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CLINICAL STUDY

Incidence of medulloblastoma in Canadian children

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Abstract Medulloblastoma is the most common malignant brain tumor in children. There was a perception of pediatric neuro-oncologists that the incidence had declined in Canada. An epidemiological survey was undertaken to determine the incidence of this tumor in Canada and if a change had indeed occurred. All patients 14 years and under diagnosed with medulloblastoma from 1990 to 2009 inclusive in Canada were included. Data collected included date of diagnosis, age at diagnosis, gender, stage, pathology, treatment, recurrence and current status. Data were analysed for change in incidence over time. Data were obtained on 574 eligible patients. The mean overall incidence per 1,000,000 persons was 4.82 (95 % CI 4.28–5.35) for the study time period. The mean age at diagnosis was 5.8 years, and there was a male predominance. Although there was an increase in incidence over the first three time periods (24 % for 1990–1994, 27.5 % for 1995–1999, 27.7 % for 2000–2004), the most recent time period (2005–2009) showed a decrease (21 %). This was true for male children while the incidence was stable for females. The mean incidence rate was double for children under the age of 5 years (7.92 per million) compared to those over 5 years (3.64 per million).This study showed that from 1990 to 2009 the incidence of medulloblastoma was relatively stable, with a slight decrease in the last five-year time period.

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Introduction

Brain tumors are the most common solid tumor in children and medulloblastoma accounts for approximately 20 % of these tumors [1]. The incidence of medulloblastoma is approximately 0.7 per 100,000 children per year [1]. There have been several reviews examining the incidence of this tumor in the pediatric population showing inconsistent results. A review from southwest England found that the incidence had declined from 5.5 per million per year from 1976 to 1984 to 2.8 from 1985 to 1991 [2]. As well, a review from the Hospital for Sick Children found that the incidence from 1990 to 1999 was lower compared to the decades prior and later [3]. Increases in incidence have been found in studies from the US: in one, the incidence of medulloblastoma increased by 23 % from 4.0 per 10^6 person years in 1973–1977 to 4.9 per 10^6 person years in 1993–1998 [4], and in another from 1973 to 2009 there was an annual percentage increase of 0.96 [5]. Other studies though have shown no changes in the incidence of medulloblastoma tumor over time [6–8].

Canada has a unique universal, health care system in which specialized health care (i.e. diagnosis, treatment and follow-up) for children with cancer is provided by regional cancer centers. The Canadian Pediatric Brain Tumor Consortium (CPBTC), is a group representing all the Canadian pediatric oncology centers. During information discussion, there was a perception amongst the members of the CPBTC that, similar to the United Kingdom findings, the incidence of medulloblastoma among Canadian children had declined over the past decade in comparison to the previous decade. To determine if this perception was correct, the CPBTC undertook a population-based study to determine if the incidence of medulloblastoma had changed during the past 2 decades.

Materials and methods

A standardized questionnaire was developed to collect data on patients with medulloblastoma. Inclusion criteria for patient data collection was any child aged 14 years or less at the time of histologic diagnosis of medulloblastoma between 1990 and 2009, inclusive, in Canada. Data collected included date of diagnosis, age at diagnosis, gender, stage, pathology, treatment received, treatment on a clinical trial, recurrence, recurrence location (if applicable), recurrence treatment (if applicable) and status of the patient at the time of the survey.

The questionnaire was completed by all 16 Canadian member centers of the CPBTC. Prior to completion of the study forms, the study was approved by the local research ethics boards. The completed questionnaires were returned to a central co-ordinating centre.

Statistics Canada conducts an age dependent population census every 5 years. Using census data published by Statistics Canada, the annual age standardized incidence rate of person having a newly diagnosed with medulloblastoma was calculated for the time periods 1990–2009 for all persons 14 years and under at time of diagnosis, males 14 years of age and under at time of diagnosis, females 14 years and under at time of diagnosis and persons under age of 5 years at time of diagnosis. Five-year mean incidence rates (with 95 % CI) were calculated for each of the time periods 1990–1994, 1995–1999, 2000–2004, and 2005–2009. Comparison of the means was done using ANOVA. Based on the information obtained from this analysis a time trend in the incidence rates over time were estimated by the conventional annual percentage change calculated as the slope of linear regression used to model the natural logarithm of the incidence rates as a function of the calendar year. Data analysis was performed using SPSS statistical software.

