

## Characteristics of Dysphagia in Elderly Patients Requiring Mechanical Ventilation

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**Abstract.** The purpose of this study was to describe the swallowing characteristics of elderly patients requiring mechanical ventilation with tracheostomy admitted to a long-term, acute-care hospital. The study was conducted through retrospective record review of patients on mechanical ventilation who had received a Modified Barium Swallow Study (MBSS) during their hospitalization. In a period from 1994 to 2002, 58 patients met the inclusion criteria. The study examined the results of both the clinical and the MBSS evaluations and compared the results and recommendations of the two examinations. Data were obtained from the MBSS records to describe the group in terms of dysphagia symptoms, frequency and occurrence of aspiration, respiratory status, and demographic variables. Parametric and nonparametric statistics were used to determine differences between the evaluations and any significant associations between aspiration and demographic variables, pharyngeal symptoms, and cognitive deficits. Significant differences were found between diet recommendations before and after the MBSS, and significant associations were found between aspiration and three pharyngeal symptoms. Although aspiration and especially silent aspiration occurred frequently in this group, most individuals were able to begin some level of oral intake after the MBSS evaluation. Due to the lack of reliable clinical evaluation measures, the MBSS is necessary for differential diagnosis of dysphagia and dietary recommendations for these individuals.

**Key words:** Tracheostomy — Mechanical ventilation — Aspiration — Dysphagia — Modified Barium Swallow Study — Respiratory failure — Deglutition — Deglutition disorders.

Patients who require long-term mechanical ventilation with tracheostomy are at risk for swallowing disorders for various reasons. Individuals on mechanical ventilation frequently exhibit difficulty coordinating breathing and swallowing, decreased laryngeal elevation, decreased pharyngeal and laryngeal sensation, and decreased subglottal pressure [1–8]. Additionally, individuals who are dependent upon a ventilator are likely to aspirate [2,4,5,9–13], and the aspiration is usually silent [14]. Both oral and pharyngeal stage swallowing abnormalities have been documented in this group, including oral transit and bolus formation deficits, delayed swallow initiation, residue throughout the pharynx and pyriform sinuses [4,10,13], and decreased duration of vocal fold closure during swallowing [8]. Swallowing disorders create serious health risks and can complicate respiratory disease and nutritional status.

Speech–language pathologists (SLPs) use a combination of evaluation techniques to determine the presence and characteristics of dysphagia. The clinical or bedside swallowing evaluation (CBSE) provides important information about oral motor abilities and cognitive skills and also allows the SLP to observe visible and audible signs of aspiration [15,16]. However, the clinical evaluation without the support of an instrumental measure like a Modified Barium Swallow Study (MBSS) will not provide an accurate assessment of pharyngeal skills and may underestimate the severity of dysphagia and aspiration which is often asymptomatic [13,14,16–21]. The

CBSE is especially unreliable for identifying aspiration in patients requiring mechanical ventilation or tracheostomy [7,21].

Instrumentation like the MBSS is also necessary to objectively determine strategies or maneuvers to increase swallowing safety and efficiency and to make dietary recommendations [4,10,20,22–24]. Dietary recommendations based on only a clinical evaluation often differ from recommendations after a MBSS and may either be overly restrictive or place the individual at risk for aspiration and choking [21,23,24]. Definitive diagnosis and appropriate swallowing guidelines are especially critical for patients with compromised respiratory status since they are more likely to have complications if they aspirate [5,14].

Although researchers are attempting to create more accurate and reliable clinical evaluations for dysphagia assessment, existing measures serve only as a screening to determine those patients who require instrumental assessment. Several studies have identified clinical indicators of dysphagia, and these in combination have been used to indicate a need for further diagnostic testing [17,22,25]. The use of multiple clinical features can better identify individuals who need further instrumental study, but this practice is not reliable enough since underestimating dysphagia can have serious consequences for the medical status of the patient. Specifically, patients with ventilator dependency who are being considered to begin oral feeding should routinely be referred for the MBSS because of the frequent occurrence of silent aspiration in this group.

