Recovery from Dysphagia Symptoms after Oral Endotracheal Intubation in Acute Respiratory Distress Syndrome Survivors

A 5-Year Longitudinal Study

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Abstract

Rationale: Nearly 60% of patients who are intubated in intensive care units (ICUs) experience dysphagia after extubation, and approximately 50% of them aspirate. Little is known about dysphagia recovery time after patients are discharged from the hospital.

Objectives: To determine factors associated with recovery from dysphagia symptoms after hospital discharge for acute respiratory distress syndrome (ARDS) survivors who received oral intubation with mechanical ventilation.

Methods: This is a prospective, 5-year longitudinal cohort study involving 13 ICUs at four teaching hospitals in Baltimore, Maryland. The Sydney Swallowing Questionnaire (SSQ), a 17-item visual analog scale (range, 0–1,700), was used to quantify patient-perceived dysphagia symptoms at hospital discharge, and at 3, 6, 12, 24, 36, 48, and 60 months after ARDS. An SSQ score greater than or equal to 200 was used to indicate clinically important dysphagia symptoms at the time of hospital discharge. Recovery was defined as an SSQ score less than 200, with a decrease from hospital discharge greater than or

equal to 119, the reliable change index for SSQ score. Fine and Gray proportional subdistribution hazards regression analysis was used to evaluate patient and ICU variables associated with time to recovery accounting for the competing risk of death.

Measurements and Main Results: Thirty-seven (32%) of 115 patients had an SSQ score greater than or equal to 200 at hospital discharge; 3 died before recovery. All 34 remaining survivors recovered from dysphagia symptoms by 5-year follow-up, 7 (23%) after 6 months. ICU length of stay was independently associated with time to recovery, with a hazard ratio (95% confidence interval) of 0.96 (0.93–1.00) per day.

Conclusions: One-third of orally intubated ARDS survivors have dysphagia symptoms that persist beyond hospital discharge. Patients with a longer ICU length of stay have slower recovery from dysphagia symptoms and should be carefully considered for swallowing assessment to help prevent complications related to dysphagia.

Keywords: deglutition; deglutition disorders; intubation; recovery of function; acute respiratory distress syndrome

(Received in original form June 12, 2016; accepted in final form December 16, 2016)

Supported by National Institutes of Health grants P050HL73994, R01HL088045, and 5K23DC013569.

Author Contributions: All authors reviewed, offered critical revision, and gave approval for final submission. M.B.B.: participated in study design, completed analyses, provided interpretation of data, and completed manuscript writing; M.H. and E.C.: participated in study design, completed analyses, and provided interpretation of data; C.S., P.A.M.-T., and D.M.N.: participated in study design, completed data acquisition, and provided interpretation of data; J.B.P.: provided interpretation of data.

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Ann Am Thorac Soc Vol 14, No 3, pp 376–383, Mar 2017

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DOI: 10.1513/AnnalsATS.201606-455OC

Internet address: www.atsjournals.org

Globally, 13 to 20 million patients are admitted to intensive care units (ICUs) each year (1). In the United States alone, there are 5 million ICU admissions yearly, with 1 million resulting in tracheal intubation. The number is expected to increase at a rate of greater than 5% annually through 2020 (2, 3).

Patient symptoms of swallowing difficulties (4) and physiologic signs of swallowing impairments (i.e., dysphagia) are commonly found postextubation in patients who had oral intubation with mechanical ventilation. Up to 56% of patients have dysphagia and 50% of those aspirate (5–10), but these figures may be underreported (11–13). In fact, aspiration pneumonia is one of the 10 most common readmission diagnoses after hospitalization for a severe illness (14), leading to an increased risk of aspiration pneumonia and death (13, 15). Moreover, in elderly patients surviving critical illness, those with dysphagia at hospital discharge are approximately four times more likely to be readmitted within 30 days (16).

