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Original research article

Post-extubation dysphagia in intensive care – a prospective observational study

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Abstract

Purpose: Dysphagia may occur in all critically ill patients, and large-scale clinical data show that post-extubation dysphagia (PED) is commonly observed in intensive care unit (ICU) patients. The study aimed to determine how dysphagia is diagnosed after extubation, and what factors influence the incidence of dysphagia after invasive airway support in selected ICUs.

Methods: A prospective observational study was conducted for five months (07/2023 to 11/ 2023), in the acute ICU and long-term ICU of the Teaching hospital in the Czech Republic.

Results: Of the 101 extubated patients in the study, only 27.7% (n = 28) were examined by a physician, and PED was confirmed in 26.7% (n = 27), representing 99% of all extubated patients. Age, gender, and ICU type were not significantly related to PED occurrence. However, the type of airway management ($p < 0.001$), duration of mechanical ventilation ($p = 0.017$), and main diagnosis ($p < 0.001$) were significantly associated with PED occurrence.

Conclusion: The study confirmed the underdiagnosis of PED in ICU patients post-extubation. Higher PED incidence was linked to tracheostomy + endotracheal cannula use, mechanical ventilation longer than 9 days, and neurological diagnoses. Training health professionals to identify PED symptoms is essential to establish uniform procedures for diagnosing and preventing PED-related complications.

Keywords: Intubation; Mechanical ventilation; Post-extubation dysphagia

Introduction

Post-extubation dysphagia (PED) is defined as the difficulty or inability to transfer food and liquid effectively and safely from the mouth to the stomach following extubation. It commonly occurs in patients with trauma and those in critical care requiring endotracheal intubation or tracheostomy for mechanical ventilation (Rassameehiran et al., 2015). A meta-analysis by McIntyre et al. (2021) demonstrated a prevalence of PED in 41% of critically ill adults. The mechanisms of PED are multifactorial and include mechanical causes, cognitive impairments, and residual effects of narcotics and anxiolytic medications. Mechanical causes appear to be the primary mechanism underlying swallowing dysfunction and are directly related to the duration of intubation and the size of the endotracheal tube. These factors cause mucosal inflammation leading to loss of its architecture, atrophy of the oropharyngeal musculature due to disuse during intubation, decreased proprioception, reduced laryngeal sensation, and laryngeal injury, which can result in oedema, granuloma formation, or vocal cord paralysis (Brodsky et al., 2014). Another relevant aspect is the presence of weakness and muscle atrophy due to immobility, prolonged sedation, or neuromuscular blockers, which can affect the swallowing apparatus. Traumatic brain injury or critical illness may also cause PED at the central level by damaging peripheral and bulbar nerves, altering cognition, or dysregulating the swallowing reflex (Rassameehiran et al., 2015).

PED can result in aspiration and subsequent complications such as aspiration pneumonia, chemical pneumonia, transient hypoxaemia, bronchospasm, or mechanical obstruction with atelectasis. Consequently, it leads to malnutrition, prolonged hospitalization, financial burden, and increased mortality (Macht et al., 2011; Schefold et al., 2017; Zielske et al., 2014). While standardized protocols have been established to systematically assess dysphagia in acute stroke patients and are recommended by guidelines (Dziewas et al., 2021), no such protocols or guidelines have been published for the intensive care unit – ICU (Spronk et al., 2022). Since post-extubation dysphagia is not routinely screened in most intensive care units, PED appears to be an under-recognized healthcare problem, potentially due to limited awareness among healthcare professionals (Zuercher et al., 2019). Early detection of PED is crucial to reduce the rate of complications. The diagnosis of dysphagia is based on screening assessments of swallowing to determine the need for further instrumental examination. The standard

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assessments for oropharyngeal dysphagia are the Videofluoroscopic Swallow Study (VFSS) and the Flexible Endoscopic Evaluation of Swallowing (FEES); these diagnostic methods allow for real-time visualization of all stages of swallowing (Troll et al., 2023).

