Background: The occurrence of second primary neoplasms in patients with head and neck carcinoma assumes greater importance as our ability to control local disease improves. Both the primary lesions and the therapeutic interventions can predispose patients to pulmonary complications.

Objective: To explore the incidence of pulmonary complications in patients with head and neck cancer who also undergo lung surgery.

Design: Survey; case series.

Setting: A tertiary care university hospital.

Results: The clinic and hospital charts of 32 patients with multiple interventions of the head and neck and lung were retrospectively reviewed, and data were recorded on the clinical and pathologic specifics of primary and second-ary neoplasms, pulmonary complications, and treatment outcomes. Twenty-eight (88%) of these patients underwent a diagnostic or therapeutic surgical procedure for a head and neck primary neoplasm. All patients (100%) underwent a pulmonary resection for malignant or non-malignant pulmonary disease. Overall, 31 patients (97%) experienced either major or minor pulmonary complications after surgery, 51 (79%) of which occurred during the immediate postoperative course. Major complications occurred in 11 patients (34%), which were fatal in one.

Conclusions: Our data suggest that patients with head and neck cancer who also experience a second pulmonary disease requiring lung resection are at high risk of developing serious pulmonary complications. These risks should be considered in planning optimal therapy.

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AS OUR ABILITY to treat head and neck cancer continues to improve, there is an increasing awareness of the effects of synchronous and metachronous primary lesions on the final outcome. It is well known that patients who are successfully treated for head and neck squamous cell carcinoma of the upper aerodigestive tract are at risk for development of a second primary tumor, with early-stage patients being at higher risk. This risk remains stable for many years, despite cessation of behavioral risk factors. These second primary tumors are thought to be attributable to the “field-cancerization” effects of known behaviors such as long-term tobacco and alcohol intake. Patients with an index tumor of the larynx are at particular risk for the development of a pulmonary malignancy.

Head and neck neoplasms, as well as their treatment, can impair deglutition and predispose the patient to aspiration. Resection of preceding or subsequent pulmonary carcinomas can have transient or permanent effects on the patient's pulmonary function, resulting in impaired pulmonary protective mechanisms. Certain patients who undergo pulmonary resections for carcinomas of bronchopulmonary origin may be at higher risk of experiencing a pulmonary complication after surgery.

Few studies have documented the incidence of pulmonary complications in patients who have had treatment for both head and neck and lung neoplasms. The purpose of this study was to determine the incidence of pulmonary complications in patients with head and neck disease who have had prior or subsequent pulmonary resections.

RESULTS

Thirty-two patients had adequate data for inclusion in our study. The mean ± SD age was 59.0 ± 12.3 years (age range, 27-81
PATIENTS AND METHODS

The head and neck tumor database of the Department of Otolaryngology–Head and Neck Surgery at the University of Pittsburgh Medical Center, Pittsburgh, Pa, was reviewed, and the names of all patients who had an index head and neck carcinoma or sarcoma during the years 1978 to 1989 were cross-referenced with individuals who had undergone pulmonary resections during that same period. A total of 75 patients were identified. Clinic and hospital charts were reviewed, and information was collected on patient demographics, surgical procedures, clinical and pathologic data, preoperative pulmonary function tests, radiographic or clinical incidence of pulmonary complications, and outcome.

Pulmonary complications were defined as clinically significant atelectasis requiring some intervention (including incentive spirometry, antibiotics, or bronchoscopy), pulmonary effusion, prolonged pneumothorax of more than 3 days’ duration, pneumonia, or other, more serious complications, including cardiorespiratory death, severe aspiration, and pharyngotraheal fistula formation. The overall incidence of pulmonary complications was divided into major and minor based on the criteria proposed by Deslauriers et al. This group defined minor complications as events thought to have no significant impact on the patient’s postoperative course, including atelectasis requiring less than 2 bronchoscopies, pleural effusion, pneumothorax, and arrhythmias responsive to treatment. Our definition included the criteria defined by Deslauriers and colleagues, as well as hemoptysis and bronchitis, as minor complications. All other complications were thought to be major. Individuals without adequate clinical or follow-up data were excluded. These data were compared with historical data presented in the literature.

Two patients had synchronous primary tumors: 1 with tumors of the larynx and oral tongue. We also included 2 patients with unknown primary sites who had cervical lymph node metastases, and 1 who had a recurrence at an undocumented primary site.

In 8 cases (25%), the stage of disease was unknown. Of the remainder, the majority presented with advanced-stage disease: 4 patients (13%) had stage I disease, 3 (9%) had stage II disease, 2 (6%) had stage III disease, and 1 (4%) had stage IV disease. Finally, 1 patient (3%) experienced a recurrence at the skull base; therefore, his disease was not classified according to the TNM staging system.

