NTSP Podcast series

National Tracheostomy Safety Project

This month's top papers: December 2025

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.

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:

- Complications of Percutaneous Tracheostomy-Assisting Techniques in Critically Ill Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials.
- Outcomes of Tracheostomy Decannulation: Study Protocol for a Longitudinal Observational Study.
- Effectiveness of Virtual Reality Simulation for Tracheostomy Education Among Healthcare Professionals.

Complications of Percutaneous Tracheostomy-Assisting Techniques in Critically Ill Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials.

Lay Summary

This study compared different techniques used to guide percutaneous tracheostomy - a common ICU procedure where a breathing tube is placed directly into the windpipe through the neck.

Doctors can perform this procedure using surface landmarks alone, or with additional guidance from ultrasound or a small camera inserted into the airway (bronchoscopy). The study analysed data from 16 randomized clinical trials involving over 1,000 critically ill patients.

The main finding was that using ultrasound guidance was associated with fewer minor bleeding complications compared with bronchoscopy guidance. Major complications were rare across all techniques, and no single method completely eliminated risk.
Overall, the study suggests that ultrasound is a safe and effective option for guiding percutaneous tracheostomy, but the experience of the clinical team and careful patient selection remain important factors in ensuring safety.

Summary for Healthcare Professionals

This 2025 systematic review and meta-analysis evaluated complication rates associated with assisting techniques for percutaneous dilatational tracheostomy (PDT) in critically ill adults. Sixteen randomized controlled trials were included, comparing anatomical landmark guidance, ultrasound guidance, and bronchoscopy guidance.

Ultrasound-guided tracheostomy was associated with a statistically significant reduction in minor bleeding compared with bronchoscopy guidance, while rates of major bleeding were low and did not differ significantly between techniques. Comparisons between ultrasound and landmark-guided approaches suggested lower overall minor complication rates with ultrasound, although procedure duration was sometimes longer. Major complications, including pneumothorax, were uncommon across all groups. The review highlights the growing evidence base supporting ultrasound guidance as a safe and effective modality to assist with PDT. However, heterogeneity in reporting, low event rates for major complications, and variable operator experience across trials limit definitive conclusions regarding superiority.

Outcomes of Tracheostomy Decannulation: Study Protocol for a Longitudinal Observational Study.

Lay Summary

This study protocol outlines a research project examining what happens after a tracheostomy tube is removed - a process known as decannulation.

Traditionally, decannulation has been considered “successful” if a patient does not need the tube reinserted within the first few days. However, this study recognises that complications can occur weeks or even months later, and that patients’ personal experiences also matter.

The researchers will follow 150 adults for three months after decannulation, recording any medical complications as well as patients’ views on breathing, sleep, secretion management, and overall wellbeing. The study also measures broader quality of life using a validated wellbeing questionnaire.

The aim is to better understand both the physical and psychological outcomes of decannulation, and to support the development of evidence-based clinical guidelines to improve patient care.

Summary for Healthcare Professionals

This prospective, longitudinal mixed-methods study protocol describes a single-centre observational investigation of 150 adult inpatients undergoing tracheostomy decannulation in a specialised neurological rehabilitation setting.

The primary outcome is the rate and timing of decannulation-related physical complications - including those not resulting in re-cannulation - over a three-month follow-up period. Secondary outcomes include complication typology, patient-reported perspectives on decannulation outcomes, human flourishing as measured by the Harvard Flourishing Measure, and identification of candidate prognostic factors such as cough strength, respiratory muscle function, secretion severity, oral intake, oral health, and independence.

Time-to-event analyses, including Kaplan–Meier and Cox regression modelling, will be used to evaluate complication-free survival and associated predictors. By extending outcome measurement beyond the traditional short-term window and incorporating patient-centred measures, this study aims to inform comprehensive, evidence-based decannulation management.

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Effectiveness of Virtual Reality Simulation for Tracheostomy Education Among Healthcare Professionals.

Lay Summary

This study looked at whether virtual reality (VR) can improve how healthcare professionals learn to manage tracheostomy emergencies.

Twenty-six clinicians attended a tracheostomy training day. All received standard face-to-face teaching, but one group also completed a 40-minute VR simulation based on the National Tracheostomy Safety Project emergency algorithm. Participants completed a short knowledge test immediately after training and again 30 days later.

