ORIGINAL ARTICLE

The descriptive epidemiology of primary lung cancer in an Alberta cohort with a multivariate analysis of survival to two years

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BACKGROUND: Lung cancer contributes significantly to cancer morbidity and mortality. Although case fatality rates have not changed significantly over the past few decades, there have been advances in the diagnosis, staging and management of lung cancer.
OBJECTIVE: To describe the epidemiology of primary lung cancer in an Alberta cohort with an analysis of factors contributing to survival to two years.
PATIENTS AND METHODS: Six hundred eleven Albertans diagnosed with primary lung cancer in 1998 were identified through the Alberta Cancer Registry. Through a chart review, demographic and clinical data were collected for a period of up to two years from the date of diagnosis.
RESULTS: The mean age at diagnosis was 66.5 years. The majority of cases (92%) were smokers. Adenocarcinoma, followed by squamous cell carcinoma, were the most frequent nonsmall cell lung cancer histologies. Adenocarcinoma was more frequent in women, and squamous cell carcinoma was more frequent in men. The overall two-year survival rates for nonsmall cell, small cell and other lung cancers were 24%, 10% and 13%, respectively. In multivariate analysis, stage, thoracic surgery and chemotherapy were significantly associated with survival to two years in nonsmall cell carcinoma; only stage and chemotherapy were significant in small cell carcinoma.
CONCLUSIONS: This study provides a Canadian epidemiological perspective, which generally concurs with the North American literature. Continued monitoring of the epidemiology of lung cancer is essential to evaluate the impact of advances in the diagnosis, staging and management of lung cancer. Further clinical and economic analysis, based on data collected on this cohort, is planned.

Key Words: *Canada; Epidemiology; Lung neoplasm; Prognosis*

L'épidémiologie descriptive de cancer pulmonaire primaire dans une cohorte de l'Alberta, avec une analyse multivariée de la survie après deux ans

HISTORIQUE : Le cancer du poumon contribue énormément à la morbidité et à la mortalité du cancer. Bien que les taux de mortalité n'aient pas beaucoup changé depuis vingt ans, le diagnostic, la classification par stade et la prise en charge du cancer du poumon se sont améliorés.
OBJECTIF : Décrire l'épidémiologie du cancer pulmonaire primaire dans une cohorte de l'Alberta, avec une analyse des facteurs contribuant à la survie après deux ans.
PATIENTS ET MÉTHODOLOGIE : Six cent onze Albertains ayant reçu un diagnostic de cancer pulmonaire primaire en 1998 ont été repérés grâce au registre du cancer de l'Alberta. Par une étude des dossiers médicaux, des données démographiques et cliniques ont été colligées pendant une période maximale de deux ans à compter de la date de diagnostic.
RÉSULTATS : L'âge moyen au diagnostic était de 66,5 ans. La majorité des cas (92 %) étaient des fumeurs. Les adénocarcinomes, suivis des carcinomes épidermoïdes, constituaient les histologies de cancers pulmonaires non à petites cellules les plus fréquentes. Les adénocarcinomes étaient plus fréquents chez les femmes, et les carcinomes épidermoïdes, chez les hommes. Après deux ans, les taux de survie globaux des cancers pulmonaires non à petites cellules, à petites cellules ou d'autres formes s'élevaient à 26 %, à 10 % et à 13 %, respectivement. Dans l'analyse multivariée, la classification par stade, la chirurgie pulmonaire et la chimiothérapie s'associaient de manière significative à la survie des carcinomes non à petites cellules après deux ans. Seules la classification par stade et la chimiothérapie étaient importantes en cas de carcinomes à petites cellules.
CONCLUSIONS : L'étude fournit un point de vue épidémiologique canadien, qui correspond en général à la documentation scientifique nord-américaine. Une surveillance continue de l'épidémiologie du cancer du poumon est essentielle pour évaluer les répercussions de la progression du diagnostic, de la classification par stade et de la prise en charge du cancer du poumon. Une analyse clinique et économique plus approfondie, fondée sur les données colligées dans cette cohorte, est prévue.

Lung cancer is the leading cause of cancer death and resulted in an estimated 18,400 deaths in Canada in 2002. Lung cancer rates continue to rise in women and have begun to decline in men, correlating with historical smoking rates. Lung cancer incidence rates are second only to prostate cancer in men and breast cancer in women (1).

