

**Critical Review:  
Factors Associated with Dysphagia Assessed via Videofluoroscopy**

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A number of factors have been suggested to inform decisions regarding recommendation for a videofluoroscopic assessment of dysphagia. The purpose of this review was to compile relevant literature and evaluate these factors in order to gain a more cohesive understanding of best practices. This critical review compiles the relevant literature to evaluate the factors that influence the decision to implement instrumental assessment as well as gain a more comprehensive understanding of best practice measures. The hypothesis is that there will be a variety of factors that are associated with dysphagia in the acute stage post stroke.

***Introduction***

Swallowing dysfunction, or dysphagia, is a common occurrence post stroke. Research suggests that swallowing difficulties are present for approximately 50% of patients in the acute stage following a cerebrovascular accident (CVA) (Mann, Hankey & Cameron, 2000). However, this incidence estimate is influenced by several factors including the diagnostic criteria used, the timing of the swallowing assessment, and the factors associated with each individual stroke patient (Mann, Hankey & Cameron, 1999).

Although dysphagia has the potential to resolve as a result of early spontaneous neurological improvement, for some individuals it is a pervasive consequence of stroke (Kidd et al., 1995). Poor nutritional state, dehydration, aspiration and reduced quality of life are all potential negative outcomes associated with dysphagia (Smithard et al., 1996). Aspiration is a major concern as it puts individuals with swallowing disorders at an increased risk for developing lower respiratory tract infections (LRTI) and pneumonia. Aspiration pneumonia manifests in approximately one third of the patients who aspirate, increasing their chance of mortality (Kidd et al., 1995).

Currently, dysphagia can be diagnosed through bedside swallowing assessments or the use of instrumentation. Videofluoroscopic Swallowing Studies (VFSS) are advantageous over bedside swallow assessments as they provide clinicians with real-time visualization of the food bolus as it moves through the oral cavity to the esophagus. This allows clinicians to parametrize the relationship of anatomy with dysphagia, which is not possible through the use of bedside assessment alone (Pisegna & Murray, 2018). Recent literature provides some evidence to support early implementation of VFSS as beneficial for patient outcomes, as it facilitates appropriate diet

modifications and effective dysphagia management. (Hwang et al., 2018, Kim & Lee, 2018, Pisegna & Murray, 2016). However, VFSS is not feasible for all patients as it requires radiation exposure, alertness, postural stability and cognitive-linguistic skills (Langmore, Kenneth & Olsen, 1988).

Currently there is limited research on what the optimal timing of VFSS post-stroke should be, as well as what factors determine the ideal candidate for VFSS. Access to VFSS instrumentation is limited in many facilities, and therefore a VFSS is not a viable option for all patients that fail the initial dysphagia screener (Pisegna & Murray, 2018). In order to develop best-practice protocols around the implementation of VFSS and promote optimal patient outcomes, it is important to understand the factors that contribute to an increased risk for dysphagia development. This information will help delineate evidence-based guidelines to inform patient qualification for VFSS. Stroke patients presenting with specified characteristics known to be associated with dysphagia in the acute phase would be candidates for timely VFSS to reduce the negative health outcomes associated with un-identified persistent dysphagia.

***Objectives***

The primary objective of this paper was to evaluate the factors influencing outcome of dysphagia in the post stroke population. The factors identified in the research have been established through the use of VFSS in the context of an experimental or clinical environment.

***Methods***

**Search Strategy**

Computerized databases (PubMed, Medline, CINAHL) were used to access current literature using the search terms: Swallowing OR dysphagia AND

MBS OR videofluoroscopy OR VFSS OR evaluation of swallowing AND stroke AND acute.

#### Selection Criteria

Articles which met the inclusion criteria were written or translated to English, pertaining to VFSS, and focused on a patient population in the acute stage following a CVA. Articles pertaining to other instrumental methods such as Fiberoptic Endoscopic Evaluation of Swallowing (FEES) were excluded, along with articles published prior to 1990. In addition, articles were not included if the patient population had experienced CVA less than 6 months prior to the study period.

#### Data Collection

The papers included in the review cover an array of designs such as retrospective, cohort study, and systematic review.

### **Results**

**Mann, Hankey and Cameron (1999)** completed a prospective observational study to determine the prognosis of swallowing function over the first six months post-acute stroke (n=128; median age: 71 years). Inclusion criteria included a first stroke and outcome measures included a clinical (median three days post stroke) and VFSS (median 10 days post stroke) assessment. As well, the occurrence of death, recurrent stroke, chest infection, recovery of swallowing function and return to normal diet was recorded for a period of six months post CVA. Two speech-language pathologists completed the clinical and instrumental assessments using standardized methods and diagnostic criteria. Appropriate statistical analysis revealed that the baseline factors associated with the development of persistent swallowing abnormalities and related complications include a delayed oral transit time, a delayed or absent swallow reflex, penetration into the laryngeal vestibule, as well as patient factors such as being a male over 70 years of age.

