ANALYSIS OF PATTERNS OF CARE OF BRAIN TUMOR PATIENTS IN THE UNITED STATES: A Study of the Brain Tumor Section of the AANS and the CNS and the Commission on Cancer of the American College of Surgeons (ACS)

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In 1977, a federal government sponsored Survey of Intracranial Neoplasms was reported. That Survey sampled 213 short-term hospitals in the United States during the years 1971-1974. From these hospitals in 50 geographically defined areas, 25,429 cases of intracranial neoplasms were discovered, of which, 2,278 were abstracted. From this Survey, it was concluded that 35,000 intracranial neoplasms occurred in the United States per year (a rate of 16.7 per hundred thousand population) and that half of these cases were secondary tumors. Therefore, it was further concluded that 15,000 primary intracranial tumors occurred each year (a rate of 3.7 per hundred thousand population), with 7,800 primary malignant tumors per year (a rate of 3.7 per hundred thousand population).

This presentation is a report of a second national Survey conducted jointly by the Brain Tumor Section of the AANS and CNS and the Commission on Cancer of the ACS. This survey was conducted in 1986 with the help of hospital-based cancer committees and consisted of 543 hospitals and 4,954 patients involved in the long-term survey in the year 1980 and 646 hospitals and 6,629 patients involved in the short-term survey in 1985. The patients surveyed in 1980 constituted the data base for evaluation of five year outcome while patients from both the 1980 and 1985 data base were used to evaluate patterns of investigation and care as they might evolve over a five year period. The largest percentage (79.3%) of the hospital based cancer committees

were in non-governmental, not-for-profit hospitals. The percentage of hospitals with less than 300 beds, 300-499 beds, and greater than 500 beds was 31.4, 41.3, and 27.3 respectively. 98% of the hospitals surveyed were JCAH accredited, 76.5% had cancer programs, 58.6% had a medical school affiliation, and 28% were members of COTH.* Only 8% of the hospitals surveyed served population bases of less than 100,000, while three-quarters of the hospitals surveyed served population bases between 100,000 and 2.5 million.

Most of the analyses of these data related brain tumor patient characteristics to treatment and outcome. The most frequently encountered histological types were compared as regards mean age, sex incidence, and race incidence. The mean age for all (3,094) glioblastoma patients was 60.2 years and that for all (2,453) patients with meningioma, 59.1 years. The astrocytoma patients (2,975) had a mean age of only 47.2 years, and the medulloblastoma patients (248) had a mean age of 15 years. When age by decades was evaluated for the major histological types, the direct relationship of percent five year survival to youth was apparent, both for gliomas and meningiomas. Throughout most histological types, there was a male predominance with the male to female ratio being highest for patients with medulloblastoma. The exception were those patients with meningiomas where there was a 68.6% female incidence. Overall, a fewer percentage of blacks had brain tumors compared to caucasians, when compared to the population base within the United States. For the most common histological types, the percentage of blacks was highest for patients with meningioma (9.5%) and medulloblastoma (7.8%).

The most common presenting symptom for all patients included in both the 1980 and 1985 surveys was progressive neurological deficit (68%). This presenting symptom was most frequently seen with patients with glioblastoma (78%), and most frequently in patients with parietal lobe disease (75%). The most frequent presenting progressive deficit symptomatically was motor weakness (45%). Headache was the presenting symptom in 54% of the patients, most frequently seen in patients with germinomas, hemangioblastomas, ependymomas, or medulloblastomas (75 to 82% of these patients). The most frequent intracranial location of tumors in patients presenting with headache was the cerebellum (70%). Seizures occurred as a presenting complaint in only 26% of the patients, most frequently seen in patients who had the diagnosis of mixed glioma, oligodendroglioma, or ganglioglioma (54 to 58% of these patients). The most frequent intracranial location in patients presenting with headache was the frontal lobe (36%). A family history of cancer was obtained in 16 to 19% of patients with brain tumors (one third of the data were

*Council of Teaching Hospitals

missing in this analysis). The incidence of family history of cancer was highest for patients with glioblastoma or lymphoma (30 to 33%).

The use of neurodiagnostic studies was compared for patients diagnosed in 1980 and 1985. Over this five year period between the surveyed cases, there was a decrease in the use of angiography, electroencephalography, isotope brain scans, and skull radiography while there was a significant increase in the use of magnetic resonance imaging. CT scanning remained the most frequent study utilized in all patients (greater than 95%) and had the highest percent positive interpretation results (98%) for both years. These imaging studies identified multiple intracranial lesions in 8% of the cases, most frequently seen in cases of lymphoma (22 out of 135 such cases for an incidence of 16%). Extracranial lesions were identified in 3% of all brain tumor patients, being most frequently observed in neuroblastoma (3 out of 17), primitive polar spongioblastoma (9 out of 78), pineoloma (1 out of 9), malignant neurilemmoma (1 out of 9), and ependymoma (9 out of 128).

