

The Aetiology of Oro-Pharyngeal Dysphagia and its Effects in Stroke

David G Smithard

David G Smithard, Consultant Geriatrician, Princess Royal University Hospital, King's College Hospital University Foundation Trust, the United Kingdom

Correspondence to: David G Smithard, Consultant Geriatrician, Princess Royal University Hospital, King's College Hospital University Foundation Trust, the United Kingdom.

Email: david.smithard@nhs.net

Telephone: +44-1689-865856

Received: January 31, 2014

Revised: September 9, 2014

Accepted: September 12, 2014

Published online: October 21, 2014

ABSTRACT

Dysphagia following stroke is common and its effects may last for many years. Swallowing frequently improves in the first few weeks. The cause of the dysphagia may be related to the stroke, by the medication used, or by concurrent illness. Assessment and intervention needs to be undertaken promptly to ensure that calories are provided; without energy, recovery cannot occur and rehabilitation cannot be undertaken. Treatment has progressed from nihilism to the present exciting times where more potential treatments and interventions in the rehabilitation are being developed.

© 2014 ACT. All rights reserved.

Key words: Dysphagia; Stroke; Rehabilitation; complications; Outcome

Smithard DG. The Aetiology of Oro-Pharyngeal Dysphagia and its Effects in Stroke. *Journal of Gastroenterology and Hepatology Research* 2014; 3(10): 1252-1264 Available from: URL: <http://www.ghrnet.org/index.php/joghr/article/view/882>

INTRODUCTION

A safe swallow is important for independent living and to maintain ones place in society. Anecdotally, being able to swallow safely will result in the ability to enjoy food such that it is not a chore to keep body and soul together but also a convivial social past time^[1].

THE NORMAL SWALLOW

The process of swallowing has been described as the most complete all or non- reflex^[2,3], however, although the pharyngeal swallow is a reflex it can be modified by the cortex depending on feedback regarding bolus size and viscosity^[4].

A normal swallow is difficult to define, but essentially it is a series of sequential coordinated events that ensures a safe passage of food or liquid from the mouth to the stomach via the pharynx and oesophagus^[5].

As food is brought towards the mouth, preparation to swallow begins; there are essentially three functions to the oropharyngeal swallow. These are bolus preparation, airway protection and bolus passage through the pharynx; and three phases, oral, pharyngeal and oesophageal (relaxation of the upper oesophageal sphincter). The relationship between these phases of timing and duration are dependent to some degree on bolus characteristics^[6].

Swallow Timings

The reflex swallow lasts less than one second, and although events are sequential there has been a debate as to when the swallow triggers and the actual sequencing of each of the various events of the swallow.

Original research on single swallows, had suggested that the swallow would trigger once a bolus passed the base of the anterior faucial arches. Subsequent to this, evidence suggests that this is true in some cases but for others the swallow does not trigger until the bolus is in the pharynx itself^[6-10].

Papers by Kendall *et al*^[11] and more recently Molfenter *et al*^[12] suggest that, although there is variability between people in their swallow, some events are always paired; the onset of arytenoid movement to the base of the epiglottis occurs before the onset of upper oesophageal sphincter opening/ relaxation and the maximal approximation of the hyoid and larynx occurs after the onset of upper oesophageal sphincter opening.

Oral Phase

The oral phase of swallowing has two components, bolus preparation and bolus transport.

As the bolus approaches the lips, the hyoid bone moves forward and upwards pulling the larynx up against the base of the tongue^[13,14]. Once the bolus has been placed in the oral cavity, lips are closed; the bolus is prepared for swallowing, by chewing and mixing with saliva in the case of a solid bolus (e.g. meat). When ready (it is personal choice how long food is chewed for before the bolus is gathered together and this will be influenced by bolus viscosity, texture, volume and personal preference^[15,16]), the bolus is collected on the tongue and trapped between the tongue and the hard palate, such that in the AP view it is said to resemble a Viking long boat. The bolus is then propelled backwards to the pharynx by an anterior-posterior rippling movement of the tongue.

Pharyngeal Phase

Passage of the bolus through the pharynx is not straightforward. Once the bolus has left the back of the tongue, it moves into the valleculae, momentarily, before passing over or around the epiglottis^[17,18]. The food then passes through the lateral food channels (pyriform sinus), before coming together to pass through the upper oesophageal sphincter, which has relaxed and opened at this time.

The movement of the bolus is not a passive phenomenon but an active process with a rippling of the lateral^[19] posterior pharyngeal walls commonly called the pharyngeal stripping wave^[20].

Oesophageal Phase

Bolus transport is an active process; as the bolus transfers through the pharynx to the upper oesophageal sphincter (UES) there is an acceleration in its passage with a reduction in UES pressure. The oesophageal phase commences once the bolus passes through the upper oesophageal sphincter. The bolus is actively transported through the oesophagus into the stomach^[21,22].

Neural Control of Swallowing

The neural control of swallowing is complex, relying on a feedback loop to permit active adjustments to the timing and duration of pharyngeal phase.

There are paired swallowing centres within the brainstem, which are a system of interconnections within the reticular formation of the medulla, near the inferior Olive. Simultaneously, information regarding the bolus characteristics (size, viscosity) are conveyed via afferents from the mouth, tongue and pharynx (cranial nerves V, VII, IX, X-XII) to the cortex, which then modulates the swallow to regulate the control of respiration and airway closure, the dimensions of the pharynx and how long the upper oesophageal sphincter remains open^[23-28].

Cortical control is complex and is detailed elsewhere^[3,23-31]. In summary the swallow is bilaterally, but asymmetrically represented^[30,32] within the cortex. The nigrostriatal pathway and the anterior insula cortex are two areas that appear to be critical for the coordination of swallowing^[3]. The Motor cortex, supplementary

motor cortex, amygdala, frontal cortex and cerebellum are also involved^[3,30]. Within these areas are numerous transmitters including substance P, Dopamine and norepinephrine^[33,34].

Airway Protection

The pharynx is an anatomical structure that is shared by both respiration and swallowing; to swallow safely, there needs to be an interruption to the respiratory cycle^[17,18,36-39]. The respiratory centre and the swallowing centres within the brainstem are connected via interneurons with a feedback loop. This interconnection drives the suspension of respiration during swallowing resulting in a period of apnoea, followed by, but not invariably, expiration. However in some clinical scenarios, inhalation rather than expiration may occur (e.g. after sequential swallowing)^[17,18]. Where it is not possible to interrupt the respiratory cycle, e.g. lung fibrosis, chronic obstructive pulmonary disease, heart failure, it may not be possible to swallow safely and consequently dysphagia results.

Protection of the airway commences at the beginning of the swallow, with the upward and forward movement of the larynx. As this is happening the false vocal cords begin to come together, followed closely by the true vocal cords and lastly the epiglottis. The vocal cords are the mainstay of laryngeal protection, not the epiglottis. Studies have shown that it is possible to swallow safely without the presence of an epiglottis^[37] and in sequential swallows the epiglottis is upright^[17].

As the bolus moves to the back of the oral cavity, the soft palate elevates to close off the nasal passages, aided by the forward movement of the posterior pharyngeal wall (Passavant's cushion)^[4,39].

Swallowing following stroke

Fifteen million people suffer a stroke annually and stroke is the third largest cause of death in the world^[40].

Stroke has two essential aetiological pathologies, ischaemic and haemorrhagic. Ischaemic strokes can be subsequently divided further by aetiology^[41], or stroke syndromes depending on stroke severity and location^[42].

The presence of dysphagia following an acute stroke may not be directly related to the incident cerebral insult. The ability to swallow safely may have many different aetiologies/premorbidity comorbidities that interplay; compounded by the fact that some older people will have presbyphagia^[43,44], and a new physiological insult has led to a decompensation of their swallow. Many people with stroke will have neurological co morbidities all of which could result in dysphagia (Dementia, Parkinson's Disease, Multiple Sclerosis, Motor Neurone Disease). Apnoea or the ability to breath hold is a central feature of a safe swallow, consequently if this is not possible (heart failure, COPD, Lung Fibrosis) or there is an erratic respiratory cycle then dysphagia will result.

Musculo skeletal disease, Rheumatoid arthritis affecting the arytenoid joint or osteoarthritis resulting in a mechanical impediment, lack of teeth and dentures can all result in an unsafe swallow resulting in a fear of swallowing or eating particular foods^[45].

The occurrence and recovery of dysphagia frequently depends on the relative dominance between the affected and unaffected hemisphere for swallowing, there has been much research investigating the lesion location, but there has been no conclusive single cortical location identified as the most relevant. Stroke within the subcortical structures, cerebellum and brainstem may be more likely to result in dysphagia, particularly because of the close

proximity of many important pathways^[3,34].

Abnormalities within the swallowing system are common following stroke. Some authors have suggested that the occurrence may be as high as 100%, how ever clinically relevant problems with swallowing or dysphagia, are present in 28-65% of people during the acute phase of stroke, reducing significantly during the early times of stroke, such that by 14 days after the stroke 90% of people will be swallowing safely^[35,46-48]. However a small proportion of people will have on going problems for some time^[49]. Some of those that appear to have returned to a safe swallow after 3 months are found to have difficulties at 6 months^[50,51]. If the swallow does not show any signs of recovery in the first ten days, it is probable that the return of a safe swallow may take between 2 and 3 months.

Swallowing Recovery

Swallowing recovery is dependent on neural plasticity^[52-54], with on either the non-affected hemisphere enlarging^[52], or other cortical areas taking over or both. Failure of the non-affected hemisphere to enlarge will result in dysphagia persisting^[52,54]. Hamdy and colleagues have undertaken many eloquent studies to show this using both fMRI and TCMS^[55,56].

Outcome

The presence of dysphagia following a stroke is an independent marker of both short and long-term outcomes.

Early/Acute complications

There are many complications of dysphagia following stroke, if the swallowing abnormality is mild there may be no clinical effects but for others they are quite serious. The majority of the complications of dysphagia are related to the aspiration (Table 1) of saliva and oral pathogens rather than food or liquids. The main consideration must be, is there a clinical problem or not, and if there is, aspiration may or not be present^[49]. However, all readily available investigations (Fibreoptic Endoscopic Evaluation of Swallowing - FEES, Videofluoroscopy) only assess the swallow for short periods of time^[57-59].

