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Influence of age on operative mortality and long-term survival after lung resection for bronchogenic carcinoma

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ABSTRACT: The proportion of elderly patients presenting with bronchogenic carcinoma is increasing. To study the impact of age on clinical presentation, management and outcome of patients, the authors have reviewed their clinical experience over the last 20 yrs.

Between 1977 and 1996, 1,079 patients underwent thoracotomy for primary lung carcinoma in the authors’ institution. Patients were grouped by age at the time of surgery as <60 yrs, 60–69 yrs and ≥70 yrs.

Although the mode of clinical presentation was similar between all age groups, patients <60 yrs were more prone to have advanced stage carcinoma at the time of diagnosis. The rates of exploratory thoracotomy and pneumonectomy were higher in patients <70 yrs, whereas lobectomies and lesser resections largely predominated in patients ≥70 yrs. The mortality rate following lobectomy and lesser resection increased from 1.3% in patients <60 yrs to 5.5% in patients ≥60 yrs (p=0.04) and the mortality rate following pneumonectomy increased from 6.5% in patients <60 yrs to 13.7% in patients ≥70 yrs (p=0.24). The specific long-term survival, which included only the patients who died from primary lung carcinoma, was similar in all age groups.

Operative mortality and survival rates are acceptable in patients ≥70 yrs. Therefore, age in itself should not constitute a contraindication to surgical lung resection for primary lung carcinoma as long as a careful preoperative assessment is performed to appropriately select surgical candidates.

As the population becomes older, the proportion of elderly patients presenting with primary lung carcinoma is increasing. Advanced age is considered as a risk factor for lung resection by many authors. However, most of the studies reporting hospital mortality according to patients’ ages were performed in the 1970s and early 1980s [1–4]. Although more recent series still report an increased operative mortality in patients >70 yrs, most of them were multicentre studies which included regional medical centres [3–6]. In contrast, other reports dealing with homogeneous groups of patients operated in one single institution and/or by the same surgeon have shown no difference in operative mortality according to age [7–9]. In order to study the impact of age on clinical presentation, management and outcome, the authors have reviewed their clinical experience over the last 20 yrs.

Materials and methods

Between January 1, 1977 and December 31, 1996 a total of 1,079 patients underwent thoracotomy for primary lung carcinoma in the authors’ institution. The authors retrospectively reviewed all available medical files and nursing charts and extracted data on methods of diagnosis, smoking habits, patients’ symptoms, types of surgical procedure, adjuvant therapy, histology and disease stage. Forty-eight patients were excluded from the analysis, 38 due to metastasis at the time of surgery (stage IV disease) and nine because of incomplete data. Information on follow-up was obtained from hospital charts, phone calls to family physicians, and examination of the regional cancer registry. All surgical procedures were performed either by staff surgeons or by senior residents under their direct supervision. The type of resection was primarily dictated by the local extent of the tumour and secondarily by cardiorespiratory function. Resection was macroscopically complete in all patients unless they presented with a stage IIIB tumour (n=98) or underwent exploratory thoracotomy (n=59). Operative mortality included 30-day mortality as well as any later death occurring during the initial postoperative hospital stay. Histological typing was conducted according to the World Health Organization [10] and tumour extent was determined according to the revised primary tumour, regional nodes, metastasis (TNM) classification for all patients [11]. Patients with evidence of mediastinal lymph node involvement underwent chemoradiotherapy and radiotherapy was given if the resection margins were not microscopically tumour-free; lately, chemotherapy has been randomly assigned to patients with regional node (N1) involvement.

As shown in figure 1, the majority of patients undergoing surgery were aged 60–69 yrs. In order to analyse the influence of age on clinical presentation, management and outcome, patients were subsequently divided...
into three categories according to their age at the time of surgery: 1) <60 yrs (n=416, 40%); 2) 60–69 yrs (n=407, 40%); and 3) ≥70 yrs (n=208, 20%).

Statistical analysis

Counts were compared with the use of Chi-squared analysis or Student’s t-test where necessary. Survival was analysed by the Kaplan-Meier method, and evaluation of the differences was conducted by the log-rank test or log-rank test for trend. A p-value <0.05 was regarded as statistically significant.

Results

As described in table 1, the group of patients aged ≥70 yrs had a significantly greater number of nonsmokers than the other two groups and a higher percentage of females (21% of females in age groups <60 yrs and 60–69 yrs, and 29% of females in age group ≥70 yrs).

Although the mode of presentation was similar between all age groups, patients <60 yrs were more prone to develop chest pain than older ones, and patients ≥70 yrs were more frequently asymptomatic than younger ones. Histological diagnosis remained unknown in 22% of the patients <60 yrs and in 14% of the patients ≥70 yrs.

Squamous cell carcinoma predominated in all age groups, but the proportion of adenocarcinoma was higher among patients <60 yrs (table 2).

The proportion of lobectomy and lesser resection was significantly higher and the rate of adjuvant therapy significantly lower in patients ≥70 yrs (table 3). These findings were partly related to the higher incidence of early stage carcinomas observed among older patients (table 2). Results of pulmonary function tests did not significantly differ between each age group: the median forced expiratory volume in one second (FEV1) was 86% of predicted values in patients <60 yrs, 75% pred in patients 60–69 yrs, and 80% pred in patients ≥70 yrs.

The overall operative mortality was similar between all age groups (table 4). However, the mortality rate following lobectomy and lesser resection increased from 1.3% in patients <60 yrs to 5.5% in patients ≥60 yrs (p=0.04), and the mortality rate following pneumonectomy increased from 6.5% in patients <60 yrs to 13.7% in patients ≥70 yrs (p=0.24). The main causes of death were pneumonia and respiratory failure in 19 patients, acute cardiac disorders in 12, pulmonary embolus in 10, haemorrhagic shock in eight, and bronchopleural fistula in seven; no causative factors were identified in 11 patients. No difference was observed between each age group.