Lung cancer survival rates have not changed significantly over the past two decades (2,3). The 1992 Canadian and Alberta five-year survival rates were only 13% and 10%, respectively (4). In fact, lung cancer has the second highest

case fatality rate of 88%, with pancreatic cancer having the highest rate at 99% (1).

However, there has been progress in patient selection, which has significantly reduced operative mortality rates from 10% to 3% (5). There have also been significant changes in staging protocols, which have allowed increased selectivity in determining who benefits from surgery (6). Thus, one could argue that while there have been no significant changes in overall lung cancer case fatality rates, there has been progress in patient selection that improves quality of life by avoiding non-beneficial, invasive procedures. There have also been promising advances in chemotherapy and radiotherapy (7), which have the greatest impact as adjuvant or palliative therapy.

More recently, good evidence has been found that 18-fluoro-deoxyglucose positron emission tomography (FDG-PET) imaging contributes to further improvements in the accuracy of lung cancer staging (8-10), which further improves patient selection, especially with regard to surgical interventions. To date, there has been slow adoption of PET technology in Canada (11). This is in contrast to the more rapid adoption and diffusion of PET technology in the late 1990s in the United States and Europe. Increased use in the United States was primarily related to an increase in approved indications, including the investigation of solitary pulmonary nodules and the staging of lung cancer.

In addition, there is continued and increasing interest in computed tomography lung cancer screening programs. For example, Nawa et al (12) recently published promising results regarding the detection of early or stage I disease with low dose computed tomography screening in a large occupational cohort.

To study the impact of continued advances in the staging and management of lung cancer, it is appropriate to establish a baseline reference and review the epidemiology of a recent Canadian lung cancer cohort. This paper is a descriptive analysis of the epidemiology of primary lung cancer in an Alberta cohort with an analysis of factors contributing to survival to two years. These data will serve as a foundation for future analysis with regard to clinical outcomes and health utilization costs.

PATIENTS AND METHODS

A PubMed (National Library of Medicine) literature search was conducted of literature cited from 1966 to July 2002.

The study population was drawn from the Edmonton Cross Cancer Institute (CCI)'s (Edmonton, Alberta) catchment area. This consists of Regional Health Authorities 6 through 17 inclusive (as per 1998 Health Authority boundaries, total population=1,599,817). The study cohort was identified through the Alberta Cancer Registry (ACR) and included the 1998 incident cases of primary bonchogenic lung cancer as classified by the International Classification of Diseases – Oncology. The numbers are provisional because some cases (or deaths) may be registered in subsequent years. Methods for the coding of cancers on the ACR have varied through the years. Therefore, caution should be exercised when comparing data with those of previous years.

The northern one-half of the province was chosen to maximize the likelihood of clinical charts being available at the CCI. A 1998 cohort was chosen because this was the most recent year for which complete data were available.

Chart reviews were conducted by an experienced health care worker. Data were transcribed onto paper data abstraction forms, which were developed through iterative consultation with individuals having specific content and methodological knowledge relative to this research. The first 15 abstracted charts were comprehensively reviewed by the first author as a validation exercise and no significant deviations were demonstrated. In addition, if there was uncertainty related to any data variable, the chart was set aside for review by the first author.

An electronic database emulating the data abstraction form was constructed using FileMaker Pro 5 software (Filemaker Inc, USA).

The diagnosis date was defined as the date of most definitive diagnosis as per the ACR Coding Manual (13). In broad categories, histopathology was the most definitive diagnosis, followed by cytology, diagnostic imaging and clinical impression. On average, patients were assessed at the CCI within 23 days of diagnosis (95% CI 15 to 30 days).

ACR records, which are regularly updated and linked to provincial vital statistics and national mortality databases, were used to assess survival to two years from the date of diagnosis. Staging for nonsmall cell lung carcinoma (NSCLC) was determined as per the 1997 Revisions in the International System for Staging Lung Cancer (14). If a separate surgical stage was recorded, then the surgical stage was used; otherwise, the clinical stage was used.

Small cell lung carcinoma (SCLC) stage was recorded as limited or extensive based on the impression recorded by the clinician at the patient's initial attendance at the CCI.

Urban versus rural residence was determined as per Canada Post definitions using postal codes (15).

