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Insight about Possible Consequences of Tracheostomy on Swallowing and Voice: Review Article

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ABSTRACT

Background: About 10% of patients requiring more than 3 days of artificial breathing are expected to require tracheostomy, making it one of the most common procedures performed in the ICU. Many tracheostomized patients have difficulty swallowing, despite the fact that tracheostomy does not necessarily imply dysphagia. The patient's capacity for expressive speech is diminished once a tracheostomy is performed.

Objective: Review of the literature on possible consequences of tracheostomy on swallowing and voice.

Methods: PubMed, Google Scholar, and Science Direct were some of the places we explored for information about Tracheostomy, Swallowing and Voice. Between July 1992 and January 2022, however, only the latest or most comprehensive study was considered. The authors also assessed the usefulness of references taken from similar books. We haven't paid attention to non-English documents because we don't have the time or money to translate them. Unpublished articles, oral presentations, conference abstracts, and doctoral dissertations were all widely acknowledged to not constitute valid scientific research.

Conclusion: Reduced laryngeal elevation is another main cause of swallowing impairment has been reported, especially with an inflated cuff, The long-held belief that tracheostomies make swallowing more difficult and increase the danger of aspiration has been disproven by a number of studies. The patient's ability to speak clearly is impaired after a tracheostomy tube is placed. Patients with tracheostomies who are otherwise healthy (i.e., have no laryngeal or pharyngeal issues) often regain their ability to speak.

Keywords: Tracheostomy, Swallowing, Voice.

INTRODUCTION

Around 10% of patients requiring more than 3 days of artificial breathing are expected to require tracheostomy, making it one of the most common procedures performed in the ICU. In addition, the rise in the number of patients requiring difficult or delayed weaning from endotracheal tube (ETT) as a result of ageing and severe comorbidities has led to the development of less invasive surgical techniques that have made tracheostomy safe to conduct at the patient's bedside [(1)].

Figure (1): Tracheostomy tube low pressure cuffed with an above-cuff suction facility [(2)].

Acute respiratory failure with the expectation of extended continuous support, inability to wean from mechanical ventilation, occlusion of the upper airway, difficulty in maintaining an adequate airway, and copious secretions are all common reasons to perform a tracheostomy [(3)].

Infections of the soft tissues of the neck or other anatomical anomalies are rare but possible contraindications to tracheostomy. Extreme respiratory distress accompanied by hypoxemia and hypercapnia that refuse to resolve may be viewed as a relative contraindication. Hematologic and coagulation problems are often seen as contraindications for tracheostomy, despite the fact that prior research has shown that this treatment can be safely carried out in patients with severe neutropenia or thrombocytopenia [(4)].

The smooth muscle segments of the oesophagus are controlled by the brain stem, major pathways of the cortex, and the enteric nervous system. It requires the coordinated actions of many muscles, each of which is innervated by a different set of nerves. The oral phase, the pharyngeal phase, and the esophageal phase make up the physiological mechanism of swallowing in a healthy individual. Blending, mashing, and swallowing are the three steps involved in getting a bolus of food from the mouth to the stomach [(5)].

Effect of tracheostomy on swallowing:

A tracheostomy is a regular operation for patients in serious condition. It helps keep the airway protected, reduces the need for mechanical ventilation, and streamlines pulmonary defecation. It also improves patient comfort, eases breathing, and protects the larynx as compared to an endotracheal tube [(6)].

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Resuming oral feeding is one of the benefits of tracheotomy versus translaryngeal intubation. A tracheostomy and dysphagia frequently occur together because breathing and swallowing share not just architecture but also neurophysiologic control [7].

Many tracheotomized patients are dysphagic (up to 83%), suggesting that this treatment can further exacerbate the already difficult task of swallowing. However, tracheostomy does not necessarily imply dysphagia. Disruption of any part of the swallowing process or the patient's native anatomy can lead to dysphagia, which in turn can lead to a longer hospital stay, an increased risk of complications, and even death. Dehydration, aspiration pneumonia, and malnutrition are all symptoms of dysphagia [8].