Despite the importance of dysphagia, little is known about the longitudinal course of recovery after hospital discharge. Patients with acute respiratory distress syndrome (ARDS) are a relevant patient population in evaluating dysphagia, given their high severity of illness, extended durations of mechanical ventilation, and ICU stay (4). Hence, our objectives were: (1) to determine the prevalence of and longitudinal time to recovery from dysphagia symptoms after hospital discharge through 5-year follow-up in ARDS survivors who had oral intubation with mechanical ventilation; and (2) to explore patient, ICU, and hospital risk factors associated with time to recovery from dysphagia symptoms after hospital discharge. Some of the results of this study have been previously reported in the form of an abstract (17).

Methods

Study Population

The present analysis is part of a prospective, multisite cohort study (Improving Care of Acute Lung Injury Patients) evaluating consecutively recruited mechanically ventilated patients with acute lung injury defined using the American-European Consensus Conference criteria (18) in effect

at the time of patient recruitment. Hereafter, we use the term ARDS to describe these patients, consistent with the Berlin criteria definition (19).

Patients in this study were consecutively recruited from 2004 to 2007 from 13 ICUs at four teaching hospitals in Baltimore, Maryland. All patients were then followed for 5 years after hospital discharge. Exclusion criteria for the parent study were: (1) more than 5 days of mechanical ventilation before ARDS onset, (2) preexisting cognitive impairment or communication/language barrier, (3) transfer into a study site ICU with preexisting ARDS of more than 24 hours' duration, (4) limitations in life support at the time of study eligibility (e.g., no use of vasopressors), and (5) preexisting illness with a life expectancy of less than 6 months. The following additional exclusion criteria were applied for the current analysis: (1) use of nasal endotracheal tube during their ICU stay (i.e., only oral endotracheal tube was included), (2) current or prior tracheotomy, (3) no consent for participation in research, (4) not eating or drinking by mouth at hospital discharge, and (5) no Sydney Swallowing Questionnaire (SSQ) completed at hospital discharge (e.g., physical or cognitive impairment preventing SSQ completion).

This study was approved by institutional review boards at each of the participating sites. Written informed consent was obtained from each study participant or their proxy if the participant was incapable of consent.

Primary Outcome

The primary outcome was recovery from clinically important symptoms of dysphagia, evaluated over longitudinal periodic follow-up assessments at 3, 6, 12, 24, 36, 48, and 60 months after ARDS. Dysphagia symptoms were evaluated using the SSQ. The SSQ is a 17-item, validated, patient-reported measure used to assess severity of dysphagia symptoms (20). For 16 of the 17 items, a visual analog scale is used in scoring the item, with patients required to place an "X" on a 100-mm line (1 point per 1 mm). Reference points at each end of the lines are "No difficulty at all" (0 points) and "Unable to swallow at all" (100 points), for example. The remaining question is multiple choice and contains six response options, with an anchor of 0 and each of the five remaining items increasing by

20 points to a maximum of 100 points. The SSQ total score ranges from 0 to 1,700, with higher scores indicating greater dysphagia symptom severity and an SSQ score greater than or equal to 200 indicating clinically important symptoms of dysphagia are present.

Patients with dysphagia (SSQ score ≥ 200) at hospital discharge were eligible to recover. We defined recovery as a patient having any follow-up SSQ score less than 200 with change from hospital discharge greater than a statistically reliable decrease in SSQ. Time to recovery is time of the first follow-up where the patient's SSQ score satisfied the definition of recovery. The Reliable Change Index is a method used to determine whether a change in score for a measurement instrument is statistically reliable (21). This approach has been completed in prior ARDS research (22). Reliable Change Index was calculated as greater than or equal to 119 points using the standard deviation of SSQ scores at hospital discharge and intraclass correlation coefficients provided by the authors of the SSQ (Michal Szczesniak and Ian Cook, personal communication, October 13, 2014) (21).

Measurement of Patient-, ICU-, and Hospital-related Exposure Variables

Patient-, ICU-, and hospital-related exposure variables evaluated for their association with recovery of dysphagia symptoms were selected based on the existing literature and investigators' prior knowledge in this field. Demographic characteristics considered were age, sex, and race. Baseline patient characteristics before hospital admission were body mass index (evaluated using standard categories) and overall comorbidity burden (evaluated using the Charlson Comorbidity Index [23]), along with specific preexisting neurological (e.g., transient ischemic attack, stroke, Parkinson disease, multiple sclerosis, dementia) or upper gastrointestinal (e.g., peptic ulcer, hiatal hernia, gastroesophageal reflux disease) comorbidity (24).

