SURVIVAL AFTER LUNG RESECTION FOR BRONCHIAL CARCINOMA

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There are many reports of the experience of groups of patients with a bronchial carcinoma treated by lung resection. In this country, for instance, there are series recorded by Sellors, Cruickshank, and Billimoria (1947), Brock (1948), Mason (1949), Taylor and Waterhouse (1950), Price Thomas (1952), and Sellors (1955). But gross yearly survival rates may be a poor guide to prognosis in the individual patient if the duration of survival is greatly influenced by factors not common to all. We have investigated the effects on survival of some of these factors in a relatively large group of patients.

The patients were operated on at the Hospitals for Diseases of the Chest by the surgeons of the two hospitals and their assistants between 1940 and 1951. All with a histological diagnosis and a record of the cell type have been included. Records of 531 patients were available; all but 13 (2%) were followed for at least two years or until death. Three were lost sight of during the first two months, two in the third month, and four more in the remaining nine months of the first year.

The experience of the patients is expressed as the chances of surviving for each of the first five years after operation. The survival rates have been calculated by the life-table method, which makes full use of the available data where groups of patients have been treated over a period of years and observed for different lengths of time. The validity of the procedure depends on the mortality remaining unchanged throughout the period. This was not true of the immediate mortality after operation. The " operative mortality," arbitrarily defined as death within two months of operation, was high in the early years. Between 1940 and 1946 it was 19%, but in 1947–49 it fell to 16% and in the next two-year period to 10%. The operative mortality must therefore be removed from the life-tables, both for investigating the

factors influencing survival and for using the rates as a guide to the prognosis of patients operated on in the future. On the other hand, the experience of those who survived operation changed little during the 12 years (Table II). Thus, for the 114 survivors during 1940–46 the chance of surviving two years was 47% and four years 34%. In the next period the corresponding rates were 48% and 36% for 155 patients; and for the period 1950–51 47% and 35% for 184 patients. It appears justified, therefore, to combine the experience of all those who survived operation during the entire 12 years.

Some were reported to have died from causes other than cancer, and in some of these post-mortem examination showed no recurrence or metastases. But unless there is a high proportion of necropsies it is impossible to estimate accurately the frequency of non-cancer deaths; no distinction is made in this investigation between death from cancer and death from other diseases. The mortality rates, therefore, are for deaths from all causes. Patients living at the time of the last report were considered to have been alive for half the particular year of observation. The survival rates for the fourth and later years are less likely to be accurate than those for the first three, as the yearly number of operations increased considerably during the later part of the period.

YEARLY SURVIVAL RATES OF THE WHOLE GROUP

These are shown in Table I and Fig. 1. Four hundred and fifty-three patients survived the early post-operative period. The largest number of deaths occurred in the second three-month period, in which there was a 13% chance of dying. But if the patient survived a year the risk of dying in the subsequent three-month periods declined from 8% to 4% during the next two years. There was a 63% chance of surviving a year, 47% two years, 39% three years, and 33% five years.

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TABLE I

SURVIVAL RATES OF PATIENTS LIVING LONGER THAN TWO MONTHS AFTER OPERATION*

Interval (Completed Months from Operation)	Last Report		" At Risk " at Start of Interval	Probability of Dying during Interval (%)	Survival Rate (%)
	Dead	Alive			
0–2	27	2	453	6·0	94
3–5	54	2	423	12·7	82
6–8	40	2	367	10·9	73
9–11	43		326	13·2	63
12–14	22	1	282·5	7·7	58
15–17	21	1	259·5	8·1	54
18–20	14	2	237	5·9	51
21–23	14		222	6·3	47
24–26	11	7	204·5	5 4	45
27–28	9	4	188	4 8	43
30–32	8	6	174	4 6	41
33–35	7	2	162	4·3	39
36–47	15	42	133	11·3	35
48–59	3	24	85	3·5	33
60–71	2	18	61	3·3	32
72–83	2	14	43	4·6	31
84–95	2	10	29	6·9	29
96–107	2	7	18 5	*11*	25
108–119	2	5	10 5	*19*	21
120+	—	6			

