Prediction of Aspiration in Patients With Newly Diagnosed Untreated Advanced Head and Neck Cancer

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Objectives: To determine the prevalence of aspiration in patients with newly diagnosed nontreated advanced head and neck cancer and to determine the ability of the clinical examination to predict aspiration in this patient population.

Design: A descriptive prevalence study of the presence of aspiration in patients with advanced (stages III and IV) head and neck cancer and a prospective correlation study between variables of the clinical evaluation with the criterion standard videofluoroscopy.

Setting: Regional veterans affairs medical center.

Patients: A consecutive sample of 27 patients without previous treatment or tracheostomy.

Interventions: All patients underwent evaluation by an otolaryngologist and speech pathologist prior to videofluoroscopy.

Main Outcome Measures: Variables in the dysphagia evaluation (consisting of a directed medical history, physical examination, and food challenge), the self-rated 45-item questionnaire, and the clinicians “educated prediction” of aspiration were analyzed with reference to aspiration on videofluoroscopy using univariate analysis.

Results: The prevalence of aspiration determined by videofluoroscopy was 41% (11 of 27 patients). Two (6%) of 32 items in the medical history, 1 (4%) of 25 items in the physical examination, and 8 (50%) of 16 items in the food challenge were found to be statistically significantly correlated (P < .05) with aspiration on videofluoroscopy by univariate analysis. Nine (25%) of 45 items in the self-rated questionnaire were correlated with aspiration on videofluoroscopy. The clinicians’ educated prediction of aspiration was not correlated with aspiration determined by videofluoroscopy.

Conclusions: Clinical evaluation alone is inadequate in predicting patients who aspirated, determined objectively by videofluoroscopic swallowing study. Further study is needed to develop an efficient dysphagia evaluation to identify patients at risk for aspiration.


MULTIPLE reports have focused on aspiration in the posttreatment phase of advanced head and neck cancer (AHNC). Information is limited regarding the incidence of aspiration in patients with newly diagnosed AHNC in the pretreatment phase. To the best of our knowledge, no data regarding the effectiveness of existing clinical tools for prediction of aspiration in this population have been reported.

Patients with AHNC may demonstrate swallowing dysfunction for a variety of reasons. Tumor mass may impair mobility of structures such as the larynx or tongue, it may also disrupt the laryngeal protective sphincter mechanism. Sensation in the upper aerodigestive tract may be altered when large mucosal surface areas are replaced by tumor, or when neural invasion occurs. Sensation and the fine coordinated motor function of swallowing may be further impaired in patients with AHNC secondary to alcohol-induced sensory and/or motor neuropathy. These swallowing dysfunctions render the patient with AHNC at a high risk for aspiration.

Once aspirating, the patients with AHNC are clearly at increased risk for developing aspiration pneumonia because of poor nutritional status, smoking history with associated pulmonary disease, cancer-related immune suppression, and poor oral hygiene. However, the causal relationship between the presence of aspiration and aspiration pneumonia has not been established for patients with AHNC. This causal
PATIENTS AND METHODS

All newly diagnosed patients with stage III or IV squamous cell carcinoma of the head and neck who presented to the Otolaryngology—Head and Neck Service at the East Orange Veterans Affairs Medical Center, East Orange, NJ, were evaluated for this study after review and approval of study protocol by the institutional review board at the East Orange Veterans Affairs Medical Center. Patients who had tracheostomy, surgery, or cancer treatment before dysphagia evaluation were excluded from this study. Twenty-seven consecutive patients between the ages of 49 and 87 years (mean age, 60 years) were included in this study. The primary sites of the lesions were the larynx (10 patients), oropharynx (9 patients), oral cavity (6 patients), and hypopharynx (2 patients).

For this study, all patients underwent a complete head and neck examination, including a flexible laryngoscopic examination. This was followed by a dysphagia evaluation by the speech and swallowing service administered by a speech pathologist. A self-rated 45-item questionnaire was then administered. Finally, a videofluoroscopic swallowing study was performed (Figure 1).

The evaluation for dysphagia was divided into 3 parts. (1) A directed medical history consisting of 32 items addressing the patients’ history of difficulty swallowing, pneumonia, weight loss, pain, diet change, and voice change. (2) Physical examination consisting of 25 items addressing labial, mandibular, and tongue motion; perioral sensation; and voice pitch, phonation, articulation, and quality. (3) A food challenge consisting of administering liquids, puree, soft solids, and dry solids and observing for coughing or choking or voice change.