Results

There were 574 children, 14 years and under, diagnosed with medulloblastoma in Canada between 1990 and 2009 inclusive. The reporting rate remained fairly constant with 24 % of the cases reported between 1990 and 1994, 27.5 % between 1995 and 1999, 27.7 % between 2000 and 2004, and 20.9 % between 2004 and 2009.

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Table 1 Incidence of medulloblastoma per million persons age 14 years and under from 1990 to 2009

Total study group	Overall (95 % CI)	1990–1994 (95 % CI)	1995–1999 (95 % CI)	2000–2004 (95 % CI)	2005–2009 (95 % CI)
Total	4.82	4.60	5.29	5.32	4.07
	(4.29, 5.35)	(3.12, 6.04)	(3.83, 6.74)	(3.65, 6.70)	(3.35, 4.78)
Under 5 years	7.92	7.03	8.04	9.39	7.21
	(6.87, 8.95)	(4.79, 9.27)	(6.07, 10.01)	(4.98, 13.80)	(6.13, 8.97)
5–14 years	3.64	3.60	4.06	3.88	3.03
	(3.06, 4.23)	(2.26, 4.95)	(2.27, 4.95)	(1.87, 5.90)	(1.99, 4.08)

The mean age at time of diagnosis was 5.81 ± 3.56 years. The age distribution was as follows: 4.5 % of the cases occurred in first year of life, 50.2 % before 5 years of age, and by age 10 years 88 % had occurred. The sex distribution was 1.7 males to 1 female.

The incidence rates fluctuated from year to year with a mean incidence rate of medulloblastoma per million persons 14 years and under for this population of 4.82 (Table 1; Figs. 1, 2). On inspection of the graphs (Figs. 1, 2) there appeared to be an upper trend in the incidence rates between 1990 and 2004 followed by a downward trend from 2005 to 2009. The difference in the annual percent change was 0.2 % (95 %CI −2.4, 2.0). Also, this trend could not be confirmed using regression modelling ($R^2 = 0.48$, $F = 0.660$, $p = 0.431$). The incidence was greater in males than females. In males it was 5.92 per million persons compared to 3.67 per million persons in females. On visual inspection, there appeared to be variation in the rate between time periods (Figs. 3, 4). The difference in the annual percentage change for males was 0.8 % (95 %CI −1.0, 2.6). For females, the difference was −1.2 % (95 %CI −3.1, 0.7), neither of which were significant. Also, this trend could not be confirmed using regression modelling (for males: $R^2 = 0.163$, $F = 2.425$, $p = 0.136$) (for females: $R^2 = 0.009$, $F = 0.120$, $p = 0.743$).

For children 5 years and under the mean incidence rate was double that of children over 5 years of age (Table 1). It was 7.92 per million persons under 5 years of age compared to 3.64 per million persons over 5 years of age. The annual percentage of change for persons under 5 years of age was 0.1 % (95 %CI −1.2, 1.5), which was not significant. For children between 5 and 14 years, the difference was −0.8 % (95 %CI −3.1, 1.5), with the difference in the annual percentage change for males being 0.8 % (95 %CI −1.0, 2.6) and for females −1.2 % (95 %CI −3.1, 0.7). None of these values were significant.

