Pulmonary Aspiration of Nasal Secretions in Patients With Chronic Sinusitis and Asthma

Muge Ozcan, MD; Hulya Ortapamuk, MD; Seniha Naldoken, MD; Isil Olcay, MD; K. Murat Ozcan, MD; Umit Tuncel, MD

Background: The role of silent aspiration of nasal secretions in the pathogenesis of asthma has often been questioned.

Objective: To investigate the presence of pulmonary aspiration of nasal secretions during sleep in patients with chronic sinusitis and asthma and in healthy controls.

Design: Prospective, controlled trial.

Subjects: The study included 13 patients with chronic sinusitis and asthma and 12 healthy controls. The diagnoses were based on history, physical examination findings, radiologic assessments, and pulmonary function test results.

Interventions: A radioactive tracer was prepared by diluting 10 mCi of technetium 99m–labeled macroaggregated albumin in 10 mL of physiologic saline. At 10 PM, just before the patients went to sleep, the solution was sprayed into their nostrils. The subjects were examined with a gamma camera to obtain views of the thorax at 8 AM the following morning. The average counts of the lungs and background and the actual lung counts (average lung count minus average background count) were determined.

Results: The average counts of the lungs were significantly greater than the average counts of the background in both the sinusitis-asthma group (P = .001) and the control group (P = .002). The difference in the actual counts of the lungs was not significant between the 2 groups (P = .79).

Conclusions: The nasal secretions were aspirated into the lungs both in patients with sinusitis and asthma and in healthy adults during sleep, and the relative amounts that were aspirated did not differ significantly between the 2 groups (P = .79). The amount of the aspirated material alone is probably not responsible for the pathogenesis of asthma in patients with chronic sinusitis.


The epidemiological association of asthma and sinusitis is well known. Treatment of sinusitis, either medical or surgical, has been demonstrated to improve management of asthma, although the reasons for that are not clear. Aspiration of sinonasal secretions into the lungs is one of the several hypotheses regarding the pathogenesis of asthma in patients with sinusitis. The results of previous studies that have investigated the pulmonary aspiration of nasal contents are quite conflicting.1-3 The present study was designed to determine the presence of pulmonary aspiration of the nasal secretions during sleep in patients with chronic sinusitis and asthma and in healthy controls.

METHODS

This prospective, controlled study included 13 patients with chronic sinusitis and asthma and 12 healthy volunteers. The patient group consisted of 6 females and 7 males between the ages of 17 and 70 years (average age, 35.4 years). The control group consisted of 7 females and 5 males between the ages of 25 and 62 years (average age, 35.8 years). The study was explained to all subjects, and their oral informed consents were obtained. The study was approved by the institutional review board.

All patients with chronic sinusitis had symptoms (eg, nasal obstruction, nasal discharge, postnasal drip, headache, and halitosis) for at least 12 weeks before their first admission to the hospital. After undergoing a complete otorhinolaryngological examination and plain sinus radiography, the patients were treated with antibiotics, decongestants, and topical nasal steroids (budesonide aqueous nasal spray, 400 µg/d) for 4 weeks. Para-nasal computed tomographic scans were performed because of persistence of the symptoms. Chronic mucosal disease was evident in all computed tomograms, and surgical treatment was planned.

Asthma was diagnosed on the basis of history of reversible airway obstruction, physical...
Patients with septal deviation, nasal polyposis, a history of nasal or pulmonary surgical intervention, respiratory disease other than asthma, pregnancy, or a history of smoking were excluded. The patients were questioned regarding a history of allergy. In vitro specific IgE levels were determined for aeroallergens by enzyme immunoassay. In case of a positive history and/or a positive result for any aeroallergen (>0.35 IU/mL), the patient was regarded as allergic and was excluded from the study.

