Copyright ©, Marcotte, P.

Critical Review: Effectiveness of FEES in comparison to VFSS at identifying aspiration

Marcotte, P.
M.Cl.Sc. Candidate
School of Communication Sciences and Disorders, U.W.O.

This critical review examines whether the videofluroscopy swallowing study (VFSS) is more effective than the fiberoptic endoscopic examination of swallowing (FEES) at identifying aspiration. Overall, research suggests that these two examinations are both fairly sensitive and specific in identifying the presence or absence of aspiration. However, FEES was found to be slightly more sensitive than VFSS in some cases.

Introduction

Aspiration can be defined as "the entrance of gastric or pharyngeal contents into the larynx or respiratory tract below the level of the true vocal folds" (Gomes et al., 2004, pg 286). Aspiration is of much concern as it can lead to aspiration pneumonia or pulmonary disease. As such, the accurate evaluation of aspiration is essential. The two main diagnostic tools for identifying aspiration are the videofluorospic swallowing study (VFSS) and the fiberoptic endoscopic examination of swallowing (FEES).

The videofluoroscopy examination of swallowing provides real-time visualization of the oral cavity, oropharynx, laryngopharynx, and esophagus while using various consistencies and volumes of barium coated materials. These materials are ingested and then their movement through the oral and pharyngeal cavities are viewed on a monitor in the radiology suite. VFSS is excellent at characterizing overall swallowing ability, as well as defining functional deficits and degree of aspiration (Kaye et al., 1997).

However, VFSS does have several disadvantages. First, it requires the use of a radiology suite including fluoroscope, monitor, and personnel, which can be very costly (Kaye et al., 1997). Second, risks associated with radiation exposure impose temporal limitations on the VFSS with maximum time for exposure being 5 minutes (Gomes et al., 2004). Third, positioning must be considered, as the patient needs to be in an upright position for a VFSS, which limits the feasibility of testing bed-ridden patients, or those in the intensive care unit. Finally, patients must be able to follow verbal commands, which requires adequate cognitive functioning (Gomes et al., 2004).

The fiberoptic endoscopic evaluation of swallowing safety involves "placement of a flexible scope into the nose down to the level of the soft palate" (Logemann, 1998, pg 58). Once the scope is in place, blue or green dyed food and liquid materials of various volumes and consistencies are given to the patient and the movement of these materials is viewed on a monitor. It provides direct visualization of the pharynx during swallowing and allows the clinician to assess the anatomic and physiologic deficits of the palate, pharynx, and larynx, as well as pooling of secretions, and the patient's ability to swallow various consistencies (Kaye et al., 1997). FEES provides several benefits in comparison to VFSS, namely that it can be done speedily, even at the bedside, it requires minimal positioning of the patient, it is less expensive, and it involves no radiation exposure. In addition, FEES can be done without food or liquid, which would thus decrease the potential for aspiration, while still gathering important information about swallowing function.

However, FEES does have some limitation, VFSS provides more information about swallowing as it includes the oral and esophageal phases, which are not assessed well in FEES as the laryngeal elevation temporarily blocks the view from the endoscope (Madden et al., 2000). Also, VFSS is more likely to reveal a problem with upper esophageal sphincter opening, esophgeal transit, and gastroesophageal reflux disease than FEES (Langmore, 2003).

Objectives

While both VFSS and FEES are used commonly in the identification of aspiration, much controversy exists as to which method is preferred. The following evidenced-based practice research attempts to identify whether VFSS or FEES is more effective at identifying aspiration.

Methods

Search Strategy
Computerized databases, including CINALD, PubMed, and MEDLINE were searched using the following search criteria

((dysphagia) OR (swallowing)) AND ((VFSS) AND (FEES)) AND ((evaluation) OR (diagnosis)) AND ((aspiration))

The search was limited to articles written in English between 1980 and 2006.

Selection Criteria
Studies were included if they compared VFSS and FEES and their ability to identify aspiration. No limits were set on the demographics of research participants or outcome measures.

