The Safety of Fiberoptic Endoscopic Evaluation of Swallowing in Acute Stroke Patients

Tobias Warnecke, MD; Inga Teismann, MD; Stefan Oelenberg; Christina Hamacher; E. Bernd Ringelstein, MD; Wolf R. Schäbitz, MD; Rainer Dziewas, MD

Background and Purpose—Fiberoptic endoscopic evaluation of swallowing (FEES) is an excellent method for the accurate examination of swallowing function in the acute phase of stroke. The present study investigates the safety of FEES related to patients characteristics in a setting of acute stroke care.

Methods—A prospective study of FEES-associated complications was carried out in 300 acute stroke patients over a 1-year period. A neurologist and a speech-language pathologist of the stroke unit team performed FEES within a mean time interval of 1.9 ± 0.8 days after stroke onset. A closely meshed monitoring of cardiovascular parameters was done during each examination. A discomfort rating was obtained from the patients.

Results—In none of the 300 subjects any airway compromise, decrease in the level of consciousness, symptomatic bradycardia/tachycardia, laryngospasm, or epistaxis requiring special treatment was observed. The incidence of self-limiting nosebleeds was 6% and did not significantly differ in relation to major stroke types (ischemic versus hemorrhagic), acute treatment strategy (thrombolysis versus no thrombolysis), or secondary prevention regime (anticoagulant therapy versus antiplatelet drugs). Whereas no alterations in diastolic blood pressure were noted, statistically significant changes in systolic blood pressure, heart rate, and oxygen saturation occurred. However, these alterations did not cause any severe adverse event and were clinically judged as being mild. The assessment of comfort revealed an excellent tolerance of FEES in >80% of patients.

Conclusion—This study demonstrates that FEES is a well-tolerated and safe method to assess swallowing function when performed by a speech-language pathologist and a neurologist in a stroke unit setting. (Stroke. 2009;40:482-486.)

Key Words: acute stroke • dysphagia • stroke units • FEES • safety

Dysphagia occurs in up to 78% of acute stroke patients.1 It is associated with the development of aspiration pneumonia, prolonged hospital stay, increased mortality, and poor long-term outcome.2–5 An accurate assessment of swallowing function in acute stroke patients is essential for guiding decisions about feeding strategy and dysphagia treatment. Because clinical dysphagia examination alone often shows an inadequate sensitivity and specificity, additional apporative techniques are recommended for an objective swallowing assessment.6–7 Fiberoptic endoscopic evaluation of swallowing (FEES) seems to be an excellent candidate for this purpose.8–11

Several studies showed that FEES is equal to or even better than videofluoroscopy (VF) in detecting aspiration and severity of residues.12–16 Preliminary evidence also suggests FEES guided dietary and behavioral management to result in a better outcome of acute stroke patients compared to a management guided by VF.13 Moreover, in the acute care of stroke patients, FEES has the advantages that it can be performed at bedside, is repeatable as often as necessary, allows evaluation of both the motor and sensory component of swallowing, and permits assessment of airway protection.17,18

Previous studies on the safety of FEES all done by otolaryngologists and speech-language pathologists included in- and outpatients with a great variety of underlying causes of dysphagia. They all found FEES to be a safe procedure.17,19–22 To date, however, no FEES safety study was carried out in an acute stroke unit setting with FEES performed by the neurologists themselves in their daily routine. This issue is of particular interest, because frequently acute stroke patients are in an unstable medical condition, are less than fully cooperative, and receive special therapeutic interventions, for example thrombolysis. All these factors may contribute to a higher complication rate of FEES in this selected group of patients. Furthermore, changes in cardiovascular parameters that are most important in the monitoring and treatment of acute stroke patients have not been systematically assessed in any previous study on FEES safety.19,21 Thus, the purpose of this study was to determine the incidence of FEES-associated complications related to patients characteristics in the setting of acute stroke care.
Materials and Methods

Patients
Three hundred consecutive acute stroke patients admitted to our stroke unit were included in the study over a 1-year period. Stroke severity was measured on admission using the National Institutes of Health Stroke Scale (NIH-SS). Inclusion criteria were ischemic stroke or intracerebral hemorrhage, and admittance earlier than 24 hours after symptom onset. Furthermore, in accordance with our local guidelines of acute stroke management, patients had to have either an NIH-SS ≥3 points or had to present with a central facial palsy (supranuclear or nuclear) or dysarthria (any degree), both established clinical risk factors for dysphagia. In all patients, the site of the brain infarction or hemorrhage was determined by computed tomography (CT) or MRI scans. Ischemic stroke subtype was classified according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria. Informed consent was obtained from all subjects, or their next of kin, in case the patient’s communication was impaired.

