

Case Report

Multidimensional Consequences of Delayed Surgical Tracheostomy in a Critically Ill Adult: A Case Report and Systems-Based Analysis

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Keywords: Tracheostomy, Critical Illness, Respiratory Insufficiency, Airway Management, Mechanical Ventilation, Sedation, Health Care Costs, Treatment Delay, Patient-Centered Care, Intensive Care Units

<https://doi.org/10.62905/001c.140853>

Tracheostomy: Official Journal of the Global Tracheostomy Collaborative

Vol. 2, Issue 2, 2025

Abstract

Background

Delays in surgical tracheostomy can impact patients, families, and ICU systems. This case highlights the consequences of delays and gives suggestions on how to optimize care delivery.

Patient case

A 32-year-old female diagnosed with severe pneumococcal pneumonia presented with progressive shortness of breath, chest pain and cough. She continued to deteriorate despite non-invasive respiratory support, resulting in tracheal intubation and prolonged invasive ventilation.

Intervention

She required surgical tracheostomy to aid weaning because of anticipated difficulty with bedside percutaneous dilatational tracheostomy (PDT). Logistical and operating room scheduling problems led to a five-day delay.

Outcome

Delayed surgical tracheostomy resulted in significantly prolonged sedation burden, likely contributed to post-emergence delirium, delayed laryngeal and physical rehabilitation, distress for the relatives, and pressure on the healthcare system in terms of bed-days and economic costs.

Conclusion

Minimizing delays between decision for ICU tracheostomy and insertion improves outcomes for patients, their relatives, and hospital systems. Innovations enabling more ICU bedside PDT to be undertaken could reduce delays.

INTRODUCTION

Tracheostomies are small tubes inserted into patients' necks, providing an artificial airway. Around 20,000 new tracheostomies are performed in UK's National Health Service (NHS) hospitals each year.¹ The two methods for tracheostomy insertion are surgical tracheostomy, or percutaneous dilatational tracheostomy (PDT). PDT is based on the Seldinger technique familiar to intensivists and anesthesiologists. PDT can be performed at the bedside in the Intensive Care Unit (ICU), eliminating the need for potentially complex scheduling of a surgical procedure. Evidence indicates that early tracheostomy following endotracheal intubation is associated with improved survival, reduced sedation burden, decreased ICU length of stay and enhanced ICU bed availability for other patients.²⁻⁵ However, delays are approximately 2.5 times more likely when a surgical tracheostomy is indicated compared to PDT.⁶ This report highlights the difficulties encountered when scheduling surgical tracheostomy in ICUs, the impact on patients, their families and the hospital system, and makes recommendations for the planning of this common procedure in the critically ill. This case report was prepared following the CARE Guidelines.⁷

PATIENT INFORMATION

A 32-year-old white British female (114kg, BMI 42.9 kg/m²) classified as having class 3 obesity, was referred by her GP to the emergency department following a 2-day history of progressive shortness of breath on exertion. She described right sided pleuritic chest pain, which was worse on inspiration, cough productive of green sputum with streaks of blood, and lethargy. Notably, she had no relevant comorbidities or significant past medical history and was previously well, having recently completed a 10km run prior to the onset of symptoms. At presentation, she was a non-smoker, lived alone and worked as a therapeutic radiographer. There was no known family history of chronic respiratory illness.

CLINICAL FINDINGS

Relevant examination findings included hypoxia, tachypnea and tachycardia along with diminished inspiratory effort, reduced breath sounds on the right lung and left basal crackles on auscultation.

TIMELINE

Table 1. Timeline of key events from admission to discharge

Day	Event
0	Referred to emergency department
1	Admitted to intensive care unit
2	Initiated invasive positive pressure ventilation
11	Tracheostomy considered
20	Decision made to proceed with surgical tracheostomy
20–25	Waiting period with continued sedation
25	Surgical tracheostomy performed
27	Complete discontinuation of intravenous sedation
40	Tracheostomy decannulated
41	Transferred out of intensive care unit
48	Discharged from hospital

DIAGNOSTIC ASSESSMENT

Chest radiograph revealed extensive bilateral mid to lower zone confluent opacity and mild right effusion. Physical examination and chest radiograph suggested a diagnosis of community-acquired pneumonia. Given the persistently low peripheral oxygen saturation despite supplemental oxygen, further imaging was undertaken. CT scanning of the thorax demonstrated an extensive consolidation of the lower lobes bilaterally, lateral segment of the middle lobe and the basal segments of the upper lobes bilaterally, with moderate volume right pleural effusion. Other relevant results (with lab reference ranges) included: CRP 467mg/L (0–5mg/L), WCC $1.0 \times 10^9/L$ ($4.11 \times 10^9/L$) with neutropenia $1.14 \times 10^9/L$ ($1.8\text{--}7.5 \times 10^9/L$) and serum sodium of 126 mmol/L (133–146 mmol/L). There was no notable diagnostic challenge in this case, as she had timely access to necessary imaging and laboratory investigations. A working diagnosis of severe pneumococcal pneumonia was later confirmed with urine antigen testing and blood culture (positive for streptococcus pneumoniae).

