

# Application Value of Flexible Endoscopic Examination of Swallowing in Acute Stroke Patients With Dysphagia

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**Background:** The aim was to study the application value of flexible endoscopic examination of swallowing (FEES) for the aspiration screening, the diagnosis of dysphagia and evaluation of the therapeutic effect in acute stroke patients with dysphagia.

**Methods:** A total of 525 patients with acute stroke who were hospitalized from October 2015 to January 2021 in the Rehabilitation Medicine Department of our hospital underwent FEES for analyzing the characteristic performance. Twenty-one cases of them were examined by video fluoroscopic swallow study and compared with the results of FEES for evaluating the reliability of the FEES, the reliability of diagnosis of dysphagia, and the consistency of the 2 methods. The effect of rehabilitation was evaluated by comparing the FEES test results before and after treatment.

**Results:** In 525 patients, the FEES revealed 378 cases of aspiration (139 cases were silent aspiration), showing a higher detection rate than water swallow test. Patients with potential cricopharyngeus achalasia got the same results through both of examinations. FEES can provide more positive indicators, guide clinical rehabilitation treatment and objectively assess the effect of rehabilitation.

**Conclusions:** Acute stroke patients with dysphagia have characteristic pharyngeal and laryngeal performance. FEES is simple to operate and has high application value in the diagnosis and treatment of dysphagia.

**Key Words:** flexible endoscopic examination of swallowing, stroke, dysphagia

(*The Neurologist* 2022;27:245–248)

Stroke, as a major threat of the health of Chinese people, is a disease characterized by high morbidity, high disability, and high mortality. The main reason for the high mortality rate of

stroke patients lies in the nervous system and internal medical complications accompanying stroke. Dysphagia is one of the most common complications of stroke patients, which increases the risk of pulmonary infection and hinders food intake, and it plays an important role in the outcome of stroke. Since the symptoms of patients after stroke are different and complex, how to diagnose the dysphagia accurately and conveniently is very important. Up to now, video fluoroscopic swallow study (VFSS) is the gold standard of swallowing examination, which has been used in clinic for a long time. However, because of the need to transport patients to a special examination site, the exposure to radiation during the examination and the inaccurate evaluation of small retention of laryngopharynx and intralaryngeal leakage caused by partial overlap of axial projection of laryngopharynx and laryngeal cavity, it is not easy to be accepted by patients and be promoted by doctors. Developed in recent years, flexible endoscopic examination of swallowing (FEES) is able to improve the detection rate of dysphagia and to directly observe aspiration, which makes up for the deficiency of VFSS, and therefore the 2 methods have a significant complementary relationship. In view of this, FEES were performed for stroke patients hospitalized in the Rehabilitation Department of our hospital from October 2015 to January 2021. The clinical data and diagnosis experience are summarized as follows:

## MATERIALS AND METHODS

### Patients

Between October 2015 and January 2021, 525 acute stroke patients (327 men, 198 women) with dysphagia were screened through the repetitive saliva swallowing test and the water swallow test after hospitalized in the Rehabilitation Department. And FEES was performed within 10 to 40 days after the onset of stroke. (Eligibility criteria included a confirmed diagnosis of acute stroke, dysphagia after screening and informed consent. Patients with critical condition, vital organ failure or cognitive impairment were excluded.) Meanwhile, 21 cases with suspected dysfunction of cricopharyngeal muscle received VFSS.

### Instruments

Full high-definition (HD) electronic nasopharyngoscope system (XION, German).

### Examination

There is no need to fast for solids and liquids before the examination. When the patient was in a sitting or semisitting position, the HD electronic nasopharyngoscope was routinely introduced through the nasal cavity and fixed after entering the nasopharynx, oropharynx, laryngopharynx, and larynx. The patient was instructed to orally take in 3 kinds of food in the form of dilute liquid, dilute thick and paste (thickening agent was prepared in a certain proportion), mostly starting from the

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X.Z.: conception and design of study/review/case series; acquisition of data: laboratory or clinical/literature search; analysis and interpretation of data collected; drafting of article and/or critical revision; final approval and guarantor of manuscript. F.L.: acquisition of data: laboratory or clinical/literature search; analysis and interpretation of data collected; drafting of article and/or critical revision. F.M.: acquisition of data: laboratory or clinical/literature search; analysis and interpretation of data collected. S.C.: conception and design of study/review/case series; acquisition of data: laboratory or clinical/literature search; final approval and guarantor of manuscript. G.O.: acquisition of data: laboratory or clinical/literature search.