ICU variables included ICU admission diagnosis category, severity of illness at ICU admission (Acute Physiology and Chronic Health Evaluation II score [25]), organ dysfunction (Sequential Organ Failure Assessment [26], calculated daily during the ICU stay to determine the maximum daily Sequential Organ Failure Assessment

score), ever reintubation, intubation duration, and ICU length of stay (LOS). Patients reintubated after less than 48 hours were considered to be continuously intubated from the initial placement of the oral endotracheal tube until extubation that persisted for greater than or equal to 48 hours (27).

Hospital variables were time from extubation to hospital discharge, hospital LOS, and muscle strength assessed using manual muscle testing that was scored using the Medical Research Council's 6-point ordinal scale (range: 0 = paralysis, 5 = normal strength) (28, 29). In addition, hospital readmission before recovery of dysphagia symptoms (on the basis of patient self-report with medical records verification [30]) was evaluated as a binary variable.

Statistical Analysis

We compared exposure variables by binary categorization of dysphagia symptoms at hospital discharge using chi-square tests (or Fisher exact tests when applicable) for categorical variables, and Wilcoxon rank-sum tests for continuous variables. Descriptive statistics were reported using median and interquartile range (IQR) for continuous data and proportions for categorical data. Considering death as a competing risk for recovery from dysphagia symptoms, the associations of individual variables with the primary outcome (i.e., recovery) were evaluated via a competing risks regression analysis using Fine and Gray proportional subdistribution hazards regression analysis, with associations presented as hazard ratios (31). Individual covariates were included in the multivariable model if they exhibited a bivariable association with the primary outcome at $P < 0.20$. A cumulative incidence function curve was used for graphical display of the results.

Standard regression diagnostics were conducted for both bivariable and multivariable models. We confirmed no violation of the proportional hazards assumption by examining Schoenfeld residual plots for each variable (32). The linearity assumption was verified by evaluating locally weighted scatterplot smoothing plots of each exposure variable against Martingale residuals from each regression model. SSQ data from the immediately preceding time point were carried forward to the next period in the

case of missing data in survivors (missing data ranged from one to seven patients at each time point over 5-year follow-up). We confirmed that there was no multicollinearity by testing variance inflation factors. P values were two sided, and statistical significance was defined as $P < 0.05$. All statistical analyses were completed using Stata statistical software, version 12.1 (33).

Results

There were 259 patients who were alive at hospital discharge, consented, and available for follow-up (Figure 1). On the basis of the exclusion criteria (see above), the following patients were not eligible for this analysis: 103 (40%) had a new or previous tracheostomy, 38 (15%) could not complete SSQ (6 were not eating orally, and 32 had cognitive and/or physical impairments), and 3 (1%) had nasal endotracheal intubation, leaving 115 (44%) with

completed SSQs at hospital discharge. These 115 patients had a median (IQR) age of 48 (40–57) years, with most being male (52%) and white (55%) (Table 1). Nineteen (17%) patients had neurological comorbidity and 22 (19%) had upper gastrointestinal comorbidity. The median (IQR) Acute Physiology and Chronic Health Evaluation II score was 23 (19–28), with durations of oral endotracheal intubation and ICU stay of 7 (5–11) and 11 (8–16) days, respectively (Table 1).

From the 115 patients completing the SSQ, 37 (32%) had clinically important symptoms of dysphagia (i.e., SSQ score ≥ 200) at hospital discharge. For the entire cohort, the median (IQR) SSQ score was 79 (23–289), with scores in those with versus without clinically important symptoms of dysphagia of 397 (307–525) versus 44 (20–81) ($P < 0.001$). Patients with versus without dysphagia symptoms at hospital discharge were generally similar (Table 1), with patients with dysphagia more frequently having preexisting upper

Note: Percentages may not add to 100% due to rounding.

