The Ice Chip Protocol: A Description of the Protocol and Case Reports

Article *in* Perspectives of the ASHA Special Interest Groups · March 2018

DOI: 10.1044/persp3.SIG13.28

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The Ice Chip Protocol: A Description of the Protocol and Case Reports

Jessica M. Pisegna

Department of Otolaryngology, Boston Medical Center
Boston, MA

Speech-Language Pathology Sciences, Boston University School of Medicine
Boston, MA

Susan E. Langmore

Department of Otolaryngology-Head & Neck Surgery, Boston University Medical Center
Boston, MA

Disclosures
Financial: Jessica M. Pisegna has no relevant financial interests to disclose. Susan E. Langmore has no relevant financial interests to disclose.
Nonfinancial: Jessica M. Pisegna has no relevant nonfinancial interests to disclose. Susan E. Langmore has no relevant nonfinancial interests to disclose.

Purpose: *There is limited information regarding the theoretical underpinnings of an Ice Chip Protocol. This article aims to discuss its use in assessment and rehabilitation of swallowing disorders.*

Method: *A brief outline of the Ice Chip Protocol has been published, but in the present commentary, we thoroughly describe the protocol. We explain the rationale, indications for use, steps, and expected outcomes. We also present 9 case reports of patients who presented as nil per os for a swallow evaluation and received the Ice Chip Protocol.*

Result: *We demonstrate that the Ice Chip Protocol led to positive outcomes in the majority of the case reports. In 77.8% of the cases (7/9), secretion amount and location improved. Our anecdotal experiences suggest that it is a safe and successful protocol for both the evaluation and rehabilitation dysphagia. However, there is no systematic evidence for support.*

Conclusion: *Clinicians and researchers are often asked to evaluate the swallows of patients who are severely dysphagic and sometimes critically ill. Our experience suggests that the Ice Chip Protocol is an effective and safe method, but it would greatly benefit from being formally studied. This commentary is meant to encourage more formal investigations of its outcomes.*

For clinicians in the field of dysphagia, the use of ice chips for swallowing assessment and rehabilitation is not a novel concept. However, despite the anecdotal use of ice chips, there is very little empirical support in the literature.

The Effect of Water on the Lungs

The membranes of the human airway are made to facilitate transport of fluid in utero while they are filled with fluid. Water-transporting proteins, called aquaporins, line the epithelia and endothelia of the lungs and facilitate the passage of fluid across the lung's lining. In adulthood, high levels of aquaporins are still present, and the lungs remain highly permeable to water (Borok & Verkman, 2002; Day et al., 2014; Verkman, Matthay, & Song, 2000).

Myriad literature endorses this premise, suggesting that trace aspiration of water does not pose a serious risk for pneumonia (Feinberg, Knebl, & Tully, 1996; Feinberg, Knebl, Tully, &

Segall, 1990; Langmore, 2001; Olson, 1970; Robbins et al., 2008; Simonelli et al., 2010; Splaingard, Hutchins, Sulton, & Chaudhuri, 1988).

The Necessary but Insufficient Requirements for Aspiration Pneumonia

Three necessary conditions must co-occur to develop aspiration pneumonia, none of which are sufficient in isolation. First, the material must be pathogenic, meaning a substance that is harmful to the lungs: secretions with bacteria, food particles, stringent liquids, and gastric contents. Second, aspiration must occur. It is impossible to get an aspiration pneumonia without aspirating. In certain situations, this will be volume or location dependent. Similarly, a trace amount of aspiration to the subglottic shelf in the superior trachea is not significant enough to create an inflammatory response. In one study, only 38% of the patients who aspirated went on to develop a pneumonia (Langmore et al., 1998). Third, the host's defense must be unable to process the aspirate. A history of lung disease, poor respiratory status, and a lowered immune system are examples of a reduced defensive system. Thus, the necessary but individually insufficient requirements for pneumonia are (a) a pathogenic aspirate must be (b) aspirated and (c) the host's defense system is unable to prevent colonization and subsequent infection (Langmore, 2011; Langmore, Schatz, & Olsen, 1988; Rohmann, Tschernig, Pabst, Goldmann, & Dromann, 2011). When all three factors occur, an aspiration pneumonia may develop.

Ideal Candidates for the Ice Chip Protocol: Who and Why

The ideal patient for the Ice Chip Protocol is someone with a suspected severe dysphagia or an unknown swallowing ability. Ice chips are ideal when the clinician is not confident in the patient's ability to safely swallow and/or has advanced pulmonary disease. These patients are likely to aspirate anything given to them; hence, the exam should be conservative with a benign bolus such as an ice chip. We view any patient who is currently tube fed as a good candidate for the Ice Chip Protocol because these patients may have a severe dysphagia and may not have swallowed any food or liquid for an extended time. In fact, it has been shown that tube-fed patients have a lower frequency of swallowing than orally fed patients, to the point where secretions are not managed (Crary & Groher, 2006).

We also regard candidacy for the Ice Chip Protocol by what the patient's current swallow status is in terms of how frequently the swallow is engaged: normal, reduced, or nonuse, which are operationally defined below and in Table 1.

Table 1. A schema to consider swallowing condition prior to the Ice Chip Protocol. We have found that ice chips are the best way to start an evaluation for patients presenting with "reduced use" or "nonuse" of the swallow.

Normal Use	**Reduced Use**		**Nonuse**
Normal frequency *(1–4 times per minute at rest[a], plus all nutrition and hydration by mouth)*	Swallowing is executed occasionally Mild——————————Severe		The swallow is rarely used, and when it is, it is mostly reflexive
Example: A patient with total oral feeding	*Example:* Mild——————————Severe A patient with a nasogastric tube, supplementing with some food or liquids boluses by mouth	Nothing by mouth with exclusive feeding via alternative means	*Example:* An intubated patient

Note. [a]*Murray et al. (1996), Langmore (2001).*

"Normal use" occurs in a patient who can swallow at a normal frequency without great hindrance (about one to four per minute at rest; Langmore, 2001; Murray, Langmore, Ginsberg, & Dostie, 1996). We define "reduced use" as executing a swallow less than someone with regular oral feeds, with only occasional engagement (such as limited tastes of food/liquid). We believe "reduced use" exists on a spectrum from mild to severe. Finally, "nonuse" of the swallow is defined as almost exclusive nonuse of the swallow, as in an intubated patient or a surgical patient who cannot volitionally execute a swallow and requires suctioning. When the swallow is engaged in this case, it is mostly reflexive. Some authors in the intubation literature have mentioned swallowing dysfunction occurs postextubation in part due to "muscle freezing" as a consequence of nonuse while intubated (Barquist, Brown, Cohn, Lundy, & Jackowski, 2001). Ideal patients for the Ice Chip Protocol are those who are eligible for trials of oral feeding but have recently shown reduced use or nonuse of the swallow (see Table 1).