The most frequently observed intracranial location of tumors of various histological types was analyzed. For gliomas, the most frequent primary lobe in the brain was the frontal and the least frequent was the occipital. However, the five year survival was greatest for occipital lobe locations (25% for patients with anaplastic astrocytoma and 8% for glioblastoma) as compared to the parietal lobe percent five year survival of 15% for anaplastic astrocytoma and 2.9% for glioblastoma.

For all brain tumor cases, 98% underwent surgical intervention. As regards the type of surgery performed, biopsy only increased in frequency from 12.4% in 1980 to 15% in 1985 (most common in cases diagnosed as lymphoma), likely representing the increased interest in stereotactic surgery during that five year interval. Subtotal resections were conducted for 45 to 50% of cases, most commonly for patients with gliomas. Total resections occurred in 36 to 40% of the patients, most frequently for the histological types of hemangioblastoma and meningioma. A shunt of the cerebrospinal fluid was conducted in 5.5% of the patients, most commonly for patients with tumors in pineal or ventricular locations. Incidence of surgical complications was unchanged between 1980 and 1985. Anesthetic complications occurred in 0.2% of cases, post-operative hemorrhage at the operative site occurred in less than 5% of the cases, and increased neurological deficit during the first 24 hours postoperatively was present in approximately 10% of the cases. Wound infections occurred in less than 2% of all surveyed cases.

Radiotherapy was administered to 52% of all brain tumor cases, most frequently for those patients with a diagnosis of germinoma or medulloblastoma. 3% of meningioma patients were treated with radiotherapy as part of their initial management. Between the years 1980 and 1985, there was a decrease in the use of cobalt sources and an increase in the use of linear accelerator sources for radiotherapy. The incidence of the use of brachytherapy was 0.5% in 1980 and increased to 1.9% in 1985.

Chemotherapy was utilized in 13.8% of all the patients with the diagnosis of glioblastoma or anaplastic astrocytoma. For those patients with the diagnosis of anaplastic glioma or medulloblastoma, 863 (11.9%) received chemotherapy.

The functional status of the patients was evaluated in the form of Karnofsky functional ratings (these data were absent or unknown in approximately 10% of the analyzed cases). The initial Karnofsky rating at the time of diagnosis for patients with glioblastoma, astrocytoma, meningioma, and medulloblastoma was equal to or greater than 70 in 52.1%, 59.4%, 70.5%, and 60.5%, respectively. Five year actuarial survival rates correlated with initial Karnofsky rating for all patients in the major histological subtypes ($p = <0.001$). For instance, in patients with glioblastoma, the five year survival was 7.6% for the 641 patients with initial Karnofsky ratings equal to or greater than 70 while it was only 3.2% for the 509 patients whose initial Karnofksy rating was less than 70. For patients with meningioma, the five year survival was 94.6% for the 656 patients with initial Karnofsky ratings equal to or greater than 70 while it was 80.5% for the 179 patients whose initial Karnofsky rating was less than 70. This study made an attempt to evaluate Karnofsky functional ratings at the beginning and at the completion of initial primary therapy for the patients in the 1980 survey. For patients with glioblastoma, the Karnofsky functional rating was equal to or greater than 70 in 58% of the patients prior to surgery plus radiation therapy and had fallen to 42.1% at the time of completion of radiation therapy ($p = <0.001$). On the other hand, Karnofsky functional ratings remained essentially stable during the course of primary treatment for patients with medulloblastoma or meningioma.

The incidence of reoperation at the time of tumor recurrence was evaluated. For high grade gliomas, 14% were reoperated upon at the time of recurrence; this figure was 44% for ependymomas, 43% for oligodendrogliomas and 33% for other low grade gliomas. Reoperation at the time of recurrence was most frequently performed for patients with neurilemmomas (15 out of 20 cases, 75%) and patients with meningiomas (67 out of 159 cases, 45%).