The main strength of this research is that it was the first study with a prospective design to evaluate the important clinical and VFSS factors that are predictive of dysphagia. However, some limitations include the wide range in the timing of clinical (0-16 days) and instrumental (0-47 days) swallowing assessments. Additionally, 10% of the participants were lost to follow up.

Overall, this study provides highly suggestive evidence that a variety of factors influence the persistence of dysphagia post stroke as assessed through VFSS.

**Smithard et al. (1997)** explored the relationship between the presence of aspiration on VFSS and the neurological site of the cerebrovascular accident in a observational prospective study involving 87 patients with acute stroke (40-93 years) recruited from a single UK hospital. All patients underwent CT scanning within a median of three days post stroke, as well as two VFSS assessments, one within a median of two days post stroke, and another within a median of 29 days following the stroke. No additional details on the protocols used, or the reliability of the procedures was provided. The patients were grouped based on the lesion location identified in the CT scan: no lesion apparent, left hemisphere, right hemisphere, parietal lobe, other lobes or not recorded. Results revealed a significant association between aspiration and lesion side for the second but not first VFSS exam with right hemispheric lesions showing a greater risk for continued aspiration.

The strengths of this study include an appropriate definition of acute phase following a stroke. However, the study included a heterogeneous patient population in terms of age and number of prior CVAs, and loss of data at follow-up. Additionally, the patient groupings did not consider the location of the stroke beyond hemisphere.

Overall, this study provides somewhat suggestive evidence that lesion side may be a prognostic indicator for persistent aspiration secondary to dysphagia.

**Kidd et al. (1995)** used a prospective observational design to track stroke-related aspiration and respiratory infection in 60 acute stroke survivors (25 males; mean age: 72 years) recruited from a single hospital in the UK. Outcome measures included a neurological exam, a water swallowing test, and a VFSS 72 hours post stroke. Based on the findings of the swallowing assessments, the group was divided into aspirators and non-aspirators and the water swallowing test was re-administered within 7-14 days post stroke, and a water test and VFSS at 3 months post. As well, aspiration, death, abnormal pharyngeal sensation, dysphagia, Lower Respiratory Tract Infection (LRTI) and discharge rates were gathered over the first 14 days. Appropriate statistical analyses revealed that infection development was significantly related to dysphagia, the presence of abnormal pharyngeal sensation and with stroke severity.

Limitations to this research include the small size of the patient subgroups, as well as potential bias due to the LRTI being completed by a single observer who was not blinded to the stroke severity, pharyngeal sensation status or the results of the water swallowing test.

Overall, this study provides highly suggestive evidence that stroke severity and abnormal pharyngeal sensation post stroke may be prognostic indicators for LRTI secondary to dysphagia.

**Kim et al. (2017)** completed a prospective observational study to investigate the usefulness of early VFSS, and how diet modifications change in acute stroke patients diagnosed with dysphagia. A total of 163 patients met well-specified inclusion criteria of having a single lesion (87 left hemisphere CVA) and no other neurological events. Outcome measures included a bedside assessment and diet modification within 24 hours post stroke, and a bedside swallow assessment and instrumental examination within 7-days post onset. Published scales were used to quantify aspiration and dysphagia. The participants were divided into three groups based on the site of their lesions: cortical lesion (CL), subcortical lesion (SCL), and brainstem/cerebellar lesion (BCL). Incidence of aspiration pneumonia for three weeks following stroke onset was also collected. Appropriate statistical analysis revealed no significant differences in behavioural ratings of dysphagia or aspiration based on lesion type/location. However, the findings that approximately 80% of diets were modified following the instrumental assessment suggested that the instrumental assessment revealed aspiration risks not evident in the behavioural assessment.

The prospective design and the clear definition of early implementation were strengths of this study. Limitations of this study included recruitment of patients who could tolerate VRSS only.

Overall this study provides suggestive evidence that side of lesion does not influence dysphagia outcomes. Relatedly, the findings suggest that VFSS may reveal risk factors not observable at bedside.

**Sang, Ho Joong, Yong Hyun, Kihun, and Jong Kyoung (2018)** investigated the association between location of lesion in acute cerebral infarction patients and the incidence of dysphagia identified using VFSS. This was done using a retrospective non-randomized clinical design. The cohort consisted of acute stroke patients (n=275) divided into 8 groups depending on lesion area. The lesion area was observed via Magnetic Resonance Imaging (MRI) in the acute stage post stroke. Some discrepancies were noted between groups in factors such as age, number of patients, and diet received. These group differences may have a confounding effect on the results, as progressive age is known to be a risk factor for greater health compromise. Additionally, it is difficult to compare patients who are tube fed to

those taking a regular diet or modified diet by mouth. Furthermore, it is difficult to garner compelling results with such small sample sizes in some groups (as low as 12). However, the measures used for analysis were deemed appropriate.