In most cases, the cuff of the tracheostomy tube is left inflated so that no food can fall into the trachea. However, in certain individuals, problems including silent inhalation during meals, which can eventually lead to serious pneumonia, occur because of leaking around the cuff, rendering this "protective" mechanism ineffective [6]. However, just because the caregiver does not aspirate any food particles from the cannula does not rule out dysphagia. Food particles may have passed through the glottis but been prevented from entering the trachea by the inflated cuff. Therefore, dysphagia can occur in a tracheotomized patient even if there is no evidence of food aspiration through the tracheal tube.

Ceriana *et al.* [9] describe a fascinating prospective, observational, single-institution study conducted over a 36-month period involving patients with tracheostomies admitted to a rehabilitation centre. The researchers set out to determine what ails people, how severe their symptoms are, and whether or not their swallowing problems may be addressed by therapy. This study is different from others in that it focuses on individuals who have both a tracheostomy and dysphagia. Incomplete backward epiglottis folding, pharyngeal retention, penetration, and aspiration were the most commonly seen swallowing dysfunctions in patients discharged from the ICU with a tracheostomy at the initial videofluoroscopy (VF).

Loss of subglottic pressure, which physiologically protects the airway and favours the coordination between respiration and swallowing, is another possible cause of the swallowing impairment described after tracheostomy. This is especially true when the cuff is left inflated, which also directly obstructs the pharyngeal pathway. Persistent airway redirection leads to laryngeal sensitivity [10]. Coughing is also impaired with a tracheostomy. Patients with tracheostomies often have low cough output and trouble starting the compressive phase of coughing [11].

Interestingly, patients with chronic respiratory disease (affected by exacerbated chronic obstructive pulmonary disease-COPD or restrictive thoracic disorders) demonstrated to have a worse baseline VF scores. In addition, this patient population also showed a worse improvement in all phases of swallowing globally and a less evident degree of reversibility. An explanation for this phenomenon may be found in the baseline respiratory disease and in the breathing-swallowing interaction problems already reported during acute exacerbation and also in stable chronic obstructive pulmonary disease (COPD) patients [12].

Reduced laryngeal elevation is another main cause of swallowing impairment has been reported, especially with an inflated cuff [13]. This study also found a prevalence of incomplete backward epiglottis folding, the mechanism of which was not fully explained by the VF data as well pharyngeal retention due to a potential lack of tongue propulsion.

But since the dysphagic patient is often the “chronic critical patient”, who frequently has acquired muscle weakness, it does not surprise that laryngeal muscular weakness can play a key role in dysphagia [14]. In fact, critical illness polyneuropathy can make all striated muscles, including the laryngeal and pharyngeal ones, weak and stiff. Consequently, it may be difficult in these patients to partition the relative contribution to dysphagia due to tracheotomy cannula and muscle weakness.

Patients who rely on a ventilator but have mild to moderate swallowing difficulties and low risk of aspiration may be able to receive their feedings orally with the assistance of a phoniatrician. Selecting the right food consistencies and paying attention to certain head positions might help reduce or eliminate the risk of aspiration. A Passy-Muir valve may help individuals with mild or moderate aspiration who are either on or off the ventilator. By increasing deglutition and decreasing aspiration, this device may be useful. Most people who need ventilators and have tracheostomies can't eat or drink by mouth because of severe swallowing difficulty. Enteral feeding is preferred when the gastrointestinal tract may be used without risk. It is less expensive, more accessible, and is associated with fewer metabolic and viral problems than parenteral nutrition [15].

Decannaulation decisions may be affected by the results of swallowing assessments using instruments like the functional endoscopic examination of the swallow (FEES) and video fluoroscopy. The former can be carried out at the bedside, but is much operator-dependent, the latter has the drawback of radiation exposure but allows for the study of all stages of swallowing [9].

FEES found aspiration in one-third of tracheostomized, cuff-deflated ICU patients where it had been overlooked by clinical bedside swallowing examination. However, FEES can be used to accurately detect the significant percentage of silent aspirators in ventilated patients who cannot tolerate cuff deflation during a bedside clinical evaluation of aspiration indicators like wet voice (around 60%). The capacity to swallow will not necessarily be affected by the presence of the tracheostomy tube cuff. Those with a healthy swallow can start drinking sooner and more safely, while those who need tube feeding can have the information they need to make that decision. It is possible to swallow while using a tracheostomy tube and its cuff. There may be fewer cases of aspiration pneumonia, more effective weaning, and earlier identification of patients who can tolerate oral food safely if phoniatric therapies are used to diagnose dysphagia early and eliminate unnecessary aspiration [8].

