

# MEDIASTINOSCOPY FOR ASSESSING MEDIASTINAL SPREAD IN CLINICAL STAGING OF CARCINOMA OF THE LUNG

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A clinical staging for carcinoma of the lung utilizing conventional diagnostic procedures and mediastinoscopy for careful assessment of the upper mediastinum has been developed. In an analysis of 144 patients, one of 83 right-sided tumors had contralateral spread compared to 7 of 61 for the left side. Bilateral spread was equal. Forty-three of 52 patients with squamous cell carcinoma had negative upper mediastinal nodes, 6 had ipsilateral, and 3 contralateral node involvement. Forty of 64 poorly differentiated tumors had involved nodes, and 28 had either contralateral or bilateral spread. Twelve of the 16 oat-cell cancers had involved nodes; 8 were bilateral. Eight of the 12 adenocarcinomas had involved nodes; 3 were bilateral. Seventy-three percent of the well-differentiated tumors fell into Stages 1 and 2; 83 percent of the anaplastic tumors in Stages 3 or 4.

THE MANAGEMENT OF CARCINOMA OF THE lung is a taxing and unrewarding problem to the surgeon, radiotherapist, chemotherapist, and others involved in patient care. Even with the most exacting diagnostic techniques, sufficient information may not be available in suspected cases to provide a basis for rational treatment. In addition to the difficulty in providing a histologic diagnosis, the usual diagnostic procedures commonly fail to indicate the extent of spread or of operability. Often exploratory thoracotomy is considered necessary to obtain tissue for diagnosis and to determine the extent of disease.<sup>6, 10, 16, 25-27</sup> Thoracotomy as an exploratory procedure is not an innocuous procedure. Mortality sta-

tistics may be as high as 10 percent.<sup>25-27</sup> Complications following this procedure are another serious deterrent.<sup>25, 26</sup>

Also, thoracotomy allows adequate evaluation only of the ipsilateral mediastinal nodes. Exploratory thoracotomies cannot be justified if less hazardous techniques are available to make a histologic diagnosis and to more accurately determine operability. For rational planning of therapy in patients with lung cancer, it is essential to know the extent of local growth and the involvement of lymph nodes, in general, and, in particular, those in the upper mediastinum.

In 1959, Carlens examined mediastinal structures through a lighted instrument which he named the mediastinoscope.<sup>4</sup> This approach had its origin in the techniques introduced by Harkens in 1954 and Radner in 1955. Harkens introduced the cervicomediastinal exploration. A lighted laryngoscope was utilized to expose a limited area on one side of the mediastinum to obtain material for tissue diagnosis.<sup>13</sup> Radner approached the mediastinum through a suprasternal incision. He opened the pretracheal fascia and with blunt dissection entered the upper mediastinum. He was thus able to remove accessible mediastinal lymph nodes.<sup>24</sup> Since its introduction in 1959, mediastinoscopy has been used in many parts of the world and the

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results of well over 6,000 cases have been reported.<sup>5, 15, 17, 23</sup>

Mediastinoscopy can be carried out under general endotracheal or local anesthesia.<sup>12</sup> Through a small transverse suprasternal notch incision, the strap muscles are separated along the mid-line to expose the anterior wall of the trachea. After opening the pretracheal fascia, blunt dissection is carried down along the trachea posterior to the innominate artery and the aortic arch (Fig. 1). The tissue is loose, permitting easy exposure of the entire trachea to its bifurcation (Fig. 2). The instrument is then introduced to visualize the trachea and paratracheal areas, the carina, right and left main bronchi, the right upper lobe bronchus, the innominate artery, the aortic arch, the right pulmonary artery, the azygos vein, the left recurrent nerve, and the esophagus from the neck to the level of the carina (Figs. 3, 4). Tumor masses and lymph nodes are readily enucleated in entirety or a specimen may be taken for biopsy. Bleeding is minimal and easily controlled by cautery, silver clip or gelfoam. Silver clips may also be used to identify the site of biopsy. The incision is closed primarily without drainage.