Table 1 Complications of Aspiration.	
Complications of Aspiration	
No obvious ill effects	
Recurrent cough	
Grumbling Pyrexia	
Chest Infection	
Asthma / COPD	
Food avoidance	
Weight loss	
Dehydration	
Cyanosis/ hypoxia	
Hypoxic fit	
Airway obstruction	
Death	

All people aspirate, usually at night when the swallow either ceases or the number of swallows is greatly reduced^[60,61]. In many there is no ensuing complication. Following stroke, up to half of those examined by videofluoroscopy will have silent aspiration; the question is “is this relevant clinically?” The literature is unclear, partly because, in many studies the cohorts are selected from those that have been referred for assessment, whereas those following consecutive stroke patients have found different results^[36,62-65]. Smithard *et al* and Ramsey *et al* only detected small numbers of people with silent aspiration, and did not note any difference in outcome^[49,64]. Schmidt,

however, in a cohort of patients referred for videofluoroscopy noted that the risk of pneumonia was greatly increased^[65]. This is an important debate as it could have a major implication for the management of dysphagia in stroke patients.

Late Effects

The presence of dysphagia or aspiration in the acute phase is associated with an increased mortality (Figures 1 and 2), the majority in the first year. Smithard *et al* noted not only a worse outcome in the presence of dysphagia, but that there was a deterioration up to five years later^[67]. Smithard *et al* reviewing the South London Stroke Register noted that mortality after stroke was increased in those people with dysphagia, but this was mainly in the first year^[67] (similar results have been seen by Hamdy –personal communication). Further work is required to find out why this is happening, is it general frailty, carer fatigue, recurrent stroke or increased morbidity.

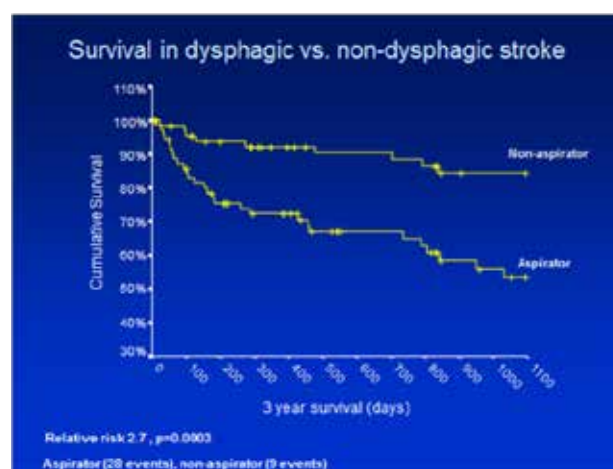


Figure 1 Survival after stroke in the presence or absence of dysphagia (Handy *et al*).

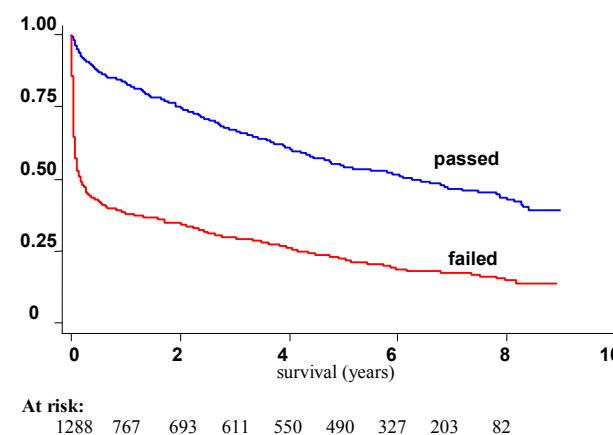


Figure 2 Survival after stroke with (failed assessment) and without (passed) dysphagia^[66].

Medication

Many people suffering a stroke also have many other medical problems and as a consequence are taking a multitude of medications. Many of these may affect the ability to swallow (Table 2) either by affecting the production of saliva, alteration of taste or conscious level^[33]. Medication with an anticholinergic action (Major antipsychotics – Chlorpromazine, Haloperidol) and some medications

with a weak individual anticholinergic action but may summate to have a greater affect (including those used in stroke prevention)^[34] can dry the mouth making swallowing more difficult.

Table 2 Medication with a negative impact on swallowing.

Class of Medication	Effect
Anti-psychotic (Chlorpromazine, Risperidone)	Dry mouth
Tricyclic antidepressants (Amitriptyline)	Dry mouth
Antibiotics	Sore mouth, Fungal Infection
Opiates (morphine, codeine)	Dry mouth, sedation
Diuretics	Dry mouth, hypocalcaemia
Benzodiazepines	Sedation
Cortico Steroids	Oral fungal infection
Metformin	Altered taste
Alpha blockers and calcium channel blockers	Dry mouth
Antiepileptic medication	Sedation
COX2 inhibitors/Non steroidal anti inflammatory agents (Naproxen)	Reduced cough

DYSPHAGIA MANAGEMENT

The management of dysphagia needs to be a proactive process, beginning from the moment a stroke occurs, or at least at the time of assessment in hospital. There are many guidelines, both local and national, regarding the management of dysphagia^[67-71], and the evidence suggests that the presence of such guidelines reduced the incidence of aspiration and chest infection^[69-71]. Despite the evidence base as many as 50% of people are not having their swallow assessed on admission to hospital^[72]. There is wide variation between therapists and countries as the way dysphagia management occurs^[73,74].

Swallow Screens

There are numerous different swallowing screens available with different sensitivities and specificities (Table 3); they all have similar core elements, some have weighted different elements to provide a score^[70,75-79]. Many swallowing screens have been assessed following stroke, and some do not involve testing the person's ability to swallow (e.g. MASA), whilst others are an extension of a previously validated screen, with the FAST added to it (ASDS)^[80-82].

Table 3 Sensitivities, Specificities, Positive predictive values (PPV) and Negative predictive Values of swallowing screens.

Reference (ref)	Screen	N	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Smithard et al	BSA	83	47	86	50	85
De Pippo ^[70]	3oz	44	76	59		
Smith ^[80]		53	80	68	50	90
Splaingard (b)		107	42	91	75	70
Daniels (a)		59	92	67		
Clave ^[67]		85	100	28.8		
Martino ^[68]	TOR-BSST					
Acute		59	96.3	63.6	76.5	93.3
Rehab		35	80	68	50	89.5
Trap ^[69]	Gugging	21	100	50	81	100
		30	100	69	74	100

a. Daniels SK, McAdam CP, Brailey K, Foundas AL. Clinical assessment of swallowing and prediction of dysphagia severity. *Am J Speech Lang Pathol* 1997; 6: 17-24

b. Splaingard ML, Hutchins B, Sulston LD, Chaudhuri G. Aspiration in rehabilitation patients: videofluoroscopy vs bedside clinical assessment. *Arch Phys Med Rehabil* 1988; 69: 637-640

The sensitivities of many of these screens is poor, but in some cases the negative and positive predictive values^[76,86] are helpful in the short term. Despite this many services use their own local,

unvalidated swallowing screen^[73,74]. One common medical myth that needs to be dispelled is that an absent gag does not mean that the swallow is compromised^[5,84-88].

Pulse oximetry has been suggested as a possible adjunct to the swallowing screen. At present the jury is out^[88-92] as there is an inconsistency in the results reported. As an isolated assessment, pulse oximetry is unhelpful, but in conjunction with a full assessment it may add some useful information.

Similar controversy surrounds the use of laryngeal auscultation. Some practitioners find it useful, others find it to inaccurate to be of any use at all as the interpretation is subjective^[93-98]. The issue may be a difference between clinical use and interpretation of sound and laboratory usefulness (in the hand of the researcher).

Ramsey *et al* investigated the feasibility of undertaking a modified swallowing screen; this was the Bedside Swallowing Assessment^[71], using radio opaque liquid, although this showed promise, not enough people with significant stroke deficit were recruited and no positive conclusion could be drawn.

It is clear that no one method, on its own, has the sufficient sensitivity and specificity to provide complete confidence in its use. An assessment that can be used with confidence, in clinical settings without access to VF or FEES is required. It is likely, that in the future a combination of clinical swallow screen/assessment with pulse oximetry and plain radiology will provide the requisite specificity and sensitivity, to permit someone to eat and drink with the confidence that the swallow is safe.

Cough Reflex

The ability to cough is important in minimizing the occurrence of aspiration as it is a protective reflex. A good cough prevents penetration becoming aspiration. This will be impaired if there is a weakness in the intercostal muscles or the diaphragm^[99,100]. There have been studies using either citric acid or air puffs to trigger the cough reflex^[101,102].

Instrumental Assessment

Following on from a screening assessment, which may have been conducted by a doctor, nurse, physiotherapist, or dentist^[75,76,103], a more in depth assessment of swallowing needs to be undertaken. This will be a further clinical assessment and possibly instrumental investigation^[103].

This will include an assessment of the oral anatomy, cognition, timing of the swallow, head positioning, breathing and the use of different consistencies. The examination of the oral anatomy would have included reviewing tongue control, dentition and the general state of mouth and dental plate hygiene^[104].

In many institutions, instrumental investigation/ assessment will be limited to videofluoroscopy (VF)^[105-109]. VF is considered the "gold" standard investigation, though inter rater concordance is less than ideal^[33]. Palmer^[106] suggested a modified form of videofluoroscopy to improve assessment and Rosenbeck developed the penetration/ aspiration scale^[111]. Guidelines and consensus statements advise and encourage the use of VF however pragmatically many clinicians employ VF when there is diagnostic uncertainty. This is often driven by availability and accessibility, but also the evidence base^[103].

FEES has been available for at least 20 years, despite this, it is not being routinely used in the UK and other north European countries. This is frequently driven by resource allocation, and availability of trained staff rather than clinical decision-making. Where FEES is used it has good inter and intra rater scores^[109].

FEES provides a lot of information regarding the swallow, but

is not able to provide conclusive evidence of aspiration, nor image the whole of bolus transport at the same time^[57,58,108-110]. One main advantage is the lack of exposure to radiation and the procedure can be undertaken at the bedside. FEES should be seen as complementary to VF rather than a replacement for it.