For the survival analysis, radiotherapy and chemotherapy were defined as the patient having had at least one external beam radiotherapy or chemotherapy treatment or session relating to lung cancer. Thoracic surgery included open lung biopsy, wedge resection, segmental resection, lobectomy and pneumonectomy. Mediastinoscopy included all utilized techniques in this cohort (ie, routine, anterior and extended).

A direct method was used for the calculation of age-standardized primary lung cancer incidence rates using the 1991 Canadian standard population, as published in the National Cancer Institute of Canada, Canadian Cancer Statistics, 1998 monograph (16).

Statistical analysis was completed using SPSS Base 10.0 software (SPSS Inc, USA). Where appropriate, χ^2 and Student's *t* tests were used.

For the survival analysis, a Cox's proportional regression survival analysis was used. The hazard ratios and their CIs are given. The hazard ratio, for a suspect prognostic variable, is mathematically determined from the derived survival curve and is a measure of the relative risk of not surviving relative to the baseline or reference state of the chosen variable. For example, in a dichotomous variable, such as presence or absence of a hypothesized prognostic variable, a hazard ratio of 2 would infer a two times relative risk of dying, with the variable being positive versus absent. The proportional hazards assumption was tested by generating and inspecting the log-minus-log plots. Exact age at diagno-

TABLE 1
Frequency of histological diagnoses

Histology	Number (%)
Adenocarcinoma	250 (41)
Squamous cell carcinoma	143 (23)
Large cell carcinoma	53 (9)
Bronchoalveolar	6 (1)
Mucoepidermoid	1(<1)
Carcinoid	7 (1)
Small cell	105 (17)
Unspecified carcinoma	39 (6)
Unspecified cancer	7 (1)
NSCLC total*	452 (74)
SCLC total*	105 (17)
Other total*	54 (9)
Total	**611 (100)**

NSCLC (nonsmall cell lung carcinoma) includes adenocarcinoma, squamous cell, large cell and bronchoalveolar carcinomas; Other includes mucoepidermoid, carcinoid, unspecified carcinomas and unspecified cancer. SCLC Small cell lung carcinoma

TABLE 2
Frequency of stage at presentation and per cent survival to two years from date of diagnosis

Cancer type and stage	n (%)	Survival rate (%)
Nonsmall cell carcinoma*		
I	68 (15)	83
II	27 (6)	63
IIIa	46 (10)	28
IIIb	105 (23)	14
IV	165 (37)	3
[I-IV]	[411 (91)]	[26]
Unspecified stage	41 (9)	17
All	452 (100)	24
Small cell carcinoma		
Limited	35 (33)	22
Extensive	67 (64)	4
[Limited and extensive]	[102 (97)]	[11]
Unspecified stage	3 (3)	0
All	105 (100)	10
Other*		
I-IV	40 (76)	13
Unspecified stage	14 (24)	15
All	54 (100)	13
Overall	**611 (100)**	**22**

Nonsmall cell lung carcinoma includes adenocarcinoma, squamous cell, large cell and bronchoalveolar carcinomas; Other includes mucoepidermoid, carcinoid, unspecified carcinomas and unspecified cancer

sis was entered as a continuous variable, decade of diagnosis as an ordinal variable and all other variables as categorical variables. A forced entry model was used for the multivariate analysis.

Statistically significant results were declared at P<0.05 (two-tailed). CIs are reported (95%) when appropriate.

This research protocol was granted ethics approval from the Alberta Cancer Board Research Ethics Committee.

RESULTS

Of the 742 individuals initially identified through the ACR, three cases were excluded because they did not have primary lung cancer diagnoses (ie, two lymphomas and one lung cancer recurrence). Of the remaining 739 individuals, 128 were listed on the cancer registry but had insufficient information for comprehensive clinical review (ie, no charts, no microfiches or no significant clinical entries). Only demographic and tumour histology information could be collected for these 128 individuals. Detailed demographic, clinical and health utilization data were collected from the remaining 611 individuals (83% of the identified 739 cases from the 1998 incident primary lung cancer cases).

The male, female and sex-combined, age-standardized primary lung cancer incidence rates per 100,000 people were 62, 42 and 50, respectively (n=739).

Unless otherwise specified, all further analyses are based on the 611 primary lung cancer cases for which more detailed clinical information was available.