The group who used VR scored higher straight after the session and retained more knowledge one month later compared to those who had standard teaching alone.
The study suggests that adding virtual reality simulation to traditional training may improve learning and memory for managing tracheostomy emergencies. However, the study was small and did not assess real-life clinical performance.

Summary for Healthcare Professionals

Siddique et al. evaluated the effectiveness of a VR-based tracheostomy simulation module delivered alongside standard teaching during a regional study day.

In this prospective single-centre study, 26 senior trainees were allocated to standard teaching alone (n=9) or standard teaching plus a 40-minute VR simulation (n=17) based on the National Tracheostomy Safety Project algorithm. Knowledge was assessed using an eight-item MCQ immediately post-training and at 30 days.

The VR group demonstrated significantly higher scores at both time points, with large effect sizes, and superior 30-day knowledge retention compared with controls.
Limitations include small sample size, non-random allocation, single-centre design, and reliance on knowledge-based rather than performance-based outcomes. The findings support VR as a potentially valuable adjunct to conventional tracheostomy education.

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Scientific abstracts and references

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J Clin Med. 2025 Nov 13;14(22):8050. doi: 10.3390/jcm14228050.

Complications of Percutaneous Tracheostomy-Assisting Techniques in Critically Ill Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Abstract

Background/Objectives: Percutaneous dilatational tracheostomy (PDT) is a commonly performed procedure in critically ill patients. Various guidance techniques, including anatomical landmark-guided (ALG), ultrasound-guided (USG) and bronchoscopy-guided (BG), aim to enhance procedural safety and efficacy. This systematic review and meta-analysis aimed to compare the safety and efficacy across ALG, USG, and BG techniques in PDT, focusing on complications and procedure times. **Methods:** A systematic review and meta-analysis of randomized controlled trials (RCTs) was conducted. Studies identified through PubMed, CENTRAL, Scopus, and Web of Science databases up to July 2025 comparing ALG, USG, and BG PDT were included. Primary outcomes were minor and major bleeding, with transient hypoxia, transient hypotension, endotracheal tube cuff puncture, pneumothorax, and procedure time as secondary outcomes. Data were pooled using random-effects models, with risk ratios (RR) and 95% confidence intervals (CI) for complications and mean differences for procedure times. Heterogeneity was assessed using I^2statistics, with Bonferroni correction for multiple comparisons. **Results:** This meta-analysis included five RCTs (568 patients) comparing USG vs. ALG, six RCTs (404 patients) comparing USG vs. BG, and five RCTs (448 patients) comparing ALG vs. BG. USG significantly reduced minor bleeding compared to ALG (RR 2.30, 95% CI 1.38-3.84, $p = 0.001$) and BG (RR 0.42, 95% CI 0.20-0.91, $p = 0.02$), and major bleeding compared to ALG (RR 2.62, 95% CI 1.00-6.86, $p = 0.04$). ALG was associated with higher minor bleeding risk than BG (RR 1.81, 95% CI 1.05-3.12, $p = 0.03$). No significant differences were found for transient hypoxia, hypotension, endotracheal tube cuff puncture, or pneumothorax across comparisons, though trends suggested lower hypoxia risk with USG and higher pneumothorax risk with ALG. Procedure times were similar (ALG: 10.4 min, USG: 11.7 min, BG: 12.7 min; $p = 0.493$). Some rare complications, like paratracheal placement and mediastinitis, were too infrequent for analysis. **Conclusions:** USG PDT significantly reduces the risk of minor and major bleeding relative to ALG and minor bleeding compared to BG, without prolonging procedure time. USG and BG show comparable safety for most non-bleeding outcomes. No significant differences in procedure times. Future research should focus on larger RCTs to assess rare complications and explore hybrid USG-BG approaches to optimize PDT safety and efficacy.

Keywords: anatomic landmark-guided; bronchoscopy-guided; complications; intensive care; meta-analysis; outcomes; percutaneous tracheostomy; ultrasound-guided.

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Conflict of interest statement
The authors declare that they have no competing interests.

