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Research paper

Frequency, associated factors, and associated outcomes of dysphagia following sepsis

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ABSTRACT

Background: Identifying dysphagia as a potential complication of sepsis may improve swallowing function and survival while decreasing hospital length of stay.
Objectives: Our goal was to determine the frequency of dysphagia in sepsis survivors on the 7th day after admission, as well as their associated factors and outcomes.
Methods: This single-centre, retrospective, observational study analysed data from sepsis survivors admitted to Okayama Saiseikai General Hospital from 2018 to 2019. Participants with sepsis were assigned to one of two study groups based on the presence or absence of dysphagia using the criterion of Functional Oral Intake Scale score <5 on the 7th day after admission. We used multivariate logistic regression to determine factors independently associated with dysphagia on the 7th day after admission. Multivariate logistic regression was also used to determine associations between groups and outcomes, including dysphagia on hospital discharge, direct discharge home (discharge of patients directly to their home), and total dependency (Barthel Index score ≤20) on hospital discharge.
Results: One hundred one patients met the study inclusion criteria, 55 with dysphagia and 46 without dysphagia. Fasting period (adjusted odds ratio [AOR]: 1.31, 95% confidence interval [CI]: 1.07−1.59) and enteral tube feeding (AOR: 8.56, 95% CI: 1.95−37.5) were independently associated with the presence of dysphagia on the 7th day after admission. Dysphagia on the 7th day after admission was associated with dysphagia on hospital discharge (AOR: 46.0, 95%, CI: 7.90−268.3), a lower chance of direct discharge home (AOR: 0.03, 95% CI: 0.01−0.15), and a higher incidence of total dependency (AOR: 9.30, 95% CI: 2.68−32.2).
Conclusions: We found that dysphagia was commonly encountered post sepsis. Fasting period and enteral tube feeding were independently associated with dysphagia on the 7th day after admission. Dysphagia on the 7th day after admission was also associated with dysphagia on hospital discharge, nondirect discharge home, and dependency in activities of daily living at the time of hospital discharge.

1. Introduction

Although clinical outcomes after sepsis have improved due to advances in patient care, sepsis is estimated to affect over 30 million people globally every year and is an important global health problem.[1,2] Approximately 10% of sepsis survivors develop cognitive and functional disabilities and require substantial, ongoing acute and long-term care.[3,4] The prevalence of dysphagia after sepsis is 17%, and 84% of sepsis survivors with dysphagia fail to recover their swallowing function by hospital discharge.[5] Critically ill patients with sepsis require copious healthcare resources and invasive ventilation.[6] In these ventilated patients, postextubation dysphagia (PED) has been observed in 3−62% of survivors, and PED was shown to persist at hospital discharge in 48% of survivors.[6,7] Nonetheless, few studies have described dysphagia after recovery

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from sepsis, even though dysphagia can cause weight loss, dehydration, depression, aspiration pneumonia, and death.[6] Furthermore, dysphagia disturbs the enjoyment of eating and drinking, which plays an important role in an individual's perception of quality of life.[2,8,9]

Fasting, tube feeding, intubation, mechanical ventilation, cerebrovascular disease, reflux oesophagitis, intensive care unit (ICU)–acquired weakness (ICU-AW), delirium, or drugs that affect concomitant critical illness with sepsis may cause impaired swallowing in sepsis survivors.[6,10,11] These factors are also associated with poor outcomes like not being discharged to home, aspiration pneumonia, longer ICU and hospital stays, and increased 90-day mortality.[6,7,10,12] Our goal in this study was to evaluate the characteristics and outcomes of patients with sepsis who developed dysphagia and the frequency of dysphagia in these patients, with the hope of supporting intensive care clinicians in recognising dysphagia as a complication of critically ill patients diagnosed with sepsis.

2. Methods

The study was approved by the ethics committee of our institution (Committee of Okayama Saiseikai General Hospital, ID: 200301), and it conforms to the provisions of the Declaration of Helsinki. Participant consent was waived.