The use of mechanical ventilation in elderly patients is increasing [26,27], and age may play a factor in mortality and morbidity for those with respiratory conditions that require mechanical ventilation [26,28–33]. Mortality rates after respiratory failure are higher with increasing age although other factors such as premorbid health status also impact prognosis. Aging creates physiologic changes in pulmonary function such as gas exchange and elastic recoil, respiratory muscle strength, and the functional reserve of the other systems that support respiration and swallowing [34–37].

The purpose of this study was to determine the swallowing characteristics and incidence of dysphagia in elderly patients on mechanical ventilation admitted to a long-term, acute-care hospital. The co-occurrence of aspiration with swallowing disorders has been documented in patients with respiratory complications, but specific characteristics of different patient groups have not been explored extensively. Most of the patients in this study used a Passy–Muir speaking

valve (PMV) as part of respiratory and swallowing rehabilitation, and although evidence is conflicting, studies have indicated that the PMV improves swallowing function and decreases aspiration [3,12,38,39]. However, since this was a retrospective chart review, it was not possible to determine the direct impact of the PMV with this group because of the nature in which the original dysphagia evaluations were conducted. Specific areas of interest in the study included any differences in recommendations from the clinical swallowing evaluation versus the MBSS, characteristics and incidence of dysphagia, and the effect of demographic variables.

## Methods

### *Sample*

Individuals in the study were adults admitted to this violates confidentiality, a 60-bed, long-term, acute-care hospital with an intensive care unit in a midwestern US city. The population of this hospital was predominantly elderly and medically complex individuals with multiple diagnoses, and many required long-term ventilator support. A major focus of the hospital was ventilator weaning and physical rehabilitation in patients transferred from area hospitals.

### *Procedure*

Data were obtained from a retrospective review of patient medical records from 1994 when the hospital opened until April 2002. Each medical chart in the facility was reviewed by the researchers. All patients on mechanical ventilation with tracheostomy who were being considered as candidates to begin oral feeding and had undergone a MBSS were included in the study. Patients who were orally intubated, who had only a tracheostomy without mechanical ventilation, or who were comatose were excluded. The average length of stay in the facility across diagnoses was 28 days. The underlying causes for the respiratory conditions varied, and the respiratory diagnoses of the subjects included respiratory failure, ventilator dependency, and airway obstruction. A protocol was designed and used by the researchers to assure that uniform information was obtained (see Appendix). Information collected from each medical record included ventilator status, dysphagia symptoms from both the CBSE and the MBSS, recommendations from the CBSE and the MBSS, demographics, and method of nutritional intake.

### Protocol for the Clinical Bedside Swallowing Evaluation

Individuals were administered two presentations of 1/2 teaspoon of thin liquids, puree, and soft solid food consistencies (i.e., graham cracker) in that order unless the prior consistency had resulted in obvious signs of aspiration or choking. Patients who wore a PMV (91.4%) had the valve on and the cuff deflated for trial swallows. Patients who could not tolerate cuff deflation or the PMV received

trial swallows with the cuff inflated. The use of food coloring or suctioning after swallows was not routinely utilized since this was regarded only as a gross screening measure for aspiration. The average length of time between the CBSE and MBSS was 9.9 days. Any delay in the MBSS after the CBSE was due to individuals being inappropriate candidates for the MBSS at the time of the CBSE because of a low level of consciousness, poor response to the trial swallows, or a medical complication prior to the study being conducted.

