
REVIEW

Evidence-based Measures for Preventing Aspiration Pneumonia in Patients with Dysphagia

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ABSTRACT

Dysphagia increases the risk of aspiration pneumonia with resultant morbidity and recurrent hospital admissions. With a rapidly ageing population and an increasing complex chronic disease burden, the prevalence of patients with dysphagia will increase. Family physicians will encounter more patients with dysphagia in various practice settings of primary, intermediate long term care and tertiary settings. We conducted a comprehensive literature review on the latest established evidence on measures to prevent aspiration pneumonia in patients with dysphagia. We found that many studies involved only small numbers of patients and lacked the methodological quality of well-conducted randomised controlled trials. Interventions that showed strongest evidence in preventing aspiration pneumonia were good oral health and the use of Angiotensin Converting Enzyme (ACE) inhibitor. We have provided a summary of key recommendations for family physicians, based on the Scottish Intercollegiate Guidelines Network (SIGN) framework in order to reflect the latest evidence-based strategies on measures to prevent aspiration pneumonia in patients with dysphagia.

Keywords: Dysphagia, Aspiration pneumonia, Oral health, Angiotensin Converting Enzyme inhibitor

INTRODUCTION

Dysphagia is the impairment of swallowing and is commonly associated with increased age, cerebrovascular diseases, and dementia¹. The prevalence of dysphagia in those above 65 years is estimated at 15%¹ and increases significantly to as high as 70% in patients with cerebrovascular disease². Dysphagia increases the risk of aspiration pneumonia³⁻⁵ and is an important cause of morbidity and recurrent hospital admissions in older patients⁶⁻¹⁰. Mortality rates can be as high as 65%⁷. Up to 15% of community-acquired pneumonia result from aspiration¹¹.

With a rapidly ageing population and an increasing complex chronic disease burden, the prevalence of patients with dysphagia will increase. Family physicians will encounter more patients with dysphagia in various practice settings of primary, intermediate long term care and tertiary settings. This evidence-based narrative review appraises the latest evidence on measures to prevent aspiration

pneumonia in patients with dysphagia and makes recommendations for the family physician.

METHODS

Multiple search strategies were used to obtain a comprehensive review of relevant articles. A PubMed search was made with the following key words "aspiration pneumonia" with limits to meta-analysis, systematic reviews and randomised controlled trials (RCT), articles in English, human studies and adults aged 19 years and above. The search yielded 264 results, which were individually screened; 14 articles were selected. A Cochrane review search on "dysphagia" yielded 53 results; and "aspiration pneumonia" yielded 10 results; of which 2 relevant articles were used. A hand search further yielded one article. A total of 17 articles were obtained and reviewed for this study.

Exclusion criteria included articles with studies done in the intensive care unit setting, anaesthesia, surgical patients and structural causes of the

Table 1. Description and levels of evidence for articles reviewed.