A self-rated questionnaire consisting of 45 statistically balanced items was developed for this study. Questions addressed 3 general areas related to swallowing impairment: social changes, diet changes, and difficulty during swallowing. Answers were graded on a 5-point severity scale. A standard Mini-Mental Status Examination was administered to confirm adequate cognition.

Following the dysphagia evaluation and administration of the self-rated questionnaire, but before videofluoroscopy, the speech pathologist made an “educated prediction” as to whether the patient would aspirate. Although it is obvious that the true cost of aspiration in the patient with AHNC is incalculable because of the difficulty in obtaining prospective studies establishing this relationship, it is reasonable to deduce that a similar relationship between aspiration and aspiration pneumonia holds in patients with AHNC as well. Detection of aspiration in the pretreatment phase of patients with AHNC is relevant only if it has practical implications on the patient’s management or outcome. If surgery is anticipated, documenting aspiration may only help in the deliberation prior to surgery; however, it is of limited comparative value, because surgery may alter the anatomy significantly and organ-preserving treatment regimens. In patients receiving radiotherapy or chemotherapy, aspiration pneumonia has the added potential morbidity associated with delay or interruption in cancer treatment. It not only can delay surgical treatment, but also can adversely affect continuity of radiotherapy or chemotherapy. Interruption of radiotherapy has been shown to decrease cancer control rates. Each day of treatment interruption in laryngeal cancer was calculated to result in an increased likelihood of local relapse by 4.8%. Furthermore, treatment gaps longer than 4 days were found to decrease local control of laryngeal cancer and increase cancer-related mortality. In addition to determining patients at risk for aspiration pneumonia, if we are to assess the functional outcome of organ preservation protocols, we must assess baseline pretreatment function as well. Clearly, pretreatment evaluation for aspiration is indicated in patients with AHNC.

Common standard tools in most institutions for assessment of aspiration in patients with AHNC incorporate clinical examination, including a directed medical history, physical examination, and food challenges, followed by videofluoroscopy. This is a costly, time-consuming process requiring specially trained person-

Figure 1. Evaluation protocol.
nel. The effectiveness of the commonly used clinical tools to predict aspiration has not been reported specifically for patients with AHNC. To our knowledge, there is no information evaluating what are effective clinical predictors of aspiration in the nontreated AHNC population. This pilot study determined the prevalence of aspiration in patients with newly diagnosed nontreated AHNC and the ability of the clinical examination to predict aspiration in this patient population.

RESULTS

PREVALENCE OF ASPIRATION

The prevalence of aspiration determined by videofluoroscopy was 41% (11 of 27 patients). In 5 (45%) of 11 patients there was no effort to cough or clear the airway when aspiration was seen on videofluoroscopy (silent aspiration). Six (55%) of 11 had overt aspiration (Figure 2).

DYSPHAGIA EVALUATION

Two (6%) of 32 items in the directed medical history part, 1 (4%) of 25 items in the physical examination part, and 8 (50%) of 16 items in the food challenge part were found to be significantly correlated ($P < .05$) with aspiration on videofluoroscopy by univariate analysis (Table 1). For these items, the correlation coefficient ranged from 0.36-0.47 (Table 2). The positive predictive value, negative predictive value, sensitivity, specificity, and percentage correctly classified for each item were calculated (Table 3). There were 2 patients who appeared to have gross aspiration clinically and were not tested with any food challenge owing to safety concerns. One patient who grossly aspirated with liquids clinically was not tested with other consistencies.

SELF-RATED QUESTIONNAIRE

Nine (25%) of 45 items in our specifically designed study questionnaire were found to be significantly correlated with aspiration on videofluoroscopy. All questions related to difficulty or distress during swallowing. None of the social or diet change questions were correlated with aspiration.

EDUCATED PREDICTION OF ASPIRATION

The clinicians’ educated prediction of aspiration before videofluoroscopy is given in Table 4. Overall, 18 (67%) of the 27 patients were correctly classified. The correlation of prediction of aspiration with objective aspiration on videofluoroscopy by univariate analysis was not statistically significant ($P = .12$).