Equipment
Equipment consisted of a 3.1-mm-diameter flexible fiberoptic rhinolaryngoscope (Olympus, ENF-P4), light source (Storz, endovision telecam, SL pal 2012020), camera (Storz, endovision telecam, SL pal 2012030), color monitor (Sony, DVM 14M2MDE), and video recorder (Sony, SVO9500MDP). All examinations were recorded and stored on a hard disc for later review.

FEES
The standard FEES protocol proposed by Langmore was followed with slight modifications as described in detail elsewhere. In brief, all patients were evaluated at bedside on the local stroke unit with the upper part of the body being elevated. The endoscope was passed through the most patent nostril without administration of a topical anesthetic or vasoconstrictor and was then moved forward along the floor of the nose through the velopharyngeal port. Afterward, the tip of the flexible endoscope was advanced into the hypopharynx. The base of the tongue, pharynx, and larynx were observed. The patient’s handling of oropharyngeal secretions and spontaneous swallowing was assessed. Next, the patient received teaspoon-sized portions of 3 different food consistencies dyed with blue food coloring for ease of visualization. The first food consistency introduced was pureed food, followed by liquid and soft solid food. All food was given in boluses of approximately 3 mL. For evaluation of the swallowing act, the endoscope was placed in the high position above the epiglottis before and during the swallow to evaluate premature spillage and delayed swallowing reflex. After the swallow, the endoscope was advanced for about 10 seconds to the low position just above the vocal cords, or aspiration, defined as any material entering the vocal cords. If penetration or aspiration occurred, the presence of protective reflexes (ie, cough reflex and swallowing reflex) was noted. In patients with a severely reduced state of consciousness (ie, stupor or coma), the above described FEES protocol was restricted to the rating of standing secretions and spontaneous swallowing.

All examinations were done within 72 hours of stroke onset. FEES was performed by a team approach involving a neurologist (T.W., R.D.) and a speech-language pathologist (S.O., C.H.), all having several years of experience with this diagnostic tool. Throughout the FEES examination patients were strictly assessed for epistaxis (nosebleed), airway comprise, vigilance, symptomatic bradycardia or tachycardia, and laryngospasm, which is defined as adduction of the vocal chords for more than 2 seconds. Pretest and post test heart rate, blood pressure, and oxygen saturation were measured and documented for each patient. In addition, the number of subjects was identified in whom FEES was associated with a decline of oxygen saturation to a level lower than 2% of the initial value or with an increase of heart rate or systolic blood pressure beyond the limits of 180 mm Hg and 100 bpm, respectively. After completion of the examination, each patient was asked to rate the level of discomfort experienced as “none,” “mild,” “moderate,” or “severe.”

Data Analysis
Statistical analyses were carried out with SPSS 15.0 for WINDOWS (SPSS Inc). The paired-samples t test was used to compare pretest and post test heart rate, blood pressure, and oxygen saturation. Categorical data were analyzed using the χ² test.

Results
Demographic features and stroke characteristics of the 300 consecutive patients enrolled in the study are presented in Table 1. With the exception of 1 patient, the FEES protocol could successfully and completely be performed in all subjects. Only 1 examination had to be stopped prematurely after the anatomic-physiological assessment, because the administration of liquid and food failed because of a severe stroke-related buccofacial apraxia. This patient was unable to adequately open his mouth or to transport any bolus by coordinated tongue propulsion into his hypopharynx.
Table 2. Discomfort Rating

<table>
<thead>
<tr>
<th>Patient Comfort</th>
<th>No. of Patients (n=165)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absolute</td>
</tr>
<tr>
<td>Not uncomfortable</td>
<td>50</td>
</tr>
<tr>
<td>Mildly uncomfortable</td>
<td>88</td>
</tr>
<tr>
<td>Moderately uncomfortable</td>
<td>22</td>
</tr>
<tr>
<td>Severely uncomfortable</td>
<td>5</td>
</tr>
</tbody>
</table>

Whereas 265 patients of the study population suffered from ischemic stroke, intracerebral hemorrhage occurred in 35 subjects. The majority of patients assessed by FEES had either an infarction in the territory of the middle cerebral artery (72.1% of patients with ischemic stroke) or the vertebrobasilar arteries (13.2% of patients with ischemic stroke) or a putaminal or caudate hemorrhage (51.4% of patients with intracerebral hemorrhage).