The Advantage of Ice

Ice chips have unique and beneficial characteristics. First, they are a small controllable volume, ranging from the size of a pea to the size of a pencil eraser (~5 × 7 mm). We have measured each ice chip to be approximately 1 ml of melted water. The clinician can easily control the amount of bolus on the spoon and the amount taken by the patient because they are small and contained entities.

Second, ice chips are a cohesive bolus. Ice chips can be easily manipulated and held in the mouth. They allow for engagement of the oral preparatory phase of swallowing, which stimulates cortical structures and their role in facilitating the transit of the bolus and initiation of the swallow (Hiiemae & Palmer, 1999; Palmer, Rudin, Lara, & Crompton, 1992). They are easier to control than a small amount of water and can be propelled into the pharynx before they melt. The patient's response to one ice chip in their mouth is very telling regarding the patient's oral control and ability to execute a volitional swallow.

Third, ice chips are a cold, familiar-tasting bolus. Patients frequently report that the cold ice "tastes good." In fact, one study demonstrated that access to water and ice chips were significantly associated with improved quality of life (Karagiannis & Karagiannis, 2014). Behind the enjoyment is a much more complicated process. A cold solid bolus stimulates thermal, chemoreceptor, and tactile receptors in the mouth. Afferent pathways to brainstem, subcortical, and cortical centers are activated as the ice is held in the oral cavity.

Fourth, we suggest that small ice chips are beneficial because they are relatively benign if aspirated. Because of the very small size of the ice chips, one of them cannot block the glottis and is therefore not a choking hazard.

The Ice Chip Protocol is based on the same tenants of any water protocol: Clean water, in and of itself, is not harmful to the lungs (Holas, DePippo, & Reding, 1994; Robbins et al., 2008). Water protocols have put forth that if a patient's mouth is kept clean, then a small amount of aspiration of water should not be harmful to the patient. We put forth that the same theory applies to small and controlled volumes of ice chips and that ice chips hold additional advantages in assessing and rehabilitating dysphagia.

The goal of this report is to describe the logistics of an Ice Chip Protocol and propose guidelines to support clinical judgment. We postulate that the Ice Chip Protocol is a safe and successful method to assess swallow ability and engage, or "wake up," the swallowing system in severely dysphagic patients who have been nil per os (NPO). It is hoped that future studies will use the proposed standardized protocol to carry out the Ice Chip Protocol and formally investigate its important clinical outcomes related to dysphagia.

Method

Nine cases in an urban hospital were reviewed retrospectively to highlight a range of patient types who received the Ice Chip Protocol. The cases included six men and three women ranging in age from 22 to 81 years old with varying etiologies (see Table 2). For each patient, the speech pathologist was consulted by the medical team to perform flexible endoscopic evaluation of swallowing (FEES). All patients were strictly NPO prior to the evaluation. The Ice Chip Protocol was administered to each patient as outlined below. A chart review was then performed to extract recommendations and outcomes.

Table 2. Patient demographics.

Case	Age (years), gender	Patient status	Medical diagnosis
1	76, female	Outpatient, ambulatory	SCCa of the oral cavity, s/p resection of the floor of the mouth with free flap, mandibulectomy, partial glossectomy
2	72, male	Outpatient, ambulatory	SCCa of supraglottis and lung s/p completion of chemoradiation and radiation treatment
3	59, male	Inpatient, nonambulatory	Sepsis and altered mental status
4	48, female	Outpatient, ambulatory	Clival meningioma, cerebellar hemorrhage, and vestibular schwannoma, multiple cranial neuropathies and neurologic deficits s/p suboccipital resection, and craniotomy, and tracheotomy (uncapped)
5	22, male	Outpatient, nonambulatory	Cerebral palsy, spastic quadriplegia
6	65, male	Outpatient, ambulatory	Follicular ameloblastoma of right mandible s/p segmental mandibulectomy, right fibula osteocuteneous free flap, right neck dissection, excision of right submandibular gland
7	82, female	Inpatient, nonambulatory	SCCa of the floor of mouth s/p manibulectomy, bilateral neck dissection, fibula free flap & tracheotomy (decanulated inpatient)
8	73, male	Inpatient, ambulatory	CABG x5 and left cerebellar, left precentral gyrus, and right occipital lobe stroke
9	81, male	Outpatient, nonambulatory	SCCa of the hard palate s/p mass excision (maxillectomy) with bilateral neck dissection and tracheostomy

Note. CABG = coronary artery bypass grafting; SCCa = squamous cell carcinoma; s/p = status post.

Preparatory Work

In order to perform the Ice Chip Protocol, we required the patients to be alert and able to sit upright. Vitals were monitored during the evaluation, especially in the acute inpatient setting, in case there was an acute change in status. Oral suctioning was available, if needed. Immediately prior to the Ice Chip Protocol, the oral cavity of each patient was cleaned using tooth and gum brushing (with a suction if needed), tongue swabbing, suctioning, hard palate scraping, and rinsing and spitting. Oral care is arguably the most important step to remove pathogenic material that could potentially be aspirated. Oral care protocols have been thoroughly documented elsewhere that are beyond the scope of this article (Carlaw et al., 2012; Chalmers, King, Spencer, Wright, & Carter, 2005; Cuccio et al., 2012; Dickinson, 2012).

Each Ice Chip Protocol was performed under the guidance of endoscopy (FEES) because it provides a direct view of the larynx, a direct view of secretions, a direct view of ice chips, and is more sensitive to detecting aspiration (Kelly, Drinnan, & Leslie, 2007; Pisegna & Langmore, 2016a, 2016b).

Procedure

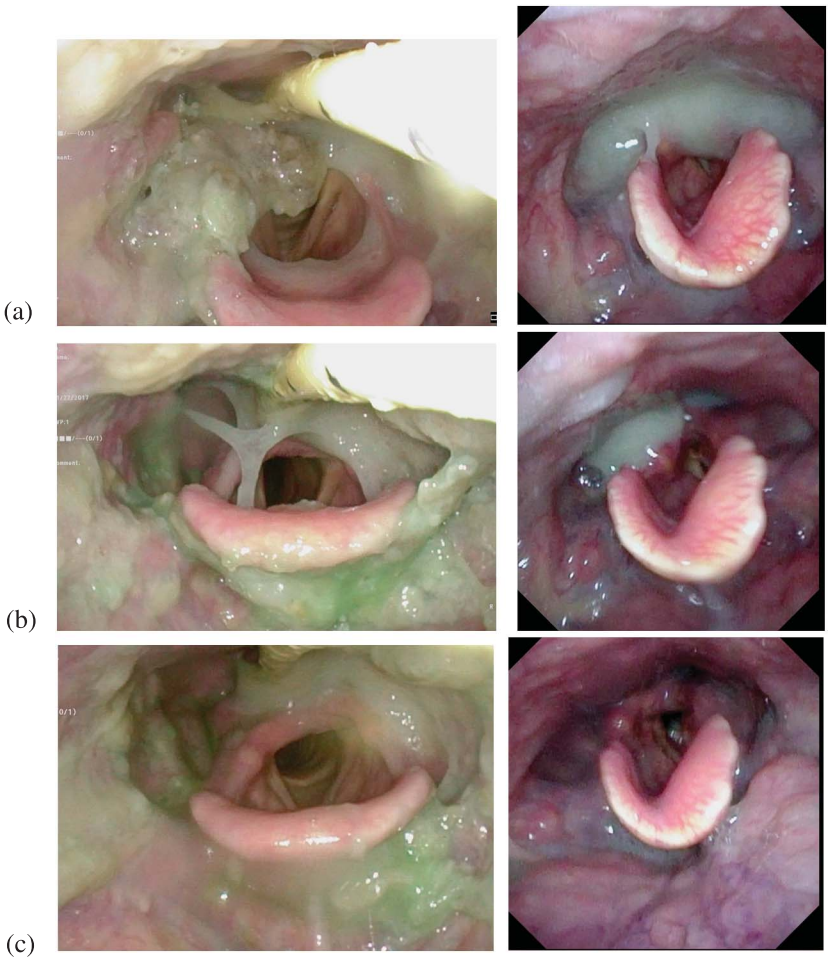
The ice chips used in our protocols were sourced from the kitchen icemaker machine on patient floors. Each ice chip was about 5 × 7 mm. We mixed a few spoonfuls of ice chips with two drops of green food dye to enhance visualization of the ice chip bolus endoscopically.