2.1. Patients

This single-centre, retrospective, observational study was performed using data from the electronic medical records of participants admitted to Okayama Saiseikai General Hospital (Okayama, Japan) for the treatment of sepsis or septic shock, which were defined using Sepsis-3 criteria.[13,14] Participants with documented or suspected infection and an acute (2 points or more) increase in the Sequential Organ-Failure Assessment (SOFA) score from baseline in the ICU or high-care unit (HCU) through the emergency units from April 2018 to September 2019 were included. Septic shock was clinically determined based on vasopressor necessity to maintain a $\geq$65 mmHg mean arterial pressure and >2 mmol/L (18 mg/dL) serum lactate level despite sufficient fluid resuscitation.[13,14] Participants with pre-existing dysphagia, terminal cancer, or discharge within 7 days of admission were excluded. The attending physician decided the sepsis treatment strategy and the nutritional plan for each patient based on published guidelines.[13,14] Our nutritional strategy for all participants was to determine energy requirements using predictive or simplistic weight-based equations (25–30 kcal/kg/day) and protein intake (1.2–2.0 g/kg/day) by attending physicians.

2.2. Definition and evaluation of dysphagia

We evaluated swallowing function in all participants unless unstable clinical conditions such as haemodynamic instability or altered mental status were present, which were determined by the treating medical team. Following this medical approval, all participants were screened for swallowing function to resume oral intake; ICU/HCU nurses screened swallowing function using a bedside swallowing screening, which included a modified water-swallowing test (MWST).[15,16] This screener involved administering 3 mL of water into the floor of the participant's mouth and scoring a behavioural response. The scale ranges from 1 to 5; 1: no drinking with choking and/or respiratory distress; 2: drinking and respiratory distress; 3: drinking and choking and/or hoarseness without respiratory distress; 4: drinking without choking and respiratory distress; 5: drinking without choking and respiratory distress, plus able to perform two repetitive dry swallows within 30 s.[15,16] Based on the results of the MWST, oral intake was suspended or resumed with dietary modification if necessary and Functional Oral Intake Scale (FOIS) level was recorded on a daily basis from the date of the assessment of MWST. The FOIS scoring is 1–7, with higher scores indicating better swallowing function.[17] Degrees of nonoral feeding are indicated by scores of 1–3, while scores of 4–7 correspond to degrees of oral feeding without nonoral supplementation.[17,18] FOIS scores <5 indicate an oral diet of a single consistency, tube supplements with consistent oral intake, tube dependent with minimal/inconsistent oral intake, or no oral feeding.[17,18] Dysphagia was defined as an FOIS score <5.[17,18] Speech and language therapy was considered if the MWST score was 3 or lower, which was regarded as at risk for aspiration.[15] In this study, speech and language therapy was defined as at least one 30-min training session with a speech and language therapist (SLT) during hospitalisation. The five SLTs in our hospital assessed oropharyngeal structure based on tonus of the tongue and/or lips, mobility of the tongue, lips, larynx, and/or jaw, and swallowing function based on food and/or saliva stasis in the oral cavity, lip sealing, and/or laryngeal elevation synchrony between swallowing and breathing. Dietary intake and content were clinically determined by attending physicians in collaboration with nurses or SLTs daily to identify signs of coughing, choking, or aspiration. Dietary content was gradually changed in the following order: yogurt, jelly, puree, thin liquids, or solids such as rice, tofu, fish, or meats during hospitalisation. These diet modifications were advanced at the rate of one or more steps per day based on the daily evaluation as mentioned earlier. We did not evaluate swallowing function with videofluoroscopic swallowing tests or fiberoptic endoscopic evaluation. Behavioural swallowing rehabilitation included swallowing exercises focusing on strengthening the base of the tongue, laryngeal range of movement, and pharyngeal constriction.[19] Compensatory swallowing rehabilitation included alternative flow of a liquid or food bolus by changing their consistency or repositioning the body, head, or neck.[19]