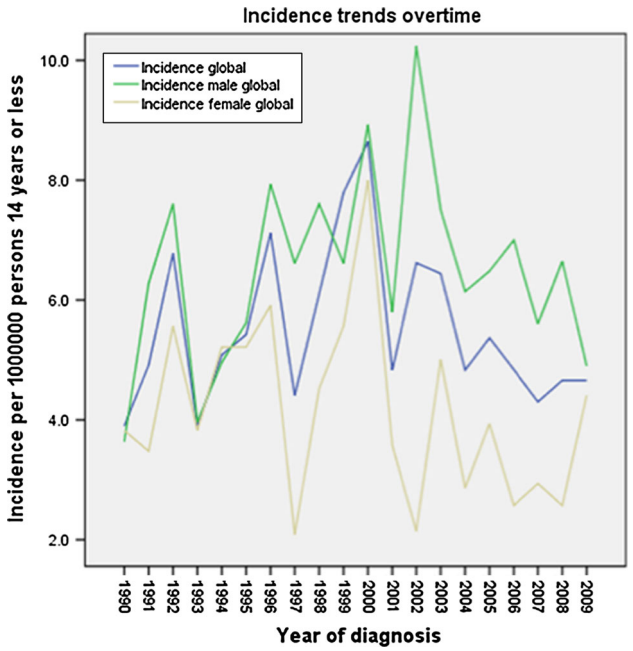
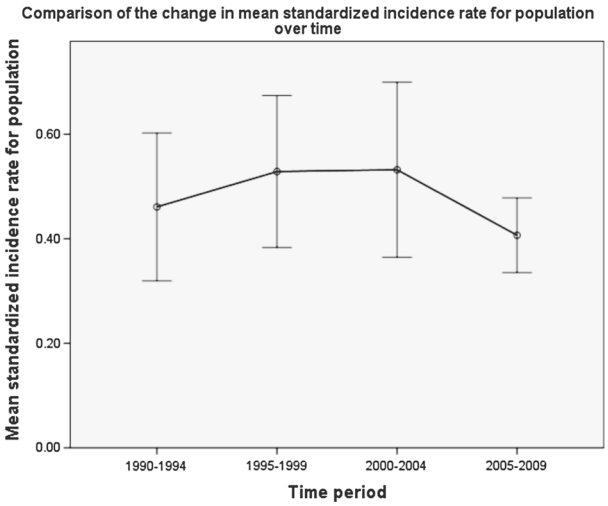


Fig. 1 Incidence of medulloblastoma per million persons age 14 years or less from 1990 to 2009

Discussion

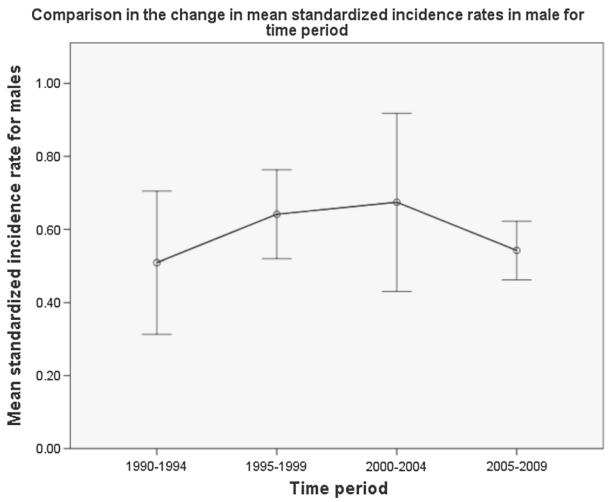
This study demonstrates that the overall incidence of medulloblastoma in Canadian children did not change significantly between 1990 and 2009; however there was a decrease in the number of patients diagnosed in the last time period (2004–2009) compared to the other time periods. There was an increase in the incidence in male patients was seen over the study time period, although not significant. In contrast, a relatively stable incidence in the number of female patients diagnosed was seen.

The lack of significant change in the number of patients diagnosed between 1990 and 2009 in Canada is a similar finding to that of other studies examining the incidence of this tumor type [7, 8]. Previous studies have shown significant changes in the incidence of medulloblastoma over time, some showing an increase and some a decrease [2–6]. The etiology of one decrease in incidence, from 1985 to 1991 compared to 1976–1984, was felt to be potentially due to a protective effect of maternal folate, iron and multivitamin supplementation [2]. This effect was questioned in another US study wherein the incidence of medulloblastoma was found to have increased by 23 % from 4.0 to 4.9 per 10^6 person years between 1973 and