FEES and VF only provide limited information regarding the swallow, other investigative techniques such as manometry, ultra sound^[112-114], EMG^[115,116], pH monitoring^[118] and scintigraphy^[119] are available and although used in clinical practice, in many areas of practice they are often research tools rather than being used in routine clinical practice.

Oral Care

Mouth care is a significant issue in many hospitals and nursing homes, either because the patient will not permit mouth care, or mouth care has been neglected^[120-125]. Anecdotally monitoring and undertaking mouth care is reduced when a patient is nil by mouth or has a nasogastric tube in situ.

Gosney *et al*^[125] showed that the use of oral metronidazole gel reduced the incidence of aspiration pneumonia and a meta-analysis has suggested that antibiotics may reduce aspiration pneumonia prophylactically by 24%.

MANAGEMENT OF NUTRITION AND HYDRATION

During the first week of stroke swallowing assessment (MASA score) eating assessment (FOIS- Functional Oral Intake Scale) and severity of stroke are associated with poor nutritional intake and dehydration^[127].

The question raised, is the deterioration in nutritional markers following a stroke due to the stroke or the consequences of stroke such as dysphagia, infection etc. Davalos *et al*^[128] found that there was evidence of a negative energy balance Spanish data though this was not supported by Elia and Weekes who noted that there was no increase in energy use following stroke in the resting state^[129].

Davalos *et al*^[129] suggested that this negative energy state could not be reversed by enteral feeding. More recent work by Nascimento and colleagues^[130] suggests that the loss of albumen during the acute phase could be reversed or halted depending on the type of feed used with whey protein being more beneficial in reducing IL6 and increasing glutathione peroxidase than casein based products^[130].

Smithard *et al*^[36] measured various anthropometric markers several times over 6 months and found a decrease in some anthropometric markers (mid arm circumference) only. This reduction in mid arm circumference was apparent whether there was aspiration present on videofluoroscopy or not and had not returned to base line by six months. Similar results had been found in a Chinese population with pneumonia^[131].

Nutrition (Calories) is essential for survival. From a stroke point of view there are essentially two methods of providing nutrition, orally or enterally (Table 4). Parenteral nutrition should only be used as a last resort where it is not possible to enterally provide nutrition.

Providing the patient has a functioning gastro-intestinal tract, it is always preferable to provide nutrition orally, either by modifying the diet or using swallowing manoeuvres^[80,132], or enteral feeding.

The decision to provide nutrition to a patient with dysphagia was always prefaced by when and which route. Prior to the FOOD trial^[133], which ran between 1996 and 2004, in many services the provision of nutrition was frequently delayed (or intravenous dextrose used) despite the request for on going physiotherapy.

Table 4 Reasons for the “Falling Out” of Nasogastric Tubes.

Reasons why Nasogastric Tubes “Fall Out”	
Pulled due to pain/ discomfort	Patient’s often remove tubes due to being unaware as to the purpose of the tube, some, however remove the tube to make a specific statement.
Agitation Movement	Often confusion and or dysphasia are also present resulting in a challenge to clinical staff.
Poor fixation	
Confusion	
Spatial Neglect	
Poor nursing	
Deliberate	

Delaying nutrition often resulted in protein energy malnutrition and then a risk of re-feeding syndrome once nutrition started^[134].

Oral Feeding

The use of oral supplements as an addition to normal in stroke, as yet does not have a good evidence base^[131,133,136]. However, when a person is not supporting their nutritional needs and they are able to swallow; they are useful when they are the only energy source.

Hydration

Hydration is as equally important, though it is often managed poorly on rehabilitation units. During the acute phase of stroke parenteral fluids are frequently provided^[137]. During the first week of recovery phase, where the swallow is compromised, the use of agents to thicken fluids, inhibits fluid intake with a consequent dehydration^[127,137].

Enteral Feeding

Enteral feeding is the provision of nutrition directly into the gastro intestinal tract. Over the years trends have changed such that rectal feeding is no longer practiced. In the western world, tubes passed nasally or percutaneously are most widely used.

Nasogastric Tubes

Nasogastric tube feeding is the usual first stage of enteral feeding, and are frequently placed early, predominantly for the administration of medication. They are not without problems (Table 5).

Table 5 Restraints used to prevent Nasogastric Tubes “falling out.

Type	Effect
Boxing Gloves (hands wrapped in bandages)	In ability to pull at the nasogastric tube
American Football helmet	Tube out of site and inaccessible
Web Spacing device	Reduces the ability to grip
Sedation	Too drowsy to fight
Nasal loop/ Bridle	To prevent a nasogastric tube falling out
Tying to the bed side	Prevents physical access to the nasogastric tube

Before feeding via the nasogastric tube can commence, it needs to be positioned correctly. Misplacement of a nasogastric tube is a constant concern and, if feeding commences when the tube is in the right main bronchus, it may prove fatal. Guidance suggests that prior to use there should be an attempt to aspirate gastric contents and check the pH. If that fails, a chest radiograph should be requested^[139,140]. Devices are being developed to assist with the placement of nasogastric tubes (eg Cortrack) and if these are reliable then it will be possible to avoid using chest films. Their role in the community is potentially exciting^[141].

There are three big questions associated with nasogastric tubes: when to feed, are they appropriate and will the regimen work? The timing of feeding remains uncertain despite the results of the FOOD Trial^[133]. The FOOD trial, a randomized control study of a family of nested studies. One of these studies investigated the timing of

the use of early enteral feeding, i.e. commencing in the first week vs no enteral feeding. Despite randomizing 859 patients, there was no statistical difference between the two groups^[133]. Do nasogastric tubes deliver nutrition, i.e. do they work? Studies have suggested that the tubes often fall out, need replacing such that feed regimes often fail^[142,143] and there is a negative body image^[142]. Concern has been raised that the use of nasogastric tubes may affect the swallow adversely, but this has not been borne out in studies^[144,145], provided that it has been positioned correctly^[144]. In a small study, it was found that placing a nasogastric tube early (in the first four days) increased the risk of a chest infection (RR 3.73, CI: 2.6-5.32), therefore it may be sensible, where possible to delay feeding by this route for a few days^[146].

Nasogastric tubes have a habit of falling out, and the reason for this needs to be sought (Table 4). If it is considered that the need for enteral feeding is short term, then restraints have been used (Table 5), the most common and least intrusive would be the use of the bridle or nasal loop^[143,147]. Although Nasogastric Tubes are frequently used with impunity, they are not without complications (Table 6) and as a consequence care is required not only with placement but also with the ongoing care.

Table 6 Complications of Nasogastric Tube placement.

Complications of Nasogastric tube placement
Recurrent placement
Nasal Ulceration
Poor tube placement / wrong placement
Food sticking to the nasogastric tube
Increased pharyngeal secretions
Feed failure
Oesophageal reflux
Aspiration
Poor body image

Enterostomy

Enterostomy tubes are used to provide long-term nutrition. The most common approach is that positioned percutaneously (PEG), via endoscopy by the gastroenterologist or the radiologically (RIG) by the radiologist. Studies suggest that these are more reliable at ensuring nutrition is provided as they are less likely to fall out. Park *et al* has also suggested that they are preferred to nasogastric tubes (Table 7) due to positive body image and reliability and completion of treatment^[136,145,148-153,155]. Complications are listed in table 8.

The timing of enterostomy tubes remains uncertain despite the results of the FOOD trial^[133]. The Cochrane database suggests that no benefit was noted in early PEG feeding. The final conclusion being that PEG feeding was not necessary prior to week four after stroke, which was a move away from clinical practice of early intervention.

Table 7 Complications of Percutaneous gastrostomy Placement.

Major complications (Reported incidence 3-19%)	Minor complications (Reported incidence 13-62%)
Gastric haemorrhage	Tube displacement
Gastrocolic fistula	Tube obstruction
Gastric perforation	Tube leakage
Gastro-oesophageal reflux	Pneumoperitoneum
Aspiration pneumonia	Skin excoriation/ infection
Peritonitis	Cellulitis
Serious abdominal wall infection	Pain at tube site
Bowel obstruction	Buried bumper syndrome
Intussusception	Over granulation of entry site
Oesophageal perforation	Diabetes control may be affected
	Nausea
	Diarrhoea

Table 8 Comparisons between Nasogastric Tube and Percutaneous Gastrostomy Tube Acceptability.

	NG Feeding	PEG Feeding
Placement	Quick and easy	Invasive
Procedure related mortality	Very low	0-1%
Replacement	Every 10-28 days	After several months
Patient tolerance	Poor	Good
Complications	Relatively infrequent	Frequent

MODIFYING SWALLOWING DYNAMICS

There are two main approaches to treatment. The therapeutic aim of treatment is to provide calories orally^[125]. The first approach is provide strategies to enable food to be taken safely by mouth, and if not to provide nutrition enterally. The second is to rehabilitate the swallow.

Swallowing Strategies

Strategies are used to provide oral nutrition in a safe way. There are two approaches, one is to modify the diet and the second is to modify the swallowing dynamics. Whichever strategy is used, and frequently both are used simultaneously, there is a voluntary modification of breathing and swallowing^[156].

Dietary Modification

Difficulties with swallowing may be consistency specific depending on which phase(s) of swallowing is affected. An oral problem would result in difficulties predominantly with liquids exceeding that with solids and perhaps thick fluids, whereas pharyngeal phase problems may be better with thinner liquids. There are problems with the descriptors of different consistency with terms such as “custard thick”, “nectar” and “thin” being terms used. There has been an attempt to use a standard terminology^[125,157] but this has not got wide spread uptake. There is ongoing work to try to resolve this problem. Concerns have been raised concerning the use of different textures and thickeners, in that the number of calories^[158] or volume of fluid consumed^[159] may be inadequate, partially due to presentation and taste.

Thickeners may be starch or gum based, which have properties of their own. Starch based thickeners are less stable if mixed with saliva, but this is also Ph dependent^[160,161]. Thickeners will also change the characteristic (including taste) of the bolus, which may not provide the wetness in the mouth and as a consequence not provide some of the feedback required around thirst^[160].