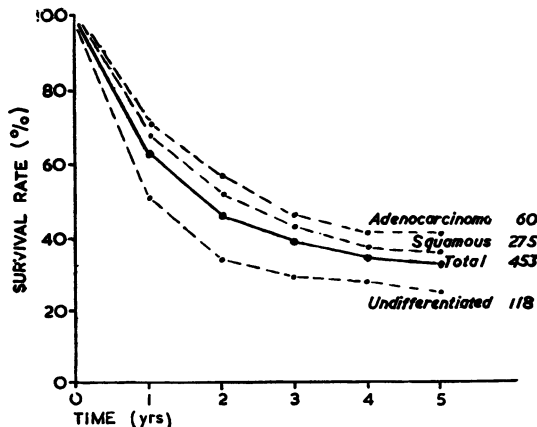* Proportions and rates based on less than 50 patients are printed in italics.

FIG. 1.—The survival rates in the three histological types.

THE INFLUENCE OF CERTAIN FACTORS ON SURVIVAL

H.stological Type.—The recording of the histological type of a tumour depends on many variables. Different pathologists may give different opinions on the same section ; and sections from different parts of a tumour may show different cell types and arrangements. It is to some extent, therefore, a matter of chance which label is assigned to a particular tumour. In this series the histological reports were given by several different pathologists during the 12 years, and the sections have not been re-examined for this investigation. Although there are undoubtedly many inconsistencies, it seems reasonable to expect that the broad classification into squamous, undifferentiated, and adenocarcinoma (including the columnar-cell type) will be sufficiently exact for an approximate estimation of the influence of histological appearances on survival.

Two hundred and seventy-five were reported to have squamous carcinomas, and the survival rate was 52% for two years and 36% for five years (Table II, Fig. 1). The corresponding rates for the 118 with undifferentiated tumours were 34% and 26%. Such differences are unlikely to have arisen by chance (Table VI). Only 60 had adenocarcinomas. The two-year rate was 57% and the five-year rate 41%, but the latter is based on relatively few patients. The experience of the squamous and adenocarcinoma groups was much the same ; and clearly to demonstrate any differences that may exist between these types would require a much larger number of patients.

MEDIASTINAL AND HILAR NODE METASTASES.—The influence of metastases in the regional lymph nodes was investigated in two ways. Although grossly involved nodes may be readily recognized at operation, not all enlarged firm nodes contain metastases. The presence of metastases is, in practice, judged both from the surgeon's observation of the macroscopic appearances and the pathologist's report on the specimen he receives. The patients operated on at one hospital were therefore divided into two groups according to the recorded opinion of the surgeon on the presence of metastases in the hilar and mediastinal lymph nodes. In the patients from the other hospital only the pathologist's report of involved nodes outside the lung was considered. In many cases, particularly in the early years, it was not clear whether the macroscopically malignant nodes removed at operation had been sectioned. On the other hand, there were several examples of reported microscopic involvement of nodes around the pulmonary vessels when there was no record of these having been considered macroscopically involved at operation. It was therefore thought that comparison between those with and without histological evidence of metastases would not be valid.

Adequate data on the surgeon's assessment of node metastases are available in 233 patients. One hundred of these did not appear to have regional metastases ; and the two-year survival rate was 61%, the five-year rate being 48% (Table II). On

TABLE II

SURVIVAL RATES FOR FIRST 5 YEARS OF PATIENTS
LIVING LONGER THAN 2 MONTHS AFTER OPERATION
RELATED TO PERIOD OF OPERATION, HISTOLOGICAL
TYPE, SIDE, LOBE, AGE, DURATION OF SYMPTOMS, SEX,
EXTENT OF RESECTION, AND PRESENCE OF ENLARGED
NODES*