The authors declare no conflict of interest.

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ISSN: 2331-2637/22/2705-0245

DOI: 10.1097/NRL.0000000000000401

paste and from small to large amounts (1, 3, 5 mL). Besides, the other 2 contrast agents were decided whether to use according to the patient's performance during examination.

## Observations

### FEES

Before eating: endoscope can visually observe the function of the patient's pharyngeal and laryngeal structure during breathing, breath-holding, coughing, pronunciation and swallowing. Suction the secretions and turn the head of the HD video rhinolaryngoscope. Ask the patient to carry on eupnea and pronounce the "E" sound. Carefully observe the laryngeal performance, saliva retention, and the presence of saliva spillage into larynx. Then ask the patient to swallow in order to observe the speed of swallow initiation, cough and nasopharyngeal closure. Use the lens to gently touch the tongue base and posterior pharyngeal wall to observe whether the patient has cough, nausea and other reflexes and to assess whether there is sensory weakness or loss.

Oral-preparatory stage: whether food bolus slips into the throat prematurely during chewing, that is, preswallowing spillage.

Oral-propulsive stage: whether food bolus can be squeezed into the pharyngeal cavity smoothly and whether the swallow initiated timely and rapidly.

Pharyngeal stage: with the lens located in the nasopharynx above the level of soft palate, the clinician can observe whether the nasopharynx is effectively and completely closed off by the soft palate elevation.

Esophageal stage: after the pharyngeal stage, food bolus is propelled into the esophagus and the pharynx and larynx are reopened for imaging. This allows the clinician to observe if epiglottis has difficulty in reflection or reduction, the amount and location of food residues in laryngopharynx (especially in vallecula epiglottica and pyriform sinus) and the presence of staining as well as its location in the larynx cavity. Only supraglottic staining is called leakage and subglottic staining is called aspiration. Besides, it is called overt aspiration if accompanied with cough reflex, and if not, it is called a silent aspiration. If laryngopharynx residue is significant, the clinician can ask patients to swallow repeatedly to observe the removal of food bolus in the pharynx and the overflow of food from pyriform sinus into larynx, that is, postswallowing spillage. If there is a large amount of food remains in pyriform sinus after swallowing, repeated swallowing is ineffective and even need to spit it out through the mouth, cricopharyngeal achalasia or esophageal obstruction cannot be excluded.

By observing the leakage, retention, aspiration, and pharyngeal clearance of oropharyngeal secretions or food of

different consistencies in the process of swallowing, including oral-preparatory stage, oral-propulsive stage, and esophageal stage (the pharyngeal stage cannot be directly observed because the endoscope fails to perform image when the pharyngeal cavity is filled with food), FEES can assess and predict the swallowing function of each stage including pharyngeal stage, therefore it has high accuracy and clinical guiding significance.

### VFSS

Instrument: SIEMENS DSA multifunctional digital gastrointestinal machine.

Preparation of contrast agents: by using 60% barium sulfate suspension and food thickening agent, food of 3 different consistencies, including dilute liquid, dilute thick and paste, were prepared according to a certain proportion.

Examination: patients took a sitting position and kept their head naturally straight. Then they swallowed three kinds of barium sulfate suspension with different consistencies in turn, starting from paste and from small to large amounts (1, 3, 5 mL). The other 2 contrast agents were decided whether to use according to the patient's performance during examination.<sup>1</sup> Clinical manifestations such as aspiration, contrast agent residues and leakage were observed during swallowing in the anteropausal and lateral positions. Once the above clinical manifestations occurred during the examination, the clinician would stop the examination in time and help the patient remove the contrast agent. The whole procedure was videotaped. The preparation of contrast agent and specific steps referred to the methods in the relevant literature,<sup>2</sup> and the degree of aspiration and dysphagia was estimated jointly by a trained rehabilitation physician and a radiologist.

## CRITERIA FOR RESULTS

Observing infraglottic staining by FEES is confirmed as aspiration, which can be classified into 2 categories. Overt aspiration refers to the one accompanied with cough reflex, and silent aspiration means an aspiration without cough. Meanwhile, aspiration can be identified by entry of barium inferior below vocal cords observed by VFSS. The absence of cough or other clinical symptoms 1 minutes after aspiration is considered as silent aspiration, otherwise it is considered as overt aspiration.