Respiratory Modifications

Maintaining a patent pharynx is complex and achieved by support of the palatal, hyoid and external tongue muscles^[15]. The period of apnoea during swallow is highly variable for both liquids and solids^[156]; however the longer the period of apnoea, absence of breathing and the faster the pharyngeal transit, the less laryngeal penetration/ aspiration there is^[162]. The apnoea may end before the larynx has fully descended, which may lend itself to increasing an aspiration risk where there is pooling.

Consequent to this, swallowing professionals have sought to harness the normal physiology, with breath holding during, and expiration after swallowing.

Postural Changes

Mechanical changes to bolus flow are achieved by changing head position to encourage bolus flow in a certain direction. Turning the

head to the side of the weak pyriform sinus, in effect closing it off, encourages bolus flow down the strong side of the pharynx. Double swallows encourage clearance of residue; Mendelsohn maneuver may assist in maintaining laryngeal elevation and closure^[163-165]. The most common benefit from swallowing manouevres, except head turning, is to increase UES opening^[166,167]. Although studies report a reduction in aspiration, the changes in physiological parameters frequently sought are often not present.

SWALLOWING REHABILITATION

Swallowing rehabilitation comes in two different formats. There are training programs and external neuromuscular stimulation.

Clinical training programs

Clinical training programs are akin to physiotherapy. The majority involve muscle strengthening exercises such as the Shaker^[168,169], forced chin tuck^[168] or the McNeil^[170] exercise program which utilises a series of exercises and techniques. Tongue strengthening, where indicated is also employed and there are devices on the market with proven results^[171].

External neuromuscular stimulation

These include transcutaneous muscular stimulation, electromagnetic stimulation and pharyngeal stimulation. Older clinical methods such as icing and faecal stimulation are have not been shown to work^[55,172,173].

Transcutaneous electrical muscular stimulation is undertaken by stimulating the external laryngeal muscles to result in laryngeal elevation. This methodology has been approved by the FDA, and is market as Vital Stim[®] by (Chattanooga). Freed *et al* have published data claiming an almost 100% improvement in swallows using 3.5 sessions per week^[174]. However, the best results are found in those that can eat something prior to treatment^[175]. A meta analysis has shown a 20% improvement^[176] the confidence limits are large. Despite some objective and subjective improvements, no cortical change has been demonstrated^[177].

Ludlow *et al* found conflicting results depending on the stimulation used, stimulation at a sensory threshold showed some improvement of the swallow using the NIH Swallow Severity Scale, but not with motor level stimulation, with a suggestion that there was a depression of the hyoid rather than an elevation putting patients at risk of aspiration^[178-179] It is unclear how this works, but sensory afferents must be part of the answer.

Electro-magnetic stimulation, via transcranial magnetic stimulation and/or electrical pharyngeal stimulation (EPS) can induce brain plasticity and improve swallowing^[55]. The brain is stimulated using a figure of eight coil situated over a predefined area of the brain to drive the pharyngeal swallow. Research has shown that using PET studies that there is an increase in the stimulated cortex, that may persist for an extended period of time^[180,181]. Although this has shown promise, at present it is not in clinical use.

Pharyngeal stimulation is undertaken by passing a nasal catheter into the pharynx that has an embedded electrode which pulse stimulates the pharynx, this provides cortical information via the parasympathetic system and as a consequence modifies the swallow/initiates a swallow. Fraser *et al*^[55] noted that 5 mHz stimulation for ten minutes produced a positive response in the cortico bulbar pathway, resulting in a reduction in pharyngeal transit times, reduction in swallow delay and response times, with a reduction in aspiration^[55]. Clinical trials are underway with a commercial

device (Phagynex trademark(TM) - Phagnesis). Swallowing is controlled bilaterally with asymmetrical cortical lateralisation; a stroke affecting the dominant swallowing hemisphere is likely to cause dysphagia^[30]. Two academic phase IIa randomised controlled trials (RCTs) have defined effective EPS dosing (5 Hz, 10 minutes daily for 3 days) and suggest that EPS reduces dysphagia using VF assessment^[55,180]. A provisional individual patient data meta-analysis of these three trials suggests that EPS is associated with improved radiological swallowing (assessed using VFS), reduced length of stay and improved functional outcome^[182].

Biofeedback

Biofeedback is a useful way of involving the patient in their rehabilitation. It works by providing the patient with a visual representation of progress, but not a representation of the swallow itself.

With swallowing, surface EMG has been used to provide this feedback. There is potential, but, as yet, has not reached routine clinical use. EMG can be measured in one of two ways, by surface recording or by an intramuscular needle. The use of needles is invasive, but provides feedback on a particular muscle; surface EMG, is easier and less invasive, but suffers from lack of specificity and repeatability. The lack of specificity is as a consequence of the signal detected at the skin is a summation of different muscles and back ground noise. There is also a risk regarding a lack of reproducibility secondary from the placement of the electrode which may not always be in exactly the same place.

The basis is that when the patient is swallowing, an EMG wave form is produced that the patient can see. With work the patient is able to modify the wave form. Huckerbee and Steele have had some positive results but more work is needed^[116,117].

Medication

As already stated, medication can have a negative impact on the ability to swallow. However, a few medications may be beneficial. These include Nifedipine MR^[183], ACE Inhibitors^[184-190], Banxia Houpo Tang^[190-192] and capsacian^[193,194]. It is possible that they all work by enhancing the synaptic levels of Substance P either in the nigral striatal system or the pharyngeal plexus^[34].

More recent work with novel compounds (TRV-1) have shown beneficial results^[195].

ETHICAL ISSUES

There are many difficult and contentious issues around the provision of nutrition. The main question is “whether to provide nutrition is appropriate or not?” Generally enteral nutrition is seen as a medical treatment. Consequently it can be stopped and started along the lines of any medical treatment^[196]. Consequently it has been suggested that, if there was doubt, a two week trial of enteral feeding should be attempted with outcomes monitored. The question that needs to be asked is this long enough and what improvements are expected in this time. What is clear is that no food equates, eventually, to no life. The decision to provide nutrition or not, must not be taken lightly, must be done and on individual case by case basis after full discussion with all parties involved including the patient if they are competent.

There are two further issues that frequently tax clinicians, firstly that of the person who wants to eat and drink, but whose swallow is unsafe and they are at high risk of aspiration. The compliance with instructions/ advice may depend on the food consistency, with less compliance being demonstrated with thickened fluids^[197]. Providing

the patient cognitively intact and is deemed to have mental capacity, and after explaining all the risks that eating and drinking entails, they should be allowed to eat and drink. If capacity is an issue, a similar discussion should be had with their representative/advocate.

The second scenario is of some one who is capable of swallowing and is able to meet their own needs but refuses to swallow. This case scenario is difficult and very burdensome on all formal and informal carers. Restraint and forced provision of nutrition will only work whilst it is being administered, with the original position rapidly returning. In a patient with mental capacity this is not an option in some countries (UK Mental Capacity Act)^[198].

The use of restraints is not encouraged, as frequently they do not influence the long-term outcome or prognosis of the patient. Where restraint is being used, it should be used for the minimum period of time after seeking legal advice.

Where possible, the person with swallowing difficulties should make the decision regarding swallowing and compliance. As part of the informed consent process and capacity is autonomy^[197]. In short a competent patient has the right of self-determination, so long as no one else is harmed^[199].

Who makes the decision and the appropriateness of a decision is always difficult. Although a proxy may have been appointed to make a medical decision, research has shown that there decision and that of the person they are acting for are, in the majority of cases, not congruent^[200].

What ever decisions are taken, it is essential that communication is paramount, to ensure that all carers (formal and informal) are aware of the plan of care; a framework may need to be implemented where the person and professionals do not agree on the best treatment.

SUMMARY

Swallowing problems following stroke are common and may be a direct result of the stroke or secondary to or exacerbated by medication or comorbid disease. Recovery is good in many but is persistent in a few. Rehabilitation techniques are improving and the future looks exciting. Complications are frequent but the most common are related to nutrition. More work is required here.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

