Radiotherapy in bone metastasis : the Dutch bone metastasis study

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Prediction of survival in patients with metastases the spinal column

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Abstract

Background: Adequate prediction of survival is important in deciding on treatment for patients with symptomatic spinal metastases. The authors reviewed 342 patients with painful spinal metastases without neurological impairment who were treated conservatively within a large, prospectively randomized radiotherapy trial. Response to radiotherapy and prognostic factors for survival were studied.

Methods: The database of the Dutch Bone Metastasis Study was used. Response to treatment and prognostic factors for overall survival (OS) were studied using a Cox regression model. A scoring system was developed to predict OS.

Results: Responses were noted in 73% of patients. In 3% of patients, spinal cord compression was reported a mean of 3.5 months after randomization. The median OS was 7 months, and significant predictors for survival were Karnofsky Performance Score, primary tumor (multivariate analysis, both P< 0.001), and the absence of visceral metastases (multivariate analysis, P= 0.02). A scoring system based on these predictors was developed: 34% of patients were in group A (median OS= 3.0 months), 48% of patients were in group B (median OS= 9.0 months), and 18% of patients were in group C (median OS= 18.7 months). Group C was comprised of patients with breast cancer, a good performance, and no visceral metastases.

Conclusions: Most patients with spinal metastases have a limited life expectancy and should be treated with caution regarding surgical procedures. Radiotherapy is a safe and effective, non-invasive treatment modality for pain. The new scoring system will enable physicians to select patients who may survive long enough to benefit from more radical treatment.

Introduction

Patients with cancer frequently develop bone metastases in the spinal column. Back pain is often the sole symptom reported; however, when the tumor mass or bone fragments compress the spinal cord or nerve roots, concomitant neurological symptoms may occur. In general, the prognosis of a patient with a disseminated cancer is limited, and treatment should be directed towards optimal palliation with minimal treatment-related morbidity. [1-4] Generally, radiotherapy is the first choice of treatment, although a surgical intervention is sometimes needed. In 1986, Harrington developed a strategy for the treatment of metastases in the spine.[1] He divided patients into 5 classes depending on the extent of neurological compromise or bone destruction *(Table 1)*. Primary radiotherapy was recommended for Classes I-III, and primary surgical intervention for Classes IV and V. Harrington noted that secondary surgery should be considered in patients with pain or neurological symptoms that were refractory to radiotherapy, or when spinal cord tolerance to radiation had been reached. [1,4] Several surgical techniques have been developed, ranging from minimal invasive methods, such as palliative decompression by laminectomy, to extensive procedures, such as radical en-bloc resection. The choice of a surgical technique depends on expected survival, treatment-related morbidity, and outcome after treatment. In general, the more extensive the surgical technique, the more prolonged the palliative effect. [1] However, Harrington commented that many patients with vertebral collapse or instability, even if they were associated with severe local compromise, did not have a sufficient projected life expectancy to warrant such major operative interventions. Adequate prediction of survival, therefore, is crucial.

We studied a large group of 342 conservatively treated patients with Harrington' Class I and II painful spinal metastases who received radiotherapy within the prospectively randomized Dutch Bone Metastasis Study on the value of a single dose of 8 grays (Gy) versus 24 Gy in 6 fractions. [5,6] We analyzed response to radiotherapy and prognostic factors for survival, and we developed a scoring system to use as a guideline for the treatment of patients with Harrington' Class I and II spinal metastases.

Materials and Method

Patient selection and follow-up

Details of the patient population and study design for the Dutch Bone Metastasis Study (DBMS) have been published elsewhere. [5,6] In short, between March 1996 and September 1998, 1157 Dutch patients with painful bone metastases

from solid tumors were randomized between a group that received a single fraction of 8 Gy (n= 579) and a group that received 6 fractions of 4 Gy (n= 578). Purpose of the study was to prove the equal effectiveness of a single fraction versus multiple fractions; endpoint of the study was response to pain. To be eligible for the study, patients had to have a maximum pain score during the preceding week of at least 2 on an 11-point pain scale ranging from 0 (no pain) to 10 (worst imaginable pain). The bone metastases had to be confi ned to an area that could be encompassed in a single radiation treatment fi eld. Patients were excluded from the study if their metastases already had been irradiated, if they had metastases in the cervical spine, or if they had a pathological fracture or compression of the spinal cord (only Harrington' Class I and II lesions were included). Patients were also excluded if they had renal cell car cinoma or malignant melanoma, because it was expected that these diseases would respond differently to radiotherapy. The Medical Ethics Committees of all participating institutions approved the study, and all patients signed informed consent forms. After randomization, intensive follow-up with 13 weekly questionnaires and, afterwards, monthly questionnaires on pain, treatment side effects, [7] quality of life, and analgesic consumption was carried out to a maximum of two years or until death. Data managers in the participating hospitals collected data on all events, such as death, retreatment and occurrence of a fracture or spinal cord compression. In December 1998, the follow up on survival and events of all patients was updated and the study was closed (maximum follow-up, 32 months). For the present study, all 342 patients with a spinal metastasis were selected, which included 30% of all randomized patients.

