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A Randomized Study of Three Interventions for Aspiration of Thin Liquids in Patients With Dementia or Parkinson's Disease

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Abstract

Purpose—This study was designed to identify which of 3 treatments for aspiration on thin liquids —chin-down posture, nectar-thickened liquids, or honey-thickened liquids—results in the most successful immediate elimination of aspiration on thin liquids during the videofluorographic swallow study in patients with dementia and/or Parkinson's disease.

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Method—This randomized clinical trial included 711 patients ages 50 to 95 years who aspirated on thin liquids as assessed videofluorographically. All patients received all 3 interventions in a randomly assigned order during the videofluorographic swallow study.

Results—Immediate elimination of aspiration on thin liquids occurred most often with honey-thickened liquids for patients in each diagnostic category, followed by nectar-thickened liquids and chin-down posture. Patients with most severe dementia exhibited least effectiveness on all interventions. Patient preference was best for chin-down posture followed closely by nectar-thickened liquids.

Conclusion—To identify best short-term intervention to prevent aspiration of thin liquid in patients with dementia and/or Parkinson's disease, a videofluorographic swallow assessment is needed. Evidence-based practice requires taking patient preference into account when designing a dysphagic patient's management plan. The longer-term impact of short-term prevention of aspiration requires further study.

Keywords

dementia; Parkinson's disease; aspiration; thickened liquids; posture

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No large-scale randomized, multi-institutional clinical trials have been completed to define the effects of interventions designed to eliminate liquid aspiration in particular patient groups, despite the fact that a number of interventions have been recommended for patients with liquid aspiration identified during radiographic studies of oropharyngeal swallow. Most of the recommended interventions have been compensatory in nature, meaning that these interventions were designed to redirect boluses away from the airway without changing airway physiology (Logemann, 1998) and have included such measures as postural changes, heightened sensory input, and thickening liquids to a nectar or honey consistency. These interventions are used because they exhibit an immediate effect, whereas rehabilitation treatments including exercise take time to be effective. One of the benefits of the radiographic study of swallowing, the *videofluorographic swallow study (VFSS)*, is its ability to evaluate the immediate effects of strategies to eliminate thin liquid or other types of aspiration (Logemann & Kahrilas, 1990; Logemann, Pauloski, Rademaker, & Colangelo, 1997; Martino, Pron, & Diamant, 2004; McCullough et al., 1999; Ohmae, Logemann, Kaiser, Hanson, & Kahrilas, 1996). Only a few studies defining the effectiveness of these various strategies in patients with particular diagnoses are available.

Effects of postural techniques have been examined in various ways. Measures of change in pharyngeal dimensions with chin-down posture—that is, touching the chin to the front of the neck—show reduced distance between (a) the base of tongue and the posterior pharyngeal wall, (b) the base of epiglottis and the posterior pharyngeal wall, and (c) the base of the epiglottis and the arytenoid (Welch, Logemann, Rademaker, & Kahrilas, 1993). Chin-down posture has been found helpful in patients aspirating thin liquids with a diagnosis of stroke, head injury, or treatment for head and neck cancer (Shanahan, Logemann, Rademaker, Pauloski, & Kahrilas, 1993). Other postural techniques have been found to be helpful for patients with other anatomic or physiologic swallow disorders such as unilateral pharyngeal weakness, which causes the bolus to be directed down the opposite side of the pharynx (Logemann, Kahrilas, Kobara, & Vakil, 1989; Ohmae, Ogura, Taraho, Kitahara,&Inouye, 1998). These kinds of observations reflect changes in the relationship of structures in the oral cavity and pharynx and the effect of the posture on the bolus. However, they do not address the effectiveness of the strategy during the physiology of the oropharyngeal swallow.

Rasley et al. (1993) reported the immediate effectiveness of postural change in eliminating aspiration in 72% of a group of 153 consecutive patients who exhibited aspiration during x-

ray on thin liquids. In another study of dysphagic patients who had been treated for head and neck cancer, a similar percent success rate was reported when patients utilized a postural change during the radiographic study after aspirating thin liquids (Logemann, Rademaker, Pauloski, & Kahrilas, 1994). A number of other authors (Karaho, Hanyu, Murase, Kitahara, & Inouye, 1997; Martin Harris et al., 2000; Ohmae et al., 1998) have reported the positive effects of postural change on aspiration of thin liquids.