The vast majority (28 [88%]) of the patients underwent a surgical procedure for the head and neck cancer. Two patients each (12% total) underwent either chemotherapy and radiation therapy or radiation therapy alone for the primary tumor. Of the patients who underwent a surgical diagnostic or therapeutic procedure, 14 (50%) had a laryngectomy. Eleven of these patients had a total laryngectomy, and 1 patient each had a laser supraglottic resection, a modified supraglottic resection, and an extended vertical hemilaryngectomy. Also, among the patients receiving surgery were 3 who underwent either a composite resection or a mandibulectomy and 2 patients who underwent a glossectomy. Two patients had a neck dissection alone, while the surgery was not specified in another 2 patients. Finally, 1 patient each underwent a debulking procedure for an unresectable tumor, a biopsy alone, a submandibular gland excision, an excision of a soft palate lesion, and a total laryngopharyngectomy.

Thirteen (46%) of the 28 patients who underwent surgical intervention received adjuvant therapy: 6 underwent postoperative radiation therapy, 1 of whom had radium implant brachytherapy; 4 underwent chemotherapy and radiation therapy; and 3 underwent chemotherapy alone.

Primary lung disease demonstrated a variety of entities:

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. (%) of Patients</th>
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<tbody>
<tr>
<td>Squamous cell carcinoma</td>
<td>21 (68)</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>6 (19)</td>
</tr>
<tr>
<td>Adenoid cystic carcinoma</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Metastatic sarcoma</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Bronchogenic cyst</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Exogenous lipid pneumonia</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Desquamative interstitial pneumonia</td>
<td>1 (3)</td>
</tr>
</tbody>
</table>

Only 14 patients had their pulmonary neoplasm classified by TNM staging criteria. Of these, the majority (10 [71%]) had stage I disease, and 4 (29%) had stage III disease. All patients underwent some type of pulmonary resection of their pulmonary lesion: 20 patients (63%) underwent a wedge resection; 11 (34%) underwent a lobectomy; and 2 (6%) underwent a segmental resection. Five patients underwent 2 simultaneous wedge resections, and 1 patient underwent a wedge resection in conjunction with a chest wall resection. These 6 patients were considered to have undergone just a wedge resection. One patient underwent a wedge resection in conjunction with a lobectomy and was considered to have undergone 2 separate procedures.

We found sporadic reference to smoking history or pulmonary history in the charts, which did not warrant evaluation. Twenty-five patients (78%) underwent a pre-
operative pulmonary function test. Twenty-one (84%) of the 25 patients had forced vital capacities (percentage of the predicted value) of 70% or more, whereas only 16 (64%) had a forced expiratory volume of 70% or more in the first minute. Finally, of the 14 patients in whom the diffusion capacity of carbon monoxide was measured, 9 (64%) were found to have more than 70% of the expected value. No prognostic value was noted for these measurements.

The mean ± SD follow-up period for our patient population was 14.4 ± 14.6 months (range of follow-up, 1-55 months) from the date of intervention of the second surgical procedure. All (97%) but 1 patient experienced a pulmonary complication within the follow-up interval (Table). Perioperative pulmonary complications (within the immediate hospitalization for surgical resection) were encountered in 79% (n = 29) of the patient population. Twenty-one (66%) of these patients experienced an effusion that was noncardiogenic in origin, whereas only 8 (25%, or 38% of those with effusion) went on to develop pneumonia. Thirteen patients (41%) had atelectasis documented on plain chest radiograph. Furthermore, 12 patients (38%) had prolonged pneumothorax as a result of the procedure. Three patients experienced pulmonary edema in the perioperative period. Three patients experienced hemoptysis, 1 of whom required a visit to the emergency department. One patient each experienced bronchitis, a pulmonocutaneous fistula, and aspiration following a tracheotomy placement. Finally, 1 patient experienced a cardiopulmonary arrest due to hypoxemia.

All 11 patients who underwent a total laryngectomy experienced a pulmonary complication. Of these patients, 4 (36%) experienced a major complication. The complication rate does not significantly differ from the 94.5% incidence of pulmonary complications experienced by the patients who underwent treatments other than a total laryngectomy. Of these patients, 9 (41%) experienced a major pulmonary complication (P > .99, 2-tailed Fisher exact test).

At the time of last follow-up visit, 15 patients (47%) were without any evidence of disease, 10 patients (31%) were dead of their disease, and 6 patients (19%) were alive with disease. Two patients died of intercurrent illness of unspecified cause, and both were without evidence of disease. One patient was unavailable for follow-up.

Recent studies have begun to explore the effects that social, psychological, and comorbid factors play on the outcomes of patients with head and neck cancer.16,17 These comorbidities must be factored into treatment strategies to ensure an optimal outcome. Patients with head and neck carcinoma are at increased risk for the development of a synchronous or metachronous primary lesion, including pulmonary tumors, which needs to be considered in the overall treatment strategy.

Our review has demonstrated that patients who have experienced both head and neck and lung disease are at increased risk of having pulmonary complications. The overall mortality rate in the postoperative period in our study was 3.1%, which compares with that reported by Massard et al.9 In their review of 114 consecutive patients with primary bronchogenic cancer and a history of upper aerodigestive cancer, they demonstrated a mortality rate of 3.5%. They reported a total nonfatal morbidity rate of 28.1%, which is dramatically different from the 78.8% incidence of perioperative pulmonary complications that we found. Furthermore, we found that nearly all patients (97%) will experience some type of pulmonary complication. Massard and colleagues did not present any data to address this question.