Ref no.	Study title; Study type; Year of publication	Participants and Sample size	Duration of follow up	Outcome measures	Level of evidence (based on SIGN)	Jadad score
12	The role of selective decontamination of the digestive tract in acute stroke; RCT; 2006	Patients from acute stroke unit Total: 203 Intervention: 103 Control: 100	3 weeks	Presence of oral pathogens on oral swabs; incidence of pneumonia	1-	5
14	Oral health care and aspiration pneumonia in frail older people: a systematic literature review; SR; 2012	Elderly from NH Total: 810 (pooled from 5 studies)	30 days–24 months	Incidence of aspiration pneumonia; improvement in swallowing & cough reflex	1-	3
15	Effect of professional oral health care on the elderly living in nursing homes; RCT; 2002	Elderly from NH Total: 141 Intervention: 77 Control: 64	24 months	Incidence of aspiration pneumonia; presence of <i>Staphylococcus</i> spp. & <i>Candida albicans</i> on oral swabs	1-	2
17	Effects of oral intake of water in patients with oropharyngeal dysphagia; RCT; 2011	Patients with dysphagia with varying diagnosis Total: 76 Intervention: 42 Control: 34	8 days	Incidence of pneumonia, hydration status and quality of life	1-	3
18	A randomised study of three interventions for aspiration of thin liquids in patients with dementia or Parkinson's disease; RCT; 2008	Patients with dementia or Parkinson's disease Total: 742	1 day	Radiological evidence of aspiration using videofluorographic studies	1-	3
19	Comparison of 2 interventions for liquid aspiration on pneumonia incidence: a randomised trial; RCT; 2008	Patients with dementia or Parkinson's disease Total: 515 Chin down posture: 259 Neutral position: 256	3 months (or till demise)	Incidence of pneumonia	1-	3
20	Effectiveness of chin-down posture to prevent tracheal aspiration in dysphagia secondary to acquired brain injury. A videofluoroscopy study; RCT; 2012	Stroke and traumatic brain injury patients with dysphagia Total: 47 (cross-over study, hence all 47 participants received both intervention and control treatments)	1 day	Radiological evidence of aspiration using videofluorographic studies	1-	2
21	Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances; Cochrane review; 2012	Heterogenous group of adults with swallowing disturbances Total: 585 NGT: 293 PEG: 292	Not mentioned	Incidence of aspiration pneumonia (one of many study outcomes)	1++	NA
22	Equal aspiration rates from postpylorus and intragastric-placed small-bore nasoenteric feeding tubes: a randomised, prospective study; RCT; 1992	Malnourished enterally fed hospital patients Total: 33 Gastric: 17 Post-pylorus: 16	Not mentioned; approximated to be 2–3 weeks	Incidence of aspiration pneumonia, diarrhoea, attainment of desired kilo-calories	1-	2
23	Pump-assisted enteral nutrition can prevent aspiration in bedridden percutaneous endoscopic gastrostomy patients; RCT; 2004	Bedbound patients on percutaneous endoscopic gastrostomy Total: 100 Crossover trial, hence all patients received both pump assisted and gravity controlled feeding	12 weeks	Duration of nutrition, reflux, vomiting, bowel movements, episodes of aspiration, incidence of pneumonia	1-	2
24	Continuous compared with intermittent tube feeding in the elderly; RCT; 1992	Patients who required nasogastric tube feeding Total: 60 Intervention: 30 Control: 30	1 week	Incidence of aspiration pneumonia, diarrhoea, clogged tubes, agitation	1-	2

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Table 1. Description and levels of evidence for articles reviewed (continued from previous page).

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Ref no.	Study title; Study type; Year of publication	Participants and Sample size	Duration of follow up	Outcome measures	Level of evidence (based on SIGN)	Jadad score
25	Can continuous pump feeding reduce the incidence of pneumonia in nasogastric tube-fed patients? A randomised controlled trial; RCT 2010	Patients on nasogastric tube feeding Total: 180 Intervention: 85 Control: 95	4 weeks	Incidence of pneumonia; mortality rates	1-	3
26	Post-stroke pneumonia prevention by angiotensin-converting enzyme inhibitors: results of a meta-analysis of five studies in Asians; MA; 2012	Post-stroke patients Total: 8,693 (pooled from all 5 studies)	24–48 months	Incidence of aspiration pneumonia	1++	NA
29	Nicergoline improves dysphagia by upregulating substance P in the elderly; RCT; 2011	Outpatients, >65 years, with dysphagia and previous pneumonia within the last 2 years Total: 60 Nicergoline (intervention): 30 Imidapril (control): 30	6 months	Pneumonia recurrence, swallowing function, serum substance P levels	1+	3
30	A pilot study of banxia houpu tang, a traditional Chinese medicine, for reducing pneumonia risk in older adults with dementia; RCT; 2007	Elderly patients with dementia and cerebrovascular disease, Alzheimer's or Parkinson's disease Total: 95 Intervention: 47 Control: 48	12 months	Incidence of pneumonia, mortality due to pneumonia, daily amount of self-feeding	1+	5
33	Aspiration and swallowing in Parkinson disease and rehabilitation with EMST: a randomised trial; RCT; 2010	Patients with Parkinson's disease Total: 68 Intervention: 33 Control: 35	4 weeks	Improvement in swallowing function	1-	5
34	Acupuncture for dysphagia in acute stroke; Cochrane review; 2008	Patients with acute stroke Total: 66 Intervention: 34 Control: 32	No mention	Improvement in swallowing function	1-	3

dysphagia (e.g. oesophageal or laryngeal tumour). Systematic reviews and meta-analysis of non-RCT trials, original articles that are non RCT and studies with less than 10 subjects were not included.

