Trends in the incidence of bladder cancer in Nova Scotia: a twenty-year perspective

R. A. McLellan, MD, C. G. French, MD, D. G. Bell, MD

Department of Urology, Dalhousie University, Queen Elizabeth II Health Sciences Centre, Halifax, Nova Scotia, Canada

MCLELLAN RA, FRENCH CG, BELL DG. Trends in the incidence of bladder cancer in Nova Scotia: a twenty-year perspective. The Canadian Journal of Urology. 2003;10(3):1880-1884.

Introduction: *Bladder cancer is the most common malignant tumor of the urinary system. Tobacco smoking has been implicated as a major risk factor for the development of bladder cancer and Nova Scotia has some of the highest smoking rates in Canada.*
We examined trends in the incidence of bladder cancer in Nova Scotia between 1980 and 1999.
Materials and methods: *Data on incident cases of bladder cancer diagnosed in Nova Scotia over a twenty-year period (1980 – 1999) were obtained from the Nova Scotia Cancer Registry. The age- standardized incidence and mortality due to bladder cancer was calculated for both genders. Trends in the incidence of bladder cancer during the study period were analyzed for three different age groups in each gender as an estimate of birth cohort. The average annual percent change (AAPC) in incidence of bladder cancer was calculated.*
Results: *Between 1980 and 1999, 3569 cases of bladder cancer were reported (male: female = 2.9:1). The overall incidence of bladder cancer increased in both males (27.5 to 39.5 cases per 100 000) and females (7.0 to 10.7 cases per 100 000). Mortality rates were stable. There was a trend towards an increase in bladder cancer rates for all age groups analyzed, with a substantial rise occurring in females less than 65 years of age. The AAPC in incidence of bladder cancer was +1.5 for males and +2.6 for females.*
Conclusions: *We hypothesize that the rising incidence of bladder cancer in Nova Scotia, particularly in individuals less than 65 years of age, is related to changes in cigarette smoking practices during the past century. As the population ages, we are likely to see an increased incidence of bladder cancer in females.*

Key Words: bladder cancer, genitourinary malignancy, cigarette smoking

Accepted for publication March 2003

Acknowledgement
The authors would like to acknowledge Mr. Ron Dewar and the Nova Scotia Cancer Registry for assistance with data acquisition and statistical analysis.

Address correspondence to D. G. Bell MD, Queen Elizabeth II Health Sciences Centre, Victoria General Site, Victoria Building, 5 South, Room 294, 1278 Tower Road, Halifax, Nova Scotia, Canada B3H 2Y9

Introduction

Bladder cancer is the most common malignant tumor of the urinary tract. Although bladder cancer can afflict people of any age, it is predominantly a disease of later life, with a peak incidence in the sixth decade.[1] Bladder cancer occurs 2 - 5 times more often in males than in females,[2] accounting for 5.5% of cancers in males and 2.3% of cancers in females.[3] It is estimated

that 5000 Canadians will be diagnosed with bladder cancer in 2002.[4]

In Canada, the national incidence of bladder cancer has been decreasing in both males and females.[4] Although there has been a concurrent decrease in mortality due to bladder cancer in Canada, this reduction in mortality has occurred mainly in males, with females comprising a disproportionate number of deaths due to bladder cancer.[4] It is not known why females with bladder cancer succumb to their disease more often than males, although hormonal[5] and genetic factors[6] have been postulated.

Various risk factors have been studied in an effort to elucidate the etiology of bladder cancer. Of all the agents studied thus far, tobacco smoking has been implicated as the major risk factor for the development of bladder cancer (with the largest public health importance). It has been estimated that tobacco smoking is responsible for approximately 50% of bladder cancer cases in males and 25% of cases in females.[7] Individuals who smoke cigarettes have a 2-4 fold increased risk of developing bladder cancer when compared with non-smokers.[8] The risk of a smoker developing bladder cancer is related to the duration of smoking and the age at smoking initiation.[9] Ex-smokers have a reduced risk of developing bladder cancer when compared with current smokers.[7,8] Occupational and environmental exposure to various carcinogens has also been studied as a cause of bladder cancer. It has been estimated that up to 20% of bladder cancer cases can be attributed to occupational exposures.[10] The average latency between chemical exposure and the development of bladder cancer is 20 years, with exposed individuals developing their disease an average of 15 years earlier than the general population.[10] Other reported causes of bladder cancer include phenacetin abuse,[11] chronic cystitis and bladder infection,[12] cyclophosphamide,[13] and pelvic irradiation.[14]

