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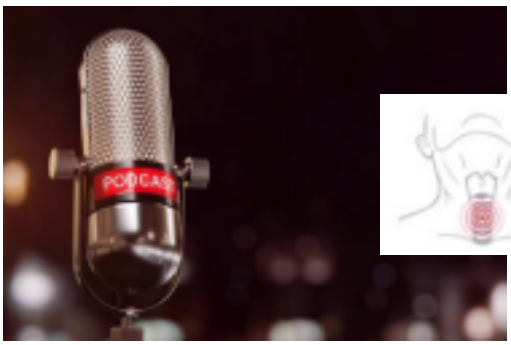

National Tracheostomy Safety Project

This month's top papers: March 2024

Welcome to the latest blog in the literature podcast from the NTSP. We try to bring you a quick roundup of what is hot in the world of tracheostomy and laryngectomy publications by scouring internationally recognised journals and media and bringing you the highlights.

The papers we will discuss this month are detailed below, along with an automated transcript of the podcast. Please note that the transcript is generated by AI and so may not be totally accurate.

You can find the links to the podcast on www.tracheostomy.org.uk and by searching for NTSP on your favourite podcast platform. Some of the podcasts are also uploaded to YouTube if you prefer to get your news that way. Check out the NTSP YouTube channel at https://www.youtube.com/c/NationalTracheostomySafetyProject. Please follow us and/or subscribe to keep up to date! https://x.com/NTSP_UK

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This month's top papers

- Safety-related outcomes for patients with a tracheostomy and the use of flexible endoscopic evaluation of swallowing (FEES) for assessment and management of swallowing: A systematic review.
- Effects of hyperbaric oxygen combined cabin ventilator on critically ill patients with liberation difficulty after tracheostomy.
- The Nasal Microarchitecture: How Does Tracheostomy Affect It?
- Impact of long-term nasal airflow deprivation on sinonasal structures and chronic rhinosinusitis in total laryngectomy patients

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Safety-related outcomes for patients with a tracheostomy and the use of flexible endoscopic evaluation of swallowing (FEES) for assessment and management of swallowing: A systematic review.

Lay Summary:

This study is a comprehensive review of existing research into a key part of recovery for patients with a tracheostomy (a breathing tube in the neck): ensuring they can safely eat and drink again. Since a tracheostomy can impair swallowing, the medical team needs to check for aspiration (food or liquid entering the lungs), which is a serious safety risk. The review focused on the use of a gold-standard diagnostic test called Flexible Endoscopic Evaluation of Swallowing (FEES), which uses a small, flexible camera to directly visualize the throat while the patient swallows.

The goal was to see if using FEES actually leads to better safety-related outcomes compared to other, less accurate tests. The review found that there is a low level of certainty (meaning the evidence is limited) that incorporating FEES into the care plan is associated with improved safety outcomes. However, the study notes that simpler bedside tests are often inadequate, particularly because they frequently miss "silent aspiration," where material enters the lungs without causing a cough. Since FEES is highly accurate at detecting this silent danger, the authors argue that relying on flawed tests is potentially more harmful to the patient. The conclusion emphasizes that while more large-scale studies are needed, FEES is currently the best tool to accurately diagnose aspiration risk, helping the medical team to start safe oral feeding sooner and improve the patient's nutrition and well-being.

Summary for Healthcare Professionals:

This systematic review assessed the evidence for the association between the use of Flexible Endoscopic Evaluation of Swallowing (FEES) and safety-related outcomes in adult patients with a tracheostomy. The analysis included seven heterogeneous studies reporting on outcomes across swallow safety, physiological function, tracheostomy cannulation duration, and the detection of upper airway pathologies.

