

Bronchogenic Carcinoma: *

A Study of Cases Treated at Johns Hopkins Hospital from 1933 to 1958

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CARCINOMA of the lung is a serious public health problem. At present it is the most common visceral carcinoma in males and in many institutions 10 per cent of all autopsies are performed for deaths from this disease.¹² In men 50 to 60 years of age, one of every three deaths results from bronchogenic carcinoma.¹

The present study was undertaken to determine factors influencing long-term survival following resectional therapy. Possible variations in therapeutic approach have been considered. Particular interest has been directed to pathologic features, including histologic type and involvement of blood vessels, lymph nodes and proximal bronchial margin.

Clinical Material

This study included 199 selected cases from a 25-year period ending in 1958. The criteria for inclusion in this series were strict. Adequate clinical information was an obvious necessity. Performance of a "curative" resection was intended to mean those cases in which the tumor was thought to have been completely excised. These in-

cluded resections with adjacent chest wall, pericardium and other structures. Procedures in which gross tumor was left behind have been excluded. All operative and post-operative deaths were included. Current follow up was required, either until the patient's death or for a minimum of 5 years. Adequate pathologic material was a basic requirement. In each case, additional sections were selected for resectioning with consecutive hematoxylin and eosin and the Verhoeff-Van Gieson staining (Fig. 1, 2). All of the old and new histologic material was independently reviewed and re-evaluated to determine the microscopic pattern of the tumor, its extension, and vascular or lymphatic invasion. These data were recorded without knowledge of the previous diagnosis, clinical information or follow up.

Clinical Features. The average age, sex ratio, racial occurrence and symptoms are listed in Table 1. A consideration of the various symptoms and their duration has been difficult to evaluate, particularly with respect to the cough. These patients frequently had a chronic cough for many years, but only the duration of a significant change in coughing (e.g., increased frequency or productivity) has been recorded.

Surgical Treatment. Pneumonectomy was the operative procedure most frequently employed (Table 2), especially in the earlier years of the study. Lobectomy

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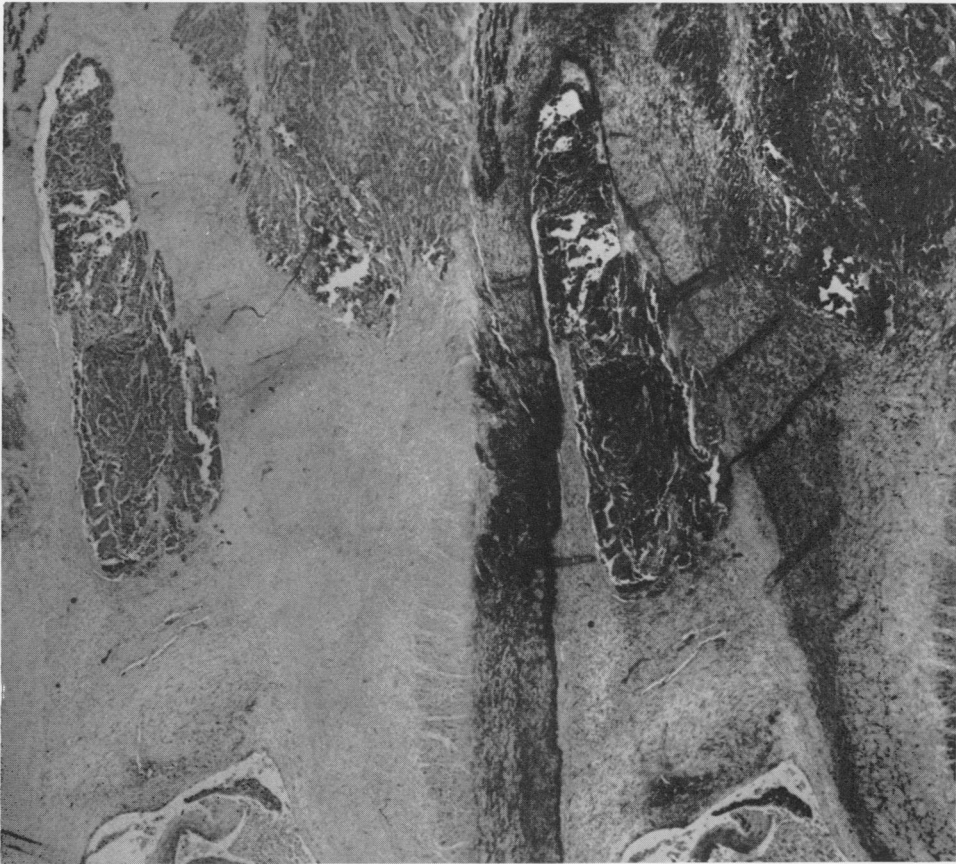


