Critical Review:
The Influence of a Tracheostomy on Aspiration Incidence in Adults

Maria Tsolis & Carly Winzinowich
M.Cl.Sc (SLP) Candidates
University of Western Ontario: School of Communication Sciences and Disorders

Abstract

The relationship between a tracheostomy tube and the incidence of aspiration is debated in the literature. This critical review examined the available evidence on the impact of a tracheostomy tube on the incidence of aspiration in adult patients. It included seven prospective, within-group, repeated measures studies and one prospective, observational, mixed study. The findings of these studies suggest that there is no causal relationship between a tracheostomy and aspiration or a significant impact on the pharyngeal phase of the swallow with the presence of a tracheostomy tube. Although the available evidence is suggestive and limited due to small, heterogenous, non-randomized samples, the overall findings suggest that speech language pathologists should not assume aspiration risk in tracheotomized patients.

Introduction

A tracheostomy tube is an artificial airway that is inserted into the trachea to manage upper airway obstruction (Leder & Ross, 2000). The placement of a tracheostomy tube is required for a variety of medical conditions and is routine during many procedures including: Artificial ventilation, sputum excretion, airway management, and certain surgeries (Meerstein et al., 2014;Tong et al., 2015).

There is a debate in the literature regarding the impact of a tracheostomy tube on the physiology of swallowing. Tracheostomy tubes have been associated with an increased risk of aspiration (when a foreign substance enters the airway, increasing the chance of aspiration pneumonia) by impairing numerous mechanisms of the swallow (Ceriano et al., 2014). Some studies report an increase in swallowing dysfunction with the presence of a tracheostomy tube, with reported incidences of aspiration ranging from 50–87% of patients (Kang et al., 2012; Ceriano et al., 2014). However, contrasting evidence presented suggests no significant association between tracheostomies and incidence of aspiration (Leder & Ross, 2000; Leder & Ross, 2005).

The presence of a tracheostomy tube has been linked to dysphagia, which is when an individual has difficulties with any phase of swallowing, which can lead to challenges with the safety or effectiveness of eating or drinking by mouth. The dysfunction of swallowing physiology that has been implicated includes: decreased laryngeal elevation (by tethering the larynx with the tracheostomy tube), decreased maximum hyoid bone movement, obstruction by the tube cuff, loss of subglottic air pressure, and a disruption in the coordination of laryngeal closure (Donzelli et al., 2005; Terk, Leder, & Burrell, 2007; Kang et al., 2012).

Leder et al. (2010) criticized numerous studies for not including pre-tracheotomy data and suggested that this has led to an inflation of significant findings and has contributed to invalid correlations. Furthermore, multiple authors suspect that the underlying medical etiology greatly contributes to the increased risk of aspiration (Leder et al., 2010; Ceriano et al., 2014). Overall, clinical perception of a causal relationship between aspiration and a tracheostomy still remains (Leder & Ross, 2000).

Further understanding this multifaceted relationship is important in order to negate possible aspiration risk, whi.353656( )-3.5012(t)]TJ 207.64 0 Td [(h)-7.0023(e)0.3239(g)-7.005

An otolaryngologist and a speech-language pathologist conducted a FEES with the tracheostomy tube in place and then again once it had been removed. Three raters assessed for laryngeal penetration and/or aspiration, as well as rated secretion levels. Interrater reliability for penetration was 96% and 100% for aspiration, among the three viewers. One-way analyses of variance (ANOVAs) were completed on the secretion severity scale and a Chi-squared analysis was completed on the presence/absence of a tracheostomy tube and of penetration/aspiration.

A majority of the patients (25/37) had penetration with both the tracheostomy tube in and out, with only two patients demonstrating a change in swallow function once the tube was removed. These results indicate no cause and effect relationship between the presence of a tracheostomy tube and aspiration. The authors speculated that the underlying medical conditions leading to the requirement of a tracheostomy influenced the risk of aspiration over and above the presence of a tracheostomy tube, especially in the case of neurological etiology. This study is suggestive of a lack of relationship within a repeated measures design, however; the heterogeneous population and lack of control group should be considered.

The prospective, consecutive study by Terk, Leder, and Burrell (2007) used a within-group, repeated measures design aimed at investigating the biomechanical effects of a tracheostomy tube, tube capping, and tube cuff deflation on aspiration status. The authors also examined hyoid and laryngeal movement and aspiration status with these conditions. Seven patients in an acute care setting with no swallowing difficulties were included in this study.

