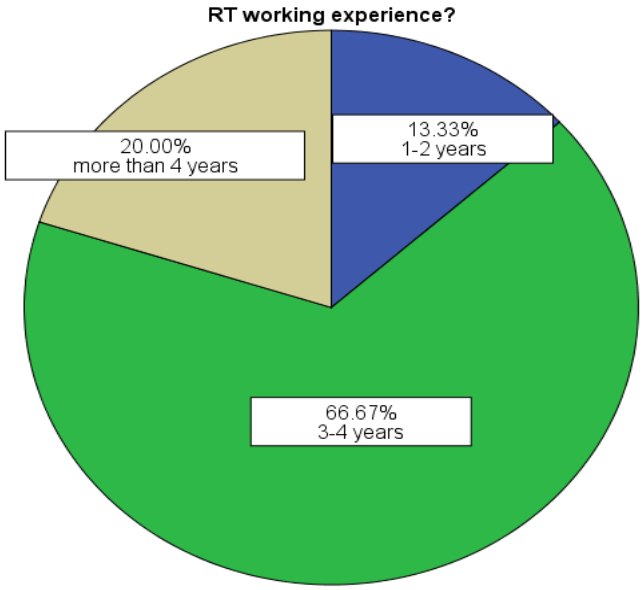
Materials and Methods

This study was carried out in the large intensive care units (ICUs) of tertiary care hospitals where the researchers were undergoing clinical rotations. During observations in these settings, it was noted that respiratory therapists routinely instilled normal saline to facilitate the removal of secretions through suctioning. This observation led to a focused search on Google Scholar and

PubMed regarding the role of normal saline instillation during endotracheal suctioning. Based on the literature review, the research topic was finalized to assess the knowledge of respiratory therapists regarding the routine use of normal saline during endotracheal suctioning. A cross-sectional study design was adopted for this research. Data were collected from respiratory therapists working at Lady Reading Hospital (LRH) and Hayatabad Medical Complex (HMC), Peshawar, at a single point in time. These tertiary care hospitals served as the study settings, and their ICUs were selected as the sites for data collection since they provided access to respiratory therapists actively involved in endotracheal suctioning. For sampling, a non-probability convenience sampling technique was employed. This method was chosen to facilitate the collection of data from readily available respiratory therapists working in the selected study settings. A sample size of 30 participants was determined using the World Health Organization (WHO) formula for sample size calculation. In this formula, the Z-value for a 90% confidence level was considered (~1.64), while the estimated proportion (p) was taken as 0.5 to ensure the maximum sample size. The margin of error (d) was set at 15% (0.15). The choice of a 90% confidence level and a relatively higher margin of error was justified by the limited population of respiratory therapists in Peshawar, which made the attainment of a larger sample size impractical. The duration of the study was approximately four to six months, during which the research activities, including data collection, analysis, and compilation, were carried out systematically. The inclusion criteria specified that only respiratory therapists working in the ICUs of HMC and LRH, who were actively involved in endotracheal suctioning as part of their routine clinical practice, were eligible to participate. The exclusion criteria ruled out all healthcare professionals other than respiratory therapists, retired respiratory therapists, as well as individuals with only practical experience in suctioning, such as nursing staff and respiratory therapy students. This ensured that the study sample consisted exclusively of qualified respiratory therapists currently engaged in ICU practice.

Results

Demographics: A total of 30 respiratory therapists participated in the study. Of these, 66.7% were from Lady Reading Hospital (LRH) and 33.3% from Hayatabad Medical Complex (HMC). Regarding professional experience, 13.3% had 1–2 years of experience, 66.7% had 3–4 years, and 20% reported more than 4 years of clinical experience (Figure).



Knowledge Assessment

When asked about the primary purpose of normal saline instillation (NSI), 86.7% of the respondents stated that it helps to loosen secretions, 6.7% reported it facilitates suctioning, 3.3% believed it prevents trauma to the trachea, and another 3.3% suggested it reduces oxygenation. (Table 1). Secondly Volume of Normal Saline Used During Suctioning (N = 30) (Table 2).

