STATISTICS ON INCIDENCE, SURVIVAL RATES AND MORTALITY ASSOCIATED WITH BRAIN TUMOURS IN AUSTRALIA

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Notes:

Central nervous system neoplasms are commonly known as brain tumours. The central nervous system comprises the brain, the spinal column and other areas. Neoplasms include tumours and other matter. In this paper we refer to the brain and other central nervous system.

When examining data on brain tumours it is important to be aware of differences in reporting. Only cancers (malignant tumours) are included in Australian Institute of Health and Welfare (AIHW) data because doctors are required by law to report only malignant cancers to State and Territory cancer registries.

Tumours that are classified as benign (low grade) are thus excluded from the AIHW data.

The Australian Bureau of Statistics (ABS) data contained in this report is from the Causes of Death collection. The ABS data allows reporting on underlying cause of death from primary brain and other central nervous system tumours, including both malignant and non-malignant (benign) tumours.

See Appendix One for more information.

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1. EXECUTIVE SUMMARY

1.1 The Australian Bureau of Statistics (ABS) Causes of Death data show a total of 1,205 people died from brain and other central nervous system (CNS) tumours in the 2001 year of registration. Of these deaths, 1,096 (91%) were attributed to malignant tumours, 61(5%) to benign tumours and 48 (4%) were of uncertain or unknown behaviour.

1.2 Compared to the 1,205 people who died from brain and other CNS tumours in the 2001 year of registration, 1,385 people died from leukaemia.

1.3 Brain tumours are the most common *solid* tumours in childhood (about a fifth of all children's cancers). Together, lymphatic leukaemia and cancers of the brain and the central nervous system accounted for nearly 44% of all cancers diagnosed in children aged 0-14 years in 1998.

1.4 Brain tumours accounted for the most cancer related deaths in children aged 0-14 years, with 38% of cancer deaths in 2000 attributed to cancers of the brain and other central nervous system (compared to 34% for leukaemia). This pattern was repeated in deaths registered in 2001, with 45 deaths due to brain tumours compared to 37 for leukaemia in children aged 0-14 years.

1.5 According to the Australian Institute of Health and Welfare (AIHW) only one in four persons diagnosed with a brain tumour will be alive five years following their diagnosis on average, if deaths from other causes are excluded.

1.6 According to AIHW Cancer data there were a total of 1,361 new cases of cancer of the brain and other central nervous system reported in 1991. Males accounted for more than half of all brain tumours diagnosed (58% male, 42% female). (This excludes benign brain and other central nervous system tumours.)

1.7 In 1996, there was an estimated 16,713 years of life lost in Australia due to brain cancer—9,636 for males and 7,076 for females. This was estimated for all persons with brain cancer who died in 1996 by summing the difference between age at death and life expectancy for the population at that age. In 1996, there was also an estimated 1,060 years of life lost due to disability from brain cancer—663 for males and 397 for females. *Source*: AIHW: Mathers C, Voc T, Stevenson C. The burden of disease and injury in Australia. AIHW cat. no. PHE 17. Canberra:AIHW. 1999.

1.8 There is evidence to suggest that more males are diagnosed with cancer of the brain and other CNS than females, and at a slightly lower age.

1.9 The median age for diagnosis for brain tumours was 55-59 years for males and 60-64 years for females.

1.10 The median age at diagnosis for brain tumours for all persons was 55-59 years, lower than for cancers as a whole (median age at diagnosis for all cancers 65-69 years).

1.11 According to AIHW data 7 people per 100,000 population were diagnosed with brain tumours in Australia in 1999. When converted to world age-standardised rates, 7.4 per 100,000 males and 4.8 per 100,000 females were newly diagnosed with brain tumours in Australia.

1.12 The most common cancers of the brain and central nervous system were cancer of the frontal lobe (271 cases), cancer of the temporal lobe (257 cases) and cancer of the parietal lobe (177 cases). However, there were also 254 cases of cancer of the brain where the site within the brain was not specified.

1.13 Most cases of cancers of the cerebellum, cerebral ventricle, and brain stem occur in young people.

1.14 Cancers of the cerebrum and lobes are most likely to occur in people aged 55 years or more.

1.15 A number of cancers including breast cancer, bowel cancer and brain cancer are diseases that occur at much higher rates in affluent countries. Australia's rates of brain cancer incidence and mortality are therefore high by world standards, but are on a par with countries such as New Zealand, Canada, the USA, and the United Kingdom. Norway, Sweden and Greece have much higher rates than Australia, possibly because of the inclusion of benign tumour data.

2. RELEVANCE/POLICY IMPLICATIONS

2.1 There are almost 1,400 new cases a year of malignant brain tumours in Australia and hundreds more of benign brain tumours that can be just as deadly if the tumour is in a vital area. More than 1,200 people die each year from malignant and benign brain tumours.

2.2 The number of new cases of malignant brain tumours in Australia has increased by 21% during the last 10 years.

2.3 The numbers of new cases and of deaths per 100,000 population due to brain tumours in Australia are high by world standards, and survival after 5 years is poor - only 1 in 4 cases.

2.4 Brain tumours are also important because there are 115 new cases per year among children. It is not only a disease that occurs among older people. Tumours of the central nervous system are now thought to be the most common form of childhood malignancies.

2.5 This provides strong evidence for a need for more research into why brain tumour incidence and mortality are high and whether improvements can be made in diagnosis and treatment that will reduce mortality and increase survival times.

3. BRAIN TUMOURS

3.1 A brain tumour is a mass of unnecessary and abnormal cells growing in the brain. A tumour that starts in the brain is a *primary* brain tumour, which in turn may be grouped into "benign" and "malignant" tumours.

3.2 A *benign* tumour consists of very slow growing cells, usually has distinct borders, and rarely spreads. Treatment and/or surgery is often effective, however, if a benign tumour is located in a vital area of the brain, it can be considered life threatening (rather than "malignant"). So, unlike most benign tumours, noninvasive tumours of the brain/CNS have the potential to be fatal.

3.3 A *malignant* brain tumour is life threatening, invasive and usually rapid growing. This is in contrast to other malignant tumours of the body that are invasive but grow more slowly.

3.4 Brain "tumour" vs brain "cancer". Primary brain tumours rarely spread outside the brain and spinal cord. In order to be labelled a cancer, a tumour must have the ability to metastasize and spread to other organs of the body. Primary brain tumours rarely spread in this way.

3.5 However, cancer cells which begin growing elsewhere in the body and then travel to the brain form metastatic brain tumours. All metastatic brain tumours are malignant since they begin as cancer elsewhere in the body.

3.6 There are more than 160 different types of brain tumours, of which some 40 are classified as malignant. It is possible that each type of tumour has different causal factors, and it's degree of severity or malignancy (the *grade* of tumour), it's location within the brain, the size of surrounding tissue mass affected by the tumour, whether it is diffuse or defined, are just some of the factors to be considered when classifying, treating or researching brain tumours.

3.7 Brain tumours are classified in several ways. The first level of classification is according to the World Health Organisation's International Classification of Diseases, now up to it's 10th edition (ICD-10). Finer detail of brain tumour types is found in WHO's cancer classification system and modifications of it.