The mean (± SD) age at time of diagnosis was 66.5±11 years (range 14 to 93 years). On average, men were slightly older than women (67.6 versus 65.1 years, P=0.005). Men accounted for 55% of the cohort. The majority of cases (79%) had urban residences, with the remainder having rural residences. The urban-rural split concurs with that of the general Alberta population as per 1996 Canadian Census data (17).

Table 1 illustrates the frequency of histological diagnosis. Overall, adenocarcinoma and squamous cell carcinoma were the most frequent NSCLC histologies. There were no significant differences in the distribution of the broad categories of NSCLC, SCLC and 'other' lung cancers by sex.

Among patients with NSCLC, the proportion of adenocarcinoma was significantly higher in women (60% women and 51% men, χ^2 test P=0.04), with the proportion of squamous cell carcinoma higher in males (38% men and 24% women, χ^2 test P=0.003). Other NSCLC histologies demonstrated no significant differences in distribution by sex.

There was no significant difference in the distribution of histologies by urban versus rural residence or by stage of disease.

Smoking 'yes/no' data was collected in 93% of the cohort. The vast majority (92%) were declared smokers. Among smokers, there was a mean (± SD) of 40±12 years of smoking per individual (data available for 67% of declared smokers) and a mean (± SD) of 44±15 pack-years of smoking (data available for 39% of declared smokers). There was a significantly higher proportion of smokers in the squamous (132 of 136, 97%) and small cell (96 of 98, 98%) carcinoma groups than in the adenocarcinoma (204 of 234, 87%) group, with P=0.002 and P=0.002, respectively.

The frequency of presenting stage and survival to two years is illustrated in Table 2. Staging information was available for 91% of patients (411 of 452) with NSCLC, 97% of patients (102 of 105) with SCLC and 76% of patients (41 of 54) with 'other' lung cancers. The 'other' lung cancers category was collapsed due to small numbers. In 38 cases, both clinical and surgical stages were recorded, with disagreements in only three instances (surgical stage lower than clinical stage in two cases and higher than clinical stage in one case). Information on survival to two years from the date of diagnosis was available for

TABLE 3
Interventions stratified by type of lung cancer and presenting stage

Cancer type and presenting stage (n)	Mediastino-scopy (%)	Invasive thoracic surgery* (%)	Chemotherapy (%)	External beam radiotherapy (%)
Nonsmall cell lung carcinoma†				
I (68)	18	85	9	26
II (27)	30	85	7	41
IIIa (46)	28	46	15	89
IIIb (105)	24	12	12	81
IV (165)	10	5	18	82
All (411)	18	30	14	71
Small cell lung carcinoma‡				
Limited (35)	31	3	86	83
Extensive (67)	8	1	64	63
All (102)	16	2	72	70

*Includes open lung biopsy, wedge resection, segmentectomy, lobectomy and pneumonectomy; †Includes adenocarcinoma, squamous cell, large cell and bronchoalveolar carcinomas; ‡Surgeries included one open lung biopsy and one pneumonectomy
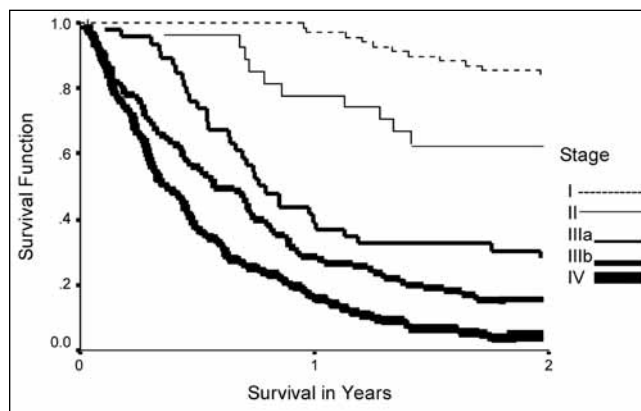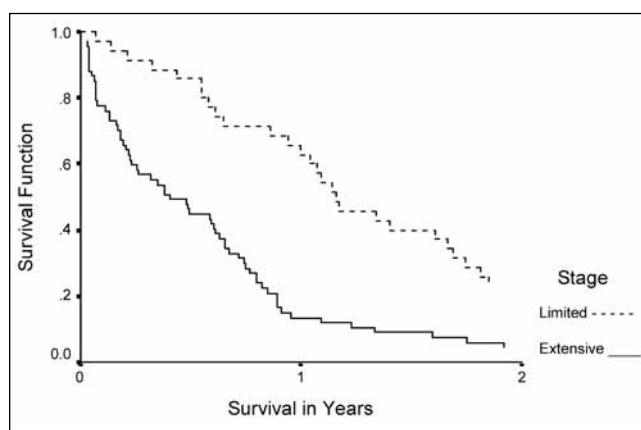
TABLE 4
Number of surgical interventions by stage for nonsmall cell lung carcinoma

