Interventions to Prevent Aspiration Pneumonia in Older Adults: A Systematic Review

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A systematic review was conducted to assess the effectiveness of the following interventions for prevention of aspiration pneumonia (AP) in older adults: compensatory strategy/positioning changes, dietary interventions, pharmacologic therapies, oral hygiene, and tube feeding. Data sources included a key word search of the MEDLINE, EMBASE, Cochrane Library, CINAHL, and HealthSTAR databases and hand searches of six journals. Reference lists of relevant primary and review articles were searched. Studies included were randomized, controlled trials (RCTs) enrolling adults aged 65 and older at risk of and assessed for AP. Two investigators extracted data on population, intervention, outcomes, and methodological quality. Of the 17 identified RCTs, eight met the selection criteria, two addressed dietary management or compensatory swallowing, two assessed pharmacological therapies, one assessed oral hygiene, and three assessed tube feeding. None of the eight trials reported use of blinding, and allocation concealment was unclear in five. Use of amantadine prevented pneumonia in one trial of nursing home residents. The antithrombotic agent cilostazol prevented AP in another trial but resulted in excessive bleeding. Insufficient data exist to determine the effectiveness of positioning strategies, modified diets, oral hygiene, feeding tube placement, or delivery of food in preventing AP. Considering how common the problem of AP is in older adults, larger, high-quality RCTs on the effectiveness of preventive interventions are warranted.

Key words: pneumonia; dysphagia; prevention; systematic review; aspiration

Aspiration pneumonia (AP) refers to lower respiratory tract infection caused by the inhalation of oropharyngeal secretions colonized by pathogenic bacteria. This syndrome is increasingly being recognized as an important health problem in older adults. A recent study showed that annual hospitalizations for AP of persons aged 65 and over increased by 94% from 1991 to 1998 in the United States. The risk of AP is higher in seniors than in other populations, primarily because of an increased incidence of dysphagia and gastroesophageal reflux. Older adults with stroke and Parkinson’s disease and individuals with dementia (including residents of long-term care facilities) are at particularly high risk. Given that more than 2 million people in the United States have dementia and that dysphagia affects up to 600,000 people with neurological disorders annually, the burden on affected individuals, their caregivers, and the healthcare system of illness due to AP is huge. Clearly, preventing AP in this population is an important healthcare priority.

A number of strategies to prevent AP have been proposed. These include changes in diet consistency (such as the use of thickened fluids), use of positioning techniques (such as the “chin down” position), use of pharmacological agents to improve the swallowing reflex, oral rinses to improve oral hygiene, and for seniors with feeding tubes, changes in positioning of the tube or method of delivery of food. In practice, use of these different strategies varies greatly.

The aim of this systematic review was to assess the effectiveness of interventions that have been evaluated for use in the prevention of AP in seniors. Specifically, the study sought to examine the various classes of interventions including compensatory strategy/positioning changes, dietary interventions, pharmacological therapies, oral hygiene, and tube feeding. In assessing this evidence, it was the aim of this study to inform clinicians about the best evidence for some commonly used interventions and to identify gaps in this area for research. To the authors’ knowledge, there have been no systematic reviews about interventions to reduce AP in seniors, although several reviews about screening for dysphagia exist.

Systematic reviews differ from traditional narrative reviews in a number of ways. First, systematic reviews address a particular clinical question. The question usually
METHODS

Search Strategy

The authors searched MEDLINE (January 1966–2001), EMBASE (1974–2001), the Cochrane Library, CINAHL, and HealthSTAR using the key words deglutition, feeding methods, posture, mouthwashes, bacterial infections, pneumonia, hospitalization, aspiration, pneumococcal infections, and respiratory tract infections and text words including chin tuck, feeding, positioning, swallowing, thickened liquid, captopril, enalapril, amantadine, semicreumbent, chlorhexidine, oral rinse, mouthwash, upright position, high fowler, fowler, and chin tuck compensatory strategy. Primary and review articles were retrieved. The authors hand-searched papers from Age and Aging, Dysphagia, Stroke, Physical Medicine and Rehabilitation, Clinical Infectious Diseases, and the Journal of the American Geriatric Society from 1997 to 2001. English and non-English papers were obtained. To reduce the possibility of publication bias, letters and abstracts were included. Reference lists of retrieved articles were reviewed.