Overall five year survival for all of the patients surveyed in 1980 was very much dependent upon initial histology. For glioblastoma patients overall, the five year survival was 5.5%, 18.2% for anaplastic astrocytoma, 32.5% for astrocytoma, 91.3% for meningioma and 60.4% for medulloblastoma. We were particularly interested in the extent of involvement by eligible patients in investigative therapy protocols and whether such involvement influenced five year per cent survival. The data suggests that approximately 5% of all patients become involved in investigational protocols which represents approximately 7.6% of the eligible patients with anaplastic gliomas. In this non-randomized and selective involvement of patients in investigative studies, those of the eligible population who did participate (111 patients) had a five year survival of 12% whereas those not participating (1070 patients) had a five year survival of 4.5%.

In conclusion, this study identified the three most commonly diagnosed primary brain tumors: glioblastoma, astrocytoma, and meningioma. For most cases, there was a caucausian and male predominance. For those patients with a diagnosis of glioblastoma, lymphoma, or neuroblastoma, there was a 30% incidence of a family history of cancer. Patients with brain tumor more often presented with progressive neurological deficit or headache as the initial symptomatology with a smaller percentage presenting with seizures. For patients with glioblastoma, there was a more favorable outcome if the tumor was located in the occipital lobe and the most unfavorable outcome occurred in parietal lobe locations. Also for glioblastoma patients, more extensive resections were carried out on younger patients who tended to have higher Karnofsky initial scores. Of particular interest was the fact that, for patients with glioblastoma, Karnofsky scores tended to decline following <u>initial</u> treatment with surgery and radiotherapy. The use of neurodiagnostic studies shifted between 1980 and 1985 towards a more increased use of magnetic resonance imaging and less frequent use of skull radiographs, angiography, and electroencephalography. As regards surgery, there was a shift toward an increased use of biopsy reflecting, in all likelihood, the emphasis upon stereotaxic biopsy techniques, between 1980 and 1985. Regardless of initial treatment, complications were relatively infrequent. There was a shift away from radiotherapy as initial management for childhood tumors and towards chemotherapy following surgery, probably reflecting the mounting concern about the effect of radiotherapy upon normal brain development particularly in very young children with brain tumor. Chemotherapy was received by 11.9% of patients with anaplastic gliomas or medulloblastoma. Investigative protocol participation occurred in only 7.6% of eligible patients. Some of these data analyses may differ from reports in the literature in the past from individual institutions or individual study

groups. On the other hand, these data, the authors feel, accurately reflect the patterns of care provided by personnel and facilities at a broad spectrum of geographic locations for patients in the United States with brain tumor diagnosed during the 1980's.

REFERENCE

Woolsey TD, and Eldredc CA. A summary report on the survey of intracranial neoplasms. Submitted to NINCDS by Westat, Inc., May, 1977.

TABLE 1

AGE AND SEX OF PATIENTS WITH PRIMARY BRAIN TUMORS -- 1980 AND 1985 PATIENTS

WHO HISTOL. CLASSIFICATION	TOTALS NO.	TOTALS %	AGE AT DIAGNOSIS MEAN	AGE AT DIAGNOSIS MEDIAN	MALES NO.	MALES %	FEMALES NO.	FEMALES %
GERMINOMA	27	0.2	19.8	17	19	73.1	7	26.9
HEMANGIOBLASTOMA	126	1.1	44.8	43	71	56.3	55	43.7
PINEALOMA/PINEOCYTOMA	11	0.1	23.6	23	7	63.6	4	36.4
PINEOBLASTOMA	5	0.0	18.4	8	4	80.0	1	20.0
CHORDOMA	17	0.2	43.0	49	6	35.3	11	64.7
MALIGNANT GLIOMA	255	2.3	50.5	57	148	58.3	106	41.7
MIXED GLIOMAS	144	1.3	41.4	41	87	60.4	57	39.6
SUBEPENDYMOMA	37	0.3	32.9	29	20	54.1	17	45.9
CHOROID PLEXUS PAPILLOMA	17	0.2	28.4	27	7	41.2	10	58.8
MALIGNANT CHOROID PLEXUS PAPILLOMA	8	0.1	25.0	2	6	75.0	2	25.0
EPENDYMOMA	137	1.2	27.5	25	85	62.0	52	38.0
ANAPL. EPENDYMOMA	21	0.2	18.7	21	12	57.1	9	42.9
ASTROCYTOMA	2975	26.6	47.2	50	1652	55.7	1316	44.3
PILOCYTIC ASTROCYTOMA	137	1.2	17.8	13	65	47.4	72	52.6
ANAPL. ASTROCYTOMA	310	2.8	49.7	54	171	55.5	137	44.5
GBM	3094	27.7	60.2	62	1699	55.1	1384	44.9
PRIMITIVE POLAR SPONGIOBLASTOMA	80	0.7	58.2	65	43	53.8	37	46.3
OLIGODENDROGLIOMA	234	2.1	42.2	43	139	59.7	94	40.3
MAL. OLIGODENDROGLIOMA	23	0.2	41.8	43	15	68.2	7	31.8
MEDULLOBLASTOMA	248	2.2	15.0	12	161	64.9	87	35.1
NEUROBLASTOMA	17	0.2	19.0	20	12	70.6	5	29.4
NEUROEPTHELIOMA	3	0.0	30.7	38	0	0	3	100.0
GANGLIOGLIOMA	35	0.3	29.1	25	19	54.3	16	45.7
MENINGIOMA	2453	21.9	59.1	61	770	31.4	1680	68.6
MAL. MENINGIOMA	133	1.2	58.0	59	53	39.8	80	60.2
HEMANGIOPERICYTOMA	91	0.8	53.3	54	43	47.8	47	52.2
NEURILEMMOMA	396	3.5	50.0	52	169	42.8	226	57.2
MAL. NEURILEMMOMA	11	0.1	49.5	49	4	35.4	7	63.6
MICROGLIOMA, LYMPHOMA	140	1.3	60.2	64	73	52.1	67	47.9