Treatment of carcinoma of the lung is a major undertaking. Correct assessment of the indications for treatment demand an understanding of the prognostic factors which can be determined preoperatively. Berg, Gibbon, Noel, and Wernig have shown that patients with cancers confined to the lung parenchyma have a better prognosis than do patients who have tumors which extended outside the lung.<sup>1, 11, 22, 35</sup> Although a number of surgeons such as Abbey-Smith, Chamberlain, and Price-Thomas have advocated extended resection for some of the more locally advanced cases, very few patients survive 3 years.<sup>6, 30, 32</sup> In Berg's series, none were alive 5 years after resection, and no patient with extensive tumor and with mediastinal lymph node involvement was alive 12 months after pulmonary resection.<sup>1</sup>

Long-term survival in bronchogenic carcinoma has been correlated with the extent of lymph node involvement. When no lymph nodes were present, or only segmental or interlobar nodes were found, the prognosis was appreciably better than when the upper mediastinal nodes were involved.<sup>1, 22</sup> Furthermore, the possibility of contralateral spread of cancer to nodes in the mediastinum has

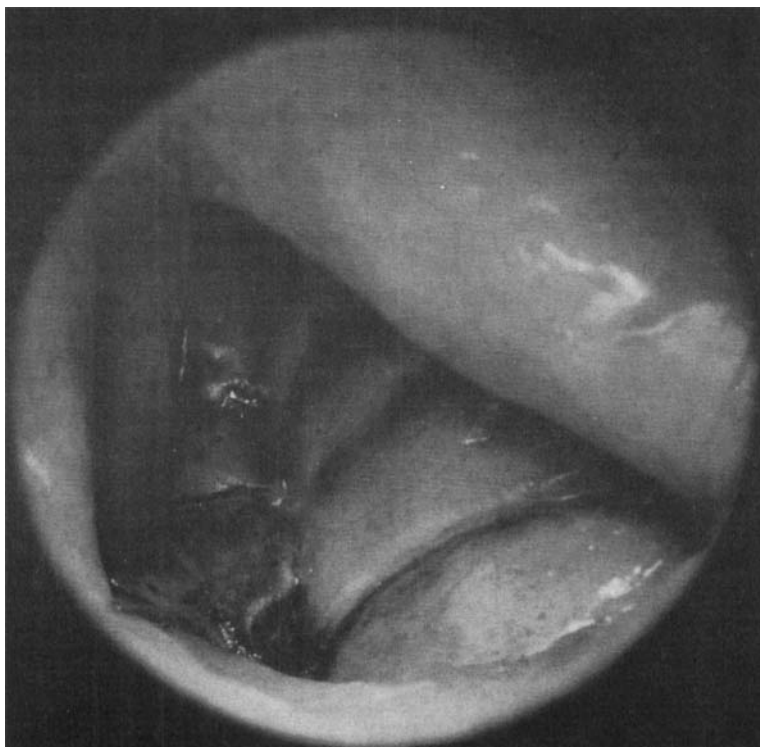
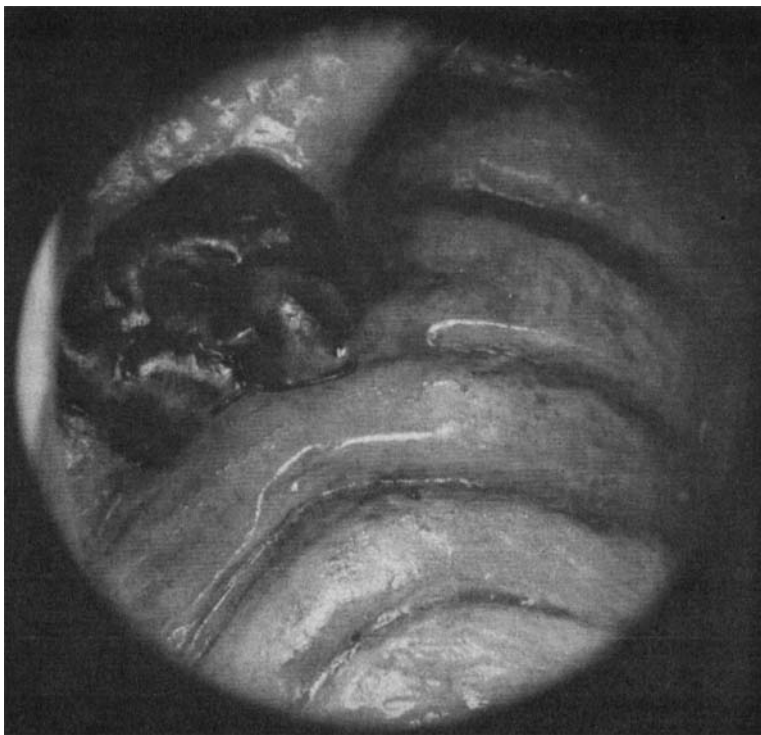