In the postoperative follow-up period, causes of death were documented in 686 patients (94% of all deaths). Lung cancer was the primary cause of death in 90% of the patients who died after pneumonectomy, 85% after lobectomy and 71% after segmentectomy. When looking specifically at patients who died from primary lung carcinoma (excluding operative deaths and any other noncancer deaths), the overall long-term survival was similar between all age groups (fig. 2).

Discussion

In Geneva, Switzerland during the last two decades, the incidence of primary lung carcinoma has largely increased among elderly females (fig. 3), whereas it has remained unchanged in males (fig. 4). Hence, in the current series...
the proportion of females was higher in the group of patients aged ≥70 yrs than in the younger groups.

The overall operative mortality was similar between patients aged <60 yrs, 60–69 yrs and ≥70 yrs. Similarly, ROXBURGH et al. [8] and KADRI et al. [9], who respectively reviewed a series of 370 and 479 patients undergoing surgery for primary lung carcinoma, reported a mortality rate of 7% and 5% in patients ≥70 yrs, and of 4.4% and 4.9% in patients <70 yrs. In contrast to previous series, the current study showed that the operative mortality following lobectomy and lesser resection increased mainly in patients >60 yrs of age and remained unchanged thereafter. The operative mortality after pneumonectomy in patients ≥70 yrs was 13.7% in the current series. In the literature, the mortality rate after pneumonectomy in patients of the same age varies from 6% [1] to 21% [12], but most authors reported a mortality rate between 9% and 13% [8, 13–15]. These differences in outcome data probably result from variable preoperative risk status, extension of pneumonectomy (radical pneumonectomy and/or resection of thoracic wall versus standard pneumonectomy), and postoperative management. In addition, the definition of operative mortality included alternatively 30-day mortality and in-hospital mortality. In the current series, both 30-day and in-hospital deaths were taken into account.

In contrast to squamous cell carcinoma which was mostly reported in patients >70 yrs, adenocarcinoma was mainly observed in patients <60 yrs. This finding probably resulted from the changing patterns of lung cancer histology over the last 20 yrs. In a previous analysis which included the same group of patients operated on between 1977 and 1996, it was reported that the proportion of females increased from 12% to 33% and that of adenocarcinoma from 20% to 35% [16]. Changing patterns in the female smoking habit have been proposed as a possible explanation for this epidemiological shift [16–18].

The incidence of asymptomatic patients increased with age, from 18% in patients <60 yrs to 24% in patients ≥70 yrs. Similar observations were reported by NUGENT et al. [19] who showed that the number of asymptomatic patients increased from 9% in patients <45 yrs to 15% in patients ≥80 yrs. This difference according to patient’s age has been attributed to a wider utilization of chest radiographs in the elderly population because of their comorbidities, which has contributed to earlier detection of lung cancer [20]. The presence of clinical signs such as haemoptysis, weight loss and lung infection was similar between each age group. However, similarly to previous reports [4, 19], it was observed that chest pain occurred more frequently in younger patients. This finding correlated with a higher incidence of mediastinal or chest wall involvement due to a more advanced stage of disease [4, 19].

The more advanced stage of disease observed in the youngest group may result from delayed diagnosis due to

### Table 3. – Surgical and adjuvant therapy by age group

<table>
<thead>
<tr>
<th>Variable</th>
<th>&lt;60 yrs</th>
<th>60–69 yrs</th>
<th>≥70 yrs</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients n</td>
<td>416</td>
<td>407</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thoracotomy only</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>0.01</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>33</td>
<td>31</td>
<td>25</td>
<td>0.09</td>
</tr>
<tr>
<td>Bilobectomy</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>0.09</td>
</tr>
<tr>
<td>Lobectomy and lesser resection</td>
<td>55</td>
<td>58</td>
<td>56</td>
<td>0.02</td>
</tr>
<tr>
<td>Adjuvant therapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>0.01</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>23</td>
<td>20</td>
<td>10</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Data are presented as percentage of patient number (n) by age group for type of surgery, and for adjuvant therapy. Patient number and p-values are given as absolute numbers.
unsuspected lung cancer at a young age. PEMBERTON et al. [21] observed that patients <40 yrs of age waited an average of 4.2 months between the onset of symptoms and diagnosis. Similarly, it was found that patients with Pancoast tumours were usually young and often had a delay of several months before the correct diagnosis was made [22]. Therefore, although screening of the general population with chest radiographs has been shown to be inefficient in lowering mortality rates, perhaps it should be restricted to young patients with a heavy smoking history [19, 23].

Surgical strategies are clearly influenced by age and disease stage at presentation. Indeed, pneumonectomies and exploratory thoracotomies were performed more frequently in patients <60 yrs, whereas lobectomies and lesser resections largely predominated in patients >70 yrs. This observation was probably related to the greater number of early stage carcinomas observed among older patients. The pulmonary function tests did not significantly differ between each age group and should not, therefore, explain the differences in surgical strategies. In the current series, the exploratory thoracotomy and pneumonectomy rates among elderly patients were higher than the rates reported by other authors [7]. This finding can be explained by the time length of the current study and the higher incidence of exploratory thoracotomy and pneumonectomy 20 yrs ago [16].

The specific long-term survival, which included only the patients who died from lung cancer, was similar between all age groups. Hence, in contrast to other authors who have argued that lung cancer has a less aggressive course in the elderly population, this observation shows that the degree of invasiveness is identical in all age groups [8].

In conclusion, lung resection in patients ≥70 yrs is shown to be an acceptable procedure with an overall operative mortality and a long-term survival similar to that of younger subgroups of patients.

References