TABLE 2

5-YEAR SURVIVAL RATE (%)

AGE AT DIAGNOSIS

HISTOLOGY	<15 %	<15 (N)	15-24 %	15-24 (N)	25-34 %	25-34 (N)	35-44 %	35-44 (N)	45-54 %	45-54 (N)	55-64 %	55-64 (N)	65-74 %	65-74 (N)	75-84 %	75-84 (N)	85+ %	85+ (N)
GBM	12*	(16)	35*	(26)	23	(51)	14	(85)	7	(183)	3	(405)	0.8	(364)	0	(135)	0*	(8)
ASTRO-CYTOMA	77	(112)	77	(103)	56	(133)	49	(136)	17	(166)	10	(245)	5	(228)	4	(70)	17*	(6)
MENINGI-OMA	100*	(1)	100*	(7)	97*	(45)	96	(122)	93	(177)	94	(240)	91	(260)	71	(91)	67*	(9)
MEDULLO-BLASTOMA	62	(66)	56*	(18)	56*	(19)	67*	(6)	100*	(1)	100*	(1)	---		---		---	

* Sample size too small

TABLE 3
LOCATION OF PRIMARY BRAIN TUMORS -- 1980 AND 1985 PATIENTS

TUMOR LOCATION	SIDE							
	LEFT		RIGHT		MIDLINE		TOTAL*	
	No.	%	No.	%	No.	%	No.	%
SUPRATENTORIAL								
FRONTAL LOBE	1727	43.1	1880	46.9	402	10.0	4009	100.0
TEMPORAL LOBE	1371	47.4	1436	49.7	85	2.9	2892	100.0
PARIETAL LOBE	1653	46.2	1794	50.1	131	3.7	3578	100.0
OCCIPITAL LOBE	477	46.7	438	47.7	57	5.6	1022	100.0
INFRATENTORIAL								
CEREBELLUM	372	34.7	368	34.3	333	31.0	1073	100.0
BRAIN STEM	98	29.2	116	34.5	122	36.3	336	100.0
SPINAL CORD	14	23.7	8	13.6	37	62.7	59	100.0

*UNKNOWN SIDE EXCLUDED

TABLE 4

BRAIN LOCATIONS OF PRIMARY TUMORS

PRIMARY SITE	1980 NO.	1980 %	1985 NO.	1985 %
CEREBRUM	164	3.4	199	3.1
FRONTAL LOBE	1073	22.5	1478	23.0
TEMPORAL LOBE	737	15.5	921	14.4
PARIETAL LOBE	726	15.2	986	15.4
OCCIPITAL LOBE	160	3.4	191	3.0
VENTRICLE	141	3.0	164	2.6
CEREBELLUM	371	7.8	453	7.1
BRAIN STEM	45	0.9	86	1.3
OTHER PARTS OF BRAIN	418	8.8	640	10.0
BRAIN, NOS	115	2.4	152	2.4
CRANIAL NERVE	157	3.3	197	3.1
CEREBRAL MENINGES	592	12.4	879	13.7
SPINAL CORD	10	0.2	4	0.1
PINEAL GLAND	13	0.3	21	0.3
UNKNOWN/BLANKS (NOT REPORTED)	43	1.0	50	1.0
TOTAL	4764	100.0	6421	100.0