Type of surgery	Stage				
	I	II	IIIA	IIIB	IV
Open lung biopsy	0	0	2	6	3
Wedge resection	4	0	0	1	0
Segmental resection	1	0	2	0	0
Lobectomy	49	13	9	3	1
Pneumonectomy	4	10	8	0	4
Unspecified	0	0	0	3	0
No surgery	10	4	25	92	157
Total (% with surgical intervention)	68 (85)	27 (85)	46 (46)	105 (12)	165 (5)

Figure 1) *Survival to two years by stage in patients with nonsmall cell lung carcinoma*

Figure 2) *Survival to two years by stage in patients with small cell carcinoma*

all 611 individuals. Although there was a reasonable survival rate to two years for patients with NSCLC stage I and II, that is, 83% and 63%, respectively, only a minority of individuals (ie, 21%) presented in these early stages. There was a rapid decline in the survival rate to two years by increasing stage for NSCLC and poor survival in SCLC irrespective of stage. The overall survival rate for 'other' lung cancers was worse than the overall survival rate for NSCLC.

Table 3 describes the frequency of various interventions by cancer type and presenting stage. Only cases with known stages were included, and 'other' cancers were not included due to small numbers. For NSCLC, general trends that were observed were expected increased surgical rates at lower stages, and increased chemotherapy and radiotherapy interventions at higher stages. Mediastinoscopy rates were lower than expected, and this may be related to failure to capture these events. As expected, chemotherapy and radiotherapy rates were high for both limited and extensive SCLC.

Table 4 provides details of the types of surgical interventions for patients with NSCLC by stage. Proportionately more aggressive surgery was observed in lower stages. For example, the proportion of any form of resection (wedge, segment, lobe or lung) was 71% for stages I through IIIa combined and 3% for stages IIIb and IV combined.

Unadjusted survival curves for NSCLC and SCLC, stratified by stage, are illustrated in Figures 1 and 2, respectively.

A univariate Cox regression analysis of survival to two years stratified by NSCLC and SCLC, as well as by stage, was conducted on the following variables: patient age at date of diagnosis (exact age and decade), urban or rural residence, sex, smoker ('yes or no'), number of years smoking, number of pack-years smoked, histology (for NSCLC and other cancers), stage, mediastinoscopy, surgery, chemotherapy and radiotherapy. The latter four variables were entered as binary 'yes or no' variables. Events were censored at two years from the date of diagnosis. Due to small numbers, 'other' cancers were not included. Table 5 illustrates the results of the univariate analysis.

Stratified by NSCLC and SCLC, variables that achieved univariate significance were included in multivariate Cox's proportional hazards regression models. Interaction was assessed in NSCLC for mediastinoscopy surgery, mediastinoscopy stage, surgery stage and chemotherapy stage. Interaction was assessed in SCLC for radiotherapy stage and chemotherapy stage. No significant interactions were found

TABLE 5
Cox regression analysis* of selected variables

Variable	Type of cancer†	Hazard ratio†	95% CI for hazard ratio
Age (years) at date of diagnosis	NSCLC	NS	
	SCLC	1.04	1.02 to 1.06
Sex (female reference)	NSCLC	1.3	1.1 to 1.6
	SCLC	NS	
Number of pack-years smoked	NSCLC	NS	
	SCLC	1.02	1.003 to 1.04
Stage‡			
I	NSCLC	Reference	
II		2.7	1.1 to 6.3
IIIa		7.6	3.9 to 15.1
IIIb		12.3	6.6 to 23.2
IV		19.9	10.7 to 37.0
Limited	SCLC	Reference	
Extensive		2.8	1.8 to 4.4
Mediastinoscopy§	NSCLC	0.7	0.5 to 0.9
Surgery§	NSCLC	0.2	0.1 to 0.3
Radiotherapy§	NSCLC	2.0	1.6 to 2.6
	SCLC	0.4	0.2 to 0.5
Chemotherapy§	NSCLC	0.7	0.5 to 0.9
	SCLC	0.2	0.1 to 0.3

