Survival after surgery for spinal and extremity metastases

Prognostication in 241 patients

Henrik C F Bauer and Rikard Wedin

We assessed the survival after surgery in 153 patients with extremity metastases and 88 with spinal metastases. The survival rate for the whole series of 241 patients was 0.30 at 1 year, 0.15 at 2, and 0.08 at 3 years. The 1-year survival rate was the same for the extremity metastases group and the spinal group. Univariate analysis showed that 1-year survival was related to metastatic load, site of primary tumor, and presence of pathologic fracture. Multivariate regression analysis showed that pathologic fracture, visceral or brain metastases, and lung cancer were negative prognostic variables. Solitary skeletal metastases, breast and kidney cancer, myeloma, and lymphoma were positive variables. A prognostication model based on these variables stratified the patients into 3 groups with a 1-year survival ranging from 0.5 to 0.0. These prognostic variables can be used for differentiating the treatment of cancer patients with pathologic fracture or epidural compression.

Tumor Service, Department of Orthopedics, Karolinska Hospital, S-104 01 Stockholm, Sweden
Tel +46 8-7292671. Fax -7294699
Submitted 94-06-25. Accepted 95-01-10

The aim of orthopedic treatment of metastatic bone disease is to ensure painless function during the remaining lifespan of the patient. There are individual patients who survive several years after pathologic fracture. In these patients, local radical surgery and reconstruction is often indicated to reduce the risk of local failure. Hence, the assessment of the prognosis for the individual patient is important for the choice of surgical treatment.

We identified clinical features related to survival after surgical treatment of patients with spinal and extremity metastases. These features were used to create a prognostication model for cancer patients with pathologic fracture.

Patients and methods

The study was based on two consecutive, prospective series of cancer patients from the Stockholm region treated surgically at our institution for bone metastases. The first series comprised 153 patients with extremity metastases treated since 1986 and the second series 88 patients with spinal metastases treated since 1990. In patients treated for more than one metastasis, survival was assessed from the time of the first procedure. 6 patients treated for both spinal and extremity metastases were included in both groups in the study. Myeloma was regarded as a metastatic bone disease. There were more patients in the extremity metastases group than in the spinal group who had visceral or brain metastases besides the skeletal metastases (Table 1). There were also more women in the extremity group, since breast cancer predominated in this group, as opposed to prostate cancer in the spinal metastases group.

The commonest locations for extremity metastases were the femur (107) and the humerus (34). Indications for surgical treatment of extremity metastases were patent (90) or imminent (63) pathologic fracture or persistent pain, despite radiotherapy.

The spinal metastases were cervical (3), thoracic (57) and lumbar (28). Indications for surgery were neurologic compromise (76) and/or pain due to epidural compression. All patients were treated with posterior decompression and stabilization, except 4 who had anterior procedures.

Statistics

All patients were followed until July, 1994, or until death, except for one patient who moved abroad and was lost to follow-up. Comparison of clinical features between the extremity and spinal groups was performed with chi-square tests or Wilcoxon's rank sum test. Survival rates 1 year after surgery were determined with Kaplan-Meier analysis. Survival of different subgroups were compared with the Mantel-Haenzel test. Cox regression analysis was used to

Table 1. Clinical features

	Extremity	Spinal
Number of patients	153	88
Sex		
men	60	57
women	93	31
Age at surgery, median (range)	63 (23–85)	63 (23–85)
Pathologic fracture		
no	63	43
yes	90	45
History of cancer[1]		
no	33	18
yes	120	71
Metastatic load		
solitary skeletal	24	14
multiple skeletal	65	57
visceral/brain	64	17
Site of primary tumor		
breast	52	14
prostate	18	29
kidney	22	8
myeloma	14	5
lung	12	6
melanoma	8	4
genito-urinary	6	5
sarcoma	7	2
other	12	8
unknown	2	9
Lag time yrs[2]		
median (maximum)	3.6 (16)	2.8 (20)

[1] Patients who present with pathologic fracture or epidural compression at diagnosis.
[2] Time between diagnosis of primary tumor and surgical treatment of bone metastases. Patients without a history of cancer excluded.

