Analysis of Surgically Treated Intraspinal Tumors in Southern Taiwan

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The medical records of 117 patients with spinal tumors who underwent surgery with pathologic confirmation from January 1999 to April 2004 at Kaohsiung Medical University Hospital were reviewed. Data from this review were compared with those obtained from the same institution 10 years earlier (covering the period 1988–1995) and from other reported series. There were 69 male and 48 female patients aged from 13 to 87 years old (mean age, 51.9). The most common pathologic findings were metastasis in 45.3% (53/117), nerve sheath tumors in 28.2% (33/117), meningiomas in 12% (14/117) and neuroepithelial tumors in 6% (7/117). The peak ages at diagnosis were 41–50 years and 61–70 years. A slight male predominance was noted for all tumors, except meningiomas. Motor weakness, even paralysis, was the major clinical presentation (64–86%), followed by sensory deficits (50%) and pain (42%). The location of tumors was most often in the thoracic (50.4%; 59/117), lumbosacral (27.4%; 32/117) and cervical spine (22.2%; 26/117) segments. Among the metastatic tumors, the lung (22.6%) and breast (15.1%) were the most common primary sites of origin, followed by unknown origin, the liver (hepatocellular carcinoma), the gastrointestinal tract and the nasopharynx (nasopharyngeal cancer).

Key Words: intraspinal tumor, spinal metastasis, statistics, Taiwan
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In 1997, we presented an analysis of intraspinal tumors in south Taiwan [1]. In total, 120 cases of intraspinal tumors diagnosed and surgically treated at Kaohsiung Medical College Hospital between 1988 and 1995 were assessed, and the results were compared with those from other series. This previous study showed that the four most common histologic types of spinal tumors were nerve sheath tumors (40%), metastatic tumors (23.3%), meningiomas (11.7%) and neuroepithelial tumors (8.3%).

The next decade was marked by improved availability and quality of noninvasive imaging modalities, especially magnetic resonance imaging (MRI), which has facilitated diagnosis and management [2]. Because the age of the patient population in Taiwan is increasing rapidly [3], the epidemiology of spinal tumors may change. The purpose of this survey was to assess spinal tumor occurrence in Taiwan during a recent 5-year period and compare this assessment with the one we reported in 1997, and with those of other reported series.

Materials and Methods

The medical histories of 117 consecutive patients who were surgically treated for intraspinal tumors between January 1999 and April 2004 in the Department of

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Neurosurgery of Kaohsiung Medical University Hospital were reviewed. Basic personal profiles, topography and anatomic location of the tumors, histologic classification, and primary site of metastatic tumor origin were obtained from the clinical records. The data were compared with data from our previous report in 1997, and also with data from the series reported by Shih, Lin and Changchien in Taiwan [4,5], Chi and Khang [6] and Suh et al [7] in Korea, Cheng [8] and Huang [9] in China, and Ardehali in Iran [10].

Results

There were 69 male and 48 female patients aged from 13 to 87 years old (mean, 51.9 years). The relative frequencies of the 117 intraspinal tumors are given in Table 1. The pathologic findings (in the order of most to least frequent) revealed metastatic tumors in 45.3% (53/117), nerve sheath tumors in 28.2% (33/117), meningiomas in 12% (14/117), neuroepithelial tumors in 6% (7/117) and others (Table 2).

Table 1. Histologic classification, sex distribution, number of cases and relative incidence of 117 intraspinal tumors

	Male	Female	*n* (%)
Metastasis	35	18	53 (45.3)
Nerve sheath tumor	21	12	33 (28.2)
Meningioma	3	11	14 (12.0)
Ependymoma	4	2	6 (5.1)
Epidermal cyst	1	2	3 (2.6)
Lipoma	0	1	1 (0.9)
Multiple myeloma	1	0	1 (0.9)
Hemangioma	1	0	1 (0.9)
Astrocytoma	1	0	1 (0.9)
Chordoma	0	1	1 (0.9)
Fibrous histiocytoma	1	0	1 (0.9)
Tendosheath fibroma	1	0	1 (0.9)
Glomangioma	0	1	1 (0.9)
Total	69	48	117 (100)

A slight male predominance was noted for all tumors (overall male/female ratio of 69/48 = 1.44:1), except for meningiomas which had an M/F ratio of 3/11 (1:3.6).

Peak frequencies of spinal tumors occurred in two age groups: 41–50 years old (23.1%) and 61–70 years old (19.7%) (Table 3). The average age of the patients at the time of surgery was 51.9 years old (48.1 in females and 53.8 in males). Only 2.6% (3/117) of spinal tumors occurred in persons under 20 years of age. Histologic results revealed ependymoma, epidermal cyst and thoracic spinal seeding of cerebellar medulloblastoma.