On an average, FEES was performed within 1.9 ± 0.8 days after symptom-onset. In 19 (6.3%) FEES examinations additional assistance of a nurse was required to help positioning the patient during the investigation. Because of a severely reduced state of consciousness, a global aphasia or a stroke-related psychosis, 135 (45%) patients were not able to adequately respond to questions. The results of the discomfort rating from patients having the ability to answer questions are demonstrated in Table 2.

None of the 300 included acute stroke patients showed any airway comprise, decrease in the level of consciousness (ie, for example from alert to stuporous or comatose), symptomatic bradycardia/tachycardia, or laryngospasm during FEES. Epistaxis occurred in 18 cases (6%). All events were minor and none required any treatment (“self-limiting nosebleeds”). In all of the 18 patients the FEES examination was continued. Table 3 shows the rates of nosebleeds in relation to the 2 main stroke categories and the concurrent medical treatment of ischemic stroke.

No significant difference was found in the number of nosebleed events between patients with ischemic stroke and intracerebral hemorrhage (P = 0.94). In the group of patients suffering from ischemic stroke, the rate of epistaxis was not higher in subjects receiving intravenous or intraarterial thrombolysis with recombinant tissue plasminogen activator (rTPA) in comparison to subjects without antithrombotic treatment (P = 0.65). Even when FEES was performed within the first 24 hours after thrombolysis, no increase in the relative rate of epistaxis was observed (4.26% versus 5.15%).

The number of nosebleed events also did not significantly differ between subjects under treatment with anticoagulant drugs (heparin or Coumarin) compared to subjects treated with antiplatelet drugs (aspirin 100 mg or clopidogrel 75 mg or aspirin 50 mg plus dipyridamole 200 mg; P = 0.50).

Table 4 summarizes the changes of vital parameters associated with the FEES procedure. Whereas no pre- and post test difference in diastolic blood pressure was noted, statistically significant alterations in systolic blood pressure (+ 3.4 mm Hg), heart rate (+ 1.9 bpm), and oxygen saturation (− 0.5%) occurred.

Looking at each patient in detail, more pronounced increases in systolic blood pressure and heart rate beyond the limits of 180 mm Hg and 100 bpm were observed in 14 (4.7%) and 5 (1.7%) subjects, respectively. In 27 (9.0%) patients oxygen saturation declined to a level lower than 2% of the initial value. In all subject these alterations were recurrent within a few minutes after finishing the FEES procedure without the necessity for any treatment intervention. Furthermore, none of the these transient changes in cardiovascular parameters caused any severe adverse event.

Discussion

The present study demonstrates that FEES is a well-tolerated and safe method to evaluate swallowing function in acute stroke patients. The procedure may easily be integrated in the day-to-day routine of a stroke unit. In our facility, FEES was successfully performed by both a speech-language pathologist and a neurologist of the stroke unit team. In a small number of patients (<10%) additional assistance of a nurse may be required to successfully complete the examination.

In comparison to former studies on FEES safety, this investigation exclusively evaluated severely affected acute stroke patients in the most critical phase of their disease.19,21 The average NIH-SS of our study population was almost 11 points, indicating a prominent neurological deficit in most of the included patients. The mean period of time from symptom-onset to FEES performance was less than 48 hours. Despite this critical ill and medical instable study population, the amount of complications during FEES did not essentially differ from previous studies that enrolled less affected patients with a great variety of underlying diseases.17,20,22 In the present study, there were no instances of airway comprise, decrease in the level of consciousness, laryngospasm, or epistaxis that required special treatment. Furthermore, no patient suffered from symptomatic brady- or tachycardia. Only the incidence of self-limiting nosebleeds was higher in the present investigation compared to former studies (6% versus 0.4%).19 This difference may result from the greater amount of less cooperative patients in our study population that tend to move their head during the FEES procedure and thereby cause a trauma of the nasal mucosa. Apart from that, other common interventions of acute stroke management, like naso-pharyngeal suctioning or placing of a naso gastric tube, were performed before FEES in several patients and may

Table 3. Rate of Epistaxis During FEES

<table>
<thead>
<tr>
<th>Patients</th>
<th>Epistaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>18/300 (6.00%)</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>16/265 (6.04%)</td>
</tr>
<tr>
<td>Thrombolysis</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>11/168 (6.55%)</td>
</tr>
<tr>
<td>Yes</td>
<td>5/97 (5.15%)</td>
</tr>
<tr>
<td>Within 24 hours</td>
<td>2/43 (4.26%)</td>
</tr>
<tr>
<td>Secondary prevention</td>
<td></td>
</tr>
<tr>
<td>Anticoagulant drugs</td>
<td>8/111 (7.21%)</td>
</tr>
<tr>
<td>Antiplatelet drugs</td>
<td>8/154 (5.19%)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>2/35 (5.71%)</td>
</tr>
</tbody>
</table>
have led to an increased vulnerability of the nasal mucosa. Finally, in contrast to previous studies, all of our patients received some kind of anticoagulant therapy or suffered from hypertension, which are both well-known risk factors for nosebleed events.²⁶,²⁷