REFERENCES

- 1 Eslick GD, Talley NJ. Dysphagia: epidemiology, risk factors and impact on quality of life- a population based study. *Alimentary Pharmacology and Therapeutics* 2008; **27**: 971-979
- 2 Miller AJ. Characteristics of the swallowing reflex induced by peripheral nerve and brainstem stimulation. *Exp Neurol* 1972; **34**: 210-222
- 3 Doty RW. Neural organization of Deglutition. In Code CF, editor. *Handbook of Physiology. Washington Dc: American Physiological Society* 1968; **4**:1861-18902
- 4 Smithard DG. Swallowing and Stroke. *Cerebrovascular Dis* 2002; **14**: 1-8
- 5 Palmer JB, Rudin NJ, LaraG, Crompton AW. Coordination of mastication and swallowing. *Dysphagia* 1992; **7**: 187-200
- 6 Dua KS, Ren J, Barden E, Shaker R. Coordination of deglutitive glottal function and pharyngeal transit during normal eating. *Gastroenterology* 1997; **112**: 75-83
- 7 Matsuo K, Hiemae KM, Gonzalez-Fernandez M, Palmer JB. Respiration during feeding on solid food: alterations in breathing during mastication, pharyngeal bolus aggregation, and swallowing. *J Appl Physiol* 2008; **104**: 674-681
- 8 Hirota N, Konaka K, Ono T, Tamine K, Kondo J, Hori K, Yoshimuta Y, Maeda Y, Sakoda S, Naritomi H. Reduced tongue pressure against the hard palate on the paralyzed side during swallowing predicts dysphagia in patients with acute stroke. *Stroke* 2010; **41**: 2982-2984
- 9 Daniels SK, Coney DM, Hadskey LD, Legendre C, Priestly DH, Rosenbek JC. Mechanism of sequential swallowing during straw drinking in healthy young and older adults. *J SLHR* 2004; **47**: 33-45
- 10 Chi-Fishman G, Sonies BC. Motor strategy in rapid sequential swallowing: new insights. *J Speech Lang Hear Res* 2000; **43**:1481-1492
- 11 Kendall KA, McKenzie S, Leonard RJ, Goncalves MI, Walker A. Timing of events in normal swallowing: a videofluoroscopic study. *Dysphagia* 2000; **15**: 74-83
- 12 Molfenter SM, Leigh C, Steele CM. Event sequence variability in healthy swallowing: building on previous findings. *Dysphagia* 2014; **29**: 234-242
- 13 Curtis DJ, Curesss DF. Videofluoroscopic identification of two types of swallowing. *Radiology* 1984; **152**:2:305-308
- 14 Borgström P, Ekberg O. Speed of peristalsis in pharyngeal constrictor muscles: Correlation to age. *Dysphagia* 1988; **2**: 140-144
- 15 Dantas RO, Kern MK, Massey BT, Dodds WJ, Kahrilas PJ, Bras-seur JG, Cook IJ, Lang IM. Effects of swallowed bolus variables on oral and pharyngeal phases of swallowing. *Am J Physiol* (Gastrointest. Liver Physiol. 21) G675-681
- 16 Normal and abnormal swallowing, Jones, B, Donner M. Eds. Springer-Verlag, New York ISBN 0-387-97347-8
- 17 Dozier TS, Brodsky MB, Michel Y, Walters B, Martin-Harris B. Coordination of swallowing and respiration in normal sequential cup swallows. *The Laryngoscope* 2006; **116**: 1489-1493
- 18 Martin-Harris B, Brodsky MB, Price CC, Michel Y, Walters B. Temporal coordination of pharyngeal and laryngeal dynamics with breathing during swallowing: single liquid swallows. *J Appl Physiol* 2003; **94**: 1735-1743
- 19 Miller JL, Watkin KL. Lateral pharyngeal wall motion during swallowing using real time ultrasound. *Dysphagia* 1997; **12**: 125-132
- 20 Logemann JA. Swallowing physiology and pathophysiology. *Otolaryngology Clinics of North America* 1983; **21**: 613-623
- 21 Baden E, Kern M, Arndorfer RC, Hofman C, Shaker R. Effects of aging on bolus kinematics during the pharyngeal phase of swallowing. *Am J Physiol Gastrointest Liver Physiol* 2006; **290**: G458-G465
- 22 Long I, Shaker R. An overview of the upper oesophageal sphincter. *Curr Gastroenterol Reports* 2000; **2**: 185-190
- 23 Car A, Jean A, Roman C. A pontine relay for ascending projections of the superior laryngeal nerve. *Exp Brain Res* 1975; **22**:197-210
- 24 Jean A. Brainstem control of swallowing: localization of the central pattern generator for swallowing. In Taylor A, editor. *Neurophysiology of the jaws and teeth*. London Macmillan Press, 1990: 294-321
- 25 Miller AJ. Characteristics of the swallowing reflex induced by peripheral nerve and brainstem stimulation. *Experimental Neurology* 1972; **34**: 210-222
- 26 Bastian RW, Riggs LC. Role of sensation in swallowing function. *Laryngoscope* 1999; **109**: 1974-1977
- 27 Dodds WJ. The physiology of swallowing. *Dysphagia* 1989; **3**: 171-178
- 28 Hamdy S, Aziz Q, Rothwell JC, Hobson A, Barlow J, Thompson DG. Cranial nerve modulation of human cortical swallowing motor pathways. *Am J Physiol (Gastrointest Liver Physiol)* 1997; **272**: G802-G808

- 29 Mosier K, Patel R, Liu W-C, Kalnin A, Maldjian J, Baredes S. Cortical representation of swallowing in normal adults: Functional implications. *Laryngoscope* 1999; **109**: 1417-1423
- 30 Hamdy S, Aziz Q, Rothwell JC, Singh KD, Barlow J, Hughes DG, Tallis RC, Thompson DG. The cortical topography of swallowing musculature in health and disease. *Nature Medicine* 1996; **2**: 1217-1224
- 31 Kern MK, Jaradeh S, Armdorfer RC, Shaker R. Cerebral cortical representation of reflexic and volitional swallow in humans. *Am J Physiol* 2001; **280**: G354-360
- 32 Martin R, Goodyear BG, Gati JS, Menon RS. Cerebral cortical representation of automatic and volitional swallowing in humans. *J Neurophysiol* 2000; **85**: 938-950
- 33 Graybiel AM Neurotransmitters and neuromodulators in the basal ganglia. *Trends Neurosci* 1990; **13**:244-254
- 34 Smithard DG, Substance P. swallowing after stroke. *Therapy* 2006; **3**: 291-298
- 35 Selley WG, Flack FC, Ellis RE, Brooks WA. Respiratory patterns associated with swallowing: Part1; The normal adult pattern and changes with age. *Age and Ageing* 1989; **8**: 168-172.
- 36 Hiss SG, Treole K, Stuart A. Effects of age, gender, bolus volume, and trial on swallowing apnea duration and swallow/ respiratory phase relationships of normal adults. East Carolina University
- 37 Ardran GM, Kemp FH. The protection of the laryngeal airway during swallowing. *BR J Radiol* 1952; **25**: 406-416
- 38 Sawzuck A, Mosier KM. Neural control of tongue movement with respect to respiration and swallowing. *CORBM* 2001; **12**: 18-37
- 39 Reginelli A, Pezzullo MG, Scaglione M, Scialpi M, Brunese L, Grassi R. Gastrointestinal disorders in elderly patients. *Radio Clin of N America* 2008; **46**: 755-771
- 40 The atlas of heart disease and stroke. WHO http://www.who.int/cardiovascular_diseases/resources/atlas/en/
- 41 Adams HP, Bendixen BH, Kappelle LJ, Biller J, Lowe BB, Gordon DL, Marsh EE. Classification of subtype of acute ischaemic stroke. Definitions used for a clinical trial. TOAST. Trial of ORG 10172 in Acute Stroke Treatment. *Stroke* 1993; **24**: 35-41
- 42 Bamford J, Sandercock P, Dennis M, Warlow C, Burn J. Classification and natural history of clinically identifiable subtypes of cerebral infarction. *Lancet* 1991; **337**: 1521-1526
- 43 Ginocchio D, Borghi E, Shindler A. Dysphagia assessment in the elderly. *Nutritional therapy and metabolism* 2009; **27**: 9-15
- 44 Lelsie P, Drinnan MJ, Ford GA, Wilson JA. Swallow respiratory patterns and ageing: presbyphagia or dysphagia? *J Gerontol Med Sci* 2005; **3**: 391-395
- 45 Walls AW. Oral health and Nutrition. *Age and Ageing* 1999; **28**: 419-420
- 46 Mann G, Hankey J, Cameron D. Swallowing function after stroke. *Stroke* 1999; **30**: 744-748
- 47 Gordon C, Hewer RL, Wade DT. Dysphagia in acute stroke. *BMJ* 1987; **295**: 411-414
- 48 Martino R, Foley N, Bhogel S, Diamant N, Speechley M, Teasell R. Dysphagia after stroke. Incidence, diagnosis and pulmonary complications. *Stroke* 2005; **36**: 2756-2763
- 49 Smithard DG, O'Neill PA, Park C, Morris J, Wyatt R, England R, Martin DF. Complications and outcome following acute stroke: does dysphagia matter? *Stroke* 1996; **27**:1200-1204
- 50 Smithard DG, O'Neill PA, England RE, Park CL, Wyatt R, Martin DF, Morris J. The Natural History of Dysphagia Following stroke. *Dysphagia* 1997; **12**: 188-193
- 51 Mann G, Hankey GJ, Cameron D. Swallowing function after stroke: Prognosis and prognostic factors at six months. *Stroke* 1999; **30**: 744-748
- 52 Hamdy S. The organization and re-organisation of human swallowing motor cortex. *Supplements to Clin Neurophysiol* 2003; **56**: 204-210
- 53 Martin RE. Neuroplasticity and swallowing. *Dysphagia* 2009; **24**: 218-229
- 54 Barritt AW, Smithard DG Role of cerebral cortex plasticity in the recovery of swallowing function following dysphagic stroke. *Dysphagia* 2009; **24**: 83-90
- 55 Fraser C, Power m, Hamdy S, Rothwell J, Hobday D, Hollander I, Tyrell P, Hobson A, Williams S, Thompson D. Driving plasticity in human adult motor cortex is associated with improved motor function after brain injury. *Neuron* 2002; **34**: 831-840
- 56 Hamdy S, Mikulis DJ, Crawley A, Xue S, Lau H, Henry S, Diamant NE. Cortical activation during human volitional swallowing; an event related fMRI study. *Am J Physiol (Gastrointest Liver Physiol)* 1999; **277**: G219-G225
- 57 Lim SHB, Lieu PK, Phua DY, Seshadri R, Venketasubramanian, Lee SH, Choo WJ. Examination of swallowing (FEES) in determining the risk of aspiration in acute stroke patients. *Dysphagia* 2001; **16**: 1-6
- 58 Colodny N. Endoscopic evaluation of swallowing (FEES) using the penetration-aspiration scale: a replication study. *Dysphagia* 2002; **17**: 308-315
- 59 Leder SB, Acton LM, Lisitano HL, Murray JT. Fiberoptic endoscopic evaluation of swallowing (FEES) with and without blue stained food. *Dysphagia* 2005; **20**: 157-162
- 60 Lichter I, Muir RC. The pattern of swallowing during sleep. *Electroencephalography and clinical neurophysiology* 1975; **38**: 427-432
- 61 Sato K, Nakashima T. Human deglutition during sleep. *Ann Otol Rhinol* 2006; **115**: 334-339
- 62 Horner J, Massey EW. Silent aspiration following stroke. *Neurology* 1998; **38**: 317-319
- 63 Ramsey DJC, Smithard DG, Kalra L. Silent Aspiration: what do we know? *Dysphagia* 2005; **20**:218-225
- 64 Holas MA, DePippo KL, Reding MJ. Aspiration and relative risk of medical complications following stroke. *Archives of Neurology* 1994; **51**: 051-1053
- 65 Schmidt J, Holas M, HalvorsonK, Reding,M. Videofluoroscopic evidence of aspiration predicts pneumonia and death but not dehydration. *Dysphagia* 1994; **9**: 7-11
- 66 Smithard DG, Smeeton NC, Wolfe CD. Long-term outcome after stroke: does dysphagia matter? *Age and Ageing* 2007; **36(1)**: 90-94
- 67 SIGN: Management of patients with stroke: identification and management of dysphagia. A national clinical guideline 2010
- 68 Summers D, Leonard A, Wentworth D, Saver JL, Simpson J, Spiker JA, Hock N, Miller E, Mitchell PH. Comprehensive overview of nursing and interdisciplinary care of the acute ischaemic stroke patient: A scientific statement from the American Heart Association. *Stroke* 2009; **40**: 2911-2944
- 69 Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S. Formal dysphagia screening protocols prevent pneumonia. *Stroke* 2005; **26**: 1972-1976
- 70 Donovan NJ, Daniels SK, Edmiston J, Weinhardt J, Summers D, Mitchell PH. Dysphagia screening: State of the art. *Stroke* 2013; **44**: e24-e31
- 71 Ramsey DJC, Smithard DG, Kalra L. Early assessments of dysphagia and aspiration risk in acute stroke. *Stroke* 2003; **34**: 1252-1257
- 72 Bravata DM, Wells CK, Lo AC, Nadeau SE, Melillo J, Chodkowski D, Struve F, Williams LS, Peixoto AJ, Gorman M, Goel P, Acompora G, McClain V, Ranjbar N, Tabewreaux PB, Boice JL, Jacewicz M, Concato J. Process of care associated outcomes. *Arch Intern Med* 2010; **170**: 804-810
- 73 Regan J, Walshe M, McMahon BP. Current evaluation of upper oesophageal sphincter opening in dysphagia: an international SLT survey. *Int J Lang Commun Disord* 2012; **47**: 156-165
- 74 Smithard DG, Fairfield CA, Roffe c, Gosney M. The Management of Dysphagia in Acute Stroke: A Questionnaire pilot study. 22nd Conference, London, May 2013: Abstract e-Book. http://www.karger.com/CED_2013_035_S3

