Prevalence, Pathophysiology, Diagnostic Modalities, and Treatment Options for Dysphagia in Critically Ill Patients

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Abstract: Postextubation dysphagia may impose a substantial burden on intensive care unit patients and healthcare systems. Approximately 517,000 patients survive mechanical ventilation during critical care annually. Reports of postextubation dysphagia prevalence are highly variable ranging between 3% and 93%. Of great concern is aspiration leading to the development of aspiration pneumonia when patients resume oral feeding. Screening for aspiration with a water swallow test has been reported to be positive for 12% of patients in the intensive care unit after extubation. This review aims to increase awareness of postextubation dysphagia and provide an updated overview of the current knowledge regarding prevalence, pathophysiology, diagnostic modalities, and treatment options.

Key Words: Dysphagia, Deglutition, ICU, Critical Care, Intubation, Screening, Assessment, Treatment, Review


Dysphagia (i.e., swallowing disorder), often identified after removal of an endotracheal tube for mechanical ventilation in the intensive care unit (ICU, postextubation dysphagia [PED]), may impose substantial burdens on ICU patients and healthcare systems. Annually, there are approximately 517,000 patients in the United States who survive mechanical ventilation during critical care,1 but the exact incidence of PED is unknown.2 Moreover, clinical practice is widely varied3,4 and the diagnosis of dysphagia is underreported.5–7

A systematic review reported a prevalence of PED between 3% and 62%.2 In neurologic populations who received a clinical evaluation after extubation, this prevalence may be as high as 93%.8 This wide range is likely due to heterogeneity in study design, patient population, diagnostic method, timing of assessment, and outcome definition. Moreover, the evidence quality from all included studies was low because of the high risk of bias from study method limitations including small sample sizes.2 Despite these shortcomings, the systematic review highlighted the need to focus efforts toward greater understanding in a large patient population where there was little agreement for how to approach screening, diagnosis, and treatment of dysphagia.5,9 Currently, research and clinical programs address these issues. This review aims to increase awareness of PED and provide an updated overview of the current knowledge regarding prevalence, pathophysiology, diagnostic modalities, and treatment options.

IMPORTANCE OF DYSPHAGIA POSTEXTUBATION

The foremost concern held by clinicians is aspiration leading to the development of aspiration pneumonia when patients resume oral feeding.10 A recent study in a large, mixed, ICU population of 933 patients after extubation reported a positive water swallow test (WST) in 12%, suggesting aspiration.11 After a repeated WST by a speech language pathologist (SLP) or physiotherapist, a presumed aspiration prevalence of 10% was found at ICU discharge. Although the sample was large, a shortcoming of this study was that physiologic swallowing impairments and their potential result of airway invasion were not confirmed by instrumental assessment, suggesting an underestimated prevalence of both.12 To this end, several studies have demonstrated prevalence as high as 25% of patients who silently aspirate (i.e., no symptoms or observable clinical signs).13–15 Choking (i.e., obstruction of food or other foreign body in the pharynx or larynx that restricts the passage of air to the lungs), a symptom and clinical sign of dysphagia, is often overlooked. Though less frequent, choking is the fourth leading cause of death due to unintentional injuries.16–19

Several reports indicated the importance of dysphagia in the ICU and its impact on clinical trajectories, including the following: increased rate of pneumonia20–24 (though not reported by others14,15,25), days on antibiotic therapy,11 reintubation,11,21 tracheostomy,22 prolonged length of ICU11,20,24 and hospital stay,11,20-22,24,26,27 increased rate of ICU readmission,11 increased in-hospital mortality,11,21,22,24,26,27 28- and 90-day mortality,11 and increased resource use among patients with PED as compared with patients without PED. When adjusted for age and disease severity, moderate and severe PED were independently associated with the composite outcome of pneumonia, reintubation, and death.24 Controlling for age, sex, disease severity, and length of mechanical ventilation, 28- and 90-day mortality was independently associated with dysphagia.11 Patients with PED had a delayed return to oral feeding and an increased rate of tube feeding/placement.11,21-23,24 They were also discharged less often to home and instead to a rehabilitation center, nursing home, or another hospital.11,21,22,24 Postextubation dysphagia at the time of hospital discharge is common. One study found that dysphagia was still present at