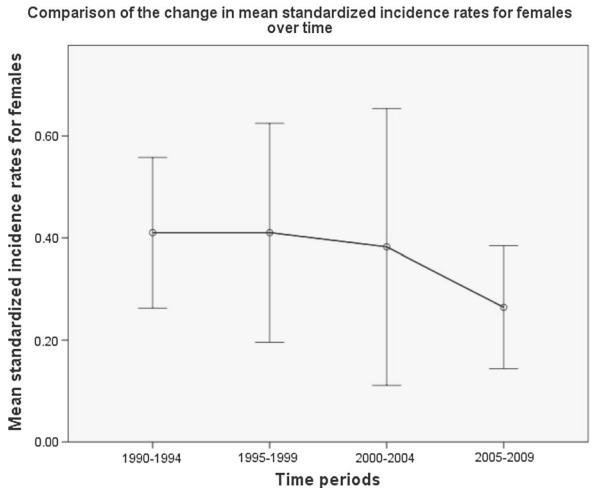
TIME PERIOD	MEAN INCIDENCE RATE per 100,000 persons 14 years or less	95% CI	
1990-1994	0.4609	0.3195-0.6024	F=1.496
1995-1999	0.5287	0.3834-0.6740	p=0.254
2000-2004	0.5321	0.3647-0.6995	
2005-2009	0.4069	0.3353-0.470	
Overall	0.4821	0.4288-0.534	

Fig. 2 Change in standardized incidence of medulloblastoma in persons age 14 years and less from 1990 to 2009



TIME PERIOD	MEAN INCIDENCE RATE per 100,000 males 14 years or less	95% CI	
1990-1994	0.5091	0.3131-0.7050	
1995-1999	0.6413	0.5195-0.7630	F=1.603
2000-2004	0.6743	0.4305- 0.9182	p=0.228
2005-2009	0.5421	0.4621-0.6221	
Overall	0.5971	0.52360.6598	

Fig. 3 Change in standardized incidence of medulloblastoma in male persons age 14 years and less from 1990 to 2009



TIME PERIOD	MEAN INCIDENCE RATE per 100,000 females 14 years or less	95% CI	
1990-1994	0.4301	0.2626-0.5580	
1995-1999	0.4103	0.1957-0.6248	F=0.958
2000-2004	0.3825	0.111-0.3848	p=0.436
2005-2009	0.2642	0.1437-0.8348	
Overall	0.3668	0.2926-0.4410	

Fig. 4 Change in standardized incidence of medulloblastoma in female persons age 14 years and less from 1990 to 2009

1977 and 1993–1998 [4], thus spanning the same time period as the Thorne et al. study [2]. Previous studies did not report the increase in male patients only, as our study demonstrated. There is no obvious explanation for this finding. A recent study examining the incidence of medulloblastoma in Greece between 1991 and 2008 also reported a non-significant increase in incidence of medulloblastoma over the last 2 decades [9].

There were two other studies examining the incidence of medulloblastoma beyond 2000, one from the Hospital for Sick Children in Toronto, Ontario, the other based on data from the Surveillance, Epidemiology and End-Results (SEER) [3, 8]. Neither study showed a significant increase in the incidence of medulloblastoma. There is one study that examined children from 1973 to 2009 and also used SEER data, and this showed an annual percent increase of medulloblastoma and PNET of 0.79 over the study time period. This study included PNET with medulloblastoma in the SEER data, which may explain why these results differ from the Smoll et al. results of SEER data [8]. Thus most studies examining the incidence of medulloblastoma post 2000 have not found a significant change in the overall incidence of medulloblastoma. Our study results support this general impression.

The strength of this study was the complete national capture of children with medulloblastoma. Due to the national health care system in Canada, and the fact that all pediatric patients with medulloblastoma would have been

seen at one of the centers in the CPBTC, this data is complete for the time period studied.

Overall, this study showed that from 1990 to 2009 there was no significant overall change in the incidence of this tumor in all Canadian children, but there was a slight decrease in incidence in the time period 2005–2009 compared to the other time periods. This information will be useful in designing future studies for children with medulloblastoma.

Conflict of interest The authors have no conflict of interest to declare.

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