FIG. 1. Represents a view through the mediastinoscope at the level of the innominate artery with left paratracheal lymph nodes.

FIG. 2. Represents a view through the mediastinoscope at the level of the tracheal bifurcation with subcarinal lymph nodes and the right pulmonary artery.



been recognized for some time. The first reported observation of the crossing of lymphatics from the left main bronchus to the right paratracheal nodes was made by Mascagni,

in 1787.<sup>18</sup> Many morbid anatomists since then have demonstrated lymphatic crossover in the mediastinum.<sup>8, 9, 10, 20, 28, 31, 33, 34</sup> This was best classified by Rouviere, in 1932, who demon-

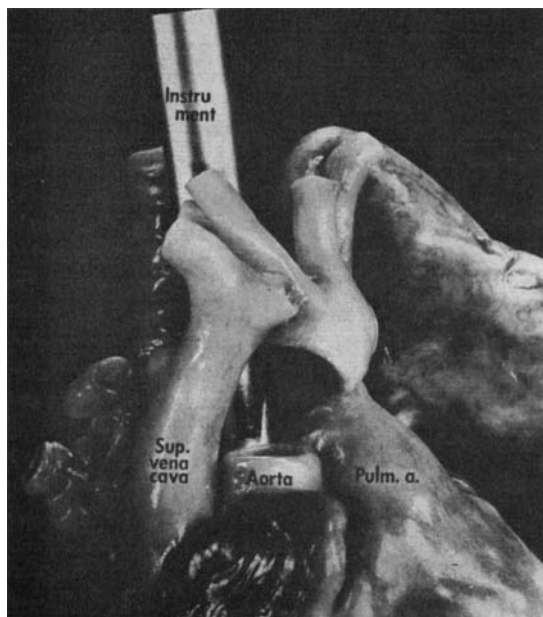


FIG. 3. Represents the related upper mediastinal anatomy from an anterior view.

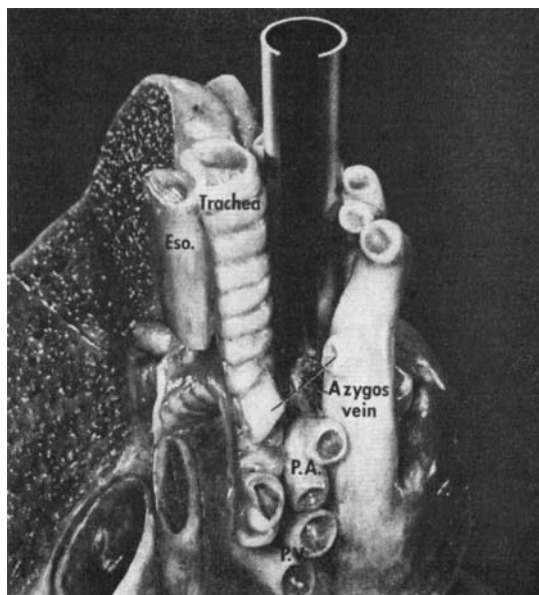


FIG. 4. Represents the related upper mediastinal anatomy from a right lateral view.

strated that bifurcation nodes drain entirely into the right paratracheal chain and, thus, all drainage pathways from left lower lobe nodes cross over to the right paratracheal nodes.<sup>28</sup>

Cordier, in 1958, carried this a step further. He reported that crossover drainage occurs both from left to right and right to left. Crossover occurred not only at the level of the carinal nodes, but between the right and left paratracheal chain of nodes as well.<sup>8</sup>

From the above considerations, it seems clear that a clinical staging program, to be of value, must identify with a high probability those patients who will benefit from the established modes of treatment and those for whom this would be a futile or even hurtful exercise.