Outcome measures included the incidence of aspiration pneumonia, improvements in swallowing and cough reflex. The results and level of evidence of the articles reviewed are presented in Table 1. Grading of levels of evidence is based on Scottish Intercollegiate Guidelines Network (SIGN) model (Table 2) and the Jadad score for clinical trials. Authors Tan WY and Low LL independently reviewed the selected articles and reached consensus on the level of evidence and recommendations.

RESULTS AND DISCUSSION

Aspiration pneumonia can be prevented and the interventions discussed will be summarised under the following categories:

1. Oral hygiene
2. Diet modifications and postural compensation
3. Type and feeding regimen for artificial enteral feeding
4. Pharmacological
5. Expiratory muscle strength training
6. Complementary alternative medicine

The levels of evidence of the individual RCTs and reviews are summarised in Table 1.

Studies on oral hygiene

A total of two RCTs and one systematic review on good oral health care were selected for review, The authors concluded that family physicians should recommend good oral health care to their patients

Table 2. SIGN levels of evidence

Level	Type of evidence
1++	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs) or RCTs with a very low risk of bias
1+	Well conducted meta-analyses, systematic reviews of RCTs or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort studies; high quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is casual
2+	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is casual
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not casual
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

and institutions should incorporate oral health care in their guidelines to reduce incidence of aspiration pneumonia. There is inadequate evidence for routine use of antibiotic gel to reduce oral bacterial load and selective decontamination of the digestive tract is not recommended currently¹².

The elderly are prone to poor oral health due to the presence of periodontal and dental disease and a lack of oral hygiene. Poor dentition increases bacteria load in the mouth and the aspiration of bacteria laden oropharyngeal secretions into the lungs is associated with an increased risk of pneumonia¹³.

A systematic review concluded that a good oral healthcare routine consisting of tooth brushing after each meal, cleaning of dentures once a day, and professional oral healthcare once a week improved the swallowing reflex and reduced the cough reflex threshold and the risk of aspiration pneumonia¹⁴. A single intervention of professional oral health care by dental hygienists, focused on mechanical cleaning of teeth with scaling by hand scalers also reduced fevers and aspiration pneumonia among elderly patients in nursing homes¹⁵. Although such frequent professional oral health care may not be practical in actual practice, good oral healthcare is a non-invasive, cost-effective and easily implemented strategy to prevent aspiration pneumonia.

Studies on diet modifications and postural compensation

A total of four RCTs on dietary modifications and postural compensation were selected for

review. The authors concluded that the use and prescription regime regimen of thickeners should be individualised to the patient. Family Physicians should also be aware that there are cost issues and risks involved when using fluid thickeners. There is a higher risk of developing dehydration and malnutrition with increasing fluid viscosity¹⁶. The increased amounts of starch in thickened drinks make them unpalatable and induces early satiety, resulting in reduced oral intake.

Postural compensation should only be recommended by a speech therapist after careful swallowing assessments.

Fluid thickening agents such as "Thick and Easy[®]" and "Thicken up[®]" are commonly prescribed for use in patients with dysphagia. Thickened fluids decreases the speed of food boluses and improves the control of swallowing. This reduces the penetration and aspiration of food materials. However micro-aspirations of oral secretions occur throughout the day, and not only during the intake of food. Therefore results of thickeners in reducing the incidence of aspiration pneumonia are mixed. Thickened fluids reduced the risk of aspiration pneumonia in patients with oropharyngeal dysphagia from varying diagnoses¹⁷. However thickened fluids in patients with dementia or Parkinson's disease only improved swallowing on videofluoroscopy¹⁸ but did not show any reduction in incidence of aspiration pneumonia over a three-month follow up¹⁹.

