Trends in Histopathology of Lung Cancer in Alberta

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ABSTRACT

Objective: To describe the trends over calendar period and birth cohort in lung cancer incidence by histopathology and sex, in Alberta.

Methods: Lung cancer data were extracted from the Alberta Cancer Registry for the years 1979 to 1998. Trends in age-standardized rates over calendar period and trends of age-specific rates over birth cohorts are presented. These trends are discussed in relation to historic smoking patterns.

Results: Lung cancer incidence is increasing over calendar period in females for all lung cancers and the histological types, adenocarcinoma, squamous cell, and small cell carcinoma. In males, all lung cancer incidence increases until 1988 and then decreases. Adenocarcinoma incidence in males increases over the whole time period, while squamous cell and small cell carcinoma incidence decreases. For females born before 1939, the incidence of all lung cancer and the three histological types increases over birth cohorts for all age groups. For those born after 1939, there is a slight decline. Male lung cancer incidence shows no marked increases over birth cohorts. In males born after 1929, all lung cancer and squamous cell and small cell carcinoma incidence decreases over birth cohorts for all age groups. Incidence of adenocarcinoma increases over all birth cohorts in males.

Conclusion: In Alberta, incidence of adenocarcinoma of the lung is increasing in both males and females, while squamous cell and small cell carcinoma are decreasing in males, but increasing in females. These trends may reflect changes in smoking habits.

In Canada, as in other parts of the developed world, lung cancer incidence continues to increase among females, while decreasing slowly among males.¹ However, the incidence rates for adenocarcinoma of the lung are increasing in both males and females in the United States and Europe, while those for squamous cell and small cell carcinoma are increasing in females and in general decreasing in males.²⁻⁷ These trends have been attributed to changing smoking patterns in relation to smoking prevalence and the type of cigarette smoked.^{3,6-8}

There has been no Canadian population-based report on the trends in the histological types of lung cancer. However, it has been observed that the distribution of histological types differ by sex.^{9,10}

This paper describes the trends in lung cancer incidence by histopathology using Alberta data. We discuss these trends in relation to historic smoking patterns.

Subjects and methods

The Alberta Cancer Registry (ACR) is mandated by the Alberta Cancer Programs Act to register all cancer cases occurring among residents of Alberta.¹¹ Data are coded according to the International Classification of Diseases, Oncology (ICDO). Data from 1979 to 1989 were originally coded using ICDO-1¹² and were subsequently converted to ICDO-2.¹³ Data from 1990 to 1998 were coded in ICDO-2. Histology, method of diagnosis, date of diagnosis, date of birth and sex were extracted from the ACR for the 19,692 invasive lung cancer cases (ICDO-2 C34) incident in Alberta residents in the years 1979 to 1998. Cases were categorized into adenocarcinoma (M8140, 8211, 8230-8231, 8250-8260, 8323, 8480-8490, 8550-8560, 8570-8572), squamous cell carcinoma (M8050-8076), small cell carcinoma (M8040-8045) and Other. These are the International Agency for Research in Cancer histological classifications for comparative studies.¹⁴ This paper addresses the trends of adenocarcinoma, squamous cell and small cell carcinoma of the lung.

Among females there were 2,158 (32%) adenocarcinomas, 1,306 (19%) squamous cell carcinomas, 1,265 (19%) small cell carcinomas, and 2,040 (30%) Other lung cancers. Among males there were 2,774 (21%) adenocarcinomas, 4,155 (32%)

La traduction du résumé se trouve à la fin de l'article.

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squamous cell carcinomas, 2,043 (16%) small cell carcinomas, and 3,951 (31%) Other lung cancers.

Trends over time may be affected by variations in quality of the cancer registry. The quality indicators Incidence:Mortality ratio and percentage of cases registered by Death Certificate Only (DCO) were investigated for the period when the Alberta Cancer Registry routinely accessed Vital Statistics, 1988 onwards. The trends over time in the method of diagnosis were investigated because of the potential confounding between trends in incidence of individual histological types and method of diagnosis.

Annual age-standardized (Canada 1991 population)¹⁵ incidence rates for all ages, for the years 1979-1998, were plotted for each sex separately for all invasive lung cancers and for each histological type. Provincial population data were obtained from Canadian census data.^{15,16} Age-specific rates (35-39 through 80-84 years) were calculated for all lung cancers and for each histological type for calendar periods (1979-1983, 1984-1988, 1989-1993, 1994-1998) and plotted against the central year of each birth cohort. The birth cohort is defined as the range of years in which the cases were born. For example, cases aged 40-44 diagnosed in the calendar period 1979-1983 would belong to the birth cohort 1935-1943 with central year 1939. For ease of interpretation of the graphs, points for each age group were joined. All graphs were plotted on the log scale for the abscissa. Trends over the birth cohorts for each age group can be read in the ordinate.

