

# The Safety of Food and Drink Consistencies Based on a Fiberoptic Endoscopic Evaluation of Swallowing Study Results in Stroke Patients with Dysphagia

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## ABSTRACT

**Objective:** Knowing such dysphagic stroke patients' ability to swallow various food consistencies from instrumental investigations will help the medical staff choose the appropriate and safe food consistencies, and lead to a better swallowing outcome. This study aimed to determine the safety of food textures and drink consistencies in stroke patients with dysphagia.

**Materials and Methods:** Stroke patients who failed the small-volume water swallow test (WST) and underwent fiberoptic endoscopic evaluation of swallowing (FEES) at the Department of Rehabilitation Medicine from 2017 to 2020 were reviewed. The patients' characteristics and safe food textures and drink consistencies from their FEES results were collected. They were given a bolus test, which included four modified food textures and three varying drink consistencies, as adapted from the International Dysphagia Diet Standardization Initiative. The sequence of bolus test was adjusted by participants' swallowing abilities individually. Moreover, their compensatory techniques were reviewed.

**Results:** Forty-three participants were recruited. Most of them (81.3%) could safely swallow one consistency of drink. Twenty-five (58.1%) could safely swallow a mildly thick liquid. About 20% of them could not safely swallow any food textures. Most participants (76%) who safely swallowed a mildly thick liquid could also safely swallow at least one kind of food texture. About half of them (53%) used the chin-tuck technique during the FEES testing.

**Conclusion:** Half of stroke patients with dysphagia who failed small-volume WST could safely swallow with a mildly thick liquid with compensatory techniques. Therefore, they should be referred to dysphagia specialists for comprehensive evaluation and management.

**Keywords:** Diet modification; stroke; dysphagia; fiberoptic endoscopic evaluation of swallowing study (Siriraj Med J 2022; 74: 395-400)

## INTRODUCTION

Stroke is the leading cause of death and long-term disability worldwide<sup>1</sup>, especially in developing countries<sup>2</sup> and Thailand.<sup>3</sup> To date, appropriate stroke management

and rehabilitation intervention<sup>4-5</sup> have been established to reduced mortality rate and disabilities. However, previous studies<sup>6-7</sup> reported lack of knowledge and awareness about stroke and its risk factors were leading to delayed

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treatment and poor outcome in developing countries. Moreover, comprehensive stroke units that incorporate rehabilitation have not been settled yet. Hence, stroke is a major public health leading to multiple disabilities<sup>8-9</sup> and impact their quality of life.<sup>10</sup>

Post-stroke dysphagia (PSD) is found in approximately 55% of acute stroke survivors.<sup>11</sup> PSD was associated with an increased 12-months-mortality, develop aspiration pneumonia and poorer functional outcomes.<sup>12</sup> Performing swallowing screening among individuals with stroke is recommended.<sup>12-13</sup> According to the dysphagia management guidelines<sup>12,14-15</sup>, stroke survivors who fail the swallowing screening should be referred to dysphagia experts and/or consider instrumental investigations, including a videofluoroscopic swallowing study and a fiberoptic endoscopic evaluation of swallowing (FEES) to confirm their swallowing pathology and to prescribe safe modified diet, and compensatory techniques.<sup>16-17</sup> Both interventions have demonstrated excellent agreement in detecting laryngeal penetration (89.58%), tracheal aspiration (96.69%), pharyngeal residue (84.38%) and also diet recommendation (100%).<sup>17</sup>

In clinical practice, the water swallow test (WST) is approved as a standard to detect aspiration risk<sup>12,18</sup> and widely used. The small volume WST (1-5 mL) has sensitivity of 63%-78% and specificity of 86%-93% and large volume WST (90-100 mL) has sensitivity of 89%-93% and specificity of 51%-55%.<sup>18</sup> Therefore, stroke survivors who fail small volume of WST were assumed at high risk of aspiration and may be recommended for NG tube-feeding and then be referred to a dysphagic specialist.<sup>12,14</sup> In developing countries, there are not enough dysphagia specialists, and the instrumental investigations require trained specialists, are costly and not generally accessible. This can lead to an unnecessarily prolonged nothing per oral period which can decondition the swallowing function.<sup>19</sup>