The chin down posture is commonly recommended by speech therapists to dysphagia patients to

prevent tracheal aspiration. However, adopting a chin down posture during swallowing avoided aspiration for half the patients on videofluoroscopy examination and was not fully protective against aspiration pneumonia²⁰.

Studies on type and feeding regime for artificial enteral feeding

A total of three RCTs and one Cochrane review on artificial enteral feeding were selected for review. The authors concluded that the incidence of aspiration pneumonia should not be a factor in deciding between nasogastric tube (NGT) or percutaneous endoscopic gastrostomy (PEG). In patients with dysphagia, the maintenance of nutrition and the prevention of aspiration are the two most cited reasons for tube feeding. It should be clarified to patients that tube feeding has not been proven to reduce aspiration pneumonia. The reason for its recommendation should be geared more towards nutritional sustenance rather than the prevention of aspiration pneumonia. Therefore, the pros and cons of tube feeding must be discussed with patients with dysphagia and their families. The choice of the different routes of tube feeding should be discussed carefully and individualised according to patient or family preference.

A Cochrane review did not show any significant differences when comparing NGT versus PEG on aspiration pneumonia incidence²¹. Positioning the nasoenteric tube into the post-pylorus area did not reduce incidence of aspiration pneumonia²².

Continuous feeding can be recommended if there is persistent high gastric residue despite interventions; and it reduced the incidence of aspiration pneumonia in PEG-fed patients compared to bolus²³ although this benefit was not reproducible in NGT patients^{24,25}. Bolus feeding should be recommended in most patients who are fed via NGT. The problems of high gastric residue can be addressed by increasing the frequency and reducing the volume of each feed, or by substituting with a feed that is nutritionally denser.

Studies on pharmacologic measures

One meta-analysis and two RCTs were selected for review. The authors concluded that angiotensin converting enzyme (ACE) inhibitors can be considered in patients with dysphagia and

hypertension requiring blood pressure control; for its secondary benefits in reducing the risk of aspiration pneumonia. The routine use of nicergoline and Banxia Houpu Tang are not recommended until larger, well-designed trials are done to validate its effectiveness.

ACE inhibitors

Angiotensin converting enzyme inhibitors are commonly used drugs for the treatment of hypertension and has reno-protective effects by reducing proteinuria. A recent large meta-analysis, found positive preventive effects of ACE inhibitors in reducing aspiration pneumonia in post stroke patients²⁶, in addition to its renal and cardio-protective effects. This effect was more pronounced in the sub-group analysis of Asian (Chinese and Japanese) and Japanese patients.

The postulated mechanism of action is through the reduction of degradation of substance P²⁷, which has a sensitising effect on both the cough and swallowing reflex²⁸. Future studies on the possible mechanism of action and the efficacy of ACE inhibitors in other ethnic groups would be useful. The optimal dose, long term efficacy, and the differences between individual ACE inhibitors also warrant further investigation. As blood pressure control is important in post stroke patients, ACE inhibitors can have a dual therapeutic effect in achieving a desired blood pressure, and reducing the risk of pneumonia in this population.

Nicergoline

Nicergoline is an ergot alkaloid derivative, and enhances the function of dopaminergic neurotransmitters in the brain, thereby inducing the secretion of substance P. Impaired substance P secretion is associated with dysphagia. Overall, nicergoline was found to be as effective as imidapril (ACE inhibitor) in improving dysphagia and pneumonia recurrence, and more effective in patients with dementia²⁹. Nicergoline can be a novel treatment for dysphagia in the elderly who do not tolerate ACE inhibitors, and larger well-designed trials are needed to validate its effectiveness.

Banxia Houpu Tang

A traditional Chinese medicine "Banxia Houpu Tang" (BHT) showed promising results in a pilot study conducted on elderly patients with dementia, cerebrovascular disease, Alzheimer's disease or Parkinson's disease residing in nursing

Table 3. SIGN grades of recommendations for prevention of aspiration pneumonia.