Figure 1. Flow diagram of study participants. ICU = intensive care unit; NPO = *nil per os*; SSQ = Sydney Swallowing Questionnaire.

Table 1. Acute respiratory distress syndrome patient characteristics, by dysphagia status at hospital discharge

	All Patients (N = 115)	No Dysphagia at Hospital Discharge* (n = 78)	Dysphagia at Hospital Discharge* (n = 37)	P Value [†]
Demographics				
Age, median (IQR), yr	48 (40–57)	48 (40–56)	48 (41–58)	0.872
Male, No. (%)	60 (52)	41 (53)	19 (51)	0.848
White, No. (%)	63 (55)	46 (59)	17 (46)	0.231
Baseline health status before admission				
Charlson Comorbidity Index, median (IQR)	1 (0–3)	1 (0–3)	2 (0–4)	0.412
Neurological disease, [‡] No. (%)	19 (17)	10 (13)	9 (24)	0.177
Upper gastrointestinal disease, [§] No. (%)	22 (19)	10 (13)	12 (32)	0.021
Body mass index, No. (%)				0.968
Underweight (<18.5 kg/m ²)	5 (4)	3 (4)	2 (5)	
Normal (18.5–24.9 kg/m ²)	28 (24)	20 (26)	8 (22)	
Overweight (25–29.9 kg/m ²)	35 (30)	24 (31)	11 (30)	
Obese (≥30 kg/m ²)	34 (30)	23 (29)	11 (30)	
ICU admission diagnosis, No. (%)				0.923
Respiratory (including pneumonia)	66 (57)	46 (59)	20 (54)	
Nonpulmonary sepsis and infectious disease	18 (16)	11 (14)	7 (19)	
Trauma	6 (5)	4 (5)	2 (5)	
Other	25 (22)	17 (22)	8 (22)	
Other ICU factors				
APACHE II score at ICU admission, median (IQR)	23 (19–28)	24 (20–28)	22 (17–27)	0.405
SOFA score at ARDS onset, median (IQR)	8 (5–10)	8 (5–10)	8 (6–10)	0.236
Maximum daily SOFA score	9 (6–11)	8 (6–11)	9 (8–12)	0.072
Ever reintubated, No. (%)	22 (19)	16 (21)	6 (16)	0.800
Intubation duration, median (IQR), d	7 (5–11)	7 (4–11)	8 (7–11)	0.085
ICU length of stay, median (IQR), d	11 (8–15)	11 (7–15)	12 (8–18)	0.105
Hospital factors				
Time from extubation to hospital discharge, median (IQR), d	11 (7–19)	11 (8–19)	11 (6–23)	0.959
Hospital length of stay, median (IQR), d	21 (14–31)	20 (14–30)	23 (14–33)	0.299
Ever hospital readmission before recovery, No. (%)	67 (58)	47 (60)	20 (54)	0.550
MRC strength score at discharge, median (IQR)	52 (46–58)	52 (46–58)	51 (46–58)	0.801
SSQ score at hospital discharge, median (IQR)	79 (23–289)	44 (20–81)	397 (307–525)	<0.001

Definition of abbreviations: APACHE II = Acute Physiology and Chronic Health Evaluation II; ARDS = acute respiratory distress syndrome; ICU = intensive care unit; IQR = interquartile range; MRC = Medical Research Council; SOFA = Sequential Organ Failure Assessment; SSQ = Sydney Swallowing Questionnaire.

*Dysphagia defined as SSQ > 200. All patients had a median (IQR) SSQ score at hospital discharge of 79 (23–289), compared with those without versus with dysphagia of 44 (20–81) versus 397 (307–525), $P < 0.001$.

[†] χ^2 test, Fisher exact test, or Wilcoxon rank-sum test.

[‡]Includes stroke and any other neurological disease (e.g., transient ischemic attack, Parkinson disease, multiple sclerosis, dementia).

[§]Includes peptic ulcer, hiatal hernia, and gastroesophageal reflux disease.

