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Metastatic carcinoma of the spine

A Study of 92 cases

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Summary. *In a retrospective study of 172 patients with disseminated carcinoma in the skeleton, 54% were shown by radiography and scintigraphy to have vertebral metastases. Breast carcinoma was the most common primary tumour, occurring in 30% of the patients, followed by lung (17%), prostate (10%) and kidney (9%). The lumbar spine was most often involved and some primary carcinomas showed a predilection for particular spinal segments. Cord compression occurred in 30% of the patients with vertebral spread and was a poor prognostic sign for long-term survival. Hypernephroma was the most common tumour to cause spinal cord involvement. The thoracic segment was the most frequent site of cord compression (43%), and pathological fracture-dislocation was the most common cause (50%).*

Résumé. *Une étude rétrospective portant sur 172 patients atteints de métastases osseuses carcinomateuses montre que 54% d'entre eux ont des métastases vertèbrales décelées à la radiographie et à la scintigraphie. Parmi celles-ci, le carcinome mammaire est la tumeur primitive la plus fréquente (30%), suivi par le cancer du poumon (17%), de la prostate (10%) et du rein (9%). La distribution segmentaire des métastases vertèbrales montre que la colonne lombaire est la plus fréquemment atteinte, et qu'il existe une affinité métastatique sélective de certains carcinomes pour des segments vertèbraux particuliers. L'apparition d'un syndrôme de compression médullaire, qui survient dans 30% des cas de dissémination vertèbrale, assombrit significativement le pronostic des ces malades. L'hypernéphrome a une propension marquée à entraîner une compression neurologique (4/8). C'est le segment dorsal qui est le plus exposé à la compression médullaire, secondaire dans 50% des cas à une fracture-luxation du corps vertèbral.*

Key words: *Carcinoma, Cord compression, Metastases, Spine*

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Introduction

Within the skeleton, the spine is the most frequent site for metastatic carcinoma [3, 4, 11, 12]. Autopsy findings have indicated that 70% of patients with skeletal metastatic carcinoma have vertebral deposits [7, 1]. In most series, breast, prostate, lung and renal carcinoma are the most common tumours to disseminate to the spine, but their respective vertebral distribution has not been clearly defined. Recent improvements in the treatment of disseminated cancer have modified attitudes towards the surgical management of spinal metastases. Therefore, it seemed appropriate to reassess the general profile of metastatic carcinoma in the spine, and to describe the pattern of spinal dissemination in various types of primary carcinoma.

Material and methods

Records of 172 patients with clinical, radiological and scintigraphic evidence of skeletal carcinoma, who were treated between 1965 and 1985 at the Department of Orthopaedics of the University of Zürich, were reviewed with particular attention to spinal lesions. Melanoma, lymphoma and sarcoma were not included. In the 92 cases (54%) with spinal metastases which form the basis of this investigation, the histological diagnosis

of the primary tumour was known except in 11 patients where the origin remained undetected. Fifty-three patients had a biopsy of the spinal lesion and the findings were consistent with the known primary carcinoma. The extent of spinal dissemination was assessed by scintigraphy and computerized tomography. Myelograms were undertaken when there was a neurological deficit.

Results

The average age of the 92 patients at initial presentation was 57 years, with an equal proportion of males and females.

The sites of the primary carcinoma in cases of spinal and extra-spinal metastases are shown in Fig. 1. The breast was the primary site in 28 of the 92 patients (30%), followed in frequency by lung (17, 18%), prostate (12, 13%) and kidney (8, 9%). Other tumours included thyroid (3), gastro-intestinal tract (9) and genital tract (4). In 38 cases (41%), the primary carcinoma was not known when vertebral metastases were first diagnosed, and remained undetected in 11 of them. In patients without spinal involvement the distribution of the primary carcinoma was similar, except that lung cancer occurred less than half as often. Patients with spinal metastases had a mean survival time of 14 months, significantly less than patients without spinal dissemination (30,4 months, $P < 0.02$).