Clinical Recommendation	Evidence Rating	References
Good oral hygiene should be encouraged and reinforced in elderly patients to prevent aspiration pneumonia.	A	14, 15
ACE inhibitors should be used for reduction of risk of aspiration pneumonia in patients with dysphagia who also require blood pressure control.	A	25
Continuous feeding should be recommended in PEG fed patients.	B	22
Dietary modifications with the use of fluid thickeners should be recommended for patients who have radiological evidence of penetration or aspiration, after assessment by a trained speech therapist.	C	16–18

homes in Japan³⁰. There was significant reduction in incidence of aspiration pneumonia over a 12-month follow up period. It was postulated that BHT increases serum substance P and dopamine levels, and thus improving swallowing and cough reflexes³¹. There was no report of any serious adverse events worldwide and none in the quoted study.

Other drugs

Numerous pharmacological agents had been studied on their effects in reducing the risk of aspiration pneumonia. A systematic review which included non-RCT studies on pharmacologic interventions and aspiration pneumonia showed lack of evidence to support the use of other pharmacological agents (such as dopamine agonists, amantadine, cilostazol, capsaicin, folic acid and theophylline)³². The use of these pharmacological agents or alternative medication in prevention of aspiration pneumonia should be limited until further consistent research outcomes.

Study on Expiratory Muscle Strength Training (EMST)

A RCT was selected for review with an evidence level of 1. The authors concluded that EMST should not be recommended until further evidence have evaluated aspiration pneumonia as one of the patient outcomes.

Expiratory muscle strength training is a swallowing rehabilitation technique aimed at the restoration of swallowing function. Expiratory muscle strength training using a calibrated device improved the swallowing mechanism during videofluoroscopy in patients with Parkinson's disease but the incidence of aspiration pneumonia was not studied³³. Future studies should also include patients with other causes of dysphagia.

Study on complementary alternative medicine

The authors concluded that acupuncture should not routinely be recommended for the treatment of dysphagia until more large-scale and methodologically sound trials incorporating acupuncture for dysphagic stroke patients are conducted to verify its clinical value.

A Cochrane review on acupuncture included only one randomised controlled trial and was inconclusive whether acupuncture had a positive effect in reducing aspiration pneumonia when added to standard Western medical treatment for acute stroke patients with dysphagia³⁴.

SUMMARY AND CONCLUSIONS

This narrative review article has appraised and summarised the latest evidence on measures to reduce aspiration pneumonia in patients with dysphagia (Table 1). Many clinical trials studied the effectiveness of various preventive strategies but many involved only small numbers of patients and lacked the methodological quality of well-conducted RCTs. Interventions that showed strongest evidence in preventing aspiration pneumonia were good oral health and the use of ACE inhibitor. Good oral hygiene is a simple and cost-effective intervention to prevent aspiration pneumonia and should be encouraged and reinforced in elderly patients by family physicians. Angiotensin converting enzyme inhibitors can also be considered in patients with dysphagia and hypertension requiring blood pressure control; for its secondary benefits in reducing the risk of aspiration pneumonia.

The use of feeding in PEG patients was also effective in reducing the incidence of aspiration pneumonia. There were also promising results for BHT and nicergoline, although larger well-designed trials

are needed to validate their effectiveness. There were insufficient evidence for the use of diet modifications, postural compensation, use of tube feeding, other pharmacological agents, expiratory muscle strength training and acupuncture to reduce aspiration pneumonia.

While waiting for further better-designed trials to provide more evidence on various preventive strategies, family physicians can recommend preventive strategies based on best current evidence (Table 3) to their patients.

LIMITATIONS OF CURRENT STUDIES

Many studies on aspiration pneumonia preventive strategies had a Jadad score of 3 or less; and lacked methodological quality to provide robust evidence and conclusions. Although all the subjects in the studies appraised have underlying dysphagia, the underlying disease states causing dysphagia were heterogeneous and the severity of the dysphagia was not well detailed in most studies. Potential confounders affecting the risk of aspiration pneumonia were not addressed.

Consequently, more robust research studies are required with more proper definition on the severity of dysphagia and to address potential confounders.

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