TABLE 5

FIVE YEAR ACTUARIAL SURVIVAL RATES BY PRIMARY SITE AND HISTOLOGY -- 1980 PATIENTS

PRIMARY SITE	ASTROCYTOMA NO.	ASTROCYTOMA % SURV.	ANAPL. ASTRO. NO.	ANAPL. ASTRO. % SURV.	GBM NO.	GBM % SURV.	MENINGIOMA NO.	MENINGIOMA % SURV.
FRONTAL LOBE	333	31.8	30*	14.6	338	6.1	153	92.3
TEMPORAL LOBE	239	29.4	17*	23.5	312	5.6	36*	87.1
PARIETAL LOBE	205	16.8	16*	15.0	323	2.9	60	90.4
OCCIPITAL LOBE	36	24.2	4*	25.0	62	8.3	26*	100.0
VENTRICLE	36	83.3	2*	0	12†	0	4*	100.0
CEREBELLUM	108	77.5	5*	50.0	8†	73.3	17*	89.5
MENINGES							533	91.5

*SAMPLE SIZE TOO SMALL

TABLE 6
RELATIVE FREQUENCY OF USE OF NEURODIAGNOSTIC STUDIES

NEURODIAGNOSTIC STUDY	1980		1985	
	% OF PATIENTS STUDIED	% WITH POSITIVE RESULTS	% OF PATIENTS STUDIED	% WITH POSITIVE RESULTS
ANGIOGRAPHY	65.8	92.2	53.6	86.8
CT BRAIN SCAN	95.6	98.0	96.6	98.5
CT SPINE SCAN	6.6	13.8	6.1	14.8
ELECTROENCEPH-ALOGRAPHY	36.8	72.5	26.9	66.1
ISOTOPE BRAIN SCAN	23.1	70.6	10.1	54.3
MYELOGRAPHY	6.1	18.1	5.8	11.9
MAGNETIC RESONANCE IMAGING	4.8	7.5	14.9	73.1
SKULL RADIOGRAPHY	37.6	33.2	17.3	30.2

TABLE 7
5 YEAR SURVIVAL BY HISTOLOGY AND CLINICAL STAGE
1980 PATIENTS

CLINICAL STAGE	HISTOLOGICAL CLASSIFICATION % (N)				
	ASTRO-CYTOMA	GBM	MEDULLO-BLASTOMA	MENIN-GIOMA	NEURI-LEMMOMA
G1	60.1 (48)	7.6 (49)	100.0 (2)	95.6 (98)	95.8 (25)
G2	59.2 (50)	12.5 (8)	0.0 (1)	100.0 (4)	100.0 (1)
G3	2.5 (52)	2.9 (39)	50.0 (4)	---- ----	---- ----
G4	21.9 (76)	4.5 (142)	50.0 (12)	---- ----	---- ----

TABLE 8

KARNOFSKY RATING* PRIOR TO ANY DEFINITIVE THERAPY

KARNOFSKY RATING	1980 NO.	1980 %	1985 NO.	1985 %
100	113	2.4	229	3.6
090	1018	21.4	1523	23.7
080	1132	23.8	1530	23.8
070	533	11.2	734	11.4
060	372	7.8	553	8.6
050	409	8.6	497	7.7
040	263	5.5	312	4.9
030	142	3.0	184	2.9
020	113	2.4	111	1.7
010	48	1.0	45	0.7
000	76	1.6	56	0.9
999 (Unknown)	389	8.2	482	7.5
Blanks (not reported)	156	3.3	165	2.6
TOTAL	4764	100.0	6421	100.0

*KARNOFSKY RATING

100 Normal: No complaints. No evidence of disease.
090 Able to carry on normal activity. Minor symptoms.
080 Normal activity with effort. Some symptoms.
070 Cares for self. Unable to carry on normal activity.
060 Requires occasional assistance. Cares for most needs.
050 Requires considerable assistance and frequent care.
040 Disabled. Requires considerable assistance and frequent care.
030 Severely disabled. Hospitalized, death not imminent.
020 Very sick. Active supportive treatment needed.
010 Moribund. Fatal processes are rapidly progressing.
999 Unknown

TABLE 9

INITIAL KARNOFSKY RATINGS--1980 AND 1985 PATIENTS

	<70 % (N)	>70 % (N)	UNKNOWN % (N)	TOTAL N
GLIOBLASTOMA	38.4 (1188)	52.1 (1612)	9.5 (294)	3094
ASTROCYTOMA	29.8 (888)	59.4 (1766)	10.8 (321)	2975
MENINGIOMA	18.8 (460)	70.5 (1729)	10.8 (264)	2453
MEDULLOBLASTOMA	23.8 (59)	60.5 (150)	15.7 (39)	248
NEURILEMMOMA	10.4 (41)	78.5 (311)	11.1 (44)	396