	No.	Chance of Surviving (%)				
		1 Year	2 Years	3 Years	4 Years	5 Years
All patients	453	63	47	39	35	33
1940–1946	114	64	47	37	34	32
1947–1949	155	64	48	41	36	35
1950–1951	184	63	47	39	35	—
Squamous	275	68	52	43	37	36
Adenocarcinoma	60	71	57	46	41	41
Undifferentiated	118	51	34	29	28	26
Right lung	210	66	51	45	40	39
Left ,,	243	61	44	37	33	31
Right upper lobe	76	72	57	45	43	43
Squamous	44	78	61	47	44	44
Undifferentiated	19	64	58	49	49	49
Left upper lobe	131	67	52	43	38	36
Squamous	78	73	60	49	42	42
Undifferentiated	35	51	31	26	25	25
Right lower lobe	114	65	50	40	34	32
Squamous	68	72	56	46	38	36
Undifferentiated	31	43	29	25	21	21
Left lower lobe	105	55	36	31	27	25
Squamous	66	57	38	33	31	28
Undifferentiated	29	44	22	22	22	22
Age less than 45 years	77	70	53	49	45	45
45–49	81	56	39	34	29	27
50–54	103	63	51	37	32	31
55–59	92	62	42	35	32	30
60–64	76	68	55	48	40	40
65 and over	24	62	45	26	26	26
Duration of symptoms:						
0–2 months	71	64	53	45	42	42
3–4 ,,	158	62	47	40	36	33
6–8 ,,	97	55	39	33	31	31
9–11 ,,	41	75	51	34	31	27
12 months or more	71	73	54	45	34	34
Men	412	62	46	38	33	31
Women	41	78	65	57	57	57
Pneumonectomy	379	61	46	38	33	32
Lobectomy	74	76	54	44	42	42
Enlarged nodes	133	44	27	14	12	11
No ,, ,,	100	77	61	51	48	48
Enlarged nodes. Pneumonectomy	113	44	25	21	18	16
Enlarged nodes. Lobectomy	20	45	40	25	25	25
No enlarged nodes. Pneumonectomy	70	74	64	53	49	49
No enlarged nodes. Lobectomy	30	83	57	47	47	47

* Proportions and rates based on less than 50 patients are printed
in italics.

the other hand, of the 133 considered to have
metastases, the corresponding rates were 27%
and 11%. The proportion with undifferentiated
tumours, that is to say those known to have a
lower survival rate, was the same in the two
groups (Table IV). The differences are clearly

significant and indicate the great effect of macro-
scopically evident regional nodes metastases on
survival (Table VI).

Although some of those with histological evi-
dence of metastases also had greatly enlarged
nodes, many had been considered at operation to
have no manifest extension of the tumour. The
two-year survival rate of 58 patients with histo-
logically demonstrated extrapulmonary node meta-
stases was 46% and the five-year rate 25%. The
report of tumour tissue in the nodes, though of
prognostic significance, does not indicate an
inevitably poor outlook, for 27 of the 58 with
this report were still alive two years after opera-
tion.

THE POSITION OF THE TUMOUR.—In 210 the
tumour was in the right lung and in 243 the left.
The proportion of undifferentiated cancers was
substantially the same in the two groups (Table
III), as was the proportion with enlarged nodes
in the sample investigated (Table IV). There
were, however, differences in the survival rates.
The two-year rate for those with a right-sided
tumour was 51% compared with 44% for those
on the left side ; and the five-year rates were 39%
and 31%.

