The Epidemiology of Brain and Central Nervous System Tumors in Massachusetts, 2001-2010

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OBJECTIVE: To examine the epidemiology of malignant and non-malignant brain/CNS tumors diagnosed from 2001-2010 in Massachusetts .

INTRODUCTION:

- Massachusetts has been collecting data on malignant and non-malignant brain tumors since the establishment of the registry in 1982.
- In response to Public Law 107-260 which established benign brain tumor registries, all state registries and hospital cancer programs beginning in 2004 were required by the National Program of Cancer Registries to collect data on all brain tumors, malignant and non-malignant (benign tumors and tumors of uncertain behavior).
- Non-malignant brain tumors are collected to measure the extent of burden of these tumors which according to the CDC bear an 'underappreciated health and financial burden'.
- While non-malignant brain tumor data had been collected by the MCR before 2004, all data analysis of non-malignant cases are from 2004 to 2010 when more complete data were available.

The Brain and Central Nervous System

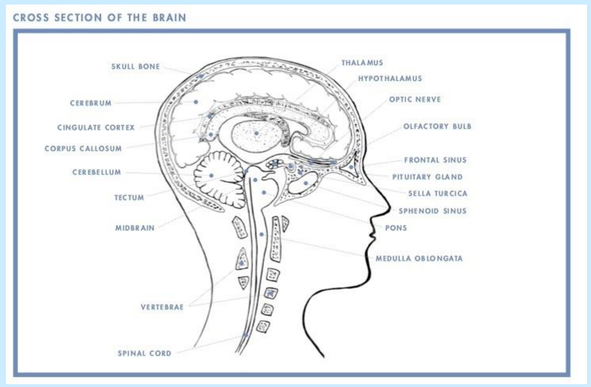
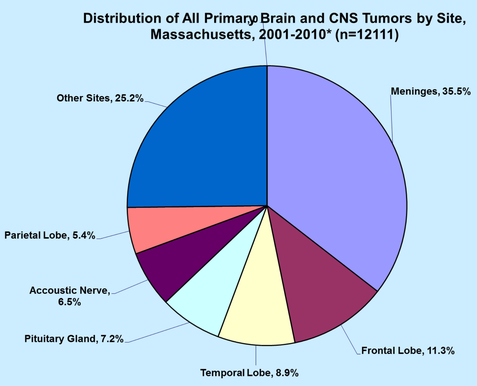


Image courtesy of the American Brain Tumor Association.

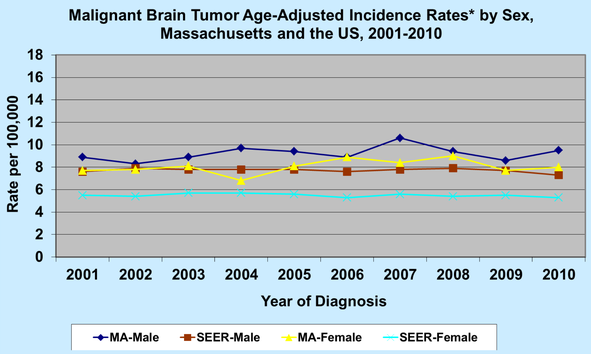
- **The brain** consists of three sections. The hindbrain (the cerebellum, the upper part of the spinal cord, and brainstem) controls the body's vital functions of breathing and heart rate. The midbrain (the uppermost part of the brainstem) controls some reflex actions and voluntary movements. The forebrain (the cerebrum) is involved with intellectual activities and divided into four lobes: the frontal, parietal, occipital, and temporal.
- **The spinal cord** runs from the brain to the bottom of the back and contains spinal nerves involved in movement, breathing, and bladder, bowel, and sexual functions.
- **The meninges** (dura mater, arachnoid mater, subarachnoid space, and pia mater) are protective layers that surround the brain and the spinal cord.
- **The ventricles** are spaces within the brain filled with cerebrospinal fluid.
- **Nerve cells** transit signals from the brain to various parts of the body via the 13 cranial nerves, among them nerves controlling smell, sight, and hearing.
- **The pituitary gland** is involved in the secretion of essential hormones, among them the growth hormone and prolactin (milk production). **The pineal gland** secretes melatonin, involved with the sleep/wake cycle.

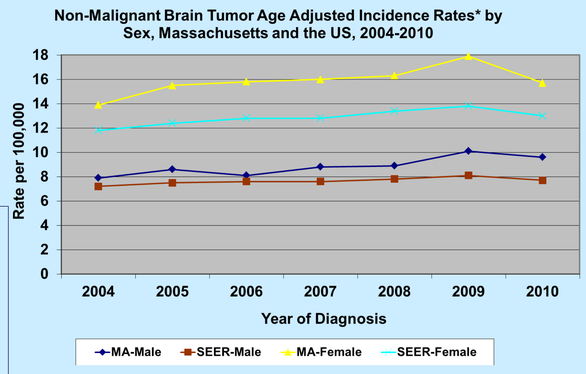


*This chart includes some meningioma and pituitary non-malignant tumors diagnosed before mandated reporting began in 2004. Data Source: Massachusetts Cancer Registry

INCIDENCE:

- There were 5,308 cases of malignant brain tumors diagnosed from 2001 to 2010 and 5,338 cases of non-malignant tumors diagnosed from 2004 to 2010.
- There were no significant changes in incidence rates for either malignant or non-malignant brain tumors in Massachusetts or the US (SEER) from 2001-2010 and 2004-2010, respectively.