Data Collection
Results of the literature search yielded the following types of articles: prospective randomized cohort study (1) and prospective within-subject design (4), retrospective within-subject design (2), and reviews (2). The prospective randomized cohort study has not been analyzed, as it did not examine the ability of VFSS and FEES to identify aspiration. The reviews have not been analyzed directly, but have been used for background information.

Results

The studies conducted by Langmore et al. (1991), Perie et al. (1996), Madden et al. (2000), and Kaye et al. (1997) have been analysed in terms of specificity, sensitivity, positive predictive value (PPV), and negative predictive value (NPV). In addition, 95% confidence intervals have been reported for each measure. The results of these studies, with the exception of the Perie et al. (1996) and Kaye et al. (1997), indicated that FEES was as sensitive and specific as VFSS in determining aspiration. The study by Perie et al. (1996), had good agreement between VFSS and FEES in identifying the presence and absence of aspiration, 82.5%, however, the sensitivity of VFSS was lower, 70%. Similarly, low sensitivity was found in the study by Kaye et al. (1996), 21.7%; however contrary to what was found by Perie et al. (1996), FEES was found to be less sensitive than VFSS.

In the Chih-Hsiu et al. (1996) study, the sensitivity, specificity, PPV, and NPV were not determined. Instead, the agreement between VFSS and FEES was examined in terms of the proportion of patients who were found to aspirate. FEES identified 3 patients whose aspiration was not detected on the VFSS. Thus, the disagreement was found to be 14.3% (4/28). FEES was found to be a more sensitive measure in identifying aspiration ($p < .05$, sign test).

In the retrospective study by Tabaee et al. (2006), the agreement between VFSS and FEES was examined for aspiration. When FEES was performed using various consistencies, aspiration was found in 38 patients (64.8%), and when VFSS was performed in 29 patients (53.7%). It was determined that only a “fair” level of intertest agreement was found between the two diagnostic tools.

Overall, the combined results of these studies suggest that VFSS and FEES are both fairly sensitive and specific in identifying aspiration; however, FEES identified aspiration appropriately in certain cases where VFSS did not.

Discussion

Study Design and Purpose
The Prospective within-subject designs, comparing the ability of VFSS and FEES to detect aspiration were conducted by Langmore, Schatz, and Olson (1991), Chih-Hsiu, Chyuan-Jiann, Yeun-Cheng, and Shiann-Yann (1996), Perie, Laccourreye, Fiahault, Hazebourq, Chaussade, and St Guily (1998), and Madden, Fenton, Hughes, and Timon (2000).

The retrospective within-subject designs comparing the ability of VFSS and FEES to detect aspiration were conducted by Kaye, Zorowitz, and Barades (1997) and Tabaee, Johnson, Gartner, Kalwerisky, Desloge, and Stewart (2006).

Subject Selection and Characteristics
There were several concerns with sample selection in both the prospective and retrospective studies. First, the sample sizes in all of these studies were relatively small, making it difficult to detect a significant difference between the assessment tools. In addition, the level of power has not been reported for any of these studies. Second, in all studies, the subjects included had various medical diagnoses, and as such may have had different symptom severity and swallowing dysfunction.

Specific to the prospective studies, random selection was not completed with subjects being selected solely on the basis of who could be given both dysphagia exams within a short period of time, which was typically within two weeks. The two-week period may have been too long for some patients, as recovery may have affected swallowing function over time, thereby limiting the comparison of VFSS and FEES. Finally, in one study by Langmore et al. (1991), only male subjects were used, which is not representative of the entire population.

In the retrospective studies, patients were included if they underwent both VFSS and FEES. Random selection and random allocation were not implemented. In the Tabaee et al. (2000) study patients were included only if they had received both VFSS and FEES within a two-week period. However, a time-line was not identified by Kaye et al. (1997), which is of some concern as recovery may have affected swallowing function over time, thereby limiting the comparison of the VFSS and the FEES examinations.