RESULTS

Over the period 1988-1998, the Incidence:Mortality ratio has remained relatively constant, varying between 1.13 and 1.23. The percentage of cases registered by DCO has remained less than 1% for all years except 1989. Over 85% of lung cancer cases have been microscopically confirmed. Prior to 1990, this percentage was consistently above 90%, but since then has decreased while the percentage diagnosed radiologically has increased. The percentage of microscopically confirmed cancers for the three histological types has been consistently over 99% for the whole study period. The decrease in microscopic confirmation is only apparent in cancers in the Other type.

Figure 1. Age-standardized incidence rates for lung cancer in Alberta, by sex, 1979-1998

Figure 2. Age-standardized incidence rates for lung cancer in Alberta, by sex and histology, 1979-1998

Figure 3. Trends in lung cancer in Alberta, by sex and birth cohort

Figure 4. Trends in adenocarcinoma of the lung in Alberta, by sex and birth cohort

Figure 5. Trends in squamous cell carcinoma of the lung in Alberta, by sex and birth cohort

Figure 6. Trends in small cell carcinoma of the lung in Alberta, by sex and birth cohort

The annual age-standardized lung cancer incidence rate has more than doubled in Alberta females between 1979 and 1998 (18 to 40 cases per 100,000 person-years) (Figure 1). The male age-standardized lung cancer incidence rate per 100,000 person-years increased from 69 in 1979 to 77 in 1988, and then decreased steadily to 63 in 1998. Thus the male: female ratio decreased from 3.8 to 1.6 between 1979 and 1988.

The age-standardized incidence rates per 100,000 person-years for adenocarcinoma of the lung approximately doubled between 1979 and 1998 for females, from 6 to 14 and for males from 9 to 18 (Figure 2). The male:female ratio remained relatively constant (1.4 in 1979 and 1.3 in 1998). The age-standardized rates per 100,000 person-years for both squamous cell carcinoma and small cell carcinoma in females increased from 3 in 1979 to 7 in 1998. In males, the age-standardized incidence rate per 100,000 person-years for squamous cell carcinoma of the lung generally decreased over the period, from 26 in 1979 to 18 in 1998. The male:female ratio decreased from 8.6 to 2.4. Small cell carcinoma also decreased in males from 12 to 9 cases per 100,000 person-years. The male:female ratio decreased from 3.9 to 1.3.

For females, adenocarcinomas are the most common lung cancer cell type for the whole period, while for males squamous cell carcinomas are the most common cell type except in 1998 when adenocarcinomas are more common. The proportion of all lung cancers that are adenocarcinomas increased in both sexes between 1979 and 1998, from 27% to 35% in females and from 13% to 29% in males.

For females born before 1939, lung cancer incidence rates increased over birth cohorts for all age groups (Figure 3). For those born after 1939, there is a slight indication of the beginning of a decline. Male lung cancer incidence does not show the marked increase over birth cohorts shown by females (Figure 3). In those born after 1929, there has been a consistent decrease in incidence over birth cohorts for all age groups.

The trends over birth cohorts for incidence of adenocarcinoma are similar for both females and males. There is an increasing trend for those born before

1939 and a slight decrease over the more recent birth cohorts (Figure 4). The trends over birth cohort for both squamous cell and small cell carcinoma in females are similar to the trend for adenocarcinoma, although the increases and decreases are less marked (Figures 5 and 6). In males there is decreasing incidence over birth cohorts except for the more recent ones, for both squamous cell and small cell carcinomas.

DISCUSSION

This paper has shown Alberta lung cancer incidence has increased in females since 1979 and since 1988 has decreased in males. The trends in the histological types are similar in females to the overall trend. In males, the trends for squamous cell and small cell carcinoma of the lung reflect the overall trend. However, for adenocarcinoma, there has been a constant increase over time, such that adenocarcinoma is more common than squamous cell carcinoma by 1998. These results are similar to those observed in Sweden (1958-1996), Switzerland (1980-1994), Italy (1976-1992), Connecticut (1988-1991) and the SEER Registries (1973-1996), except that the Italian registry reported an increase in male small cell carcinoma between 1976 and 1992, and the SEER Registries report a decline in female small cell and male adenocarcinoma between 1991 and 1996.³⁻⁷ Subsequently, the SEER registries have reported a stabilizing of rates for female small cell carcinoma.¹⁷

The increase in adenocarcinoma could be attributed to improved diagnostic ability, particularly for peripheral tumours.² However, Alberta has had a high rate of microscopic confirmation for lung cancer in the period under study. In fact, since 1990 there has been a slight decline in the proportion of lung cancers microscopically confirmed. It could be argued that cases of adenocarcinoma, squamous cell and small cell carcinoma may have been missed, which would result in a decrease in the observed trend. This may partly explain the decreases in squamous cell and small cell carcinomas in males but would be inconsistent with the increases observed for all other histological types. During the entire study period, the percentage of cases in the Other histological type remained

constant at approximately 30%. Thus the observed increases in adenocarcinoma in both males and females and squamous cell and small cell carcinoma in females cannot be explained by improved diagnostic ability.

The proportion of microscopic confirmation is high but the study would be strengthened if all diagnoses had been confirmed by central pathological review. This was not feasible since this was a population-based study using historical data involving almost 20,000 cases.