The degree of dysphagia can be assessed respectively by analyzing the video of FEES and VFSS according to the dysphagia severity scale of VFSS (Table 1). The swallowing function is assessed on the basis of the score: 10 is basically normal, 9-7 is mildly abnormal, 6-2 is severe, and 2-0 is extremely severe. In this study, a score <10 was considered

**TABLE 1.** Dysphagia Severity Scale of VFSS<sup>3</sup>

Score	Oral Stage	Pharyngeal Stage	Degree of Aspiration
0	Food enters the pharynx and larynx by gravity alone	The pharynx and larynx cannot be lifted upwards	Massive aspiration without cough
1	Food cannot enter the pharynx and larynx in the form of bolus	Excessive retention of food in vallecula epiglottica and pyriform sinus	Massive aspiration with cough
2	Food cannot be transported completely into the pharynx and larynx at once	Small amounts of food retention in vallecula epiglottica and pyriform sinus	Small amounts of aspiration without cough
3	The contrast agent can be completely delivered to the pharynx and larynx	Transport all the food into esophagus in one swallow	Small amounts of aspiration with cough
4	—	—	No aspiration

VFSS indicates video fluoroscopic swallow study.

positive for dysphagia and a score = 10 was considered negative for dysphagia (Table 1).

**RESULTS**

The presence and proportion of positive laryngeal signs of 525 patients who underwent FEES are described in Table 2.

A total of 378 cases of aspiration were detected by FEES (139 cases were silent aspiration), while 267 cases were suspected aspiration in water swallow test. Therefore, FEES is more sensitive to aspiration, especially to silent aspiration.

FEES and VFSS have their own advantages and limitations (Table 3). The results for grading the severity of dysphagia are consistent, but VFSS is able to assess the esophageal stage under direct vision and to determine the degree of cyclopharyngeal muscle opening and esophageal peristaltic velocity.

FEES were rechecked 1 month after rehabilitation treatment and the result showed that all patients were improved to varying degrees compared with when they were just admitted (Table 4). FEES can provide more positive indicators and sensitively detect the efficacy of rehabilitation treatment.

**DISCUSSION**

The incidence of dysphagia is high after acute stroke, with about 51% to 73% of stroke patients reported to develop dysphagia.<sup>4</sup> Poole et al<sup>5</sup> counted the incidence of dysphagia in 128 patients with first stroke and showed that the detection rates were 51% in clinical evaluation and 64% in flexible endoscopic examination. Therefore, cooperating with flexible endoscopic examination is beneficial to improve the detection rate of dysphagia. If dysphagia after stroke occurs in oropharyngeal stage, it will not only cause malnutrition, but also cause aspiration pneumonia in severe cases, leading to hospitalization and even death of patients.<sup>6</sup> So it is vital to understand the risk of dysphagia.<sup>7</sup> Stroke patients should be routinely screened for dysphagia before eating and drinking.<sup>8</sup> In clinical practice, medical staff have been constantly pursuing simple and feasible screening methods.<sup>9</sup>

**TABLE 2.** Positive Pharyngeal and Laryngeal Signs Observed by FEES in 525 Cases

Signs	Patients n (%)
Pharyngeal and laryngeal sensory deficits	395 (75.23)
Space-occupying lesion in pharynx and larynx (epiglottic cyst, etc.)	26 (4.95)
Vocal cord paralysis	168 (32.00)
Clonus of lateral pharyngeal wall	16 (3.05)
Preswallowing spillage	107 (20.38)
Oral disorder with inability of squeezing food into pharynx	52 (9.90)
Delayed swallow initiation	275 (52.38)
Impaired swallow initiation requiring external manipulation	50 (9.52)
Delayed reflection and reduction of vallecula epiglottica after swallowing	11 (2.10)
Redention	273 (52.00)
Leakage	409 (77.90)
Aspiration (overt)	220 (41.90)
Aspiration (silent)	144 (27.43)
Postswallowing spillage	66 (12.57)

FEES indicates flexible endoscopic examination of swallowing.

**TABLE 3.** The Comparison of Findings of FEES and VFSS

	FEES	VFSS
Pharyngeal and laryngeal sensory deficits	186/21	—
Space-occupying lesion in pharynx and larynx (epiglottic cyst, etc.)	0/21	—
Vocal cord paralysis	9/21	—
Clonus of lateral pharyngeal wall	4/21	—
Preswallowing spillage	20/21	—
Oral disorder with inability of squeezing food into pharynx	13/21	13/21
Delayed swallow initiation	21/21	21/21
Impaired swallow initiation requiring external manipulation	12/21	15/21
Delayed reflection and reduction of vallecula epiglottica after swallowing	0/21	—
Redention	21/21	21/21
Leakage	21/21	—
Aspiration	19/21	19/21
Postswallowing spillage	10/21	—
Dysfunction of cyclopharyngeal muscle	21/21	12/21
Weakened esophageal peristalsis or esophageal obstruction	—	6/21

FEES indicates flexible endoscopic examination of swallowing; VFSS, video fluoroscopic swallow study.