Swallowing rehabilitation<sup>20</sup> consists of an indirect swallowing therapy (oromotor stimulation and exercise) and a direct swallowing therapy (swallowing training with a modified diet and/or compensatory techniques). Direct-swallowing therapy follows the principles of neuromuscular rehabilitation to facilitate increased muscle strength.<sup>21</sup> Dietary modification is a crucial treatment for dysphagia and can reduce the risk of aspiration.<sup>22</sup> According to systematic review<sup>23</sup>, show a reduction in the risk of penetration-aspiration with liquids, as they progress from the thin to the very thick end of the viscosity continuum. Benjapornlert P, et al<sup>24</sup> reported thin liquid with large volume (10 mL) showed the highest risk of penetration and aspiration in the healthy elderly with

dysphagia risk. However, a small amount of moderately thick liquid (4 mL) was the safest.

However, there is no consensus evidence whether stroke survivors with dysphagia especially in whom failed a small volume of WST should be NPO until they meet dysphagia experts or receive instrumental assessment or try to start training with diet modification.<sup>25</sup> Knowing such patients' ability to swallow various food consistencies from instrumental investigations will facilitate an earlier direct swallowing therapy, help the medical staff choose the appropriate and safe food consistencies, and lead to a better swallowing outcome.

The objective of this study is to find the safe food textures and drink consistencies for individuals with stroke who fail the small- volume WST based on their FEES results.

## MATERIALS AND METHODS

This retrospective study was conducted in stroke survivors who failed the small-volume WST and underwent the FEES procedure at the Department of Rehabilitation Medicine from 2017 to 2020. The patients who had a history of surgery or cancer in the head or neck or other neurological diseases affecting the swallowing function, such as Parkinson's disease or brain tumor were excluded.

Demographic data and the FEES result, including the safe food and drink consistencies and compensatory technique, were reviewed from medical records.

The research protocol was approved by the Siriraj Institutional Review Board (Si 752/2019). The clinical trials registry number is TCTR20200322002.

### The water swallow test (WST)

The small volume of WST (5 mL) were done 3 attempts by physiatrists. The presence of abnormal signs including coughing, a vocal change, or a decrease in oxygen saturation of more than 2% at any attempts, were considered as failing the WST.

### The fiberoptic endoscopic evaluation of swallowing (FEES)

The FEES was performed by dysphagia specialists who had experience in the procedure at least 50 cases.

The definition of a "safe swallow" of each consistency tested when performing the FEES was determined by penetration-aspiration scale<sup>26-27</sup>  $\leq 2$  and his or her not having a residual content of more than 25%. Otherwise, the swallows were determined to be "unsafe."

Each subject was tested with various consistencies of food and drinks which were adapted from the International Dysphagia Diet Standardization Initiative (IDDSI).<sup>28</sup>

The three drink consistencies consisted of a thin liquid, a mildly thick liquid, and a moderately thick liquid. The four food textures consisted of a pureed, minced and moist, soft and bite-sized, and regular diet.

The FEES protocol, participant swallowed a 5-mL of each drink and food consistency and 2 times for each consistency. The FEES protocol began with a mildly thick liquid. If it was safe, then a thin liquid would be tested. If that failed, then a moderately thick liquid would be tested. The food textures were tested if the patient passed one of liquid-consistency test. A pureed item was initially tested, and then the patient progressed to minced and moist, soft and bite-sized, and finally, a regular diet. The test was stopped at the consistency which was considered unsafe. Finally, the endoscopists determined the food and drink consistency which the patient could safely swallow.

### Statistical analysis

The data were analyzed using the IBM SPSS statistics, version 23.0 (IBM corporation). The subjects were categorized into two groups based on their FEES results: 1) indirect- swallowing therapy (IT): These patients could not safely swallow any consistency of food or drink, and 2) direct-swallowing therapy (DT): These individuals could swallow at least one consistency of food or drink.

Quantitative data, including age, BMI and stroke onset, were reported by mean and standard deviation or median and interquartile range. Qualitative data, including demographic data, ability to swallow various drink consistencies and food textures, compensatory techniques used were reported by number or percentage. The Fisher's exact test was used to compare the categorical variables. The independent t-test or Mann-Whitney U-test was used to compare the continuous variables. A multivariate logistic regression analysis, with an adjustment for potential confounding factors, was used to estimate the adjusted odds ratio. A P-value <0.05 was considered statistically significant.

## RESULTS

Forty-three patients were included for analysis.