Perceived Complications

In terms of potential complications, 60% of respondents reported that NSI does not cause adverse effects. However, 20% indicated that it decreases oxygen saturation, 13.3% believed it reduces pH, and 6.7% stated that it increases heart rate and systolic blood pressure.

Table:1, Primary Purpose		Frequency	Percent %
	to loosen secretions	26	86.7
	to prevent trauma to the trachea	1	3.3
	to facilitate suctioning	2	6.7
	to reduce oxygenation	1	3.3
	Total	30	100.0
Table:2, Volume NS		Frequency	Percent %
	• 5-10 ml	5	16.7
	• 3-5 ml	13	43.3
	• 1-3 ml	11	36.7
	• 5-8 ml	1	3.3
	• Total	30	100.0
Table:3, Complications		Frequency	Percent %
	increases heart rate and SBP	2	6.7
	decrease Ph	4	13.3
	decrease oxygen saturation	6	20.0
	none of the above	18	60.0
	Total	30	100.0

Factors Influencing Use: When asked what factors influence their decision to use NSI, 86.7% stated that patient secretions and high peak pressure were the primary considerations, 10% mentioned oxygenation status, and 3.3% cited personal preference (Table 4)

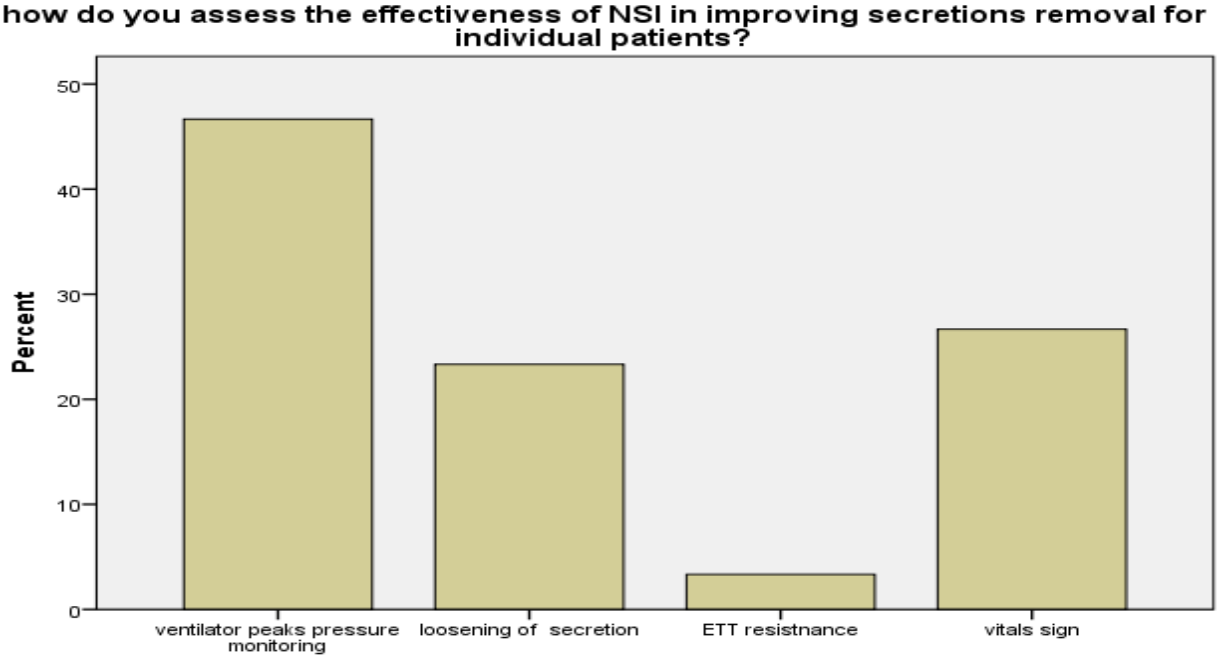
Table 4, Factors that influence the use of NS		Frequency	Percent
	Patient secretions and high peak pressure	26	86.7
	Patient`s oxygenation status	3	10.0
	Personnel preference	1	3.3
	Total	30	100.0