2.3. Grouping and outcomes

Participants were categorised into two groups for analysis. The dysphagia group and the non-dysphagia group were defined based on the presence or absence of dysphagia defined as an FOIS score <5 on the 7th day after admission. Due to a paucity of data on dysphagia after sepsis, this time point was chosen based on prior evidence that examined dysphagia in participants recovering from an ischaemic stroke.[18,20] The primary outcome was incidence of dysphagia on the 7th day after admission. Secondary outcomes included the factors associated with dysphagia on the 7th day after admission and association between dysphagia on the 7th day after admission and dysphagia at hospital discharge, direct discharge home (defined as discharge of the patient directly to his or her home as opposed to an interfacility transfer, transfer to a nursing home, or death), and total dependency on hospital discharge (defined as a Barthel Index score $\leq$20).[11,17,21,22]

2.4. Data collection and analysis

We collected the following data from participants' medical records: clinical information (age, sex, weight, height, septic shock, SOFA score on ICU admission, presence of delirium within 7 days after admission, living at home before admission); laboratory findings (C-reactive protein and procalcitonin on ICU admission); medical history (history of hypertension, diabetes, chronic kidney disease, cerebrovascular disease, dementia, cancer, congestive heart failure, neurological disorder); infection focus; procedures

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during hospitalisation (use and duration of endotracheal tube, mechanical ventilation, tracheostomy, vasopressor administration, use and duration of enteral tube feeding, fasting period); MWST assessment (timing and score); oral intake (timing and FOIS score); interventions (timing and use of physical therapy and speech and language therapy); and outcome measures (aspiration pneumonia clinically diagnosed by criteria including inflammatory findings in the lungs with apparent/suspicious aspiration episodes,[23,24] total hospital stay, length of ICU/HCU stay, FOIS score on the 7th and 14th day after admission and hospital discharge, 30-day mortality, direct discharge home, and total dependency as indicated by the Barthel index score). Data on feeding tube use were collected as a binary variable; feeding tube use was defined as any enteral tube treatment during hospitalisation.

2.5. Statistical analyses

Continuous variables are presented as median and interquartile ranges. Categorical variables are presented as numbers and percentages. Categorical variables were compared using the Fisher's exact probability test. The Mann–Whitney *U* test was used to evaluate variables with non-normal distributions. Multivariate logistic regression was performed to adjust covariates (age, fasting period, enteral tube feeding, endotracheal tube, and SOFA score) to identify the variables independently associated with dysphagia on the 7th day after admission. Then, multivariate logistic regression was performed to identify the association between dysphagia on the 7th day after admission and secondary outcomes after adjustment for fasting period, endotracheal tube, SOFA score, and speech and language therapy. Logistic regression analysis results were expressed using odds ratios (ORs) and 95% confidence intervals (CIs). A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) software for Windows (version 15.0, SPSS, Chicago, IL, USA).

3. Results

During the 1.5-year study period, 129 participants with septic shock or sepsis were admitted. After excluding cases with pre-existing dysphagia (n = 18) or terminal cancer (n = 2) and those who were discharged within 7 days (n = 8), 101 met the inclusion criteria. Of the 101 participants, 88 were screened for swallowing function by the MWST on median day 3 after admission, when the screening was medically approved. Of the 88 participants who had been screened for swallowing function, 65 initiated oral intake, while 16 remained restricted from oral intake based on the MWST screening results. Thirteen participants were not screened for swallowing function by the MWST; nine were too unstable to allow screening, eventually assigned to the dysphagia group, and the remaining four participants resumed oral intake within 2 days, subsequently allocated to the non-dysphagia group. Ultimately, 55 (55.4%) participants were assigned to the dysphagia group and 46 (45.6%) to the non-dysphagia group based on the FOIS level on the 7th day after admission. The median FOIS score on the 7th day after admission was 1 in the dysphagia group and 6 in the non-dysphagia group. The clinical and demographic characteristics of the study cohort are listed in Table 1. The median MWST and FOIS scores were lower in the dysphagia group than in the non-dysphagia group (3 vs. 5 and 2 vs. 6, respectively), both of which scores were documented on median day 3 after admission in both groups. The median weight of the participants in the dysphagia group was less than that of the participants in the non-dysphagia group (46.0 vs. 53.5 kg) on ICU admission. The incidence of septic shock was higher in the dysphagia group (27.2% vs. 10.8%), and median SOFA scores were higher in the dysphagia group (5 vs. 3). The incidence of delirium was higher in the dysphagia group (54.5% vs. 30.4%). There were no significant differences in medical history, infection focus, or laboratory findings. The use of mechanical ventilation (34.5% vs. 10.8%), tracheostomy placement (9.0% vs. 0%), and endotracheal tube (34.5% vs. 10.8%) during hospitalisation were more frequent in the dysphagia group. However, the duration of mechanical ventilation (4 vs. 2 days, CI: −21.7 to 6.62) and duration of endotracheal tube placement (4 vs. 2 days, CI: −10.2 to 3.47) did not differ between the groups. Of the total cohort requiring intubation, 79.1% (19/24) presented with dysphagia on the 7th day after admission. Enteral tube feeding use was more frequent in the dysphagia group (38.1% vs. 6.5%) and was needed for a longer duration (14 days vs. 1 day). The fasting period was longer in the dysphagia group (4 vs. 3 days). Speech and language therapy was performed in 57 of 101 (56.4%) participants during hospitalisation, 43 of 55 (78.1%) in the dysphagia group and 14 of 46 (30.4%) in the non-dysphagia group. There were no differences in the timing and number of speech and language therapy sessions between the two groups.