THERAPEUTIC INTERVENTION

Oxygen supplementation was insufficient to maintain adequate oxygenation, necessitating transfer to the ICU for initiation of high flow nasal oxygen therapy and a trial of continuous positive airway pressure (CPAP), with a low threshold to escalate to invasive positive pressure ventilation (IPPV) if clinical deterioration persists.

Despite non-invasive respiratory support, her condition worsened, requiring sedation, tracheal intubation, and invasive ventilation 48-hours after presentation. Quintuple sedation with intravenous opiates, propofol, benzodiazepines, clonidine, and ketamine were used to facilitate neuromuscular blockade, prone ventilation, suppress respiratory drive, and tolerate inverse-ratio ventilation. The extent of bilateral consolidation and refractory hypoxemia ($P_{aO_2}/F_{iO_2} < 150\text{mmHg}$) in the setting of severe ARDS necessitated the use of prone ventilation to improve oxygenation by optimising ventilation-perfusion matching along with inverse ratio ventilation to enhance alveolar recruitment.

Tracheostomy was considered likely on ICU-day-11 due to ongoing high ventilatory and oxygen requirements and a transthoracic echocardiogram demonstrating moderate probability of pulmonary hypertension associated with the acute illness. However, she was not considered stable enough for the procedure until ICU-day-20. Our Unit does not use hard cut-offs to determine suitability

for percutaneous or surgical tracheostomy, but an improving overall trajectory, inspired oxygen concentration of less than 50%, PEEP of less than 10cm H₂O, a driving pressure of less than 20 cmH₂O, and cardiovascular stability are typical metrics that indicate an appropriate balance of support and physiological reserve to tolerate the procedure. Bedside PDT can occur whilst other ICU therapies are continued, such as haemodialysis, whereas surgical tracheostomy also requires a window of stability in which these therapies could be suspended temporarily. A bedside ultrasound revealed a prominent anterior jugular vein and significant residual soft tissue oedema, leading to a referral to the head-and-neck surgical team for surgical tracheostomy. However, surgical tracheostomy was delayed for various reasons until ICU Day 25.

The delay was most attributed due to (an understandable) reluctance to undertake the procedure “out of hours” (including over a weekend), availability of an appropriately senior surgeon and assistant, and competition with urgent and emergency cases in the emergency theatre suite.

FOLLOW UP AND OUTCOME

The daily preparation for theatre and repeated cancellation of the procedure led to notable changes in ICU management including:

- Continued administration of significant amounts of sedation.
- Prolonged presence of an oral trans-laryngeal tracheal tube.
- Initiating and discontinuing enteral feeding and associated insulin infusions, including pre-operative fasting periods.
- Adjustments to prophylactic anticoagulation.

Following successful surgical tracheostomy, all intravenous sedation was reduced and stopped within 48 hours of the tracheostomy (ICU-day-27) and the patient gradually weaned from ventilatory support. No adverse events were reported during this period. She was successfully decannulated on ICU-day-40 and discharged to the respiratory ward and then home. We are pleased to report that she has subsequently made a full recovery, returned to work and co-authored this paper.

DISCUSSION

This case highlights the impact of delays when a surgical tracheostomy is required. To our knowledge, our report is the first to detail the additional sedation burden required when delays occur, and to discuss the impact of the delay on the patient, their family and the hospital system. However, the generalizability of findings from a single case is inherently limited, underscoring the need for future research in larger patients' cohorts.

The ideal timeline for tracheostomy is to undertake the procedure as soon as it becomes clear that tracheostomy is indicated.⁸ Delays beyond this point have been associated with adverse outcomes including prolonged mechanical ventilation, increased ICU length of stay, greater sedation exposure, and higher healthcare costs.^{10,11} Published data from the recent COVID-19 pandemic suggests the mean delay from decision to performing surgical tracheostomy is between 3–5 days, with similar logistical challenges to those highlighted in our case.² The 5-day delay in this case, fell within this range but had a measurable impact on both clinical management and hospital resources.