In those studies that have looked at effects of postures or thickened liquids on aspiration of thin liquids, the patient populations were most often stroke and head injury (Schmidt, Holas, Halvorson, & Reding, 1994). None of these studies included a large number of patients, were randomized, or included patients with dementia and/or Parkinson's disease. Patients with a physician's diagnosis of dementia who have difficulty swallowing thin liquids or patients with Parkinson's disease with dementia are rarely included in such studies because of the significant associated motor, behavioral, or cognitive problems that these patients often exhibit. For example, patients with dementia may have difficulty following directions. Those with Parkinson's disease often have anatomic postural changes and/or tremor disorders that make their utilization of postural change or acceptance of thickened liquids limited. These patients have high rates of aspiration and pneumonia and exhibit no spontaneous recovery that might be confused with the treatment effect in this study (Bushman, Dobmeyer, Leeker, & Perlmutter, 1989; Feinberg, Ekberg, Segall, & Tully, 1992; Horner, Alberts, Dawson, & Cook, 1994; Stroudley & Walsh, 1991).

Reports of the success of thickening liquids are not based upon randomized studies, nor are they even based on quantified examinations of the swallow with and with-out thickened liquids of either nectar or honey consistency in patients who aspirate on thin liquids. Frequently, the method of thickening liquids is not standardized (Robbins et al., 2002). Nonetheless, thickening liquids is often recommended as a strategy for management of swallowing problems in a variety of oropharyngeal dysphagic patients, including those with a delay in triggering of the pharyngeal swallow, when oral control of thin liquid is poor, or when airway protection is reduced during swallow (Garcia, Chambers, & Molander, 2005; Logemann, 1998; O'Gara, 1990; Penman & Thomson, 1998).

It is well documented that changing the viscosity of food systematically affects certain characteristics of swallow physiology (Lazarus et al., 1993; Reimers-Neils, Logemann, & Larson, 1994; Steele & Van Lieshout, 2004). Steele and Van Lieshout (2004) examined changes in tongue movement patterns during swallows of various liquid consistencies. Results using electromagnetic mid-sagittal articulography found small differences only in the sip-mass modulation. Studies by Reimers-Neils et al. (1994) and Nicosia et al. (2000) identified changes in electromyography of submandibular muscles as bolus viscosity increased, with greater EMG activity used as bolus viscosity increased. A study by Bülow, Olsson, and Ekberg (2003) compared swallow physiology radiographically in 40 oropharyngeal dysphagic individuals swallowing thin liquids, carbonated thin liquids, and thickened liquids and found that carbonation resulted in significantly improved swallow versus thickened or thin liquids. These authors summarized by recommending carbonated liquids over thickened liquids because they appeared to be safer than thickened liquids.

Kuhlemeier, Palmer, and Rosenberg (2001) reported differences in aspiration rates across liquid consistencies with highest aspiration for thin liquids as compared with thicker liquid consistencies. Speed of bolus movement is reduced as liquid becomes thicker, and thicker liquids are usually easier for patients to control. A problem with thickening liquid may occur for patients with reduced tongue strength, as thicker liquid or more viscous material requires greater lingual pressure generation (Reimers-Neils et al., 1994; Robbins et al., 2005). Thus, a

variety of patient characteristics must be taken into account when thickened liquids are recommended as a management strategy for aspiration of thin liquids.

Garcia et al. (2005) examined the practice patterns of 145 professionals who responded to a 25-item Internet survey about the use of thickened liquids. All of these clinicians were members of the American Speech-Language-Hearing Association Division 13, Swallowing and Swallowing Disorders (Dysphagia). The majority of these respondents (85%) agreed that thickening thin liquids was an effective intervention despite the fact that no data are available to show the frequency of effectiveness of various thicknesses of liquids in subgroups of dysphagic patients with a range of swallow disorders. In contrast, 5% of the respondents disagreed and said that they did not feel these were effective strategies. The opinions of the respondents indicated that nectar-thick consistency was more favorably viewed than honey-like or spoon-thick consistencies. The respondents also indicated that their patients often disliked the thickened liquids. Thus, thickening liquids as a management strategy can affect the patient's quality of life. Results of the survey indicate that half the respondents ordered thickened liquids for one fourth to three-fourths of their patients with swallowing difficulties. Their preferred thickness was nectar-like consistency followed by honey-like consistency. This agrees with data from another survey taken in Great Britain looking at patient responses to various thickeners (Macqueen, Taubert, Cotter, Stevens, & Frost, 2003). These data indicate the high frequency of use of thickened liquids in the management of dysphagic patients despite the complete lack of data supporting the effectiveness of this procedure. Clearly, the effectiveness of thickened liquids of either nectar or honey-like consistency can be examined during the patient's diagnostic study.

A review of the literature on effects of postural changes and/or thickened liquids in patients with dementia and/or Parkinson's disease found no studies of the effects of these strategies on aspiration of thin liquids. A great deal more research is needed on effectiveness of various postural changes and thickened liquids in eliminating aspiration of thin liquids in patients with dementia or Parkinson's disease.

In 1998, the Communication Sciences and Disorders Clinical Trials Research Group (CSDRG) embarked on its first randomized clinical trial to investigate which of three commonly used interventions provides the most effective short-term management of thin liquid aspiration in dysphagic geriatric patients with dementia and/or Parkinson's disease. This study was designed to evaluate the immediate effectiveness of three common management strategies for these patients in preventing liquid aspiration: (a) thickened liquid–nectar, (b) thickened liquid–honey, and (c) chin-down posturing. Our major hypothesis, based on the existing published data at the time of project design, was that chin-down posture would be most successful in eliminating aspiration on thin liquids.