The summary of evidence found low to very low certainty that incorporating FEES into the multidisciplinary management of tracheostomy patients is associated with improved safety-related outcomes. Despite the low certainty of the current evidence base, the review highlights the diagnostic limitations of alternative point-of-care assessments, such as the Clinical Swallowing Evaluation (CSE) and the Modified Evans Blue Dye Test (MEBDT), noting that their subjective nature and poor sensitivity often fail to detect silent aspiration, a major risk factor for aspiration pneumonia. Conversely, FEES provides objective visualization of laryngeal penetration and aspiration, the dynamic swallowing profile, and allows for the detection of laryngeal injury, all of which inform safer weaning and decannulation decisions. The authors conclude that relying on less accurate subjective assessments (CSE and MEBDT) carries a greater potential for harm due to misdiagnosis. Therefore, FEES remains an essential component of the swallowing assessment pathway, and further research with larger, standardized cohorts is warranted to establish high-certainty evidence.

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Effects of hyperbaric oxygen combined cabin ventilator on critically ill patients with liberation difficulty after tracheostomy.

Lay Summary:

This study investigated a powerful new treatment combination for critically ill patients who struggle to breathe on their own after receiving a tracheostomy, a condition called liberation difficulty. The treatment combined a chamber delivering hyperbaric oxygen (HBO)—breathing pure oxygen in a pressurized environment—with an in-cabin ventilator (ICV). Researchers analyzed 148 patients who were on a ventilator, had lung inflammation, and low consciousness levels. They compared patients who were successfully removed from the ventilator (SL group) after the combination therapy to those who were not (NSL group). The results showed that the HBO-ICV combination significantly improved several vital signs. The successful group saw major gains in their oxygen levels (partial pressure of oxygen and blood saturation) and a measurable improvement in their level of consciousness (Glasgow Coma Scale, or GCS) after treatment. The improvement in GCS, in particular, was significantly higher in the successfully liberated group. Although both groups showed some improvement in heart function, the overall gain was not significantly different between the successful and unsuccessful groups. The study concludes that the combination of hyperbaric oxygen and in-cabin ventilation is effective at boosting the respiratory and overall function of these complex patients. This comprehensive therapy offers a promising way to address the multiple challenges of liberation difficulty, helping critically ill patients regain independent breathing and improve their conscious state.

Summary for Healthcare Professionals:

This retrospective cohort study investigated the therapeutic efficacy of combining Hyperbaric Oxygen (HBO) therapy with an In-Cabin Ventilator (ICV) in 148 critically ill patients experiencing liberation difficulty post-tracheostomy. Inclusion criteria mandated ongoing mechanical ventilation, lung inflammation on CT, and significant neurological impairment (GCS≤9). Following intervention, 111 cases were stratified into successfully liberated (SL, n=72) and not successfully liberated (NSL, n=28) groups. The HBO protocol involved pressurization to 0.20 MPa (2.0 ATA) for 20 minutes, followed by 60 minutes of ventilator oxygen inhalation.

The primary finding was that the HBO-ICV combination was associated with significant physiological improvements in the SL group. Compared to the NSL group, the SL cohort demonstrated statistically greater improvements in Glasgow Coma Scale (GCS) scores, partial pressure of oxygen (PaO_2), oxygen saturation (SaO_2), and Oxygenation Index (OI). Although both groups showed numerical improvements in cardiac function indices (LVEF, LVESV, LVEDV, SV), the intergroup difference in improvement was not statistically significant. The study concludes that this combined therapy effectively enhances respiratory function, cardiopulmonary function, and neurological status. This evidence supports the use of HBO combined with ICV as a valuable, comprehensive approach to simultaneously address the multifactorial challenges of weaning difficulty in complex, critically ill patients.

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The Nasal Microarchitecture: How Does Tracheostomy Affect It?

Lay Summary:

This study looked at how having a major breathing tube—a tracheostomy—affects the delicate lining and function of a person's nose. Normally, the nose acts as the body's natural humidifier and filter, ensuring that the air reaching the lungs is clean, warm, and moist. However, when a tracheostomy is performed, air bypasses the nose entirely. Researchers performed a prospective study on 30 patients, taking small tissue samples (biopsies) from the nose before the surgery and again four weeks later.