Despite a decrease in the national incidence of bladder cancer, the incidence of bladder cancer in Nova Scotia is increasing. Recent data shows that Nova Scotia has the highest incidence of bladder cancer in the country (along with Quebec) and, in 2002, the incidence of bladder cancer in Nova Scotia females will be the highest in the country.[4] In this study we report the changes in the incidence of bladder cancer in Nova Scotia between 1980 and 1999.

Materials and methods

Data was retrieved from the Nova Scotia Cancer Registry (NSCR) on all incident cases of bladder cancer diagnosed between the years 1980 and 1999. The pathological diagnosis for each case was recorded. At the NSCR, transitional cell carcinoma is coded the same for both superficial and invasive disease. Primary carcinoma in situ is coded differently and was not included in the study.

We evaluated trends in incidence and mortality in males and females for each year in the study period (1980-1999). The age adjusted incidence and mortality rates (per 100 000 individuals) were calculated for both genders (standardized to the 1991 Canadian population). The data was then grouped into four different time periods: 1980 – 1984, 1985 – 1989, 1990 – 1994, and 1995 – 1999. For each time period, incident cases were placed into one of three age groups: 0 – 44, 45 – 65, and greater than 65 years of age. These ages were chosen as an estimate of birth cohort. The average annual number of bladder cancer cases was calculated for each age group in each time period by dividing the total number of cases in each age group by the number of years in each study period.

The average annual percent change (AAPC) in incidence of bladder cancer in Nova Scotia was calculated as outlined by Statistics Canada[4] (linear regression of the log transformed age-standardized rates).

Results

A total of 3569 cases of bladder cancer were reported to the NSCR between 1980 and 1999. Males were diagnosed with bladder cancer 2.9 times more often than females (2647 cases in males versus 922 in females). The majority of bladder cancers diagnosed during the study period were transitional cell carcinomas Table 1.

Figures 1 and 2 demonstrate the age standardized incidence and mortality rates of bladder cancer in women and men in Nova Scotia per 100 000 individuals. Between 1980 and 1999, the overall

TABLE 1. **Classification of bladder tumors**

Pathologic diagnosis	**% of total**
Transitional cell carcinoma	89.9
Malignant neoplasm	3.2
Carcinoma	1.9
Squamous cell carcinoma	1.9
Adenocarcinoma	0.8
Other	2.3

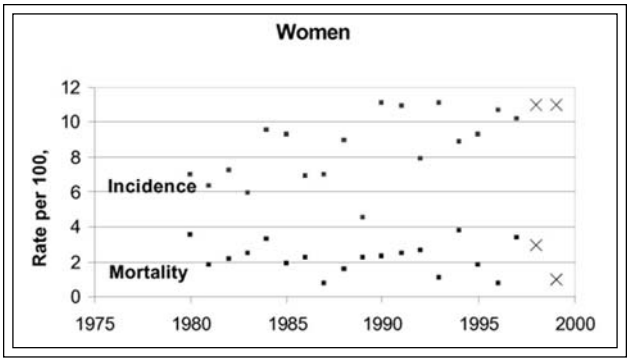

Figure 1. Incidence and mortality rates (per 100 000 individuals) of bladder cancer in Nova Scotia females.