The increasing trends in incidence of adenocarcinoma over birth cohorts are consistent with those observed in Sweden, Switzerland and Italy.³⁻⁵ However, Connecticut reported a decrease in incidence rates for adenocarcinoma for both sexes starting for those born after 1939.⁵ While the rate of increase has slowed in Alberta, there is no indication of a decrease in trend except for those born after 1949. This decrease is so small that it is impossible to conclude that the trend will continue. The differences between sexes in trends for squamous cell and small cell carcinoma that are seen in Alberta, are also observed in Sweden, Switzerland and Connecticut.^{3,5,6}

The trends in lung cancer incidence rates may be due to differential changes in lifestyle or smoking habits acquired by the different birth cohorts. We will discuss the changes in smoking prevalence and changes in cigarette composition in Canada. It has been estimated that the peak prevalence of smoking occurred in the 1920-1929 birth cohort for males and the 1930-1939 cohort for females.¹⁸ For males the prevalence has subsequently declined, but for females there has been no decline in subsequent birth cohorts.

The different patterns in the trends for squamous cell and small cell carcinoma between females and males may be explained by different trends in the prevalence of smoking. Smoking patterns would tend to be acquired early in life (ages 20-24)¹⁹ and affect cohort patterns in disease incidence later in life.²⁰ In 1966, 43% of females aged 20-24 smoked compared to 32% in 1986.²¹ The corresponding figures for males are 60% and 31%, a much larger decrease. Unfortunately, consistent Canadian smoking data do not exist before 1966.

Although the risk of adenocarcinoma is less strongly related to tobacco than either squamous cell or small cell carcinoma, the increase in adenocarcinoma of the lung may, in part, be explained by the changes in cigarette composition.²²⁻²⁵ It is hypothesized that those who smoke filter cigarettes and/or low tar cigarettes tend to take larger puffs and inhale more deeply.⁸ This would facilitate the carcinogens reaching the periphery of the lung, which would result in an increase in adenocarcinoma. In both Europe and the United States, the change to filter cigarettes started in the 1950s and the level of tar in cigarettes has decreased from the 1930s.²⁶⁻²⁸ Canadian data would indicate that recent trends are similar to those observed in Europe and the United States.²⁹ The proportion of smokers in Canada smoking lower tar cigarettes (less than 15mg tar per cigarette) has increased in both females and males.²¹ In 1977, 48% and in 1986, 74% of female smokers smoked low tar cigarettes. The corresponding figures for males are 33% and 63%. From the little data available on Alberta, the trends in smoking behaviour for Alberta seem similar to those for Canada.¹⁹ Assuming that the trends observed are a continuation of earlier trends, the changes in the composition of cigarettes smoked may in part explain the increase in the rates of adenocarcinoma.

In summary, adenocarcinoma of the lung is the most common histological type in females in Alberta, and in 1998 became more common than squamous cell carcinoma in males. The incidence of adenocarcinoma of the lung is increasing in both males and females, while squamous cell and small cell carcinoma are decreasing in males, but increasing in females. These trends may reflect changes in smoking habits.

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RÉSUMÉ

Objectif : Décrire les tendances de l'incidence du cancer du poumon en Alberta selon l'histopathologie et le sexe, par période du calendrier et par cohorte de naissance.

Méthode : Les données sur le cancer du poumon sont extraites du Alberta Cancer Registry (1979 à 1998). Les tendances des taux sans strate d'âges (présentées par période du calendrier) et les tendances des taux par âge (présentées par cohorte de naissance) sont analysées selon les schémas historiques du tabagisme.

Résultats : L'incidence du cancer du poumon par période du calendrier est en hausse chez les femmes pour tous les types de cancers du poumon et pour les types histologiques adénocarcinome, carcinome spinocellulaire et carcinome à petites cellules. Chez les hommes, l'incidence de tous les cancers du poumon s'accroît jusqu'en 1988 et diminue par la suite. L'incidence des adénocarcinomes chez les hommes augmente pour l'ensemble de la période, mais l'incidence des carcinomes spinocellulaires et à petites cellules diminue. Chez les femmes nées avant 1939, l'incidence par cohorte de naissance de tous les cancers du poumon et des trois types histologiques augmente pour tous les groupes d'âge. Chez les femmes nées après 1939, les taux diminuent légèrement. Globalement, l'incidence du cancer du poumon chez les hommes ne présente aucune augmentation marquée par cohorte de naissance, mais l'incidence des adénocarcinomes augmente pour toutes les cohortes de naissance, et, chez les hommes nés après 1929, l'incidence par cohorte de naissance de tous les cancers du poumon, des carcinomes spinocellulaires et des carcinomes à petites cellules diminue pour tous les groupes d'âge.

Conclusion : En Alberta, l'incidence des adénocarcinomes du poumon est en hausse tant chez les hommes que chez les femmes, tandis que l'incidence des carcinomes spinocellulaires et des carcinomes à petites cellules diminue chez les hommes, mais augmente chez les femmes. Ces tendances sont peut-être liées à l'évolution des habitudes de tabagisme.

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