MAJOR BRAIN TUMOR HISTOLOGIES:

GLIOMAS:
- arise from the supportive, or gluey, tissue of the brain. There are three types of glial cells that can develop tumors: the astrocyte (star-shaped cell) which can become an astrocytoma, the oligodendrocyte (insulates the neuron) which can become an oligodendroglioma, and the ependymal cell (lines the fluid cavities in the brain) which can become an ependymoma.

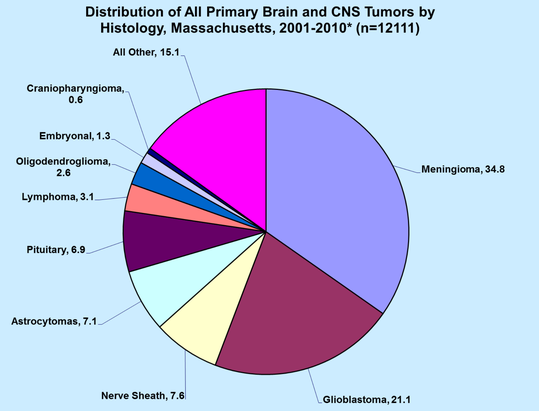
MENINGIOMAS:
- arise from the arachnoid mater and are primarily found in the brain but can also occur in the spinal cord.
- nearly always benign and slow growing with symptoms usually occurring as the result of the tumor compressing against the brain.

EMBRYONAL TUMORS:
- begin in the embryonic (fetal) cells in the brain and spinal cord; nearly 75% of these tumors are diagnosed in people under the age of 20.

NERVE SHEATH TUMORS:
- slow growing benign tumors located in the acoustic nerve, one of the cranial nerves.

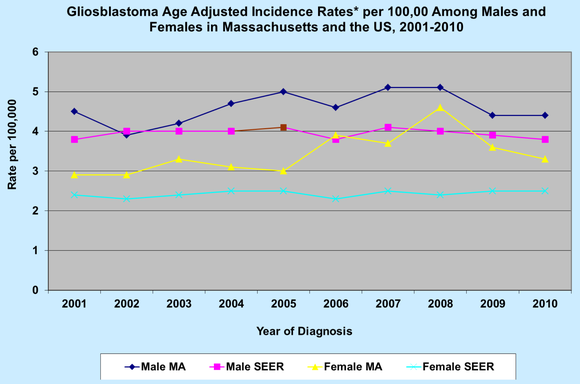
CNS LYMPHOMAS:
- cancers that develop in cells called lymphocytes, which are located in the lymph nodes and lymphoid tissue (such as the spleen and bone marrow) and used in the fight against infections and disease.
- can develop anywhere in the central nervous system but are most common in the lobes of the cerebrum.

PITUITARY GLAND:
- involved in the secretion of several essential hormones. Nearly 100% of these tumors are benign and slow growing. Most of these tumors grow in the front two-thirds of the gland.

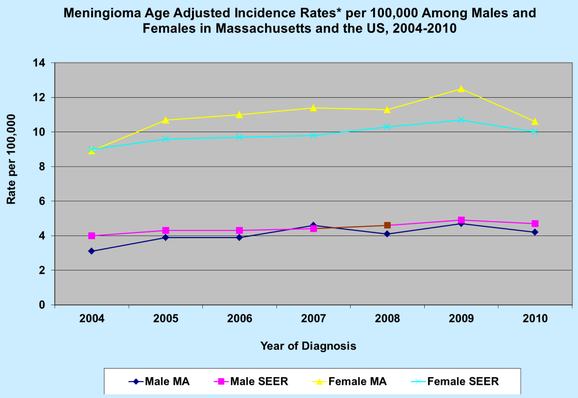


*This chart includes some meningioma and pituitary non-malignant tumors diagnosed before mandated reporting began in 2004. Data Source: Massachusetts Cancer Registry

- Glioblastomas represented over 50% of malignant gliomas.



- While the glioblastoma incidence rate remained steady from 2001-2010 for males, there was an significant increase for females, but this increase was confined to 2006-2008 with rates falling in 2009 and 2010. There were no changes in US rates.



- There were no significant changes in meningioma incidence in either Massachusetts or the US from 2004 to 2010.