Statistical analyses

The database was analyzed using SPSS 11.0 for Windows (SPSS Inc., Chicago, IL, USA). Response to radiotherapy was calculated in alignment with the Bone Metastases Consensus Working Party Guidelines. [8] The Kaplan-Meier method was used for survival analyses. The following patient characteristics were studied for their prognostic value for predicting survival: Karnofsky Per formance Score,[9] primary tumor, visceral involvement, solitary versus multiple bone metastases, and response to radiotherapy. The Cox proportional hazards model was used for univariate and multivariate analyses. A scoring system for prediction of survival was developed based on the results of the multivariate analyses, using Karnofsky Performance Score, primary tumor and visceral involvement as prognostic factors. The points allocated for each entered variable were derived from the hazard ratios from the univariate analyses. The scores were added together to produce a prognostic score. All reported P-values are based on two-sided tests with P< 0.05 taken to be signifi cant.

TABLE 1 HARRINGTON' CLASSIFICATION[a] OF METASTASES TO THE SPINAL COLUMN

Class I	no signifi cant neurological involvement
Class II	involvement of bone without collapse or instability
Class III	major neurological impairment (sensory or motor) without signifi cant involvement of bone
Class IV	vertebral collapse with pain due to mechanical causes or instability but without signifi cant neurological compromise
Class V	vertebral collapse with pain due to mechanical causes or instability combined with major neurological impairment.

[a] *Harrington KD. Orthopedic surgical management of skeletal complications of malignancy. Cancer 1997; 80(8 Suppl.):1614-1627*

Results

Patient characteristics, response to treatment and follow-up

Of the 342 trial patients with a spinal metastasis, 53% were male, and 47% were female. Most patients had breast cancer (42%), prostate cancer (24%), or lung cancer (21%). Thirteen percent had tumors located at other sites (3% colorectal, 2% bladder, 1% esophagus, 3% other sites, and 4% unknown primary). At the time of randomization, 60% of the patients presented with more than one bone metastasis. The mean patient age at randomization was 66 years (range 34-90 years). The mean Karnofsky Performance Score was 70. Forty-eight percent of patients were randomized to receive a single fraction of 8 Gy, and 52% were randomized to receive 24 Gy in 6 fractions.

For all patients, the median overall survival was 7 months (mean overall survival, 11 months, 95% CI 10-12 months). At the end of the study period, 75% of the patients had died.

After treatment, 73% of patients responded with lesser pain, with no differences in response between the single fraction and the multiple fraction regimen (P= 0.52). Toxicity 1 month after radiotherapy was scored in approximately 78% of the patients with a spinal metastasis. Patients reported no or only mild nausea (74%), vomiting (84%), itching (94%), and painful skin (96%). Severe nausea, vomiting, itching, and painful skin were reported in 9.5%, 5.3%, 0.7%, and 0.8% of the patients, respectively.

During follow-up, 11% of the patients received a second treatment for recurrent or continuing pain or for compression of the spinal cord. In total, 12 spinal cord compressions were reported (3%) after a mean of 3.5 months after randomization (range, from 3 days-15 months). Nine patients with spinal cord compression received a second course of radiotherapy, and 3 patients were given best supportive care. Neurological outcomes after second radiotherapy treatment were not reported in the follow-up questionnaires. No patient under went surgery for spinal cord compression. After a diagnosis of spinal cord compression, median overall survival was 1 month (mean overall survival, 4 months, 95% CI, from 2 weeks-8 months).