Traditional beliefs that tracheostomies make swallowing difficult and increase the danger of aspiration have been disproven by a number of studies in recent years. Studies employing fiberopticendoscopy found no association between tracheostomies and aspiration. No association between tracheostomy and dysphagia has been found in kinetic studies measuring swallowing function with a tracheostomy tube present [13]. These researches looked at the short-term and immediate consequences of tracheostomy tubes for patients' swallowing performance and kinematics. However, current research shows that the tracheostomy tube's parts, like the speaking valve and cuff, have an impact on swallowing physiology [16].

Tracheostomy and Speaking:

The patient's ability to speak clearly is impaired after a tracheostomy tube is placed. Patients with tracheostomies who are cognitively stable and have no laryngeal or pharyngeal issues often regain their ability to speak. The quality of life for a patient with a tracheostomy is improved by their capacity to speak. This can be accomplished in a number of ways, depending on whether the patient is breathing on their own or needs a ventilator [17].

Spontaneously Breathing cases:

By placing a finger over the proximal opening of the tracheostomy tube when the cuff is deflated (or with a cuffless tube), patients (or their carers) can control airflow into the upper airway and create speech. While some patients have developed considerable expertise using this approach, the vast majority lack the physical capabilities necessary to do so. Patients who are breathing on their own may be able to communicate by using the speaking valve, which channels exhaled air into the upper airway. Many people can benefit from this approach, but there are also several situations in which a speaking valve shouldn't be used [17].

Only when the patient is awake, alert, and trying to communicate can the speaking valve be used. The patient must be medically stable, able to tolerate cuff deflation, and able to exhale past the tracheostomy tube and through the upper airway. The need for finger occlusion and the unpleasantness of persistent capping owing to upper airway blockage are both avoided when using a one-way valve. A good one-way speaking valve requires a louder voice than the ambient noise level in order to produce audible and understandable conversation [18].

Patients with copious secretions may still have trouble with airway clearance, despite the speaking valve's potential to make expectoration simpler. A phoniatrician's opinion can be helpful in determining the patient's risk for aspiration prior to the placement of the speaking valve. When the speaking valve is in place, the patient must be able to exhale normally around the tracheostomy tube. The speaking valve allows for the measurement of tracheal pressure. Passive exhalation (without speech) with the speaking valve in place shows a tracheal pressure of 5 cmH_2O, which may be indicative of high expiratory resistance. It may be necessary to consider a smaller tube if the tracheal pressure is high [19].

In a study including 8 participants with a tracheostomy who were able to breathe on their own, **Prigent *et al.*** [20] looked at how using a speaking valve affected breathing-swallowing interactions. Three water bolus sizes (5, 10, and 15 mL) were randomised and tested, along with chin electromyography, a cervical piezoelectric sensor, and nasal and tracheal flow measurements. The use of a speaking valve had no effect on swallowing features or breathing-swallowing synchrony, the researchers discovered. However, the speaking valve restored the normal amount of expiratory flow toward the upper airway after swallowing, whereas without it, it was almost nonexistent. This could be significant for preventing laryngeal penetration or aspiration.

Rebreathing (dead space) may be reduced because the patient inhales through the tracheostomy tube (in addition to inhaling through the upper airway) and exhales through the upper airway, although this has not been researched. Patients with chronic obstructive pulmonary disease (COPD) may be able to regulate their exhalation with the help of a speaking valve, albeit this has not been thoroughly investigated. It has been reported that a speaking valve can enhance olfactory perception [21].

Patients who have trouble with audible phonation, swallowing, and having an understandable voice may benefit from a fenestrated tracheostomy tube if a one-way speaking valve is not an option. Fenestrated tubes, with all their purported advantages, actually reduce exercise resistance, airflow resistance, and muscle performance. This may be because the presence of the tube body in the trachea causes the inner diameter to decrease, creating increased resistance [22]. The formation of granulation tissue at the site of fenestrations in the tracheostomy tube has also been a source of controversy among clinicians [23].