The duration of the days between WST and FEES procedure, mean  $\pm$  SD was  $5.9 \pm 5.5$  days. Table 1 shows the number and percentage of subjects who could safely swallow various drink consistencies. Most participants (81.3%) could safely swallow one consistency of drink. Twenty-five participants (58.1%) could safely swallow a mildly thick liquid. Six participants (13.9%) could safely swallow liquid. Eight (18.6%) were not allowed to swallow any consistency of drink. More than half (60%) of the

patients could safely swallow at least one kind of food consistency. About 40% were not allowed to swallow any food textures.

Twenty-five subjects who could safely swallow a mildly thick liquid could safely swallow pureed, minced and moist, and soft and bite-sized items, at a percentage of 40%, 24%, and 12%, respectively. It was determined that 76% of the subjects who could safely swallow a mildly thick liquid could safely swallow at least one kind of food consistency.

Four subjects who could safely swallow moderately thick liquid, 25% (1/4) could safely swallow pureed and others were unable to swallow any food consistency.

Table 2 summarizes the demographic and clinical characteristics of the subjects in the IT and DT groups. Infratentorial lesion, a history of pneumonia, and a younger age significantly characterized the IT group. Other factors were not significantly different between the two groups.

According to the univariate analysis, the three variables associated with the severity of dysphagia were infratentorial lesion ( $p=0.022$ ), a history of pneumonia ( $p=0.028$ ), and a younger age ( $p=0.023$ ). By multivariate analysis using the stepwise logistic regression, the strongest independent risk factor for the severity of dysphagia was infratentorial lesion (adjusted OR 9.33, 95% CI 1.50-58.01), as shown in Table 3.

**TABLE 1.** The participants' final abilities to safely manage various drink consistencies and food textures

Drink consistencies and food textures*	N (%), (n=43)
Drink	
Thin liquid	6 (14.0)
Mildly thick	25 (58.1)
Moderately thick	4 (9.3)
Unable to drink any drink consistencies	8 (18.6)
Food	
Pureed	11 (25.6)
Minced and moist	12 (27.9)
Soft and bite-sized	3 (7.0)
Regular	0 (0)
Unable to eat any food textures	9 (20.9)
Not tested	8 (18.6)

Most of participants (83.7%) used at least one compensatory technique. One fourth of them used 2 compensatory techniques and 16 % of them used more

than 2 compensatory techniques. The multiple swallows were the most common technique used, at about 53%, followed by the chin tuck, at about 20%.

**TABLE 2.** Demographic data.

Characteristics	Subjects (n=43)	IT <sup>1</sup> (n=8)	DT <sup>2</sup> (n=35)	P-value
Age (years), mean $\pm$ SD	68.5 $\pm$ 13.6	58.75 $\pm$ 13.26	70.74 $\pm$ 12.9	0.023*
BMI <sup>3</sup> (kg/m <sup>2</sup> ), mean $\pm$ SD	20.4 $\pm$ 3.8	19.37 $\pm$ 3.31	20.71 $\pm$ 3.9	0.383
Duration of stroke (days), median (range)	118 (65-318)	77.5 (51-503)	120 (71-292)	0.502
Male gender, n (%)	26 (60.5)	7 (87.5)	19 (54.3)	0.119
Stroke type: Infarction, n (%)	32/42 (76.2)	7/8 (87.5)	25/34 (73.5)	0.655
Lesion location: Infratentorial, n (%)	8/39 (20.5)	4/7 (57.1)	4/32 (12.5)	0.022*
Recurrent stroke, n (%)	10 (23.3)	1 (12.5)	9 (25.7)	0.655
History of aspiration pneumonia, n (%)	12 (27.9)	5 (62.5)	7 (20)	0.028*
On tracheostomy, n (%)	2 (4.7)	0 (0)	2 (5.7)	1.000
Bedside-swallowing evaluation, n (%)				
Abnormal gag reflex	19 (44.2)	3 (37.5)	16 (45.7)	1.000
Presence of aphasia	6 (14)	1 (12.5)	5 (14.3)	1.000
Tongue weakness	28 (65.1)	4 (50)	24 (68.6)	0.419
Abnormal laryngeal excursion	39 (90.7)	8 (100)	31 (88.6)	1.000
Tube feeding, n (%)				
No tube feeding	1 (2.3)	0 (0)	1 (2.9)	N/A
NG <sup>4</sup> tube	41 (95.3)	7 (87.5)	34 (97.1)	N/A
PEG <sup>5</sup>	1 (2.3)	1 (12.5)	0 (0)	N/A