In the multivariate analysis, fasting period (adjusted OR: 1.31, 95% CI: 1.07–1.59, $p = 0.006$) and enteral tube feeding (adjusted OR: 8.56, 95% CI: 1.95–37.5, $p = 0.004$) were independently associated with dysphagia on the 7th day after admission in participants with sepsis, while age, endotracheal tube, and SOFA score were not associated factors (Table 2).

Table 3 shows patient outcomes (complications, duration of hospitalisation, dysphagia, and mortality) for both groups. The incidence of aspiration pneumonia during hospitalisation (29.0% vs. 0%), incidence of dysphagia on the 14th day after admission (71.4% vs. 0%), incidence of dysphagia on hospital discharge (60.0% vs. 4.3%), and incidence of total dependency on hospital discharge (56.6% vs. 15.9%) were significantly higher in participants with dysphagia on the 7th day after admission than in those without dysphagia (Table 3). Additionally, length of hospital stay was longer in the dysphagia group (22 vs. 17 days). Fewer participants with dysphagia on the 7th day after admission were directly discharged home (12.7% vs. 71.7%), and 30-day mortality was higher (20.0% vs. 2.1%) in these participants. The incidence of dysphagia on the 7th day after admission was independently associated with subsequent dysphagia on hospital discharge (adjusted OR: 46.0, 95% CI: 7.90–268.3), direct discharge home (adjusted OR: 0.03, 95% CI: 0.01–0.15), and total dependency (adjusted OR: 9.30, 95% CI: 2.68–32.2) (Table 4).

4. Discussion

Our study showed that the frequency of dysphagia after sepsis was 54.4% on the 7th day after admission and 34.6% on hospital discharge. Fasting period and enteral tube feeding were independently associated with dysphagia on the 7th day after admission. Dysphagia on hospital discharge, nondirect discharge home, and total dependency on hospital discharge were also independently associated with dysphagia on the 7th day after admission in post-sepsis participants.

Zielske et al. described the association between sepsis and dysphagia by assessing swallowing function using the FOIS score on the 14th day after diagnosis of sepsis and comparing patients with sepsis and critically ill patients without sepsis.[11] More patients recovering from sepsis (24/30, 80%) had impaired oral intake than critically ill patients who did not have sepsis (16/30, 53%). Sepsis was a significant risk factor for aspiration, with an adjusted OR of 5.8.[11] We used dysphagia on the 7th day after admission for our study because a prior, retrospective study of patients with ischaemic stroke included similar swallowing evaluations performed on the 7th day, and two-thirds of the stroke patients with dysphagia

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Table 1
Characteristics of patients who were treated for sepsis (n = 101).