FIG. 1. Photomicrographs of consecutive sections of an undifferentiated carcinoma of the small cell type obtained with H & E (left) and the Verhoeff-Van Gieson (right). Wall of the blood vessel is clearly delineated by dark staining of elastic tissue. ($\times 10$)

TABLE 1. *Clinical Features*

Average age	57.5 years
Sex	
Male	91%
Female	9%
Race	
White	78%
Negro	22%
Duration of symptoms	7.1 months
Symptoms	
Cough	75%
Weight loss	41%
Hemoptysis	38%
Chest pain	38%
Dyspnea	17%

has been employed with increasing frequency in recent years. Segmental or wedge resection was performed in four cases as an excisional biopsy. When the unexpected diagnosis was returned after review of the permanent sections, the patient was advised to undergo a more definitive resec-

TABLE 2. *Surgical Procedure*

Pneumonectomy	137
Lobectomy	46
Bilobectomy	12
Segmental or wedge resection	4
Total	199



FIG. 2. Photomicrograph of a squamous cell carcinoma that invaded main pulmonary vein. Disarrayed, focally destroyed black elastic tissue delineates tumor within vein from that surrounding blood vessel. Verhoeff-Van Gieson. (X 30)

TABLE 3. Pathologic Classification and Incidence of Blood Vessel Invasion

	No. Cases	Incidence of Blood Vessel Invasion		
		Entire Group	Patients That Died < 5 Yr.	Survivors ≥ 5 Yr.
Bronchiolar carcinoma	8	1/8 (12.5%)	0/1 (0%)	1/7 (14.3%)
Adenocarcinoma	24	16/24 (66.7%)	13/18 (72.2%)	3/6 (50%)
Squamous cell carcinoma, Grade II	76	57/76 (75%)	46/60 (76.7%)	11/16 (68.8%)
Squamous cell carcinoma, Grade III	47	41/47 (87.2%)	38/39 (97.4%)	3/8 (37.5%)
Undifferentiated (large cell) carcinoma	29	27/29 (93.1%)	26/27 (96.3%)	1/2 (50%)
Undifferentiated (small cell) carcinoma	15	15/15 (100%)	14/14 (100%)	1/1 (100%)
Total	199	157/199 (78.9%)	137/159 (86.2%)	20/40 (50%)

Statistical Analysis	Blood Vessel Invasion		
	+	-	
Patients That Died in Less Than 5 Years	137* (125)**	23* (34)**	159
Survivors of 5 Years of More	20 (32)	20 (8)	40
	157	42	199 = N

$\chi^2 = 22.977; P < 0.001.$

* Observed values.
** Expected values.