^{||}Data were collected for 102 participants. Percentages may not add up to 100% due to rounding.

gastrointestinal comorbidity ($P = 0.021$). Overall, 58% of all patients were readmitted to the hospital during the 5-year follow-up period, with no statistically significant difference between groups ($P = 0.550$).

In the 37 patients with dysphagia (i.e., SSQ ≥ 200) at hospital discharge, during the 5 years of follow-up after discharge, 3 (8%) died, 2 within 3 months and 1 before the 2-year follow-up. At less than or equal to 6 months after discharge, 27 of 35 (77%) survivors recovered from their dysphagia, and at 5 years, 34 of 34 (100%) survivors recovered, with a median (IQR) time to recovery of 3 (3–6) months. The trajectory of recovery from clinically

significant dysphagia symptoms during 5-year follow-up for ARDS survivors is plotted in Figure 2.

In bivariable regression analysis, four exposures were potentially associated (at $P < 0.20$) with a longer time to recovery from dysphagia after hospital discharge and were included in the multivariable model: (1) higher Charlson Comorbidity Index, (2) upper gastrointestinal disease, (3) a nontrauma ICU admission diagnosis, and (4) longer ICU LOS (Table 2). In the multivariable regression model, ICU LOS was independently and significantly associated with longer time to recovery from dysphagia symptoms, with a hazard

ratio (95% confidence interval) of 0.96 (0.93–1.00; $P = 0.047$) per day.

To visualize the association between time to recovery and ICU LOS, we plotted the estimated cumulative incidence function setting ICU LOS to 8 and 18 days, corresponding to the 25th and 75th percentiles of ICU LOS, respectively (Figure 3). At 6 months, there was a 13% difference in cumulative incidence of recovery between patients at the 25th percentile (70% recovery, 8 d) and 75th percentile (57% recovery, 18 d) for ICU LOS. It took 12 months for 75% of patients with ICU LOS of 8 days to recover, whereas it took 24 months for same

Figure 2. Recovery from dysphagia symptoms during 5-year follow-up for acute respiratory distress syndrome survivors. The thin gray lines and blue line indicate individual and mean trajectories, respectively. The horizontal red line indicates the 200-point threshold above which clinically significant dysphagia symptoms are present. D/C = discharge; SSQ = Sydney Swallowing Questionnaire.

proportion of patients with ICU LOS of 18 days to recover.

Discussion

This multisite study is the first, to our knowledge, to prospectively follow ARDS survivors with symptoms of dysphagia after oral intubation with mechanical ventilation over a 5-year period after hospital discharge. In our sample of 115 patients, 37 (32%) reported clinically important symptoms of dysphagia at the time of discharge from the hospital. Of these 37 patients, the median (IQR) time to recovery was 3 (3–6) months, with 23% of survivors having symptoms persisting more than 6 months. All resolved within 5 years after hospital discharge. After evaluation of 18 patient, ICU, and hospital variables potentially associated with recovery from dysphagia, we found that each ICU day was independently associated with a 4% increase in the probability of delayed recovery from dysphagia symptoms after hospital discharge. These new analyses on the prevalence of clinically important dysphagia symptoms and their trajectory of recovery over time add to the list of known impairments after critical care (34, 35).

Previously, we reported that during the first 6 days of intubation, the duration of oral endotracheal intubation in patients with ARDS was independently associated with patient-reported dysphagia symptoms at hospital discharge, with a plateau beyond 6 days (4). Other studies suggest an association between intubation duration and dysphagia. A retrospective study of more than 2,000 patients suggested that both duration of intubation and reintubation are significant risk factors for dysphagia post extubation (10). Moreover, this same study found that intubation for more than 7 days was associated with moderate to severe dysphagia. In another study, this same group of researchers found similar results in a prospective population of patients with neurological injury (36). Data from our sample of patients with ARDS with an 8-day median duration of intubation extend these previous findings by suggesting that most patients recover from dysphagia symptoms within 6 months of hospital discharge, but symptoms may persist as long as 5 years and are influenced by ICU LOS.