TABLE 10

PRIMARY SITE BY KARNOFSKY RATING FOR GLIOBLASTOMAS

PRIMARY SITE	KARNOFSKY RATING, % (N)			
	< 70	≥ 70	UNKNOWN	TOTAL
FRONTAL LOBE	38.5 (318)	52.0 (429)	9.5 (78)	100.0 (825)
TEMPORAL LOBE	36.4 (260)	55.3 (395)	8.3 (59)	100.0 (714)
PARIETAL LOBE	39.4 (303)	52.5 (404)	8.1 (62)	100.0 (769)
OCCIPITAL LOBE	24.7 (37)	59.3 (89)	16.0 (24)	100.0 (150)

TABLE 11

RELATIONSHIP OF AGE AND HISTOLOGY TO INITIAL KARNOFSKY RATING--1980 AND 1985 PATIE

KARNOFSKY <70

	GLIOBLASTOMA		ASTROCYTOMA		MENINGIOMA	
AGE	NO.	%	NO.	%	NO.	%
15	10	32.3	79	23.5	1	10.0
16-35	21	15.5	115	17.6	19	14.7
36-55	184	30.7	203	26.2	75	11.4
56-75	794	54.7	493	45.4	257	22.3
75+	176	63.1	116	66.3	107	46.3

	MEDULLOBLASTOMA		ALL CASES	
AGE	NO.	%	NO.	%
15	82	29.2	178	26.2
16-35	50	15.8	220	16.2
35-55	72	24.7	578	22.4
56-75	103	38.6	1736	37.9
75+	27	62.8	466	58.8

TABLE 12
KARNOFSKY RATINGS AT START AND COMPLETION OF PRIMARY THERAPY
1980 PATIENTS

TREATMENT	GBM >70				MEDULLO. >70				MENINGIOMA >70			
	START		COMP.		START		COMP.		START		COMP.	
	%	(N)	%	(N)	%	(N)	%	(N)	%	(N)	%	(N)
SURGERY	45.5	(153)	24.1	(52)	70.0	(11)	61.5	(8)	78.3	(602)	74.0	(481)
SURGERY & RADIOTHERAPY	58.0	(288)	42.1	(153)	69.9	(40)	72.0	(36)	95.0	(17)	100.0	(13)
SURGERY, RADIOTHERAPY & CHEMOTHERAPY	64.8	(172)	47.1	(105)	75.0	(14)	61.5	(8)				

TABLE 13

FIVE YEAR ACTUARIAL SURVIVAL RATES BY HISTOLOGY AND KARNOFSKY -- 1980 PATIENTS

	KARNOFSKY RATING PRIOR TO TREATMENT			
	<70		>70	
HISTOLOGY	NO.	%	NO.	%
GLIOBLASTOMA	509	3.2	641	7.6
ASTROCYTOMA	397	17.7	682	42.6
MENINGIOMA	179	80.5	656	94.6
MEDULLOBLASTOMA*	26	49.0	66	65.3

*Sample size too small

TABLE 14
5-YEAR SURVIVAL RATES (%)
TYPE OF SURGERY

HISTOLOGY	BIOPSY %	(N)	Sub-total Resection %	(N)	Total Resection %	(N)	Shunt %	(N)	Sub-total & Shunt %	(N)	Total Resection & Shunt %	(N)
GBM	3	(134)	5	(809)	8	(230)	-	-	28*	(8)	-	-
ASTROCYTOMA	23	(218)	27	(638)	52	(195)	35*	(17)	61*	(42)	93*	(17)
MENINGIOMA	63*	(11)	78	(161)	96	(696)	50*	(2)	65*	(9)	76*	(10)
MEDULLOBLASTOMA	50*	(2)	48*	(51)	77*	(22)	33*	(3)	88*	(18)	57*	(7)

*Sample size too small

TABLE 15

SURGICAL COMPLICATIONS

	1980		1985	
	NO.	%	NO.	%
ANESTHETIC PROBLEM	11	0.2	20	0.2
HEMORRHAGE AT OP SITE	193	4.2	305	4.8
INCREASED NEURO. DEFICIT (FIRST 24 HOURS)	528	11.4	685	10.8
WOUND INFECTION	76	1.6	99	1.6