TABLE 4. *Pathologic Classification and Incidence of Lymph Node Involvement*

	No. Cases	Incidence of Lymph Node Involvement		
		Entire Group	Patients That Died < 5 Yr.	Survivors ≥ 5 Yr.
Bronchiolar carcinoma	8	1/8 (12.5%)	1/1 (100%)	0/7 (0%)
Adenocarcinoma	24	10/24 (41.7%)	7/17 (38.9%)	3/6 (50%)
Squamous cell carcinoma, Grade II	76	39/76 (51.3%)	34/60 (56.7%)	5/16 (31.2%)
Squamous cell carcinoma, Grade III	47	30/47 (63.8%)	24/39 (61.5%)	6/8 (75.0%)
Undifferentiated (large cell) carcinoma	29	10/29 (34.5%)	10/27 (37.0%)	0+2 (0%)
Undifferentiated (small cell) carcinoma	15	12/15 (80%)	11/14 (78.6%)	1/1 (100%)
Total	199	102/199 (51.3%)	87/159 (54.7%)	15/40 (37.5%)

Statistical Analysis	Lymph Node Involvement		
	+	-	
Patients That Died in Less Than 5 Years	87* (81)**	72* (78)**	159
Survivors of 5 Years or More	15 (21)	25 (19)	40
	102	97	199 = N

$X^2 = 3.134; 0.05 < P < 0.10.$

* Observed values.

** Expected values.

tion. In each instance the patient refused the procedure.

Pathologic Features

Pathologic classification of all cases was accomplished in the following histologic types: 1) bronchiolar (or alveolar cell) carcinoma, 2) adenocarcinoma, 3) squamous cell carcinoma, 4) undifferentiated carcinoma, large cell type, and 5) undifferentiated carcinoma, small (or oat) cell type (Table 3). Histologic patterns varied considerably. Consequently, some overlapping and occasional problems in definition are encountered. However, the majority of the bronchogenic carcinomas can be satisfactorily classified into these five categories. ("Bronchial adenomas" and primary mes-

enchymal neoplasms within the lung are not included in the present report.)

Bronchiolar carcinoma. This very well differentiated papillary and glandular adenocarcinoma, believed to arise from the terminal bronchiolar epithelium, characteristically lines the alveoli with fairly uniform cells. These vary from low cuboidal to columnar and may produce abundant mucus. With this tumor the general architecture of the lung is characteristically preserved.

Adenocarcinoma. These tumors range from well differentiated papillary or glandular adenocarcinomas, with or without mucous formation, to highly undifferentiated or anaplastic tumors manifesting few, yet definite, areas of glandular formation. Adenocarcinomas uniformly show invasion or destruction of the pulmonary parenchyma.

Squamous cell carcinoma. The familiar and characteristic features of keratin formation, clear cells, intercellular bridges, keratohyaline granules and growth as islands or nests of relatively clearly de-

TABLE 5. *Pathologic Features*

Average size of lesions	4.9 cm.
Proximal bronchial margin positive	11.9%
Regional lymph nodes positive	51.2%
Regional lymph nodes negative	48.8%
Blood vessel invasion positive	78.9%
Blood vessel invasion negative	21.1%

