Radiotherapy Alone for Patients with Operable Carcinoma of the Lung*

Joel D. Cooper, M.D., F.C.C.P.; F. Griffith Pearson, M.D., F.C.C.P.;
Thomas R. J. Todd, M.D., F.C.C.P.; G. Alexander Patterson, M.D.;
R. J. Ginsberg, M.D., F.C.C.P.; Joan Basiuk, R.N.; Vicki Blair, R.N.; and
William Cass, M.D.

Between 1966 and 1980, 72 patients with operable carcinoma of the lung were treated primarily with radiotherapy because coexisting, nontumor related medical problem, or patient refusal prevented thoracotomy. We compared results obtained in this group with results obtained by thoracotomy in 123 consecutive patients over the age of 70, who were assessed in a similar fashion, but who underwent thoracotomy. All patients in both groups had proven, nonsmall cell carcinoma of the lung without clinical, laboratory, or radiologic evidence of tumor spread. All patients in both groups had a negative staging mediastinoscopy, and bronchoscopic findings consistent with operability. Many of the patients treated with radiotherapy had less than a curative dose as their general medical condition prevented a course of radical radiotherapy. It is apparent, however, that the results of radiotherapy for patients with operable carcinoma of the lung may be disappointing and that for patients who are marginal in terms of operative risk, the benefits of surgical resection may warrant the risks involved.

Surgical resection is generally considered the treatment of choice for patients with localized, operable, nonsmall cell carcinoma of the lung. When such a tumor presents in an elderly or medically unfit patient, an assessment must be made as to the balance between the risks of the operation vs the potential benefits. This must be compared with the potential risks and benefits of alternative treatment, usually radiotherapy.

The basis for this decision-making was highlighted by McNeil et al. The authors explored the attitude of older patients to risk-taking. Surgical resection was characterized in this article as offering somewhat improved chances for five-year survival but at greater risk in the short term for postoperative death, when compared to radiotherapy. The authors advocated incorporation of the patients' attitude towards risk taking in the decision-making process. Based upon their assessment of the risk-benefit data available for surgical resection vs radiotherapy, the authors concluded that many, if not most, patients over the age of 60 should be treated with radiotherapy.

The basic data used by the authors in their analysis were at variance with our own experience and prompted this review.

**Materials and Methods**

A computer-assisted review was made of all patients with carcinoma of the lung admitted to our Thoracic Surgical Service between 1966 and 1980. We identified those patients with presumed operable, nonsmall cell carcinoma of the lung who were nonetheless referred by us for radiotherapy as the primary treatment. The

*From the Division of Thoracic Surgery, University of Toronto and the Toronto General Hospital, Toronto, Canada.

Manuscript received and accepted August 7.

Reprint requests: Dr. Cooper, 10-226 Eaton Building, Toronto General Hospital, Toronto, Ontario M5G 1L7, Canada

---

Table 1—Reasons for Nonoperability

<table>
<thead>
<tr>
<th>Reason</th>
<th>No. Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>16</td>
</tr>
<tr>
<td>Cardiac Status</td>
<td>27</td>
</tr>
<tr>
<td>Pulmonary Status</td>
<td>46</td>
</tr>
<tr>
<td>Coexisting Disease</td>
<td></td>
</tr>
<tr>
<td>(non-tumor related)</td>
<td>16</td>
</tr>
<tr>
<td>Patient Refusal</td>
<td>10</td>
</tr>
</tbody>
</table>
factors which influenced the dose of radiation administered could not be ascertained retrospectively in many cases, but it must be presumed that patients receiving the lower doses were not considered suitable for a higher dose of radiation.

For purposes of comparison, we reviewed all patients over the age of 70 with carcinoma of the lung seen during the same 15-year time period. We selected those patients who were deemed operable by the identical criteria applied to the radiotherapy group but in whom a thoracotomy was performed. As the average age of the radiotherapy group was 66 years, we selected, for the comparison, only patients over the age of 70 in order that results in the thoracotomy group not be biased by a more favorable age distribution. Patients who received adjuvant radiotherapy or chemotherapy were excluded. Follow-up data were obtained as of January 1984.

RESULTS

Radiotherapy

Of the 72 patients in the radiotherapy group, five were lost to follow-up. Of the remaining patients, two are alive and 65 are dead. The survival curve, using the Life Table Method, is shown in Figure 1 for all patients. The cumulative five-year survival was 6 percent. Only six patients survived three years or more. Of these, five subsequently died (three of tumor), and one is alive following resection of a recurrence at ten years. Of the 35 patients who received 4,000 rads or more, five survived more than three years, and of these, four survived more than five years. Of the 31 patients who received less than 4,000 rads, one patient survived three years and none survived five years. The median survival for the entire group of patients was nine months; for patients receiving 4,000 rads or more, ten months; and for patients receiving less than 4,000 rads, seven months.