A radioactive tracer was prepared by diluting 10 mCi (370 MBq) of technetium 99m-labeled macroaggregated albumin (99mTc-MAA) with a half-life of 6 hours in 10 mL of physiologic saline. A nasal pump spray was used to administer the solution into the nose. The volume ejected from the pump was 50 μL for each puff. The whole-body dose that was yielded from 1 mCi of 99mTc was 15 millirads (150 μGy). At 10 PM, just before the patients went to sleep, 2 puffs of spray were directed into the nose. The subjects drank several glasses of water before imaging to clear the radioactivity from the oropharynx and esophagus. A commercially available gamma camera equipped with an all-purpose, low-energy collimator was used for imaging. Anterior thorax images were obtained in 256 × 256 matrix size. One million counts were collected for each image. An all-purpose, low-energy collimator was used for imaging. The results of our study indicate that silent pulmonary aspiration of nasal secretions takes place both in patients with sinusitis and asthma in normal adults during sleep. The association between asthma and sinusitis was recognized more than a century ago. There is a high

The difference between the actual counts of the right lungs and background was statistically significant in the sinusitis-asthma group (P = .001). This difference was also significant in the control group (P = .002) (Table). These results reveal that the nasal secretions gain access into the lungs both in patients with chronic sinusitis and asthma and in normal controls. The difference in the actual counts of the lungs between the 2 groups was not statistically significant (P = .79), nor were the counts of the background (P = .28) (Table). The difference between the left and the right background counts was not statistically significant (P = .72); therefore, the background was quite uniform.

There were no significant differences between the actual counts of the right lungs (P = .59) and the left lungs (P = .07) in the sinusitis-asthma and control groups when the right and left lungs were considered separately. The difference between aspiration into the right and left lungs of the subjects was not significant in the sinusitis-asthma group (P = .31), whereas aspiration into the right lung was more prominent in the control group (P = .003).

When the scans were visually examined, hot spots (deposition of the radioactive material in the lungs) were seen in 4 patients in the sinusitis-asthma group and in 3 patients in the control group (Figure). The radioactive material was also observed in the gastrointestinal tract in all patients.

The Mann-Whitney U test and the Wilcoxon test were used for statistical analysis. P < .05 was considered statistically significant.

### RESULTS

### COMMENT

The results of our study indicate that silent pulmonary aspiration of nasal secretions takes place both in patients with sinusitis and asthma and in normal adults during sleep. The association between asthma and sinusitis was recognized more than a century ago. There is a high

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Lung</th>
<th>Background</th>
<th>ALC</th>
<th>Mean</th>
<th>ALC</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6226</td>
<td>0.1625</td>
<td>0.1525</td>
<td>0.1575</td>
<td>0.4651</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.4784</td>
<td>0.1312</td>
<td>0.1000</td>
<td>0.1156</td>
<td>0.3628</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.3149</td>
<td>0.3150</td>
<td>0.2600</td>
<td>0.2875</td>
<td>0.0274</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.4869</td>
<td>0.1900</td>
<td>0.1902</td>
<td>0.1901</td>
<td>0.2968</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.4354</td>
<td>0.2750</td>
<td>0.2600</td>
<td>0.2675</td>
<td>0.1679</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.5126</td>
<td>0.1982</td>
<td>0.2100</td>
<td>0.2041</td>
<td>0.3175</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.6944</td>
<td>0.1869</td>
<td>0.1949</td>
<td>0.1909</td>
<td>0.5053</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.5365</td>
<td>0.1145</td>
<td>0.1145</td>
<td>0.1145</td>
<td>0.4220</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0.4849</td>
<td>0.1927</td>
<td>0.1927</td>
<td>0.1927</td>
<td>0.2022</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.6698</td>
<td>0.2575</td>
<td>0.3066</td>
<td>0.2821</td>
<td>0.3877</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>0.5072</td>
<td>0.2298</td>
<td>0.2304</td>
<td>0.2301</td>
<td>0.3401</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0.6583</td>
<td>0.2557</td>
<td>0.2545</td>
<td>0.2551</td>
<td>0.4032</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>0.6945</td>
<td>0.2567</td>
<td>0.3498</td>
<td>0.3033</td>
<td>0.3912</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: ALC, actual lung count; L, left lung; R, right lung.

©2003 American Medical Association. All rights reserved.
The arrows show the hot spots in the lung indicating aspiration of the radioactive material (b indicates background; GI, gastrointestinal tract; and k, kidney).

incidence of radiographic evidence of sinusitis (30%–70%) in patients with asthma, and, conversely, 34% of the patients with sinusitis have asthma. It has been reported that medical and surgical treatment of sinusitis causes an improvement of the asthma when the 2 conditions coexist. Those data strongly suggest that sinusitis plays an etiologic role in lower airway disease. The mechanism by which sinusitis might induce or aggravate asthma is not clearly known. There are several hypotheses, including the presence of the nasobronchial reflex, enhancement of β-adrenergic blockade by bacterial toxins, and delivery of cytokines and bronchoconstrictive mediators that were produced in sinuses into the lungs by either blood or aspiration.