3.8 The American Brain Tumor Association's "A Primer of Brain Tumors" is intended to be a reference manual for brain tumour patients and their carers. Appendix 1 contains the full chapter text on which most of the above information is based.

4. THE NATIONAL CANCER STATISTICS CLEARING HOUSE

4.1 The National Cancer Statistics Clearing House (NCSCH) was established in 1986 to foster the development and dissemination of national cancer statistics for Australia. It is supervised by the Australasian Association of Cancer Registries (AACR) and is operated by the AIHW in collaboration with the AACR.

4.2 The NCSCH aims to specifically:

- enable computation and publication of national statistics on cancer;
- allow tracking of interstate movement of cancer cases via record linkage;
- facilitate exchange of scientific and technical information between cancer registries and promote standardisation in the collection and classification of cancer data; and
- facilitate cancer research both nationally and internationally.

4.3 The NCSCH receives data from individual State and Territory cancer registries on cancer diagnosed in residents of Australia. This commenced with cases first diagnosed in 1982. Data from this collection is used to compile national cancer incidence and prevalence statistics.

4.4 With regard to mortality data, cancer deaths are recorded as an underlying cause of death or associated cause of death on a person's death certificate. This is forwarded to the Registrar of Births, Deaths and Marriages in each state or territory, who makes this information available to the ABS for coding purposes. ABS is now working to improve the accuracy of cause of death cancer coding by referring these cases to state and territory cancer registries. The cancer registries then advise ABS of the exact cancer description and ICD code. However, this is not yet done in all states.

4.5 This procedure has implications for the gathering of accurate data relating to brain tumour deaths.

4.6 The latest available cancer statistics are documented in AIHW's annual publication "Cancer in Australia 1999".

5. STATISTICAL TERMS

5.1 Incidence means how many people get a particular type of disease every year, usually expressed as the number of new cases per 100,000 people in the general population. Because some conditions are more age-specific, incidence by age is also an important measure.

5.2 Survival after a diagnosis of cancer is an important measure in assessing the broad impacts of prevention, of early detection methods, and of treatment. Relative survival is the ratio between what actually happened to a group of people with cancer and what would normally have occurred to them in the absence of cancer. A common measure is the 5-year relative survival ratio, which is the relative survival over the first 5 years following a diagnosis of cancer. A relative survival rate of 100% indicates that the disease has made no difference to the survival of the group over this period. A survival rate of less than 100% indicates that fewer members of the group survived for 5 years than would have been expected for similar people in the general population.

5.3 Mortality statistics mean the number of people who have died from a particular condition in a year.

5.4 When examining data on brain tumours note there are differences in reporting. Only malignant cancers are included in the AIHW data because doctors are required by law to report malignant cancers to State and Territory cancer registries but not benign cases.

5.5 The ABS data allows reporting on underlying cause of death from primary brain and other central nervous system tumours, including both malignant and non-malignant (benign) tumours..

6. GENERAL CANCER STATISTICS

6.1 Cancer is an important cause of morbidity and mortality in Australia. Excluding non-melanocytic skin cancers, there were 82,185 new cancer cases and 34,695 deaths due to cancer in Australia in 1999. Almost one in three males (29%) and one in four females (25%) die from cancer *["Cancer in Australia 1999", AIHW].*

6.2 The most common types of cancer are: Cancers of the breast (13.0%), colon (14.2%), prostate (12.5%), skin (10.0%) and lung (9.5%) which together accounted for over half of all new cancer cases registered in 1999.

6.3 In 2000, cancer was the second leading cause of death in children aged 0-14 years [*"Australia's Children: Their health and well-being 2002", AIHW]*

6.4 Cancer of the eye and melanoma of the eye is not included unless specified.

7. BRAIN TUMOUR INCIDENCE

7.1 There were 1,361 new cases of cancers of the brain and central nervous system in 1999, of which 792 (58.2%) were males. In total, this accounted for 1.6% of all new cancer cases *[National Cancer Statistics Clearing House, AIHW data cube].*

7.2 The most common cancers of the brain and central nervous system were cancer of the frontal lobe (271 cases), cancer of the temporal lobe (257 cases) and cancer of the parietal lobe (177 cases). However, there were also 254 cases of cancer of the brain where site within the brain was not specified.

7.3 Cancers of the cerebrum and lobes are most likely to occur in people aged 55 years or more.

7.4 Most cases of cancers of the cerebellum, cerebral ventricle, and brain stem occur in young people.

7.5 Incidence of brain cancer between 1990 and 1999 increased in males by an average of 0.2% per annum and decreased in females by an average of 1.0% per annum.

7.6 In children, leukaemia (a cancer of white blood cells) is the most common cancer, accounting for approximately one-third of all childhood cancers. *['Australia's Children: Their health and well being 2002", AIHW]*

7.7 Brain tumours are the most common *solid* tumours in childhood and make up about a fifth of all children's cancers *(Miller et al. 1995, from 'Australia's Children: Their health and wellbeing 2002", AIHW]*

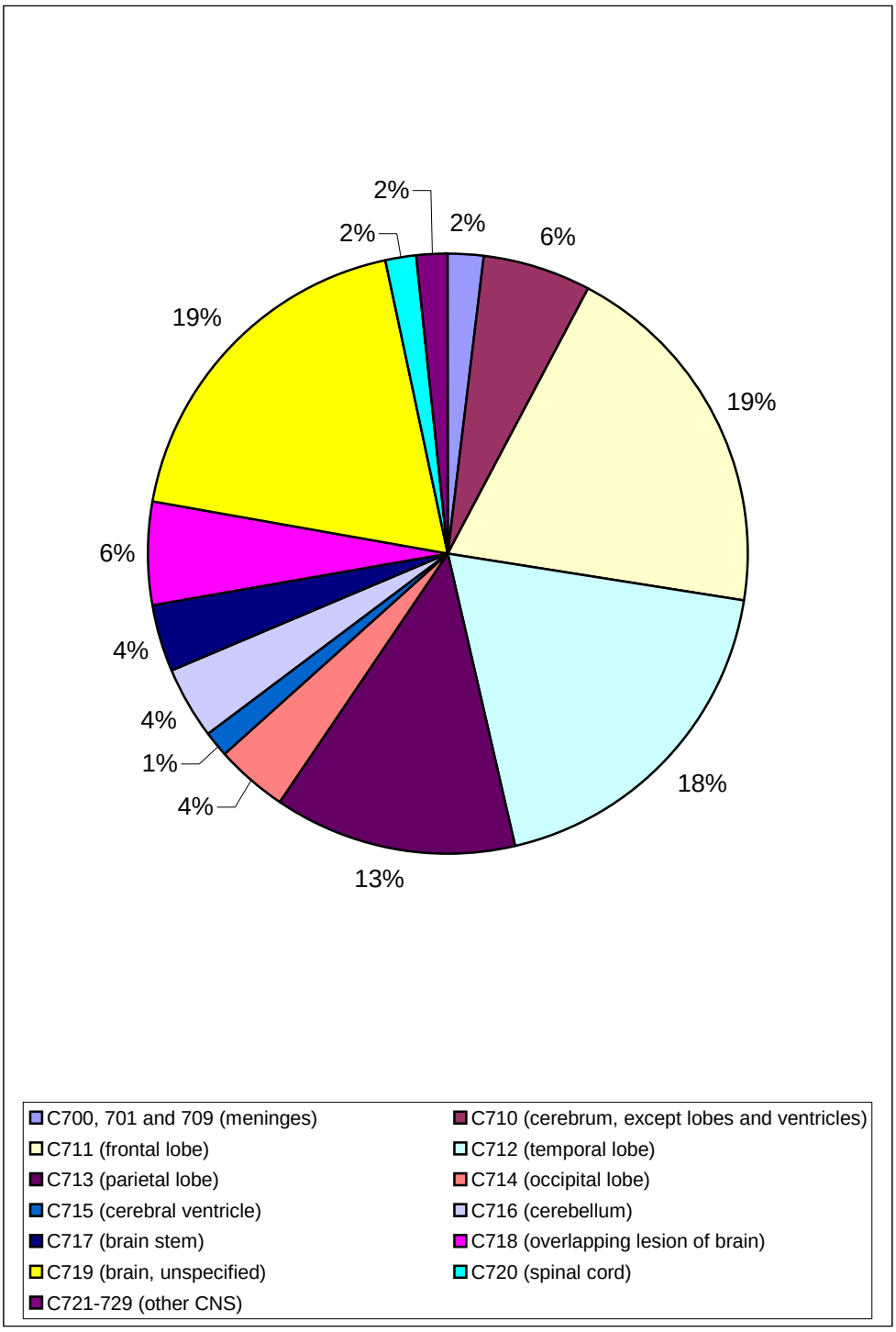
7.8 For example, in 1998 the most common types of cancers among children aged 0-14 years were lymphatic leukaemia (4.1 per 100,000 boys, 3.8 per 100,000 girls) and cancers of the brain and other CNS (3.4 per 100,000 boys, 3.7 per 100,000 girls). These accounted for nearly 44% of all cancers diagnosed in this age group *[AIHW and AACR 2000].*