The study aimed to determine how dysphagia is diagnosed after planned extubation and the factors that influence the incidence of dysphagia after invasive airway support, using endotracheal and tracheostomy tubes in selected intensive care units of a teaching hospital.

Materials and methods

Study design

To obtain the necessary data, a prospective observational study was conducted over a period of 5 months (07/2023 to 11/2023) in the acute ICU and long-term ICU of the Teaching Hospital Brno. The collected data were anonymized and recorded in a custom-designed data sheet with predefined sections, including demographic information, data related to airway management, and dysphagia diagnosis (see more in data collection description section below).

Inclusion criteria

Patients older than 18 years, hospitalized in acute ICU and long-term ICU in the same healthcare facility, who had an endotracheal or tracheostomy tube inserted for at least 24 hours as a form of invasive airway management during their hospitalization, and were scheduled for extubated during the study period were included in the study.

Exclusion criteria

Patients younger than 18 years, those with a cerebrovascular injury including stroke, patients without invasive airway management, and those with a pre-existing diagnosis of dysphagia before the current hospitalization were excluded from the study.

Data collection tools and timing description

For evaluating the dysphagia status in the study patients the following test was used.

The Gugging Swallowing Screen (GUSS) is a tool to screen aspiration risk for suspected dysphagia. The GUSS was used for three hours with an interval of one hour after extubation. The GUSS consists of two stages: a non-swallow clinical screening followed by a direct bolus-swallowing assessment. In the first stage, patients are evaluated on their ability to stay vigilant for 15 minutes, perform a voluntary cough, and swallow saliva without any changes in their voice or drooling. Patients who score ≥5 on this initial assessment move on to the second stage, which tests their swallowing ability using three types of boluses. The test begins with a non-liquid bolus (pudding), starting with one-third to one-half of a teaspoon, followed by five more half-teaspoon portions. This is followed by liquid water, beginning with 3 ml, and progressively increasing to 5, 10, 20, and 50 ml. The final test involves solid dry food, repeated five times. The second stage is stopped if any of the four aspiration signs – delayed or absent swallowing, coughing, drooling, or voice change – are observed. The GUSS scoring system categorizes the severity of swallowing impairment and provides dietary recommendations. A score between 0 and 9 points indicates a high risk of aspiration, requiring full nasogastric tube feeding, which means no food intake by mouth, while a score of 20 suggests normal swallowing ability with no restrictions on oral intake, including full liquid consumption (Trapl et al., 2007).

FEES is an endoscopic method used for the examination of oral transport and the pharyngeal phase of swallowing. FEES was subsequently performed within three hours of a positive GUSS result. Visualization of the swallow using FEES involves introducing a flexible nasopharyngolaryngoscope into the pharynx. FEES provides an extensive view of the pharyngeal phase of swallowing and enables the detection of indirect signs of impairment within the oral and esophageal phases. The aims of FEES are, in particular, to identify pathological movement patterns, assess the effectiveness and safety of swallowing, determine suitable food consistencies or forms of nutrition, and guide the use of therapeutic maneuvers for each patient (Dziewas et al., 2016).

Statistical analyses

IBM SPSS Statistics version 28.0 was used to process the data. For the evaluation of the association between categorical variables, Fisher's exact test was used. Continuous data were assessed using the Mann–Whitney *U* test concerning the observed categories. Statistical significance was considered at a 5% significance level.

Ethical aspects

The study was conducted according to the Declaration of Helsinki. Consent for the research was obtained from the hospital management. Anonymity of the respondents was safeguarded as the healthcare professional conducting the studied used data from patient's health records within their facility.

Results

Participant characteristics

A total of 101 patients who were scheduled for extubation and extubated during the study period were included in the analysis. The demographic characteristics of the involved patients are presented in Table 1.