Table 2. 1-year survival rate based on clinical features[1]

	Extremity	Spinal	All	p[2]
Sex				
male	0.30	0.21	0.28	
female	0.32	0.31	0.32	
Age at surgery				
≤ 65	0.30	0.29	0.30	
> 65	0.33	0.21	0.30	
Pathologic fracture				
no	0.36	0.27	0.33	0.04
yes	0.28	0.25	0.27	
History of cancer				
no	0.41	0.36	0.39	
yes	0.29	0.24	0.27	
Metastatic load				
solitary skeletal	0.55	0.54	0.54	0.0001
multiple skeletal	0.36	0.28	0.33	
visceral/brain	0.17	0.00	0.14	
Site of primary tumor				
myeloma	0.62	–	0.58	0.0001
kidney	0.48	–	0.36	
breast	0.28	0.48	0.32	
prostate	0.18	0.20	0.20	
lung	0.00	–	0.06	
Lag time yrs[3]				
< 3 years	0.32	0.09	0.24	
≥ 3 years	0.27	0.38	0.30	

[1] Only subgroups of at least 10 patients were assessed.
[2] Statistical analysis based on all patients.
[3] Patients without history of cancer excluded.

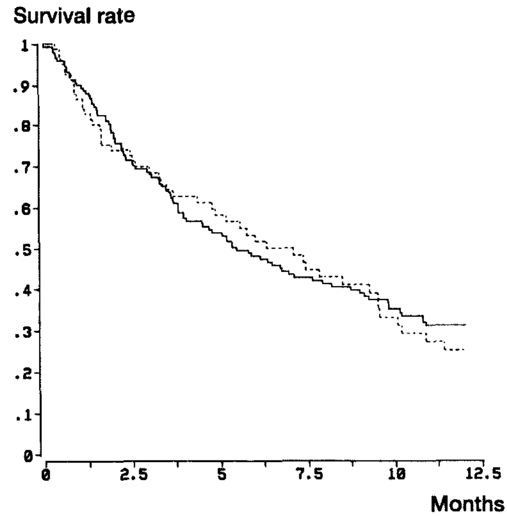

Figure 1. Survival after surgery. There were 40 patients in the extremity group (solid line) and 12 in the spinal (dashed line) alive at 1 year, p 0.6.

assess the prognostic influence of different clinical features on 1-year survival.

Results

The survival rate for the whole series of 241 patients was 0.3 at 1 year, 0.15 at 2, and 0.08 at 3 years. The 1-year survival rate was 0.31 for the extremity metastases group and 0.25 for the spinal (Figure 1). 6 patients in the extremity group and 3 in the spinal died within 2 weeks of surgery.

Univariate analysis showed that the 1-year survival was related to the metastatic load of the patients, site of the primary tumor, and presence of a pathologic fracture (Table 2). Hence, the survival rate was highest for patients who only had a solitary skeletal metastasis and lowest for those who also had visceral or brain metastases. Patients with kidney and breast cancer, myeloma, and lymphoma had the highest chance of surviving 1 year and those with primary lung cancer the lowest. Patent pathologic fracture was related to lower survival compared to patients without fracture. This impact of fracture was evident in the extremity group only. A long interval between diagnosis of the primary tumor and surgery was associated with a better survival rate in the spinal, but not in the extremity group. Otherwise, the survival rates based on different clinical features were fairly equal for patients with spinal and extremity metastases.

Table 3. Cox regression analysis of clinical features associated with 1-year survival

	Coefficient	SD	p
Negative features			
Patent pathologic fracture	0.43	0.18	0.02
Visceral/brain metastases	0.76	0.19	0.0001
Primary lung cancer	0.81	0.29	0.005
Positive features			
Solitary skeletal metastasis	–0.58	0.29	0.02
Myeloma/lymphoma	–0.66	0.36	0.07
Kidney cancer	–0.68	0.28	0.01
Breast cancer	–0.57	0.21	0.006

Multivariate regression analysis of survival was based on the clinical features proven prognostic for survival on univariate analysis. The analysis showed that pathologic fracture, visceral or brain metastases, and lung cancer were negative prognostic variables for 1-year survival. Solitary skeletal metastasis, breast and kidney cancer, myeloma, and lymphoma were positive variables (Table 3).