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hospital discharge in 17% and 55% of patients with mild and moderate to severe dysphagia, respectively.\textsuperscript{21} Another study demonstrated that 32% of patients after oral endotracheal intubation for acute respiratory distress syndrome reported clinically important dysphagia symptoms at hospital discharge. At 6 mos of follow-up, 23% of those reporting symptoms at discharge still reported clinically important dysphagia, but all recovered at 5-yr follow-up.\textsuperscript{28} In patients with a tracheostomy, swallowing dysfunction is associated with a significant delay of decannulation.\textsuperscript{29}

**AWARENESS OF DYSPHAGIA**

Postextubation dysphagia is well recognized as a common sequela of intubation and can have serious consequences. Although ICU physicians are aware of the importance of PED and consider it a relevant issue,\textsuperscript{30,31} it is remarkable that several surveys report that only a few hospitals use a standardized screening protocol in all patients.\textsuperscript{3,30} An online survey in 528 respondents from 69 countries showed that only 28% of the ICUs use a specified dysphagia-related protocol.\textsuperscript{30} Similarly, 22% of ICUs in the Netherlands use a protocol to screen all extubated patients.\textsuperscript{31} According to a national survey of American Speech-Language-Hearing Association–certified SLPs working in ICUs, 41% of the hospitals use bedside screening protocols.\textsuperscript{3} A prospective, multisite, cohort study found that the two sites that did not have a swallow assessment (i.e., swallow screening or videofluoroscopic swallow study [VFSS]) protocol in place completed an assessment in 24% of acute respiratory distress syndrome patients after extubation. The remaining site with a nurse assessment and SLP referral algorithm assessed 53% of these patients.\textsuperscript{4} Collectively, these percentages indicate that although clinicians recognize the relevance of dysphagia, many ICUs do not seem to address PED per protocol in clinical practice and there is no standardized approach to screening and/or assessment, despite prevalence of PED exceeding 60%.\textsuperscript{2,3,32} Priority to other clinical factors related to ICU patient care, such as hemodynamic stability, weaning from mechanical ventilation, and oxygen requirements, might explain these low numbers.

An increased awareness of PED will lead to earlier assessment and intervention, possibly resulting in improved outcomes, but clinical recognition of patients most at risk for dysphagia may not be clear. Two of the largest areas of disagreement published in the research literature until 2010 are age and intubation duration.\textsuperscript{2} Age is a highly reviewed variable across adult patient populations with dysphagia.\textsuperscript{33–36} A consensus for whether age is associated with PED may not be apparent. Age has been analyzed using different methods with mixed results. It is when specific ICU patient populations are studied that differences emerge. Mixed medical and surgical\textsuperscript{14,21,28,37,38} and neurological\textsuperscript{8} patient populations do not seem to have an association, whereas cardiac\textsuperscript{30,39–41} and trauma\textsuperscript{15,42,43} patient populations may have an association with age.\textsuperscript{25}

Intubation duration and the effect it has on the prevalence of dysphagia are often discussed in both research and clinical forums as an elusive risk factor, leading to arbitrary cut points in time for swallow screening and assessment.\textsuperscript{3} Despite decades of controversy,\textsuperscript{2} the association of dysphagia frequency and severity with increased duration of intubation is indeed strongly supported by more recent studies.\textsuperscript{8,21,23,38,44} In part, this may be due to concomitant occurrence of ICU-acquired weakness with inherent swallowing muscle weakness and pharyngeal sensation loss.\textsuperscript{45–48} Similarly, ICU patients are often bed bound with limited movement.

Differences for the awareness of dysphagia in the ICU may exist among patient populations. Clinicians in the ICU may be more sensitive to a higher prevalence of dysphagia among stroke patients because decades of research have established a high prevalence and public awareness maintains a high level of awareness in this patient group. Interestingly, the prevalence of patients intubated annually exceeds new occurrences of stroke.\textsuperscript{49–51} An increased awareness may also apply to patients with other neurological diseases, for example, neuromuscular diseases,\textsuperscript{22} patients with head and neck cancer,\textsuperscript{53} or those with a tracheostomy.\textsuperscript{29} Indeed, an increased rate of swallow screening was reported in patients with a tracheostomy versus patients after extubation.\textsuperscript{31}

Awareness of ICU-acquired dysphagia continues to gain momentum and is underscored by its importance to patients and healthcare system resources.\textsuperscript{6,54} Intensive care unit physicians agree that dysphagia management could be improved and that there is a necessity to learn more about dysphagia assessment.\textsuperscript{30} Furthermore, an international group of ICU clinicians acknowledged that systematic screening of swallowing function requires further evaluation and placed ICU-acquired swallowing dysfunction on the intensive care medicine research agenda.\textsuperscript{55}