LE 2 PROGNOSTIC FACTORS FOR PREDICTING SURVIVAL IN 342 PATIENTS WITH SPINAL METASTASES TREATED WITH THE DUTCH BONE METASTASIS STUDY

	%	Mean OS (95% CI)	Median OS	*P-value*[b]	HR	95% CI
[c]						
40	8	7.2 (4.2-10.1)	3.8		1	
70	44	8.5 (6.9-10.0)	4.6	0.55	0.9	0.6-1.3
100	48	14.2 (12.3-16.0)	10.2	0.001	0.5	0.3-0.7
nary tumor						
er	13	5.4 (3.6-7.3)	3.8		1	
g	21	4.4 (3.4-5.4)	2.9	0.34	1.2	0.8-1.8
state	24	12.3 (10.1-14.6)	9.2	< 0.001	0.4	0.3-0.6
ast	42	15.6 (13.5-17.6)	14.1	< 0.001	0.3	0.2-0.4
ceral metastases						
	25	7.2 (5.5-8.8)	4.5		1	
	75	12.3 (10.9-13.7)	8.1	< 0.001	0.6	0.4-0.8
er bone metastases						
	60	11.6 (10.1-13.1)	7.6		1	
	40	10.4 (8.5-12.2)	5.5	0.23	1.2	0.9-1.5
ponse to radiotherapy						
	27	7.6 (5.6-9.5)	3.4		1	
	73	12.8 (11.3-14.2)	8.1	< 0.001	0.5	0.4-0.7

S= overall survival in months, 95% confidence interval between brackets
Cox proportional hazards model for univariate analysis with P-value, hazard ratio and 95% confidence interval
KPS= Karnofsky Performance Score, a conditional score ranging from 0% (death) to 100% (normal situation, no complaints)