	Dysphagia group (n = 55)	Non-dysphagia group (n = 46)	All (n = 101)	p-value
Clinical information				
FOIS score on the 7th day after admission	1 (1–4)	6 (6–7)	4 (1–6)	0.001
Male sex, n	31/55 (56.3%)	25/46 (54.3%)	56/101 (55.4%)	0.844
Age, years	83 (74–90)	82 (78–88)	83 (77–90)	0.675
Height, cm	159 (150–165)	157 (151–166)	159 (150–165)	0.760
Weight, kg	46.0 (40.4–53.5)	53.5 (44.1–61.1)	49.0 (41.0–56.0)	0.007
Living at home before admission, n	35/55 (63.6%)	34/46 (73.9%)	69/101 (68.3%)	0.291
Delirium, n	30/55 (54.5%)	14/46 (30.4%)	44/101 (43.5%)	0.004
SOFA score	5 (3–8)	3 (2–5)	4 (3–7)	0.002
Septic shock, n	15/55 (27.2%)	5/46 (10.8%)	20/101 (19.8%)	0.047
Medical history				
Hypertension, n	40/55 (72.7%)	38/46 (82.6%)	78/101 (77.2%)	0.341
Diabetes, n	22/55 (44.0%)	17/46 (36.9%)	39/101 (38.6%)	0.838
CVD, n	8/55 (14.5%)	9/46 (19.5%)	17/101 (16.8%)	0.597
CHF, n	21/55 (38.1%)	26/46 (56.5%)	47/101 (46.5%)	0.075
Cancer, n	12/55 (21.8%)	8/46 (17.3%)	20/101 (19.8%)	0.624
CKD, n	11/55 (20.0%)	8/46 (17.3%)	19/101 (18.8%)	0.802
Dementia, n	19/55 (34.5%)	14/46 (30.4%)	33/101 (32.6%)	0.677
Neuro disorder, n	7/55 (12.7%)	4/46 (8.6%)	11/101 (10.8%)	0.452
Laboratory findings				
C-reactive protein test, mg/dl	9.9 (2.4–18.9)	6.0 (2.2–15.8)	8.9 (2.4–17.1)	0.821
Procalcitonin, ng/ml	3.1 (0.2–13.6)	2.2 (0.2–17.5)	2.9 (0.22–16.5)	0.814
Infection focus				
Respiratory tract, n	18/55 (32.7%)	19/46 (41.3%)	37/101 (36.6%)	0.412
Urinary tract, n	13/55 (23.6%)	8/46 (17.3%)	21/101 (20.7%)	0.472
Skin/soft tissue, n	1/55 (1.8%)	3/46 (6.5%)	4/101 (3.9%)	0.328
Abdominal cavity, n	16/55 (29.0%)	11/46 (23.9%)	27/101 (26.7%)	0.654
Neurological, n	1/55 (1.8%)	0/46 (0%)	1/101 (0.9%)	1
Cardiac, n	1/55 (1.8%)	0/46 (0%)	1/101 (0.9%)	1
Infections without a clear primary site of infection	5/55 (9.0%)	5/46 (10.8%)	10/101 (9.9%)	0.500
Procedures				
Enteral tube feeding, n	21/55 (38.1%)	3/46 (6.5%)	24/101 (23.7%)	<0.001
Enteral tube duration, days	14 (3–24)	1 (1-1)	13 (2–19)	0.005
Fasting period, days	4 (2–7)	3 (2–5)	4 (2–6)	0.006
Endotracheal intubation, n	19/55 (34.5%)	5/46 (10.8%)	24/101 (23.7%)	0.009
Endotracheal intubation duration, days	4 (2–9)	2 (1–5)	4 (2–7)	0.245
Tracheostomy, n	5/55 (9.0%)	0/46 (0%)	5/101 (4.9%)	N/A
Ventilator use, n	19/55 (34.5%)	5/46 (10.8%)	24/101 (23.7%)	0.009
Vasopressor use, n	18/55 (32.7%)	7/46 (15.2%)	24/101 (23.7%)	0.063
Ventilator duration, days	4 (1–12)	2 (1–5)	3 (2–10)	0.259
Tracheostomy duration, days	28 (11–48)	N/A	28 (11–48)	N/A
Assessment				
MWST, n	46/55 (83.6%)	42/46 (91.3%)	88/101 (87.1%)	0.199
MWST score	3 (3–4)[a]	5 (4–5)[b]	4 (3–5)[c]	<0.001
Timing of MWST assessment, days	3 (2–6)[a]	3 (2–5)[b]	3 (2–5)[c]	0.052
Timing of FOIS assessment (or timing attempt to initiate oral intake), days	3 (2–6)	3 (2–5)	3 (2–5)	0.252
FOIS score after the MWST	2 (1–4)	6 (5–7)	4 (1–6)	<0.001
Interventions				
Physical therapy, n	55/55 (100%)	46/46 (100%)	101/101 (100%)	1
Speech and language therapy, n	43/55 (78.1%)	14/46 (30.4%)	57/101 (56.4%)	<0.001
Behavioural swallowing rehabilitation, n	41/55 (74.5%)	14/46 (30.4%)	55/101 (54.4%)	<0.001
Compensatory swallowing rehabilitation, n	43/55 (78.1%)	14/46 (30.4%)	57/101 (56.4%)	<0.001
Number of speech and language therapy, days/week	3 (3–4)	3 (2–4)	3 (3–4)	0.257
Timing of physical therapy, days	3 (2–3)	2 (2–3)	2 (2–3)	0.028
Timing of speech and language therapy, days	4 (3–6)	3 (2–5)	3 (3–5)	0.266