Method

Participating Institutions

Between May 20, 1998, and enrollment closure on September 16, 2005, 47 acute-care hospitals and 79 sub-acute residential facilities (such as nursing homes) combined to enroll 742 patients. Informed consent was obtained from all patients or from the patient's representative, and each clinical facility was covered by an Institutional Review Board (IRB) approved by the Office for Human Research Protections and the Department of Health and Human Services (DHHS). In addition, the overall protocol was approved by the Northwestern University Institutional Review Board.

Participants

The vast majority of participants comprised patients referred for the study by their speech-language pathologist who, after completing a bedside swallow screening with the patient, suspected that the patient was aspirating thin liquids. Bedside swallow symptoms warranting referral to the study included throat clearing, cough, choking, or gurgly voice during or after liquid swallows. Each patient had a physician's diagnosis of stable or progressive dementia (nonresolving types), Parkinson's disease, or both, and was between the ages of 50 and 95 years at the time of enrollment. Each speech-language pathologist discussed the patient's diagnosis, symptoms, and the study with the physician to ensure accuracy of diagnosis. To be enrolled in this study, patients could not have a history of potentially confounding medical issues, including a history of smoking or alcohol abuse; head or neck cancer; 20+ year insulin-dependent diabetes; or other sudden-onset, progressive, or infectious neurological disease other than all types of dementia or Parkinson's disease. History of smoking or alcohol abuse may have negative effects on swallowing and were thus elimination criteria. Patients with Parkinson's disease had no history of medication changes within 6 months of the study. Additionally, patients must not have had pneumonia within the last 6 weeks at the time of eligibility assessment and must have been able to comply with all three interventions.

Procedures

Patients meeting the above criteria were referred for a videofluorographic swallow study (VFSS; also known as a modified barium swallow) to assess their swallowing function. A clinical VFSS was performed first, followed by the VFSS research procedure used in this investigation. The research VFSS was completed with the patient seated and viewed in the lateral plane (Logemann, 1998). For the research VFSS, each participant was given up to six trial swallows of thin liquid: three small-volume (3-ml) swallows from a spoon, followed by three self-regulated swallows selected by the patient from an 8-oz cup filled with 6 oz of liquid. Aspiration on one or more of these trial swallows qualified the patient for the study and randomization. Eligibility for the study was determined by the local clinician with subsequent confirmation of aspiration on thin liquids on at least one of the trial swallows performed by the Central Laboratory. Participating clinicians could request Central Laboratory review of eligibility prior to randomization. Conference calls including all project staff and participating clinicians were scheduled every other week to discuss patient eligibility, diagnoses, and other questions that arose to ensure consistency of diagnosis, procedures, and so forth.

The primary interventions under study were a chin-down posture while consuming thin liquids and no postural adjustment during swallows of nectar and honey-thickened liquids. The thin, nectar- and honey-thickened liquids were produced by E-Z-EM Corporation (Lake Success, NY; VaribarTM) specifically for the study. Centipoise values for the three liquids were: thin liquid, 15 cps; nectar, 300 cps; and honey, 3000 cps.

After demonstrating aspiration during the clinical VFSS on at least one of the six swallows, patients were randomized in the radiographic suite to a sequence of presentations of each of the three interventions (chin-down posture, nectar-thick liquids, honey-thick liquids) in a crossover design. All patients received all three interventions. For chin-down posture, patients were instructed to put their chins down to touch their chests or necks. In some cases, they were assisted with gentle pressure on their head. Some of the patients with dementia needed repetitions of the instructions. For the nectar- and honey-thickened liquids, the patients were instructed to take the food from a spoon, hold the food in their mouths, and then swallow it. Patients were excluded if they could not perform a chin-down intervention.

Randomization was stratified by age at enrollment (50–79 years or 80–95 years) and by diagnosis (Parkinson's disease or dementia). During the chin-down intervention, defined as

touching the chin to the front of the neck, they were each given three swallows of 3 ml of thin liquid from a spoon and three swallows of the same liquid from an 8-oz cup filled with 6 oz of liquid. On the two thickened liquid interventions, they were given three swallows of 3 ml of thickened liquid from a spoon and three self-regulated swallows, performed as separate swallows, each from an 8-oz cup filled with 6 oz of the thickened liquid. After each intervention, the patients with Parkinson's disease and no dementia were asked to rate the intervention as easy/pleasant, average, or difficult/unpleasant. In addition to swallow assessment, speech-language pathologists were asked to rate the severity of the dementia patients using the Bedford Alzheimer Nursing Severity Scale (Volicer, Hurley, Lathi, & Kowall, 1994), and the neurologist rated Parkinson's disease using the Hoehn and Yahr scale (Hoehn & Yahr, 1967).