- 75 Nathadwarawala KM, Nicklin J, Wiles CM. A timed test of swallowing capacity for neurological patients. *Journal of Neurology Neurosurgery and Psychiatry* 1992; **55**: 822-855
- 76 Clavé P, Arreola V, Romea M, Medina L, Palomera E, Serra-Prat M. Curacy of the volume-viscosity swallow test for clinical screening of oro-pharyngeal dysphagia and aspiration. *Clin Nutr* 2008; **27**: 806-815
- 77 Martino R, Silver F, Teasell, Bayley M, Nicholason G, Streiner DL, Diamant NE. The Toronto bedside swallowing screening Test (TOR_BSST) *Stroke* 2009; **40**: 555-561
- 78 Trapl M, Enderle P, Nowotny M, Teuschl Y, Matz K, Dachenhausen, Brainin M. Dysphagia Bedside Screening for acute stroke patients: The Gugging swallow screen. *Stroke* 2007; **38**: 2948-2952
- 79 DePippo KL, Holas MA, RedingMJ. Validation of the 3 oz water swallow test for aspiration following stroke. *Archives of Neurology* 1992; **49**: 1259-1261
- 80 Speyer R, Baijens L, Haijen M, Zwijnenberg I. Effects of therapy in oropharyngeal dysphagia by speech and language therapists: A systematic review. *Dysphagia* 2010; **25**: 40-65
- 81 Antomius N, Carnaby-Mann G, Crary M, Miller L, Hubbard H, Hood K, Sambandam R, Xavier A, Silliman S. Analysis of a physician tool for evaluating dysphagia on an inpatient stroke unit: the modified Mann assessment of swallowing ability. *J Stroke and Cerebrovasc Dis* 2010; **1**: 49-57
- 82 Edmiaston J, Connor LT, Loehr L, Nassief A. Validation of a dysphagia screening tool in acute stroke patients. *Am J Crit Care* 2010; **19**: 357-364
- 83 Smithard D G, O'Neill PA, Park C, England R, Renwick RS, Wyatt R, Morris J, Martin DF. Can bedside assessment reliably exclude aspiration following acute stroke? *Age and Ageing* 1998; **27**: 99-106
- 84 Smithard,D.G., Rukker,C., Bath,P. Jenkinson,M. and Potter,J. Absent gag, unable to swallow? *Age and Ageing* 1996; **25**(S2): P11(26)
- 85 Davies AE, Kidd D, Stone SP, MacMahon J. Pharyngeal sensation and gag reflex in healthy subjects. *Lancet* 1995; **345**: 487-488
- 86 Ramsey D, Smithard D, Donaldson N, Kalra K. Is the gag reflex useful in the management of swallowing problems in acute stroke? *Dysphagia* 2005; **20**: 105-107
- 87 Leder,S.B. Gag reflex and dysphagia. *Head and Neck* 1996; **18**: 138-141
- 88 Haraf F, Polkey M, Smithard D, Moxham J, Kalra L. Respiratory muscle weakness and aspiration in acute stroke patients. International Stroke Conference 2005, New Orleans, LA, USA, February 2-4, 2005
- 89 Collins M J, Bakheit AM. Does pulse oximetry reliably detect aspiration in dysphagic stroke patients. *Stroke* 1997; **28**(9): 1773-1775
- 90 Ramsey DJC, Smithard DG, Kalra L. Can pulse oximetry or a bedside swallowing assessment be used to detect aspiration after stroke? *Stroke* 2006; **37**: 2984-2988
- 91 Smith,H.A., Lee,S.H., O'Neill,P.A. and Connolly,M.J. Oxygen desaturation on swallowing plus speech and language therapy swallow assessment improves prediction of penetration and aspiration in acute stroke. *Age and Ageing* 1999; **28**(S1): 98
- 92 Sherman B. Nisenbom JM, Jesberger BL, Morrow CA, Jesberger JA. Assessment of dysphagia with the use of pulse oximetry. *Dysphagia* 1999; **14**:152-156.
- 93 Borr C, Hielscher-Fastabend M, Lücking A. Reliability and validity of cervical auscultation. *Dysphagia* 2007; **22**: 225-234
- 94 Chichero JAY, Murdock B. Detection of swallowing sounds: Methodology revisited. *Dysphagia* 2002; **17**: 40-49
- 95 Bateman C, Leslie P, Drinnan M. Adult dysphagia Assessment in the UK and Ireland: Are SLTs Assessing the same factors? *Dysphagia* 2007; **22**: 174-186
- 96 Zenner PM, Losinski DS, Mills RH. Using cervical auscultation in the clinical dysphagia examination in long-term care. *Dysphagia* 1995; **10**: 27-31
- 97 Hamlet S, Penney DG, Formolo J. Stethoscope acoustics and cervical auscultation of swallowing. *Dysphagia* 1994; **9**: 63-68
- 98 Balasubramaniam RK, Baht JS. Cervical auscultation review. *Advances in Life Science and Technology* 2012; **6** (on Line)
- 99 Addington,W.R., Stephens,R.E. and Gilliland,K.A. Assessing the laryngeal cough reflex and the risk of developing pneumonia after stroke. *Stroke* 1999; **30**: 1203-1207
- 100 Addington WA, Stephens RE, GillilandK, Rodriguez M. Assessing the laryngeal cough reflex and the risk of developing pneumonia after stroke. *Arch Phys Med Rehabil* 1999; **80**: 150-154
- 101 Aviv JE. Kim T, Thomas JE, Sunshine S, Kaplan S, Close LG. Fiberoptic endoscopic evaluation of swallowing with sensory testing (FEEST) in health controls. *Dysphagia* 1998; **13**: 87-92.
- 102 Aviv JE, Martin JH, Keen MS, Debell M, Blitzer A. Air pulse quantification of supraglottic and pharyngeal sensation: a new technique. *Ann Otol Rhinol Laryngol* 1993; **102**: 777-780
- 103 European Society for Swallowing Disorders Position Statement. *Dysphagia* 2013; **28**: 280-335
- 104 Serra-Prat M, Palomera M, Gomez C, Sar-Shalom D, Saz A, Montoya JG, Navayas M, Palomera E, Calve P. Oropharyngeal dysphagia as a risk factor for malnutrition and lower respiratory tract infection in independently living older persons: a population-based prospective study. *Age and Ageing* 2012; **41**: 376-381
- 105 Splaingard ML, Hutchins B, Sulton LD, Chaudhuri G Aspiration in rehabilitation patients: videofluoroscopy vs bedside clinical assessment. *Archives of Physical Medicine and Rehabilitation* 1988; **69**: 637-640
- 106 Palmer JB, Kuhlemeier, Tippett, Lynch C. A protocol for the videofluorographic swallowing study. *Dysphagia* 1983; **8**: 209-214
- 107 Scott A, Perry A, Bench J. A study of interrater reliability when using videofluoroscopy as an assessment of swallowing. *Dysphagia* 1998; **13**: 223-227
- 108 Langmore SE, Schatz K, Olson N Endoscopic and videofluoroscopic evaluations of swallowing and aspiration. *The Annals of Otolaryngology, Rhinology, and Laryngology* 1991; **100**: 678-681
- 109 Kelly AM, Drinan MJ, Lelsie P. Assessing penetration and aspiration: How do videofluoroscopy and fibre optic endoscopic evaluation of swallowing compare? *The Laryngoscope* 2007; **117**: 1723-1727
- 110 Bülow M, Olsson R, Ekberg O. Videomanometric analysis of supraglottic swallow, effortful swallow, and chin tuck in health volunteers. *Dysphagia* 1999; **14**: 67-72
- 111 Rosenbeck JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. *Dysphagia* 1996; **11**: 93-98
- 112 Watkin KL. Ultrasound and swallowing. *Folia Phoniatrica et Logopedica* 1999; **51**: 199-212
- 113 Fanucci A, Cerro P, Diotallevi P, Letto F, Metastasio F. The echographic visualisation of the lingual bolus. *The reference point in a study of dysphagia Radiologica Medica* 1992; **83**: 74-75
- 114 Sonies,B.C. Ultrasound imaging and swallowing in Jones B. and Donner,M.W. Normal and abnormal swallowing. Imaging in diagnosis and therapy. Springer-Verlag. New York. 1991
- 115 Cappabianca S, Reginelli A, Monaco L, Del Vexhio L, Di Martino N, Grassi R. Combined videofluoroscopy and manometry in the diagnosis of oropharyngeal dysphagia: examination technique and preliminary experience. *Radiol med* 2008; **113**: 923-940
- 116 Steele CM, Bennett JW, Chapman-Jay S, Polacco RC, Molfenter SM, Oshalla M. Electromyography as a biofeedback tool for rehabilitating swallow muscle function. 2012 www.intechopen.com
- 117 Huckabee, ML, Steele, CM An Analysis of Lingual Contribution to Submental sEMG Measures and Pharyngeal Biomechanics during Effortful Swallow. *Archives of Physical Medicine and Rehabilitation* 2006; **8**: 1067-1072