Of the 65 known deaths, 55 of the patients died as a result of their tumor. At the time of death, 75 percent of these patients had intrathoracic disease with or without distant metastases.

Results of Thoracotomy

The results of patients 70 years and older undergoing thoracotomy for nonsmall cell carcinoma of the lung were similarly evaluated. As in the radiotherapy group, only those patients with a negative staging mediastinoscopy were included. A total of 123 patients were evaluated. One patient underwent thoracotomy without resection. There were seven postoperative deaths for an operative mortality of 5.7 percent. Resection consisted of lobectomy in 105 patients, pneumonectomy in 14 patients, and wedge or segmental resection in three patients. The distribution of cell types is shown in Table 3.

The survival curve using the Life Table Method for the thoracotomy patients is shown in Figure 2. The five-year cumulative survival was 46 percent. Patients who had thoracotomy without resection and those who died in the postoperative period are included in the results. The median survival was 2.0 years.

DISCUSSION

We are in agreement with the thesis by McNeil and co-authors\textsuperscript{1} that the decision-making process regarding the best mode of therapy requires information as to the risk-benefit analysis of each proposed therapy. Only with such data can the attitude of the patient toward short- and long-term risk-taking be incorporated into the decision-making process. This is especially true for patients in the older age group. We feel, however, that

---

Table 2—Cell Type in 72 Patients with Operable Lung Cancer Treated with Radiotherapy Alone

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous</td>
<td>53 (72%)</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>5 (7%)</td>
</tr>
<tr>
<td>Large Cell</td>
<td>7 (9%)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>9 (12%)</td>
</tr>
</tbody>
</table>

Table 3—Cell Type in 123 Patients Undergoing Surgical Resection

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous</td>
<td>61%</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>17%</td>
</tr>
<tr>
<td>Large Cell</td>
<td>2%</td>
</tr>
<tr>
<td>Mixed or Unspecified</td>
<td>20%</td>
</tr>
</tbody>
</table>

---

F IC:URE 1. Actuarial survival of 67 patients with clinically operable carcinoma of the lung who were treated primarily with radiotherapy. None of the patients underwent thoracotomy.

F IC:URE 2. Actuarial survival for 123 consecutive patients over the age of 70 undergoing thoracotomy for carcinoma of the lung. Results include patients who died postoperatively and patients who underwent thoracotomy but did not have a resection performed.
the survival curves for surgical treatment used by McNeil et al are overly pessimistic compared to the results which might be expected in a carefully selected group of patients in whom preoperative mediastinoscopy has been utilized to improve the chances for successful resection. The operative mortality figure which they utilized is also overly pessimistic for operative patients in general, though it might be appropriate for elderly, high-risk patients. A recent review of the modern operative mortality for pulmonary resection indicated that pneumonectomy in patients over 70 years carried a 6 percent operative mortality.2

The expected cure with radiotherapy, as utilized by McNeil et al,1 was based on one radiotherapy series: 38 patients referred by one consultant as reported by Hilton.3 These patients all had localized tumors which were considered operable. All patients were in good to excellent physical condition with an average age of 58 years, and all received between 4,000 and 5,500 rads over a seven to eight week course. Nine patients in that group survived five years, for an overall five-year survival of 22.5 percent. This type of result has not been reported in any other series. It is apparent from our experience that the results obtained by Hilton3 in a relatively young, fit population all of whom received radical radiotherapy, do not apply to radiotherapy administered to an elderly, medically unfit group of patients.

Our own study has defects as well, which restrict the nature of the conclusions which can be drawn. Aside from the defects inherent in a selective, retrospective review, it was not possible to determine why nearly 50 percent of patients referred for radiotherapy received less than 4,000 rads. It must be presumed that the medical conditions, such as limited pulmonary reserve which prompted referral for radiotherapy in the first place, also restricted the dose of radiation which they were thought able to tolerate. It must be emphasized, however, that the purpose of this report is not to evaluate the results of radiotherapy for an optimum group of operable patients, but to evaluate the overall results obtained in a consecutive group of patients with operable carcinoma of the lung for whom radiotherapy, rather than resection, seemed appropriate at the time.