1. Observation of Swallowing Anatomy and Secretions

Upon entry into the pharynx and before the Ice Chip Protocol, we noted the swallowing anatomy, vocal fold mobility, and the patient's ability to close the glottis with a cued cough or phonation (Part 1 speech tasks of the FEES).

We rated secretions before the swallow because they have the potential to block the bolus path; lead to penetration, aspiration, or both; and may accumulate with added boluses (see Figure 1a). We rated them after the ice chip trials to indicate the success, or lack thereof, of the ice chip trials in engaging the swallow and loosening (see Figure 1b), moving, and clearing secretions (see Figure 1c) using a standardized rating tool (Marianjoy 5-point ordinal scale; Donzelli, Brady, Wesling, & Craney, 2003).

Figure 1. Secretions (a) before, (b) during, and (c) after the Ice Chip Protocol in NPO patients in need of a swallow evaluation.



2. Administration of Ice Chips: Three Trials

Trial 1: We put one-half to two ice chips (<2 ml fluid volume) on a clean spoon and administered them with the following directions to the patient: "Take these ice chips, move them around your mouth, and swallow all at once when you are ready." The amount of ice to start with required clinical judgment regarding the patient's condition and ability within the flexible structure of this protocol. During and after the first trial of ice chips, we observed the following outcomes to build a clinical impression:

• **Oral control**
○ Bilateral lip closure; manipulation of the ice chips with the tongue; jaw movement. ○ Spillage: anterior spillage, laterality and amount; posterior spillage, laterality and amount; length of spillage in seconds (some spillage is normal on liquids from 0 to 3 s to the valleculae and 0–1.5 s to the piriform sinuses (Butler et al., 2011; Dua, Ren, Bardan, Xie, & Shaker, 1997; Saitoh et al., 2007; Stephen, Taves, Smith, & Martin, 2005).
• **Initiation of the swallow**
○ Where was the head of the bolus when the swallow was triggered; was the swallow initiation delayed; was it spontaneous or cued; brisk or effortful (i.e., pumping or slowed movements)?
• **Airway closure**
○ Did the epiglottis retroflex; did the laryngeal complex elevate?
• **Penetration or aspiration**
○ Penetration–Aspiration Scale (PAS 1–8; Rosenbek, Robbins, Roecker, Coyle, & Wood, 1996) ○ When did penetration or aspiration occur: before, during, or after the swallow; was the patient's reaction to penetration/aspiration (cough, throat clear, repeated swallowing) necessary, spontaneous, or strong?
• **Secretions**
○ If secretions were present, were they mostly cleared, partly cleared, or not at all by the swallow; did the ice chips thin the secretions; did they loosen and move; did the patient sense the secretions; was suctioning required? ○ We wait to rerate the secretion scale formally (Donzelli et al., 2003) until after the end of the protocol, not in between trials, because the loosening of secretions typically makes them worse before they can be cleared.
• **Pharyngeal clearance/residue**
○ Was there compete and adequate white out? ○ How much of the melted ice chips remained; if there was some residue, where did it pool; how did the patient manage them; were any strategies necessary and effective in clearing the pooling (e.g., double swallow, head turn)?
• **The patient's response**
○ Ice chip trials usually make the patient more alert due to the coldness, wetness, and required engagement. Was the patient more awake; did he or she express enjoyment over the ice chips or was his or her response muted; what was the vocal quality like?

A critical aspect of the Ice Chip Protocol was that even if the outcomes of the first trial are poor (i.e., the swallow is delayed or aspiration occurred), the trials continue. Reengaging the swallowing mechanism often required more than one attempt, especially after prolonged NPO status. Engaging the sensory and motor neural pathways may take multiple attempts, even over several days, to recover the swallow. We must emphasize that clinicians may see aspiration.

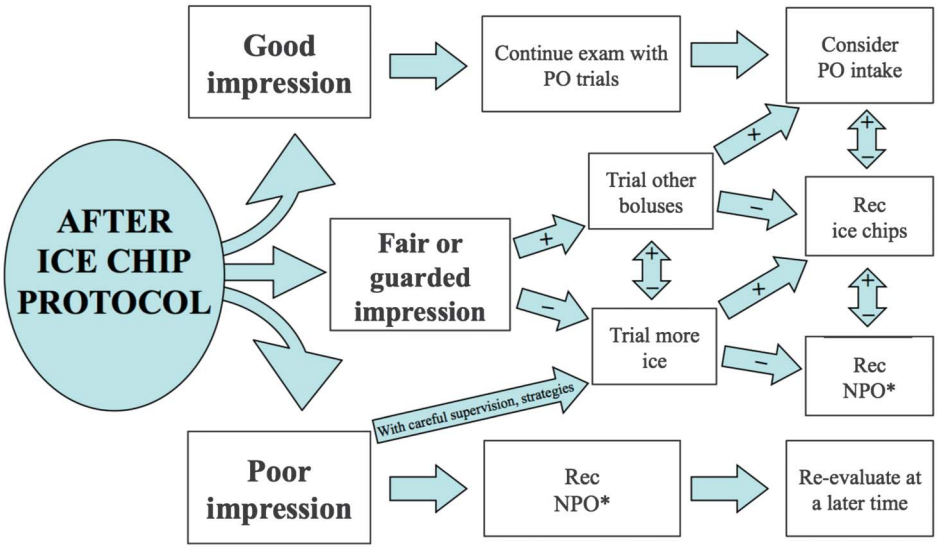
Trial 2: We performed a second trial of one-half to two ice chips in the very same manner regardless of the outcome of the first trial (an exception would be an emergency change in status/alertness/vital signs). Again, we made note of the aspects described above, including oral control, initiation, airway closure, and so forth.