The survival rates have also been calculated for
the different lobes of the lungs (Table II and Fig.
2). There were 76 in the right upper lobe with
two- and five-year rates of 57% and 43%, com-
pared with 50% and 32% for the 114 with tumours
in the right lower lobe. Similarly the left upper
lobe with 131 cases had a higher survival rate,
52% and 36%, than the left lower lobe, 36%
and 25%, with 105 cases. The survival rates
both for squamous and undifferentiated tumours
maintain the same pattern as those of the whole
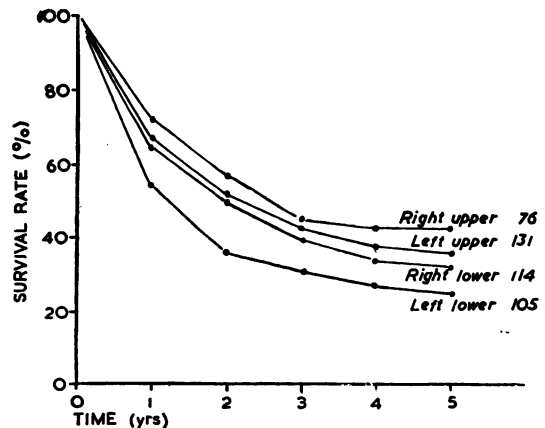group. For example, for squamous tumours the

FIG. 2.—The survival rates in the upper and lower lobes of both lungs.

two-year rates were 61% for the right upper lobe, 60% for the left upper lobe, 56% for the right lower lobe, and 38% for the left lower lobe, and the rates for undifferentiated tumours were 58%, 31%, 29%, and 22%. However, the difference in survival between the two upper lobes is small and may well have been due to chance. So may that between the upper and lower lobes of the right lung.

The lowest survival rates were found with left lower lobe tumours, and the differences between this lobe and the others are much less likely to have been chance findings (Table VI). There were, moreover, insignificant differences in the distribution of histological types between the lobes, and only a very slightly higher proportion of left lower lobe tumours with enlarged nodes in the sample examined. It may be, therefore, that the observed differences in survival rates were indeed due to the situation of the tumour.

SEX.—There were only 41 women among the 453 patients surviving operation. Their two- and five-year survival rates were 65% and 57%, compared with 46% and 31% for the men, although there was a higher proportion of women with undifferentiated tumours (Tables II and III). There were, on the other hand, probably fewer women with enlarged nodes, there being 42% compared with 59% in the sample examined. The difference in the survival rates is considerable and was probably not due to chance (Table VI). But with such a small number of women and such unequal distribution between the sexes of the two factors known to influence prognosis, it is impossible to be sure that the differences in mortality were due only to sex differences in the behaviour of the tumour.

AGE.—No regular pattern of survival in relation to the age of the patients was detected (Table II). Thus, the two-year rates ranged from 39% for those between 45 and 49 years to 55% between 60 and 64, and the five-year rates from 27% to 40%. But survival did not consistently decrease or increase with advancing age. The proportion with undifferentiated tumours was lower in those over 60 (Table III). This factor would tend to increase the survival rate; but, although the prognosis was indeed slightly better in those between 60 and 64 than in those between 45 and 60 the difference was small. Those under 45 had similar surival rates to those aged 60 to 64, 53% for two years and 45% for five years.

THE DURATION OF SYMPTOMS BEFORE OPERATION.—It might be expected that the chances of surviving would vary inversely with the duration

TABLE III

HISTOLOGICAL TYPE RELATED TO PERIOD OF OPERATION, SITE OF TUMOUR, SEX AND AGE OF PATIENTS, DURATION OF SYMPTOMS AND EXTENT OF OPERATION