Univariate analysis – survival to two years from the date of diagnosis; †Hazard Ratio equals Exp(B) in SPSS output and is related to the risk, relative to the baseline or reference condition, of not surviving to two years from the date of diagnosis; ‡Stage entered as a categorical variable with stage I or limited stage as the reference comparator; §Mediastinoscopy included all used techniques in this cohort (ie, routine, anterior and extended); Surgery included open lung biopsy, wedge resection, segmental resection, lobectomy or pneumonectomy; Radiotherapy and chemotherapy treatments or sessions were related to the patient's lung cancer. NS Not significant; NSCLC Nonsmall cell lung carcinoma; SCLC small cell lung carcinoma

TABLE 6
Multivariate Cox regression analysis* of selected variables

Variable	Type of cancer	Hazard ratio†	95% CI for hazard ratio
Stage‡			
I	NSCLC	Reference	
II		2.7	1.2 to 6.4
IIIa		6.4	3.1 to 13.2
IIIb		9.0	4.6 to 17.9
IV		14.5	7.3 to 29.0
Limited	SCLC	Reference	
Extensive		2.2	1.02 to 4.9
Surgery§	NSCLC	0.5	1.02 to 4.9
Chemotherapy§	NSCLC	0.5	0.4 to 0.7
	SCLC	0.02	0.002 to 0.1

Forced entry model, survival to two years from the date of diagnosis; †Hazard Ratio equals Exp(B) in SPSS output and is related to the risk, relative to the baseline or reference condition, of not surviving to two years from the date of diagnosis, ‡Stage entered as a categorical variable with stage I or limited stage as the reference comparator; §Mediastinoscopy included all used techniques in this cohort (ie, routine, anterior and extended); Surgery included open lung biopsy, wedge resection, segmental resection, lobectomy or pneumonectomy; Radiotherapy and chemotherapy treatments or sessions were related to the patient's lung cancer. NSCLC Nonsmall cell lung carcinoma; SCLC Small cell lung carcinoma

when all interaction variables and the univariate significant variables were entered into the model. For NSCLC, stage, surgery and chemotherapy remained significant. For SCLC only, stage and chemotherapy remained significant. Table 6 provides the detailed results of the multivariate analysis.

DISCUSSION

Our data demonstrate that for NSCLC, adenocarcinoma was the most frequent histology at 55%, followed by squamous cell carcinoma (32%), large cell carcinoma (12%) and bronchoalveolar cell carcinoma (2%). This correlates to the North American literature (2,18,19), which also show a preponderance of adenocarcinoma over squamous cell carcinoma. It should be noted that the European literature demonstrates the opposite, that is, a preponderance of squamous cell carcinoma over adenocarcinoma (18).

Previously published Canadian data (20), based on a 1984 Alberta cohort, reported 26%, 15%, 22% and 37% proportions for stages I, II, III and IV, respectively. Our data demonstrated 16%, 6%, 37% and 41% per stage, respectively. There is an apparent increase in the proportion of later stages in our data. One reason for this difference may be due to different proportions of unstaged cases. In our NSCLC data, only 9% of cases (41 of 452) were of an unspecified stage, whereas Gentleman et al (20) reported that 41% (283 of 683) were

unstaged. Furthermore, we did not assign imputed stages to our unstaged data, whereas Gentleman et al did. Gentleman et al state that their imputation methodology resulted in a reduction of stage IV disease and a corresponding increase in earlier stages. Other reasons for the apparent difference in distribution of stages may be differences in data collection methodology or changes in methods for assigning stage. It would seem unlikely that the differences are due to a trend of diagnosis at a later stage in time (ie, 1984 versus 1998). It is also unlikely that our methodology was biased toward staging people at a later course in their disease, because stage was assigned based on investigations surrounding the date of diagnosis.

Gentleman et al (20) also reported that only 27% of their 1984 cohort were female (SCLC and NSCLC), which is significantly different than our study, in which 45% were female. This difference is thought to be due to the fact that lung cancer incidence rates have been rising faster in women than men for the past few decades, most likely due to different sex-specific smoking rates. Our data, with respect to proportions of lung cancer cases by sex, generally agree with the 1998 Canadian Cancer Statistics figures for Alberta (ie, 42% female) (16).