TABLE 6. *Detailed Analysis of Those Surviving 5 Years or More*

Path.	Date ⁷	Age	Race	Sex	Size ⁸ (cm.)	P.B.M. ⁹	B.V.I. ¹⁰	Ln. ¹¹	Op. ¹²	X-ray ¹³	Follow up	
1.	Bronch. ¹	11/49	62	W	M	?	?	0	+	Lobe	0	D. 4/55 Ca.
2.	Bronch.	6/54	76	W	M	2	0	+	0	Lobe	0	1/62 1+w
3.	Bronch.	1/58	69	W	M	3	0	0	0	Lobes	0	1963 1+w
4.	Bronch.	6/55	54	W	M	1.5	0	0	0	Lobe	0	10/64 1+w
5.	Bronch.	6/54	69	W	M	?	0	0	0	Lobe	0	7/64 1+w
6.	Bronch.	3/55	69	W	M	4	?	0	0	Lobe	0	3/62 1+w
7.	Bronch.	10/52	66	W	M	6	0	0	0	Lobe	0	6/62 1+w
8.	Adeno. ²	1/58	55	W	M	13	?	0	+	Lobes	0	6/63 1+w
9.	Adeno.	1/50	54	C	M	3	0	0	0	Lobe	0	6/62 1+w
10.	Adeno.	2/58	34	C	M	3.5	0	0	0	Lobe	0	6/63 1+w
11.	Adeno.	5/58	56	W	M	3	0	+	0	Lobe	0	6/63 1+w
12.	Adeno.	10/54	45	C	F	4	?	+	+	Pn.	0	11/60 q+w
13.	Adeno.	5/51	47	W	M	4.5	0	+	+	Pn.	0	D. 7/56 met. ca.
14.	Sq. II ³	5/45	55	W	M	?	?	0	0	Pn.	0	11/60 1+w
15.	Sq. II	12/58	59	W	M	3	?	+	+	Wedge (poor risk)	+	12/63 1+w
16.	Sq. II	7/50	55	W	M	2	?	0	0	Pn.	0	1962 1+w
17.	Sq. II	6/48	61	W	M	1.5	0	0	0	Pn.	0	D. 1960 rec. ca.?
18.	Sq. II	6/45	49	W	M	2	0	0	+	Pn.	0	D. 1959 recur. ca.
19.	Sq. II	12/51	64	W	M	3	0	0	+	Lobe	0	D. 1961??
20.	Sq. II	1/49	66	W	M	5	0	+	+	Lobe	0	3/58 1+w D. 7/60??
21.	Sq. II ¹	5/50	66	W	M	2	0	+	+	Pn.	0	4/60 1+w
22.	Sq. II	7/50	65	W	F	3.5	?	+	0	Pn.	0	2/59 1+w
23.	Sq. II	1/55	52	W	M	6	0	+	0	Pn.	0	2/64 1+w
24.	Sq. II	5/53	61	W	M	4	0	+	0	Lobe	0	D. 9/58 M.I.
25.	Sq. II	12/51	48	W	M	3	?	+	0	Pn.	0	D. 6/56 M.I.
26.	Sq. II	3/53	67	C	M	7	0	+	0	Pn.	0	1961 1+w
27.	Sq. II	6/55	53	C	M	?	0	+	0	Lobe	+	D. 10/60 recur. ca.
28.	Sq. II	3/41	61	W	M	2	0	+	0	Pn.	0	D. 3/46 ca. colon
29.	Sq. II	7/55	55	C	M	4	0	+	0	Pn.	0	3/61 1+w
30.	Sq. III ⁴	8/49	50	W	M	6	?	+	+	Pn.	0	1962 1+w
31.	Sq. III	2/49	45	W	M	4	?	0	+	Pn.	0	6/62 1+w
32.	Sq. III	8/51	62	W	M	1.5	?	+	0	Pn.	0	D. 3/57 recur. ca.
33.	Sq. III	3/49	40	W	M	6	0	+	0	Pn.	0	D. 11/54??
34.	Sq. III	1/46	64	W	M	5	0	0	+	Pn.	0	D. 8/51 M.I. no ca.
35.	Sq. III	7/43	65	W	M	6	0	0	+	Pn.	0	D. 1951 of HCVD no ca.
36.	Sq. III	6/54	58	W	M	1.5	?	0	+	Pn.	0	1/62 1+w
37.	Sq. III	2/55	40	C	M	4	0	0	+	Pn.	0	1/62 1+w
38.	Lg. Cell ⁵	3/53	28	C	F	4	0	0	0	Wedge	0	6/62 1+w
39.	Lg. Cell	5/57	68	W	M	2.5	?	+	0	Lobe	0	1962 1+w
40.	Sm. Cell ⁶	2/57	53	W	M	7	?	+	+	Pn.	0	1961 1+w