COMMENT

The prevalence of aspiration determined by videofluoroscopy, in our group of 27 patients is 41%. The number of patients in this pilot study is small, not allowing for the comparison of the incidence of aspiration between specific primary sites of tumor. To our knowledge, there is only 1 previously reported documentation of the prevalence of aspiration in the newly diagnosed nontreated AHNC population that similarly reported a 44% prevalence of aspiration in a group of 78 patients. \(^1\) This along with our report are the only 2 reports in which only consecutive untreated patients were included. The 2 reports provide baseline reference data on the incidence of aspiration in patients with untreated AHNC to which posttreatment data may be compared. Muz et al\(^9\) did report an incidence of aspiration of 33% in a large group of patients with head and neck cancer determined by scintigraphy. However, this group was heterogeneous including all patients regardless of treatment or presence of tracheostomy.

The percentage of silent aspiration in our group, defined as having no detectable effort to clear the throat or cough during aspiration documented on videofluoroscopy, was 45% (12 patients). Smith et al\(^10\) reported that of 51 patients with head and neck cancer who aspirated, 26 patients (51%) did so silently. Patients were not dif-

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**Table 1. Dysphagia Evaluation**

<table>
<thead>
<tr>
<th>Dysphagia Evaluation Part</th>
<th>Total No. of Items</th>
<th>No. (%) of Items With Significant Correlation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directed medical history</td>
<td>32</td>
<td>2 (6)</td>
</tr>
<tr>
<td>Physical examination</td>
<td>25</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Food challenge</td>
<td>8</td>
<td>4 (50)</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>7 (11)</td>
</tr>
</tbody>
</table>

* $P < .05$.

**Table 2. Dysphagia Evaluation**

<table>
<thead>
<tr>
<th>Dysphagia Evaluation Part</th>
<th>$R$</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoids pureed foods</td>
<td>0.43</td>
<td>.03</td>
</tr>
<tr>
<td>Wet voice quality</td>
<td>0.36</td>
<td>.049</td>
</tr>
<tr>
<td>Wet voice quality</td>
<td>0.37</td>
<td>.05</td>
</tr>
<tr>
<td>Coughs or chokes on liquid</td>
<td>0.41</td>
<td>.03</td>
</tr>
<tr>
<td>Coughs or chokes on puree</td>
<td>0.43</td>
<td>.02</td>
</tr>
<tr>
<td>Wet or hoarse voice on liquid</td>
<td>0.47</td>
<td>.01</td>
</tr>
<tr>
<td>Wet or hoarse voice on puree</td>
<td>0.41</td>
<td>.03</td>
</tr>
</tbody>
</table>
The standard clinical evaluation used was inefficient in predicting aspiration. For this purpose, we first have to determine which elements of the clinical evaluation are most useful in predicting aspiration. Standard clinical dysphagia evaluation is administered by a skilled professional and consists of a directed medical history, physical examination, and food challenge. This subjective evaluation is used not only to detect aspiration but also for therapeutic dietary modification. The clinical evaluation in our study included 65 variables of which only 7 were correlated with aspiration on videofluoroscopy (Table 2). Furthermore, the correlation was not strong for these 7 variables in this pilot study ($R=0.36-0.47$). The standard clinical evaluation used was inefficient in the detection of aspiration as indicated by the small number of items that correlated with the presence of aspiration. Further regression analysis to see if any combination of variables can more accurately predict aspiration awaits a larger patient sample size. In the stroke population, similar variables (wet voice quality, coughing on liquids, and voice change with liquids) to those found in our report were also found to correlate with the presence of aspiration.11-17 However, to our knowledge, there are no similar reports available for comparison with our data for patients with AHNC.

To be useful as a screening test, we, as clinicians, would prefer a test with a high sensitivity. For these 7 correlating items, sensitivities ranged from 0% to 45%. To rely solely on these items would fail to identify 55% to 100% of the aspirators. Thus, these variables are not useful as independent screening tools for detection of aspiration. However, the specificity for these variables was very high (88%-100%); with any of these variables present, the clinician should have a high suspicion that the patient is aspirating. Four of these 7 most predictive items involved a food challenge. The food challenge is easy to administer as it requires very little time and no instrumentation in the physician’s office (or clinical setting). Much of the information obtained from the remaining time-consuming components of the dysphagia history and physical examination cannot reliably predict aspiration.

