Carcinoma of the Lung in Iceland*

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The population of Iceland is almost 200,000. High standards of living and education associated with a carefully controlled national health program and medical statistics make possible a thorough investigation of the incidence and epidemiology of diseases. In the field of geographic pathology, the compiled statistics should therefore provide reliable data in spite of a small number of individual cases.

Lung cancer was a rare disease in Iceland until a few years ago. In a total of 1,738 necropsies performed at the Department of Pathology of the University of Iceland during the years 1932-1950, there were only 14 cases of primary lung carcinoma (11 men and three women). There has since been a significant increase in the incidence: in the years 1951-1960 48 cases were found in 1,955 necropsies (32 men and 16 women).

In Iceland, there is no mining or heavy industry to contaminate the atmosphere. Other pulmonary irritants, such as smoke from coal or oil furnaces are rather insignificant, since the only urban community, the capital Reykjavik (pop. 80,000) is mainly heated with hot spring water. The industry is small scale and mostly powered by electricity. Automobile exhaust gas has been insignificant as automobiles have not been a common family property until the last decade. Cigarette smoking was uncommon in the country until the Second World War, but has increased continuously and has now become quite popular. Figure 1 shows the increase in sale of cigarettes in the country during the years 1920 to 1959 and the curve has continued upward at the same rate. There seems, therefore, to be a good reason to link the increasing incidence of carcinoma with smoking, other contamination of the atmosphere being negligible.

This report is a survey of lung cancer in Iceland during a 34-year period from 1931 to 1964. The age, sex and geographic distribution is recorded and a comparison made between smoking habits and histologic types of carcinoma.

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Table 1—Carcinoma of Lung in Iceland (Average annual incidence per 100,000)

<table>
<thead>
<tr>
<th></th>
<th>1955-59</th>
<th>1960-64</th>
<th>1955-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>10.3</td>
<td>13.6</td>
<td>12.1</td>
</tr>
<tr>
<td>Women</td>
<td>5.1</td>
<td>7.8</td>
<td>6.5</td>
</tr>
</tbody>
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Facilities for thoracic surgery were first available in 1955 and a special investigation is made of the material from the Department of Thoracic Surgery of the University of Iceland, which is the only surgical chest service in the country.

One of us (G.F.P.²) has previously summarized all cases of lung carcinoma diagnosed clinically and verified histologically in the country during the years 1931 to 1954 and this material will be included in the present study. The remainder of the cases comes from the files of the National Cancer Registry, which was established in 1955. The Department of Pathology of the University of Iceland is the only pathologic institute in the country and all hospitals send their surgical or necropsy material there for histologic diagnosis. Most patients dying in the University Hospital come to necropsy in the department and all the other hospitals in the city use the same facility. The surgical files and necropsy protocols of the Department of Pathology therefore cover all the pathologic-anatomic examinations in the country from the beginning. The Cancer Registry has from the beginning been partly based on the files of the Department of Pathology.

With these studies combined, 197 cases of primary lung carcinoma were found. The hospital records of all the patients were studied, and the macroscopic descriptions of the surgically resected lungs and necropsies were reviewed. All available microscopic slides were re-examined and the tumors classified histologically. A standard classification was adhered to: squamous cell carcinoma, undifferentiated large cell carcinoma, small cell carcinoma (oat cell carcinoma), adenocarcinoma and alveolar cell carcinoma (bronchiolo-alveolar cell carcinoma). In this way, we were able to classify histologically 116 cases (70 per cent) of the total in the last ten-year period. There were 34 patients with primary lung carcinoma during the first part of the study period, which covered the years 1931-1954. In the Cancer Registry, which covers the years 1955-1964, 163 patients were listed and we have chosen to divide this period into two five-year intervals to demonstrate better the increase in incidence of lung carcinoma. We have also divided the Cancer Registry material in two subgroups from the standpoint of the clinical course of the patients. In group A are 82 patients who were admitted to the University Hos-

### Table 2—Carcinoma of Lung in Iceland

<table>
<thead>
<tr>
<th>Years</th>
<th>Urban Men</th>
<th>Urban Women</th>
<th>Urban Total</th>
<th>Rural Men</th>
<th>Rural Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931-1954</td>
<td>25</td>
<td>9</td>
<td>34</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>1955-1959</td>
<td>43</td>
<td>21</td>
<td>64</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>1960-1964</td>
<td>64</td>
<td>35</td>
<td>99</td>
<td>31</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td>65</td>
<td>197</td>
<td>114</td>
<td>57</td>
</tr>
</tbody>
</table>

### Table 3—Carcinoma of Lung in Iceland 1955-1964

<table>
<thead>
<tr>
<th>Histologic Types</th>
<th>Group A</th>
<th>Group B</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Squamous</td>
<td>20</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>11</td>
<td>7</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Oat cell</td>
<td>14</td>
<td>6</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Alveolar</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Group A—Patients admitted to the Thoracic Surgical Department, University Hospital.
Group B—Patients from other hospitals.
hospital for diagnosis and/or treatment and in group B are 81 patients who were admitted to other hospitals. There is reason to believe that most patients suspected of having resectable lung carcinoma, have been referred to the Department of Thoracic Surgery after it was established in 1955 and are therefore included in group A.