Seven hundred forty-two patients were randomized to an order of presentation of each of the interventions. Two randomized patients were deemed ineligible by the Central Laboratory following randomization, and 29 patients did not attempt any swallows or did not have any evaluable swallows for at least one intervention (all three interventions not attempted or not evaluable, $n = 6$; two interventions not attempted or not evaluable, $n = 8$; one intervention not attempted or not evaluable independent of outcome on the other two interventions, $n = 5$; one intervention not attempted or not evaluable due to differential aspiration on another two interventions, $n = 10$). One additional patient was randomized 2 weeks short of the minimum eligibility age of 50 years, 6 patients were incorrectly stratified, and 2 patients were given all three interventions but not in the randomly assigned sequence; however, all are included in all analyses. Thus, 711 patients are included in the analysis.

Statistical Modeling and Analyses

Unadjusted pair-wise comparisons of aspiration on each intervention during the VFSS were determined by a McNemar test of classification agreement (SAS Procedure FREQ; SAS Institute, Cary, NC). Aspiration on each intervention was evaluated both independently of aspiration on the other interventions and exclusively—that is, aspiration on only that intervention during the VFSS. Consistency of findings from this simple approach was tested in a model-based analysis. Specifically, risk factors associated with aspiration on each of the treatments during the VFSS were identified using a repeated measures logistic regression (SAS Procedure GENMOD; SAS Institute, Cary, NC), wherein each of the three interventions was considered a measurement. The intervention order as actually received and various risk factors were included in the model as follows: Demographic variables included age, gender, race, and education. Medical variables included presence of gastrostomy, diagnosis (dementia and/or Parkinson's disease), and applicable disease severity ratings (Bedford Alzheimer Nursing Severity Scale; Bellelli, Fisoni, Bianchetti, & Trabucchi, 1997; or Hoehn/Yahr scale). When utilizing the entire data set, disease severity was classified as Parkinson's disease only, dementia only, or dementia with Parkinson's disease. Disease severity ratings were analyzed only in the subgroup of patients with either dementia only (using the Bedford Alzheimer Nursing Severity Scale, range: 7–28), Parkinson's disease only (Hoehn & Yahr staging of Parkinson's disease rating, range: 1–5), or dementia with Parkinson's disease.

Model simplification continued until the reduced model yielded a significant ($p < .05$) worsening of fit according to the likelihood ratio criterion. For all models, the order of intervention assignment was maintained in the model. Odds ratios (ORs) and 95% confidence intervals (CIs), which describe the association between aspiration and the risk factor, were computed for each variable.

Results

Demographics

Participant characteristics for this study are presented in Table 1. Seventy percent were male, 59% were age 80 years and older, 15% were minorities, and 63% graduated from high school. Forty-nine percent had some form of dementia, 32% had Parkinson's disease without dementia, and 19% had Parkinson's disease with dementia. Three percent of participants did not exhibit signs of aspiration prior to the VFSS, and 9% had a gastrostomy.

Intervention Effects

Table 2 presents the rates of aspiration during each intervention for all study participants overall and within diagnosis. Approximately half (49%) of the participants aspirated on all three of the interventions, whereas 25% of participants did not aspirate on any of the three interventions. Thirty-nine percent of participants with Parkinson's disease without dementia aspirated on all three interventions, and more than 50% of participants with dementia with or without Parkinson's disease aspirated on all three interventions ($p < .001$). No differences were observed in terms of race or gender.

Overall, significantly more participants aspirated on thin liquids despite using chin-down posturing than when using nectar-thickened liquids (68% vs. 63%; $p < .001$) or honey-thickened liquids (68% vs. 53%; $p < .0001$). In addition, significantly more participants aspirated on nectar-thickened liquids than on honey-thickened liquids (63% vs. 53%; $p < .0001$). The associations remain the same when evaluating intervention differences among those participants who aspirated on only one intervention. In both cases, similar effect sizes were observed within each diagnosis group, although some comparisons were not statistically significant because of reduced sample size.

Among participants who had success on one of the interventions (that is, aspirated on two of the interventions), significantly fewer participants had success on thin liquids using chin-down posturing as compared with nectar-thickened liquids (1% vs. 2%; $p < .05$) or honey-thickened liquids (1% vs. 9%; $p < .0001$). In addition, significantly fewer participants had success on nectar-thickened liquids compared with honey-thickened liquids (2% vs. 9%; $p < .0001$). Similar effect sizes were seen within each diagnosis group, although the comparison of chin-down posturing to nectar-thickened liquids was not statistically significant for any of the diagnoses.