CVD, cerebrovascular disease; CHF, congestive heart failure; CKD, chronic kidney disease; SOFA, Sequential Organ-Failure Assessment; FOIS, Function Oral Intake Scale; MWST, modified water swallowing test.
[a] Of 55 participants, nine were missing.
[b] Of 46 participants, four were missing.
[c] Of 101 participants, 13 were missing.

did not recover functional oral intake.[18,25] Our study revealed that more than half of the patients with sepsis (54.4%) developed dysphagia by the 7th day after admission. Moreover, Sasegbon et al. also showed that sepsis patients with dysphagia failed to recover their swallowing function by hospital discharge.[26] These results were consistent with those from our study, which showed continued dysphagia at hospital discharge (34.6%). However, the rate of dysphagia at day 7, day 14, and hospital discharge significantly decreased (54.4% vs. 43.7% vs. 34.6% $p < 0.001$). We hypothesised that the mechanism of these results might be recovery from sepsis, decrease in drugs, physical therapy, and/or speech and language therapy.

Iwashyna et al. reported that elderly survivors of severe sepsis experience substantial cognitive impairment and functional disability.[4] Although the study assessed 11 categories of deficits (eating, dressing, restroom use, ambulation, daily hygiene, getting in and out of bed, shopping for groceries, preparing a hot meal, taking medicines, making telephone calls, and managing finances), dysphagia was not included in the analysis.[4] Dysphagia can cause malnutrition, dehydration, and aspiration pneumonia and results in

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Table 2
Factors associated with dysphagia 7 days after admission.

	Adjusted OR (95% CI)	p-value
Factor		
Age	1.01 (0.96–1.07)	0.500
Fasting period	1.31 (1.07–1.59)	0.006
Enteral tube feeding	8.56 (1.95–37.5)	0.004
Endotracheal tube	1.34 (0.35–5.10)	0.660
SOFA score	1.18 (0.97–1.44)	0.094

Variables: age, fasting period, enteral tube feeding, endotracheal tube, and SOFA score were used to adjust for the outcomes in the multivariate logistic regression.
CI, confidence interval; OR, odds ratio; SOFA, Sequential Organ-Failure Assessment.

longer hospital stays, increased need for nursing home care, and increased mortality.[6,10,27] Although our results did not support an association between intervention by SLTs and dysphagia severity, SLT intervention may still contribute to better outcomes.[6] In addition, the ability to eat and drink can be an important part of an individual's perception of their quality of life.[2,8,9]

ICU-AW may be one of the factors associated with dysphagia post sepsis. In a review of ICU-AW, Zuercher et al. described the following six potential mechanisms for ICU-acquired dysphagia: (i) direct injury from tracheostomy and endotracheal tubes, (ii) neuromyopathy causing muscular weakness, (iii) lessened laryngeal sensory function, (iv) damaged sensorium, indicating a more centrally located problem, (v) gastroesophageal reflux, and (vi) dyssynchronous swallowing and breathing.[6]