	Squamous		Adeno-Carcinoma		Undifferentiated		Total
	No.	%	No.	%	No.	%	
All patients ..	275	61	60	13	118	26	453
1940–1946 ..	73	64	11	10	30	26	114
1947–1949 ..	95	61	23	15	37	24	155
1950– ..	107	58	26	14	51	28	184
Right lung ..	126	60	31	15	3	25	210
Left ,,	149	61	29	12	65	27	243
Right upper lobe	44	58	13	17	19	25	76
Left ,, ,,	78	60	18	14	35	26	131
Right lower lobe	68	60	15	13	31	27	114
Left ,, ,,	66	62	10	9	29	28	105
Age less than 45	42	54	10	13	25	32	77
45–49 ..	50	62	9	11	22	27	81
50–54 ..	62	60	13	13	28	27	103
55–59 ..	53	58	11	12	28	30	92
60–64 ..	51	67	14	18	11	15	76
65+ ..	17	71	3	12	4	17	24
Duration of symptoms:							
0–2 months	45	63	5	7	21	30	71
3– 5 ,, ..	94	61	21	12	43	27	158
6– 8 ,, ..	59	61	12	12	26	27	97
9–11 ,,	26	63	9	23	6	14	41
12+ ,,	44	62	11	15	16	23	71
Men	260	63	51	12	101	25	412
Women ..	15	37	9	22	17	41	41
Pneumonectomy	237	63	42	11	100	26	379
Lobectomy ..	38	51	18	24	18	25	74

of symptoms before operation. This was true in this series for duration of symptoms up to eight months, the two-year rate being 53% for those with symptoms for less than three months and 39% for six to eight months. But for longer durations the chance of survival appeared to improve and became 54% for two years in those who had had symptoms for a year or more. This could hardly have been due to the slight differences in the proportions of squamous tumours and the finding of enlarged nodes (Tables III and IV). It is probable that those who are still fit enough for operation and who have no overt metastases nine months or longer from the start of illness tend to have slowly growing, localized tumours. The lowest survival rates occurred in those with histories of six to eight months, which appears to be the time at which there is the most chance of the cancer being disseminated. For instance, among the patients with a bronchial carcinoma seen at the Brompton and Royal Marsden Hospitals during 1951 the proportion with evidence of metastases when first seen was highest in those with five months' history (Bignall, 1955a). A similar relation between survival rate and duration of symptoms before diagnosis is seen in those who are

TABLE IV

PRESENCE OF ENLARGED MEDIASTINAL NODES AT OPERATION RELATED TO HISTOLOGICAL TYPE AND SITE OF TUMOUR, PERIOD AND EXTENT OF OPERATION, AGE AND SEX OF PATIENTS, AND DURATION OF SYMPTOMS*

	Without Enlarged Nodes		With Enlarged Nodes		Total
	No.	%	No.	%	
All patients	100	43	133	57	233
Squamous	64	43	85	57	149
Undifferentiated	26	46	31	54	57
Adenocarcinoma	10	*37*	17	*63*	27
Right lung	46	43	61	57	107
Left ,,	54	43	72	57	126
Right upper lobe	19	*46*	22	*54*	41
Left ,, ,,	31	46	36	54	67
Right lower ,,	25	43	33	57	58
Left ,, ,,	22	38	36	62	58
Year of operation:					
1940–1946	30	55	24	45	54
1947–1949	34	42	46	58	80
1950–1951	36	36	63	64	99
Pneumonectomy	70	38	113	62	183
Lobectomy	30	60	20	40	50
Age less than 45	20	*46*	23	*54*	43
45–49	16	*43*	21	*57*	37
50–54	16	*33*	33	*67*	49
55–59	26	52	24	48	50
60–64	17	*39*	26	*61*	43
65+	7	*54*	6	*46*	13
Men	89	41	125	59	214
Women	11	*58*	8	*42*	19
Duration of symptoms:					
0–2 months	21	*48*	23	*52*	44
3–5 ,,	38	42	53	58	91
6–8 ,,	19	*44*	24	*56*	43
9–11 ,,	8	*38*	13	*62*	21
12+	14	*41*	20	*59*	34

* Proportions and rates based on less than 50 patients are printed in italics.

not treated. In a series of 255 untreated patients the median survival time after diagnosis was five months in those who had had symptoms for less than two months ; but it fell to three months in the group with four to five months' illness before diagnosis, and rose again to seven months in patients with symptoms for a year or longer (Bignall, 1955b).

The chances of surviving five years were much the same in all groups except those with very short histories, suggesting that death may have occurred later in those with long histories because of the slow growth of the malignant tissue. The proportion in whom the growth was entirely eliminated probably depended little on the duration of symptoms before operation.