Table 1. New cases of cancers of the brain and other central nervous system, sex, Australia, 1999

	Males	Females	Persons	% male
C700 (cerebral meninges)	11	11	22	50.0
C701 (spinal meninges)	1	0	1	100.0
C709 (meninges, unspecified)	1	1	2	50.0
C710 (cerebrum, except lobes and ventricles)	49	30	79	62.0
C711 (frontal lobe)	159	112	271	58.7
C712 (temporal lobe)	160	97	257	62.3
C713 (parietal lobe)	96	81	177	54.2
C714 (occipital lobe)	40	14	54	74.1
C715 (cerebral ventricle)	12	6	18	66.7
C716 (cerebellum)	33	19	52	63.5
C717 (brain stem)	26	23	49	53.1
C718 (overlapping lesion of brain)	42	36	78	53.8
C719 (brain, unspecified)	140	114	254	55.1
C720 (spinal cord)	17	9	26	65.4
C721 (cauda equina)	2	1	3	66.7
C722 (olfactory nerve)	0	1	1	0.0
C723 (optic nerve)	2	11	13	15.4
C724 (acoustic nerve)	1	0	1	100.0
C725 (other and unspecified cranial nerves)	0	2	2	0.0
C728 (overlapping lesion of brain and other parts of central nervous system)	0	0	0	0.0
C729 (central nervous system unspecified)	0	1	1	0.0
C70-C72 (total)	**792**	**569**	**1,361**	**58.2**

Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare.

Figure 1. Distribution of cancers of the brain and other central nervous system, Australia, 1999



Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare.

Table 2. New cases of cancers of the brain and central nervous system, age and sex, Australia, 1999

	Age group								
	0-14	**15-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75-84**	**85+**	**Total**
					Males				
C700, 701 and 709 (meninges)	1	2	0	3	2	4	1	0	13
C710 (cerebrum, except lobes and ventricles)	2	3	5	7	11	10	10	1	49
C711 (frontal lobe)	4	29	24	25	31	29	12	5	159
C712 (temporal lobe)	4	21	19	33	34	31	16	2	160
C713 (parietal lobe)	1	6	10	24	18	17	18	2	96
C714 (occipital lobe)	2	2	2	10	6	17	1	0	40
C715 (cerebral ventricle)	3	3	2	2	0	1	1	0	12
C716 (cerebellum)	20	6	0	2	1	3	1	0	33
C717 (brain stem)	10	8	3	2	3	0	0	0	26
C718 (overlapping lesion of brain)	1	1	4	5	11	8	9	3	42
C719 (brain, unspecified)	10	11	6	20	17	38	30	8	140
C720-729 (central nervous system)	4	2	5	3	4	3	1	0	22
C70-C72 (total)	**62**	**94**	**80**	**136**	**138**	**161**	**100**	**21**	**792**
					Females				
C700, 701 and 709 (meninges)	0	3	1	3	4	0	0	1	12
C710 (cerebrum, except lobes and ventricles)	3	6	2	3	5	4	5	2	30
C711 (frontal lobe)	4	10	16	14	14	31	22	1	112
C712 (temporal lobe)	5	7	5	13	21	27	18	1	97
C713 (parietal lobe)	2	5	9	8	18	19	15	5	81
C714 (occipital lobe)	1	1	0	3	0	8	0	1	14
C715 (cerebral ventricle)	1	2	1	1	0	0	0	1	6
C716 (cerebellum)	11	4	0	1	2	1	0	0	19
C717 (brain stem)	6	7	2	2	1	2	2	1	23
C718 (overlapping lesion of brain)	1	1	0	2	8	11	11	2	36
C719 (brain, unspecified)	9	6	8	6	10	29	31	15	114
C720-729 (central nervous system)	10	3	4	1	2	0	0	2	25
C70-C72 (total)	**53**	**55**	**48**	**57**	**85**	**132**	**104**	**32**	**569**
					Persons				
C700, 701 and 709 (meninges)	1	5	1	6	6	4	1	1	25
C710 (cerebrum, except lobes and ventricles)	5	9	7	10	16	14	15	3	79
C711 (frontal lobe)	8	39	40	39	45	60	34	6	271
C712 (temporal lobe)	9	28	24	46	55	58	34	3	257
C713 (parietal lobe)	3	11	19	32	36	36	33	7	177
C714 (occipital lobe)	3	3	2	13	6	25	1	1	54
C715 (cerebral ventricle)	4	5	3	3	0	1	1	1	18
C716 (cerebellum)	31	10	0	3	3	4	1	0	52
C717 (brain stem)	16	15	5	4	4	2	2	1	49
C718 (overlapping lesion of brain)	2	2	4	7	19	19	20	5	78
C719 (brain, unspecified)	19	17	14	26	27	67	61	23	254
C720-729 (central nervous system)	14	5	9	4	6	3	1	2	47
	0	0	0	0	0	0	0	0	0
C70-C72 (total)	**115**	**149**	**128**	**193**	**223**	**293**	**204**	**53**	**1,361**

Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare

Table 3. New cases of cancers of the brain and central nervous system, distribution by age, Australia, 1999

	Age group								
	0-14	15-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Males	Per cent								
C700, 701 and 709 (meninges)	7.7	15.4	0.0	23.1	15.4	30.8	7.7	0.0	100.0
C710 (cerebrum, except lobes and ventricles)	4.1	6.1	10.2	14.3	22.4	20.4	20.4	2.0	100.0
C711 (frontal lobe)	2.5	18.2	15.1	15.7	19.5	18.2	7.5	3.1	100.0
C712 (temporal lobe)	2.5	13.1	11.9	20.6	21.3	19.4	10.0	1.3	100.0
C713 (parietal lobe)	1.0	6.3	10.4	25.0	18.8	17.7	18.8	2.1	100.0
C714 (occipital lobe)	5.0	5.0	5.0	25.0	15.0	42.5	2.5	0.0	100.0
C715 (cerebral ventricle)	25.0	25.0	16.7	16.7	0.0	8.3	8.3	0.0	100.0
C716 (cerebellum)	60.6	18.2	0.0	6.1	3.0	9.1	3.0	0.0	100.0
C717 (brain stem)	38.5	30.8	11.5	7.7	11.5	0.0	0.0	0.0	100.0
C718 (overlapping lesion of brain)	2.4	2.4	9.5	11.9	26.2	19.0	21.4	7.1	100.0
C719 (brain, unspecified)	7.1	7.9	4.3	14.3	12.1	27.1	21.4	5.7	100.0
C720-729 (central nervous system)	18.2	9.1	22.7	13.6	18.2	13.6	4.5	0.0	100.0
C70-C72 (total)	7.8	11.9	10.1	17.2	17.4	20.3	12.6	2.7	100.0
Females	Per cent								
C700, 701 and 709 (meninges)	0.0	25.0	8.3	25.0	33.3	0.0	0.0	8.3	100.0
C710 (cerebrum, except lobes and ventricles)	10.0	20.0	6.7	10.0	16.7	13.3	16.7	6.7	100.0
C711 (frontal lobe)	3.6	8.9	14.3	12.5	12.5	27.7	19.6	0.9	100.0
C712 (temporal lobe)	5.2	7.2	5.2	13.4	21.6	27.8	18.6	1.0	100.0
C713 (parietal lobe)	2.5	6.2	11.1	9.9	22.2	23.5	18.5	6.2	100.0
C714 (occipital lobe)	7.1	7.1	0.0	21.4	0.0	57.1	0.0	7.1	100.0
C715 (cerebral ventricle)	16.7	33.3	16.7	16.7	0.0	0.0	0.0	16.7	100.0
C716 (cerebellum)	57.9	21.1	0.0	5.3	10.5	5.3	0.0	0.0	100.0
C717 (brain stem)	26.1	30.4	8.7	8.7	4.3	8.7	8.7	4.3	100.0
C718 (overlapping lesion of brain)	2.8	2.8	0.0	5.6	22.2	30.6	30.6	5.6	100.0
C719 (brain, unspecified)	7.9	5.3	7.0	5.3	8.8	25.4	27.2	13.2	100.0
C720-729 (central nervous system)	40.0	12.0	16.0	4.0	8.0	0.0	0.0	8.0	100.0
C70-C72 (total)	**9.3**	**9.7**	**8.4**	**10.0**	**14.9**	**23.2**	**18.3**	**5.6**	**100.0**
Persons	Per cent								
C700, 701 and 709 (meninges)	4.0	20.0	4.0	24.0	24.0	16.0	4.0	4.0	100.0
C710 (cerebrum, except lobes and ventricles)	6.3	11.4	8.9	12.7	20.3	17.7	19.0	3.8	100.0
C711 (frontal lobe)	3.0	14.4	14.8	14.4	16.6	22.1	12.5	2.2	100.0
C712 (temporal lobe)	3.5	10.9	9.3	17.9	21.4	22.6	13.2	1.2	100.0
C713 (parietal lobe)	1.7	6.2	10.7	18.1	20.3	20.3	18.6	4.0	100.0
C714 (occipital lobe)	5.6	5.6	3.7	24.1	11.1	46.3	1.9	1.9	100.0
C715 (cerebral ventricle)	22.2	27.8	16.7	16.7	0.0	5.6	5.6	5.6	100.0
C716 (cerebellum)	59.6	19.2	0.0	5.8	5.8	7.7	1.9	0.0	100.0
C717 (brain stem)	32.7	30.6	10.2	8.2	8.2	4.1	4.1	2.0	100.0
C718 (overlapping lesion of brain)	2.6	2.6	5.1	9.0	24.4	24.4	25.6	6.4	100.0
C719 (brain, unspecified)	7.5	6.7	5.5	10.2	10.6	26.4	24.0	9.1	100.0
C720-729 (central nervous system)	29.8	10.6	19.1	8.5	12.8	6.4	2.1	4.3	100.0
C70-C72 (total)	**8.4**	**10.9**	**9.4**	**14.2**	**16.4**	**21.5**	**15.0**	**3.9**	**100.0**

Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare

Table 4. New cases of cancers of the brain and central nervous system, distribution by cancer within age group, Australia, 1999