PROPOSED CLASSIFICATION

As stated by the International Union Against Cancer: "The immediate purpose of staging is to facilitate the accurate, concise description of the apparent extent of the disease in a way that can readily be communicated to others or reproduced by them. What is needed is simply an agreement on the recording of such precise information on the extent of the disease as to make possible the combination or re-combination of cases according to any agreed plan."<sup>14</sup> Ideally, a staging technique should describe the primary site, the presence of cancerous nodes and their location, and the presence or absence of metastasis. This makes an assessment of treatment plan possible and permits comparisons of treatments by different modalities and in different institutions. The classification of carcinoma of the lung proposed here is based upon the T, N, and M system. It utilizes the conventional diagnostic procedures plus mediastinoscopy.

CLASSIFICATION OF LUNG CANCER

- T = Tumor  
N = Lymph nodes involved  
M = Distant metastasis  
(Tumor is classified in the highest possible T group)  
T<sub>1</sub> Discrete tumor of any size in the lung periphery not in contact with chest wall, mediastinum, or hilum. May have associated density limited to a lobe or less.  
T<sub>2</sub> Tumors involving hilum; tumors involv-

ing bronchus wall at least 1 cm distal to the carina; may have associated density of an entire lung.

T<sub>3</sub> Tumors involving the bronchus wall within 1 cm of the carina or any tumors involving the parietal pleura. Multiple primary neoplasms in one lung.

T<sub>4</sub> All tumors involving by contiguous growth structures beyond the parietal pleura.

(N<sub>0</sub> includes no lymph nodes proximal to the right second division of the trachea.)

- N<sub>0</sub> No nodes involved.  
N<sub>1</sub> Ipsilateral nodes only involved.  
N<sub>2</sub> Contralateral or bilateral nodes involved.  
M<sub>0</sub> No evidence of extrathoracic disease.  
M<sub>1</sub> Evidence of extrathoracic disease, e.g., supraclavicular nodes, liver, bone, etc.

The tumor is classified in the highest possible T group. The position and extent of growth of the tumor rather than the size determine the T classification. This is in accord with the conclusions reached by Bignall and Moon, Noel, Berg, Clifton, and Nickson and others.<sup>1, 2, 7, 21, 22</sup> Clinically, it is not always possible to distinguish between lesions which involve the parietal pleura but do not go beyond. This is so even with the most exacting x-ray planography. However, medial lesions within reach of the mediastinoscope may be so delineated.

In the past, Noel and Berg demonstrated that segmental and interlobar nodes did not appreciably influence the prognosis one way or the other.<sup>1, 22</sup> However, the involvement of mediastinal nodes has been recognized by Saltzer, Clifton, and others as being important indicators of the prognosis for individual cases.<sup>1, 7, 22, 29</sup> This involvement may include any one of the 3 potential chains described by Rouviere—the anterior mediastinal or prevascular, the posterior mediastinal or esophageal, or the paratracheal chains. In the classification proposed here, nodes proximal to the right second division of the trachea are not considered mediastinal. The class N<sub>0</sub> is assigned to those cases in which no upper mediastinal nodes are recognized. The class N<sub>1</sub> indicates ipsilateral nodal involvement, N<sub>2</sub> contralateral or bilateral involvement.

STAGES OF LUNG CANCER

| Stage | T              | N              | M              |
|-------|----------------|----------------|----------------|
| I     | T <sub>1</sub> | N <sub>0</sub> | M <sub>0</sub> |
|       | T <sub>2</sub> | N <sub>0</sub> | M <sub>0</sub> |
| II    | T <sub>1</sub> | N <sub>1</sub> | M <sub>0</sub> |
|       | N <sub>2</sub> | N <sub>1</sub> | M <sub>0</sub> |

|    |                                                 |                |                |
|----|-------------------------------------------------|----------------|----------------|
| A  | T <sub>1</sub>                                  | N <sub>2</sub> | M <sub>0</sub> |
|    | T <sub>2</sub>                                  | N <sub>2</sub> | M <sub>0</sub> |
|    | T <sub>3</sub>                                  | N <sub>0</sub> | M <sub>0</sub> |
|    | T <sub>3</sub>                                  | N <sub>1</sub> | M <sub>0</sub> |
| B  | T <sub>3</sub>                                  | N <sub>2</sub> | M <sub>0</sub> |
|    | T <sub>4</sub>                                  | N <sub>0</sub> | M <sub>0</sub> |
|    | T <sub>4</sub>                                  | N <sub>1</sub> | M <sub>0</sub> |
|    | T <sub>4</sub>                                  | N <sub>2</sub> | M <sub>0</sub> |
| IV | Any T, N,<br>Combination<br>with M <sub>1</sub> |                |                |