Duration of ICU stay, rather than duration of oral endotracheal intubation, had a statistically significant association with time to recovery from dysphagia

after hospital discharge. Duration of oral endotracheal intubation was excluded from the multivariable model on the basis of the *a priori* approach used for variable selection for the multivariable model (i.e., requiring $P < 0.20$ in bivariable association for inclusion in multivariable model). One possible explanation for this finding is that recognition of postextubation dysphagia or respiratory insufficiency necessitated further ICU intervention or observation and delayed ICU discharge. Alternatively, a longer ICU stay may be an indicator of sicker patients that may be a marker for patients with worse dysphagia. However, these findings should be further evaluated in large patient samples.

Prospective studies using standard clinical practice demonstrate referral for swallowing assessment by speech-language pathologists is highly variable in patients extubated from oral intubation with mechanical ventilation (10, 37, 38). Our data suggest that approximately one-third of orally intubated ARDS survivors have symptomatic dysphagia at hospital discharge on the basis of the validated SSQ self-report survey. Together with previously reported high prevalence of aspiration in this patient population (5–9, 36), these issues highlight the need for consistent use

Table 2. Factors associated with recovery of dysphagia in patients with acute respiratory distress syndrome with oral endotracheal intubation

	Bivariable Analysis		Multivariable Analysis	
	Hazard Ratio* (95% CI)	P Value [†]	Hazard Ratio* (95% CI)	P Value [†]
Demographics				
Age	0.99 (0.96–1.01)	0.221		
Male	0.92 (0.54–1.57)	0.757		
White	0.86 (0.51–1.47)	0.587		
Baseline health status before admission				
Charlson Comorbidity Index	0.90 (0.82–1.00)	0.045	0.94 (0.83–1.06)	0.327
Neurological disease [‡]	1.27 (0.79–2.02)	0.325		
Upper gastrointestinal disease [§]	0.42 (0.22–0.83)	0.012	0.54 (0.26–1.14)	0.106
Body mass index				
Normal (18.5–24.9 kg/m ²)	Reference			
Underweight (<18.5 kg/m ²)	0.80 (0.47–1.36)	0.405		
Overweight (25–29.9 kg/m ²)	0.73 (0.38–1.41)	0.344		
Obese (≥30 kg/m ²)	0.74 (0.37–1.50)	0.408		
ICU admission diagnosis				
Respiratory (including pneumonia)	Reference		Reference	
Nonpulmonary sepsis and infectious disease	1.29 (0.72–2.31)	0.399	0.90 (0.44–1.81)	0.762
Trauma	2.23 (1.42–3.51)	0.001	1.51 (0.89–2.59)	0.130
Other	0.84 (0.41–1.69)	0.620	1.01 (0.59–2.04)	0.767
ICU factors				
APACHE II score at ICU admission	1.01 (0.99–1.04)	0.330		
SOFA score at ARDS onset	1.00 (0.95–1.07)	0.902		
Maximum daily SOFA score	0.98 (0.93–1.05)	0.607		
Ever reintubated	1.13 (0.71–1.79)	0.604		
Intubation duration	0.97 (0.94–1.01)	0.208		
ICU length of stay	0.96 (0.93–1.00)	0.060	0.96 (0.93–1.00)	0.047
Hospital factors				
Time from extubation to hospital discharge	0.99 (0.98–1.01)	0.427		
Hospital length of stay	0.99 (0.98–1.01)	0.255		
MRC strength score at hospital discharge	1.01 (0.97–1.05)	0.664		
Ever hospital readmission before recovery	1.38 (0.80–2.38)	0.251		
SSQ				
SSQ score per 5 points at hospital discharge	1.00 (0.99–1.01)	0.684		

Definition of abbreviations: APACHE II = Acute Physiology and Chronic Health Evaluation II; ARDS = acute respiratory distress syndrome; CI = confidence interval; ICU = intensive care unit; MRC = Medical Research Council; SOFA = Sequential Organ Failure Assessment; SSQ = Sydney Swallowing Questionnaire.