	Age group								
	0-14	15-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Males	**Per cent**								
C700, 701 and 709 (meninges)	1.6	2.1	0.0	2.2	1.4	2.5	1.0	0.0	1.6
C710 (cerebrum, except lobes and ventricles)	3.2	3.2	6.3	5.1	8.0	6.2	10.0	4.8	6.2
C711 (frontal lobe)	6.5	30.9	30.0	18.4	22.5	18.0	12.0	23.8	20.1
C712 (temporal lobe)	6.5	22.3	23.8	24.3	24.6	19.3	16.0	9.5	20.2
C713 (parietal lobe)	1.6	6.4	12.5	17.6	13.0	10.6	18.0	9.5	12.1
C714 (occipital lobe)	3.2	2.1	2.5	7.4	4.3	10.6	1.0	0.0	5.1
C715 (cerebral ventricle)	4.8	3.2	2.5	1.5	0.0	0.6	1.0	0.0	1.5
C716 (cerebellum)	32.3	6.4	0.0	1.5	0.7	1.9	1.0	0.0	4.2
C717 (brain stem)	16.1	8.5	3.8	1.5	2.2	0.0	0.0	0.0	3.3
C718 (overlapping lesion of brain)	1.6	1.1	5.0	3.7	8.0	5.0	9.0	14.3	5.3
C719 (brain, unspecified)	16.1	11.7	7.5	14.7	12.3	23.6	30.0	38.1	17.7
C720-729 (central nervous system)	6.5	2.1	6.3	2.2	2.9	1.9	1.0	0.0	2.8
C70-C72 (total)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Females	**Per cent**								
C700, 701 and 709 (meninges)	0.0	5.5	2.1	5.3	4.7	0.0	0.0	3.1	2.1
C710 (cerebrum, except lobes and ventricles)	5.7	10.9	4.2	5.3	5.9	3.0	4.8	6.3	5.3
C711 (frontal lobe)	7.5	18.2	33.3	24.6	16.5	23.5	21.2	3.1	19.7
C712 (temporal lobe)	9.4	12.7	10.4	22.8	24.7	20.5	17.3	3.1	17.0
C713 (parietal lobe)	3.8	9.1	18.8	14.0	21.2	14.4	14.4	15.6	14.2
C714 (occipital lobe)	1.9	1.8	0.0	5.3	0.0	6.1	0.0	3.1	2.5
C715 (cerebral ventricle)	1.9	3.6	2.1	1.8	0.0	0.0	0.0	3.1	1.1
C716 (cerebellum)	20.8	7.3	0.0	1.8	2.4	0.8	0.0	0.0	3.3
C717 (brain stem)	11.3	12.7	4.2	3.5	1.2	1.5	1.9	3.1	4.0
C718 (overlapping lesion of brain)	1.9	1.8	0.0	3.5	9.4	8.3	10.6	6.3	6.3
C719 (brain, unspecified)	17.0	10.9	16.7	10.5	11.8	22.0	29.8	46.9	20.0
C720-729 (central nervous system)	18.9	5.5	8.3	1.8	2.4	0.0	0.0	6.3	4.4
C70-C72 (total)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Persons	**Per cent**								
C700, 701 and 709 (meninges)	0.9	3.4	0.8	3.1	2.7	1.4	0.5	1.9	1.8
C710 (cerebrum, except lobes and ventricles)	4.3	6.0	5.5	5.2	7.2	4.8	7.4	5.7	5.8
C711 (frontal lobe)	7.0	26.2	31.3	20.2	20.2	20.5	16.7	11.3	19.9
C712 (temporal lobe)	7.8	18.8	18.8	23.8	24.7	19.8	16.7	5.7	18.9
C713 (parietal lobe)	2.6	7.4	14.8	16.6	16.1	12.3	16.2	13.2	13.0
C714 (occipital lobe)	2.6	2.0	1.6	6.7	2.7	8.5	0.5	1.9	4.0
C715 (cerebral ventricle)	3.5	3.4	2.3	1.6	0.0	0.3	0.5	1.9	1.3
C716 (cerebellum)	27.0	6.7	0.0	1.6	1.3	1.4	0.5	0.0	3.8
C717 (brain stem)	13.9	10.1	3.9	2.1	1.8	0.7	1.0	1.9	3.6
C718 (overlapping lesion of brain)	1.7	1.3	3.1	3.6	8.5	6.5	9.8	9.4	5.7
C719 (brain, unspecified)	16.5	11.4	10.9	13.5	12.1	22.9	29.9	43.4	18.7
C720-729 (central nervous system)	12.2	3.4	7.0	2.1	2.7	1.0	0.5	3.8	3.5
C70-C72 (total)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare

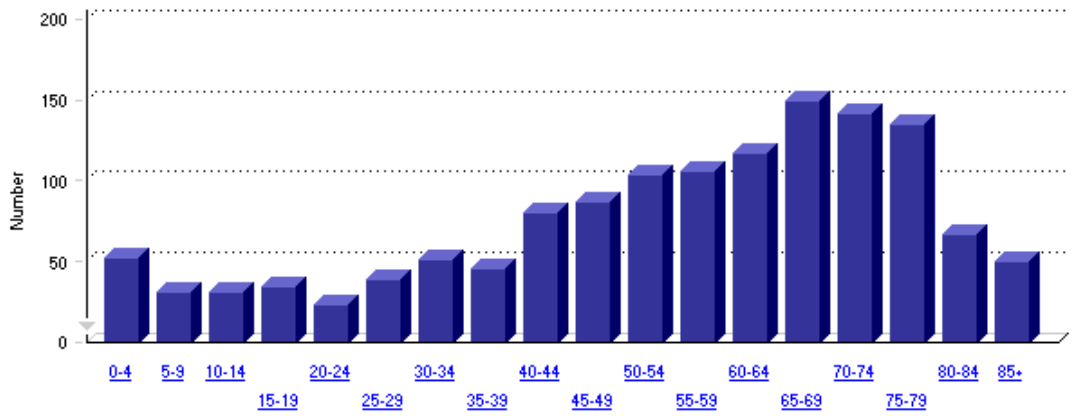
Table 5. Cancers of the brain and other central nervous system, number of new cases and age standardised rates, 1999

	Males	Females	Persons
New cases	784	564	1,348
% of all registrable cancers	0.95	0.69	1.64
Rates per 100,000 population			
Crude rate	8.3	5.9	7.1
Australian age-standardised rate (1991)	8.1	5.4	6.7
World age-standardised rate	7.4	4.8	6.0

Source: National Cancer Statistics Clearing House; AIHW interactive cancer data cube

- 7 people per 100,000 population were diagnosed with cancer of the brain or other CNS in Australia in 1999.
- When converted to world age-standardised rates, 7.4 per 100,000 males and 4.8 per 100,000 females were newly diagnosed with brain/CNS cancer in Australia.
- For an international comparison, Australian figures are almost identical to Ireland's world age-standardised rates, where 7.0 per 100,000 males and 4.8 per 100,000 females were diagnosed with malignant cancer of the brain in 1994-1996 *[All-Ireland Cancer Statistics 1994-1996].*

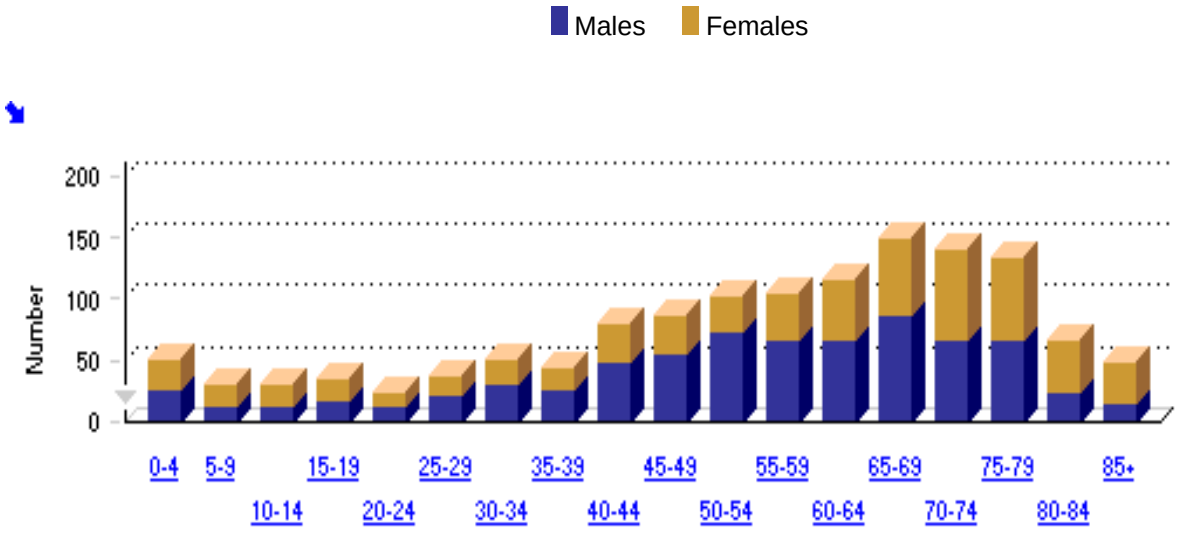
Figure 2. Number of new cases of cancer of the brain and other CNS, by 5 year age groups, 1999



Source: National Cancer Statistics Clearing House; AIHW interactive cancer data cube

- Median age at diagnosis for cancer of the brain and other CNS was 55-59 years, lower than for cancers as a whole (median age at diagnosis for all cancers 65-69 years).