In another Canadian, retrospective, cohort-based study of 169 patients diagnosed with NSCLC between 1988 and 1990, Ouellette et al (21) reported proportions by stages (female/male) of 25%/26%, 2%/6%, 20%/34%, 6%/7% and 25%/19% for stages I, II, IIIa, IIIb and IV, respectively. Their data have proportionately more lower stage cases than ours. The differences may be due to different study populations. Our data were based on a Cancer Registry population, while the data reported by Ouellette et al were based on a retrospective cohort (consecutive cases) of individuals attending to a university hospital.

TABLE 7
Survival rates to two years by stage – A comparison with the literature

Stage – NSCLC	Present study survival ratios (n=411) (%)	Mountain* clinical staging (n=5230) (%)	Mountain* surgical staging (n=1910) (%)
Ia	30/31 (97)	79	86
Ib	25/33 (76)	54	76
I†	56/68 (83)	66	81
IIa	7/10 (70)	49	70
IIb	10/16 (63)	41	56
II†	17/27 (66)	44	61
IIIa	13/46 (28)	25	40
IIIb	15/105 (14)	13	
IV	5/165 (3)	6	
Stages I to IV	107/411 (26)	22	

Data from reference 14; †Four stage I cancers and one stage II cancer were not subcategorized. NSCLC Nonsmall cell lung carcinoma

Compared with a large, clinically staged, North American lung cancer cohort (n=5230) (14), our population experienced longer two-year survival rates for stages I through III, with minimal differences for stages IIIb and IV. However, our survival results are closer to the surgically staged cohort (n=1910) published in the same paper (14). One possible reason for these differences is that Mountain's (14) clinically staged cohort included small cell carcinoma (n=642 or 11.9% of the cohort), and their surgically staged cohort did not. Our data show that small cell carcinoma has a generally poorer prognosis than large cell carcinoma, and we have analyzed it separately. This may account for the difference between our data and Mountain's clinically staged cohort, as well as the agreement with their surgically staged cohort. Table 7 summarizes these comparisons.

Fry et al (22) also reported survival by stage in a large (n=713,043) American lung cancer cohort (NSCLC and SCLC combined) diagnosed between 1985 and 1995. The two-year survival rates by stage were 59%, 41%, 24%, 13% and 5% for stages I, II, IIIa, IIIb and IV, respectively, which is similar to Mountain et al's (14) clinically staged cohort.

The relatively high two-year survival rate for patients with stage I NSCLC in our cohort (85%) is in agreement with a recent review by Dominioni et al (23). This supports the benefit of early diagnosis, and Dominioni et al go further to argue that relatively high two-year survival rates support targeted screening of high-risk individuals (eg, smokers).

There were 128 individuals identified on the ACR who had insufficient information for full analysis. The majority of these cases never attended the CCI or had very little information available in CCI charts. They either went to an alternate Alberta Cancer Centre or never presented to any Alberta Cancer Centre. It is possible that some only sought community-based palliative care and that some only received curative surgery.

However, basic demographic and survival data were available for these 128 individuals. When compared with our study cohort (n=611), the mean age of this group was older, at 72.2 years (P<0.0001), 59% were male (not significant [NS]), 88% were urban (NS) and 22% survived to two years from the date of diagnosis (NS). It is reassuring to note that this cohort experienced a similar overall survival rate and were similar with regard to sex and urban or rural composition.

Lung cancer is a preventable disease. The fact that the vast majority of our cohort (92%) smoked at some point in their life, with an average of 40 years and 44 pack-years of smoking, does not come as a surprise. It has been well established that smoking accounts for 80% to 90% of the population attributable risk for primary lung cancer (24), and that the incidence of primary lung cancer closely correlates to smoking rates, with a latent period of 15 to 20 years (25). We would be remiss if we failed to state that the single most effective intervention in the fight against lung cancer is to reduce the population's primary or secondary exposure to inhaled tobacco smoke.

CONCLUSIONS

The present study describes the epidemiology and survival experience of a relatively large 1998 Canadian cohort with primary lung cancer. This research provides a Canadian baseline for which to assess established, newly adopted and future technologies or interventions relative to primary lung cancer. Based on data collected to date on this cohort, further clinical and economic analysis, including a cost-effectiveness analysis of FDG-PET imaging for the staging and management of primary lung cancer, is planned.

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