The vertebral distribution of metastases within the spine is shown in Fig. 2. The lumbar spine was involved in 52 of the 92 patients (56%), followed by the thoracic segment (43%), the cervical segment (25%), and the sacrum (13%). Multiple involvement was common. The metastatic deposits had a predilection for the segmental junctions. The vertebral body of T12 had the highest metastatic rate in the whole spine and the lumbar segment had the highest metastatic mass. There was an overall increasing frequency of dissemination from cranial to caudal. The segmental distribution of spinal metastases from various carcinomas is shown in Table 1. The majority of primary carcinoma disseminated preferentially to the lumbar spine, except for kidney which showed a striking predilection for the thoracic spine (62%). Lung cancer had the highest metastatic rate to the lumbosacral segment (15 of the 17 cases, 88%), followed by breast, gastro-intestinal tract and prostate.

The distribution of origin of the spinal metastases within each segment of the spine is shown in Fig. 3. In the cervical segment, breast was the most common primary tumour. Kidney and lung cancer were mostly found in the thoracic spine and the lumbar spine respectively, whereas metas-

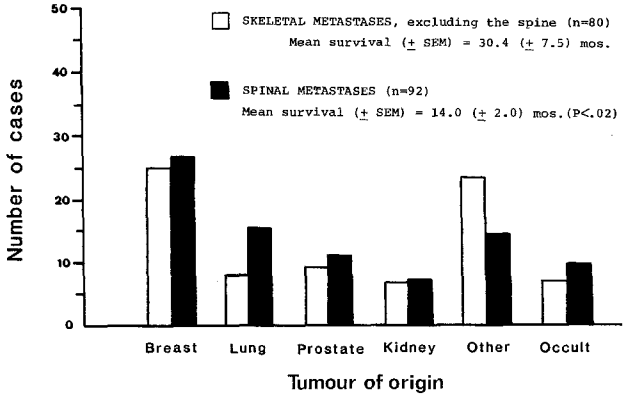

Fig. 1. Frequency distribution of the primary carcinomas with skeletal metastases

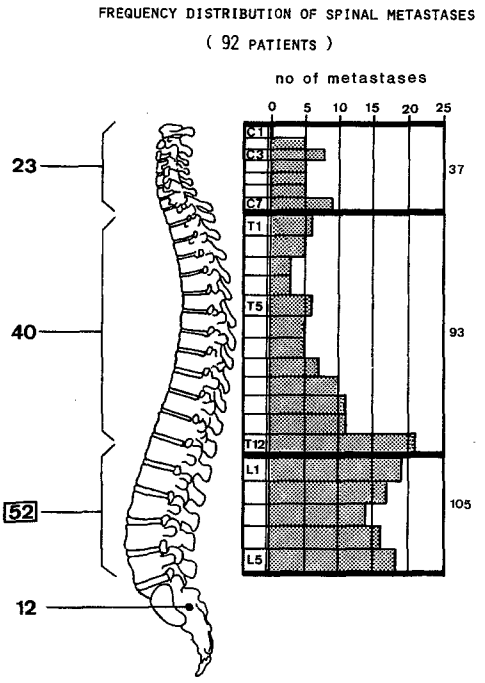

Fig. 2. Frequency distribution of spinal metastases (92 patients)

Table 1. Segmental distribution of spinal metastases from primary carcinoma (74 cases). PC = primary carcinoma

PC (no. of cases)		No. segments involved	C-SPINE no.	%	T-SPINE no.	%	LS-SPINE no.	%
BREAST	(28)	52	14	50	15	54	23	82
LUNG	(17)	24	3	18	6	35	15	88
PROSTATE	(12)	18	3	25	7	58	8	67
KIDNEY	(8)	9	1	12	5	62	3	37
GI	(9)	14	2	22	5	56	7	78

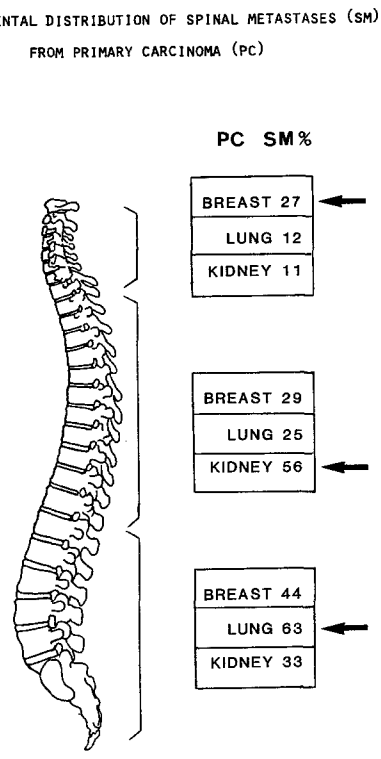

Fig. 3. Segmental distribution of spinal metastases (SM) from primary carcinoma (PC)