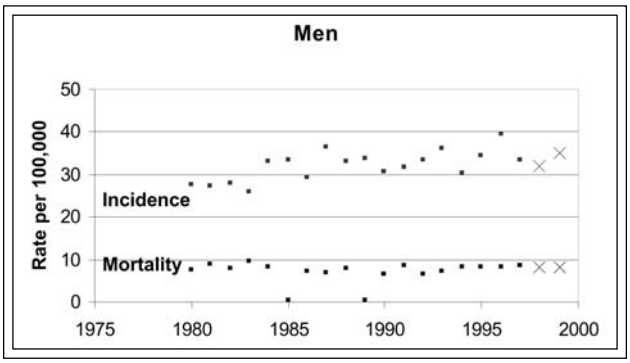

Figure 2. Incidence and mortality rates (per 100 000 individuals) of bladder cancer in Nova Scotia males.

incidence of bladder cancer increased in both males (27.5 to 39.5 cases per 100 000) and females (7.0 to 10.7 cases per 100 000). The mortality rate due to bladder cancer remained stable in both males and females throughout the study period.

Figures 3 and 4 demonstrate the annual average number of cases of bladder cancer diagnosed in women and men in three different age groups in four different time periods. In both sexes, the majority of cases were diagnosed in individuals greater than 65 years of age throughout the study period. There was a trend towards an increase in the average number of bladder cancer cases diagnosed in all age groups seen over time. In females Figure 3, the most dramatic increase occurred in women less than 65 years of age between the time periods comprising 1985 – 1989 and 1990 – 1994. This trend is maintained in the females less than 65 years of age in the time period comprising 1995 – 1999. In Figure 4, we see a consistent number of bladder cancer cases diagnosed in males less than 65 years of age. There was a trend towards an increased occurrence of bladder cancer over time, especially in male greater than 65 years of age.

Figure 5 presents the AAPC in incidence of bladder

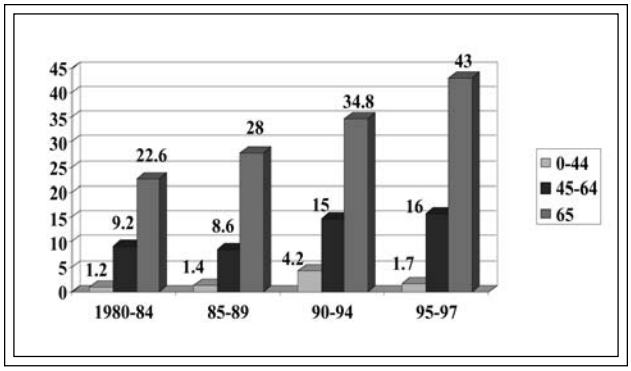

Figure 3. The average annual number of cases of bladder cancer reported in Nova Scotia females divided into three age groups (0-44, 45-65, >65). The average annual number of reported cases in each age group is compared in four different time periods.

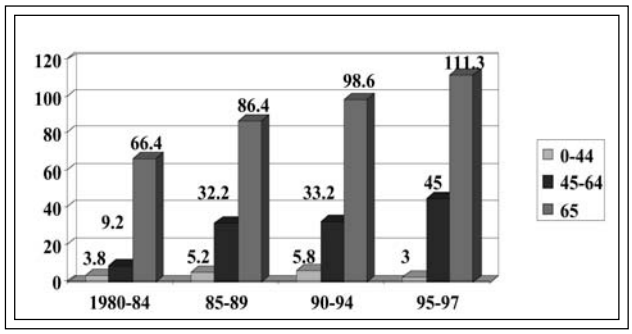

Figure 4. The average annual number of cases of bladder cancer reported in Nova Scotia males divided into three age groups (0-44, 45-65, >65). The average annual number of reported cases is compared in four different time periods.