Tumors were most often located in the thoracic (50.4%; 59/117), lumbosacral (27.4%; 32/117) and cervical spine (22.2%; 26/117) segments (Table 4). Metastatic tumors were the most frequent histologic finding in the cervical segment (42.3%; 11/26) and thoracic segment (47.5%; 28/59). In the lumbosacral segment, the two most frequent histologic findings were metastatic tumor (43.8%; 14/32) and nerve sheath tumor (40.6%; 13/32). Meningiomas tended to be found in the thoracic spine (71.4%; 10/14).

Most intraspinal tumors occurred in the extradural (ED) space (51.3%; 60/117) or the intradural–extramedullary (ID–EM) space (38.5%, 45/117)

Table 3. Incidence of 117 intraspinal tumors according to age and sex

Age (yr)	Male	Female	Cases, *n* (%)
1–10			
11–20	2	1	3 (2.6)
21–30	2	2	4 (3.4)
31–40	12	11	23 (19.7)
41–50	15	12	27 (23.1)
51–60	12	9	21 (17.9)
61–70	13	10	23 (19.7)
71–80	11	3	14 (12.0)
>80	2	0	2 (1.7)
Total	69	48	117 (100)

Table 2. Clinical presentation and relationship with major pathologic classifications

	Pain (%)	Sensory deficit (%)	Weakness (%)	Paralysis (%)	Cases (%)
All intraspinal tumors	37.5	44.6	55.4	16.1	100
Metastasis	29.6	33.3	44.4	33.3	45.3
Nerve sheath tumor	62.5	43.8	43.8		28.2
Meningioma	18.2	72.7	90.9		12.0
Neuroepithelial tumor	50.0		75.0		6.0

Table 4. Distribution of spinal tumors by segmental location and pathology classification

	C	T	LS	Cases, *n* (%)
Metastasis	11	28	14	53 (45.3)
Nerve sheath tumor	7	13	13	33 (28.2)
Meningioma	2	10	2	14 (12.0)
Ependymoma	2	4	0	6 (5.1)
Epidermal cyst	1	2	0	3 (2.6)
Others	3	2	3	8 (6.8)
Total	26 (22.2%)	59 (50.4%)	32 (27.4%)	117 (100)

C = cervical; T = thoracic; LS = lumbosacral.

Table 5. Incidence of 117 spinal tumors according to sites

	ED	ED+ID	IDEM	IM	Cases, *n* (%)
Metastasis	52		1		53 (45.3)
Nerve sheath tumor	2	2	29		33 (28.2)
Meningioma			14		14 (12.0)
Ependymoma				6	6 (5.1)
Epidermal cyst				3	3 (2.6)
Others	6		1	1	8 (6.8)
Total	60 (51.3%)	2 (1.7%)	45 (38.5%)	10 (8.5%)	117 (100)

ED = extradural; ID = intradural; IDEM = intradural–extramedullary; IM = intramedullary.

(Table 5). The most common ED tumors were metastatic tumors (86.7%; 52/60). Nerve sheath tumors (64.4%; 29/45) and meningiomas (31.1%, 14/45) were the most commonly found ID–EM tumors. Intramedullary (IM) tumors accounted for 8.5% (10/117). Neuroepithelial tumors, including ependymoma and astrocytoma, were the most common IM tumors (70%; 7/10). In only two cases (1.6%) did tumors occur in both the ED and ID spaces, and both of these were neurilemmomas.

In this series, there were 53 cases with metastatic tumors. The most often involved segment was the thoracic spine (52.8%; 28/53). The most common primary sites of origin for metastasized spinal tumors were lung (22.6%, 12/53) and breast (15.1%; 8/53) (Table 6), with unknown primary cancers accounting for 15.1% (8/53), and hepatic cell carcinoma (HCC), gastrointestinal tract cancer, nasopharyngeal cancer, thyroid cancer, and others accounting for the rest.

A comparison of the histologic classification, number of cases and relative incidence of intraspinal tumors in other reports is shown in Table 7. In our series, metastatic tumors have become the most common spinal lesions rather than nerve sheath tumors. The distribution of the histologic classification in this series was similar to that reported by Ardehali in Iran [10].

Table 6. Metastatic tumors and their primary sites

Site of primary tumor	Cases, *n* (%)
Lung	12 (22.6)
Breast	8 (15.1)
Unknown	8 (15.1)
Hepatocellular carcinoma	6 (11.3)
Gastrointestinal tract	6 (11.3)
Nasopharyngeal cancer	3 (5.7)
Thyroid	2 (3.8)
Ureter	2 (3.8)
Kidney	2 (3.8)
Sarcoma	2 (3.8)
Lymphoma	1 (1.9)
Skin SCC	1 (1.9)
Total	53 (100)

SCC = squamous cell carcinoma.