The average annual incidence of lung carcinoma is shown in Table 1. The figures from the Cancer Registry were used and the two five-year periods listed separately and combined.

In Fig. 2 the age and sex distribution during the entire study period is shown.

Table 2 lists the sex and geographic distribution within the three separate time intervals of the study period.

Table 3 shows the revised histologic classification of the lung carcinomas and Table 4 shows the relationship between smoking and histologic types.

During the years 1955 to 1964 a total of 55 thoracic operations were performed because of suspected primary carcinoma of the lung. The operations can be subdivided according to the extent of the final surgical procedure: exploratory thoracotomies 31 (26 men and five women), pneumonectomies 18 (12 men and six women) and lobectomies six (four men and two women). Most of the operations were performed during the last years of the period. Table 5 summarizes the results, histologic types, resectability and survivals as well as mediastinal lymph node involvement. Numbers in brackets are two to five and one-half year survivals. Four of the patients had only palliative resections. The total resectability rate was 43.6 per cent or 24 of 55 patients.

It is hoped that more intensive preoperative investigations may improve this last figure. On the other hand, aiming at a high resectability rate may tend to deprive patients with doubtfully resectable tumors of a possible cure or at least palliative surgery. A surgical resection was performed on 28.5 per cent of the patients with lung cancer diagnosed in the country during this period. The mortality rate (within 30 days of the operation or subsequently from some complication which could be directly attributed to surgery) was 3.2 per cent in the group of explorative thoracotomies, 5.6 per cent in the group of pneumonectomies and none with lobectomies. Total mortality rate in the resected series is therefore 4.2 per cent. Of the pneumonectomies, 22 per cent were extended resections with no mortality.

Of the patients with squamous cell carcinoma, 48 per cent of the tumors were
resectable and 70 per cent of the patients are now living two to five and one-half years later. Of those surviving, 57 per cent had involvement of the mediastinal lymph nodes at surgery. There was no operative death among the patients with squamous cell carcinoma. The remainder of the patients with squamous cell carcinoma lived nine months to three and one-half years after the resection.

Of the patients with undifferentiated carcinoma, 33 per cent had resection and 16.7 per cent of those were alive 26 months later. One of those patients died five weeks after surgery from bronchopleural fistula and empyema. This patient was the only one with major postoperative complications. The remainder of the patients with undifferentiated carcinoma lived nine to 27 months after the resection.

Of the patients with oat-cell carcinoma, only one had resection and he is still alive two and one-half years later, in spite of metastasis in mediastinal lymph nodes at surgery.

Of the patients with adenocarcinoma, 50 per cent had resection and none of them is now alive; the postoperative survival in this group varied from three to seven months, one died of pulmonary emboli, the others of metastatic disease. All the patients with alveolar cell carcinoma had resection, but there was no cure. This last group lived from five months to two and one-half years after the operation and 50 per cent of them had metastasis in mediastinal lymph nodes at surgery.

Of the entire group of patients having resection, 37.5 per cent are still living two to five and one-half years after the operation.

**DISCUSSION**

The figures in Table 1 clearly indicate the increase in incidence of lung carcinoma in the country and by comparison with the curve in Fig. 1, one can bring forth the theory that the increase is due to rapidly rising consumption of tobacco. The time interval of 15 to 20 years between the onset of smoking and occurrence of cancer
is also consistent with this theory. The age and sex distribution during the entire period appears in Fig. 2. The age incidence is comparable to statistics from other countries, but the high ratio of women is unusual, there being a man:woman ratio of 1.9:1 from 1955 to 1964 and 2.8:1 from 1931 to 1954.

When these figures are compared with the geographic distribution (Table 2), one can see that the incidence among men is similar in urban and rural areas, but among the women, there are twice as many primary lung carcinomas in the urban as in the rural group. The significance of these figures may lie in the fact that smoking among women occurs mainly in the urban areas and is relatively much less common in the rural group (urban:rural population—2:3).

The average age of the patients in group A is 55.8 years for men and 58.7 years for women. The corresponding figures for group B are 63.2 years for men and 69.8 years for women.