Table 1. Demographic characteristics of the study participants (*n* = 101)

Age (years)	mean 58.7; min. 21; max. 89	
Gender		
Women	46	45.5
Men	55	54.5
Main hospitalization diagnosis (based on ICD-10 codes)		
Neurological	20	19.8
Traumatological	9	8.9
Respiratory	27	26.7
Metabolic	19	18.8
Cardiovascular	26	25.7
Airway management		
Tracheostomy cannula	7	6.9
Endotracheal cannula	70	69.3
Tracheostomy + Endotracheal cannula	24	23.8
Type of intensive care		
Acute ICU	91	90.1
Long-term ICU	10	9.9
Patients with diagnosed PED		
Acute ICU	23	25.3
Long-term ICU	4	40.0

The majority of patients were hospitalized in an acute ICU, with most receiving mechanical ventilation support via endotracheal tube.

Of the total cohort of 101 (100%) patients, only 27.7% (n = 28) were examined by a physician after elective extubation, and PED was confirmed in 26.7% (n = 27) of patients. This means that PED was confirmed in 99% of all extubated patients who were examined. The GUSS test was used to diagnose PED in 25 patients (24.8%) with a mean GUSS screening test score of 11.88 (moderate dysphagia with a high risk of aspiration). The lowest value indicating a severe swallowing disorder was 5 points, and the highest measured value was 19 points. In 10 patients, PED was confirmed using the FEES instrumental examination based on positive GUSS results. In an additional 2 patients, PED was diagnosed via FEES without prior use of the GUSS test. No other screening tool or other examination methods were used for further diagnosis. All diagnostics were subject to the individual physician on duty's personal clinical judgment. There was no other specialist involved in the PED examination (e.g., speech and language therapist, physiotherapist, intensive care nurse specialist), and no uniform process for PED identification was in use.

Association between selected sociodemographic factors and the incidence of PED

Age and gender were not associated with the occurrence of PED. Also, no significant difference in the incidence of PED between acute and long-term ICU was confirmed.

Association of selected factors in airway management

The type of airway management, duration of mechanical ventilation, and the underlying diagnosis had a significant impact on the occurrence of PED (see Table 2). All patients (n = 101) involved in the study had a nasogastric probe inserted during mechanical ventilatory support. Due to the number of patients and the main study aim of identifying the tools and methods of PED diagnostics, no other factors were studied and analysed.

Table 2. The incidence of PED in relation to sociodemographic factors and factors in airway management

Factors	Groups	Positive PED	*P*-value
Gender	Women	26.1%	0.871
	Men	27.3%	
Age	mean 58.7	mean 59.0	0.893
Type of intensive care	Acute ICU	25.3%	0.318
	Long-term ICU	40.0%	
Airway management	Tracheostomy cannula	42.9%	**<0.001**
	Endotracheal cannula	11.4%	
	Tracheostomy + Endotracheal cannula	66.7%	
Artificial pulmonary ventilation time	Average time 8.8 days	Average time of 9 and more days	**0.017**
Main diagnosis	Neurological	70.0%	**<0.001**
	Traumatological	0.0%	
	Respiratory	18.5%	
	Metabolic	26.5%	
	Cardiovascular	11.5%	

Discussion

PED is a common issue in ICUs, yet there are no national or international guidelines for its prevention, screening, and treatment available in the Czech Republic. Our prospective observational study investigated the methods of PED diagnosis in a selected group of patients scheduled for extubating at intensive care units in one of the largest teaching hospitals in the Czech Republic. The prospective observational study revealed inadequate PED diagnostics, with only 27.7% of patients screened using a screening tool, and the diagnosis being based solely based on the clinical judgment of healthcare providers. A survey by Marian et al. (2018) indicated lower awareness of dysphagia issues among ICU physicians compared to those in neurological ICUs. Other studies also confirm insufficient awareness of PED, often reporting a lack of assessment protocols and screening procedures in intensive care units. Mpouzika et al. (2023) found that over 85% of Greek-Cypriot ICUs lacked a standard screening protocol for PED, with the issue being significantly underestimated. A prospective study by van Snippenburg et al. (2019) showed that PED screening is not regularly conducted in Dutch ICUs, and nearly half lacked diagnostic, therapeutic, or rehabilitation protocols, despite recognizing PED as a significant and relatively common problem in ICUs with potentially serious consequences for patients.