*A hazard ratio less than 1 indicates a longer time to recovery from dysphagia. Findings from the multivariable regression analysis demonstrate a statistically significant hazard ratio of 0.96 for a 1-day increase in ICU length of stay, indicating a 4% increase in the probability of delayed recovery from dysphagia symptoms after hospital discharge for each additional 1-day increase in ICU length of stay.

[†]P values calculated using Fine and Gray proportional subdistribution hazards regression models (31). Covariates were included in the multivariable model on the basis of a bivariable association of $P < 0.20$.

[‡]Includes stroke and any other neurological disease (e.g., transient ischemic attack, Parkinson disease, multiple sclerosis, dementia).

[§]Includes peptic ulcer, hiatal hernia, and gastroesophageal reflux disease.

of swallowing evaluation protocols with sensitive and reliable tools for identifying dysphagia during hospitalization (39).

In prospective studies of mixed medical ICU patients, dysphagia occurs in up to one-half of orally intubated survivors, with approximately 50% of these patients demonstrating overt signs of aspiration (5–10). Silent aspiration—an asymptomatic finding—occurs in approximately 12.5% of patients intubated more than 48 hours (5, 7).

Patient complaints and symptoms, swallowing screening tests, and bedside swallowing assessments by a speech-

language pathologist do not detect silent aspiration (39). Silent aspiration may only be detected using an instrumental swallowing assessment (e.g., videofluoroscopic swallow study, fiberoptic endoscopic evaluation of swallowing). Use of an instrumental assessment, similar to clinical swallowing evaluations, is highly variable in its availability and use. There is further variability, in that patients are instrumentally assessed based on their particular combination of risk factors, yet there is little consensus or rigorous clinical research regarding indications for instrumental assessment.

Although a definitive list of risk factors for postextubation dysphagia has not been established, a systematic review found that consistent risk factors were: ICU and hospital LOS, multiple intubations, sepsis, and poor functional status (8). Risk factors that were cited as still being debated for their association with postextubation dysphagia included age, intubation duration, and renal impairment. Rigorous studies in postextubated patient populations are required to understand swallowing physiology, ultimately with the goals of improved screening, diagnosis, and treatment.

Figure 3. Adjusted cumulative incidence function of recovery from dysphagia symptoms for 37 patients discharged from hospital, by the 25th (8 days) and 75th (18 days) percentiles for intensive care unit length of stay, during 5-year follow-up for acute respiratory distress syndrome survivors. D/C = discharge; ICU = intensive care unit.

Limitations

There are several limitations to our study. First, the sample size was small, leading to imprecision in the estimates of recovery time and the potential of being underpowered to identify additional variables associated with time to recovery from dysphagia. Likewise, not all potentially important variables associated with recovery from dysphagia were available for evaluation, because some were not included in the parent study. Second, the ARDS

survivors were all recruited in a single city. Hence, the results may not be generalizable to other populations.

Third, no physiological data on swallowing (i.e., from instrumental assessment, such as the videofluoroscopic swallow study or fiberoptic endoscopic evaluation of swallowing) were collected for these patients, only patient-reported symptoms. Fourth, generalizability is limited by the eligibility criteria of this study. Finally, as with most evaluations of critically

ill patients, there was no information available about preintubation swallowing function. Despite these limitations, this study makes a novel contribution toward building a foundation of knowledge regarding recovery from dysphagia symptoms after ARDS.

Conclusions

Our multisite, longitudinal, cohort study found that one-third of ARDS survivors had clinically important dysphagia symptoms after oral intubation with mechanical ventilation. Approximately one-quarter of patients required more than 6 months to recover, with recovery extending through the entire 5-year follow-up period. A longer ICU LOS is associated with slower recovery from dysphagia symptoms and helps to identify patients at greater risk of postdischarge swallowing problems. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

Acknowledgment: The authors thank the patients who participated in the study and the research staff who assisted with data collection and management for the study, including Nardos Belayneh, Kim Boucher, Abdulla Damluji, Victor Dinglas, Kristin Sepulveda, Faisal Siddiqi, and Jennifer Titus.

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