THE EXTENT OF OPERATION.—With such a varied group of patients operated on during a period of 12 years by many different surgeons it is impossible to relate survival to small technical

differences. Seventy-four had a lobectomy and 379 a pneumonectomy. The two- and five-year rates for those having a lobectomy were 54% and 42% compared with 46% and 32% after pneumonectomy (Table II). But the differences cannot be attributed to the extent of the resection. The proportion of undifferentiated tumours in the two groups was similar (Table III). But the sample in which the presence of gross evidence of metastases was investigated suggests that many more who had a lobectomy (as might be expected) had no evidence of node involvement (Table IV). Sixty per cent. having a lobectomy had no manifestly enlarged nodes compared with only 38% of those who had a pneumonectomy. The two- and five-year survival rates after pneumonectomy when no enlarged nodes were recorded were 64% and 49% (Fig. 3). These rates differ little from those following lobectomy without enlarged nodes —57% and 47%. Among those with enlarged
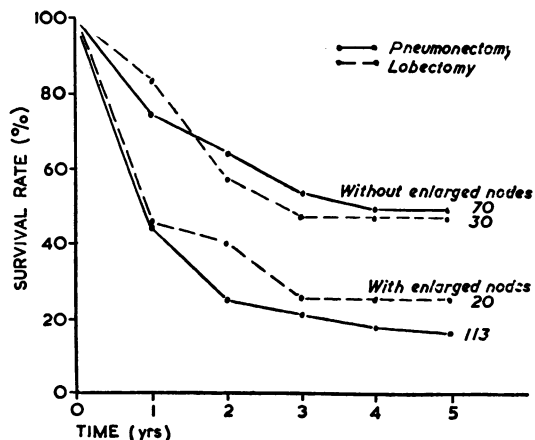

FIG. 3.—The survival rates after pneumonectomy and lobectomy of patients with and without enlarged extrapulmonary nodes.

nodes the rates were slightly higher in the lobectomy group, 40% and 25% compared with 25% and 16%. It seems reasonable to conclude that there is no convincing evidence that the chances of survival of those who lived through the immediate post-operative period were materially affected by the extent of resection the surgeon considered advisable for the particular patient. On the other hand, there was a clear difference in operative mortality.

OPERATIVE MORTALITY.—The operative mortality decreased considerably during the 12 years from 1940 to 1951. In the last two years it was 10%, there being 21 deaths in 205 patients (Table V). During this period none of the 42 patients who had a lobectomy died within two months of

TABLE V

OPERATIVE MORTALITY DURING 1950 AND 1951 RELATED TO EXTENT OF OPERATION, SIDE OF TUMOUR, AND AGE OF PATIENTS

	Total	Died in First Two Months	
		No.	%
All patients	205	21	10
Pneumonectomy ..	163	21	13
Lobectomy	42	0	0
Right lung	96	12	12
Left „	109	9	8
Age less than 50	58	4	7
50–59	87	9	10
60+	60	8	13

OPERATIVE MORTALITY:
Pneumonectomy and lobectomy
  P = 0.016 by exact test of significance
Right and left sides
  $\chi^2 = 0.59$ using Yate's correction for small numbers
  $n = 1$ $0.5 > P > 0.3$
Age
  $\chi^2 = 0.95$ $n = 2$ $0.7 > P > 0.5$

