Abstract

Objective. This study tested the hypotheses that swallow apnea duration (SAD) will increase given barium versus water, chemesthetic stimuli (i.e., water < ethanol, acid, and carbonation) mixed with barium, age (older > younger), and genetic taste differences (supertasters > nontasters).

Methods. Eighty healthy women were identified as nontasters and supertasters, equally comprising 2 age groups: 18 to 35 years and 60+ years. The KayPentax Swallowing Signals Lab was used to acquire SAD via nasal cannula during individually randomized swallows of 5 mL barium, 2.7% w/v citric acid with barium, carbonation with barium, and 50:50 diluted ethanol with barium. Data were analyzed using path analysis, with the mediator of chemesthetic perception, adjusted for repeated measures.

Results. Significant main effects of age (P = .012) and chemesthetic stimuli (P = .014) were found, as well as a significant interaction between chemesthetic stimuli and age (P = .028). Older women had a significantly longer SAD than younger women. Post hoc analyses revealed that barium mixed with ethanol elicited a significantly longer SAD than other bolus conditions, regardless of age group. There were no significant differences in SAD between barium and water conditions, and no significant effect of chemesthetic perception (P > .05).

Conclusion. Ethanol added to barium elicited longer SAD compared to plain barium, but not the other chemesthetic conditions. Older women had a longer SAD than younger women in all conditions. These findings may influence design of future studies examining effects of various stimuli on SAD.

Introduction

• Dysphagia is very common, and potential sequelae can have a major impact on morbidity and mortality
• Swallowing and respiration must be coordinated for a safe swallow.
• Swallowing apnea duration (SAD), a centrally-mediated cessation of breathing, is a physiologic parameter that may be used to determine a point of breakdown in patients with dysphagia.1
• Manipulating SAD could improve airway protection.
• Chemesthetic stimulation by citric acid and ethanol have been shown to prolong SAD in healthy women.2
• Genetic taste group has been shown to affect SAD. Supertasters had a longer SAD than nontasters.2

• Previous studies have demonstrated longer SAD in older adults.2-5
• Barium is used in videofluoroscopic swallowing studies (VFSS), and may affect SAD. Accordingly, experimental questions of this study were:
  1. Does the addition of barium to chemesthetic stimuli affect SAD?
  2. Will older adults still demonstrate longer SAD than younger adults with the addition of barium?
  3. Will barium affect the changes in SAD that result from genetic taste differences?

Methods

Participants

• Eighty healthy adult women, divided evenly into 2 age groups: 18-35 years and over 60 years.
• Women were studied, as they are more likely to be either supertasters or nontasters.

Apparatus

• KayPentax Digital Swallowing Workstation (KayPentax, Lincoln Park, NJ)
• Nasal cannula to measure SAD.

Procedure

• Four 5 mL bolus conditions were administered: 1.71 M barium, 2.7% w/v citric acid and barium, 50:50 ethanol/barium, and carbonated barium.
• 1.71 M barium sulfate was used since this concentration is the minimum necessary for radiologic studies.
• Carbonated barium was compounded immediately prior to administration by mixing 1.11 g sodium bicarbonate and 0.77 g citric acid with 50 g 1.71 M barium sulfate.
• Boluses were chilled prior to presentation, and participants were blinded to sample identity except for carbonation.
• One trial of each bolus was given since SAD is stable across multiple trials.4
• SAD was extracted from airflow waveforms offline.
• SAD was operationally defined as a plateau in the airflow signal, which indicates no airflow detection by the nasal cannula.

Results

Older women had a significantly longer SAD than younger women (P = .012). However, there was a significant age*stimulus interaction: plain barium, barium with carbonation, and barium with citric acid, older women had longer SAD. Barium mixed with ethanol elicited a longer SAD (P = .018), but barium mixed with citric acid or carbonation did not significantly affect SAD. There was not a significant difference in SAD based on genetic taste group (P > .05).

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Mean SAD by Age Group (± SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium</td>
<td>0.702 (±0.050)</td>
</tr>
<tr>
<td>Barium and citric acid</td>
<td>0.752 (±0.050)</td>
</tr>
<tr>
<td>Barium and carbonation</td>
<td>0.757 (±0.050)</td>
</tr>
<tr>
<td>Barium and ethanol</td>
<td>0.908 (±0.054)</td>
</tr>
</tbody>
</table>

Table 1. Swallowing apnea duration by age group and stimulus

Conclusions

Longer SAD in healthy older adults, irrespective of the addition of barium, is a robust finding replicated in multiple studies. Barium appears to negate differences in SAD between genetic taste groups. Ethanol appears to be potent enough to overcome any blunting effect of barium in regards to chemesthesis-induced SAD lengthening. More data is needed in patients with swallowing disorders. Men should be included in future studies, and the effects of more substances on SAD should be elucidated. Finally, the relationship of SAD to airway protection needs to be further evaluated.

References