\*A *p*-value <0.05 indicates statistical significance

<sup>1</sup>IT, indirect swallowing therapy (subject was not safe to swallow any consistency of food or drink); <sup>2</sup>DT, direct swallowing therapy (subject was safe to swallow at least one consistency of food or drink); <sup>3</sup>BMI, body mass index; <sup>4</sup>NG, nasogastric; <sup>5</sup>PEG, percutaneous endoscopic gastrostomy, Values are represented as mean  $\pm$  SD or median  $\pm$  IQR or n (%)

**TABLE 3.** Factors associated with poor ability to safely swallow.

Characteristics	Crude odds ratio	Adjusted odds ratio
Age	0.94 (0.88, 0.99)	-
History of aspiration pneumonia	6.66 (1.27, 34.84)	-
Infratentorial lesion	9.33 (1.50, 58.01)	9.33 (1.50, 58.01)

## DISCUSSION

Ours is the first study to elucidate such patients' ability to swallow various consistencies of food and drinks. This knowledge will help clinicians to choose the appropriate consistency for each individual, and this will improve the efficacy and safety of the swallowing therapy.

This study showed that most participants could safely swallow one kind of drink, and about half of them could safely swallow a mildly thick liquid such as any liquid or juice with thickener, drinkable yogurt, skimmed milk. The IDDSI<sup>28</sup> recommends to measure how thick a liquid by the flow test measures. For mildly thick liquids, the 4-8 mL remaining in a 10 mL syringe after 10 seconds of flow should observe. It might be an option to start swallowing- training and closely monitor the aspiration under experienced healthcare providers. However, the authors suggest that those patients should be referred to dysphagia expert for comprehensive evaluations.

Furthermore, if patients fail to swallow a moderately thick consistency such as honey or smoothies, then no drinks or food will be allowed for the training. If our subjects could safely swallow a mildly thick liquid, most of them could also safely swallow one kind of food consistency. These might be useful to precede the swallowing training.

Kagaya et al.<sup>29</sup> demonstrated that body position, such as chin down, head rotation, etc., can also minimize aspiration. In our study, half of the patients were recommended to use the multiple swallow technique, and 20% were encouraged to use the chin tuck position. Thus, the study results were affected not only by the modified textures or consistencies, but by the compensatory techniques. Ultimately, compensatory techniques should be used along with a modified diet as dysphagia management.

In the present study, some participants were not allowed to swallow any food. Those included 1.) Patients who were not safe after swallowing mildly and then moderately thick consistencies of drink, and who then did not test with any food. According to the IDDSI<sup>28</sup>, a moderately thick liquid consistency is comparable to a liquidized texture of food (the first level of food texture). If they were not safe with this consistency, they would not be safe for food testing. 2.) Patients were not safe after any food-texture testing. However, 13.9% of the subjects could safely swallow a thin liquid. These findings may be due to a false positive of the WST but also from the false negative in FEES. Moreover, compensatory techniques were applied while performing the FEES.

Daniel SK et al.<sup>30</sup> showed that infratentorial lesion has a significantly higher likelihood of an abnormal PAS

score, when compared to those in the right hemisphere. This is because the cranial nerve nuclei, the nerve tract, and the reticular interneurons which are responsible for the swallowing function within the brainstem structures are clustered.<sup>31</sup> This is consistent with our study. History of aspiration pneumonia was found more in IT group (62.5%) than DT group (20%). However, this factor did not show a significant association, it might be due to small sample size in IT group.

This study has some limitations. First, this is retrospective study, so there was a high risk of bias and missing data. The FEES did not perform in the same day of WST. In addition, this FEES protocol did not test all the drink consistencies and food textures in all the participants. The endoscopists tested with drink consistencies first and then progressed to food textures, as described in the study method. Therefore, each patient was not tested with the same FEES protocol.

To conclude, half of stroke patients with dysphagia who failed small-volume of WST could safely swallow with a mildly thick liquid with compensatory techniques. Thus, they should be referred to dysphagia specialists for comprehensive management as soon as possible. Infratentorial lesion proved to be a factor associated with poor ability to safely swallow.

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