Since the prognostic variables carried approximately equal weight, 3 subgroups of patients were created based on the following 5 positive criteria for survival: (1) absence of visceral metastases, (2) absence of pathologic fracture, (3) solitary skeletal metastasis, (4) not primary lung cancer, and (5) primary tumor breast, kidney, lymphoma or myeloma. The most favorable prognostic group, fulfilling 4–5 criteria had a 1-year survival rate of 0.5, the intermediate group with 2–3 criteria had a rate of 0.25, whereas all patients with 0–1 criterion died within 6 months of surgery (Figure 2).

Discussion

The vast majority of the patients in this study had advanced metastatic disease. For example, the median survival with a diagnosis of skeletal metastases in prostate cancer is reported to be 2 years, but the figure was only 5 months after surgery for pathologic fracture or epidural compression (Ernst et al. 1991, Yamashita et al. 1993). Hence, pathologic fracture occurs in the end-stage of the malignant disease and is evidence that oncologic treatment is failing. Important exceptions, notably kidney cancer and myeloma, are associated with a good chance of surviving more than 1 year after pathologic fracture (Niederle et al. 1986, Coleman and Rubens 1987, Yazawa et al. 1990, Smith et al. 1992). Furthermore, breast cancer confined to the skeleton appears to be associated with a favorable prognosis (Sherry et al. 1986).

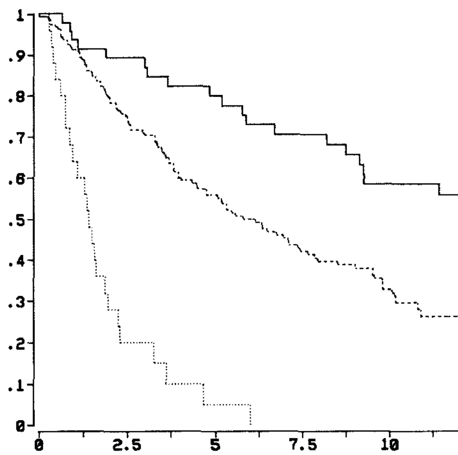

Figure 2. Survival in relation to prognostic criteria identified by Cox regression analysis. There were 28 patients with 0–1 criteria (dotted line), 164 with 2–3 (dashed line), and 49 patients with all 4–5 criteria (solid line).

The selection of patients for surgical treatment of bone metastases will influence survival rates. The 1-year survival of 0.3 reported here is about equal to other series of surgically-treated extremity or spinal metastases patients (Harrington et al. 1976, Bono et al. 1991, Habermann et al. 1992, Kocialkowski and Webb 1992). However, Harrington (1988) reported that 55 of 77 patients operated for spinal metastases survived 1 year. There were considerably more multiple myelomas, lymphomas and breast cancer patients in his series compared to ours which explains the difference. The vast majority of his patients were treated with anterior decompression which precludes extensive spinal involvement or poor general health. In our series, patients with pathologic fracture or neurologic deficit were accepted for surgery, unless they were obviously terminal.

An important implication of the equal survival times for spinal and extremity metastases is that metastatic site is not of major importance when deciding whether or not to operate. The obvious surgical indication for a pathologic fracture of the femoral neck also applies to a pathologic fracture of the thoracic spine with neurologic compromise.

Survival was poor for all patients who had visceral or brain metastases. Patent pathologic fracture was associated with a poor survival in extremity patients, but not in spinal Habermann et al. 1992). The age of the patient did not influence survival and should not be used to decide whether surgical treatment of patients with skeletal metastases should be done.