Generally, it is customary to group together the combinations of T, N, and M in such a way that a reproducible assessment of extent of disease can be made in sufficient numbers of patients to be useful for prognostic purposes. The suggested stages based upon the proposed classifications is as follows: Stage 1 includes the T<sub>1</sub>, T<sub>2</sub> tumors in which no upper mediastinal nodes had been recognized. Stage 2 are those T<sub>1</sub>, T<sub>2</sub> tumors with ipsilateral upper mediastinal nodes. Stage 3A includes T<sub>1</sub>, T<sub>2</sub> tumors with contralateral nodes, and T<sub>3</sub> tumors with no nodes or with ipsilateral upper mediastinal nodes. Stage 3B are the T<sub>3</sub> tumors with contralateral or bilateral nodes and all of the T<sub>4</sub> tumors. Stage 4 is used for any combination of T and N plus extrathoracic disease. It is clearly understood that as experience accumulates with these groupings, the need for regroupings may become necessary. No consideration is given to cell type in the above system of classification.

### RESULTS

These data are derived from an analysis of 144 patients with a diagnosis of primary carcinoma of the lung established by exploratory thoracotomy, bronchoscopy, or mediastinoscopy. They are available from a series of 200 patients who had mediastinoscopy and a clinical diagnosis of carcinoma of the lung.

In this series there were 83 tumors located in the right lung and 61 located in the left lung. Although only one of 83 had solely contralateral spread from the right to the left as compared to 7 out of 61 for the left to the right, bilateral spread was approximately the same right to left as left to right. The percentage of negative mediastinal nodes was the same on both sides (Table 1). Four

### CARCINOMA OF LUNG

| SITE              | NUMBER OF PATIENTS | MEDIASTINOSCOPY |              |                |           |
|-------------------|--------------------|-----------------|--------------|----------------|-----------|
|                   |                    | NEG.            | POSITIVE     |                |           |
|                   |                    |                 | Ipsi-lateral | Contra-lateral | Bilateral |
| <b>RIGHT LUNG</b> | <b>83</b>          | <b>38</b>       | <b>19</b>    | <b>1</b>       | <b>25</b> |
| RUL               | 60                 | 23              | 15           | 1              | 21        |
| RLL               | 14                 | 8               | 4            | -              | 2         |
| COMBINED          | 9                  | 7               | -            | -              | 2         |
| <b>LEFT LUNG</b>  | <b>61</b>          | <b>33</b>       | <b>12</b>    | <b>7</b>       | <b>9</b>  |
| LUL               | 40                 | 21              | 8            | 6              | 5         |
| LLL               | 14                 | 10              | 2            | 1              | 1         |
| COMBINED          | 7                  | 2               | 2            | -              | 3         |

TABLE 1.

broad categories of histology are identified (with which practically every pathologist will find something to disagree): 1. the well-differentiated squamous cell carcinoma; 2. the more poorly differentiated; the undifferentiated, the anaplastic large cell carcinoma; 3. the very undifferentiated small cell (oat cell) carcinoma, and 4. the adenocarcinoma.<sup>3, 22</sup>

Mediastinal lymph node involvement was determined in this group of 144 patients (Table 2). It was found that 43 of 52 patients with squamous cell carcinomas had negative upper mediastinal nodes. Six were found to have positive ipsilateral nodes, and

### CARCINOMA OF LUNG

| PATHOLOGY                                                    | NUMBER OF PATIENTS | MEDIASTINOSCOPY |              |                |           |
|--------------------------------------------------------------|--------------------|-----------------|--------------|----------------|-----------|
|                                                              |                    | NEG.            | POSITIVE     |                |           |
|                                                              |                    |                 | Ipsi-lateral | Contra-lateral | Bilateral |
| WELL DIFFERENTIATED squamous cell                            | 52                 | 43              | 6            | 2              | 1         |
| LARGE CELL POORLY DIFFERENTIATED undifferentiated anaplastic | 64                 | 20              | 16           | 6              | 22        |
| SMALL CELL UNDIFFERENTIATED oat cell                         | 16                 | 4               | 4            | -              | 8         |
| ADENOCARCINOMA                                               | 12                 | 4               | 5            | -              | 3         |

TABLE 2.