Table 2. Causes of cord compression

– Pressure due to pathological fracture-dislocation:	50%
– Pressure due to enlarging extradural deposit:	39%
– Spinal angulation following vertebral collapse:	11%
– Intradural metastases:	0%

tases of breast cancer had a greater tendency to spread to the whole spine.

A neurological deficit occurred in 28 cases (30%) and was a poor prognostic sign for long-term survival. The mean survival of patients with bone metastases in this group was 7.0 ± 3.7 months, and was significantly shorter compared to the patients without a neurological deficit (14.3 ± 13.7 months, $P < 0.01$). Hypernephroma was the most common tumour (4/8) to cause spinal cord involvement which correlates well with the strong tendency for the thoracic spine to be the site of cord compression (43%) in this study. Pressure due to pathological fracture-dislocation was the most frequent cause of cord compression occurring in 50% of the cases (Table 2). Intradural metastases, which are rare, were not found in the present series.

Discussion

Several factors contribute to the high incidence of metastatic deposits in the vertebral column. Secondary spread to the spine occurs mainly via the blood stream. The vertebral venous system, consisting of valveless veins running parallel to the vertebral column, forms extensive anastomoses with the venous channels of the chest wall, the pelvis and the thorax. Functional venous connections with the vertebral system have been demonstrated for the prostatic venous plexus and the breast [2]. Similarly, the thyroid drains partly into the vertebral system by virtue of tracheo-oesophageal anastomoses. It has been estimated that under physiological conditions, 5–10% of the blood derived from the organs of the caval and portal systems drains into the vertebral venous plexus, which functions as an intercaval shunt [15]. Retrograde blood flow in these venous anastomoses is likely to occur during Valsalva manoeuvres [2], thereby facilitating the seeding of tumour microemboli in the vertebral body. Although this theory is supported by experimental studies with animals [8], there is currently no evidence which suggests a similar mechanism in man.

It has been postulated that red marrow, mostly contained in the axial skeleton, provides a favourable environment for the establishment of metastatic cells. Intrinsic properties of the marrow vessel walls, as well as interactions between tumour cells and bone marrow cells in terms of differential adherence, are among the factors advanced to explain the enhanced susceptibility of bone marrow to metastatic growth [6, 13]. Further evidence to support the role of red marrow in secondary deposition is found in the increasing metastatic gradient from the cervical to the lumbar segments, correlating with the topographical distribution of bone and bone marrow mass in the spine [4, 20].

Some primary carcinomas seem to have a predilection for particular segments of the spine, kidney for the thoracic, lung for the lumbar and breast for the cervical segment. Although particular haemodynamic and anatomical aspects of the vascular supply to the spine must influence this selective pattern of spread, it cannot fully predict metastatic distribution within the spine.

Like numerous other authors [1, 14, 16, 17, 18] we found that the thoracic segment was the commonest site for cord compression in the present study. According to Tarlov [19] and Dommisse [10], the thoracic spine is the most vulnerable by virtue of the anatomical arrangement of its vascular supply and the narrowness of the spinal canal,

especially from T4 to T9, the so-called "critical vascular zone of the spinal cord". However, injection studies by Louis [15] and Crock et al. [9] have demonstrated that the thoracic spine receives a well-developed regular segmental arterial supply, which does not support the concept of a limited blood supply, as previously reported. Biomechanical studies have shown that the load distribution within the spine places the thoracic vertebral bodies at high risk of fracture, particularly at the apex of the thoracic kyphosis and at the thoracolumbar area. Clinical support for this concept is found in the high frequency of wedge fractures of the thoracic segment in osteoporotic patients [20].

It therefore seems that biomechanical rather than vascular factors determine the likelihood that thoracic spinal metastases may cause cord compression. In such cases early surgical stabilization is warranted, in order to prevent spontaneous progression of these lesions toward vertebral collapse and neurological impairment.

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