**PATHOPHYSIOLOGY**

Dysphagia in an ICU patient can be multifactorial. Dysphagia can be the direct result of the underlying disease requiring ICU admission, for example, brain injury\textsuperscript{56,57} or stroke.\textsuperscript{58,59} Dysphagia may also be acquired during ICU admission as a result of ICU care (i.e., iatrogenic). Treatments leading to iatrogenic dysphagia may include medications with their known (or unknown) adverse effects\textsuperscript{60} and intubation, whether through trauma during endotracheal tube placement or duration of the endotracheal intubation.\textsuperscript{8,13,21,23,38,44} A third reason for dysphagia is a preexisting swallowing disorder, which may be related to an underlying pathology, such as head and neck disease, radiation, or a neurological disease\textsuperscript{52,53,61} or completely subclinical and, therefore, unknown.\textsuperscript{62} In this latter group, a preexisting swallowing disorder may become apparent during ICU admission due to a decreased swallowing functional reserve\textsuperscript{53,64} or inability to compensate to sustain function. Although the pathophysiology of PED is not completely understood,\textsuperscript{55} several mechanisms have been proposed.\textsuperscript{66} More research into these mechanisms is warranted.\textsuperscript{2,3,11,28,67}

The first mechanism proposed is direct laryngeal injury caused by the endotracheal or tracheostomy tube. Laryngeal injury may be defined as mucosal lesions and/or fractures and dislocations of bony and cartilaginous structures in the supraglottic, glottic, and subglottic areas of the airway. For a long time, clinicians have known that laryngeal and tracheal injuries may be found in patients after extubation or decannulation\textsuperscript{66–71} and are likely the result of pressures and other forces placed on the tubes\textsuperscript{72–75} that may not be relieved simply
by repositioning the patient’s head.72 A recent systematic review reported that most patients have some degree of laryngeal injury, along with alterations in the patient’s voice (i.e., dysphonia).44 Minor injuries, such as erythema and edema, were most frequently observed. In approximately 95% of the patients, these injuries were observed in the interarytenoid space (i.e., the area where the endotracheal tube is situated). More serious injuries such as ulcerations and granulation tissue had a lower prevalence of 31% and 27%, respectively. Importantly, laryngeal injury is not only present after extubation but also shown to be associated with dysphagia44 and worse Penetration-Aspiration Scale (PAS) score.13,76

The second mechanism relevant for swallowing dysfunction in ICU patients is neuromuscular weakness. Intensive care unit–acquired weakness is common and has been associated with decreased patient outcomes.77 It has been proposed that swallowing dysfunction may be due to disuse atrophy,78 sarcopenia and malnutrition,79,82 and generalized muscle weakness.45 In a cohort of patients with a tracheostomy and critical illness polyneuropathy, the prevalence of dysphagia was high (20 of the 22 patients) but there was no association found between the 21 patients who improved and the presence of a tracheostomy tube.83 Muscle weakness also has been associated with symptomatic aspiration, residue, and PAS score higher than 1.84 More specifically, the tongue is an important muscle during swallowing. Although there is no clear evidence for an association of clinically assessed tongue dysfunction with aspiration in adults patients with dysphagia,85 there is evidence of weakness, extending to 2 weeks after extubation.86 Similar findings were reported in another study that also included lip strength.87

The third mechanism is a decreased oropharyngeal and/or laryngeal sensation. Somatosensory tongue dysfunction was found in patients after extubation.86 Specifically, light touch sensation, oral stereognosis, and 2-point discrimination were compared with an age-matched, non-ICU patient group. They found that all were impaired shortly after extubation and gradually improved within 14 days but remained below normal values. Another study reported no difference in oral sensation between groups with and without PED, although the sample size was small.84 During fiberoptic endoscopic evaluation of swallowing (FEES), laryngeal sensation is tested using the endoscope to touch the arytenoid cartilages to elicit the laryngeal adductor reflex (LAR). Although no association was found between LAR and penetration/aspiration or secretions in a mixed inpatient sample,88 decreased laryngeal sensation (absence of the LAR) in patients after extubation was found to be associated with aspiration.89 Findings from changes in LAR should be interpreted cautiously, considering the variability in pressures placed on the arytenoid mucosa by different clinicians to elicit the LAR.90 Another study in patients after extubation did not find an association between decreased laryngeal sensation and PAS score, which might also be due to the low sample size of 39 patients.13 Earlier, it was hypothesized that decreased sensation may be due to damage of the pharyngeal and laryngeal wall, linking laryngeal damage to an impaired sensation.37 Pharyngeal sensation is important in the triggering of the swallowing reflex, which may explain the swallowing reflex delay reported in patients after extubation as compared with ICU patients who have not been intubated.37 Besides laryngeal damage, altered sensation from the endotracheal tube,37 neurological impairment,8 medications frequently used in the ICU such as sedatives and anesthesia,37,92 and level of consciousness may affect pharyngeal and/or laryngeal sensation and the swallowing reflex.37,92