Trial 3: We repeated one-half to two ice chips for a third time, regardless of the outcomes of the first and second trial (exception: an emergency change in status/alertness/vital signs). In other words, even if it did not go well on the first two trials, we continued with a third trial. We made note of the events of the third trial for each of the outcome areas listed above, in addition to any new clinical information.

3. Clinical Decision Making: A Decision Tree

After three trials of ice chips, we formed a clinical judgment about the patient's ability to swallow. Figure 2 depicts a decision tree based on our decision-making process. It is worth repeating that each patient was taken on a case-by-case basis and the patient's response was closely monitored for acute changes. Other nonswallowing factors too abundant to list were considered while building a clinical judgment (i.e., cognitive status, dependence for feeding, medical conditions).

Figure 2. Decision making after the first three trials of ice chips.



*Note. *Unless the patient is a candidate for a free water protocol, comfort measures only, or other extenuating circumstances. NPO = nil per os; PO = per os; Rec = recommend.*

From our experience, there are three overall impressions that could be made after three trials of ice chips: (a) a good impression, (b) a fair/guarded impression, or (c) a poor impression. The subjective labels of these results are intentional, as clinical impression is difficult to specifically outline. The following text aims to describe each pathway in Figure 2 to combine clinical impression with outcomes of the three administrations of ice chips.

"A Good Impression": It's going well.

Possible next steps include additional trials of ice chips, larger volumes of ice chips, thin or nectar-thick liquid, or foods such as pureed solids. Each facility's protocol for other bolus trials may differ; a standardized protocol for FEES is described elsewhere (Langmore, 2001).

- *Complete or adequate oral control and manipulation*
- *No lengthy spillage anteriorly/posteriorly*
- *Quick and timely initiation of the swallow*
- *If aspiration occurred, a spontaneous cough/throat clear was successful at clearing the aspirate*
- *Secretions reduced, if they were present*
- *The patient became more awake and alert*

"A Fair/Guarded Impression": It's going ok.

If the clinical impression is more favorable (+), then other boluses could be trialed. If the clinical impression is less favorable (–), then perhaps the patient requires more attempts on ice to fully engage the swallow. In the case studies, it was not unusual for many trials of ice to be carried out to clear oral and pharyngeal secretions.

- *Reduced oral control*
- *Mild to moderate spillage anteriorly/posteriorly*
- *Delayed initiation of the swallow*
- *If aspiration occurs, a spontaneous or cued cough/throat clear is inconsistently successful*
- *Same or reduced secretions and/or secretions are mobilized to be suctioned, coughed up, or swallowed*
- *Each trial of ice chips seemed slightly better than the prior*

"A Poor Impression": It's not going well.

After three trials of small ice chips, the clearest stopping guideline is if the patient cannot execute initiation of the swallow, or if they become less alert. We may also stop if we see three or more events of silent aspiration with no attempt to eject or unsuccessful ejection of the bolus upon cueing. We recommend retrying the Ice Chip Protocol at a later time (once the patient's status improves).

- *No initiation of the swallow (two to three times)*
- *Consistent spillage of whole ice chips into the larynx*
- *Aspiration with no spontaneous response for more than three times OR cued cough/ throat clear was unsuccessful OR silent aspiration occurred more than three times*
- *Excessive coughing resulting in shortness of breath*

- *Significant change in vitals to outside of normal limits*
- *Increase in amount of secretions, which are not cleared despite cueing*
- *An excessively gurgly voice with no success at spontaneous or cued clearing*

Results

Table 3 describes each of the nine patients who began with NPO status and received the Ice Chip Protocol. The length of NPO ranged from 7 days to 2.3 years, and all patients were receiving nutrition, hydration, and medication via a feeding tube at the time of the evaluation. Two experienced speech language pathologists reviewed the videos and determined clinical recommendations. Aspiration was seen in five of nine cases. In six of the cases, clinical impression of swallowing ability was determined to be fair/guarded, which is expected given the extended length of NPO presented by all of the patients. However, the flow chart proposed for the Ice Chip Protocol enabled the clinicians to follow a favorable (+) or unfavorable (−) impression of the swallowing presentation, which assisted with the often borderline and difficult clinical decision making. In two cases, the impression was "good," and in one case, the impression was "poor." In all but one case, it was recommended to start taking at least ice chips or other boluses, and the one case (Case 7) was complicated by many other factors during the inpatient course.

Table 3. Descriptive outcomes of Ice Chip Protocol case studies (all performed under endoscopy).

Case	Baseline diet	Baseline secretions[a]	Ice Chip Protocol	Secretions after protocol[a]	Recommendations	Follow-up
1	• NPO since surgery (27 days) • Gtube dependent • Seen in outpatient clinic	• 3	• "Fair/guarded impression (−)" pathway to decision making • Thick secretions • Aspiration seen on multiple trials • Head turn to right effective at reducing penetration/aspiration • Severely reduced clearance	• 3	• 2–4 ice chips at a time, 20 times per day • Use water spritzer throughout the day to loosen oral secretions • Nutrition and medications via Gtube[b] • Return for continued swallow therapy	• Maintained good health, no decline in pulmonary status • At 2 months[c], thick phlegm was gone (no longer needing suction), thin liquids in large volumes PO, supplementing nutrition via 2 cans per day in Gtube[b]
2	• NPO since surgery (79 days) • Gtube dependent • Seen in outpatient clinic	• 2	• "Fair/guarded impression (−)" pathway to decision making • Aspiration on first trial but ejected with immediate, strong cough • A SSGM effective at eliminating aspiration	• 2	• Small spoonfuls of ice chips throughout the day using SSGM • All other nutrition, hydration, and medications via Gtube[b] • Return for continued swallow therapy	• Patient did not start on ice chips until 2nd visit, then began taking ice chips at home • Maintained good health, no decline in pulmonary status • At 3rd visit, thin liquids mastered with SSGM • At 4th visit, upgraded to soft solids, thin liquids liquid wash with supersupraglottic swallow • At 4 months, taking 100% oral diet, Gtube removed

(continued)