Two reviewers independently screened results of the search strategy for potentially relevant citations. Two reviewers then independently assessed all retrieved articles for possible inclusion. Differences about classification were resolved by discussion and reexamination of the relevant studies. Authors of selected studies were contacted to provide detailed information.

Selection Criteria

To identify studies for inclusion in this analysis, study populations included patients aged 65 and older who were at risk for aspiration. This could have been on the basis of documented oropharyngeal dysphagia, previous stroke, previous aspiration, or tube feeding. Only RCTs were included. The following categories of interventions were assessed: compensatory strategy/positioning changes, dietary interventions, pharmacologic therapies, oral hygiene, and feeding tubes. Interventions included a comparison with placebo, no intervention, or another class of intervention. Studies had to include AP (the primary outcome of this review) to be eligible. Secondary outcomes related to the effects of aspiration that were assessed included dehydration, gross aspiration, nutritional intake, and death. Eligible studies required radiological confirmation of pneumonia. Furthermore, any adverse effects resulting from the use of such interventions were examined. Studies of postoperative AP were excluded.

Data Extraction and Validity Assessment

One reviewer performed extraction of data from individual studies independently and another reviewed them. Referral to original studies resolved discrepancies.

Study validity was assessed using three criteria: allocation concealment, blinding, and follow-up. Each of these criteria was categorized as being met, unmet, or unclear. Adequate follow-up was defined as 80% of participants. Studies were categorized as having a low risk of bias if all of the criteria were met, as having a moderate risk for bias if one or more were partly met, or as having a high risk for bias if one or more of the criteria were not met. Two reviewers assessed study validity independently and resolved disagreements by consensus.

Data Synthesis

A qualitative analysis was undertaken because of the significant clinical heterogeneity between studies within intervention classes and outcomes. Interventions were classified as having a positive, negative, or no overall effect on the primary outcome depending on whether a significant difference in AP between study groups was demonstrated. The effect was considered to be positive if the intervention group showed greater reduction in AP than the control group and negative if the control group showed greater reduction. In this manner, the study also classified interventions for each of the secondary outcomes: nutrition, dehydration, gross aspiration, and death.

RESULTS

Search Results

One thousand nine hundred seventy-nine citations, 1,139 from MEDLINE, 465 from EMBASE, 25 from the Cochrane Library, 30 from CINAHL, and 320 from Health STAR were identified. Twenty-eight potentially relevant articles were retrieved. Seventeen of these were RCTs. Eight of the 17 trials were included for the review. Nine studies were excluded because they did not consider AP as an outcome (seven studies) or addressed a different study question (two studies addressed postoperative aspiration pneumonitis).

Of the eight studies included in this review, two assessed dietary management or compensatory swallowing, two assessed pharmacological therapies (one amantadine and one antithrombotic therapy), one assessed oral hygiene, and three assessed tube feeding. Ages of the participants (for studies reporting this information) ranged from 61 to 99. The percentage of men was greater than that of women (mean 71%, range 55–80%), but three studies did not report sex.

Inclusion criteria applied to four studies that limited participants to a history of stroke or other neurological disease, two of which excluded patients who were immunocompromised and two that required fluoroscopic confirmation of dysphagia. Two studies were limited to hospitalized patients that were to receive enteral feedings, and one study was limited to residents of nursing homes. The number of participants in each trial ranged from 33 to 417, with a total of 1,234 participants included in the eight trials combined. Attempts to obtain additional infor-
mation from authors of six of the included studies were unsuccessful.

Study Results
The results for each trial, grouped according to intervention category, are presented in Table 1. Trials were classified as having a positive, negative, or no effect, under the classifications of AP and each of the secondary outcomes examined in the selected studies (nutrition, dehydration, gross aspiration, and death). Four studies had a positive effect on AP. Otherwise, studies showed no effect or did not assess outcomes (Table 1).

Dietary Intervention and Compensatory Strategy
Two RCTs were found in this category (Table 1). In one study, 66 patients with pseudobulbar dysphagia in a chronic facility were randomized to pureed foods and non-altered fluids (n = 23) or to a soft mechanical diet with altered fluids (n = 23).21 There were 28 documented episodes of AP in the participants receiving pureed foods, compared with five episodes in residents receiving the soft mechanical diet with thickened liquids. However, 10 episodes were repeat aspirations in the pureed group, and one was a repeat episode in the mechanical diet group. It is unclear how many patients in each group had one or more episodes.