Patient Preference

Participants with Parkinson's disease without dementia were given the opportunity to assess each intervention for their preference (Table 3). A rating was not obtainable for 40 participants. A significantly smaller percentage of participants rated the honey-thickened intervention as easy or pleasant as compared with either the chin-posturing intervention or the nectar-thickened intervention (29% vs. 37%; $p < .05$ and $p < .01$, respectively). When participants in this group rated only one of the three interventions as easy or pleasant, participants were significantly more likely to rate the chin-posturing intervention as easy or pleasant as compared with the honey-thickened intervention (9% vs. 3%; $p < .05$).

Multivariable Models

Table 4 presents the results of amultivariable model that looks at which study characteristics are associated with increased frequency of aspiration on each of the three interventions for all participants. The model controlled for age, gender, and order in which the interventions were presented. Participants who were in the older stratum (age 80–95 years) were significantly less likely than participants in the younger stratum (age 50–79 years) to aspirate on thin liquids

using chin-down posturing (OR = 0.60, 95% CI: 0.43, 0.85) or on honey-thickened liquids (OR = 0.64, 95% CI: 0.47, 0.87). Participants were significantly more likely to aspirate on honey-thickened liquids when the intervention was presented last in the sequence than when the honey-thickened liquid intervention was presented first in the sequence (OR = 1.54, 95% CI: 1.17, 2.01). Participants with dementia (and/or Parkinson's disease) were significantly more likely to aspirate regardless of intervention as compared with participants who only had Parkinson's disease.

Table 5 presents the results of a multivariable model that examines which study characteristics are associated with increased frequency of aspiration on each of the three interventions for participants with dementia only. The model controlled for age, gender, and order in which the interventions were presented. Participants were significantly more likely to aspirate on honey-thickened liquids when the intervention was presented last in the sequence than when the honey-thickened liquid intervention was presented first in the sequence (OR = 1.63, 95% CI: 1.14, 2.32). Participants with a Dementia Severity Score of 21 to 28 were significantly more likely to aspirate on the nectar-thickened liquid intervention as compared with participants with a Dementia Severity Score of 7–14 (OR = 2.33, 95% CI: 1.08, 5.06). Table 6 presents the results of a multi-variable model that looks at which study characteristics are associated with increased frequency of aspiration on each of the three interventions for participants with Parkinson's disease only. The model controlled for age, gender, and order in which the interventions were presented. Participants with a gastrostomy were significantly more likely to aspirate on honey-thickened liquids (OR = 2.90, 95% CI: 1.11, 7.59). Increased severity on the Hoehn and Yahr scale did not increase the likelihood of aspiration.

The analysis of participants with both dementia and Parkinson's disease is not presented. There were no significant findings in this subgroup, which was under-powered due to small sample size.

Discussion

This randomized clinical trial of 711 patients with a diagnosis of dementia and/or Parkinson's disease examined the immediate effects in the fluoroscopy suite of three compensatory interventions to prevent aspiration of thin liquids: (a) chin-down posture, (b) nectar-thickened liquids, and (c) honey-thickened liquids. These compensatory strategies were used because patients with dementia could not use therapy interventions that required the following of more complex directions.

Our major hypothesis, based on the existing published data at the time of project design, was that the chin-down posture would be most successful in eliminating aspiration on thin liquids. Based on the results of this study, this hypothesis must be rejected. During the radiographic study, each participant received all three interventions in random order. Results showed that the most frequently successful intervention to eliminate thin liquid aspiration immediately was the honey-thickened liquid, followed closely by the nectar-thickened liquid and then the chin-down posture. This was true for all three patient diagnostic groups. However, for about half the patients, there was at least one intervention that was consistently best; however, that intervention varied from patient to patient. This also means that about half of the patients received no benefit from any intervention, emphasizing the need to look for other interventions to eliminate aspiration. We did observe a significantly higher rate of benefit on at least one intervention for patients with Parkinson's disease only compared with patients with dementia with or without Parkinson's disease. Patients with most severe dementia exhibited least effectiveness on all interventions, probably reflecting greater physiologic abnormality in their swallows than patients with less severe dementia. In contrast, severity of Parkinson's disease did not relate to success in the three interventions. Clinicians caring for patients similar to those

in this study must examine the effectiveness of all three interventions for each patient, as this study reveals that aspiration of thin liquid could be eliminated with one or more of the three interventions in approximately half the patients. No assumptions can be made that any one of these interventions will be successful in all patients, even all of those with the same diagnosis. We also hypothesized that younger patients would be more successful with postural change, but, interestingly, the oldest patients (ages 80–95 years) were most successful in using the chin-down posture. This may relate to changes in the natural neck posture with age or in the way the size of their valleculae is changed by chin-down posture. We are examining these possible differences with age, and the results will be reported in a later article. Additionally, we found that older people were more successful on thickened liquids, particularly the honey, than younger patients.