3	• NPO (8 days) • NGT dependent • Seen as inpatient	• 5	• "Fair/guarded impression (+)" pathway to decision making • First 2 trials of 1 chip were absorbed by dry mouth, adequate oral stage • 8 trials of 3–5 ice chips were administered, loosening oral/pharyngeal secretions • Patient tried to clear secretions with swallows, some suctioning required with cueing to cough, ultimately removed from larynx • Secretions were penetrated but not aspirated • Further PO trials were carried out after Ice Chip Protocol (nectar-thick liquids and pureed solids)	• 3	• Nectar-thick liquids and pureed solids in 1/2 meal volumes • Supplement PO intake with NGT[b]	• By discharge 2 weeks later, NGT had been removed and patient was on grounds and thin liquids • No decline in pulmonary status
4	• NPO since surgery (824 days; 2.3 years) • Gtube dependent • Seen in outpatient clinic	• 3	• "Good impression" pathway to decision making • Silent aspiration occurred on first 2 trials of 2 ice chips, but a cued strong cough was effective • No aspiration on subsequent trials but poor management of secretions and reduced pharyngeal clearance	• 2	• 1 ice chip, 5 times per sitting, 3 times per day, under close supervision with a cue to cough after every trial • Nutrition and medications via Gtube[b] • Return for continued swallow therapy	• At 1 month[c], patient taking only ice chips and on free water protocol at nursing home • At 4 months: taking 1/4 teaspoon of puree • No decline in pulmonary status
5	• NPO (for "a long time") • Gtube dependent • Seen in outpatient clinic	• 4	• "Good impression" pathway to decision making • Spillage to piriform sinuses, but no aspiration seen on multiple trials of ice chips • Further PO trials were carried out after Ice Chip Protocol (thin liquid, nectar-thick liquid, and puree boluses)	• 1	• 2–4 ice chips at a time, 30 times per day • Return for continued swallow therapy	• By 4th visit, patient demonstrated improvement in swallow initiation and was upgraded to puree solids and thin liquids • No decline in pulmonary status

(continued)

6	• NPO (14 days) • Gtube dependent • Seen in outpatient clinic	• 2	• "Fair/guarded impression (+)" pathway to decision making • First trial of 1 chip loosened oral secretions, which were swallowed • On the second trial, penetration to the vocal folds occurred before the swallow, an immediate strong, spontaneous cough cleared it • The third trial of ice was swallowed briskly without penetration/aspiration, or any residue • Further PO trials were carried out after Ice Chip Protocol (thin liquids and pureed, ground solids)	• 1	• Ground solids and thin liquids • Return for continued swallow therapy	• Patient did not return for follow-up[c]
7	• NPO (8 days) • NGT dependent • Seen as inpatient	• 5	• "Poor impression" pathway to decision making • On first trial, pt aspirated spillage of melted ice before swallow initiation, which had to be cued • No patient reaction, cued cough not successful at clearing aspiration and pooled ice chip in piriform sinus • On second trial, swallow initiation was brisker, but silent aspiration occurred on residue after the swallow, a delayed cough was weak an ineffective • Third trial same as the second • Severe residue of ice chips remained, although initial secretions were reduced • Suctioning was required • No further trials carried out	• 3	• Strict NPO • All other nutrition, hydration, and medications via NGT[b] • Percutaneous endoscopic gastronomy tube was placed due to poor swallowing ability and complicated hospital course	• One month later, patient was reevaluated in outpatient setting, had remained NPO[c] • Swallow ability improved, speech-language pathologist rec transition to oral feeding with pureed solids and thin liquids • Continue to use Gtube as indicated by other team members

(continued)

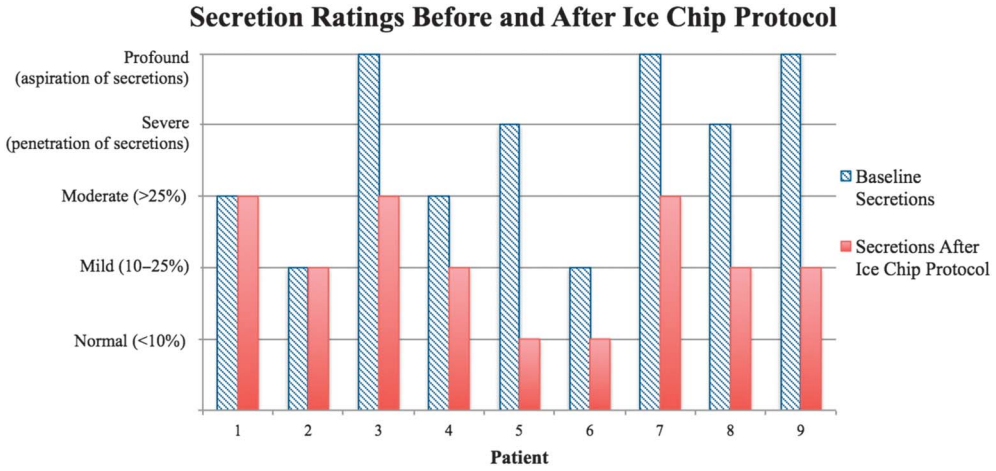
8	• NPO (7 days) • NGT dependent • Seen as inpatient	• 4	• "Fair/guarded impression (+)" pathway to decision making • First ice chip was absorbed by mouth, pt was extremely dry • Second and third ice chip were swallowed but copious dry secretions loosened, cough was spontaneous and strong, suctioning required but successful • Further PO trials were carried out after Ice Chip Protocol (thin liquids, nectar-thick liquids, and pureed)	• 2	• Nectar-thick liquids by spoon only (<5 ml) and 2–4 ice chips at a time, throughout the day • Supplement PO intake with NGT[b]	• About 1 month later, pt was reevaluated in outpatient clinic[c] • Rec nectar-thick liquids and pureed solids
9	• NPO (20 days) • Gtube dependent • Seen in outpatient clinic	• 5	• "Fair/guarded impression (−)" pathway to decision making • First trial of 1 chip loosened oral secretions, which were swallowed • On the second trial, brisk swallow, immediate strong, spontaneous cough on penetrating residue • The third trial of ice same as second • Further ice chip trials were carried out, pt successfully coughed up thick yellow secretions • Other PO trials were carried out after Ice Chip Protocol (thin liquids and pureed)	• 2	• 1 ice chip, 5 times per sitting, 3 times per day, under close supervision with a cue to cough after every trial • Nutrition and medications via Gtube[b] • Return for continued swallow therapy	• Patient did not return for follow-up[c]

Note. Gtube = gastronomy tube; NGT = nasogastric tube; NPO = nil per os; PO = per os; Pt = patient; rec = recommend; SSGM = supersupraglottic maneuver.

[a]Donzelli et al. (2003). [b]For any decision making regarding calorie counting, means of alternative nutrition, and amount via NGT of Gtube, we always defer to the other medical professionals to make those determinations (nutrition/dietary). [c]In the outpatient clinic, follow-up visits did not happen as frequently as requested.

The amount of secretions was greatly reduced by the Ice Chip Protocol, as demonstrated in Figure 3, highlighting the baseline secretion score and the secretion score after the Ice Chip Protocol. In no instances did the secretions get worse, but that was likely due to suctioning, which was a goal of the protocol and an advantage to clear the pharynx for other trials. In 77.8% of the cases (7/9), secretion amount and location improved.

Figure 3. Secretion ratings with the 5-point Marianjoy secretions rating scale at baseline before any trials were carried out and after three administrations of ice chips, per the Ice Chip Protocol.



Long term follow-up data (diet maintenance, pulmonary status, quality of life) was limited due to access to what was documented in the electronic medical records alone, and therefore, no long-term outcomes could be investigated. However, it can be stated that none of the patients who returned to clinic became significantly worse from the Ice Chip Protocol and none reported recurrent aspiration pneumonias, hospitalization, or a worsening health status.