The findings confirmed that bypassing the nose causes significant damage to its inner lining. The vast majority of subjects (80%) showed a breakdown of the protective lining of the nose, which changed from a strong, layered appearance to a single layer of flattened cells. Furthermore, 80% of patients had a marked reduction in the essential glands that produce mucus and moisture. This damage leaves the patient more vulnerable to breathing problems. The authors conclude that these long-term changes to the nasal lining are severe and underscore the necessity for patients to use devices like Heat and Moisture Exchangers (HMEs) to compensate for the loss of the nose's filtering function, protecting the lungs from dry, unfiltered air.

Summary for Healthcare Professionals:

This prospective observational study investigated the histological changes occurring in the nasal mucosa post-tracheostomy, addressing the physiological consequences of upper airway bypass. The study included 30 adult patients undergoing tracheostomy, with inferior turbinate mucosal biopsies obtained prior to the procedure and at a four-week follow-up for those who remained cannulated.

The results demonstrated significant, quantifiable atrophic and structural changes in the nasal microarchitecture post-tracheostomy. Specifically, 80% of subjects exhibited atrophy of the lining epithelium, with the pseudostratified lining transitioning to a single layer of flattened cells. Concurrently, 80% showed a marked reduction in the number of seromucinous glands in the stroma, signifying compromised mucociliary clearance and humidification capability. Additionally, stromal fibrosis was noted in 43.3% of subjects. The authors conclude that these histological changes confirm that tracheostomy leads to a significant degradation of the nasal mucosa, which is essential for air conditioning and filtration. These findings underscore the clinical necessity of implementing aggressive humidification and filtration strategies, such as Heat and Moisture Exchangers, to prevent secondary pulmonary morbidity resulting from the loss of natural upper airway function.

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Impact of long-term nasal airflow deprivation on sinonasal structures and chronic rhinosinusitis in total laryngectomy patients

Lay Summary:

This study investigated how permanently stopping airflow through the nose affects the structures inside the nose and sinuses, using patients who had undergone a total laryngectomy (TL) as a model. A TL, the surgical removal of the voice box, makes patients breathe permanently through a stoma in the neck, bypassing the nose's natural filtering and humidifying function.

Researchers compared 45 TL patients to a control group of 38 similar patients who still breathed through their nose, analyzing CT scans taken several years after surgery. The main discovery was that while the larger sinus cavities themselves were not damaged, the soft tissue inside the nose—specifically the inferior turbinate mucosa—shrank significantly in TL patients. The volume of this soft tissue lining decreased drastically, from 4.6 mL to 2.8 mL, while no change was observed in the control group. This suggests that the discontinuation of natural nasal airflow directly causes the internal lining of the nose to atrophy (waste away).

The good news is that despite this structural change, the long-term lack of nasal airflow did not significantly increase the severity of chronic rhinosinusitis (sinus infection) or chronic sinus opacification, as measured by the Lund-Mackay score. The study concludes that the lack of nasal airflow primarily impacts the nasal lining, but does not lead to a greater burden of chronic sinusitis. This underscores the necessity of continuous humidification and filtering care for these patients to compensate for the nose's diminished function.

Summary for Healthcare Professionals:

This retrospective cohort study evaluated the long-term structural and pathological effects of nasal airflow cessation on the sinonasal tract in patients following Total Laryngectomy (TL), utilizing CT imaging a median of 6.3 years post-TL. The objective was to determine changes in sinonasal structures and the association with Chronic Rhinosinusitis (CRS). The study compared 45 TL patients to 38 control patients who underwent non-tracheostomy head and neck surgery.

The methodology involved measuring the volume of the paranasal sinuses, maxillary sinus ostium mucosal width, and the Lund-Mackay Score (LMS) for sinus opacification. The most significant finding was the marked atrophy of the inferior turbinate soft tissue volume (ITSTV) in the TL cohort. The mean ITSTV in the TL group decreased significantly from 4.6±1.3 mL preoperatively to 2.8±1.1 mL postoperatively ($p<.001$), a change not observed in the control group. This structural change occurred irrespective of the presence of nasal septal deviation.