Silent aspiration of sinonasal secretions into the lungs has been investigated only in a few radionuclide studies. Some authors have reported the presence of pulmonary aspiration. Huxley et al studied 20 healthy subjects and 10 patients with depressed consciousness to investigate aspiration of pharyngeal secretions during sleep. They found that 70% of the patients and 45% of the healthy subjects aspirated nasal secretions during sleep. Ozagar et al investigated aspiration of nasal secretions into the lungs in patients with acute sinonasal infections and concluded that the amount of secretions aspirated into the lungs did not increase during acute sinonasal infection. Contrary to the results of the aforementioned studies, Bardin et al did not demonstrate pulmonary aspiration of sinus contents in 13 patients with chronic maxillary sinusitis in serial scintigraphic evaluation of the lungs within a period of 24 hours.

Sleep is the most probable time of the day for silent aspiration of the nasal secretions, because the cough reflex is depressed during this time. A greater stimulus is required to produce cough during sleep, and in deep sleep a stimulus must first result in arousal to a lighter level of sleep before cough occurs. Technetium 99m–labeled MAA is nonabsorbable through the respiratory tract, so diffusion into the bloodstream does not play a role in its physical clearance. The normal mucociliary clearance half-life of inhaled 99mTc-MAA is 24 hours. Delayed mucociliary clearance is seen in patients with airway inflammation (eg, chronic obstructive pulmonary disease, asthma, and viral infections). Physiologic factors such as aging and sleep can also delay mucociliary clearance. The mucociliary clearance time is not known in case of aspiration; however, Bardin et al reported that the material was still visible in the lung 24 hours after its bronchoscopic administration into the bronchus. The swallowed 99mTc-MAA is not absorbed through the gut. However, the prepared solution may contain a small amount of free 99mTc. Moreover, an additional amount of free 99mTc may be released owing to digestion of the albumin. The absorption of free 99mTc into the circulation causes a background radioactivity that must be estimated in order to demonstrate the actual pulmonary aspiration of the material. The background radioactivity may differ among individuals but must be more or less constant in different regions of the same person, as was the case in our study.

The results of our study reveal that the nasal secretions are aspirated into the lungs both in patients with sinusitis and asthma in normal adults during sleep. Similar to Ozagar et al, we measured the radioactivity in the lungs and background in an objective manner and obtained numerical data for statistical analysis. In fact, it is very difficult to determine the real amount of the aspirated nasal secretion into the lungs. In this study, we demonstrated the “relative” pulmonary aspiration by subtracting the background count from the count of the lungs. The amount of this relative aspiration was not significantly different between the healthy controls and the patients with sinusitis and asthma (P = .79). Therefore, the amount of the aspirated material alone is probably not responsible for the pathogenesis of asthma in patients with chronic sinusitis.

It may be concluded that nasal secretions are aspirated into the lungs both in normal adults and in patients with chronic sinusitis and asthma. The relative amount of aspirated material did not differ significantly between the 2 groups in the present study (P = .79). Therefore, it can be hypothesized that the contents of the aspirated material, rather than its amount, play a role in the pathogenesis of asthma. Long-term irritation of the lower airways with both bacterial toxins and inflammatory products in nasal secretions may induce or aggravate asthma as a result of the silent aspiration of those materials in patients with chronic sinusitis. Further studies are needed to confirm this hypothesis.

CONCLUSIONS

©2003 American Medical Association. All rights reserved.

Downloaded From: https://archotol.jamanetwork.com/ by a Non-Human Traffic (NHT) User on 04/23/2019
Submitted for publication August 26, 2002; final revision received November 20, 2002; accepted December 17, 2002.

Corresponding author and reprints: Muge Ozcan, MD, Yucetepe sitesi, A blok 59/6, 06580 Anittepe Ankara, Turkey (e-mail: mugeozcan@yahoo.com).

REFERENCES


CME Announcement

In fall 2003, online CME will be available for JAMA/Archives and will offer many enhancements:

- Article-specific questions
- Hypertext links from questions to the relevant content
- Online CME questionnaire
- Printable CME certificates and ability to access total CME credits

We apologize for the interruption in CME and hope that you will enjoy the improved online features that will be available in fall 2003.