* All rates were age adjusted to the 2000 US Standard Population. The data source for all graphs and tables in this poster was the MCR, except for the general population data, which was derived from US Census estimates and the national data which came from the SEER 18 Registries.

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DEMOGRAPHIC COMPARISONS 2006-2010:

Years of diagnoses were combined into a five-year grouping of 2006-2010 data, the most recent period for both types of brain tumors, for the following comparisons: sex, race/ethnicity, and Massachusetts/national data. The following significant differences were found.

- Males had significantly higher rates of glioblastoma compared to females.
- Females had statistically significantly higher rates of meningioma compared to males.
- Massachusetts had significantly higher rates of diffuse astrocytoma and ependymal tumors while SEER had higher rates of nerve sheath tumors, meningiomas, and pituitary tumors.
- White, non-Hispanics and Hispanics had significantly elevated rates of glioblastomas compared to other racial/ethnic groups.
- Black, non-Hispanics had significantly higher rates of meningiomas compared to white, non-Hispanics and Hispanics, but not Asian, non-Hispanics. They also had significantly higher rates of pituitary tumors compared to white, non-Hispanics, but not compared to Asian, non-Hispanics or Hispanics.

2006-2010 Age Adjusted Rates per 100,000 and 95% Confidence Intervals		
	Males	Females
	Rate	Rate
Glioblastoma	4.5 (4.1,4.8)	2.9 (2.7,3.2)
Meningioma	4.1 (3.8,4.5)	8.7 (8.3,9.2)
	MA	SEER
Diffuse Astrocytoma	0.4 (0.3,0.5)	0.1 (0.1,0.1)
Ependymal Tumors	0.4 (0.4,0.5)	0.1 (0.1,0.1)
Nerve Sheath Tumors	1.2 (1.1,1.3)	1.9 (1.9,2.0)
Meningioma	6.6 (6.3,6.9)	8.2 (8.0,8.3)
Pituitary Tumors	1.8 (1.7,2.0)	3.6 (3.5,3.7)

2006-2010 Age Adjusted Rates per 100,000 and 95% Confidence Intervals				
	White, NH	Black, NH	Asian, NH	Hispanic
	Rate	Rate	Rate	Rate
Glioblastoma	3.1 (2.9,3.3)	1.1 (0.6,1.6)	1.0 (0.4,1.6)	2.8 (1.9,3.6)
Meningioma	5.3 (5.1,5.6)	7.1 (5.8,8.4)	4.9 (3.6,6.1)	3.3 (2.5,4.2)
Pituitary Tumors	1.4 (1.3,1.6)	2.4 (1.7,3.1)	1.4 (0.8,2.0)	1.4 (0.9,1.8)

SURVIVAL:

Cause-specific five-year survival for malignant brain tumors ranged from 1% for glioblastomas to nearly 100% for pilocytic astrocytomas, a low grade glioma. Five-year survival was not possible to calculate for non-malignant tumors as they only became reportable in 2004. Since mortality status was not available at the time of analyses for 2010 deaths, the last year of diagnosis with five year follow up time was 2004.

Five Year Cause Specific Survival Percentages for Massachusetts and SEER cases diagnosed from 2001 to 2004		
Malignant Brain Tumor Type	**MA 5-Year Survival**	**US SEER 5-Year Survival**
Pilocytic Astrocytoma (n=93)	96.8%	94.8%
Diffuse Astrocytoma (n=126)	37.8%	50.2%
Anaplastic Astrocytoma (n=117)	24.6%	29.3%
Glioblastoma (n=953)	1.0%	4.5%
Oligodendroglioma, low grade (n=94)	78.9%	82.1%
Anaplastic Oligodendroglioma (n=65)	42.7%	53.5%
Ependymoma (n=67)	89.0%	83.7%
Malignant Glioma, NOS (n=96)	36.8%	46.0%
Embryonal Tumor (n=159)	71.0%	61.2%
CNS Lymphoma (n=138)	35.7%	33.1%

SUMMARY:

- There were no significant changes in incidence rates for either malignant or non-malignant brain tumors in Massachusetts from 2001-2010 and 2004-2010, respectively.
- Gliomas were the common malignant tumor. The most common types of gliomas were glioblastomas, anaplastic astrocytomas, and diffuse astrocytomas.
- Glioblastomas, the deadliest type of brain tumor, had a 1% cause-specific survival for cases diagnosed from 2001-2004. Males were significantly more likely to be diagnosed with glioblastoma, but there were no changes in incidence. The incidence fluctuated for females. White, non-Hispanics and Hispanics were significantly more likely to be diagnosed with a glioblastoma than the other two racial/ethnic groups from 2006-2010.
- There were no significant changes in the incidence of meningiomas, the most common non-malignant brain tumor from 2004-2010.
- Females and black, non-Hispanics were significantly more likely to be diagnosed with a meningioma.
- Black, non-Hispanics were more likely to be diagnosed with a pituitary tumor.