¹ Bronch. = Bronchiolar carcinoma.² Adeno. = Adenocarcinoma.³ Sq. II = Squamous cell carcinoma, Grade II.⁴ Sq. III = Squamous cell carcinoma, Grade III.⁵ Lg. Cell = Undifferentiated carcinoma, large cell type.⁶ Sm. Cell = Undifferentiated carcinoma, small cell type.⁷ Date of operation.⁸ Size of resected tumor (? = size unknown).⁹ Proximal bronchial margin (? = not examined, 0 = examined and no tumor found, + = tumor found).¹⁰ Blood vessel invasion (0 = not found, + = tumor found).¹¹ Lymph node involvement (0 = not found, + = tumor found).¹² Operations (Pn. = Pneumonectomy, Lobe(s) = Lobectomy [or Bilobectomy], Wedge = Wedge Resection).¹³ Postoperative radiation therapy (0 = not done, + = done).

marked cells distinguish the squamous cell (or epidermoid) carcinomas. Based on the predominant pattern of differentiation, these neoplasms were subdivided into Grade I (very well differentiated), Grade

II (moderately well differentiated) and Grade III (poorly differentiated). No Grade I tumors were encountered in the present series. It is also recognized that Grade III, poorly differentiated squamous

TABLE 7. Results of Surgical Treatment

Survival	%
< 2 years	67
2 to 5 years	13
> 5 years	20

cell carcinomas may merge subtly into the category of undifferentiated carcinoma.

Undifferentiated carcinoma, large cell type. Neoplasms of this type lack two features: 1) recognizable differentiation toward adenocarcinoma or squamous cell carcinoma, and 2) perceptible areas of the characteristic small (or oat) cell type.

Undifferentiated carcinoma, small cell type. Tumors of this type are characterized by fairly uniform, monotonous small cells that may appear round, oval or spindle, completely lacking differentiation. The cells are small, cytoplasm is scant or lacking, and necrosis may be conspicuous. Occasionally the tumor cells may be arranged about small blood vessels in pseudo-rosettes, resembling "pigs eating out of a trough."

The *pathologic features* of the resected specimens are tabulated (Tables 3-5). The finding of tumor cells in the section of the proximal bronchial margin was a significant factor. Not only was lack of healing of the

TABLE 8. Factors Affecting 5-Year Survival

Comparison of cell types	%
Bronchiolar carcinoma	87
Adenocarcinoma	25
Squamous cell	
Grade II	21
Grade III	17
Undifferentiated (large cell) carcinoma	7
Undifferentiated (small cell) carcinoma	7

bronchus a major threat, but also local recurrence can be anticipated. The proximal bronchial margin was examined in 109 cases. Tumor was found in 13 instances (11.9%). Twenty-three of 96 patients without involvement of the proximal bronchial margin survived more than 5 years. Only one of 13 patients with invasion of this margin is living and well more than 5 years after operation. (See Case 40, Table 6).

The regional lymph nodes were involved in approximately one half of the cases (Tables 4, 5).

The frequency of vascular invasion is listed in Table 3.

Surgical Results

Table 7 shows that 20 per cent of the patients (40) survived 5 years or longer. A detailed analysis of these patients is presented in Table 6. An attempt was made to evaluate possible factors contributing to survival of this group. As might be expected, prolonged survival was associated with the better differentiated types (Table 8). Only one of the patients with bronchiolar carcinoma died before 5 years, while only one of the group having undifferentiated, small cell carcinomas survived more than 5 years—a 53-year-old man who had a 7-cm. left hilar mass. Left pneumonectomy was performed. The resected specimen showed carcinoma within the proximal bronchial margin, hilar lymph

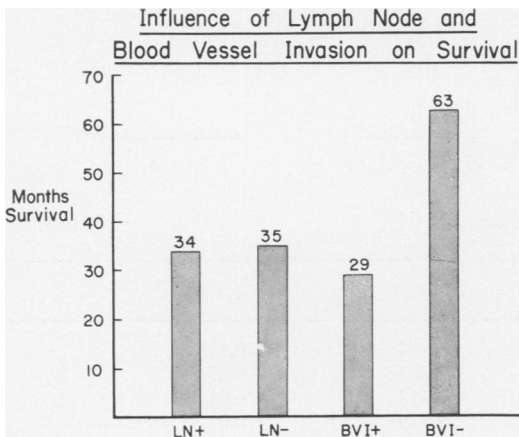


FIG. 3. Graph showing influence of lymph node involvement and blood vessel invasion on average survival time. See text and Table 9.