Nerve sheath tumors were the main intraspinal tumor surgically treated in Korea and China [6–9].

Discussion

The anatomic and gender distribution of spinal tumors found in this study are similar to those in our previous study and other reported series [1,7,11–14]. However,

Table 7. Histologic classification, number of cases and relative incidence of spinal tumors in comparison to other reports

Country	Taiwan	Taiwan	Taiwan	Korea	Iran	China
Author	Su	Cheang	Shih	Suh	Ardehali	Huang
Reference	This study	1	4	7	10	9
Year	2004	1997	1978	2002	1990	1982
Cases, *n*	117	120	277	151	179	2,355
Metastasis	45.3	23.2	17.3	4.6	39.6	4.6
Nerve sheath tumor	28.2	40.0	40.3	37.1	24.5	47.1
Meningioma	12.0	11.7	11.5	23.8	20.1	14.0
Neuroepithelial tumor	6.0	9.2	4.0	17.2	10.0	10.8

several important changes have taken place during the recent 5-year period.

First, metastatic tumors have become the most common spinal lesions, rather than nerve sheath tumors. The frequency of metastatic tumors is clearly increasing, especially in Taiwan (see Table 7) [1,5,15]. This may be the result of increased availability and improved quality of noninvasive imaging modalities, especially MRI [2]. A much lower incidence of metastatic tumors was noted in Korea [6,7], Japan and China. Some epidemiologic surveys have tried to assess the trends in central nervous system tumor occurrence over time, and the differences in their incidence. However, these surveys vary in their uniformity of case definition and ascertainment or in study methodologies [6,16,17].

Second, since our 1997 report [1], the age distribution of patients with spinal tumors has changed by a decade. The average age at diagnosis and surgery has increased (44.4 *vs.* 51.9 years). This may be a result of advances in technology and care, aging of the population, and the trend toward more aggressive treatment of older patients in recent years. Male patients were older than female patients (53.8 *vs.* 48.1 years). This is the opposite of our 1997 result (40.2 *vs.* 49.3 years). In the present study, more than half of the intraspinal tumors occurred between age 30 and 60 years (60.7%). There were two peak ages: 41–50 and 61–70 years old. Since the 1997 report, the percentage of patients aged >60 years old has increased (20% *vs.* 33.4%). Both this and our previous study showed that, most commonly, intraspinal tumors in patients aged >60 years old are metastatic.

Third, the two most common primary sites of metastatic spinal tumor origin were lung and breast, followed by unknown origin, HCC, gastrointestinal tract, and nasopharynx. Lung and breast were also reported to be the most common primary sites of origin in industrialized countries [18–21]. However, it has also been suggested that the incidence of spinal epidural metastases depends on the incidence of the primary tumor [22]. Our results reflect the fact that the incidence of HCC and nasopharyngeal cancer is higher in Taiwan than other industrialized countries. With improvements in cancer diagnosis and management, metastatic cancers of unknown origin became less frequent and fell to third place among metastatic cancers, compared with our data in 1997 (Table 7).

Finally, motor weakness and even paralysis were diagnosed in a high percentage of patients (Table 2), especially in patients with metastatic tumors (77.7%) and meningiomas (90.9%). MRI and computed tomography remain the two most useful tools for diagnosis and management. Sagittal T1-weighted MRI of the entire spine is a rapid and sensitive screening test that can be performed at modest cost [22].

Although epidemiologic surveys of the occurrence of central nervous system tumors to determine trends over time are difficult to carry out, we assessed the occurrence of intraspinal tumors during a recent 5-year period and compared it with a similar assessment at the same institute in 1997. Anatomic and gender distributions were similar between studies. Changes in the relative frequencies of histologic classification, primary site of metastatic tumor origin, and age distribution at diagnosis were demonstrated.