The fact that our results indicate that honey-thickened liquid was least successful in eliminating aspiration when it was introduced last in the order of randomized techniques may reflect the effects of fatigue. Exercises to improve tongue strength in patients using the thickened liquids may be helpful (Robbins et al., 2005). Clinicians need to be sure that older patients can sustain the increased muscle effort needed to swallow thicker liquids (Reimers-Neils et al., 1994), particularly honey, over the length of drinking a cup of fluid or drinking fluids throughout or after eating a meal or throughout the day.

These results emphasize the importance of introducing the three strategies to eliminate aspiration on thin liquids to patients in the radiographic diagnostic study for oropharyngeal dysphagia or other instrumental diagnostic study in order to define which strategy or combination of strategies is effective for the individual patient. In this way, patients and families can be counseled about their choices for management of their aspiration. A radiographic study is also important prior to identifying a patient as aspirating. Three percent of our participants were identified as aspirating and yet exhibited no bedside symptoms of aspiration. Several studies have shown the difficulty in identifying aspiration using only a bedside examination (Logemann, 1998; Splaingard, Hutchins, Sulton, & Chaudhuri, 1988).

It is important to emphasize that in this study, the interventions were examined for their immediate effects. These immediate effects do not necessarily indicate the long-term effectiveness of the interventions. Extended follow-up is needed to define the long-term effectiveness of each of the interventions and their relationship to the development of changes in health status, including pneumonia. Studies of the long-term effects of thickened liquids should also assess their effects on hydration and nutrition. There is still an unanswered question regarding whether patients can remain hydrated on nectar or honey as their only liquid viscosity. In addition, when considering these three interventions, clinicians should realize the importance of monitoring the preparation of the consistencies to be sure that patients are receiving the appropriate viscosity if the best intervention for them is thickening liquid.

Data on our patient preferences were collected only from those with Parkinson’s disease without dementia. Patients with dementia were judged not to be reliable reporters. The data on preference in this study are similar to data collected by other investigators showing a dislike for the honey-thickened liquids as compared with the other options of thin liquids and nectar-thickened liquids. This result supports our hypothesis that patients would prefer chin-down posture to thickened liquids. Some patients also disliked the nectar but not as much as the honey. Patient preference is an important element in selecting an intervention and may affect the patient’s compliance with the intervention (Colodny, 2005). Many patients or their families reject thickened liquids as an intervention and prefer to risk aspiration pneumonia rather than accept thickened liquids. This was true of the patients and their families in this study. Some patients would not participate in the study because they did not wish to take thickened liquids; this wish was sometimes stated in the advanced directives, even if thickened liquids might

eliminate their aspiration as demonstrated on thin liquids. Patient choice is an important component of evidence-based practice (Logemann, 2004).

It must be emphasized that this study looked only at the short-term, immediate effects of these three interventions on safety of swallow. Longer-term effects on swallow safety and their relationship to health outcomes must be considered. However, these results do indicate that all three interventions are effective at least in the short term with some patients, whereas only one or two interventions are effective with other patients. It is important that clinicians examine these three strategies with these patient populations and their effects on swallow safety before ordering one of the interventions. In addition, patient compliance, predicted perhaps by their preferences, must be considered when choosing an intervention (Colodny, 2005).

This study illustrates the fact that no assumptions can be made about the uniform effectiveness of any one of these three interventions with a particular patient. Patients deserve the opportunity to display the effectiveness of strategies on their swallows rather than receiving an order to utilize any one of them with no careful assessment. One of the observations that we have made in this study is that some patients came to the radiographic study already placed on thickened liquids, yet they did not exhibit any aspiration on thin liquids during the radiographic study (Pulliza, Hind, & Robbins, 2000). It is clear that clinicians will order thickened liquids for patients suspected of aspirating thin liquids, especially in patients who are being treated in locations where a radiographic study is not readily available. Unfortunately, this means that some of these patients are required to take thickened liquids with no objective evaluation of their effectiveness. It is clear from patient preference that the patients' quality of life may be quite negatively affected. Therefore, confirmation or validation of effectiveness justifies fluoroscopic evaluation.

For some patients, this study shows that thickened liquids can be quite effective in either nectar or honey form in eliminating aspiration on thin liquids in the short term, but modification of other material properties may be needed for some patients. This study looked only at patients with dementia and/or Parkinson's disease. Every diagnosis should be examined in this regard.

For patients with diagnoses that involve muscle weakness, swallowing thicker liquids may be more difficult because of the greater pressure required during swallow to clear them through the mouth and pharynx (Nicosia et al., 2000; Reimers-Neils et al., 1994). More research is needed on thickened liquids and other viscosities in relationship to their effectiveness with particular types of dysphagia. More investigations to identify additional interventions are also needed for various groups of patients. There were clearly a number of patients in this present study who did not benefit from any of the interventions examined. The introduction and assessment of treatment strategies for evaluation during the radiographic study can provide important information for patient management.

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Table 1

Characteristics of Part I patients.