TABLE VI

TESTS OF SIGNIFICANCE ON TWO-YEAR SURVIVAL RATES

	2-year Rate (%)	Standard Error	Difference	Standard Error of Difference	Difference / Standard Error
Squamous ..	52.0	3.0	} 18.3	5.5	3.3
Undifferentiated ..	33.7	4.6			
Without enlarged nodes	61.5	5.0	} 34.2	6.3	5.3
With enlarged nodes	27.3	3.9			
Right upper lobe..	57.2	5.7	} 5.6	7.1	0.8
Left „ „ ..	51.6	4.3			
Right lower lobe	50.1	4.8	} 14.1	6.8	2.1
Left „ „ ..	36.0	4.7			
Right upper lobe	57.2	5.7	} 7.1	7.5	0.9
„ lower „ ..	50.1	4.8			
Left upper lobe ..	51.6	4.3	} 15.6	6.4	2.4
„ lower „	36.0	4.7			
Men	45.7	2.4	} 19.5	7.9	2.4
Women ..	56.2	7.5			

operation compared with 21 (13%) of the 163 who had a pneumonectomy. Moreover, during the whole 12-year period only one of the 74 patients treated by lobectomy died in the early post-operative period. The mortality during 1950 and 1951 was 7% in those under 50 years of age, 10% in the sixth decade, and 13% in those over 60. Although these differences are slight, it might be expected that the immediate risk of the operation would increase with age. The operative mortality was higher in those who had a resection done on the right side, being 12% compared with 8% on the left side. Following pneumonectomy the mortality was 16% on the right and 10% on the left. But both differences are small and may have

been due to chance (Table V). It is unlikely that the early prognosis is affected by the side of the lesion.

DISCUSSION

The poorer prognosis of undifferentiated tumours after lung resection is well known (Adams, 1948 ; McDonald, McBurney, Carlisle, and Patton, 1951 ; Borrie, 1952 ; Kirklin, Mc-Donald, Clagett, Moersch, and Gage, 1955). So, too, is the considerable influence of metastases in the regional nodes on survival (Overholt and Schmidt, 1949 ; Churchill, Sweet, Soutter, and Scannel, 1950 ; Moore, 1951 ; Carlisle, McDonald, and Harrington, 1951 ; Thompson, 1952 ; Borrie, 1952 ; Ochsner, Ray, and Acree, 1954).

Carlisle and others (1951), from a study of 68 patients with squamous tumours at the Mayo Clinic, concluded that the prognosis was worse when the tumour was in the left lung. Borrie (1952) reported that eight of 13 patients alive three years after operation had had upper lobe lesions, although there had been a greater proportion of lower lobe tumours among the 72 resected. Our investigation also suggests that lower lobe tumours cause death within five years more frequently than those in the upper lobe, the difference between the right and left lungs being largely due to the low survival rate with tumours of the left lower lobe.

A slightly better prognosis with upper lobe tumours might merely be due to certain factors affecting selection for operation. Owing to the nearness of the primary to the supraclavicular nodes, the recurrent laryngeal nerve on the left and the superior vena cava on the right, it might be expected that more patients with upper lobe tumours would be judged unfit for exploration and therefore for resection. In those with lower lobe tumours involvement of regional nodes may have to be much greater before it becomes manifest. That such selection takes place is suggested by the study of 637 unselected patients seen at the Brompton and Royal Marsden Hospitals during 1951 and 1952. The bronchial location of the tumour was known in 505 cases. Two hundred and twenty-seven had cancers in the upper lobe ; 53 (23%) had clinical or radiographic evidence of metastases when they were first examined at the hospitals, and 60 (26%) had a resection. On the other hand, only 27 (16%) of 166 with lower lobe cancers had manifest metastases and 57 (34%) had a resection. Furthermore, Borrie (1952) found that there was more node involvement in the resected specimens when the primary was in

the lower lobes. Those with upper lobe tumours who have the lung resected are probably, as a group, in a less advanced stage of the disease than those with lower lobe tumours, and the result of operation would be expected to be better.