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Outcomes of Tracheostomy Decannulation: Study Protocol for a Longitudinal Observational Study

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Abstract
Background: Tracheostomy management aims to achieve optimal decannulation outcomes in tracheostomized patients. Successful removal of the tracheal cannula (decannulation) is key from a physical and psychological health perspective. Decannulation success is commonly defined as the absence of physical complications leading to re-cannulation within a few hours or days post-decannulation. However, this definition does not account for complications occurring weeks or months later, or for (serious) complications that require actions other than re-cannulation. Additionally, the definition neglects the patients' experience of the decannulation outcome. This manuscript outlines the protocol of a study designed to comprehensively evaluate decannulation outcomes long-term, incorporating both physical and psychological variables.
Methods: This longitudinal, prospective, single-centre mixed-methods observational study entitled 'Outcomes of tracheostomy decannulation: A longitudinal observational study' aims to include a consecutive sample of 150 adult inpatients hospitalized in a large neurological rehabilitation centre specialized for spinal cord injury and prolonged weaning. Adult inpatients of various diagnoses who have undergone tracheostomy are eligible for inclusion if decannulation is sought and occurs in the study centre and if they are able to communicate in German, French, Italian, or English. Outcomes of interest include the rate and type of physical complications (occurring up to 3 months post-decannulation) and the consequences (e.g., intubation), the patients' view on benefits/harms of decannulation, and human flourishing pre- and post-decannulation. Candidate prognostic variables for complications post-decannulation are examined 1 week prior to decannulation and 1 month and 3 months post-decannulation. Data relating to the decannulation process, including decannulation criteria, will be recorded. Complication rates will be evaluated over 3 months post-decannulation using Kaplan-Meier and Nelson-Aalen estimators and time-to-event analysis. Decannulation-related complications will be descriptively analysed. Longitudinal changes in patient perspectives on decannulation outcomes are qualitatively and descriptively assessed, and the distribution across groups with and without complications is assessed.
Discussion: A comprehensive understanding of physical and psychological decannulation outcomes will build the basis for optimized clinical decisions related to tracheostomy management and guide the development of an evidence-based clinical guideline for decannulation management.

Trial registration: ClinicalTrials.gov identifier: NCT06047665 WHAT THIS PAPER ADDS: What is already known on the subject Tracheostomy management is a multidisciplinary task and targets a timely and safe removal of the tracheal cannula (decannulation). Successful decannulation is key from a physical and psychological health perspective. Decannulation success is commonly defined as the absence of physical complications leading to re-cannulation within a few hours or days post-decannulation (short-term). What this paper adds to existing knowledge This study evaluates a variety of physical decannulation outcomes (including complications that do not result in a re-cannulation) for 3 months post-decannulation (long-term). Patients' perspective on decannulation outcomes are assessed as the views of those affected are key for a comprehensive assessment of decannulation outcomes. What are the potential or actual implications of this work? The data will build a foundation for optimized clinical decision-making related to decannulation management. The study will guide patient care pre- and post-decannulation to support positive long-term decannulation outcomes, reduce decannulation related medical and psychological sequalae, and contribute to economic decannulation management in relation to health care costs. This research will inform the development of an evidence-based clinical decannulation guideline.
Keywords: complications; critical care; mechanical ventilation; patient reported outcome; rehabilitation; tracheostomy decannulation.

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Effectiveness of Virtual Reality Simulation for Tracheostomy Education Among Healthcare Professionals

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Abstract
Objective: The objective of this study is to evaluate the effectiveness of virtual reality (VR) simulation in tracheostomy teaching for healthcare professionals and its impact on short- and medium-term knowledge retention.
Method: A prospective educational study was conducted among 26 healthcare professionals (17 VR; 9 non-VR). Both groups received standard face-to-face tracheostomy teaching, while the VR group additionally completed a 40-minute hybrid simulation using Goggleminds™ software based on the National Tracheostomy Safety Project algorithm. Knowledge was assessed using an eight-item multiple-choice questionnaire immediately after training (Day 0) and after 30 days (Day 30). Data were analysed using independent-samples *t*-tests and Mann-Whitney *U* tests to confirm robustness.
Results: Participants in the VR group achieved significantly higher mean scores immediately after training (7.24 ± 0.75) compared with the non-VR group (6.33 ± 0.87; $p = 0.01$). At 30 days, the VR group demonstrated superior knowledge retention (6.88 ± 0.93) compared with the non-VR group (4.67 ± 1.00; $p < 0.001$). These findings indicate that VR-based tracheostomy simulation enhances both learning and retention of knowledge compared with conventional teaching.

Conclusion: VR-based tracheostomy simulation significantly improved knowledge acquisition and 30-day retention among healthcare professionals. Integrating VR into tracheostomy education may help to standardise training, improve confidence, and enhance patient safety in emergency airway management.
Keywords: airway, airway obstruction, endoscopy, laryngology, laryngomalacia, medical education, paediatric airways, stridor, surgical techniques

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