Variable	*N*	%
All patients[a]	711	100
Gender		
Female	213	30
Male	498	70
Age		
50–79[b]	294	41
80–95	417	59
Race		
White	606	85
Black	52	7
Hispanic	20	3
Asian or Pacific Islander	31	4
Other	2	<1
Educational level		
No formal education	6	1
Some grammar school	121	17
Some high school	114	16
High school graduate	219	31
~1 year of college	164	23
~1 year of graduate school	63	9
Not reported	24	3
Diagnosis		
Dementia–Alzheimer's	109	15
Dementia–Single or multistroke	109	15
Dementia–Other	133	19
Parkinson's disease–No dementia	228	32
Parkinson's disease–Dementia	132	19
Has a gastrostomy		
No	648	91
Yes	63	9

[a] Excludes 31 patients who did not complete Part I or who were deemed ineligible for Part I by the Central Laboratory.

[b] One patient in this group was 2 weeks short of age 50 years at enrollment.

Table 2

Rates of aspiration during each intervention for all study patients, by diagnosis.

	Diagnosis							
	PD only (*N* = 228)		Dementia only (*N* = 351)		PD + Dem (*N* = 132)		Overall (*N* = 711)	
Category	***N***	**%**	***N***	**%**	***N***	**%**	***N***	**%**
Aspiration frequency								
On none of the three interventions	74	32	69	20	34	26	177	25
On one of the three interventions	39	17	49	14	18	14	105	15
On two of the three interventions	27	12	41	12	15	11	83	12
On all three of the interventions	88	39	192	55	66	50	346	49
Comparison across diagnosis for success on at least one intervention							***p* < .001**	
Aspiration on each intervention								
Chin-down (CD)	134	59	261	74	91	69	486	68
Nectar-thickened (NT)	123	54	241	69	84	64	448	63
Honey-thickened (HT)	100	44	205	58	70	53	375	53
Pair-wise comparisons								
CD vs. NT	*p* > .05		***p* < .01**		*p* > .05		***p* < .001**	
CD vs. HT	***p* < .0001**		***p* < .0001**		***p* < .0001**		***p* < .0001**	
NT vs. HT	***p* < .001**		***p* < .0001**		***p* < .01**		***p* < .0001**	
Aspiration on only one intervention								
CD	21	9	31	9	11	8	63	9
NT	15	7	14	4	5	4	34	5
HT		3	4	1	1	1	8	1
Pair-wise comparisons								
CD vs. NT	*p* > .05		***p* < .05**		*p* > .05		***p* < .01**	
CD vs. HT	***p* < .001**		***p* < .0001**		***p* < .01**		***p* < .0001**	
NT vs. HT	***p* < .01**		***p* < .05**		*p* > .05		***p* < .0001**	
Success on only one intervention								
CD		2	3	1	1	1	6	1
NT	7	3	6	2	2	2	15	2
HT	18	8	32	9	12	9	62	9

	Diagnosis							
	PD only (*N* = 228)		Dementia only (*N* = 351)		PD + Dem (*N* = 132)		Overall (*N* = 711)	
Category	***N***	**%**	***N***	**%**	***N***	**%**	***N***	**%**
Pair-wise comparisons								
CD vs. NT	*p* > .05		*p* > .05		*p* > .05		***p* < .05**	
CD vs. HT	***p* < .001**		***p* < .0001**		***p* < .01**		***p* < .0001**	
NT vs. HT	***p* < .05**		***p* < .0001**		***p* < .01**		***p* < .0001**	

Note. Pair-wise comparisons in bold are statistically significant at the α = .05 level. PD = Parkinson's disease; PD + Dem = Parkinson's disease with dementia.

Table 3

Patient preference rates for each intervention for patients with Parkinson's disease.[a]

	(*N* = 188[b])	
Category	***N***	**%**
Assessed intervention as easy/pleasant		
Chin-down (CD)	70	37
Nectar-thickened (NT)	70	37
Honey-thickened (HT)	55	29
Pair-wise comparisons		
CD vs. NT	$p > .05$	
CD vs. HT	$\mathbf{p < .05}$	
NT vs. HT	$\mathbf{p < .01}$	
Assessed only that intervention as easy/pleasant		
CD	16	9
NT	10	5
HT	5	3
Pair-wise comparisons		
CD vs. NT	$p > .05$	
CD vs. HT	$\mathbf{p < .05}$	
NT vs. HT	$p > .05$	

Note. Pair-wise comparisons in bold are statistically significant at the α = .05 level.

[a] Only patients with Parkinson's disease were asked to assess the interventions.

[b] Data are not available for 40 patients.

Table 4

Results of multivariate analysis on intervention-specific aspiration for all study patients (N = 711).