Conversely, the cessation of nasal airflow did not significantly affect the volume of the four paranasal sinuses or the width of the maxillary sinus ostium. Furthermore, there were no significant postoperative changes in the LMS in either group, indicating that long-term airflow deprivation does not significantly increase the burden of chronic rhinosinusitis. The study concludes that nasal airflow is a critical determinant of inferior turbinate mucosal health, but its chronic absence does not necessarily result in aggravated chronic rhinosinusitis.

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Scientific abstracts and references

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Int J Speech Lang Pathol. 2024 Mar 10:1-11. doi: 10.1080/17549507.2023.2293633. Online ahead of print.

Safety-related outcomes for patients with a tracheostomy and the use of flexible endoscopic evaluation of swallowing (FEES) for assessment and management of swallowing: A systematic review.

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PURPOSE: The purpose of this systematic review was to examine safety-related outcomes for patients with tracheostomy after flexible endoscopic evaluation of swallowing (FEES) to assess and manage their swallow, when compared to other non-instrumental swallow assessments such as clinical swallowing examination (CSE) and/or a modified Evans blue dye test (MEBDT). METHOD: Three databases were searched for articles referring to safety-related outcome data for adults with a tracheostomy, who underwent FEES and CSE and/or MEBDT. Articles were screened using predefined inclusion/exclusion criteria. RESULT: The search strategy identified 2097 articles; following abstract and full-text screening, seven were included for review. The summary of evidence found low to very low certainty that FEES was associated with improved outcomes across swallow safety, physiological outcomes, tracheostomy cannulation duration, functional outcomes, and detection of upper airway pathologies. CONCLUSION: This systematic review demonstrated low to very low certainty evidence from seven heterogeneous studies with low sample sizes that incorporating FEES may be associated with improved safety-related outcomes. There is less evidence supporting the accuracy of other swallow assessments conducted at the point of care (i.e. CSE and MEBDT). Future research requires studies with larger sample sizes and routine reporting of safety-related outcomes with use of FEES.

DOI: 10.1080/17549507.2023.2293633 PMID: 38462820

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Biomed Eng Online. 2024 Mar 7;23(1):30. doi: 10.1186/s12938-024-01220-4.

Effects of hyperbaric oxygen combined cabin ventilator on critically ill patients with liberation difficulty after tracheostomy.

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BACKGROUND: Critically ill patients undergoing liberation often encounter various physiological and clinical complexities and challenges. However, whether the combination of hyperbaric oxygen and in-cabin ventilator therapy could offer a comprehensive approach that may simultaneously address respiratory and potentially improve outcomes in this challenging patient population remain unclear. METHODS: This retrospective study involved 148 patients experiencing difficulty in liberation after tracheotomy. Inclusion criteria comprised ongoing mechanical ventilation need, lung inflammation on computed tomography (CT) scans, and Glasgow Coma Scale (GCS) scores of ≤ 9. Exclusion criteria excluded patients with active bleeding, untreated pneumothorax, cerebrospinal fluid leakage, and a heart rate below 50 beats per minute. Following exclusions, 111 cases were treated with hyperbaric oxygen combined cabin ventilator, of which 72 cases were successfully liberated (SL group) and 28 cases (NSL group) were not successfully liberated. The hyperbaric oxygen chamber group received pressurization to 0.20 MPa (2.0 ATA) for 20 min, followed by 60 min of ventilator oxygen inhalation. Successful liberation was determined by a strict process, including subjective and objective criteria, with a prolonged spontaneous breathing trial. GCS assessments were conducted to evaluate consciousness levels, with scores categorized as normal, mildly impaired, moderately impaired, or severely impaired. RESULTS: Patients who underwent treatment exhibited improved GCS, blood gas indicators, and cardiac function indexes. The improvement of GCS, partial pressure of oxygen (PaO2), oxygen saturation of blood (SaO2), oxygenation index (OI) in the SL group was significantly higher than that of the NSL group. However, there was no significant difference in the improvement of left ventricular ejection fraction (LVEF), left ventricular end-systolic volume (LVESV), left ventricular end-diastolic volume (LVEDV), and stroke volume (SV) between the SL group and the NSL group after treatment. CONCLUSIONS: Hyperbaric oxygen combined with in-cabin ventilator therapy effectively enhances respiratory function, cardiopulmonary function, and various indicators of critically ill patients with liberation difficulty after tracheostomy.