TABLE 16

RADIATION THERAPY COMPLICATIONS FOR VARIOUS TUMOR TYPES

COMPLICATIONS	GBM NO.	GBM %	ASTRO. NO.	ASTRO. %	MEDULLO. NO.	MEDULLO. %
LOOD CYTOPENIA	16	0.7	10	0.5	22	10.9
PIDERMAL REACTION REQUIRING TREATMENT	111	5.1	78	4.2	3	1.5
ROWTH RETARDATION	15	0.7	10	0.5	3	1.5
EUROLOGICAL WORSENING	262	12.0	176	9.4	8	4.0
OR INTELLECTUAL UNCTION	134	6.1	60	3.2	3	1.5
USEA REQUIRING REATMENT	68	3.1	69	3.7	20	10.0

TABLE 17

FIVE YEAR PERCENT
ACTUARIAL SURVIVAL RATES BY HISTOLOGY--1980 SERIES

WHO HISTOLOGICAL CLASSIFICATION	NO. PATIENTS	SURV. %
GERMINOMA	10	67.7*
HEMANGIOBLASTOMA	58	92.6
PINEALOMA/PINEOCYTOMA	4	35.7*
PINEOBLASTOMA	2	50.0*
CHORDOMA	5	100.0*
MALIGNANT GLIOMA	118	21.0
MIXED GLIOMAS	58	64.4*
SUBEPENDYMOMA	20	79.2*
CHOROID PLEXUS PAPILLOMA	8	87.5*
MALIGNANT CHOROID PLEXUS PAPILLOMA	4	50.0*
EPENDYMOMA	60	49.5*
ANAPL. EPENDYMOMA	6	30.0*
ASTROCYTOMA	1289	32.5
PILOCYTIC ASTROCYTOMA	64	77.7
ANAPL. ASTROCYTOMA	94	18.2
GBM	1276	5.5
PRIMITIVE POLAR SPONGIOBLASTOMA	35	7.3
OLIGODENDROGLIOMA	91	60.6
MAL. OLIGODENDROGLIOMA	7	34.6*
MEDULLOBLASTOMA	112	60.4
NEUROBLASTOMA	5	75.0*
NEUROEPTHELIOMA	1	100.0*
GANGLIOGLIOMA	19	72.7*
MENINGIOMA	955	91.3
MAL. MENINGIOMA	38	60.7*
HEMANGIOPERICYTOMA	53	82.5*
NEURILEMMOMA	161	96.3
MAL. NEURILEMMOMA	4	75.0*
MICROGLIOMA, LYMPHOMA	52	21.4

*Sample Size Too Small (Too Much Variation in the Estimates)

TABLE 18
NEUROSCIENCE PERSONNEL

	HOSPITAL BED SIZE					
	<300		300-499		≥500	
	No. PTS	%	No. PTS	%	No. PTS	%
UROSURG.						
NO	35	2.1	23	0.6	2	0.0
YES	1624	97.9	3608	99.4	4804	100.0
	1659		3631		4806	
UROL.						
NO	26	1.6	63	1.7	2	0
YES	1630	98.4	3547	98.3	4803	100.0
	1656		3610		4805	
URORAD.						
NO	1075	65.6	1884	53.1	1181	25.2
YES	563	34.4	1662	46.9	3510	74.8
	1638		3546		4691	
UROANEST.						
NO	1294	81.2	2771	79.9	1737	38.9
YES	300	18.8	695	20.1	2732	61.1
	1594		3466		4469	
URO-OPH.						
NO	1286	79.0	2630	75.1	1696	37.4
YES	341	21.0	872	24.9	2842	62.6
	1627		3502		4538	
UROPATH.						
NO	1382	85.1	2508	70.7	2133	45.4
YES	242	14.9	1038	29.3	2562	54.6
	1624		3546		4695	

TABLE 19

OTHER PERSONNEL

	HOSPITAL BED SIZE					
	<300		300-499		>500	
	No.	PTS	%	No.	PTS	%	No.	PTS	%
NEUROSCIENCE TRAINED RN'S									
WARD									
NO	734		47.7	1304		37.6	549		11.6
YES	806		52.3	2162		62.4	4191		88.4
	1540			3466			4740		
OP. ROOM									
NO	600		37.5	1200		34.1	294		6.2
YES	1001		62.5	2315		65.9	4431		93.8
	1601			3515			4725		
MED. ONCOL.									
NO	41		2.5	5		0.1	4		0.1
YES	1618		97.5	3630		99.9	4803		99.9
	1659			3635			4807		
RADIOL.									
NO	12		0.7	1		0	17		0.4
YES	1629		99.3	3630		100	4789		99.6
	1641			3631			4806		
ENDO.									
NO	202		12.2	250		6.9	64		1.3
YES	1455		87.8	3377		93.1	4742		98.7
	1657			3627			4806		
OTOLARY.									
NO	71		4.3	8		0.2	50		1.0
YES	1572		95.7	3623		99.8	4729		99.0
	1643			3631			4779		