			Chin-down		Nectar-thickened		Honey-thickened	
Risk factor	**Risk group**	**Reference group**	**OR[a]**	**95% CI**	**OR[a]**	**95% CI**	**OR[a]**	**95% CI**
Age (years)	≥80	≤79	**0.60**	**(0.43, 0.85)**	0.80	(0.58, 1.10)	**0.64**	**(0.47, 0.87)**
Gender	Male	Female	1.16	(0.80, 1.68)	1.01	(0.71, 1.44)	1.08	(0.77, 1.53)
Administration order[b]	Second	First	1.09	(0.81, 1.46)	1.07	(0.81, 1.40)	1.13	(0.86, 1.48)
	Third	First	1.24	(0.91, 1.69)	1.04	(0.79, 1.37)	**1.54**	**(1.17, 2.01)**
Diagnosis	Dementia only	PD–no dementia	**2.33**	**(1.60, 3.41)**	**1.95**	**(1.36, 2.80)**	**2.00**	**(1.40, 2.85)**
	PD–with dementia	PD–no dementia	**1.72**	**(1.08, 2.74)**	1.54	(0.99, 2.40)	1.54	(0.99, 2.39)

Note. Risk factors in bold are statistically significant at the α = .05 level. OR = odds ratio; CI = confidence interval.

[a] ORs greater than 1.00 imply that patients in the risk group have an increased risk of aspiration on that intervention compared with patients in the reference group.

[b] Administration order looks at the association between whether the intervention in that column was administered first, second, or third, and any aspiration on that intervention.

Table 5

Results of multivariate analysis on intervention-specific aspiration for study patients with dementia only ($N = 282^a$).

			Chin-down		Nectar-thickened		Honey-thickened	
Risk factor	**Risk group**	**Reference group**	**OR[b]**	**95% CI**	**OR[b]**	**95% CI**	**OR[b]**	**95% CI**
Age (years)	≥80	≤79	**0.68**	**(0.38, 1.22)**	**0.68**	**(0.39, 1.20)**	**0.62**	**(0.36, 1.09)**
Gender	Male	Female	**1.20**	**(0.70, 2.08)**	**1.32**	**(0.77, 2.25)**	**1.03**	**(0.60, 1.75)**
Administration order[c]	Second	First	**1.02**	**(0.67, 1.54)**	**1.26**	**(0.93, 1.72)**	**1.26**	**(0.89, 1.79)**
	Third	First	**0.87**	**(0.59, 1.29)**	**0.95**	**(0.69, 1.31)**	**1.63**	**(1.14, 2.32)**
Dementia severity	15–20	7–14			**1.44**	**(0.77, 2.68)**		
	21–28	7–14			**2.33**	**(1.08, 5.06)**		

Note. Risk factors in bold are statistically significant at the α = .05 level. Race, education, and presence of gastrostomy were not associated with increased or decreased risk of aspiration on any of the three interventions. Dementia severity was not associated with increased or decreased risk of aspiration for the chin-down and honey-thickened interventions.

[a] Sixty-nine patients were excluded from the analysis due to missing values for at least one factor in the final model.

[b] ORs greater than 1.00 imply that patients in the risk group have an increased risk of aspiration on that intervention compared with patients in the reference group.

[c] Administration order looks at the association between whether the intervention in that column was administered first, second, or third, and any aspiration on that intervention.

Table 6

Results of multivariate analysis on intervention-specific aspiration for study patients with Parkinson's disease only (N = 228).

			Chin-down		Nectar-thickened		Honey-thickened	
Risk factor	**Risk group**	**Reference group**	**OR[a]**	**95% CI**	**OR[a]**	**95% CI**	**OR[a]**	**95% CI**
Age (years)	≥80	≤79	0.61	(0.35, 1.04)	0.94	(0.55, 1.59)	0.60	(0.35, 1.01)
Gender	Male	Female	1.11	(0.52, 2.38)	0.78	(0.37, 1.68)	1.06	(0.50, 2.26)
Administration order[b]	Second	First	1.15	(0.71, 1.89)	1.05	(0.65, 1.71)	0.93	(0.55, 1.58)
	Third	First	1.54	(0.91, 2.60)	1.14	(0.69, 1.90)	1.47	(0.91, 2.38)
Has gastrostomy	Yes	No	—	—	—	—	**2.90**	**(1.11, 7.59)**

Note. Risk factors in bold are significant at the α = .05 level. Race, education, and increased severity on the Hoehn and Yahr scale were not associated with increased or decreased risk of aspiration on any of the three interventions. Presence of a gastrostomy was not associated with increased or decreased risk of aspiration for the chin-down and nectar-thickened interventions. Em dashes indicate that gastrostomy was not significant in the models evaluating the chin-down and nectar-thickened interventions.

[a] ORs greater than 1.00 imply that patients in the risk group have an increased risk of aspiration on that intervention compared with patients in the reference group.

[b] Administration order looks at the association between whether the intervention in that column was administered first, second, or third, and any aspiration on that intervention.