In our study, the most used tool for PED assessment was the GUSS screening tool (in 24.8% patients). The primary advantage of GUSS is its simplicity and multi-consistent nature, allowing dietary recommendations based on the achieved score. In dysphagic patients, the risk of penetration and aspiration during swallowing varies with bolus consistency, with thin liquids posing a higher risk compared to more viscous consistencies (Troll et al., 2023). Therefore, timely dysphagia screening post-extubation and regular reassessment should be standard practice in ICUs. Bedside swallowing function assessment has recently demonstrated good accuracy in detecting PED in critically ill patients post-extubation (Maamar et al., 2022). Although FEES and VFSS are the gold standards for PED diagnosis, they are not always available to patients due to

capacity constraints of the healthcare facility (Maamar et al., 2022). VFSS carries the risk of radiation exposure and requires patient transfer to the radiology department, which is more challenging for patients' post-ICU tracheal intubation. Currently, the commonly used clinical method for assessing swallowing dysfunction is bedside assessment (Xia and Ji, 2023).

A systematic review by Perren et al. (2019) suggests that systematic screening of all potential PED patients in ICUs is key for early detection and monitoring, as well as for designing and testing new therapeutic interventions. Research outcomes indicate significant variability in PED screening methods and clinical assessments, prompting an international expert panel to address definitions of critical illnesses, screening approaches, confirmatory evaluations, treatment recommendations, and identify optimal patient-centered outcomes for future clinical trials. The absence of a standard protocol for PED screening and its potential impact on patient health highlight the urgent need for the development of international guidelines for PED screening and treatment (Mpouzika et al., 2023; Perren et al., 2019).

Significant factors influencing PED incidence in our study included the duration and type of airway management, with patients having a tracheostomy tube for an average of 9 and more days showing higher PED incidence. This is corroborated by meta-analysis findings that identified intubation and tracheostomy duration as significant risk factors for post-extubation dysphagia (Hou et al., 2023). Tracheostomy can disrupt vocal cord reflexes, cause laryngopharyngeal coordination issues, and lead to mucosal inflammation, resulting in tissue architecture loss observable within 24 hours (Pandian et al., 2024). All the above-mentioned symptoms must be evaluated immediately after extubating and could be identified by specialist intensive care nurse who spent a majority bedside time. The authors are aware that other relevant factors could also play an important role in PED incidence, however we were mainly focused on the diagnostic and tools for early PED identification.

Critically ill patients experience muscle mass loss and rapid skeletal muscle atrophy in the limbs due to immobility during intensive care, significantly reducing muscle strength (Sidiras et al., 2019). Patients whose coordination and muscle strength are additionally impacted by ICU hospitalization and chronic neurological conditions may have a higher incidence of PED, as confirmed in our results. Schefold et al. (2017) also reported a higher number of neurological patients with PED, speculatively linking some cases to specific conditions such as stroke or injury. Based on this knowledge, we excluded patients with stroke or previously diagnosed dysphagia from our study for more accurate ability to discriminate other than acute neurological brain injury of ischemia as well as bleeding. Thus, in our study we also excluded patients after brain injury, as we expected this would negatively impact the validity of results due to a higher incidence of PED before the ICU hospitalisation.

All patients in our research sample received enteral nutrition via a nasogastric tube. Post-extubation, 78.3% of patients retained the nasogastric tube. The nasogastric tube is an additional risk factor for PED, causing delayed laryngeal elevation, oesophageal sphincter insufficiency, and swallowing difficulties (Tang et al., 2023). It is even more alarming that the patients with nasogastric tube were not examined for PED even later as we could expect the higher risk of aspiration.