Procedures
In all of the prospective studies, the VFSS and FEES protocols were described in detail. However, different consistencies and volumes of food and liquid were used across the VFSS and FEES evaluations in the studies by Chih-Hsiu et al. (1997) and Perie et al. (1998), and these variables were not described by Madden et al. (2000). The study conducted by Langmore et al. (1991) was the only study to use the same food and liquid consistencies and

volumes in both examinations. Also, the order of administration of the diagnostic tests was not controlled in any way. There was no mention in any of these articles as to whether the patients were given VFSS or FEES first, and whether randomization of the order of the administration of the diagnostic tests was attempted in any way.

Several issues mitigate definitive conclusions from either of the retrospective studies as patient charts were reviewed, as videotapes of the studies were not available for all patients. This poses some concern as information in charts may have been incorrect or incomplete. In addition, different speech-language pathologists were involved in the diagnostic evaluations of swallowing in both of these studies, and as such, it is possible that they had different training and ability in identifying aspiration episodes appropriately. In both studies, the VFSS and FEES protocols were described in detail, however, different food and liquid consistencies and volumes were used during the examinations.

Measurement Tools and Outcome Measures

A conventional, appropriate operational definition for aspiration was provided in all of the prospective studies with the exception of Madden et al. (2000). The lack of an operational definition is of concern as aspiration may have been defined differently by Madden et al. (2000), making the results incomparable to those of the other studies. Examinations were scored by separate investigators who did not have knowledge of the results of the other examinations (ie. blinding of raters) in the studies conducted by Langmore et al. (1991) and Chih-Hsiu et al. (1996), although inter-rater reliability was not reported in either of these research studies. In addition, the examiners' training or familiarity with the rating scales was not specified in any of the studies and it is not known how much experience they may have had at identifying aspiration using either one of the diagnostic tools.

In the retrospective studies, Tabaee et al. (2006) provided a conventional, appropriate operational definition for aspiration; however, none was provided by Kaye et al. (1997). Also, criteria for patient selection through chart review was not described in detail in either of these studies.

Statistical Analysis

In Langmore et al. (1991), Perie et al. (1998), Madden et al. (2000), and Kaye et al. (1997) results of the VFSS were compared with FEES in terms of sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the identification of aspiration. In addition, 95% confidence intervals (CI) were provided for each measure. These measures are appropriate for this type of data as the sensitivity identifies the proportion of patients who truly aspirate who were found to aspirate on both tests, and the specificity identifies the proportion of patients who do not aspirate and who were not found to aspirate on both tests. The positive predictive value determines the probability of aspiration in general when a patient is found to aspirate and the negative predictive value is the probability of a patient not aspirating in general when aspiration was not found on either test. These measures are all appropriate when comparing two assessment measures of aspiration.

Chih-Hsiu et al. (1996) examined the degree of agreement between VFSS and FEES in identifying aspiration. The results were expressed in terms of percentages, more specifically, the percentage of individuals who were found to aspirate during either one of the diagnostic tests out of the total number of patients. This measurement is not ideal as the sensitivity, specificity, PPV, NPV, and 95% confidence intervals have not been examined.

The statistical analysis for the Tabaee et al. (2006) study was performed to determine the comparative agreement between the results of the VFSS and the FEES. Severe dysphagia (aspiration) was analyzed using an unweighted kappa and kappa with quadratic weighting as a test of intertest agreement. This statistical analysis is appropriate in that it measures the interobserver variation between two or more independent tests and is based on the difference between the degree of observed versus expected agreement. Specifically related to the identification of aspiration for VFSS and FEES, a percentage was calculated of the number of individuals out of the total sample who were found to aspirate on each of the diagnostic tools. This analysis has been completed appropriately for this type of data.

Summary Statement

The prospective within-subject design is not the "gold standard" wherein both subjects and examiners are blinded. However, this design does have some advantages over the retrospective studies in that much more control can be implemented in an attempt to avoid confounding variables. Overall, it would have been more appropriate if a cohort of subjects with the same disorder or disease had been used, if the examinations were scored by separate, blinded examiners in all cases, if an appropriate time interval was provided between the administration of each test and if the same food and liquid consistencies and volumes were used throughout. These elements would have provided more reliable and valid evidence.