The educated prediction of aspiration by a speech pathologist knowledgeable in swallowing disorders was not found to be significantly correlated with aspiration on videofluoroscopy. We, as clinicians, would fail if we relied on intuition to identify which patients are aspirating.

In this pilot study, clinical evaluation alone does not seem to be reliable or efficient for predicting aspiration in the AHNC population. More work is needed to develop an efficient, focused, and directed dysphagia evaluation that can more accurately alert the clinician to whether the patient aspirates or to at least identify the patients who are at risk for aspiration. Until more patients are evaluated to identify more accurate clinical predictors of aspiration, we recommend videofluoroscopy.

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**Table 3. Dysphagia Evaluation Correlation With Predictive Values, Sensitivity, Specificity, and Correct Classification**

<table>
<thead>
<tr>
<th>Dysphagia Evaluation Part</th>
<th>PPV</th>
<th>NPV</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Correctly Classified†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directed medical history</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVOIDS PURED FOODS</td>
<td>100</td>
<td>67</td>
<td>27</td>
<td>100</td>
<td>70 (19/27)</td>
</tr>
<tr>
<td>WET VOICE QUALITY</td>
<td>80</td>
<td>68</td>
<td>36</td>
<td>94</td>
<td>70 (19/27)</td>
</tr>
<tr>
<td>Physical examination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WET VOICE QUALITY</td>
<td>71</td>
<td>70</td>
<td>45</td>
<td>88</td>
<td>70 (19/27)</td>
</tr>
<tr>
<td>Food challenge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COUGHS OR CHOKES ON LIQUIDS</td>
<td>60</td>
<td>70</td>
<td>33</td>
<td>88</td>
<td>68 (17/25)†</td>
</tr>
<tr>
<td>COUGHS OR CHOKES ON PUREE</td>
<td>0</td>
<td>67</td>
<td>0</td>
<td>100</td>
<td>67 (16/24)§†</td>
</tr>
<tr>
<td>WET OR HOARSE VOICE ON LIQUIDS</td>
<td>100</td>
<td>70</td>
<td>30</td>
<td>100</td>
<td>73 (19/28)</td>
</tr>
<tr>
<td>WET OR HOARSE VOICE ON PUREE</td>
<td>100</td>
<td>67</td>
<td>11</td>
<td>100</td>
<td>68 (17/25)†</td>
</tr>
</tbody>
</table>

*All data are given as percentages unless otherwise indicated. PPV indicates positive predictive value; NPV, negative predictive value.
†The numerator indicates the number of patients with the symptom; denominator, total number of patients evaluated.
‡Two patients with clinically gross aspiration were not tested with food challenge.
§One patient who was noted to grossly aspirate with liquids was not tested with other consistencies.

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**Table 4. Educated Prediction of Aspiration**

<table>
<thead>
<tr>
<th>Videofluoroscopic Swallowing Study Result</th>
<th>(−) Aspiration</th>
<th>(+) Aspiration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(−) Prediction of aspiration</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>(+) Prediction of aspiration</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>11</td>
<td>27</td>
</tr>
</tbody>
</table>

*Positive predictive value equals 60% (6 of 10 patients); negative predictive value, 71% (12 of 17 patients); sensitivity, 55% (6 of 11 patients); specificity, 75% (12 of 16 patients); and correctly classified, 67% (18 of 27 patients).
for the objective determination of aspiration in newly diagnosed nontreated AHNC. Pretreatment determination of aspiration is indicated in many patients with AHNC, particularly those who are candidates for organ-preservation protocols. Videofluoroscopic evaluation not only gives accurate information about aspiration, but also can be used to direct the patient in diet changes, postural modifications, sensory enhancement techniques, and various swallowing maneuvers to improve swallowing function. Developing a more efficient dysphagia evaluation may free resources for rehabilitation endeavors.

CONCLUSIONS

The prevalence of aspiration in our pilot study in patients with newly diagnosed untreated AHNC was 41%. Clinical evaluation alone is inadequate in predicting patients who aspirated determined objectively by videofluoroscopy. Though we have identified several elements in the clinical examination that correlate with aspiration on videofluoroscopy, more study is needed to develop an efficient dysphagia evaluation to identify patients most at risk.

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REFERENCES