Mechanically Ventilated Patients:

For patients with a tracheostomy who are receiving mechanical ventilation, time to phonation is a crucial indicator of quality of care and quality of life. The longer a patient remains unable to verbally communicate, the higher the risk of adverse events, delayed decannulation, and prolonged hospital stay. When patients are not given speech rehabilitation, they are unable to alert others to emergencies, and aphonic patients report profound distress that manifests as anxiety, frustration, isolation, and fear. The patient can use the talking tracheostomy tube to communicate in a soft whisper. The gas flow rate is between 4-6 L/min, and it is connected to a thumb port on the gas line. By closing the thumb port, the patient or caregiver can direct gas into the larynx, allowing for a gentle whisper. The talking tracheostomy tube uncouples breathing and talking by allowing the patient to use their voice when the cuff is inflated. The usage of this tube requires a tube change unless it is put at the time of the tracheostomy procedure. Poor or barely audible (at best) voice quality is unfortunately common (Figure 2) [23].

A large portion of the supplementary flow may be lost from the stomal site if the resistance to air flow is lower above the stoma than through the upper airway. Upper airway secretions can reduce voice quality, and those above the cuff can obstruct the flow of air or gas. It may take many days of use for the patient to acquire voice when using this gadget. Some patients can't get their voices to sound good enough with the device, even after lots of practice and instruction [23].

Figure (2): Talking tracheostomy tubes. Courtesy Smiths Medical [17].

The silicone speech cannula on the Blom fenestrated tracheostomy tube is equipped with 2 separate valves. All of the air that is inhaled opens the flap valve and shuts the bubble valve, effectively sealing the fenestration. The flap valve closes at the end of inspiration. When you breathe out, the pressure causes the bubble valve to collapse, opening the fenestration and allowing all of the air to flow into the upper airway and make phonation possible. As the exhaled breath is routed through the upper airway and away from the ventilator, a false low expiratory volume warning could be triggered without the exhaled volume reservoir. A small silicone bellows system, the exhaled volume reservoir, expands and retains gas during inspiration, then returns that gas to the ventilator during exhalation, where it is measured as exhaled volume (Figure 3) [17].

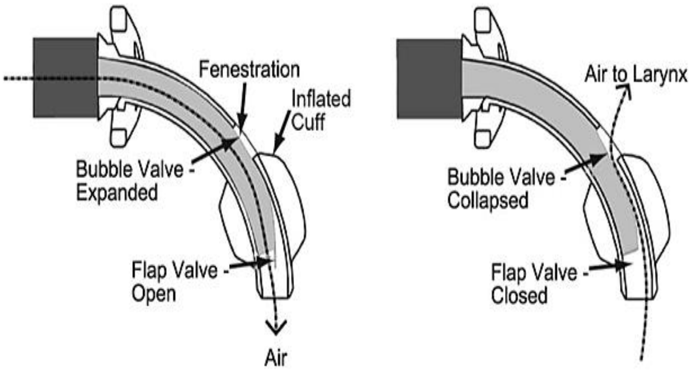

Figure (3): Blom fenestrated speech cannula [17].

The larynx is a transducer, changing the mechanical energy produced by the lungs into sound waves. One objective way to evaluate laryngeal health is by gauging how well this conversion works. Sound intensity (acoustic power) can be expressed as a percentage of wind force (aerodynamic power). Airflow and glottal airway resistance interact to produce phonatory aerodynamics, a set of expiratory functions. The laryngeal fine-tuning abilities are lost if the airway is blocked, hence the link between breathing and voice is crucial. When you have to work harder to breathe, it's hard to keep up a normal speaking volume. Psub (subglottic pressure) is greater in individuals with greater lung volume compared to those with smaller lung volumes [24].
Not enough airflow throughout the glottic cycle to enhance the Bernoulli effect leads to changes in speech pressure level (SPL), Psub, and maximum phonation time (MPT) [22]. Subglottic pressure is exactly proportional to the loudness of the sound source, such that if you raise your subglottic pressure, the volume of the sound will rise as well [25].

CONCLUSION

It has also been noted that reduced laryngeal elevation, especially with an inflated cuff, is a major source of swallowing difficulties. Several studies have debunked the common belief that tracheostomies make swallowing more difficult and increase the likelihood of aspiration. The patient's ability to speak clearly is impaired after a tracheostomy tube is placed. Vocal recovery is possible for many people who have had a tracheostomy and are otherwise healthy and cognitively stable.

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