Figure 3. Number of new cases of cancer of the brain and other CNS, by 5 year age groups and gender, 1999



Source: National Cancer Statistics Clearing House; AIHW interactive cancer data cube

- In 1999, a total of 1,348 new cases of cancer of the brain and other CNS were reported. Males accounted for more than half of all brain tumours diagnosed (58% male, 42% female).
- The median age for diagnosis was 55-59 years for males and 60-64 years for females.
- In summary, there is evidence to suggest that more males are diagnosed with cancer of the brain and other CNS than females, and at a slightly lower age.

8. BRAIN TUMOUR SURVIVAL STATISTICS AND YEARS OF LIFE LOST

8.1 The average 5-year relative survival proportion for all registrable cancers diagnosed in Australia between 1992 and 1997 was 56.8% for males and 63.4% for females.

8.2 One in four males diagnosed with cancers of the brain were alive five years following their diagnosis (23.8%) compared to 41.2% of males diagnosed with leukaemia.

8.3 Figures are similar for the 5-year relative survival proportion for females diagnosed with cancers of the brain at 23.8%, compared to 43.2% of females diagnosed with leukaemia.

8.4 In terms of prognosis, cancers of the brain rate amongst the five lowest relative survival rates for males and fourth lowest for females.

8.5 In 1996, there was an estimated 16,713 years of life lost in Australia due to brain cancer—9,636 for males and 7,076 for females. This was estimated for all persons with brain cancer who died in 1996 by summing the difference between age at death and life expectancy for the population at that age.

8.6 In 1996, there was also an estimated 1,060 years of life lost due to disability from brain cancer—663 for males and 397 for females. [*Source*: AIHW: Mathers C, Voc T, Stevenson C. The burden of disease and injury in Australia. AIHW cat. no. PHE 17. Canberra:AIHW. 1999.]

Table 6. Five-year relative survival ratios for all registrable cancers and selected individual cancer sites, diagnosis period, males, Australia

	Diagnosis period		
Cancer site	1982-1986	1987-1991	1992-1997
Males		(Per cent)	
Testis	91.1	95.2	95.4*
Melanoma	83.0	87.2	90.0*
Thyroid	81.0	82.6	87.9
Prostate	59.3	64.3	82.7*
Hodgkin's lymphoma	74.1	79.1	82.6*
Bladder	71.2	71.6	70.8
Kidney	50.8	53.7	59.9*
Colon	50.2	54.7	58.3*
Rectum	48.7	51.2	56.6*
Non-Hodgkin's lymphoma	49.6	51.1	54.6*
Leukaemia	39.4	43.3	41.2
Brain	24.8	24.3	23.8
Stomach	19.2	21.6	22.6*
Unknown primary	11.7	13.0	13.4
Lung	9.3	10.7	11.0*
Pancreas	4.2	4.4	5.4
All registrable cancers	43.8	48.1	56.8*

* Change between 1982-1986 and 1992-1997 is statistically significant at the 95% level.

Source: AIHW and AACR 2001

Table 7. Five-year relative survival ratios for all registrable cancers and selected individual cancer sites, diagnosis period, females, Australia

	Diagnosis period		
Cancer site	1982-1986	1987-1991	1992-1997
Females		(Per cent)	
Thyroid	87.8	91.9	95.6*
Melanoma	90.9	93.5	94.6*
Hodgkin's lymphoma	73.8	79.9	84.4*
Breast	72.3	77.8	84.0*
Uterus	76.1	78.5	81.4*
Cervix	69.6	72.0	74.6*
Bladder	67.2	65.2	64.7
Rectum	52.3	56.0	60.6*
Colon	51.3	54.7	58.7*
Kidney	49.4	52.7	57.5*
Non-Hodgkin's lymphoma	49.9	54.6	55.8*
Leukaemia	39.4	44.2	43.2*
Ovary	34.4	37.7	42.0
Stomach	21.1	21.8	24.8*
Brain	24.1	25.3	23.8
Lung	11.8	11.9	14.0*
Unknown primary	10.4	10.9	11.5
Pancreas	4.1	5.4	5.2
All registrable cancers	55.3	59.1	63.4*

* Change between 1982-1986 and 1992-1997 is statistically significant at the 95% level.

Source: AIHW and AACR 2001

- 5-year relative survival for all registrable cancers increased between 1982-1986 and 1992-1997 on average from 43.8% to 56.8% for males and from 55.3% to 63.4% for females.

- However, cancers of the brain showed small decreases in relative survival over this period for both males and females. Although these decreases were not statistically significant, the figures indicate that the relative survival for brain tumours remains unchanged whilst survival rates for most other cancers have improved on average.

9. BRAIN TUMOUR MORTALITY

9.1 Although brain tumours account for a relatively small proportion of new cancer cases reported each year, brain tumours have a disproportionately higher mortality rate and decreased survival rates when compared to the more common types of cancer.

9.2 In 2000, 105 children aged 0-14 years died from cancer. Most of the deaths (38% or 40 deaths) were due to cancer of the eye, cancer of the brain and other parts of the CNS; 36 deaths (34%) were due to cancers of the lymphoid and haematopoietic tissues.

9.3 In 2001, cancer of the brain and other CNS accounted for the most childhood cancer deaths, with 45 deaths, compared to 37 children who died from leukaemia. (See Table 8 below).

1.16 In total 1,205 people died from tumours of the brain and other CNS in 2001, compared to 1,385 who died from leukaemia. This included 61 deaths where a benign (non-cancerous tumour) was the underlying cause of death. This compares with 1,385 people who died from leukaemia.

Table 8. Comparison of deaths caused by Brain and other CNS tumours and Leukaemias, by age at death, 2001 registration year, Australia

Age at death in years	Brain and other CNS tumours[1]	Leukaemia[2]
0-4	17	12
5-9	14	17
10-14	14	8
15-19	11	11
20-24	9	12
25-29	12	16
30-34	24	19
35-39	38	19
40-44	51	27
45-49	61	30
50-54	114	58
55-59	126	72
60-64	109	97
65-69	138	126
70-74	151	199
75-79	156	251
80-84	88	212
85+	72	199
TOTAL	1,205	1,385

(1) Includes ICD-10 codes C70-C72, D32, D33, D42, D43 – Malignant and benign neoplasms
(2) Includes ICD-10 codes C91-C95

Source: ABS Cause of Death collection, Australian Bureau of Statistics

10. TRENDS IN BRAIN TUMOUR INCIDENCE AND MORTALITY

10.1 The number of new cases of cancers of the brain and central nervous system has increased from 891 in 1982 to 1,361 in 1999. The age-standardised rate increased from 6.5 per 100,000 population to 7.3 per 100,000 population during the same period.