Impaired cognition and decreased consciousness are other important factors in PED. In an elective non-ICU setting, decreased orientation and inability to follow commands were reported to increase the odds of aspiration of liquids by 31% and 57%, respectively.93 In the ICU, many factors can contribute to a decreased orientation or consciousness, for example, (residual) effects of sedatives,37,66 delirium,66 and traumatic brain injury.95 Although delirium has been suggested as a potential contributor to dysphagia,94,95 there is stronger evidence that cognition may be the broader underlying factor.

The fifth mechanism is coordination between breathing and swallowing. The coordination of swallowing and laryngeal closure or the respiratory pause97 is important for the safety of swallowing and is slowly diminishing with increasing age.98,99 Opening of the larynx before the bolus has passed may lead to aspiration. During high respiratory drive, healthy subjects exhibited a shortened respiratory pause by ending the respiratory pause earlier when compared with the normal condition. This may compromise the safety of the swallow and may increase the risk of aspiration.100 In patients after extubation recovering from respiratory failure, this mechanism may be especially important.101,102 In a case study, a different coordination between breathing and swallowing was shown in a patient after extubation for respiratory failure.103

Though not strictly related to the development of swallowing dysfunction itself, the final mechanism that may be mentioned is gastroesophageal reflux, increasing the risk of aspiration in extubated patients. Whereas aspiration of colonized secretions from the oropharynx may cause aspiration pneumonia, aspiration of gastric contents may lead to aspiration pneumonitis, which is a different clinical entity.104 In-depth discussion of this entity is beyond the scope of this review.

The pathophysiologic mechanisms described previously do not typically occur in isolation. Patients often exhibit a combination of mechanisms, each uniquely contributing to clinical dysphagia, that is, any individual patient is characterized by a spectrum of mechanisms explaining individual dysphagia. This may explain some of the variability in prevalence and heterogeneity in study results. A study that used VFSS to investigate patterns of swallowing disorders in patients after long-term intubation (with and without a tracheostomy tube present) reported many different mechanisms: tongue dysfunction, dysfunction of the pharyngeal constrictor muscles, motility disorder of the upper esophageal sphincter, and a delayed swallowing reflex, among others. In some patients, a combination of these mechanisms was present.105 Accordingly, each patient is unique and the diagnostic and treatment approaches should be individualized to each patient’s needs.

**DIAGNOSTIC APPROACH**

Most patients with suspected PED will go through the logical progression from screening to diagnostic work-up to
intervention (Fig. 1). The first step, with most patients, is to screen for clinical signs and symptoms of dysphagia after extubation while considering the goals of assessment, patient status, and choice of screening tools. Before discussing screening, we must first draw the distinction between dysphagia (physiologic swallow impairment) and risk of aspiration (a result of physiologic swallowing impairments or dysphagia) at the screening level only. Oropharyngeal and esophageal dysphagia may not be appreciated during a clinical examination as readily as patient symptoms and clinical signs of laryngeal penetration and aspiration.36

**Screening**

Identification of patients at risk for swallowing impairments is the top priority after extubation. To this end, there are many screening tools for dysphagia106 and aspiration.12 Broadly, clinical symptoms or signs of dysphagia/aspiration include coughing, choking, throat clearing, and a wet gurgly voice. Introduction of liquids and foods that result in one or more of these patient responses indicates a failed screening and will thus require a more formal evaluation by an SLP. Few screening tools have been studied in ICU patient populations. We are only aware of three screening tests with data from patients assessed for PED—a bedside swallowing evaluation,107 the Yale Swallow Protocol,108 and the Postextubation Dysphagia Screening.109 Although the bedside swallowing evaluation, Yale Swallow Protocol, and Postextubation Dysphagia Screening each have a different method, all three maintain the same two premises: (1) assess the patient who is ready to be assessed regardless of time after extubation and (2) assess aspiration risk. The bedside swallowing evaluation, a test only administered by SLPs, uses common practice evaluation tools that include an oral motor/cranial nerve examination, administration of up to five liquid and food consistencies, and a 3-oz WST.107 The Yale Swallow Protocol uses three orientation questions and tests three simple commands before attempting a 3-oz WST.108 The Postextubation Dysphagia Screening begins with four steps to assure patient readiness, taking into consideration alertness, respiratory status, symptoms, and tubes before attempting a trial that uses a 3-oz WST.109 The Yale Swallow Protocol and Postextubation Dysphagia Screening may be completed by anyone with the proper training to do so. In many cases, nurses are responsible for screening patients after extubation.24,65,110 A fourth screening test, the Gugging Swallowing Screen, is being evaluated, but validation data for the ICU are yet to be published.111