This case adds unique value by quantifying the financial burden of sedation during the delay. The sedation costs alone totalled £4,541, representing 12.2% of that month's sedation expenditure in our ICU (Table 2). This granular costing data is rarely reported in the literature and illustrates the downstream economic effects of procedural delays.¹²

Additionally, this case underscores the real-world operational constraints that contribute to delays—weekend service limitations, prioritisation of emergency cases, and availability of senior staff. These barriers are often acknowledged but rarely illustrated in

Table 2. Sedation Costs and Doses During Total ICU Stay and the 5-Day Delay in Surgical Tracheostomy

Sedative Agent	Total ICU Stay (41 Days)		Delay Period (5 Days)		Proportional Impact	
	Cost (£)	Dose (g)	Cost (£)	Dose (g)	Of Total ICU Dose (%)	*Of ICU Monthly Drug Budget (%)
Alfentanil	1,327	2.28	405	0.696	30.5%	15.1%
Morphine Sulphate	1.38	1.82	3.50	1.40	76.9%	24.3%
Midazolam	155	3.53	7.40	0.168	4.8%	0.9%
Propofol	276	154	51	28	18.2%	6.6%
Diazepam	0.33	0.033	0.25	0.025	75.8%	11.2%
Ketamine	209	20.5	85	8.16	39.8%	34.0%
Total	1,969	–	552	–	30.5%	12.2%

*Delay expenditure is expressed as a percentage of the total ICU drug budget for sedation for the corresponding month in a 23-bed ICU. Proportional dose values represent the percentage of each agent's total ICU dose administered during the 5-day surgical tracheostomy delay period.

depth through case-based evidence. It is essential to acknowledge that while such constraints are understandable, they have a compounding effect on patient recovery, sedation burden, and ICU throughput.

From the patient's perspective, the prolonged sedation period contributed to her post-emergence delirium. Furthermore, an extended duration of trans-laryngeal intubation increases the risk of laryngeal trauma, delays verbal communication, and impairs secretion management, which may lead to microaspiration and secondary infections.^{13,14} This aligns with evidence suggesting that early tracheostomy could reduce the incidence of ventilator-associated pneumonia and facilitate more rapid weaning from both sedation and mechanical ventilation.^{15,16}

From a family's perspective, delays can be incredibly stressful and frustrating.¹⁷ In this case, the patient's family expressed understandable frustration that surgical demands from other departments appeared to take precedence over their daughter's needs. This experience reflects broader findings that relatives of critically ill patients in the ICU frequently report high levels of anxiety, depression and stress – factors that may be further exacerbated by procedural delays.^{17,18}

In terms of hospital systems, prolonged ICU occupancy due to delays in tracheostomy placement consumes valuable critical care resources. At approximately £3,000 per day, an additional 5–7 days in ICU has significant cost implications, particularly during periods of bed shortages.¹⁹

We propose several practical recommendations informed by this case:

- **Early anatomical assessment:** Perform neck ultrasound and clinical assessment within the first week of ICU admission for patients likely to require prolonged ventilation.
- **Standardized protocols:** Develop multidisciplinary protocols for perioperative management, including standardised criteria for stopping enteral nutrition and anticoagulation in preparation for surgical tracheostomy.
- **Innovative technology:** Explore the use of image-guidance systems to increase clinician confidence in performing percutaneous tracheostomy, even in challenging anatomies.⁶

In conclusion, this case demonstrates that understandable delays in performing surgical tracheostomy can compromise patient care, contribute to emotional distress for families and impose eco-

nomic burdens on hospital systems. Innovations that broaden the safe application of ICU-based percutaneous tracheostomy may help mitigate such delays and enhance clinical outcomes. Furthermore, local quality improvement efforts and national audits should consider decision-to-procedure interval as a potential metric of care quality.

PATIENT PERSPECTIVE

"I went from being relatively fine to being apparently not well very quickly, in a space of Friday being at work to being admitted on a Wednesday and to being intubated the following day or so. I woke up couples of weeks later having had a tracheostomy. It was hard because waking up from sedation and not really knowing what was going on, I was still on some quite serious ketamine effect. I was seeing things nobody should see, and confusion was the main one. I learnt they had to wait for about 1 week to put the tracheostomy tube in because I believe I got a slightly unique physiology. This was particularly hard for my mum who is a nurse, but it was fine at the end."

Informed Consent

This case report was published with the written consent of the patient and as a co-author.

Funding sources

This research is part-funded by the National Institute for Health and Care Research (NIHR) Invention for Innovation (i4i) programme (NIHR206447) and HealthTech Research Centre in Emergency and Acute Care. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care. NIHR206447 is a programme of research to develop safer systems for bedside PDT in ICU.

Submitted: March 19, 2025 EST. Accepted: June 12, 2025 EST. Published: June 30, 2025 EST.

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