TABLE 20
NEUROSURGERY FACILITIES

	HOSPITAL BED SIZE					
	<300		300-499		≥500	
	No.PTS	%	No.PTS	%	No.PTS	%
N-PT. BEDS (#)						
0	1039	66.6	1546	46.2	538	12.1
1-19	213	13.6	607	18.2	574	12.9
20-39	209	13.4	979	29.3	2248	50.7
>40	100	6.4	212	6.3	1076	24.1
	1561		3344		4436	
P. ROOMS (#)						
0	980	59.8	1760	51.4	869	19.4
1-5	608	37.1	1583	46.2	3466	77.4
>5	51	3.1	80	2.4	144	3.2
	1639		3423		4479	
NEURO ICU BEDS (#)						
0	1138	72.9	2116	63.5	1487	33.6
1-9	311	19.9	917	27.5	1953	44.1
10-19	60	3.8	174	5.2	878	19.8
>20	52	3.4	126	3.8	114	2.6
	1561		3333		4432	
EC. ROOM						
NO	1519	92.3	3209	90.1	3764	80.1
YES	126	7.7	351	9.9	937	19.9
	1645		3560		4701	
ORD						
NO	1252	75.7	1958	54.8	1202	25.4
YES	401	24.3	1612	45.2	3539	74.6
	1653		3570		4741	

TABLE 21
NEUROSCIENCE FACILITIES

	HOSPITAL BED SIZE					
	<300		300-499		≥500	
	NO. PTS	%	NO. PTS	%	NO. PTS	%
ANGIO.						
NO	39	2.3	8	0.2	0	0
YES	1624	97.7	3635	99.8	4806	100
	1663		3643		4806	
CT SCAN						
NO	42	2.5	0	0	0	0
YES	1621	97.5	3643	100	4806	100
	1663		3643		4806	
EEG						
NO	42	2.5	26	0.7	0	0
YES	1621	97.5	3612	99.3	4806	100
	1663		3638		4806	
NUCL. SCAN						
NO	43	2.6	20	0.6	0	0
YES	1614	97.4	3606	99.4	4806	100
	1657		3626		4806	
MRI SCAN						
NO	994	59.9	2111	58.4	1675	35.0
YES	666	40.1	1502	41.6	3104	65.0
	1660		3613		4779	
ULTRASO.						
NO	34	2.0	9	0.2	1	0
YES	1629	98.0	3634	99.8	4806	100
	1663		3643		4807	
EMG/NCV/SSEP						
NO	540	35.1	606	18.8	357	8.1
YES	999	64.9	2611	81.2	4029	91.9
	1539		3217		4386	

TABLE 22
THERAPY FACILITIES

	HOSPITAL BED SIZE					
	<300		300-499		>500	
	NO.PTS.	%	NO.PTS.	%	NO.PTS.	%
GA. RADIORX						
NO	800	48.1	854	23.7	324	6.8
YES	863	51.9	2751	76.3	4443	93.2
	1663		3605		4767	
. RES. UNIT						
NO	1430	86.3	2775	79.0	2543	55.0
YES	227	13.7	737	21.0	2081	45.0
	1657		3512		4624	
. EXP. PROT.						
NO	1072	69.0	2061	61.7	1986	45.0
YES	481	31.0	1279	38.3	2429	55.0
	1553		3340		4415	

TABLE 23

RESIDENCY TRAINING PROGRAMS

	HOSPITAL BED SIZE					
	<300		300-499		≥500	
	No. PTS	%	No. PTS	%	No. PTS	%
N. SURG.						
NO	1546	93.3	3041	85.0	2511	52.7
YES	111	6.7	536	15.0	2258	47.3
	1657		3577		4769	
MED. ONCOL.						
NO	1414	85.1	2719	75.5	2299	48.4
YES	248	14.9	882	24.5	2448	51.6
	1662		3601		4747	
RAD. ONCOL.						
NO	1627	97.8	2995	83.2	2821	59.1
YES	36	2.2	606	16.8	1949	40.9
	1663		3601		4770	