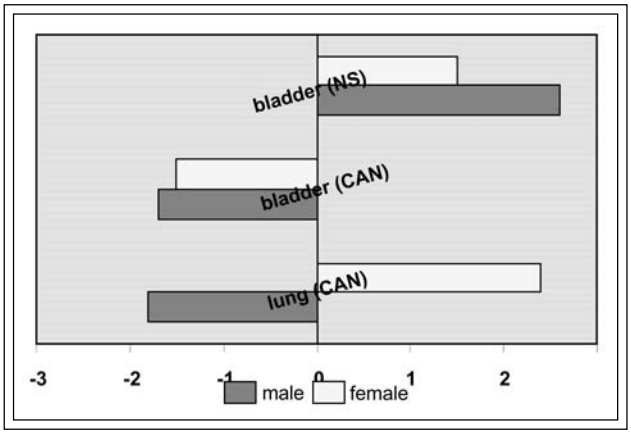

Figure 5. The AAPC in incidence of bladder cancer in Nova Scotia (1980-1999) compared to the AAPC in incidence of bladder and lung cancer (1989-1996) in Canada (CA = Canada, NS = Nova Scotia).

cancer in Nova Scotia in comparison to the national AAPC in incidence of bladder and lung cancer for both women and men. While the national incidence of bladder cancer is decreasing for both sexes (females = -1.5, males = -1.7), the incidence of bladder cancer is increasing in Nova Scotia. The AAPC in incidence of bladder cancer in Nova Scotia is +2.6 for women and +1.5 for men. Nationally, the AAPC in incidence of lung cancer (a cancer clearly linked to cigarette smoking) is decreasing for men (- 1.8) and increasing for women (+2.5).

Conclusions

Our study demonstrates that the recorded incidence of bladder cancer has increased in Nova Scotia between 1980 and 1999. This increase has occurred in both genders, with the most marked increase in bladder cancer diagnosis observed in females less than 65 years of age. These findings are dependent on consistent and accurate reporting of cases and the coding practices of the NSCR. We acknowledge that provincial variation in coding practices must be considered when comparing our data with that collected at a national level. Despite variability in coding practices between provinces, coding practices in Nova Scotia did not change during the study period. Therefore, changes in coding practices do not account for our findings. The NSCR does not differentiate between superficial and invasive forms of bladder cancer. Due to this fact, we cannot comment on the distribution of disease severity in our population. Nova Scotia does not have a population based screening program for bladder cancer nor have there been advances in diagnostic methods within the study period to account for the increased incidence of bladder cancer.

In addressing possible etiologic factors that could explain our findings, we hypothesize that the observed increase in incidence of bladder cancer in Nova Scotia is related to cohort variation of cigarette smoking practices. It is known that tobacco smoking is a major risk factor for the development of bladder cancer.[7,8] During the last year of the study period, Nova Scotia had the second highest smoking prevalence in Canada.[15] In addition, Nova Scotian females ranked second in smoking prevalence. Unfortunately, data on smoking practices in Nova Scotia over the last century is not available. In Canada, male smoking incidence rose dramatically after World War I and reached its peak in the 1940's among males born between 1910 and 1929.[16] This correlates with the high incidence of bladder cancer we observed in males under 65 years of age during the 1980's, which continued into the 1990's. When compared with previous cohorts, females born between 1910 and 1919 demonstrated the greatest increase in smoking rates. Cigarette smoking increased dramatically among Canadian females during the 1920's and reached its peak incidence in the 1960's in females born during the 1940's.[16] We hypothesize that the rising incidence of bladder cancer in Nova Scotia females under 65 years of age is related to the rising incidence of cigarette smoking among females between 1920 and 1950. We also suggest that the temporal difference between genders in peak cigarette smoking incidence could be manifested by the delayed increase in incidence of bladder cancer we observed in females under 65 years relative to that which occurred in males. This effect is similar to that seen for lung cancer, a cancer strongly associated with cigarette smoking. The incidence of lung cancer peaked in the late 1980's in males, but continues to climb in females,[4] reflecting the later adoption of tobacco usage by females.

While the incidence of bladder cancer is rising in Nova Scotia, the national incidence of bladder cancer is decreasing, making it apparent that cigarette smoking cannot be the only factor responsible for the rising incidence of bladder cancer in Nova Scotia. This suggests that environmental factors, occupational exposures, or factors not yet identified are potentially responsible for provincial variations in bladder cancer incidence. Further investigation into the etiology of our findings is required if public health measures are to be initiated in an effort to reverse the observed increase in bladder cancer incidence in Nova Scotia.