TABLE 9. *Blood Vessel Invasion and Lymph Node Involvement in Non-Survivors and Survivors*

Group	Patients That Died in Less Than 5 Years	Survivors of 5 Year or More
(1) B.V.I. Negative; L.N. Negative		
Bronchiolar Carcinoma	1	5
Adenocarcinoma	2	2
Squamous cell carcinoma, Grade II	9	2
Squamous cell carcinoma, Grade III	0	0
Undifferentiated (large cell) carcinoma	1	1
Undifferentiated (small cell) carcinoma	0	0
Total	13/23 (56.5%)	10/23 (43.5%)
(2) B.V.I. Negative; L.N. Positive		
Bronchiolar carcinoma	0	1
Adenocarcinoma	3	1
Squamous cell carcinoma, Grade II	5	3
Squamous cell carcinoma, Grade III	1	5
Undifferentiated (large cell) carcinoma	0	0
Undifferentiated (small cell) carcinoma	0	0
Total	9/19 (47.4%)	10/19 (52.6%)
(3) B.V.I. Positive; L.N. Negative		
Bronchiolar carcinoma	0	1
Adenocarcinoma	9	1
Squamous cell carcinoma, Grade II	16	8
Squamous cell carcinoma, Grade III	14	2
Undifferentiated (large cell) carcinoma	17	1
Undifferentiated (small cell) carcinoma	4	0
Total	60/73 (82.2%)	13/73 (17.8%)
(4) B.V.I. Positive; L.N. Positive		
Bronchiolar carcinoma	0	0
Adenocarcinoma	4	2
Squamous cell carcinoma, Grade II	30	3
Squamous cell carcinoma, Grade III	24	1
Undifferentiated (large cell) carcinoma	9	0
Undifferentiated (small cell) carcinoma	10	1
Total	77/84 (91.7%)	7/84 (8.3%)

Statistical Analysis

Group	vs	Group	t	P
1	vs	2	0.597	>0.1
1	vs	3	2.265	<0.05
1	vs	4	3.153	<0.01
2	vs	3	2.829	<0.01
2	vs	4	3.746	<0.001
3	vs	4	1.744	<0.1

TABLE 10. *Involvement of Proximal Bronchial Margin and Blood Vessel Invasion in Non-Survivors and Survivors*

Group	Patients That Died in Less Than 5 Years	Survivors of 5 Year or More
(1) P.B.M. negative; B.V.I. negative	14/27 (51.9%)	13/27 (48.1%)
(2) P.B.M. negative; B.V.I. positive	59/69 (85.5%)	10/69 (14.5%)
(3) P.B.M. positive; B.V.I. negative	3/3 (100%)	0/3 (0%)
(4) P.B.M. positive; B.V.I. positive	9/10 (90%)	1/10 (10%)

Statistical Analysis				
Group	vs	Group	t	P
1	vs	2	6.45	<0.05
1	vs	3	160.0	—*
1	vs	4	3.82	<0.06
2	vs	3	3.43	<0.1
2	vs	4	.434	N.S.**
3	vs	4	1.055	N.S.**

* There are too few observations for a significance test. However, there does appear to be a difference that would almost certainly be significant with a larger sample.

** Not significant.

nodes and veins. He received no pre- or postoperative chemotherapy or irradiation.