- 118 Sifrim D, Castell D, Dent J. Gastro-oesophageal reflux monitoring: review and consensus report on detection and definitions of acid, non acid and gas reflux. *Gut* 2004; **53**: 1024-1031
- 119 Balan KK, Vinjamin S, Maltby P, Bennett J, Woods S, Playfer JR, Critchley M. Gastroesophageal reflux inpatients fed by percutaneous endoscopic gastrostomy (PEG): detection by a simple scintigraphic method. *Am. J. Gastroenterol* 1998; **93**: 946-949
- 120 Gosney M, Martin MV, Wright AE. The role of selective decontamination of the digestive tract in acute stroke. *Age and Ageing* 2006; **35**: 42-47
- 121 Millins B, Gosney M, Jack CIA, Martin MV, Wright AE. Acute stroke predisposes to oral gram negative bacilli- a cause of aspiration pneumonia. *Gerontology* 2003; **49**: 17
- 122 Terpenning MS, Taylor GW, Lopatin DE, Kerr CK, Dominguez BL, Loesche WJ. Aspiration pneumonia: dental and oral risk factors in an older veteran population. *J Am Geriatr Soc* 2001; **49**(5): 557-633-176
- 123 Brady MC, Furlanetto D, Hunter R, Lewis SC, Milne V. Staff led interventions for improving oral hygiene in patients following stroke (Review) The Cochrane Library 2011, Issue 7 <http://www.thecochranelibrary.com>
- 124 Van de Beek D, Wijidicks EFM, Vermeij FH, de Haan RJ, Prins JM, Spanjaard L, Dippel DWJ, Nederkoom PJ. Preventive antibiotics for infections in acute stroke. A systematic review and meta analysis. *Arch Neurol* 2009; **66**: 1076-1081
- 125 McCullough G, Pelleteir C, Steele C. National dysphagia diet: what to swallow? *The ASHA Leader* 2003; **4**
- 126 Crary MA, Carnaby-Mann G, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. *Arch Phys Med Rehabil* 2005; **36**: 1516-1520
- 127 Crary MA, Humphrey JL, Carnaby-Mann G, Sambandam R, Miller L, Silliman S. Dysphagia, nutrition and hydration in ischaemic stroke at admission and discharge from acute care. *Dysphagia* 2013; **28**: 69-76
- 128 Dávalos A, Ricart W, Gonzalez-Huix F, Soler S, Marrugat J, Molins A, Suñer R, Genís D. Effect of malnutrition after acute stroke on clinical outcome. *Stroke* 1996; **27**: 1082-1032
- 129 Weeke E, Elia M. Resting energy expenditure and body composition following cerebro-vascular accident. *Clinical Nutrition* 1992; **11**: 18-22
- 130 Aguilar-Nascimento JE de, Silveira BRP, Dock-Nascimento DB. Early enteral nutrition with whey protein or casein in elderly patients with acute ischaemic stroke: a double blind randomized trial. *Nutrition* 2011; **27**: 440-444
- 131 Woo J, Ho SC, Mak YT, Law LK, Cheung A. Nutritional status of elderly patients during recovery from chest infection and the role of nutritional supplementation assessed by a prospective randomised single blind trial. *Age and Ageing* 1994; **23**: 40-48
- 132 Neuman, S. Swallowing therapy and neurologic patients: Results of direct and indirect therapy methods in 66 patients suffering from neurological disorders. *Dysphagia* 1993; **8**: 150-153
- 133 The FOOD Trial Collaboration. Routine oral nutritional supplementation for stroke patients in hospital (FOOD): a multicentre randomized controlled trial. *Lancet* 2005; **365**: 755-763
- 134 Stranga Z, Brunner A, Leuenerberger M, Grimble RF, Shenkin A, Allison SP, Lobo DN. Nutrition in clinical practice – the refeeding syndrome: illustrative cases and guidelines for prevention and treatment. *Eur J Clin Nutr* 2008; **62**: 687-694
- 135 Garibella, S.E., Parker, S.G., Taub, N. and Castleden, C.M. A randomized, controlled, single-blind trial of nutritional supplementation after acute stroke. *J Parenter Enteral Nutr* 1998; **22**: 315-319
- 136 Rabadi MH, Coar PL, Lukin M, Lesser M, Blass JP. Intensive nutritional supplements can improve outcomes in stroke rehabilitation. *Neurology* 2008; **71**: 1856-1861
- 137 Challiner YC, Jarrett D, Hayward MJ, al-Jubouri MA, Julios SA. A comparison of intravenous and subcutaneous hydration in elderly acute stroke patients. *Postgrad Med J* 1994; **70**: 195-197
- 138 Affoo R. Critical Review: Does consumption of thickened fluids increase the risk of dehydration in post-stroke patients. Thesis: School of Communication Sciences and Disorders U.W.O. 2008
- 139 Sparks DA, Chase DM, Coughlin, Perry E. Pulmonary complications of 9931 Narrow-bore nasoenteric tubes during blind placement: A critical review. *J Parenteral and Enteral Nut* 2011; **35**: 625-629
- 140 Krenitsky J. Blind bedside placement of feeding tubes: Treatment or threat. *Pract Gastroenterol* 2011; **March**: 32-42
- 141 Gray R, Tynan C, Reed L, Hasse J, Kramlich M, Roberts S, Suneson J, Thompson J, Neylon J. Bedside electromagnetic-guided feeding tube placement: an improvement over traditional placement technique? *Nutrition in Clinical Practice* 2007; **22**: 436-444
- 142 Park RHR, Allison MC, Lang J, Spence E, Morris AJ, Danesh BJZ, Russell RI, Mills PR. Randomised comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding in patients with persisting neurological dysphagia. *BMJ* 1992; **304**: 1406-1409
- 143 Bevan J, Conroy SP, Harwood R, Gladman JRF, Leonardi-Bee J, Sach T, Bowling T, Sunman W, Gaynor C. Does looped nasogastric tube feed improve nutritional delivery for patients with dysphagia after acute stroke? A randomised controlled trial. *Age and Ageing* 2010; **39**: 624-630
- 144 Dziewas R, Warnecke T, Hamacher C, Oelenberg S, Teismann I, Kraemer C, Ritter M, Ringelstein EB, Schaebitz. Do nasogastric tubes worsen dysphagia in patients with acute stroke? *BMC Neurology* 2008; **8**: 28 doi:10.1186/1471-2377-8-28
- 145 Wang TG, Wu MC, Chang YC, Hsiao TY, Lien IN. The effect of nasogastric tubes on swallowing function in persons with dysphagia following stroke. *Arch Phys Med Rehabil* 2006; **87**: 1270-1273
- 146 Langdon PC, Lee AH, Binns CW. High incidence of respiratory infections in “nil by mouth” tube-fed acute ischaemic stroke patients. *Neuroepidemiology* 2009; **32**: 107-113
- 147 Anderson MR, O'Connor M, Mayer P, O'Mahoney D, Woodward J, Kane K. The nasal loop provides an alternative to percutaneous endoscopic gastrostomy in high risk dysphagic patients. *Clin Nutr* 2004; **23**: 501-506
- 148 O'Mahony D, McIntyre AS. Artificial feeding for elderly patients after stroke. *Age and Ageing* 1995; **24**: 533-535
- 149 Nyswonger, G.D. and Helmechen, R.H. Early enteral nutrition and length of stay in stroke patients. *Journal of Neuroscience Nursing* 1992; **24**: 220-223
- 150 Norton, B., Homer-Ward, M., Donnelly, M.T., Long, R.G. and Holms, G.K.T. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after dysphagic stroke. *British Medical Journal* 1996; **312**: 13-16
- 151 Finucane TE, Bynum JPW. Use of tube feeding to prevent aspiration pneumonia. *Lancet* 1996; **348**: 1421-1424
- 152 James A, Kapur K, Hawthorne AB. Long-term outcome of percutaneous endoscopic gastrostomy feeding in patients with dysphagic stroke. *Age and Aging* 1999; **27**: 671-676
- 153 Ha L, Hauge T. Percutaneous endoscopic gastrostomy (PEG) for enteral nutrition in patients with stroke. *Scand J Gastroenterol* 2003; **38**: 962-966
- 154 H.-U. Laasch L, Wilbrahama, K, Bullenb, A, Marriotta, J.A.L. Lawrancec, R.J. Johnsonc, S.H. Leed, R.E. Englanda, G.E. Gamblee, D.F. Martin Gastrostomy Insertion: Comparing the Options—PEG, RIG or PIG? *Clinical Radiology* 2003; **58**: 398-405
- 155 Gomes Jr CAR, Lustosa SAS, Matos D, Andriolo RB, Waisberg DR, Waisberg J. Percutaneous endoscopic gastrostomy versus