3 had contralateral positive nodes. On the other hand, only 20 of 64 patients with poorly differentiated tumors had negative upper mediastinal nodes and 28 had evidence of contralateral or bilateral spread. Eight of 16 oat-cell carcinomas showed bilateral lymph node involvement. Four of the 12 patients with adenocarcinomas had negative mediastinal nodes; 5 had ipsilateral lymph node involvement, and 3 had bilateral lymph node spread.

Of the 52 patients with well-differentiated squamous cell carcinoma, almost three fourths (73%) fell into Stages 1 or 2. However, of the patients with large cell poorly differentiated, undifferentiated, or anaplastic carcinoma, over three fourths of these patients (83%) fell into Stages 3 and 4. The small number of patients with small cell (oat cell) carcinoma had a staging distribution similar to those with anaplastic carcinoma. Seven of the 12 patients with adenocarcinoma fell into the lower stages (Table 3). It seems apparent that the degrees of differentiation represented by the 4 histologic groups does suggest that the biological character is accounted for by the proposed staging system.

Although sufficient data is not available to us at this time for a valid analysis of survival, the data to date suggests that Stages

1 and 2 have a better survival than Stage 3, and Stage 3 is better than Stage 4. It is hoped that by utilizing this staging procedure in a prospective study, more valid prognostication can be reported at a future date.

In 200 consecutive patients with carcinoma of the lung, there were 3 bleeding episodes. Two patients lost approximately 75 cc of blood, and one patient lost approximately 250 cc of blood. Bleeding in all cases was controlled with pressure or hemostatic agents.

Four patients developed a bradycardia which was readily alleviated by atropine, and 2 patients developed temporary left recurrent nerve paresis. Three patients developed a pneumothorax or mediastinal emphysema. Treatment was required in only one case, and this was accomplished by drainage through the mediastinal incision to a water seal. Thus, the morbidity rate in this series was 6%. There were no mortalities in this series.

The clinical staging proposed here requires careful assessment of the upper mediastinum. It does not take into account spread into the lower mediastinum or below the diaphragm. In reality this staging technique with respect to "N" is based on histologic proof of tumor in the mediastinal lymph nodes. Of great interest was the correlation of mediastinal spread, contralaterality, and bilaterality which occurred with increasing frequency as the degree of differentiation was lost in the tumor.

The usefulness of the staging procedure lies in its bringing together cases with similar extent of disease. Value judgments as to the efficacy of treatment from one institution to another can be made in a more rational manner. Staging as proposed, we believe, will contribute significantly in assessing operability. It is equally important in those cases for whom radiotherapy and chemotherapy may be required either alone or as adjunct to the surgical therapy. As more cases are done, survival statistics for each of the T, N, and M categories will be accumulated so that valid conclusions as to the usefulness of each of the classification categories will emerge.

### CARCINOMA OF LUNG

| PATHOLOGY                                                             | NUMBER OF PATIENTS | STAGE |    |       |    |    |
|-----------------------------------------------------------------------|--------------------|-------|----|-------|----|----|
|                                                                       |                    | I     | II | A III | B  | IV |
| WELL DIFFERENTIATED<br>squamous cell                                  | 52                 | 34    | 4  | 8     | 3  | 3  |
| LARGE CELL<br>POORLY DIFFERENTIATED<br>undifferentiated<br>anaplastic | 64                 | 10    | 4  | 24    | 16 | 10 |
| SMALL CELL<br>UNDIFFERENTIATED<br>oat cell                            | 16                 | 3     | 3  | 5     | 4  | 1  |
| ADENOCARCINOMA                                                        | 12                 | 4     | 3  | 2     | 1  | 2  |

TABLE 3.

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