10.2 The number of deaths from cancers of the brain and central nervous system increased from 680 in 1982 to 1,030 in 1999. Statistically the age-standardised mortality rate was fairly stable during this period. In 1999 the age-standardised death rate from cancers of the brain and central nervous system was 5.6 per 100,000 population.

Table 9. Cancers of the brain and central nervous system: incidence and mortality, Australia, 1982-1999

	Incidence			Mortality		
Year	**New cases**	**ASR (A)**	**ASR (W)**	**Deaths**	**ASR(A)**	**ASR(W)**
1982	891	6.5	5.7	680	5.2	4.2
1983	931	6.7	5.8	773	5.8	4.7
1984	969	6.8	5.9	812	5.9	4.8
1985	962	6.6	5.7	797	5.7	4.6
1986	1,010	6.8	5.9	742	5.1	4.2
1987	1,069	7.1	6.1	797	5.4	4.4
1988	1,109	7.3	6.2	865	5.8	4.6
1989	1,122	7.2	6.1	830	5.5	4.4
1990	1,123	7.1	6.0	951	6.2	5.0
1991	1,209	7.5	6.4	906	5.8	4.6
1992	1,253	7.6	6.5	981	6.1	4.9
1993	1,219	7.3	6.2	933	5.7	4.5
1994	1,283	7.6	6.4	1,001	6.0	4.7
1995	1,278	7.4	6.3	979	5.8	4.6
1996	1,308	7.4	6.3	1,026	5.9	4.7
1997	1,308	7.3	6.1	1,036	5.8	4.6
1998	1,331	7.3	6.1	1,023	5.7	4.5
1999	1,361	7.3	6.1	1,030	5.6	4.4

Note: Rates are expressed per 100,000 population and age-standardised (AS Rate) to both the Australian 2001 Standard Population and the current World Standard Population.

Source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare.

11. INTERNATIONAL COMPARISON

11.1 A number of cancers including breast cancer, bowel cancer and brain cancer are diseases that occur at much higher rates in affluent countries. Australia's rates of brain cancer incidence and mortality are therefore high by world standards, but are on a par with countries such as New Zealand, Canada, the USA, and the United Kingdom.

11.2 Norway, Sweden and Greece have much higher rates than Australia. This may or may not be due to the inclusion of benign brain tumours (non-cancerous tumours).

Table 10. Cancers of the brain and nervous system, incidence and mortality, males and females, GLOBOCAN 2000 database

Population	Cases	Crude	ASR (W)	Deaths	Crude	ASR (W)
			Males			
World	100,446	3.29	3.59	71,615	2.35	2.61
More developed countries	41,034	7.10	5.85	30,664	5.31	4.10
Less developed countries	59,416	2.40	2.83	40,955	1.66	2.02
Australia	**776**	**8.27**	**6.97**	**645**	**6.88**	**5.40**
New Zealand	180	9.44	8.59	111	5.85	4.83
Canada	1,231	7.98	6.75	935	6.06	4.75
United States of America	10,307	7.51	6.45	7,312	5.33	4.34
Russian Federation	4,349	6.33	5.73	3,757	5.47	4.91
Denmark	228	8.68	7.04	196	7.48	5.33
Finland	202	8.03	6.81	154	6.05	4.53
Ireland	152	8.25	7.32	127	6.79	5.72
Norway	224	10.08	8.03	124	5.59	4.28
Sweden	636	14.39	11.05	341	7.71	5.07
United Kingdom	2,380	8.24	6.39	1,802	6.24	4.50
Greece	812	15.49	10.62	600	11.43	7.43
Italy	2,349	8.45	6.28	1,620	5.83	3.85
Spain	1,624	8.38	6.52	1,180	6.09	4.32
Yugoslavia	380	7.17	6.05	265	5.02	4.04
France	2,001	6.95	5.70	1,562	5.43	3.94
Germany	3,770	9.36	7.02	2,788	6.92	4.86
The Netherlands	590	7.54	6.15	448	5.73	4.34
			Females			
World	75,610	2.52	2.54	55,999	1.86	1.88
More developed countries	32,538	5.33	4.06	25,394	4.16	2.80
Less developed countries	43,076	1.80	2.03	30,604	1.28	1.46
Australia	**572**	**6.01**	**4.80**	**468**	**4.93**	**3.64**
New Zealand	131	6.66	5.46	101	5.22	3.94
Canada	962	6.12	4.80	708	4.49	3.24
United States of America	7,744	5.49	4.35	5,951	4.21	2.98
Russian Federation	3,658	4.67	3.74	3,594	4.59	3.33
Denmark	199	7.47	5.80	158	5.93	3.61
Finland	185	7.00	5.74	126	4.77	3.29
Ireland	110	5.89	5.00	98	5.23	3.90
Norway	200	8.90	6.60	77	3.39	2.38
Sweden	704	15.67	11.29	284	6.30	3.77
United Kingdom	1,790	5.98	4.43	1,359	4.54	2.99
Greece	593	10.96	7.09	423	7.84	4.54
Italy	1,881	6.38	4.38	1,252	4.25	2.45
Spain	1,450	7.15	4.99	903	4.46	2.69
Yugoslavia	256	4.77	3.80	165	3.08	2.38
France	1,619	5.34	4.15	1,300	4.29	2.69
Germany	3,109	7.41	4.84	2,448	5.83	3.40
The Netherlands	436	5.47	4.49	363	4.56	3.10

GLOBOCAN 2000: Cancer Incidence, Mortality and Prevalence Worldwide, Version 1.0.

IARC CancerBase No. 5, Lyon, IARCPress, 2001

12. HOSPITAL INPATIENT STATISTICS

(Source: AIHW Australian hospital statistics database, Excludes patients treated as out-patients at hospitals)

- In 2000–01, there were 4,739 separations from hospitals in Australia of persons with a principal diagnosis of cancer of the brain or central nervous system, with an average stay of 11.2 days. There were 659 deaths.

- Treatment was mainly acute care (4,020 separations) and palliative care (607 separations).

- The most common procedures undertaken were:
  – CAT scan 1,296
  – MRI 1,119
  – removal of intercranial tumour 1,113
  – examination of skull, meninges or brain 827
  – biopsy of brain or meninges 428
  – chemotherapy 373
  – injection or transfusion of terapeutic or prophylactic substance
  – transfusion of blood and gamma globulin

- The most common additional diagnoses were:
  – hemiplegia 639
  – personal history of certain other diseases 396
  – hypertension 359
  – convulsions, not elsewhere classified 347
  – secondary malignant cancer of other sites 309
  – speech disturbances, not elsewhere classified 302
  – problems related to lifestyle 280
  – Type 2 diabetes 260
  – epilepsy 218

Appendix 1: A Primer of Brain Tumors, 7th Edition, American Brain Tumor Association

(Note: US spelling of tumor is retained in this appendix.)

Brain Tumor Basics

The adult body normally forms new cells only when they are needed to replace old or damaged ones. Infants and children form new cells to complete their development in addition to those needed for repair. A tumor develops if normal or abnormal cells multiply when they are not needed.