- nasogastric tube feeding for adults with swallowing disturbances (Review). *The Cochrane Library* 2010; **11**. <http://www.thecochranelibrary.com>
- 156 Martin-Harris B. Coordination of respiration and swallowing. *GI Motility online* (2006) doi:10.1038/gimo10. Downloaded 18.06.2014.
 - 157 Clavé P, De Kraa M, Arreola V, Girvent M, Farré R, Palomera E, Serra-Prat M. The effect of bolus viscosity on swallowing function in neurogenic dysphagia. *Alimentary Pharmacology and Therapeutics* 2006; **24**: 1385-1394
 - 158 Wright L, Cotter D, Hickson M, Frost G. Comparison of energy and protein intakes of older people consuming a textured modified diet with a normal hospital diet. *J Human Nutrition and Dietetics* 2005; **18**: 213-219
 - 159 Whelan K. Inadequate fluid intakes in dysphagic acute stroke. *Clin Nutr* 2001; **20**: 423-428
 - 160 Cichero JAY. Tickening agents used for dysphagia management: effect of bioavailability of water, medication and feels of satiety. *Nutrition J* 2013; **12**: 54 <http://www.nutritionj.com/content/12/1/54>
 - 161 Hansen B, O'Leary MT, Smith CH. The effect of saliva on the viscosity of thickened fluids. *Dysphagia* 2012; **27**: 10-19
 - 162 Nilsson H, Ekberg O, Bülow M, Hindfelt B. Assessment of respiration during videofluoroscopy of dysphagic patients. *Academic Radiology* 1997; **4**: 503-507
 - 163 Hoffman MR, Mielens JD, Ciucci MR. High-resolution manometry of pharyngeal swallow pressure events associated with effortful swallow and the Mendelsohn maneuver. *Dysphagia* 2012; **27**: 418-426
 - 164 Hori K, Tamine K, Barbezat C, Maeda Y, Yamori M, Muller F, Ono T. Influence of Chin-down posture on tongue pressure during dry swallow and bolus swallows in healthy subjects. *Dysphagia* 2011; **26**: 2238-245.
 - 165 McCullogh TM, Hoffman MR, Ciucci MR. High resolution manometry of pharyngeal swallow pressure events associated with head turn and chin tuck. *Ann Otol Rhinol Laryngol* 2010; **119**: 369-376
 - 166 Terre R, Mearin F. Effectiveness of chin-down posture to prevent tracheal aspiration in dysphagia secondary to acquired brain injury. A videofluoroscopic study. *Neurogastroenterology & Motility* 2012; **24**: 414-419
 - 167 Ashford J, McCabe D, Wheeler-Hegland K, Frymark T, Mullen R, Musson N, Schooling T, Hammond CS. Evidence based systematic review: Oropharyngeal dysphagia behavioural treatments. Part III – Impact of dysphagia treatments on populations with neurological disorders. *JRRD* 2009; **46**: 195-204
 - 168 Yoon WL, Khoo JKP, Liow SJR. Chin tuck against resistance (CTAR): New method for enhancing suprahyoid muscle activity using a Shaker-type exercise. *Dysphagia* 2014; **29**: 243-248
 - 169 Shaker R, Kern M, Bardan E, Taylor A, Stewart ET, Hoffman RG, Arndorfer RC, Hofmann C, Bonnevier J. Augmentation of deglutitive upper esophageal sphincter opening in the elderly by exercise. *AJP. Gastrointestinal and Liver Pathology* 1997; **272**: G1518-G1522
 - 170 Carnaby-Mann GD, Crary MA. McNeill dysphagia therapy programme: a case controlled study. *Arc Phys Med Rehabil* 2010; **91**: 743-749
 - 171 Burkhead LM, Sapienza CM, Rosenbeck JC. Strength-training exercise in dysphagia rehabilitation: principles, procedures, and directions for future research. *Dysphagia* 2007; **11**: 251-265
 - 172 Lazzara G de L, Lazarus CL, Logemann JA. Impact of thermal stimulation on the triggering of the swallow reflex. *Dysphagia* 1986; **1**: 73-77
 - 173 Power M, Fraser CH, Hobson A, Singh S, Tyrrell P, Nicholson DA, Turnbull I, Thompson DG, Hamdy S. Evaluating oral stimulation as a treatment for dysphagia after stroke. *Dysphagia* 2006; **1**: 45-55
 - 174 Freed ML, Freed L, Chatburn RL, Christian M. Electrical stimulation for swallowing disorders caused by stroke. *Respiratory Care* 2001; **46**: 466-474
 - 175 Langdon C, Blacker D. Dysphagia in stroke: A new solution. *Stroke Research and Treatment*. 2010; 570403 (on line) doi:10.4061/2010/570403.
 - 176 Carnaby-Mann GD, Crary MA. Examining the evidence on neuromuscular electrical stimulation for swallowing. *Arch Otolaryngol Head Neck Surg* 2007; **133**: 564-571
 - 177 Gallas S, Marie JP, Leroi AM, Verin E. Sensory transcutaneous electrical stimulation improves post stroke dysphagia patients. *Dysphagia* 2010; **25**: 291-297
 - 178 Ludlow CL. Effects of surface electrical stimulation both at rest and during swallowing in chronic pharyngeal dysphagia. 13th Annual Scientific Meeting of the Dysphagia Research Society. Montreal, Que., Canada, October 14-16, 2004
 - 179 Ludlow CL, Humbert I, Saxon K, Poletto, Sonies B, Crujido L. Effects of surface electrical stimulation both at rest and during swallowing in chronic pharyngeal dysphagia. *Dysphagia* 2007; **22**: 1-10
 - 180 Jayasekeran V, Singh S, Tyrrell P, Michou E, Jefferson S, Mistry S, Gamble E, Rothwell J, Thomson D, Hamdy S. Adjunctive functional pharyngeal electrical stimulation reverses swallowing disability after brain lesions. *Gastroenterology* 2010; **138**: 1737
 - 181 Hamdy S, Rothwell JC, Brooks DJ, Baily D, Aziz Q, Thompson DG. Identification of the cerebral loci processing human swallowing with H2 15O PET activation. *J Neurophysiol* 1999; **81**: 1917-1926
 - 182 Hamdy S, Rothwell JC, Aziz Q, Thompson DG. Organisation and reorganization of human swallowing motor cortex; implications for recovery after stroke. *Clin Sci* 2000; **98**: 151-157
 - 183 Perez I, Smithard DG, Davies H, Kalra L. Pharmacological treatment of dysphagia in stroke. *Dysphagia* 2013; **12**: 691-698.
 - 184 Sekizawa K, Matsui T, Nakagawa T, Nakayama K, Sasaki H. ACE Inhibitors and pneumonia. *Lancet* 1998; **352**: 1069
 - 185 Marik PE and Kaplan D. Aspiration pneumonia and dysphagia in the elderly. *Chest* 2003; **124**: 328-336
 - 186 Sekizawa K, Ujiie Y, Itabashi S, Sasaki H, Takishima T. Lack of cough reflex in aspiration pneumonia. *Lancet* 1990; **335**: 1228-1229
 - 187 Nakajoh K, Nakagawa T, Sekizawa K, Matsui T, Arai H, Sasaki H. Relation between incidence of pneumonia and protective reflexes in post stroke patients with oral or tube feeding. *J Intern Med* 2000; **247**: 39-42
 - 188 Arai T, Yasuda Y, Takaya T, Toshima S, Kashiki Y, Yoshimi N, Fujiwara H. ACE inhibitors and symptomless dysphagia. *Lancet* 1998 **352**: 115-116
 - 189 Arai T, Yasuda Y, Takaya T, Toshima S, Kashiki Y, Yoshimi N, Fujiwara H. ACE inhibitors and symptomless dysphagia. *Chest* 2000; **117**: 1819-1820
 - 190 Tomaki M, Ichinose M, Miura M, Hirayama Y, Kageyama N, Yamauchi H and Shirato K. Angiotensin converting enzyme (ACE) inhibitor-induced cough and substance P. *Thorax* 1996 **51**: 199-201
 - 191 Iwasaki K, Wang Q, Seki H, Satoh K, Takeda A, Arai H, Sasaki H. The effects of the traditional Chinese medicine, “Banxia Houpo Tang (Hange-Koboku To) on the swallowing reflex in Parkinson's disease. *Phytomedicine* 200; **7(4)**: 259-263
 - 192 Kanda A, Ebihara S, Yasuda H, Takashi O, Sasaki T, Sasaki H A combination therapy for pneumonia in elderly people. *JAGS* 2004; **52**: 846-847
 - 193 Ebihara T, Takahashi H, Ebihara S, Okazaki T, Sasaki T, Watando A, Nemoto M, Sasaki H. Capsaicin troche for swallowing dysfunction in older people. *J American Geriatrics Society* 2005; **53(5)**: 824-828
 - 194 Rofes L, Arreola, Martin A, Clavé P. Natural Capsaicinoids improve swallow response in older patients with oropharyngeal dysphagia. *Gut* [gutjnl-2011-300753v1](http://gut.bmj.com/lookup/doi/10.1136/gut.2011.230753) 62/9/1280

- 195 Rofes L, Arreola V, Martin A, Clavé P. Effect of oral Piperine on the swallow response of patients with oropharyngeal dysphagia. *J Gastroenterol* December 2013 DOI 10.007/s005335-01300920-0
- 196 Raffin A. Ethics and withdrawal of life support in JF Murray and JA Nadel (Eds). Philadelphia: WB Saunders Co.
- 197 Kaizer F, Spiridigliozzi AM, Hunt MR. Promoting shared decision-making in rehabilitation: Development of a framework when patients with dysphagia refuse diet modification recommended by the treatment team. *Dysphagia* 2012; **27**: 81-87
- 198 Mental Capacity Act 2005. HMSO London http://www.legislation.gov.uk/ukpga/2005/9/pdfs/ukpga_20050009_en.pdf
- 199 Badger J, Ladd RE, Adler P. Respecting patient autonomy versus protecting the patient's health: a dilemma for healthcare providers. *JONA's Healthcare Law, Ethics & Regulation* 2009; **11**: 120-124
- 200 Wagner LCB. Exploring complications of advance directives and the obligations of a rehabilitation team. *Top Stroke Rehabil* 2001; **8**: 56-59

Peer reviewer: Heather Shaw Bonilha Ph.D., CCC-SLP, Associate Professor, Dept of Health Sciences & Research, College of Health Professions, Medical University of South Carolina, 77 President St. MSC 700, the United States; Gary H. McCullough, Ph.D., CCC-SLP, Interim Dean, The Graduate School, Professor, Communication Sciences & Disorders, University of Central Arkansas, 201 Donaghey Avenue, Torreyson West 328, Conway, AR 72035-0001, the United States; Ebru Karaca Umay, MD, Associate Professor, Ankara Diskapi Yildirim Beyazit Education and Research Hospital, Ankara, Turkey.