The distribution of the tumor cell types in the radiotherapy group shows a preponderance of squamous cell carcinoma, which we would presume to be a more favorable group. The potential for cure with radiotherapy in this group was considered higher than for other cell types,4 and this doubtless played a role in the selection process of patients with operable carcinoma who were referred for radiotherapy.

We were concerned that the group referred for radiotherapy may have been biased with respect to the site of the primary tumor and that patients with a central tumor, requiring pneumonectomy, might be considered a high risk for surgery, and thus, referred for radiotherapy. We therefore separately analyzed the results in both the radiotherapy group and the surgical resection group for patients with central tumors and for patients with peripheral tumors. Within each treatment group (radiotherapy or surgery), the results obtained with peripheral tumors were similar to those obtained with centrally located tumors. We therefore concluded that the location of the original tumor did not influence the overall results of the study.

It is generally conceded that a radiation dose of less than 4,000 rads represents palliation rather than an attempt at cure. However, there is no firm evidence to suggest that a dose in excess of 4,000 rads results in improved survival. For unresectable, nondisseminated, nonsmall cell carcinoma, a randomized trial demonstrated no clear evidence that 6,000 rads was superior to 4,000 rads in terms of induction of tumor regression or duration of survival.5 In a recent report, Choi and Doucette6 found that five-year survival following radiotherapy for localized, unresectable nonsmall cell bronchogenic carcinoma did vary with the radiation dose and target volume. Actuarial five-year survival was 7.5 percent with the radiation dose greater or equal to 5,000 rads, whereas there was no five-year survival from patients receiving less than this dose. The authors also noted that for squamous cell carcinoma, the primary site and regional lymphatic areas were the most common sites of failure. This is consistent with our finding that 75 percent of patients dying of tumor had persistent or recurrent intrathoracic disease.

In analyzing the relatively poor results with radiotherapy in our series, we considered that there may have been an unintentional bias such that the patients referred for radiotherapy, though deemed operable, may have had more advanced tumor than was apparent from the evaluation. This might occur if the assessment that a patient was unfit for surgery was based on overall poor performance or poor condition somehow related to systemic effects of the carcinoma. Upon reviewing the records, however, we have found that the medical disability which prompted radiotherapy referral was generally related to a specific, preexisting problem such as severe emphysema, a history of cardiac problems, etc., and not to nonspecific medical problems or recent deterioration.

The relatively high five-year survival in the surgical group reflects the highly selected nature of patients whom we choose for thoracotomy. We routinely use staging mediastinoscopy and generally eliminate from operative consideration patients with superior mediastinal lymph node involvement. Such selection improves both resectability and survival rates for those subject to thoracotomy.7

The purpose of this review was to provide informa-
tion to assist in the difficult decision-making process for patients with operable carcinoma of the lung who are considered to have a higher risk than usual for surgery. Certain limited conclusions appear justified; the results of radiotherapy for this group of patients are discouraging considering the favorable stage of the tumor which these patients had at the time of initial referral. The discouraging results were no doubt influenced, at least in part, by the fact that many patients could not be considered for a radical dose of radiotherapy any more than they could be considered for a thoracotomy. It might be argued that all patients referred for radiotherapy were, in fact, "surgical failures," as surgical assessment had been performed and referral for radiotherapy was made by the surgical service. It is undoubtedly true that many patients referred for radiotherapy could not have been considered for operation because the patient was too poor an operative risk. For other patients, however, the decision for radiotherapy was based upon the expectation that radiotherapy would provide a significant cure rate, especially with localized, well-staged, presumed operable, squamous cell carcinoma.

Based upon the results of this study, it now seems appropriate to reassess the risk-benefit analysis of both surgery and radiotherapy for patients with operable carcinoma of the lung considered to be marginal in terms of operative risk. A comparison of the relative benefits of resection versus radiotherapy in this group may well prompt the physician and the patient to consider accepting a significant operative risk in exchange for a much greater chance for long-term survival.

References

Vascular Surgery, 1985

The Second International Vascular Symposium, Vascular Surgery 1985 (current state of the art) will be held May 23-24 at the Waldorf-Astoria Hotel, New York. The program is sponsored by the Department of Surgery, Long Island Jewish-Hillside Medical Center, New Hyde Park, The Postgraduate Institute for Medical and Dental Education and the Health Sciences Center, State University of New York at Stony Brook; School of Medicine, State University of New York at Stony Brook. For information, contact Ms. Ann J. Boehme, Continuing Education Coordinator, Long Island Jewish-Hillside Medical Center, New Hyde Park, New York 11042 (212:470-2114).