As presented graphically in Figure 3 and in Tables 9–11, absence of blood vessel invasion appeared to present a much more favorable prognosis, whereas the presence or absence of lymph node invasion or involvement of the proximal bronchial margin was not nearly as important. In Table 12 a comparison of clinical factors reveals little significant difference between the long-term survivors and the entire group except for the somewhat smaller size of the lesion noted at operation in the five-year survival group. The influence of the type of operative procedure or subsequent survival is

analyzed in Table 13. Although the operation performed may be influenced by multiple factors, not the least of which is the extent of tumor at the time of operation, prolonged survival in the lobectomy group is probably significant.

Discussion

During the past 25 years a gradually accumulated experience with resectional therapy for bronchogenic carcinoma has indicated the multiple factors which seem to influence long-term survival following operation. In a previous analysis of cases from this hospital spanning a 10-year period (1942–1951) which is included in the

TABLE 11. *Comparison of the Absence of Lymph Node Involvement and Blood Vessel Invasion in Non-Survivors and Survivors*

	Entire Group	Patients That Died in Less Than 5 Years	Survivors of 5 Year or More
Negative Lymph Nodes	97/199 (48.8%)	72/159 (45.3%)	25/40 (62.5%)
Negative for Blood Vessel Invasion	42/199 (21.1%)	22/159 (13.8%)	20/40 (50%)

Statistical analysis: See Tables III and IV

25 of 97 cases (25.8%) without positive lymph nodes survived 5 years or more.

20 of 42 cases (47.6%) without blood vessel invasion survived 5 years or more.

Statistical analysis: $t = 2.45, P < 0.05$.

present study, the operability rate was 62 per cent with a relatively low resectability rate of 32 per cent.⁴ There seemed to be a direct relationship between the type of lesion and resectability. In 333 histologically proved cases seen in this 10-year period there was an overall 5-year survival rate of 6 per cent. These data are comparable to those pooled from other reported series of cases.^{1, 10}

In the present study an effort has been made to achieve a detailed analysis of those cases undergoing "curative" resections for bronchogenic carcinoma. Factors which have appeared to be significant in relation to longterm survival are: 1) *type of cell* and 2) *blood vessel invasion*.

The significance of size of lesion, type of resection and involvement of lymph nodes and proximal bronchial margin was uncertain.

In the material for analysis no apparent relationship emerged between survival and sex, age, race or duration of symptoms. This is in agreement with the majority of previous reports.¹ Recently, however, Feinstein has outlined a detailed *pre-therapeutic symptomatic staging* that suggests that accurate prognostic estimation and valid therapeutic evaluation may be improved by adding clinical symptoms to the morphologic features.⁵

With respect to type of cell, it appears that bronchiolar carcinoma may carry an

TABLE 13. *Influence of Operative Procedure on 5-Year Survival*

22 Pneumonectomies	22/137 (16.1%)
18 Lobectomies or segmentectomies	18/ 62 (29.0%)

entirely different prognosis from other forms of bronchogenic carcinoma.⁹ The 5-year survival rates following "curative" resections for squamous cell and adenocarcinoma are comparable (25% vs. 19%). There is no significant difference between the behavior of Grade II and Grade III squamous cell carcinoma; survival with both large and small cell undifferentiated carcinomas has been poor (7%).

Although the significance of blood vessel invasion in bronchogenic carcinoma has been subject to controversy,^{3, 11} in the present study vascular invasion emerges as an important criterion for projecting prognosis. Admittedly it is impossible to examine all areas of a tumor for vascular invasion but a thorough, systematic evaluation does allow a good opportunity to judge the ability of the lesion to penetrate contiguous vascular structures. It is important to recognize, though, that *no single criterion* can serve as an infallible indicator of prognosis. Certainly a number of patients in whom vascular invasion was absent subsequently expired with metastatic disease (Tables 3, 9, 11). In contrast, 20 patients with vascular invasion were included among the long-term survivors. When the presence or absence of vascular invasion was included with other significant features in the overall evaluation of prognosis, however, this feature appeared to assume an added significance.