Studies on ICU-acquired dysphagia have been largely limited in sample size, and moreover, risk factors for predicting dysphagia have varied between studies.[6,10,11] Our study suggests that it may be challenging to predict which patients will develop dysphagia after sepsis treatment from their baseline characteristics because there were no differences in age or comorbidities between our study groups. We speculate that the inconsistency of the predictors identified in different studies originates from differences in the sepsis severity indicated by SOFA scores. In our sepsis patients, SOFA scores were low in both groups as compared with previous studies, and endotracheal tubes were placed in only 23.7% of patients.[6] In general, endotracheal intubation contributes to PED, especially endotracheal intubation lasting longer than 48 h.[5,6,7] However, our study suggests that dysphagia is a common condition that cannot be entirely attributed to PED.

Our results revealed that dysphagia was associated with enteral tube feeding and fasting period. We examined the relationship between dysphagia and enteral tube feeding and noted a significantly higher incidence of feeding tube regimen in patients with dysphagia than in those without dysphagia.[18] However, the relationship is bidirectional; dysphagia may lead to tube feeding and fasting.[6] Although the difference in the fasting period between the groups was only 1 day in our study, prolonged fasting period caused nutritional deficits, leading to life-threatening skeletal muscle mass atrophy and ICU-AW.[28] Earlier nutritional management within 48 h is needed to shorten the duration of mechanical ventilation and length of hospital stay and reduce the incidence of ICU-AW.[14,29,30] Our study indicates that a longer fasting period might negatively affect recovery of swallowing.

Macht et al. described the association of dysphagia after critical care and poor outcomes, such as the low proportion of patients discharged to home, aspiration pneumonia, and difficult oral intake, consistent with our results.[12] Our study revealed that dysphagia on the 7th day after admission was associated with dysphagia on discharge, nondirect discharge home, and total dependency. The number of patients recovering from sepsis who will need long-term care services, including dietary management, is expected to continue to increase, given the aging population.[31,32] Therefore, resolving dysphagia in post-sepsis patients is considered an important goal to improve their lives and decrease morbidity. However, definite physical and pharmacological strategies to mitigate or prevent dysphagia in post-sepsis care patients have not been established. Further study is needed to find simple, easy, effective interventions for post-sepsis patients with dysphagia. Head of bed elevation and early SLT evaluation, while

Table 4
Univariate and multivariate logistic regression comparing the incidence of dysphagia on hospital discharge, discharge to home, and total dependency between patients with dysphagia 7 days after admission and patients without dysphagia 7 days after admission.

	Crude OR (95% CI)	Adjusted OR (95% CI)
Dysphagia on hospital discharge		
Dysphagia group (day 7)	33.0 (7.24–150.3)	46.0 (7.90–268.3)
Non-dysphagia group (day 7)	1 (ref)	1 (ref)
Direct discharge home		
Dysphagia group (day 7)	0.05 (0.02–0.15)	0.03 (0.01–0.15)
Non-dysphagia group (day 7)	1 (ref)	1 (ref)
Total dependency		
Dysphagia group (day 7)	4.69 (1.89–11.6)	9.30 (2.68–32.2)
Non-dysphagia group (day 7)	1 (ref)	1 (ref)

Variables, including fasting period, endotracheal tube, SOFA score, and speech and language therapy were used to adjust for outcomes in multivariate logistic regression.
CI, confidence interval; OR, odds ratio; ref, reference value; SOFA, Sequential Organ-Failure Assessment.

Table 3
Outcomes of dysphagia and non-dysphagia patients who were treated for sepsis (n = 101).