A video fluoroscopic swallowing study (VFSS) was conducted during tracheostomy. VFSS is a standard procedure that is used to visualize the physiology of the swallow, completed in combination or independently of a FEES. Differences between the variables were analyzed with the student's t test. Reliability testing with a Pearson correlation was performed on 21% of the data. Intra-observer reliability for combined measurements of maximum hyoid displacement and larynx-to-hyoid approximation was r = 0.97 and interobserver reliability for the absence of aspiration was 100%.

No significant differences were found for maximum hyoid bone displacement and larynx-to-hyoid bone approximation during normal swallowing based on tracheostomy tube presence, tube cuff status, or tube capping status. The study provides suggestive evidence that there are no significant differences between aspiration status with the presence of a tracheostomy. Appropriate measures were put in place to determine suitable reliability with both intra-observer and interobserver reliability, however; the participant group was very small.

The prospective study by Kang et al. (2012) used a within-group repeated measures design that aimed to kinematically investigate the effect of tracheostomy on the swallowing process in patients with swallowing difficulties. Thirteen patients participated that had different types of hemorrhagic strokes. Patients underwent a VFSS study during the time they had a tracheostomy, as well as after the tracheostomy tube was removed.

The authors measured 21 timed interval variables during swallowing in the pharyngeal phase, as well as the extent of laryngeal elevation. During this, they used a gold standard scale to determine the presence of penetration or aspiration. Upon kinematic analysis, no significant difference in any variable pertaining to laryngeal elevation or pharyngeal constriction was found when pre and post-decannulation VFSS test data was compared. This indicates that the removal of a tracheostomy tube does not significantly affect the kinematics of swallowing in stroke patients.

This study provides suggestive evidence that there are no significant differences among between aspiration status and presence of a tracheostomy in the stroke population. Appropriate measures were put in place to determine proper reliability with both intra-observer and interobserver reliability. This study provides additional evidence within a specific population, however; the number of participants is small.

Ceriano et al. (2014) investigated the influence of the underlying disease on the relationship between a tracheostomy and swallowing dysfunction. This single-center study was an observational, prospective, repeated-measures design. A total of 187 patients who had been tracheotomized in the ICU were included in the study. These patients were followed at a single rehab

procedure. To determine the differences between the groups the Mann-Whitney test was used.

It was found that the pulmonary group had worse scores than the neurological group during the initial VFSS when the tracheostomy was in place, and also had less improvement in their swallow physiology post-rehab. This was suspected to be due to the nature of a chronic respiratory disease leading to breathing-swallowing coordination difficulties and to the expected recovery in the neurological patients.

The authors concluded that tracheostomy does not imply swallowing dysfunction, and that a tracheostomy cannula did not significantly impair laryngeal elevation. The evidence provided by this article is equivocal due to the numerous variables that were not controlled and to the lack of randomization or control group, although the findings could be useful when managing these two population groups.

A study by Tong et al. (2015) set out to investigate if dysphagia and aspiration improved following decannulation (removal of the tracheostomy tube), specifically with patients with a traumatic brain injury (TBI). This was a single group design that looked at non-randomized, prospective data. The 17 participants met criteria for having a TBI and a tracheostomy. The small sample was heterogeneous in terms of severity of injury, period of onset to decannulation, and the interval between VFSS.

All patients had a VFSS one month before the placement of a tracheostomy tube and again within 1

Given the populations in which a tracheostomy tube is required, there is expected heterogeneity and uncontrolled extraneous variables, such as: age, comorbidities, etiology, and time post-tracheostomy. Additionally, ethical and medical concerns prevent randomizing groups, which further decreases the validity of these studies. Similarly, sample size is consistently limited due to the challenges finding patients who fit inclusion criteria.

Further research is required to provide more compelling evidence and to confirm no association between tracheostomies and incidence of aspiration. Future studies with a variety of medical populations should be completed with randomized groups and homogenous samples, with the inclusion of a control group where possible.

More specifically, future studies should focus on replicating the lack of a cause and effect relationship via FEES/VFSS with a sample not including HNC or neurological conditions. These populations are associated with known swallowing difficulties and expected spontaneous recovery regardless of tracheostomy tube presence, therefore making it difficult to isolate the effects of this relationship (Donzelli et al., 2005).

Clinical Implications

The current review did not provide compelling evidence