## Definition of Terms

Aspiration was defined as material passing below the level of the true vocal folds. Silent aspiration was defined as aspiration that occurred without an audible reaction or cough from the individual. Penetration was defined as the presence of material in the laryngeal vestibule or airway entrance that may or may not have been cleared but that did not pass below the level of the true vocal folds during the observed period. A uniform CBSE protocol and MBSS protocol was utilized by the SLPs who performed the original assessments. The policy for SLPs in this facility was to recommend the MBSS for ventilator-dependent patients as soon as individuals could tolerate the procedure if there was any suspected pharyngeal component from the clinical examination. Therefore, the majority of patients on mechanical ventilation underwent a MBSS before beginning oral intake.

## Results

### *Data Analysis*

Statistical comparisons were made with the measures of chi squared, *t*-test, and one-way ANOVA using SPSS version 11.0 statistical software (SPSS Inc., Chicago, IL). Descriptive statistics were also calculated for means and frequency counts.

### Demographics

There were 58 patients who met the requirements for inclusion in the study over the specified time period. A description of each subject and diet recommendations are provided in Table 1. Summary information about age, gender, PMV use, and NPO status is listed in Table 2. The primary respiratory condition which created the need for mechanical ventilation was respiratory failure for 86% of subjects (50/58) and ventilator dependence for 14% (8/58). History information about the underlying disease creating the respiratory condition was not available. Individuals who had been previously prescribed a PMV by their physicians used the valve during the dysphagia evaluations. Gender distribution was roughly commensurate at 58.6% female and 41.4% male. The mean age of the group was 69.7 years of age with a range of 36–86 years. Discharge dispositions at the end of the

hospital stays were home (19%), expired (36.2%), nursing home (37.9%), and hospital transfer (6.9%). This information gives an indication of the severity of illness in these individuals.

## CBSE and MBSS Results

Prior to the MBSS, 84.5% of the participants were NPO or prohibited from any oral intake. A paired-samples *t*-test revealed that the differences between diet recommendations from the CBSE and the MBSS were statistically significant for both food ( $t = -7.021$ ,  $df = 57$ ,  $p = 0.001$ ) and liquid ( $t = -7.592$ ,  $df = 57$ ,  $p = 0.001$ ). After the MBSS, only 24.1% of individuals remained NPO, and 69.6% were allowed thin or nectar-consistency liquids indicating that the results of the MBSS allowed for a less restrictive diet than was recommended from the CBSE (see Table 2). However, this result may have been impacted by the fact that the SLPs at this facility regularly used MBSS with patients on mechanical ventilation prior to beginning an oral diet due to the high incidence of clinically undetected pharyngeal dysfunction. SLPs in other hospitals may be more likely to recommend an oral diet from only the CBSE without instrumental assessment. The most common dietary consistency initiated after the MBSS was puree (34.5%) followed closely by mechanical soft (32.8%). The most common liquid recommendations for patients after the MBSS were thin (44.6%), nectar (25%), honey (7.1%), and no liquids (23.3%). Compensatory strategies that alleviated aspiration were identified on the MBSS for 63.8% of patients.

### Dysphagia Symptoms

Patients exhibited multiple symptoms of both oral and pharyngeal stage dysphagia during the MBSS, including impaired anterior–posterior bolus transport, delayed swallow, laryngeal penetration, and vallecular and pyriform sinus residue (see Table 3). Aspiration was present in 41.4% of patients and occurred with equal frequency before and during the swallow (12.1%) and at times during both the oral and pharyngeal stages of the swallow (10.3%). Aspiration was silent 83.3% of the time when it occurred.