A possible explanation of the differences between the right and left lower lobes—and to a less extent between the upper lobes—may be found in the anatomy of the lymphatics. Rouvière (1932) states that the lymphatics from the lower third of the left lung, as well as some of the vessels from the middle third, drain through the bifurcation lymph nodes into the right paratracheal chain. Warren and Drinker (1942) demonstrated in dogs that the greater part of the lymph from both lungs eventually passed into the vessels in the right paratracheal region ; only a small amount from the left lung entered the blood stream from the left paratracheal system. The distribution of metastases could not be expected to follow strictly the physiological path of the lymph, for once a pathway becomes blocked by tumour the lymph stream is probably diverted into other channels. McCort and Robbins (1951) investigated the site of the metastases in 115 patients who had a thoracotomy for bronchial carcinoma. Although 11 of 22 with right upper lobe tumours had right paratracheal metastases, only two of 32 with left upper lobe tumours had metastases in the left paratracheal nodes and three had involvement of nodes on the right side. There was, however, no similar suggestion of crossed dissemination from left lower lobe tumours. But investigation of the spread of lung cancer in the mediastinum clearly requires post-mortem examination, and evidence derived only from clinical, radiographic, and operative findings is incomplete. There is certainly some clinical evidence that crossed dissemination occurs from left-sided tumours. For instance, superior vena caval obstruction can be caused by a tumour in the left lung ; and there was one such case in 24 treated for this complication in the patients seen at the Brompton and Royal Marsden Hospitals during 1951 and 1952. Moreover, metastases in the right paratracheal nodes occasionally occur after a left pneumonectomy.

In the 637 patients seen in 1951 and 1952 there was no evidence of the selection of less advanced cases for operation among those with right lower lobe tumours. Thus, 83 had tumours in this lobe and only seven (8%) had manifest metastases at the first examination ; 33 (40%) had a resection. There were, on the other hand, 20 (24%) with metastases among 83 with left lower lobe cancers :

and 24 (29%) of these had a resection. It may be that the low survival rate of those with left lower lobe tumours is largely due to some of them having tumour tissue in the right upper mediastinal nodes, which are, of course, inaccessible at operation. This factor may be less important in the left upper lobe tumours if the lymph tends to take the more direct route by the left paratracheal chain. This explanation of the findings is, of course, merely a hypothesis. There may be many other factors contributing.

The risk of death in a particular patient cannot be accurately estimated. But the experience of this large group suggests that the chances of surviving the early period after operation may be of the order of 90% and of surviving each successive year to five years, 55%, 40%, 35%, and 30%. The chances are increased by there being no macroscopically involved nodes, the tumour being of the squamous or adenocarcinoma type, and in the upper lobes, particularly on the right side. The prognosis may be better in those with a very short or very long history and may possibly be better in women. The immediate risk is less after a lobectomy and in younger patients.

SUMMARY

We have studied the duration of life after lung resection for bronchial carcinoma and investigated the effects of various factors on survival in a group of 531 patients treated at the Hospitals for Diseases of the Chest between 1940 and 1951.

Four hundred and fifty-three survived the early post-operative period. Their chance of surviving one year was 63%, two years 47%, and five years 33%.

The two- and five-year rates for those reported to have squamous tumours was 52% and 36% compared with 34% and 26% for those with undifferentiated growths.

The apparent involvement of the mediastinal nodes at operation had a considerable influence on survival. The two- and five-year rates for those without enlarged nodes were 61% and 48%, but for those with enlarged nodes the rates were 27% and 11%.

The prognosis appeared to depend to some extent on the situation of the tumour. The highest survival rates were observed with cancers of the right upper lobe, the two-year rate being 57%. The left upper and right lower lobes had similar though slightly lower rates. But the two-year rate with cancers of the left lower lobe was significantly lower, being only 36%.

No regular pattern of survival in relation to age was detected.

The prognosis was better in women than in men.

The survival rates were lower in those with symptoms for six to eight months than in those with either shorter or longer histories.

The observed differences in survival rates following pneumonectomy and lobectomy could be largely attributed to the smaller proportion with involved mediastinal nodes among those having a lobectomy.

The operative mortality decreased from 19% between 1940 and 1946 to 10% in 1950 and 1951. No patient during these two years died after a lobectomy, compared with 13% after pneumonectomy. The operative mortality increased with age.

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