We highlight two of the case studies below:

Case 1: Aspiration was seen during and after the first three swallows as the ice chips mixed with the secretions, but a cued throat clear ejected all secretions and water out of the airway. Multiple trials of ice in larger volumes (up to five ice chips) were effective at clearing all secretions, although there was moderate residue of the melted ice chips pooling in the piriform sinuses. It was recommend that she take two to four ice chips at a time, 20 times per day, and use water spritzer into her mouth throughout the day to loosen oral and pharyngeal secretions. Within 2 months, her secretions were gone, and she was taking thin liquids without any problems. Over 4 months, the patient began taking puree and thin liquids with onset of therapeutic trials. She was started on semisolids foods, but because of a prolonged oral stage, she still required a Gtube, which stayed in place until 8 months postsurgery when she was able to take enough PO.

Case 4: Silent aspiration was seen on the first two trials of ice chips, but a cued cough was strong. No aspiration occurred on subsequent trials, but clearance of the ice chips was reduced and required multiple swallows to clear the melted ice and secretions. It was recommended that she receive aggressive oral care and be given single ice chips, five times per sitting, three times per day under close supervision. A family member was taught how to cue the patient to take ice, look for signs of a swallow, and then cue to cough. Upon follow-up, the patient remained pneumonia free despite reports of frank aspiration out of the tracheostomy tube. At the 2-month follow-up, the patient was receiving ice chips and was put on a free water protocol by the nursing home, remaining pneumonia free. At the 4-month follow-up, the patient demonstrated the ability to take very small volumes of puree for pleasure feeding. At 8 months, no pulmonary complications were reported.

Discussion

The goal of this commentary was to describe the theoretical framework of a proposed Ice Chip Protocol. Our clinical experience suggests that the Ice Chip Protocol is a safe and successful protocol to both evaluate and rehabilitate dysphagia where other boluses would not have been as successful. Our case studies demonstrated that the Ice Chip Protocol is effective in reducing secretions and assessing the oral and pharyngeal stage of swallowing in a safe and functional way. Furthermore, we demonstrated several anecdotal cases where ice chips were used in a rehabilitative fashion and moved patients to recover the swallow. Other countries appear to be using a similar technique involving an ice chip exercise, which is also used for swallowing rehabilitation in severely dysphagic patients (A. Kaneoka, personal communication, April 10, 2015). Outcomes of the Ice Chip Protocol are largely unstudied. Only one published study could be found: a poster from 2011 describing two small cohorts of patients who took ice chips during a FEES protocol. The authors found that aspiration on ice chips was predictive of aspiration on thin liquids and also predictive of a diet recommendation (Kaszuba, Brady, Wesling, Donzelli, & Stewart, 2011). That study's findings demonstrate the advantage of using ice to assess for aspiration risk prior to more difficult boluses. What remain unknown are other outcomes involving safety in using ice chips for evaluation purposes and efficacy for rehabilitation.

Frequently asked questions from a wide range of clinicians have been collected to assist in the dissemination and implementation of the Ice Chip Protocol. The answers, compiled in the Supplementary Material, are based on the clinical experience from the authors' combined >40 years of experience using the Ice Chip Protocol. It is important to note that, in most cases, taking ice chips was not the treatment goal but was viewed as a means of transitioning from an NPO status to oral intake of liquids and food. In most cases, ice chips were viewed as a practice bolus to stimulate the swallow mechanism and to build strength until other foods and liquids could be taken safety.

The case studies we have documented here exemplify ideal candidates for the Ice Chip Protocol: patients on NPO status who have reduced use or nonuse of the swallow. After prolonged NPO, it is likely that the swallowing musculature will demonstrate atrophy and weakness. One may wonder what length of time contributes to significant deconditioning. There is no clear evidence to answer this question, but literature discussing skeletal muscle of the limbs suggests that after 7–14 days of disuse, atrophy and weakness will set in (Baldwin, Paratz, & Bersten, 2013; Bloomfield, 1997; Brooks & Myburgh, 2014; Clark, Fernhall, & Ploutz-Snyder, 2006; Narici & de Boer, 2011). The neurological input to the muscular system will also become disengaged with extended disuse. In a seminal study, Clark and colleagues (2006) found significant interplay between the muscular system and the neurological system: Neural factors explained 48% of the variation in strength loss over 4 weeks.

The theory supporting the Ice Chip Protocol is the same as that of water protocols. Taken collectively, the outcomes of 12 clinical trials documenting water protocols do not support an increased rate of pneumonia in dysphagic patients who take water orally with a structured protocol in place. The trials included patients across the acute, subacute, and long-term rehabilitation settings (Becker, Tews, & Lemke, 2008; Bernard, Loeslie, & Rabatin, 2012, 2015; Bronson-Lowe et al., 2008; Carlaw et al., 2012; Frey & Ramsberger, 2011; Garon, Engle, & Orminston, 1997; Karagiannis, Chivers, & Karagiannis, 2011; Murray, Doeltgen, Miller, & Scholten, 2016; Panther, 2005; Robbins et al., 2008; Scibilia, Hreha, Piscopo, Adler, & Barrett, 2016). Some of the water protocol authors did discuss the use of unrestricted water and ice chips (Bernard et al., 2012; Panther, 2005). In fact, one author noted, "In our practice, ice chips are more likely to be the first step toward allowing water in the acute care environment" (Panther, 2005). In further support, there are three systematic reviews that concluded that pneumonia is not significantly different in those who take thin liquids with compensation versus those who take thickened liquids (Gillman, Winkler, & Taylor, 2017; Kaneoka, Pisegna, Saito, & Langmore, 2016; Steele

et al., 2015). Despite these claims, no conclusions can be made about the use of ice chips themselves because they are unstudied. We propose the use of ice chips as a protocol for clinicians to use before, in supplementation to, or in replace of a water protocol to both assess and rehabilitate a dysfunctional swallow.

Limitations

The reports here are anecdotal and are, as such, limited by a lack of a large controlled sample size. They should be taken as anecdotal experiences alone and hopefully indicate the need for greater study. Similarly, given the restrictions that accompany retrospective studies, it could not be empirically determined if the Ice Chip Protocol resulted in shorter feeding tube durations, reduced pneumonia incidence rates, earlier discharge from the hospital, or quality of life improvements. Other factors could be influential, such as history of intubation, ambulatory status, breathing abilities and reserve, disease course, and age. These variables would be invaluable for future studies.

Conclusion and Future Directions

The Ice Chip Protocol is intended to assist clinicians in evaluating a swallow, especially in patients with severe dysphagia or extended NPO status. In the majority of the case reports, patients were given ice chips and demonstrated an overall decrease in pharyngeal secretions and subsequent success in transitioning to food and liquids by mouth. Our experience suggests that the Ice Chip Protocol is an effective and safe method, but it would greatly benefit from being formally studied to determine the safety, utility, and outcomes. This commentary is meant to encourage more formal investigations of the use of ice chips in swallowing evaluation and rehabilitation using the proposed protocol.