FEES is able to confirm retention, residue, leakage, aspiration, and other abnormal signs in the process of swallowing under direct vision, and to precisely assess the degree and position of dysphagia.<sup>10</sup> St John and Berger<sup>11</sup> pointed out that the positive prediction rate of aspiration risk was 76% and the negative prediction rate was 100% in the endoscopic assessment of dysphagia in pharyngeal stage. Many scholars<sup>10</sup> claim that FEES fails to assess oral and esophageal stage of swallowing. However, we found that the situation of these 2 stages can be inferred by spillage, residual quantity and its site, though the food transportation cannot be observed under direct vision. And the results of this method were consistent with that of VFSS. Besides, FEES has significant advantages in terms of pharyngeal sensory deficits,<sup>12</sup> space-occupying lesion in pharynx and larynx, vocal

**TABLE 4.** Results of Reexamining FEES of 525 Patients After Half a Month to 1 Month of Rehabilitation Treatment

	Improved n (%)
Pharyngeal and laryngeal sensory deficits	325 (61.90)
Space-occupying lesion in pharynx and larynx (epiglottic cyst, etc.)	0
Vocal cord paralysis	79 (14.29)
Clonus of lateral pharyngeal wall	5 (0.95)
Preswallowing spillage	78 (14.86)
Oral disorder with inability of squeezing food into pharynx	42 (8.00)
Delayed swallow initiation	169 (32.19)
Impaired swallow initiation requiring external manipulation	29 (5.52)
Delayed reflection and reduction of vallecula epiglottica after swallowing	6 (1.14)
Redention	121 (23.81)
Leakage	256 (48.76)
Aspiration (overt)	47 (8.95)
Aspiration (silent)	16 (3.05)
Postswallowing spillage	68 (12.95)

FEES indicates flexible endoscopic examination of swallowing.

cord paralysis, clonus of lateral pharyngeal wall, minor leakage, and postswallowing spillage, etc. There were consistencies between the results of FEES and VFSS (eg, oral disorder with inability of squeezing food into pharynx, delayed swallow initiation, swallow initiation disorder which requires the assistance of external manipulation, retention, aspiration, etc.). These indicators serve as the main basis for assessment, therefore FEES and VFSS both can evaluate the degree and position of dysphagia precisely. Twenty-one patients with potential esophageal dysphagia screened by FEES were also confirmed by VFSS, with 12 cases of cricopharyngeal achalasia and 9 cases of weakened esophageal peristalsis. The results were highly consistent, but VFSS had irreplaceable advantages in identifying the position of esophageal dysphagia. VFSS, as the gold standard for the assessment of dysphagia, has been widely recognized for its accuracy, whereas FEES can also draw almost the same results in a simpler and more feasible way. Besides, FEES is of great significance for the assessment, rehabilitation and food selection of dysphagia because of its higher sensitivity to mild and potential dysphagia and its ability to provide more comprehensive information, therefore it is expected to become an important method for objective assessment of swallowing function.

The FEES reviewed 1 month after the patient's rehabilitation showed that it could detect subtle changes in swallowing process sensitively. For example, pharyngeal and laryngeal sensation was restored at different degrees, vocal cord paralysis was improved in a few patients and swallow initiation also showed an improvement of varying degrees. However, postswallowing spillage and penetration were slightly deteriorated with the improvement of swallow initiation, which was considered to be associated with the increased amount of food swallowed, the enhanced force of swallowing and the incomplete closure of the laryngeal cavity. Mild aspiration and no aspiration can easily and accurately be distinguished by FEES.

In conclusion, FEES has consistency with VFSS. FEES can be used as the main clinical assessment method for dysphagia because of its advantages of convenient operation, noninjury, and low price. Combined with VFSS, it can comprehensively assess dysphagia, provide reference for

rehabilitation treatment and evaluate its therapeutic effect. FEES is expected to be the first choice of examination for dysphagia in clinical practice, while its reliability needs to be further compared with VFSS. Currently, FEES can be repeatedly performed in the process of rehabilitation treatment according to the patient's condition in order to ensure the pertinence and effectiveness of treatment as well as provide convenient and feasible objective assessment for clinical rehabilitation.

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