A brain tumor is a mass of unnecessary, and abnormal, cells growing in the brain.

When doctors describe brain tumors, they often use the words "benign" or "malignant." Those descriptions refer to the degree of malignancy or aggressiveness of a brain tumor. It is not always easy to classify a brain tumor as "benign" or "malignant" as many factors other than the pathological features contribute to the outcome.

This chapter was updated by Peter C. Burger, MD, Johns Hopkins Hospital, Department of Pathology, Baltimore, Maryland. We thank him for his assistance with that update.

PRIMARY BRAIN TUMORS

A tumor that starts in the brain is a primary brain tumor. Glioblastoma, astrocytoma, medulloblastoma, and ependymoma are examples of primary brain tumors. Primary brain tumors can be grouped into "benign" tumors and "malignant" tumors.

Benign brain tumors

A "benign" brain tumor consists of very slow growing cells, usually has distinct borders, and rarely spreads. When viewed microscopically, the cells have an almost normal appearance. Surgery alone might be an effective treatment for this type of tumor. A brain tumor composed of benign cells, but located in a vital area, can be considered to be life-threatening - although the tumor and its cells would not be classified as "malignant."

Malignant brain tumors

A malignant brain tumor is life-threatening, invasive, and usually rapidly growing. Other malignant tumors are invasive but grow more slowly. Malignant brain tumors are often called brain cancer. Since primary brain tumors rarely spread outside the brain and spinal cord, they do not exactly fit the general definition of "cancer" -- a tumor that has the ability to spread to other organs of the body. Since brain tumors generally do not spread to other organs, they do not meet the true definition of cancer. Thus, we say that brain tumors are either "benign" or "malignant."

Brain tumors can be malignant if they are located in a critical part of the brain or cause life-threatening damage.

Some types of malignant brain tumors can spread to other locations in the brain and spine, but they rarely spread to other parts of the body. They invade and destroy healthy tissue. They lack distinct borders due to their tendency to send "roots" into nearby normal tissue. They can also shed cells that travel to distant parts of the brain and spine by way of the cerebrospinal fluid. Some malignant tumors, however, do remain localized to a region of the brain or spinal cord.

METASTATIC BRAIN TUMORS

Cancer cells that begin growing elsewhere in the body and then travel to the brain form metastatic brain tumors. For example, cancers of the lung, breast, colon and skin (melanoma) frequently spread to the brain. All metastatic brain tumors are, by definition, malignant.

All metastatic brain tumors are malignant since they begin as cancer elsewhere in the body.

TUMOR NAMES

Tumors are diagnosed and then named based on a classification system. Most centers now use the World Health Organization classification system for this purpose.

TUMOR GRADING

Tumors are graded to facilitate communication, to plan treatment, and to predict outcome. The grade of a tumor indicates its degree of malignancy. Grade is assigned based on the tumor's microscopic appearance using some or all of the following criteria:

- similarity to normal cells (atypia)
- rate of growth (mitotic index)
- indications of uncontrolled growth-dead tumor cells in the center of the tumor (necrosis)
- potential for invasion and/or spread (infiltration) based on whether or not it has a definitive margin (diffuse or focal)
- blood supply (vascularity)

Using the WHO (World Health Organization) grading system, grade I tumors are the least malignant and are usually associated with long-term survival. The tumors grow slowly, and have an almost normal appearance when viewed through a microscope. Surgery alone might be an effective treatment for this grade of tumor. Pilocytic astrocytoma, craniopharyngioma, and many tumors of neurons - for example, gangliocytoma and ganglioglioma - are examples of grade I tumors.

Grade II tumors are relatively slow growing but have a slightly abnormal microscopic appearance. Some can invade adjacent normal tissue and recur. Sometimes these tumors recur as a higher grade.

Grade III tumors are, by definition, malignant, although there is not always a sharp distinction between a grade II and a grade III tumor. The cells of a grade III tumor are actively reproducing abnormal cells and infiltrate adjacent normal brain tissue. These tumors tend to recur, often as a higher grade.

The most malignant tumors are given a grade of IV. They reproduce rapidly, can have a bizarre appearance when viewed under the microscope, and infiltrate widely. These tumors induce the formation of new blood vessels so they can maintain their rapid growth. They also have areas of dead cells in their center. Glioblastoma multiforme is the most common example of a grade IV tumor.

Tumors often contain several grades of cells. The highest or most malignant grade of cell determines the grade, even if most of the tumor is a lower grade.

Some tumors undergo change. A "benign" growth might become malignant. In some tumors, a lower-grade tumor might recur as a higher-grade tumor. Only rarely, after treatment, do higher-grade tumors become lower-grade.

All grading systems have inherent difficulties - they are not precise.

- criteria used to assign grades are subject to interpretation by each pathologist
- tumors are not uniform, and the sample examined might not be representative of the entire tumor.

CHANGE OF DIAGNOSIS

Your diagnosis and the name of your tumor might be changed. There are several factors that might cause the change in diagnosis:

- Inspecting only a small sample of the tumor, such as that obtained by a needle biopsy, might not be representative of the whole tumor.
- Tumors do not always remain static. They can undergo transformation, usually to a higher grade. If that occurs, the name and grade of the tumor might change. A grade III anaplastic/malignant astrocytoma could become a glioblastoma (also called a grade IV astrocytoma).
- You should also be aware that classification of brain tumors by the pathologist is a subjective procedure that is not always straightforward. Different pathologists might disagree about the classification, and grade, of the same tumor.

TUMOR STAGING (PRIMARY BRAIN TUMORS)

"Staging" determines if a tumor has spread beyond the site of its origin. In cancers such as breast, colon, or prostate this is primarily accomplished by a pathologist's examination of nearby tissue such as lymph nodes. In those cancers, staging is a basic part of the diagnostic work-up.

Staging for central nervous system (CNS) tumors is usually inferred from CT scan or MRI images, or by examining the cerebrospinal fluid. Scans taken after surgery are used to determine if there is remaining tumor. CNS tumors that are especially prone to spread are studied with both scan images and laboratory tests. For example, patients with medulloblastoma will often have their cerebrospinal fluid examined for the presence of tumor cells. Those patients will also have scans of their spinal cord because of that tumor's tendency to spread there.

Staging information often influences treatment recommendations and prognosis.

PROGNOSIS

Prognosis means prediction. It is an educated guess about the future course of a disease in a specific individual. Prognosis is based on the type of tumor, its grade, location, and spread (if any), the age of the patient, how long the patient had symptoms before the tumor was diagnosed, how much the tumor has affected the patient's ability to function, and the extent of surgery if surgery was performed.

The type of therapy is also instrumental. Certain tumors, although malignant, can be cured by radiation therapy or chemotherapy. Others, by virtue of their location, may ultimately be lethal in spite of their "benign" appearance under the microscope.

ABOUT "LESIONS"

"Lesion" is a general term which refers to any change in tissue. Tumor, inflammation, blood, infection, scar tissue, or necrosis (dead cells) are all examples of lesions that may be found in the brain. Determining the nature of the lesion is the work of the pathologist.

Source: http://www.abta.org