References

Baldwin, C. E., Paratz, J. D., & Bersten, A. D. (2013). Muscle strength assessment in critically ill patients with handheld dynamometry: An investigation of reliability, minimal detectable change, and time to peak force generation. *Journal of Critical Care, 28*(1), 77–86. https://doi.org/10.1016/j.jcrc.2012.03.001

Barquist, E., Brown, M., Cohn, S., Lundy, D., & Jackowski, J. (2001). Postextubation fiberoptic endoscopic evaluation of swallowing after prolonged endotracheal intubation: A randomized, prospective trial. *Critical Care Medicine, 29*(9), 1710–1713.

Becker, D., Tews, L., & Lemke, J. (2008). *An oral water protocol for rehabilitation patients with dysphagia for liquids*. Paper presented at the American Speech-Language Hearing Association Convention, Chicago, IL.

Bernard, S., Loeslie, V., & Rabatin, J. (2012). *Use of free water guidelines in critical illness survivors with dysphagia*. Paper presented at the Chest Convention, Atlanta, GA.

Bernard, S., Loeslie, V., & Rabatin, J. (2015). Use of a modified Frazier water protocol in critical illness survivors with pulmonary compromise and dysphagia: A pilot study. *The American Journal of Occupational Therapy, 70*. https://doi.org/10.5014/ajot.2016.016857

Bloomfield, S. A. (1997). Changes in musculoskeletal structure and function with prolonged bed rest. *Medicine & Science in Sports & Exercise, 29*(2), 197–206.

Borok, Z., & Verkman, A. S. (2002). Lung edema clearance: 20 years of progress: Invited review: Role of aquaporin water channels in fluid transport in lung and airways. *Journal of Applied Physiology (1985), 93*(6), 2199–2206. https://doi.org/10.1152/japplphysiol.01171.2001

Bronson-Lowe, C., Leising, K., Brownson-Lowe, D., Lanham, S., Hayes, S., Ronquillo, A., & Blake, P. (2008). *Effects of a free water protocol for patients with dysphagia*. Paper presented at the American Speech-Language Hearing Association Convention, Chicago, IL.

Brooks, N. E., & Myburgh, K. H. (2014). Skeletal muscle wasting with disuse atrophy is multi-dimensional: The response and interaction of myonuclei, satellite cells and signaling pathways. *Frontiers in Physiology, 5,* 99. https://doi.org/10.3389/fphys.2014.00099

Butler, S. G., Maslan, J., Stuart, A., Leng, X., Wilhelm, E., Lintzenich, C. R., . . . Kritchevsky, S. B. (2011). Factors influencing bolus dwell times in healthy older adults assessed endoscopically. *Laryngoscope, 121*(12), 2526–2534. https://doi.org/10.1002/lary.22372

Carlaw, C., Finlayson, H., Beggs, K., Visser, T., Marcoux, C., Coney, D., & Steele, C. M. (2012). Outcomes of a pilot water protocol project in a rehabilitation setting. *Dysphagia, 27*(3), 297–306. https://doi.org/10.1007/s00455-011-9366-9

Chalmers, J. M., King, P. L., Spencer, A. J., Wright, F. A., & Carter, K. D. (2005). The oral health assessment tool–validity and reliability. *Australian Dental Journal, 50*(3), 191–199.

Clark, B. C., Fernhall, B., & Ploutz-Snyder, L. L. (2006). Adaptations in human neuromuscular function following prolonged unweighting: I. Skeletal muscle contractile properties and applied ischemia efficacy. *Journal of Applied Physiology (1985), 101*(1), 256–263. https://doi.org/10.1152/japplphysiol.01402.2005

Crary, M. A., & Groher, M. E. (2006). Reinstituting oral feeding in tube-fed adult patients with dysphagia. *Nutrition in Clinical Practice, 21*(6), 576–586. https://doi.org/10.1177/0115426506021006576

Cuccio, L., Cerullo, E., Paradis, H., Padula, C., Rivet, C., Steeves, S., & Lynch, J. (2012). An evidence-based oral care protocol to decrease ventilator-associated pneumonia. *Dimensions of Critical Care Nursing, 31*(5), 301–308. https://doi.org/10.1097/DCC.0b013e3182619b6f

Day, R. E., Kitchen, P., Owen, D. S., Bland, C., Marshall, L., Conner, A. C., . . . Conner, M. T. (2014). Human aquaporins: Regulators of transcellular water flow. *Biochimica et Biophysica Acta, 1840*(5), 1492–1506. https://doi.org/10.1016/j.bbagen.2013.09.033

Dickinson, H. (2012). Maintaining oral health after stroke. *Nursing Standard, 26*(49), 35–39. https://doi.org/10.7748/ns2012.08.26.49.35.c9233

Donzelli, J., Brady, S., Wesling, M., & Craney, M. (2003). Predictive value of accumulated oropharyngeal secretions for aspiration during video nasal endoscopic evaluation of the swallow. *Annals of Otology, Rhinology, and Laryngology, 112*(5), 469–475. https://doi.org/10.1177/000348940311200515

Dua, K. S., Ren, J., Bardan, E., Xie, P., & Shaker, R. (1997). Coordination of deglutitive glottal function and pharyngeal bolus transit during normal eating. *Gastroenterology, 112*(1), 73–83.

Feinberg, M. J., Knebl, J., & Tully, J. (1996). Prandial aspiration and pneumonia in an elderly population followed over 3 years. *Dysphagia, 11*(2), 104–109.

Feinberg, M. J., Knebl, J., Tully, J., & Segall, L. (1990). Aspiration and the elderly. *Dysphagia, 5*(2), 61–71.

Frey, K. L., & Ramsberger, G. (2011). Comparison of outcomes before and after implementation of a water protocol for patients with cerebrovascular accident and dysphagia. *Journal of Neuroscience Nursing, 43*(3), 165–171. https://doi.org/10.1097/JNN.0b013e3182135adf

Garon, B., Engle, M., & Orminston, C. (1997). A randomized control study to determine the effects of unlimited oral intake of water. *Journal of Neurological Rehabilitation, 11,* 139–148.

Gillman, A., Winkler, R., & Taylor, N. F. (2017). Implementing the free water protocol does not result in aspiration pneumonia in carefully selected patients with dysphagia: A systematic review. *Dysphagia, 32*(3), 345–361. https://doi.org/10.1007/s00455-016-9761-3

Hiiemae, K. M., & Palmer, J. B. (1999). Food transport and bolus formation during complete feeding sequences on foods of different initial consistency. *Dysphagia, 14*(1), 31–42. https://doi.org/10.1007/PL00009582

Holas, M. A., DePippo, K. L., & Reding, M. J. (1994). Aspiration and relative risk of medical complications following stroke. *Archives of Neurology, 51*(10), 1051–1053.