**Assessment**

Once a patient has failed the swallow screening (i.e., presented with clinical signs of aspiration—coughing, choking,
wet vocal quality\textsuperscript{12}), an instrumental assessment is usually considered necessary. Goals for the instrumental assessment—typically either a VFSS or FEES—are to identify the reason(s) for impairments, determine a plan for how these impairments may be overcome, and make a recommendation for diet consistencies that are safe for the patient, whether by oral or nonoral means.\textsuperscript{112,113}

The execution of both the VFSS and FEES testing may be challenging for patients with critical illness. Among the challenges for performing VFSS are transportation of the patient from the ICU to the radiology department (unless a portable C-arm fluoroscope is available bedside); ICU clinicians/ personnel for transport, including concerns for equipment, patient stability, and resuscitation if necessary; and lines, tubes, and drains that may obscure the radiograph (e.g., central lines). Clinical concerns related to FEES include bleeding risk, level of agitation, and tolerance of the procedure. Specific to PED, FEES advantages include the following: portability into an ICU patient’s room, opportunity for a formal assessment of voice and laryngeal function after extubation when injury is expected,\textsuperscript{44} convenience of scheduling the SLP directly instead of multiple departments (i.e., radiology + SLP), and reduced cost (by comparison to VFSS). Although VFSS falls short in these respects, the physiologic data on the oropharyngeal swallow and views of the esophagus that are unavailable by FEES are advantageous.\textsuperscript{1,14,115} Ultimately, the decision to choose one instrumental assessment over the other depends on availability of the equipment to perform the procedure and the clinical questions that need to be answered, keeping in mind that the assessments are complementary and a referral to complete the other remains a viable option.\textsuperscript{116}

**APPROACH TO MANAGEMENT**

Although inconsistency of swallow screenings and referrals to SLPs for more formal assessment\textsuperscript{3,4} may suggest that swallowing is not a high priority among ICU clinicians, critically ill patients might disagree. A study of 115 patients who were awake and able to participate in a quality of life questionnaire during endotracheal intubation with mechanical ventilation in the ICU found that swallowing was a top priority; behind airway, breathing, and overall comfort and the ability to communicate with the medical staff and visitors.\textsuperscript{117} It is with this perspective that we must approach patients in the ICU. Moreover, the ICU team (i.e., critical care physicians and nurses) must work in a multidisciplinary team model that may include physiostatists, otolaryngologists, SLPs, and radiologists for evaluation and treatment of dysphagia and laryngeal or airway impairments, dieticians for nutritional needs, and gastroenterologists for esophageal and digestive issues, to name a few.

Therapy for dysphagia in the ICU—as in all patient populations—is approached as either compensatory or rehabilitative, with some techniques being both. Compensatory techniques make up for what the body cannot accomplish on its own but will not improve a patient’s physiology (e.g., strength). Examples of this include changes to food and/or drink consistencies and body postures. Rehabilitative techniques (e.g., exercises) are designed to improve specific physiologic impairments, moving toward normal (or typical).\textsuperscript{118–124}

The level of acuity of patients in the ICU will temper the astute clinician’s approach to the number of repetitions and sets of exercises and the duration of treatment sessions. Patients may not remain attentive for long periods, and they will tire quicker when compared with non-ICU patients. Frequently consulting with the patient’s nurse (and the medical team) will keep clinicians current on the patient’s condition and level of tolerance from day to day. Remaining flexible in this quickly changing environment will build rapport with the patient that allows for greater success and greater trust with the medical teams.

**CONCLUSIONS**

Postextubation dysphagia is common in the ICU and may remain unrecognized in the absence of pre-established protocols. Ameliorating PED is likely to reduce the morbidity and mortality associated with sequelae of dysphagia, most prominently aspiration pneumonia. Evaluation strategies are available and should be used as part of an individualized plan of care. Research efforts should continue and focus on further elucidating pathophysiology, optimizing screening, and individualizing treatment in this challenging population.

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