Chi-squared analysis was used to determine associations between the presence of aspiration and gender, laryngeal penetration, cognitive deficits, vallecular residue, pyriform residue, delayed pharyngeal swallow, and decreased anterior–posterior bolus transport. The presence of residual material in the pyriform sinuses ( $p = 0.039$ ), laryngeal penetration ( $p = 0.001$ ), and decreased anterior–posterior bolus

**Table 1.** Descriptions of subjects, diagnoses, and diet recommendations

Pt no.	Age	Gender	Diagnosis	CBSE diet rec	MBSS diet rec
1	78	M	Vent Depen	NPO	NPO
2	69	M	Vent Depen	NPO	NPO
3	80	F	Vent Depen	NPO	Mech Soft Puree/Meat
4	80	F	Resp Fail	Puree	Puree
5	77	M	Vent Depen	NPO	NPO
6	76	F	Resp Fail, Vent Depen	NPO	Mech Soft
7	66	F	Resp Fail, Vent Depen	NPO	Puree
8	74	M	Resp Fail, Vent Depen	NPO	Mech Soft
9	79	F	Resp Fail, Vent Depen	NPO	NPO
10	65	F	Vent Depen	NPO	Puree
11	53	M	Resp Fail, Vent Depen	NPO	Puree
12	82	F	Resp Fail	NPO	Puree
13	70	M	Resp Fail	NPO	Puree
14	66	M	Resp Fail, Vent Depen	NPO	Mech Soft
15	79	F	Resp Fail, Vent Depen	NPO	Puree
16	54	F	Vent Depen	NPO	NPO
17	54	F	Vent Depen	NPO	Mech Soft
18	70	F	Resp Fail	NPO	Mech Soft
19	66	F	Resp Fail, Vent Depen	NPO	Puree
20	75	F	Resp Fail	NPO	Mech Soft
21	83	M	Resp Fail	NPO	Puree
22	78	F	Resp Fail, Vent Depen	Mech Soft	Mech Soft
23	77	M	Resp Fail	NPO	Mech Soft
24	36	F	Resp Fail	NPO	Mech Soft
25	75	F	Resp Fail	NPO	Mech Soft Puree/Meat
26	68	F	Resp Fail	NPO	Puree
27	76	M	Resp Fail	Mech Soft Puree/Meat	Mech Soft Puree/Meat
28	74	F	Resp Fail	NPO	NPO
29	62	M	Resp Fail	NPO	Puree
30	62	M	Resp Fail	NPO	Mech Soft
31	74	F	Resp Fail	Regular	Mech Soft
32	74	F	Resp Fail	Mech Soft	Mech Soft
33	66	M	Resp Fail	NPO	Mech Soft
34	73	M	Resp Fail, Airway Obstr	NPO	NPO
35	42	M	Resp Fail, Vent Depen	NPO	NPO
36	74	F	Resp Fail, Vent Depen	NPO	Puree
37	74	F	Resp Fail	Puree	Puree
38	70	F	Resp Fail, Airway Obstr	NPO	NPO
39	37	M	Resp Fail, Vent Depen	NPO	Mech Soft
40	86	F	Resp Fail	NPO	Puree
41	58	F	Resp Fail, Vent Depen	NPO	NPO
42	80	F	Resp Fail, Vent Depen	Mech Soft	Mech Soft
43	82	F	Resp Fail	NPO	Puree
44	70	M	Resp Fail, Vent Depen	NPO	NPO
45	73	M	Resp Fail, Vent Depen	NPO	Puree
46	70	F	Resp Fail	NPO	Puree
47	76	M	Resp Fail	NPO	Puree
48	71	F	Resp Fail	Mech Soft Puree/Meat	Mech Soft
49	68	M	Vent Depen	NPO	NPO
50	69	F	Resp Fail, Vent Depen	NPO	Regular
51	69	F	Resp Fail	NPO	Regular
52	72	F	Resp Fail	NPO	Puree
53	58	M	Resp Fail	NPO	Mech Soft
54	77	F	Resp Fail	NPO	Mech Soft
55	70	M	Resp Fail, Airway Obstr	NPO	NPO

**Table 1.** Continued

Pt no.	Age	Gender	Diagnosis	CBSE diet rec	MBSS diet rec
56	76	M	Resp Fail	NPO	NPO
57	75	M	Resp Fail, Vent Depen	NPO	Puree
58	55	F	Resp Fail	Mech Soft	Mech Soft

**Table 2.** Summary demographics of subjects and frequency of NPO

Mean age	Male	Female	PMV use	NPO prior to MBSS	NPO after MBSS
69.7 yrs	41.4%	58.6%	91.4%	84.5%	24.1%

transport ( $p = 0.027$ ) were significantly associated with aspiration. A one-way ANOVA demonstrated no significant association between age and aspiration although it was expected that aspiration would be associated with increasing age.