Indian J Otolaryngol Head Neck Surg. 2024 Feb;76(1):842-845. doi: 10.1007/s12070-023-04290-3. Epub 2023 Oct 31.

The Nasal Microarchitecture: How Does Tracheostomy Affect it?

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This study aims to evaluate the histological changes in the nasal mucosa post Tracheostomy. A prospective observational study was done on 30 patients undergoing Tracheostomy after obtaining written informed consent from patients/legally accepted representatives. Prior to Tracheostomy, anterior rhinoscopy was done, and findings were noted; nasal mucosal biopsy was obtained from the inferior turbinate. The patients enrolled were followed up for four weeks, and in the patients still having Tracheostomy, repeat inferior turbinate biopsies were taken and compared. Statistically significant atrophy of lining epithelium was seen in 80% of the subjects, i.e., pseudostratified lining epithelium at Baseline with multilayered appearance changed to a single layer of flattened cells at follow-up. There was also a marked reduction in the number of seromucinous glands in the stroma at follow-up in 80% of the subjects. Additionally, fibrosis in the stroma was noted in 43.3% of subjects at follow-up. The results from this study indicate that Tracheostomy, likely as a result of nasal airflow deprivation, brings about significant changes in the microanatomy of the nasal airway. The extent of this causation and its implication in nasal pathology must be studied in larger populations with extended follow-up periods.

Laryngoscope Investig Otolaryngol. 2024 Jan 17;9(1):e1214. doi: 10.1002/lio2.1214. eCollection 2024 Feb.

Impact of long-term nasal airflow deprivation on sinonasal structures and chronic rhinosinusitis in total laryngectomy patients.

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OBJECTIVE: Total laryngectomy (TL) patients are good models in which to evaluate the effects of nasal airflow cessation on the sinonasal tract. Here, we evaluated changes in sinonasal structures and association with sinus opacification in the computed tomography (CT) images 3 years post-TL. METHODS: Patients who underwent TL from 2005 to 2017 in a teaching academic center were reviewed retrospectively. Patients with a final follow-up CT taken less than 3 years after TL, tracheoesophageal puncture, inadequate CT image, or history of sinonasal surgery were excluded. The control group included patients who underwent a partial laryngectomy or hypopharyngectomy without requiring a tracheotomy for more than a month. Altogether, 45 TL patients and 38 controls were selected. The volume of all four paranasal sinuses, inferior turbinate soft tissue volume (ITSTV), maxillary sinus natural ostium (MSNO) mucosal width, and Lund-Mackay scores (LMS) were measured on preoperative and postoperative CT scans. RESULTS: The mean duration between surgery and the final CT scan was 6.3 ± 2.4 and 5.5 ± 2.3 years for the TL and control groups, respectively. Neither group showed significant changes in the four paranasal sinuses' volume or MSNO mucosa width. The ITSTV decreased significantly, from 4.6 ± 1.3 to 2.8 ± 1.1 mL ($p < .001$), in the TL group, regardless of the presence of nasal septal deviation, showing ITSTV reduction on both concave and convex sides. By contrast, the control group showed no significant changes in ITSTV. Postoperative LMS changes in both groups were insignificant. The number of patients with LMS aggravation or alleviation was the same in both groups, regardless of preoperative sinus opacification. CONCLUSIONS: Paranasal sinus structures and sinus opacification are not affected significantly by nasal airflow cessation; however, the inferior turbinate mucosa is affected by long-term discontinuation of nasal airflow. LEVEL OF EVIDENCE: 4 (case-control study).