Interestingly, we found no difference in the rate of epistaxis in relation to different forms of secondary prevention regimes (ie, anticoagulant therapy and antiplatelet drugs). Furthermore, the present investigation demonstrated that there is no increased risk of nosebleeds in patients receiving intravenous or intraarterial thrombolysis with rTPA previously.

The strict and detailed monitoring of vital parameters while performing FEES revealed only a slight increase of the mean heart rate from 81.5 to 83.4 bpm and a minimal decrease of the mean oxygen saturation from 96.7% to 96.2%. In our opinion, these changes in mean values of cardiovascular parameters are of minor importance in the clinical context, neither causing nursing staff or physicians to take any special actions nor requiring any particular precautions when performing the FEES procedure. Whereas diastolic blood pressure was not altered during FEES, a mild increase of mean systolic blood pressure of 3.4 mm Hg was observed. The degree of mean systolic blood pressure elevation was found to depend on the time interval between symptom-onset and FEES performance: Patients assessed by FEES within 24 hours of symptom-onset showed the highest increase in systolic blood pressure (+4.7 mm Hg). On the other hand, when FEES was performed between 48 and 72 hours post-stroke no significant alteration of systolic blood pressure occurred. This observation may result from the increasing medical stabilization of the patients and the incipient effect of the antihypertensive treatment on the third day after stroke. Taken together, the mentioned alterations of cardiovascular parameters were only mild and possibly of no clinical significance. Interestingly, the FEES-associated raise of heart rate and systolic blood pressure found in this study was clearly less marked than that encountered during placement of nasogastric tubes in acute stroke patients with dysphagia causing an increase of the mean heart rate from 85 to 108 bpm and of the mean systolic blood pressure from 141 to 176 mm Hg.²⁸

Although all of the patients in our study were assessed shortly after their admission to our stroke unit in a potentially very alarming situation for most of them and did not receive a topical anesthesia or a vasoconstrictor, more than 80% reported no or only mild discomfort during FEES. This result is in line with previous investigations describing an excellent tolerance of transnasal flexible laryngoscopy in the majority of patients.¹⁹,²¹ Because the surroundings on a stroke unit often may additionally frighten the patients, we want to underline the perception of Cohen and coworkers that it is crucial for a successful FEES examination to make all efforts to keep the patient calm and relaxed.¹⁷ Therefore, wherever applicable we thoroughly explained the FEES procedure to the patient, answered all questions before inserting the endoscope, and provided further explanations during the examination.

In conclusion, our study showed that FEES is a well-tolerated and safe method to assess swallowing function when performed by a team of a speech-language pathologist and a neurologist in a stroke unit setting.

Disclosures
None.

References

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Table 4. Changes of Cardiovascular Parameters During FEES

<table>
<thead>
<tr>
<th>Patients</th>
<th>Mean Heart Rate (bpm) Pretest/Posttest</th>
<th>Mean Systolic Blood Pressure (mm Hg) Pretest/Posttest</th>
<th>Mean Diastolic Blood Pressure (mm Hg) Pretest/Posttest</th>
<th>Mean SO² (%) Pretest/Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>81.5/83.4 P&lt;0.05</td>
<td>147.9/151.3 P&lt;0.05</td>
<td>74.8/75.9 P=0.10</td>
<td>96.7/96.2 P&lt;0.05</td>
</tr>
<tr>
<td>Within</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 hours (n=110)</td>
<td>83.6/85.1 P&lt;0.05</td>
<td>148.3/153.0 P&lt;0.05</td>
<td>76.5/78.0 P=0.14</td>
<td>96.9/96.4 P=0.07</td>
</tr>
<tr>
<td>48 hours (n=116)</td>
<td>79.7/81.7 P&lt;0.05</td>
<td>150.0/153.3 P&lt;0.05</td>
<td>74.2/75.7 P=0.10</td>
<td>96.5/96.2 P=0.07</td>
</tr>
<tr>
<td>72 hours (n=74)</td>
<td>81.3/83.8 P&lt;0.05</td>
<td>144.2/145.7 P=0.37</td>
<td>73.3/73.0 P=0.82</td>
<td>96.6/95.9 P&lt;0.05</td>
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</tbody>
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