Recommendations

It is difficult to have absolute confidence in the research findings due to concerns regarding subject design, subject selection, outcome measures/measurement tools, and statistical analysis. However, it appears that both VFSS and FEES have similar sensitivity and specificity in identifying aspiration, however FEES was found to identify aspiration appropriately in certain cases where VFSS did not. As such, either diagnostic measure can be used and it is likely that similar results will be found in

terms of the patient's swallowing ability. In sum, at the current time, research in this area supports the use of both VFSS and FEES in the assessment of aspiration in patients who are at risk of developing aspiration pneumonia. It is recommended that more research be conducted in this area. In addition, researchers should attempt to incorporate the following when conducting studies in this area:

1. Larger sample sizes.
2. Same food and liquid consistencies and volumes for both studies.
3. Studies (VFSS and FEES) should be conducted within the shortest possible time period (e.g., 24 hours).
4. Cohort of patients with the same diagnoses (e.g., stroke) should be included.
5. Experimenter blinding when possible.
6. Prospective studies rather than retrospective.

Conclusions

Aspiration can often lead to aspiration pneumonia, which can be fatal in many cases. As such, the accurate assessment and identification of aspiration is essential. As previously mentioned the two main diagnostic measures of aspiration are the FEES and the VFSS. Overall, research in this area suggests that both of these measures are sensitive and specific when identifying aspiration, however, FEES was found to be slightly more sensitive than VFSS. More research with larger sample sizes and more control in terms of timing between studies, food and liquid volumes and consistencies with a cohort of patients with the same diagnosis should be conducted in the future. Ideally, attempts should be made to use VFSS and FEES simultaneously in order to determine which assessment tool is more effective at identifying aspiration.

References

Aviv JE. Proscpective, randomized outcome study of endoscopy versus modified barium swallow in patients with dysphagia. *Laryngoscope* 2000; 110: 563-574.

Gomes GF, Campos AC, Pisani JC, Macedo ED, Veira MC. Diagnostic methods for the detection of anterograde aspiration in enterally fed patients. *Curr Opin Clin Nutr Metab Care* 2004; 7: 285-292.

Kaye, GM, Zoroqitz, RD, Baredes, S. Role of flexible laryngoscopy in evaluating aspiration. *Ann Otol Rhinol Laryngol* 1997; 106: 705-709.

Langmore SE. Evaluation of orophryngeal dysphagia: which diagnostic tool is superior? *Curr Opin Otolyngol Head Neck Surg* 2000; 8: 489-496.

Langmore SE, Schatz, K, Olson N. Endoscopic and videofluroscopic evaluations of swallowing and aspiration. *Ann Otol Rhinol Laryngol* 1991; 100: 678-681.

Logemann, J. Evaluation and Treatment of Swallowing Disorders. Texas: Pro-Ed, 1998.

Madden C, Fenton J, Hughes J, Timon C. Comparison between videofluroscopy and milk-swallow endoscopy in the assessment of swallowing function. *Clin. Otolaryngol* 2000; 25: 504-506.

Perie, S, Laccourreye L, Flahault A, Hazebroucq V, Chaussade S, St Guily JL. Role of videoendoscopy versus modified barium swallow in patients with dysphagia. *Laryngoscope* 2000; 110: 563-574.

Tabaee A, Johnson PE, Gartner CJ, Kalwerisky K, Desloge RB, Stewart M. Patient-Controlled comparison of flexible endoscopic evaluation of ewallowing with sensory testing (FEEST) and videofluroscopy. *Laryngoscope* 2006; 116: 821-825.

Wu CH, Hsiago TY, Chen JC, Chang YC, Lee SY. Evaluation of swallowing safety with fiberoptic endoscope: comparison with videofluroscopic technique. *Laryngoscope* 1997; 107: 396-401