Our review did include certain pulmonary complications (prolonged pneumothorax, hemoptysis, pulmonary edema, or fistula) that were not necessarily attributable to the head and neck surgical problem. The incidence of pulmonary complications in patients undergoing thoracotomies for lung carcinoma was studied by Busch et al.10 who found that 39% of 106 patients experienced a pulmonary complication. The majority of their patients experienced a major complication (22%), which was defined as pneumonia or the need for (1) mechanical support for more than 4 days, (2) a tracheotomy, or (3) repeated bronchoscopies. Their reported incidence of fatalities attributable to pulmonary complications was 2% of the entire population and 33% of the overall deaths. Other, older series have reported that between 50% and 70% of deaths were directly attributable to pulmonary complications.11,12

Our population consisted of a significant number of patients who underwent total laryngectomies. Therefore, comparisons of the pulmonary complication rates in patients who undergo total laryngectomy deserve mention. A review of pulmonary complications experienced by patients who underwent total laryngectomies at our institution has been previously published.13 In this review, postoperative pulmonary complications occurred in 12 (3.7%) of the 384 patients involved. This figure is dramatically different from the 97% incidence of total pulmonary complications found in our series. Furthermore, 4 (36%) of the patients in our review who underwent a total laryngectomy experienced a major complication. The incidence of major or total pulmonary complications did not significantly differ between the patients who underwent a total laryngectomy and those

<table>
<thead>
<tr>
<th>Pulmonary Complications</th>
<th>No. (%) of Patients</th>
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<tbody>
<tr>
<td>None</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Minor</td>
<td>29 (91)</td>
</tr>
<tr>
<td>Effusion</td>
<td>21 (66)</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>13 (41)</td>
</tr>
<tr>
<td>Prolonged pneumothorax</td>
<td>12 (38)</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Major</td>
<td>11 (34)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>8 (25)</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Aspiration</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Fistula formation</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Pulmonaryogenic fatality</td>
<td>1 (3)</td>
</tr>
</tbody>
</table>
who underwent other head and neck therapeutic interventions.

There are several factors that contribute to the development of pulmonary complications in patients who undergo a total laryngectomy. First, they lose the ability to contract expiratory muscles against a closed glottis, which prevents a sudden increase in intrathoracic pressure and thereby decreases the energy available to shake the tracheobronchial tree.14 Second, patients who undergo a total laryngectomy and a pulmonary resection have a decrement in vital capacity, which potentially decreases the total volume and duration of expiration available to expel pulmonary secretions. Third, several investigators have found that pulmonary functions in patients who have undergone a total laryngectomy are not normal and that the expiratory pulmonary function was significantly lower than expected.15

Another change in pulmonary function may be the loss of the natural positive end-expiratory pressure provided by the glottis. This loss may cause atelectatic collapse of small airways,16 predisposing the patient to such complications as pneumonia. Furthermore, patients with synchronous or metachronous primary neoplasms of the aerodigestive tract may have a longer or more involved smoking history, possibly impairing mucociliary clearance.17

These findings have implications for the treatment strategy for patients with head and neck primary neoplasms who have had prior lung surgery. Preoperative pulmonary function tests do not seem to help identify the patients who will go on to experience these complications. If a patient is a candidate for a conservative or partial laryngectomy, the physician may decide against such a procedure in order to give that patient the highest likelihood of avoiding respiratory difficulties. The risk of pulmonary morbidity may tip the balance toward more radical procedures, such as total laryngectomy, or non-surgical therapy. Even with a total laryngectomy, however, patients may develop pulmonary problems.

Because of the limited number of patients who underwent radiation therapy alone or chemotherapy in conjunction with radiation therapy, no conclusions can be made about the safety of these modalities as an alternative. The use of combined chemotherapy and radiation therapy protocols is beginning to result in excellent local and regional control of upper aerodigestive tract tumors. Yet, the increased incidence of distant failure in conjunction with an increased risk of pulmonogenic complications may influence decisions to treat in this fashion. These questions remain to be elucidated.

Patients who undergo oncologic head and neck surgery and require subsequent pulmonary resection should be closely monitored and may need further surgery to prevent these potential problems. Treatment options include tracheostomy with a Passy-Muir valve, laryngeal stent, laryngotraheal separation, or total laryngectomy.

In conclusion, a retrospective chart review of 32 consecutive patients who experienced head and neck neoplasms and who underwent a pulmonary resection revealed that these patients are at increased risk of developing pulmonary complications. The majority of these patients will experience complications in the perioperative period, but may be at continued risk during follow-up. Without proper recognition and intervention, pulmonogenic fatality may result. These points should be considered in planning the treatment of patients who are at risk for the development of more than 1 primary lesion of the upper aerodigestive tract.

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REFERENCES