Training and Barriers: Training-related findings showed that 63.3% of respiratory therapists had not received formal education regarding NSI risks, while 36.7% had. Most respondents (86.7%) reported facing no barriers in implementing NSI, whereas 13.3% experienced challenges. A large majority (96.7%) considered NSI best practice for patients with thick secretions if specifically indicated (Table 5).

Table 5, NSI is best for thick secretion?		Frequency	Percent %
	yes	29	96.7
	no	1	3.3
	Total	30	100.0

Clinical Effectiveness and Complications

The majority (76.7%) of participants reported that secretion characteristics were the main factor guiding the decision to use NSI, while 23.3% attributed the decision to other considerations. Experienced-based complications included aspiration (16.7%), ventilator-associated pneumonia (10%), bronchospasm and increased intracranial pressure (13.3%), and airway irritation or bleeding (6.7%). Effectiveness of NSI was most commonly assessed by ventilator peak pressure monitoring (46.7%), followed by monitoring patient vital signs (26.7%), and observing secretion loosening (23.3%) (Figure 2). Importantly, most respondents indicated that NSI did not affect patient comfort or anxiety levels.



Discussion

In 1997, the study suggested not to the NS solution should not be used routine-wise; instead, its use should be based on the conditions of the patients. Previous studies report that NSI during suction harms a patient`s oxygenation. The isotonic-normal saline may lower body O_2 saturation, raise intracranial pressure, blood pressure, and cause cardiopulmonary collapse and cardiac dysrhythmias, and hospital-acquired infections(13,14, 15,16). Brazilian study in 2009, NSI reduced the occurrence of microbiologically diagnosed ventilator-associated pneumonia (VAP). Later on, while the effects of NSI on the risk of pneumonia and hemodynamics is a topic of debate, it is responsible for lowering blood O_2 levels. Therefore, this procedure of NSI is not recommended. Good and extremely high-quality, powered healthcare practices are needed to evaluate the safety and effectiveness of NSI and to inform healthcare practice (17,18, 19,22). NSI is associated with desaturation, lowered pH, raised production of secretions, reduced occurrence of ventilator-associated pneumonia (VAP), elevated heart rate, and also increased systolic blood pressure. NSI has more harmful effects than benefits. It also causes bronchospasm(20,21, 23). Our findings are the same as previous studies, NSI helps in loosening secretion but has more harmful effects compared to benefits. In our findings NSI also decreases oxygen saturation, increases heart rate and SBP, raises ICP, causes bronchospasms, and decreases blood pH, but the key difference is that NSI sometimes may cause VAP and aspiration, our findings suggest that NSI should not be used in severe airway bleeding.

Conclusion

Normal saline instillation (NSI) has both potential benefits and adverse effects on patient outcomes. While it may assist in loosening secretions during suctioning, findings from the experience of respiratory therapists suggest that its routine use should be avoided. NSI is particularly contraindicated in patients with severe airway bleeding and should only be applied when clinically indicated. Reported complications include decreased oxygen saturation and pH levels, increased heart rate, systolic blood pressure, and intracranial pressure, as well as risks of bronchospasm, airway bleeding, and airway irritation. Importantly, NSI was not found to affect patient comfort or anxiety levels. To minimize the need for NSI, the use of heat and moisture exchangers (HME) and humidifiers is recommended for mechanically ventilated patients. These devices help maintain secretion moisture, prevent thickening and drying, and reduce the risk of ventilator-associated pneumonia (VAP), thereby supporting better patient outcomes.

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