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REFERENCES

1. Cheang CM, Hwang SL, Hwong SL. An analysis of intraspinal tumors in south Taiwan. *Kaohsiung J Med Sci* 1997;13:229–36.
2. Jordan JE, Donaldson SS, Enzmann DR. Cost effectiveness and outcome assessment of magnetic resonance imaging in diagnosing cord compression. *Cancer* 1995; 75:2579–86.
3. Chow LP. Need for health policy in Taiwan: can lessons be learned from the U.S. experience? *Kaohsiung J Med Sci* 1989;5:600–9.
4. Wu CC. Spinal cord tumor. In: *Chinese Contemporary Textbook of Surgery (Lin TU), Vol. 3, Brain, Neurosurgery (Chun-Jen Shih)*. Taipei: The Commercial Press, 1990: 567–601. [In Chinese]
5. Changchien Y. Spinal cord tumor. *J Formos Med Assoc* 1964;63:477–87.
6. Chi JG, Khang SK. Central nervous system tumors among Koreans—a statistical study on 697 cases. *J Korean Med Sci* 1989;4:77–90.
7. Suh YL, Koo H, Kim TS, et al. Tumors of the central nervous system in Korea: a multicenter study of 3221 cases. *J Neurooncol* 2002;56:251–9.
8. Cheng MK. Spinal cord tumors in the People's Republic of China: a statistical review. *Neurosurgery* 1982;10:22–4.
9. Huang WQ. Pathological analysis of 1,872 cases of tumors of the nervous system. *Zhonghua Nei Ke Za Zhi* 1982;21:482–5.
10. Ardehali MR. Relative incidence of spinal canal tumors. *Clin Neurol Neurosurg* 1990;92:237–43.
11. Abdel-Wahab M, Etuk B, Palermo J, et al. Spinal cord gliomas: a multi-institutional retrospective analysis. *Int J Radiat Oncol Biol Phys* 2006;64:1060–71.
12. Surawicz TS, McCarthy BJ, Kupelian V, et al. Descriptive epidemiology of primary brain and CNS tumors: results from the Central Brain Tumor Registry of the United States, 1990–1994. *Neuro-oncol* 1999;1:14–25.
13. Jinnai T, Koyama T. Clinical characteristics of spinal nerve sheath tumors: analysis of 149 cases. *Neurosurgery* 2005;56:510–5.
14. Conti P, Pansini G, Mouchaty H, et al. Spinal neurinomas: retrospective analysis and long-term outcome of 179 consecutively operated cases and review of the literature. *Surg Neurol* 2004;61:34–43.
15. Kepes JJ, Chen WY, Pang LC, Kepes M. Tumors of the central nervous system in Taiwan, Republic of China. *Surg Neurol* 1984;22:149–56.
16. Lantos PL, Vandenberg SR, Kleihues P. Tumors of the nervous system. In: Graham DI, Lantos PL, eds. *Greenfield's Neuropathology*, 6th edition. New York: Oxford University Press, 1997:584–6.
17. Davis FG, Preston-Martin S. Epidemiology. In: Bigner DD, Mclendon RE, Brunner JM, eds. *Russell and Rubinstein's Pathology of Tumors of the Nervous System*, 6th edition. London: Arnold, 1998:5–45.
18. Klimo P Jr, Thompson CJ, Kestle JR, Schmidt MH. A meta-analysis of surgery versus conventional radiotherapy for the treatment of metastatic spinal epidural disease. *Neuro-oncol* 2005;7:64–76.
19. Chamberlain MC, Kormanik PA. Epidural spinal cord compression: a single institution's retrospective experience. *Neuro-oncol* 1999;1:120–3.
20. Godersky JC, Smoker WR, Knutzon R. Use of magnetic resonance imaging in the evaluation of metastatic spinal disease. *Neurosurgery* 1987;21:676–80.
21. Rodichok LD, Ruckdeschel JC, Harper GR, et al. Early detection and treatment of spinal epidural metastases: the role of myelography. *Ann Neurol* 1986;20: 696–702.
22. Prasad D, Schiff D. Malignant spinal-cord compression. *Lancet Oncol* 2005;6:15–24.

高雄醫學大學近五年脊椎脊髓腫瘤之分析

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本研究分析 1999 年 1 月至 2004 年 4 月期間在高雄醫學大學附設中和紀念院神經外科接受手術的 117 例脊椎腫瘤的流行病學特性。並與我們於 1997 年所發表的統計資料比較。脊椎脊髓腫瘤的病理分類依發生率為轉移性腫瘤 (45.3%)，神經細胞膜腫瘤 (28.2%)，脊膜瘤 (12%)，神經膠瘤 (6%) 等。脊椎脊髓腫瘤的男性病患較多，但脊膜瘤以女性為主。年齡為 13－87 歲，平均的年齡為 51.9 歲。好發的年齡層為 30－70 歲，以 41－50 及 61－70 歲者有較高的比率。脊椎脊髓腫瘤所佔脊椎位置主要胸椎 (50.4%)，依次為腰薦椎 (27.4%) 及頸椎 (22.2%)。解剖位置上，脊膜外 (51.3%) 與脊膜內脊髓外 (38.5%) 佔多數。脊膜外腫瘤主要是轉移性腫瘤，脊膜內脊髓外腫瘤則是神經細胞膜腫瘤及脊膜瘤。轉移性腫瘤的來源最多的是肺癌及乳癌。來源不明的轉移性腫瘤仍佔有 15.1%。與 1997 年的統計資料比較，轉移性腫瘤的比率超越神經細胞膜腫瘤。平均年齡由 44.4 歲增為 51.9 歲。肺癌及乳癌雙雙增加成為轉移性腫瘤最常見的來源。

關鍵詞：脊椎脊髓腫瘤，轉移性腫瘤，統計分析，台灣
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