Due to inconsistent procedures, researchers are attempting to create a PED risk prediction model in intensive care based on the available scientific information. Xia and Ji (2023) and Chen et al. (2024) both indicate a high probability of PED occurrence in ICU patients with intubation, aged ≥65 years, APACHE II score ≥15, tracheal intubation duration ≥72 hours, and nasogastric tube duration ≥72 hours. However, these models are prone to bias due to numerous limitations in their development and lack of external validation. In our study, we did not confirm an age-dependent prevalence of PED. This may be due to the small sample size and a potential bias, as the youngest patient with PED was 22 years old. A significantly higher incidence of PED was observed in patients with an endotracheal tube inserted and located in place for 9 days or longer. Neurological diagnosis was significantly associated with PED prevalence.

The main study aim focused on the identification of the tools and methods of PED diagnostics. Thus, we only analyzed a limited number factors. In future research, it could be beneficial to investigate other possibly PED relevant and related factors (such as secondary hospitalization diagnosis and comorbidities, or previous type of care – if a patient was admitted from another healthcare facility, which was not the case in our study).

A PED diagnosis is crucial in critically ill patients, especially those who require prolonged mechanical ventilation. PED is associated with serious complications, such as aspiration pneumonia, malnutrition, and prolonged hospital stays. Early detection of PED using the GUSS screening tool or FEES enables healthcare professionals to implement timely interventions, including swallowing therapy, dietary adjustments, and the use of specialized feeding techniques to prevent further complications. Given the patient's previous treatment and condition, it is important to assess the quantitative component of consciousness and the patient's level of psychomotor activity before the PED screening, for example using the Richmond Agitation and Sedation Scale. PED diagnosis is particularly important in patients with underlying neurological conditions, where the risk of dysphagia is heightened. Identifying PED early also contributes to better patient outcomes by reducing the likelihood of readmission and improving the overall recovery process. It also facilitates more efficient resource use within healthcare settings by preventing avoidable complications and reducing the length of intensive care unit stays. Given its association with significant morbidity, the diagnosis of PED should not be overlooked. By implementing thorough assessments, clinicians can improve the quality of care and enhance the safety and well-being of patients who have undergone extubation.

Strengths and limitations of our study

The main strength is that this was an unicentric study, where all data were collected by the person who cared for the hospitalized patients. Therefore, the data can be expected to be more accurate.

Due to inadequate PED diagnostics in the overall research sample, it was not possible to determine PED prevalence rates in the selected ICU units during the five-month observation period. Therefore, it is not feasible to compare the studied incidence nor prevalence with other studies, and the results could not be generalized to a broader population. A multicentric study would be beneficial to provide more data for quality care improvement.

Conclusion

The study verified the underdiagnosis of PED in ICU in a selected group of patients after planned extubation. We found

that the process of PED examination and identification relies on personal clinical judgment. So far, there are no uniform processes in operation in the Czech Republic. As most symptoms of PED are relatively easy to identify, it could be incorporated in the specialized nursing education. Nurse specialist in intensive care must be able to screen the patients to be able to inform other professionals how to proceed and provide further investigation of possible complications. It is necessary to train health professionals in the issue of PED and its complications to be able to establish uniform procedures for more safety care and higher professional satisfaction of care providers. Among the most suitable tools for the early screening of PED, we identified the GUSS test, which should be followed up by the FESS and VFSS in patients with PED symptoms. The main problem in the prevention of PED is related to the ability to take food and the risk of aspiration. Proper PED assessment allows early identification of cognitive changes in patients with communication problems.

Authors' contributions

SS: conceptualization, design, methodology, data management, formal analysis, interpretation, supervision, writing original draft, and editing. *VB:* investigation and data collection, data management and writing the original draft. *AP:* interpretation, supervision, writing the original draft.

Ethical aspects and conflict of interest

The authors have no conflict of interest to declare.

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