Unfortunately, the importance of examining the proximal bronchial margin was not realized in the earlier days of resectional treatment, but in recent years this aspect has been emphasized in the routine investigation of operative specimens. The importance of *in situ* changes and submucosal infiltration or lymphatic permea-

TABLE 12. *Comparison of 5-Year Survivors with Entire Group*

	5-Year Group	Entire Group
Age	56 yr.	57.5 yr.
Sex		
Male	93%	91%
Female	7%	9%
Race		
White	80%	78%
Negro	20%	22%
Duration of symptoms	7.8 mo.	7.1 mo.
Size of lesions	3.8 cm.	4.9 cm.

tion have been recognized heretofore.¹ This mode of spread may assume added significance in the case of squamous cell and undifferentiated carcinoma—lesions that seem to share a propensity for involvement of the proximal bronchial margin.^{4, 8}

Garland and associates⁷ calculated that untreated bronchogenic carcinomas of the squamous cell type may require about 9.1 years to attain a size of 2 cm. in diameter, while adenocarcinoma requires 25.5 years. The period of silent growth of primary lung cancers often may be measured in decades rather than months or years.

It is not surprising, therefore, that in the present series, the factor of the size of lesion is relatively unimportant in forecasting postoperative results. One should be hesitant to reject any case for operation simply on the basis of size of the lesion. In every large series of patients with bronchogenic carcinoma there are a significant number with large, centrally located tumors and protracted symptoms who have survived for long periods following radical excision.² The inclusion of such cases in the present series (Table 6) probably contributes to the discrepancies in duration of symptoms between the 5-year survivors and the overall group.

In the past, considerable controversy has existed concerning the optimal surgical approach for bronchogenic carcinoma. In most large series, as in the present study, it has become apparent that, where feasible, lobectomy offers at least an equal, if not better, opportunity than pneumonectomy for long-term survival.^{6, 10} This conclusion is dependent on the ability of the surgeon to remove all the neoplastic tissue with the former procedure. Its application would naturally be more frequent in the case of characteristically peripheral lesions such as adenocarcinoma. Squamous cell and undifferentiated carcinomas usually appear in a more central location and the application of a more limited procedure imposes an obligation on the surgeon to ensure that

residual tumor is not left at the site of resection.

Age of patient would appear to have no influence on survival. There were no significant differences in the average age of the patients surviving resectional therapy and the overall group.

The presence of lymph node metastasis appeared to have surprisingly little effect on long-term survival where all involved tissue was felt to have been removed grossly at the time of operation. Twenty per cent of the entire series of 199 patients survived 5 years or longer. Of that group without positive lymph nodes (Table 11), 26 per cent lived 5 years or more; this contrasts strikingly with a similar comparison of the influence of blood vessel invasion, where 48 per cent of the cases without blood vessel involvement survived 5 years or longer. A comparison of the combined influence of blood vessel and lymph node invasion (Table 9) suggests there may be some additive influence on long-term survival following resectional therapy. This combined effect would not appear to be as prominent, however, as previous authors have suggested.¹¹ The presence or absence of blood vessel invasion is much more important in determining the prognosis of the individual patient.

Summary

As experience with resectional treatment for bronchogenic carcinoma has increased, a number of factors have assumed prominence in influencing long-term survival following operation. The present study includes an extensive analysis of these factors as encountered in 199 cases of bronchogenic carcinoma treated at the Johns Hopkins Hospital within a 25 year period (1933–1958). The following criteria were satisfied prior to inclusion in this study:

- 1) complete clinical records, 2) definitive "curative" resection, 3) pathologic material available for restudy, and 4) follow up until death or for a minimum of 5 years.

Analysis of this material indicates that long-term survival following operation is related to histologic type and blood vessel invasion.

Although there appeared to be some relationship between involvement of lymph nodes and proximal bronchial margin, size of lesion and type of operation, the importance of these factors was less decisive.

There appeared to be no apparent relationship between survival and sex, age, race or duration of symptoms.

A comprehensive analysis of the 40 patients who survived 5 years or more after operation is presented.

Acknowledgments

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