	Dysphagia group (n = 55)	Non-dysphagia group (n = 46)	All (n = 101)	p-value
Patient Outcomes				
Aspiration pneumonia, n	16/55 (29.0%)	0/46 (0%)	16/101 (15.8%)	<0.001
ICU or HCU stay, days	5 (3–8)	5 (3–8)	5 (3–8)	0.545
Hospital stay, days	22 (16–32)	17 (12–24)	19 (14–28)	0.013
Dysphagia on the 14th day after admission,[a] n	35/49 (71.4%)	0/31 (0%)	35/80 (43.7%)	<0.001
FOIS score on the 14th day after admission[a]	1 (1–4)	6 (5–7)	5 (1–7)	<0.001
Dysphagia on hospital discharge, n	33/55 (60.0%)	2/46 (4.3%)	35/101 (34.6%)	<0.001
FOIS score on hospital discharge	4 (1–5)	7 (6–7)	6 (4–7)	<0.001
30-day mortality, n	11/55 (20.0%)	1/46 (2.1%)	12/101 (11.8%)	0.006
Direct discharge home, n	7/55 (12.7%)	33/46 (71.7%)	40/101 (39.6%)	<0.001
Barthel Index score on hospital discharge	10 (0–52)	80 (40–98)	40 (0–85)	<0.001
Total dependency, n	30/53 (56.6%)	7/44 (15.9%)	37/97 (38.1%)	<0.001

ICU, intensive care unit; HCU, high-care unit; FOIS, Function Oral Intake Scale.
[a] Early discharge from hospital did not allow us to follow up 6 and 15 patients on the 14th day after admission, respectively.

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the patient is maintained *nil per os* during recovery, should be considered.[6]

This study has several limitations. First, it was a single-centre, retrospective, observational investigation. The number of participants in the analysis was relatively small. Therefore, we could not compare dysphagia in the presence or absence of sepsis or the presence or absence of intubation. A multicentre study with more participants is warranted. Second, we could not access medical records for changes in and potential recovery of swallowing function over time at medical institutions outside of our hospital. Third, our study had some limitations based on the standard care protocols used at our institution. Swallowing function may not have been accurately assessed because SLTs were not provided for all patients, SLTs did not evaluate swallowing function using videofluoroscopic swallowing tests or fiberoptic endoscopic evaluation, and the MWST score was only evaluated on the day of physician permission to resume oral intake. Indeed, only less than 30% of ICUs have their own protocol for dysphagia assessment and management according to the multicentre international survey.[33] Further clinical studies are needed to establish a standardised protocol or algorithm for dysphagia care following sepsis. Assessment of pre-existing dysphagia was based on self-reports or surrogate reports and was therefore not as accurate as it would have been if measured systematically, and we did not evaluate energy requirements and protein intake. The timing of speech and language therapy was based on the attending physician's preference, which might have caused selection bias. Fourth, the relationship between dysphagia and fasting or tube feeding is bidirectional. Dysphagia can necessitate tube feedings, but tube feedings and fasting can also lead to dysphagia. Fifth, we defined our dysphagia criterion as FOIS <5 according to the previous study.[17,18] Some participants with FOIS scores of 5 or higher might have swallowing dysfunction. Finally, dysphagia after sepsis has not been well studied. Therefore, few previous studies have been based on Sepsis-3 criteria. Further study is needed to better understand these interrelated factors.

5. Conclusions

In this retrospective analysis, we found that dysphagia was commonly encountered (54.4%) following sepsis. Fasting period and enteral tube feeding were independently associated with dysphagia on the 7th day after admission. Dysphagia on the 7th day after admission was associated with poor outcomes like dysphagia on hospital discharge, nondirect discharge home, and dependency in activities of daily living at the time of hospital discharge. Because the number of patients treated for sepsis increases each year, further research is needed to reduce dysphagia in sepsis survivors.

Credit authorship contribution statement

Takashi Hongo: Conceptualisation, Methodology, Validation, Investigation Resources, Data Curation, Writing - Original Draft, **Tetsuya Yumoto:** Conceptualisation, Writing - Review & Editing, **Hiromichi Naito:** Conceptualisation, Methodology, Investigation, Writing - Review & Editing, Project administration, **Toshifumi Fujiwara:** Conceptualisation, Writing - Review & Editing, **Jun Kondo:** Resources, **Satoshi Nozaki:** Resources, **Atsunori Nakao:** Supervision

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Availability of data and materials

Data are available upon reasonable request.

Conflict of Interest

The authors declare no conflicts of interest related to this research.

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