Another study randomized 115 hospitalized patients with recent stroke and dysphagia to one of three graded interventions to prevent aspiration.22 One group received, on the basis of videofluoroscopic results, training on compensatory positioning and recommendations about diet (Group A). The patients and their family members were then given a choice of diet consistency that they felt was most appropriate. The second group received the same information as the first, but in this group the diet was prescribed (i.e., they were not free to choose) (Group B). In the third group, the consistency of the diet was prescribed and controlled on a daily basis. Participants in this group also received daily reinforcement of compensatory swallowing technique (Group C). Five of the 38 participants in Group B developed AP, compared with one of 38 in Group A, but this was not significantly different (odds ratio (OR) = 5.61, 95% confidence interval (CI) = 0.57–272.2, P = .09). Two of 39 participants in Group C developed AP, compared with one in Group A, but the difference again was not significant (OR = 2.00, 95% CI = 0.10–121.1, P = .57). Participants in Group C were less likely to develop AP than those in Group B (OR = 0.36, 95% CI = 0.03 = 2.39), but again the difference was not significant (P = .22).

No deaths occurred in study participants. Two participants in each of Group A and B were calorie-nitrogen deficit, as were three in Group C (differences were not statistically significant). Dehydration occurred in three participants in Group A, none in Group B, and one in Group C (differences were not statistically significant).22

Pharmacologic Therapies
Two RCTs addressed pharmacological interventions (Table 1). There was one study on RCT in which patients with stroke were randomized to amantadine 100 mg/d or no treatment and were followed over a 3-year period.23 Five of 83 (6%) patients who received amantadine versus 22 of 80 (28%) who received no treatment developed radiologically confirmed pneumonia (OR = 0.17, 95% CI = 0.05–0.50, P < .001).

In another study from the same institution, patients with a history of stroke were randomized to cilostazol (a cyclic adenosine monophosphate phosphodiesterase inhibitor), an antithrombotic to lower stroke recurrence, or to no active treatment.24 The patients were followed for 3 years. Twelve of 152 patients assigned to cilostazol (8%) versus 35 of 145 patients randomized to no treatment (24%) developed pneumonia (OR = 0.33, 95% CI = 0.15–0.71, P < .001), but 27 (18%) patients who received this drug developed adverse effects, including 11 (7%) who experienced bleeding.

Oral Hygiene
One RCT conducted in residents of nursing homes addressed oral care25 (Table 1). The investigators randomized nursing home residents to oral care (nurses or caregivers cleaned the teeth of residents after every meal with
an applicator of povidone iodine) or to no active treatment. Pneumonia was noted in 21 of 184 (11%) patients assigned to oral hygiene versus 34 of 182 (19%) patients who received no oral care (OR = 1.74, 95% CI 0.93–3.26, P = .052).

Feeding Tubes
There were three RCTs in this category (Table 1). One study randomized 33 enterally fed hospitalized patients to postpyloric or intragastric placement of a feeding tube.26 Six of 15 patients (40%) randomized to postpyloric positioning versus five of 16 patients (31%) randomized to intragastric placement developed AP (OR = 1.47, 95% CI = 0.26–8.31, P = .61). Three (19%) in the postpylorus group versus five (29%) in the intragastric group failed to achieve desired calories (P = .47). There was no significant difference in tube displacements between the two groups (P = .70).

In another study, 60 hospitalized patients prescribed nasogastric feeding were randomized to continuous or intermittent nasogastric tube feeding.27 Ten of 30 (33%) fed with continuous versus five of 30 (17%) fed with intermittent tube feeding developed AP (OR = 2.5, 95% CI = 0.64–10.7, P = .13). There was no significant difference between the two groups in the discrepancy between calories recommended and those provided (P = .10). The risk of diarrhea was significantly less in those fed by continuous feeding (OR = 0.07, 95% CI = 0.00–0.57, P = .002, but more participants fed continuously experienced clogged tubes (OR = 5.0, 95% CI = 1.34–21.0, P = .011).

A third study randomized 40 hospitalized patients at risk for aspiration to percutaneous endoscopic gastrostomy tubes (PEG) or nasogastric feeding.28 Two of 19 patients randomized to PEG tubes developed AP versus none of 19 in the nasogastric group (OR undefined, P = .15). Although both groups had similar prescribed feeds, the nasogastric group received a significantly lower percentage of their prescribed food than the PEG group (55% vs 93%, P = .01).