## Discussion

Many patients who are ventilator-dependent are elderly and have swallowing disorders that result in aspiration. In this study, as in other studies, patients on mechanical ventilation aspirated frequently. With mechanical ventilation and tracheostomy, adverse changes in the swallowing mechanism occur as a result of disuse muscle atrophy, desensitization, and chronic laryngeal damage, and these affects accumulate over time. Reinstating oral intake as soon as it is safe may prevent further loss of feeding and swallowing skills. Since aspiration in patients with ventilator dependence is typically silent, the MBSS is necessary when these individuals are being considered as candidates to begin oral feeding.

Diet recommendations made from the CBSE in this study were significantly different from those made after the MBSS was conducted and, almost always, the individual was allowed to begin oral intake or upgrade the diet. These data demonstrate that although elderly patients on mechanical ventilation are at high risk for dysphagia, they can often safely have some oral intake and should not be assumed to be profound aspirators because of their respiratory status. It is important to provide oral intake as soon as patient safety is ascertained with the MBSS in order to avoid the negative affects of being NPO, including discomfort, muscle atrophy, sensory deprivation, tube feeding risks, and nutritional deficiencies.

A return to oral intake is associated with increased quality of life, social interaction, independence, and as an important step toward recovery [40–47].

It should be noted that 91.4% of individuals utilized the PMV while eating and swallowing, although it was not possible to determine its impact on swallowing. It is interesting that the individuals in this study on mechanical ventilation aspirated with equal frequency before and during the swallow and also tended to aspirate during the oral and pharyngeal stages of the swallow. Oral stage dysfunction may occur from a combination of factors including generalized weakness and frailty, dry mouth from the ventilator from being NPO, decreased oral motor skills from disuse, and oral motor deficits from underlying neurological conditions. The multiple instances of aspiration that occurred may have been due to difficulty coordinating swallowing with the cycling of the ventilator.

Additionally, patients on mechanical ventilation frequently require anti-anxiety medications and these may cause sedation and decrease cognitive awareness needed for safe swallowing. Laryngeal penetration and pyriform sinus residue may occur from reduced sensitivity to material in the pharynx, poor laryngeal elevation from the tracheostomy tube tethering, and a weak swallow from decreased subglottal pressure. Once food or liquid reached the level of the airway entrance, these patients were unable to clear the material.

## Conclusion

This research provides information about the characteristics and prevalence of dysphagia in elderly patients on mechanical ventilation and, as with other patient groups, demonstrates the importance of the MBSS. These results provide additional justification for the routine use of the MBSS to improve patient safety and to facilitate a timely return to oral feeding. The clinical examination is valuable but is not sufficient for determining the safety of oral feeding or appropriate dietary recommendations. Elderly adults with ventilator dependence vary in their strengths and weaknesses, and many can tolerate some level and

**Table 3.** Pharyngeal abnormalities observed on MBBS

Swallow delay	Anterior–posterior movement	Vallecular stasis	Pyriform stasis	Penetration	Aspiration	Silent aspiration <sup>a</sup>
84.2% <sup>b</sup> (48/57)	82.8% (48/58)	75.5% <sup>b</sup> (39/52)	51.9% <sup>b</sup> (27/52)	38.6% <sup>b</sup> (22/57)	41.4% (24/58)	83.3% (20/24)

<sup>a</sup>Percentage of silent aspiration in those who aspirated during the MBSS.