Since primary tumor and metastatic load but not skeletal site, govern survival the two patient series, i.e., extremity and spinal metastases, could be combined for prognostic analysis. Prognostication based on site of primary tumor, metastatic load and pathologic fracture showed that survival was closely related to the number of prognostic variables present. We did not assess survival for different histologic subtypes of primary tumors, e.g., squamous cell carcinoma, adenocarcinoma or small cell carcinoma of the lung, since the number of patients in each subgroup would be too small for comparison. Nor did we account for oncologic treatment, since the vast majority had advanced cancer in whom no further specific oncologic treatment was possible. The high survival rates reported for certain types of primary tumors reflect the natural course of the disease, e.g., kidney cancer, and/or effective treatment, e.g., myeloma. Close cooperation with oncologists is mandatory in the preoperative evaluation of cancer patients with a pathologic fracture or epidural metastases.

The rate of local failure after surgery for skeletal metastases increases with time. Failures are due to either local tumor recurrence or implant failure or both and appear equally in extremities and in the spine (Yazawa et al. 1990, King et al. 1991). The failure rate may be reduced by performing local en bloc excisions and reconstructions instead of curettage and stabilization. However, only patients with a long expected survival should be candidates for more extensive metastatic surgery. The prognostication model presented may be applied to select patients for wide surgery and reconstruction. Although survival will not be improved by radical resections of solitary metastases, the morbidity associated with local failures can be reduced. Life expectancy should be taken into account along with other factors when deciding to perform prophylactic stabilization (Keene et al. 1986, Mirels 1989). Prophylactic stabilization may not be indicated in patients with little chance of surviving even a couple of months.

References

Bono B, Cazzaniga P, Pini V, Zurrida S M, Sagnolo R, Torelli L, Corona C, Bono A. Palliative surgery of metastatic bone disease: a review of 83 cases. Eur J Cancer 1991; 27 (5): 556–8.

Coleman R E, Rubens R D. The clinical course of bone metastases from breast cancer. Br J Cancer 1987; 55: 61–6.

Ernst D S, Hanson J, Venner P M. Analysis of prognostic factors in men with metastatic prostate cancer. Uro-Oncology Group of Northern Alberta. J Urol 1991; 146: 372–6.

Habermann E T, Sachs R, Stern R E, Hirsh D M, Anderson W J Jr. The pathology and treatment of metastatic disease of the femur. Clin Orthop 1982; 169: 70–81.

Harrington K. Anterior decompression and stabilization of the spine as a treatment for vertebral collapse and spinal cord compression from metastatic malignancy. Clin Orthop 1988; 233: 177–97.

Harrington K D, Sim F H, Enis J E, et al. Methylmethacrylate as an adjunct in internal fixation of pathologic fractures: experience with 375 cases. J Bone Joint Surg (Am) 1976; 58: 1047–55.

Keene J S, Sellinger D S, McBeath A A, Engber W D. Metastatic breast cancer in the femur: a search for the lesion at risk of fracture. Clin Orthop. 1986; 203: 282–8.

King G J, Kostuik J P, McBroom R J, Richardson W. Surgical management of metastatic renal carcinoma of the spine. Spine 1991; 16: 265–71.

Kocialkowski A, Webb J. Metastatic spinal tumors: survival after surgery. Eur Spine J 1992; 1: 43–8.

Mirels H. Metastatic disease in long bones: a proposed scoring system for diagnosing impending pathologic fractures. Clin Orthop. 1989; 249: 256–64.

Niederle B, Roka R, Schemper M, Fritsch A, Weissel M, Ramach W. Surgical treatment of distant metastases in differentiated thyroid cancer: indication and results. Surgery 1986; 100: 1088–97.

Sherry M M, Greco F A, Johnson D H, Hainsworth J D. Metastatic breast cancer confined to the skeletal system. An indolent disease. Am J Med 1986; 81: 381–6.

Smith E M, Kursh E D, Makley J, Resnick M I. Treatment of osseous metastases secondary to renal cell carcinoma. J Urol 1992; 148: 784–7.

Yamashita K, Denno K, Ueda T, et al. Prognostic significance of bone metastases in patients with metastatic prostate cancer. Cancer 1993; 71: 1297–302.

Yazawa Y, Frassica F J, Chao E Y S, Pritchar D J, Sim F H, Shives T C. Metastatic bone disease: A study of the surgical treatment of 166 pathologic humeral and femoral fractures. Clin Orthop 1990; 251: 213–9.