Assessment of Validity
All studies had at least one validity criterion that was not met. Using the authors’ definition, this corresponds to a high risk for bias. Blinding was not met in any of the eight studies. Allocation concealment was met in three studies and was unclear in five. In contrast, follow-up was over 80% in all studies (mean 92%, range 82–100%). The mean duration of follow-up was 1.5 years (range 7 days to 3 years).

DISCUSSION
A striking finding of this review was the limited number of RCTs conducted to reduce AP in older adults. This is particularly notable given the large burden of illness associated with AP. Of the studies that were identified, all had methodological shortcomings that met the definition for having a high risk for bias.

Although two RCTs using pharmaceutical agents showed a positive effect, use of these agents (amantadine and cilostazol) for reducing AP is unlikely to gain widespread acceptance in practice. Amantadine, which was associated with a 20% absolute risk reduction in pneumonia in one study,23 is known to cause gastrointestinal and neurological side effects and has a propensity to interact with psychotropic medications. It is also quite plausible that the mechanism was not through an effect on the swallowing reflex but through direct long-term prophylaxis due to amantadine’s antiviral effect.29 This agent has activity against influenza virus and in Canada is used for influenza prophylaxis. The second RCT showed that cilostazol, an antithrombotic agent, had an effect in reducing aspiration.24 Widespread use of cilostazol would have even greater potential for harm than amantadine. Although the drug was reported to reduce pneumonia (24% to 8%, absolute reduction), 27 (18%) patients who received the drug developed adverse effects, including 11 (7%) who experienced bleeding.

The effect of an oral hygiene program in residents of nursing homes in reducing AP was of borderline significance (OR = 1.74, 95% CI = 0.93–3.26, P = .052). More research is needed to assess this strategy. Investigators and outcome assessors do not appear to have been blinded to treatment allocation in this study, potentially introducing ascertainment bias. The same group that reported the use of amantadine and cilostazol in preventing AP conducted this study.23,24 Because the effectiveness of an oral hygiene program in preventing AP appears to be promising, other investigators should replicate this study.

Use of thickened liquids is frequently recommended for seniors with oropharyngeal dysphagia. This review demonstrates that there are few clinical trial data to support the use of changes in diet consistency for reducing AP. One study reported a reduced incidence of AP in participants randomized to a soft mechanical diet and thickened liquids,21 but a difference in proportions between the two groups (number of participants who had AP) was not specified. Furthermore, it is unclear whether the mechanical diet or the thickened liquids had an effect. Recommendations for the use of thickened liquids are often based on videofluoroscopic findings, which have variable correlation with the development of AP.10,31 Clearly, it is preferable to base practice on studies that have hard clinical outcomes. Trials to assess the effect of consistency of fluids in preventing AP need to be conducted.

Positioning strategies are sometimes recommended for older adults at high risk for aspiration. These may include the chin tuck position, upright position during and after meals to prevent gastric reflux, and semirecumbent position for bed. Few data exist to support any of these strategies. One study, which did not show a difference between groups allocated to various intensities of positioning strategies and diet manipulation, was not adequately powered to demonstrate significant differences.22 Unexpectedly, the groups allocated to more-intense strategies were more likely to develop AP. The confidence intervals do not exclude important protective effects. Because the actual compensatory positions are not described, it is difficult to speculate on the reason for these results. More studies are needed to assess the effect of positioning strategies. These strategies, such as the chin tuck or chin down position, are inexpensive and potentially feasible, but large numbers of patients are required to detect differences in clinical outcomes.

The three RCTs of enteral feedings included in this review were not designed to address AP specifically. Rather,
they were conducted to assess a variety of complications associated with enteral feeding. As a consequence, they were underpowered to detect differences for AP. Optimal placement (postpyloric vs intragastric) remains unknown.26 Although intermittent feedings appear to reduce AP, this needs to be confirmed in a larger trial.27 One study showed that PEG tubes may lead to higher rates of AP, 28 but the numbers were small, and therefore statistical significance was not reached.

In summary, clinical trial data to establish best practices with respect to reducing AP in the elderly are limited. Considering how common the problem of AP is in older adults, larger, higher-quality RCTs of the effectiveness of different strategies are warranted.

REFERENCES