<sup>b</sup>N varies based on data that was available in medical record.

amount of oral intake. These individuals may have multiple symptoms of dysphagia that are not visible or audible, and SLPs and medical personnel should not make assumptions about the swallowing status of individuals who are ventilator-dependent.

Instrumental assessment like the MBSS is critical for making any type of dietary recommendation and to assure an adequate diagnosis of oropharyngeal and laryngeal function. The MBSS can be performed with patients on mechanical ventilation using a portable ventilator in the radiology suite or a portable fluoroscopy unit at the bedside. An individual's quality of life may be greatly improved by determining if there are any consistencies that can be eaten safely as opposed to unnecessarily restricting oral intake.

Eating is a positive functional outcome of dysphagia intervention, may prevent further loss of

skills and muscle atrophy, and is less expensive than tube feeding. As technology extends lifespan, the number of patients with ventilator dependence will increase. SLPs will be frequently required to evaluate and make recommendations regarding swallowing safety for these patients and must be aware of the complicated issues involved. Long-term acute care with mechanical ventilation and nonoral feeding is very costly with uncertain outcomes and no reliable method of prediction for mortality rates and quality of life. Healthcare providers are seeking the tools to best assess and intervene with these chronically ill patients to balance safety, quality of life, and costs of care. The ability to swallow safely is a very important part of overall health and well-being, and appropriate dysphagia intervention can increase both psychosocial and physical outcomes.

## Appendix: Data Collection Protocol

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Patient No. \_\_\_\_\_ Diagnosis(es) \_\_\_\_\_

Date of bedside: \_\_\_\_\_ Age: \_\_\_\_\_ Gender: \_\_\_\_\_

Tracheostomy: yes    no                      Ventilator: yes    no                      Type of trach: \_\_\_\_\_

Ventilator Setting: \_\_\_\_\_ PMSV: yes    no

Functional Cognitive Deficits: yes    no

### Clinical evaluation:

Diet recommended:    NPO                      puree                      mech soft/puree meat                      mech soft                      regular  
    thin liquids                      nectar liquids                      honey                      no liquids

Dysphagia Dx (Oral): Normal                      Mild                      Mod                      Severe  
 Pharyngeal dysphagia (suspected):                      Normal                      Mild                      Mod                      Severe  
 Aspiration suspected: yes    no                      MBS recommended: yes    no

### Pharyngeal symptoms:

Cough after swallow                      Change in voice quality                      Nasal secretions/watery eyes  
 Delayed swallow                      Decreased laryngeal elevation                      History of pneumonia  
 History of dysphagia                      Dysphonia                      Abnormal cough                      Dysarthria  
 Decreased O<sub>2</sub> sats

### Compensatory recommendations:

Chin tuck                      Double swallow                      Small bite size                      No straw  
 Liquids by spoon                      Alternate liquids/solids                      Lingual sweep

**Other:**

**Results of MBS:** Date: \_\_\_\_\_

Oral motor skills: A-P transport:	Normal	Impaired		
Delayed onset of swallow: yes	no	Decreased laryngeal elevation: yes	no	
Residue in anterior sulcus: yes	no	Residue in lateral sulcus: yes	no	
Vallecular residue: yes	no	Pyrimiform residue: yes	no	
Penetration occurred: before	during	after swallow		
Cleared? yes	no	Which consistencies: _____		
Aspiration occurred: before	during	after swallow		
Which consistencies: _____		Aspiration silent: yes	no	

**Diet recommended:** NPO puree mech soft/puree meat mech soft regular  
thin liquids nectar liquids honey no liquids

**Compensatory recommendations:**

Chin tuck	Multiple swallows	Effortful swallow
Supraglottic swallow	Super-supraglottic	Mendesohn Maneuver
Alternate liquids/solids	Lingual sweeps	No straw
		Small bite size

Oral motor exercises recommended: \_\_\_\_\_

Postural change recommended: \_\_\_\_\_

Dysphagia therapy recommended: yes no

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