The results of the study stated that symptoms of dysphagia were present in lateral or bilateral brainstem lesions, as well as cortical and subcortical brain lesions. They found a significant correlation between residue in the vallecula and pyriform sinuses and lesions in the medulla or pons. There were however, no significant associations found in relation to aspiration and penetration, which is arguably the most consequential symptom of dysphagia.

In contrast to previous studies, this paper did not find any significant differences in swallowing function based on left versus right hemisphere. It is difficult to create an ideal study in a retrospective format as many factors cannot be accounted for. As a result, this article only presents suggestive evidence of their claims.

**Terré and Mearin (2006)** sought to identify the predictors of aspiration in the post acute phase of a CVA using VFSS. The study consisted of a single group study with greater than one variable, without a parallel control group. Patients with suspected dysphagia (n= 64) were included in the study with an average of 3 months post CVA. They completed an analysis of several variables including age, sex, mean evolution of time, Functional Independence Measure (FIM) score, stroke etiology, stroke location, presence of absence of pneumonia post stroke, clinical examination findings, and VFSS findings for the oral and pharyngeal phase of the swallow.

The results indicated no correlation between the presence of cough during swallowing and aspiration. However there was a statistically significant relation between changes in voice quality and penetration to the laryngeal vestibule. Factors that were found to predict the presence of dysphagia were a history of pneumonia, as well as posterior brain lesions. Silent aspiration was also stated to be of greater risk if there was a history of orotracheal intubation and abnormalities in velopharyngeal reflex, i.e. absent gagging. Overall VFSS was found to be the most accurate and reliable predictor of dysphagia and aspiration, compared to the bedside clinical exam, as many signs of silent aspiration may be imperceptible.

**Perry and Love (2001)** offer a systematic review that seeks to delineate the incidence and outcomes of dysphagia in acute stroke. They do not focus solely on the Videofluoroscopic Swallowing Study (VFSS) but report on many studies which include this form of assessment such as Robbins et. al

and Smithard et al. Out of a total of 248 potential studies only 26 met the inclusion and quality criteria and were included in the current review.

From the evidence in the literature it was found that early screening and VFSS was correlated with higher incidence of dysphagia. This is likely due to stroke having the most impact on the patient within the acute phase. Additionally, this review noted the association between side of lesion (left versus right), with dysphagia being pervasive in the right sided lesion population. There was a correlation between bilateral sensory loss and lower respiratory tract infection despite other measures presenting as asymptomatic for dysphagia. The researchers suggests this is thus a predictive factor of dysphagia, and specifically silent aspiration. Conflicting evidence was presented on the predictive factors of length of hospital stay, and degree of disability. However, stroke severity is presented as a highly suggestive factor contributing to dysphagia.

The article addresses the shortcomings of VFSS such as radiation exposure and need to take materials by mouth. This may impact the population included in the studies and thus impact the potential correlations observed. This review offers a comprehensive understanding of the literature available at the time, but is unfortunately less compelling due to the earlier date of publication.

### ***Discussion/ Recommendations***

The current literature provides insight into the factors which are associated with the development of dysphagia post stroke. The factors identified through this critical review include: the hemispheric site of lesion, the stroke severity, the patient's phase of recovery, history of LRTI, history of orotracheal intubation, bilateral pharyngeal sensory loss, delayed oral transit time, a delayed/absent swallow reflex, penetration into the laryngeal vestibule, pharyngeal residue, the patient's age and sex. Based on the findings, it is suggested that these factors could help inform the decision to implement instrumental assessments in the acute stage post stroke.

This critical review revealed several shortcomings in the literature. Currently, there are limited resources on these risk factors and how they can be used to guide best practice. Ultimately, more comprehensive research is needed in order to better delineate best practice guidelines for the implementation of instrumental assessment. It should be noted that some of the factors found to be associated with a persistent dysphagia diagnosis can only be evaluated using VFSS or another form of instrumentation that allows direct visualization of the

swallowing mechanism. This therefore provides further justification for the use of instrumentation in the acute stage post stroke to ensure that adequate recommendations are being made for the patient. As discussed in previous articles, instrumental assessments are not feasible for all patients. However, the case is strongly argued by the literature that instrumentation is the gold standard for assessment compared to the bedside swallowing assessment.

### ***Conclusion***

Future steps should aim to develop best-practice protocols and timing guidelines around the implementation of VFSS to promote optimal patient outcomes. In order to do so, more comprehensive investigation into the factors associated with dysphagia are required.

### ***Clinical Implications***

Understanding the factors associated with persistent dysphagia in the acute phase post stroke will help develop evidence based guidelines around the optimal timing and candidacy for instrumental assessments. These protocols, based on the patient's presenting profile, will help guide clinicians through the decision making process to determine patient priority.

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