Kaneoka, A. (2015, May). [Ice Chip Exercise].

Kaneoka, A., Pisegna, J. M., Saito, H., & Langmore, S. E. (2016, February). *Adverse events associated with intake of thin liquids versus thick liquids in patients who aspirate: A systematic review and meta-analysis*. Paper presented at the Dysphagia Research Society Annual Convention, Phoenix, AZ.

Karagiannis, M. J., Chivers, L., & Karagiannis, T. C. (2011). Effects of oral intake of water in patients with oropharyngeal dysphagia. *BMC Geriatrics, 11,* 9. https://doi.org/10.1186/1471-2318-11-9

Karagiannis, M. J., & Karagiannis, T. C. (2014). Oropharyngeal dysphagia, free water protocol and quality of life: An update from a prospective clinical trial. *Hellenic Society of Nuclear Medicine, 17*(*Suppl. 1*), 26–29.

Kaszuba, S., Brady, S., Wesling, M., Donzelli, J., & Stewart, J. (2011). *Clinical utility of blue ice chips with patients who are NPO during the FEES: Pilot data.* Paper presented at the American Speech-Language Hearing Association.

Kelly, A. M., Drinnan, M. J., & Leslie, P. (2007). Assessing penetration and aspiration: How do videofluoroscopy and fiberoptic endoscopic evaluation of swallowing compare? *Laryngoscope, 117*(10), 1723–1727. https://doi.org/10.1097/MLG.0b013e318123ee6a

Langmore, S. E. (2001). *Endoscopic evaluation and treatment of swallowing disorders* (2nd ed.). New York, NY: Thieme.

Langmore, S. E. (2011). Why I like the free water protocol. *Perspectives: Swallowing and Swallowing Disorders, 20,* 116–120. https://doi.org/10.1044/sasd20.4.116

Langmore, S. E., Schatz, K., & Olsen, N. (1988). Fiberoptic endoscopic examination of swallowing safety: A new procedure. *Dysphagia, 2*(4), 216–219.

Langmore, S. E., Terpenning, M. S., Schork, A., Chen, Y., Murray, J. T., Lopatin, D., & Loesche, W. J. (1998). Predictors of aspiration pneumonia: How important is dysphagia? *Dysphagia, 13*(2), 69–81. https://doi.org/10.1007/PL00009559

Murray, J., Doeltgen, S., Miller, M., & Scholten, I. (2016). Does a Water protocol improve the hydration and health status of individuals with thin liquid aspiration following stroke? A randomized controlled trial. *Dysphagia, 31*(3), 424–433. https://doi.org/10.1007/s00455-016-9694-x

Murray, J., Langmore, S. E., Ginsberg, S., & Dostie, A. (1996). The significance of accumulated oropharyngeal secretions and swallowing frequency in predicting aspiration. *Dysphagia, 11*(2), 99–103.

Narici, M. V., & de Boer, M. D. (2011). Disuse of the musculo-skeletal system in space and on earth. *European Journal of Applied Physiology, 111*(3), 403–420. https://doi.org/10.1007/s00421-010-1556-x

Olson, M. (1970). The benign effects on rabbits' lungs of the aspiration of water compared with 5 percent glucose or milk. *Pediatrics, 46*(4), 538–547.

Palmer, J. B., Rudin, N. J., Lara, G., & Crompton, A. W. (1992). Coordination of mastication and swallowing. *Dysphagia, 7*(4), 187–200.

Panther, K. (2005). The Frazier free water protocol. *Perspectives: Swallowing and Swallowing Disorders, 14,* 4–9.

Pisegna, J. M., & Langmore, S. E. (2016a). *Clinician ratings of residue depend on the instrumental evaluation.* Paper presented at the Dysphagia Research Society, Chicago, IL.

Pisegna, J. M., & Langmore, S. E. (2016b). Parameters of instrumental swallowing evaluations: Describing a diagnostic dilemma. *Dysphagia, 31*(3), 462–472. https://doi.org/10.1007/s00455-016-9700-3

Robbins, J., Gensler, G., Hind, J., Logemann, J. A., Lindblad, A. S., Brandt, D., . . . Miller Gardner, P. J. (2008). Comparison of 2 interventions for liquid aspiration on pneumonia incidence: A randomized trial. *Annals of Internal Medicine, 148*(7), 509–518.

Rohmann, K., Tschernig, T., Pabst, R., Goldmann, T., & Dromann, D. (2011). Innate immunity in the human lung: Pathogen recognition and lung disease. *Cell and Tissue Research, 343*(1), 167–174. https://doi.org/10.1007/s00441-010-1048-7

Rosenbek, J. C., Robbins, J. A., Roecker, E. B., Coyle, J. L., & Wood, J. L. (1996). A Penetration–Aspiration Scale. *Dysphagia, 11*(2), 93–98.

Saitoh, E., Shibata, S., Matsuo, K., Baba, M., Fujii, W., & Palmer, J. B. (2007). Chewing and food consistency: Effects on bolus transport and swallow initiation. *Dysphagia, 22*(2), 100–107. https://doi.org/10.1007/s00455-006-9060-5

Scibilia, S., Hreha, K., Piscopo, C., Adler, U., & Barrett, A. M. (2016). *Implementing a free water protocol in an inpatient rehabilitation facility: Outcomes and care transitions.* Paper presented at the Archives of Physical Medicine and Rehabilitation.

Simonelli, M., Ruoppolo, G., de Vincentiis, M., Di Mario, M., Calcagno, P., Vitiello, C., . . . Gallo, A. (2010). Swallowing ability and chronic aspiration after supracricoid partial laryngectomy. *Otolaryngology-Head and Neck Surgery, 142*(6), 873–878. https://doi.org/10.1016/j.otohns.2010.01.035

Splaingard, M. L., Hutchins, B., Sulton, L. D., & Chaudhuri, G. (1988). Aspiration in rehabilitation patients: Videofluoroscopy vs bedside clinical assessment. *Archives of Physical Medicine and Rehabilitation, 69*(8), 637–640.

Steele, C. M., Alsanei, W. A., Ayanikalath, S., Barbon, C. E., Chen, J., Cichero, J. A., . . . Wang, H. (2015). The influence of food texture and liquid consistency modification on swallowing physiology and function: A systematic review. *Dysphagia, 30*(1), 2–26. https://doi.org/10.1007/s00455-014-9578-x

Stephen, J. R., Taves, D. H., Smith, R. C., & Martin, R. E. (2005). Bolus location at the initiation of the pharyngeal stage of swallowing in healthy older adults. *Dysphagia, 20*(4), 266–272. https://doi.org/10.1007/s00455-005-0023-z

Verkman, A. S., Matthay, M. A., & Song, Y. (2000). Aquaporin water channels and lung physiology. *American Journal of Physiology-Lung Cellular and Molecular Physiology, 278*(5), L867–L879.

History:
Received July 30, 2017
Revised October 08, 2017
Accepted November 15, 2017
https://doi.org/10.1044/persp3.SIG13.28