The pathologic study of the material shows a pattern of distribution among the histologic groups much different from larger studies in other countries. There is a peculiarly high incidence of oat-cell and undifferentiated carcinomas and a corresponding lower number of squamous cell carcinomas. Squamous cell carcinoma has always been the type most commonly linked with cigarette smoking, but our study shows that smoking is also fairly common among patients with undifferentiated and oat-cell carcinoma. In trying to explain the high incidence of these types of primary lung carcinoma, one has to imply that the oat-cell and undifferentiated carcinomas may also be induced by smoking in the same or a higher degree than the squamous type. This may indeed be true and possibly due to a genetically different host response or reactivity of the bronchial epithelium to the carcinogenic substances in the tobacco smoke. Icelanders are a highly inbred nation due to the geographic position of the country. Another peculiarity of malignant tumors among the nation is the remarkably high incidence of stomach cancer among both sexes, especially men, where it constitutes over 50 per cent of all cancers in death statistics.

The relationship between smoking and the histologic types is further stressed by the figures in Table 4. A true history of smoking habits is often difficult to obtain and in some of the case histories, there is even no mention of smoking, which accounts for the large number of cases in the unknown group.

**Summary**

During the period 1931-1964 197 cases of primary lung carcinoma were diagnosed in Iceland. Lung carcinoma is on the increase and a definite correlation is found with the sale of cigarettes in the country.

The incidence among women is high, especially in urban areas.

Surgery was performed on 55 patients:
- 31 exploratory thoracotomies, 24 resections.
- Mortality rate was 3.2 per cent in the group of exploratory thoracotomies and 4.2 per cent in the resected series.

There is a preponderance of oat-cell carcinoma (33.6 per cent) and undifferentiated carcinoma (34.5 per cent) in this series. Squamous cell carcinoma was found in only 19.8 per cent.

Prognosis is most favorable for patients with squamous cell carcinoma; 48 per cent were resected and 70 per cent of those are now living two to five and one-half years later.

**Resumen**

Durante el periodo 1931-1964 se diagnosticaron 197 casos de carcinoma pulmonar primario en Islandia. El carcinoma pulmonar está en aumento con una relación probada con la venta de cigarillos en ese país. La incidencia entre las mujeres es alta, particularmente en los medios urbanos.

Cincuenta y cinco pacientes fueron tratados quirúrgicamente: 31 toracotomías exploradoras y 24 resecciones. La mortalidad fue de 3.2 por ciento en el grupo de la operación exploradora y de 4.2 por ciento en el de las resecciones.

Se observó una preponderancia del "oat cell carcinoma" (33.6 por ciento) y carcinoma indiferenciado (34.5 por ciento). En esta serie el carcinoma a células escamosas se observó en solo el 19.8 por ciento.
El pronóstico es mas favorable en el carcinoma de células escamosas, de los cuales 48 fueron tratados por resección con supervivencia de dos a cinco años en el 70 por ciento.

RESUMÉ

197 cas de cancers primitifs du poumon ont été diagnostiqués en Islande entre 1931 et 1964. Le cancer pulmonaire est en extension et il y a un rapport formel entre cette extension et l'augmentation de la vente des cigarettes dans le pays.

La fréquence du cancer chez les femmes est élevé, particulièrement dans les zones urbaines.

55 malades furent traitées chirurgicalement; 31 furent l'objet d'une simple thoracotomie exploratrice; 24 subirent une résection. La mortalité fut de 3,2% dans le groupe de ceux qui avaient eu une thoracotomie exploratrice ed de 4,2% chez ceux qui avaient eu une exérèse.

Il y a dans cette série une prédominance de cancers à petites cellules (33,6%) et de cancers indifférenciés (34,5%). Les cancers épidermoïdes ne se trouvèrent que dans 19,8% des cas.

Le pronostic est bien meilleur chez les malades atteints de cancer épidermoïdes. Pour eux, 48% subirent une exérèse et 70% parmi eux sont encore vivants de 2 à 5 ans et demi après l'intervention.

ZUSAMMENFASSUNG


Die Häufigkeit bei Frauen ist hoch, besonders in städtischen Wohngebieten.

Bei 55 Patienten wurden chirurgische Maßnahmen durchgeführt; 31 mal eine Probethorakotomie, 24 mal eine Resektion. Die Mortalität betrug bei der Gruppe der Probethorakotomien 3,2%, bei der Gruppe der Resektionen, 4,2%.

Es zeigt sich ein Überwiegen von kleinzelligen Karzinomen (33,6%) und undifferenzierten Karzinomen (34,5%) in diesen Serien. Plattenepithelkarzinode wurden nur in 19,8% der Fälle gefunden.

Die Prognose ist am günstigsten für die Patienten mit Plattenepithelkarzinomen; es wurden 48% reseziert, von denen jetzt 70% zwei bis fünfhalb Jahre danach noch leben.

REFERENCES


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