This study indicates that although the incidence of bladder cancer is increasing in Nova Scotia, mortality due to this disease has remained the same. This trend may be changing. Cancer Care Nova Scotia predicts a 37.6% increase in prevalence of bladder cancer in Nova Scotian females between 1999 and 2010,[17] with a corresponding 25% increase in mortality. In Canada, the most significant reductions in mortality due to bladder cancer have occurred in males. With the observed rising incidence of bladder cancer in Nova Scotia females (especially those less than 65 years of age), we can expect not only more cases of bladder cancer as this cohort ages but also increasing mortality due to this disease in the future. □

References

1. Flamm J. Superficial bladder cancer prophylaxis under 40 years of age. Efficacy of topical prophylaxis. *Brit J Urol* 1990;66:286-287.
2. Cohen SM, Johansson SL. Epidemiology and etiology of bladder cancer. *Urol Clin North Amer* 1992;19:421-428.

3. Messing EM, Catalona W. Bladder Cancer. Campbell's Urology. Walsh PC, Retik AB, Vaughan DE Jr, Wein AJ Jr. Philadelphia: WB Saunders; 1997:2329.
4. National Cancer Institute of Canada: Canadian Cancer Statistics 2002, Toronto;2002.
5. Horn EP, Tucker MA, Lambert G, Silverman D, Zametkin D, Sinha R, et al. A study of gender-based cytochrome P 450 1A2 variability: a possible mechanism for the male excess of bladder cancer. *Cancer Epidemiol Biomarkers Prev* 1995;4:529-533.
6. Risch A, Wallace DMA, Bathers S, Sim E. Slow N-acetylation genotype is a susceptibility factor in occupational and smoking related bladder cancer. *Human Mol Genet* 1995;4:231-236.
7. Augustine A, Hebert JR, Kabat C, Wynder EL. Bladder cancer in relation to cigarette smoking. *Cancer Res* 1988;48:4405-4408.
8. Burch JD, Rohan TE, Howe GR, Risch HA, Hill GB, Steele R, et al. Risk of bladder cancer by source and type of tobacco exposure: a case-control study. *Int J Cancer* 1989;44:622-628.
9. Bedwani R, el-Khwsky F, Renganathan E, Braga C, Abu Seif HH, Abul Azm T, et al. Epidemiology of bladder cancer in Alexandria, Egypt: Tobacco smoking. *Int J Cancer* 1997;73:64-67.
10. Schulte PA, Ringen K, Hemstreet GP, Ward E. Occupational cancer of the urinary tract. *Occup Med* 1987;2:85-107.
11. Piper JM, Tonascia J, Metanoski GM. Heavy phenacetin use and bladder cancer in women aged 20 to 49 years. *N Eng J Med* 1985;313:292-295.
12. Kantor AF, Hartge P, Hoover RN, Narayana AS, Sullivan JW, Fraumeni JF Jr. Urinary tract infection and risk of bladder cancer. *Am J Epidemiol* 1984;119:510-515.
13. O'Keane, JC. Carcinoma of the urinary bladder after treatment with cyclophosphamide. *N Engl J Med* 1988;319:871.
14. Sella A, Dexeus FH, Chong C, Ro JY, Logothetis CJ. Radiation therapy – associated invasive bladder tumours. *Urology* 1989;33:185-188.
15. Health Canada. *2. Description of Survey*. CTUMS (Canadian Tobacco Use Monitoring Survey), February-December 1999.
16. Ferrence RG. Sex differences in cigarette smoking in Canada, 1900-1978: A reconstructed cohort study. *Can J Pub Health* 1988;79:160-165.
17. Saint-Jaques N, MacIntyre M, Dewar R, Johnston G. Cancer Statistics in Nova Scotia: A Focus on 1995-1999. Surveillance and Epidemiology Unit, Cancer Care Nova Scotia, 2002.