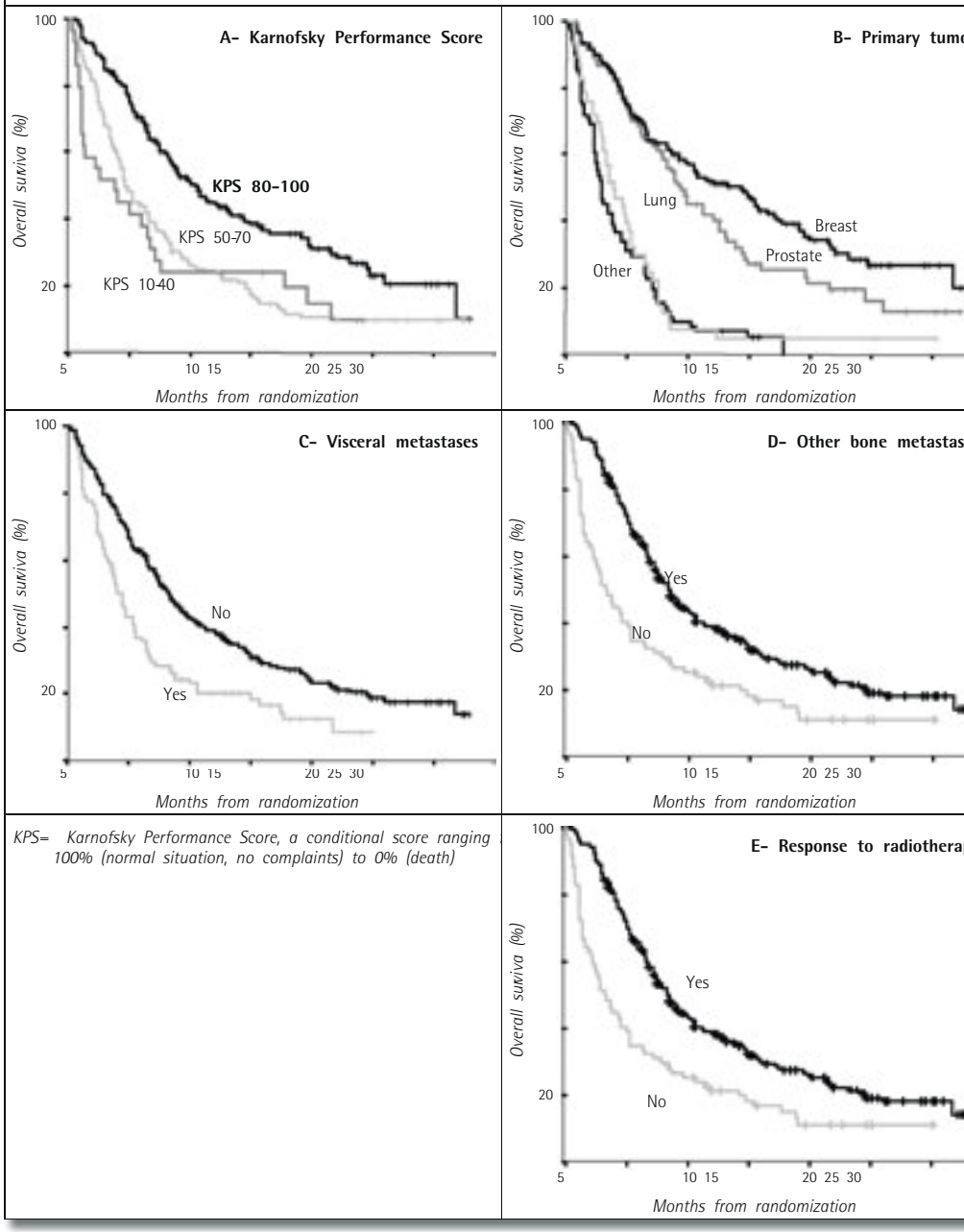
Prognostic factors for survival

Prognostic factors for survival were studied in the 342 trial patients *(Table 2)*. Patients who had Karnofsky Performance Scores between 80-100 had a signifi - cantly prolonged survival compared with patients who had lower performance scores. Surprisingly, patients who had Karnofsky Performance Scores between 50-70 did not have a better prognosis compared with patients who had scores of only 10-40: their median overall survival was 4.6 months versus 3.8 months, respectively (P= 0.55). Patients with breast cancer and prostate cancer had the best overall survival, median 14.1 and 9.2 months (P< 0.001). Twenty-fi ve per- cent of the patients had visceral metastases at the time of randomization. Their overall survival was signifi cantly worse compared with patients who had no visceral metastases, median 4.5 versus 8.1 months (P< 0.001). Presence of other bone metastases in 60% of the patients was not an adverse factor for survival: median overall survival was 7.6 months in patients with other bone metas tases versus 5.5 months in patients with no other bone metastases (P= 0.23). Most patients with other bone metastases had breast cancer (50%) or prostate cancer (28%), and 74% of those patients received concomitant systemic therapy.

Patients whose pain responded to radiotherapy had a better survival than non- responders (median survival, 8.1 months vs. 3.4 months, P< 0.001). Figure 1 shows the survival curves for the different prognostic factors. The signifi cantly predictive factors of the univariate analyses were tested in a multivariate analysis: Karnofsky Performance Score, primary tumor, and

FIGURE 1

Survival curves for prognostic factors in 342 patients with spinal metastases who were treated within the Dutch Bone Metasta



KPS= Karnofsky Performance Score, a conditional score ranging 100% (normal situation, no complaints) to 0% (death)

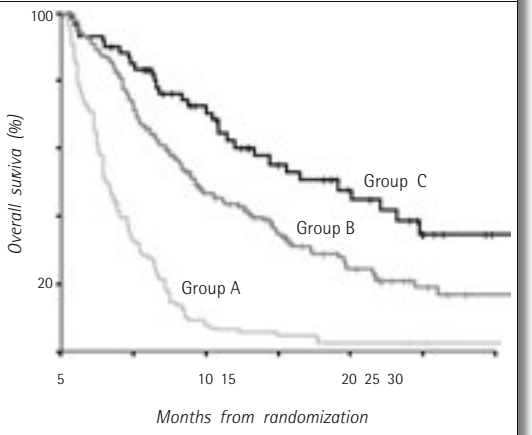
BLE 3 DESIGN OF SCORING SYSTEM FOR PREDICTING SURVIVAL IN 342 PATIENTS WITH SPINAL METASTASES TREATED WITHIN THE DUTCH BONE METASTASIS STUDY

gnostic factors		Points
S[a]	80-100	2
	50-70	1
	20-40	0
mary tumor	Breast	3
	Prostate	2
	Lung	1
	Other	0
ceral metastases	No	1
	yes	0
al points	Group A	0-3
	Group B	4-5
	Group C	6

S = Karnofsky Performance Score, a conditional score ranging from 0% (death) to 100% (normal situation, no complaints)

FIGURE 2

Survival curves for the adjusted scoring system based on prognostic factors in 342 patients with spinal metastases who were treated within the Dutch Bone Metastasis Study



visceral involvement remained signifi cantly predictive for survival (P< 0.001, P< 0.001, and P= 0.02, respectively). We excluded response to radiotherapy from the multivariate analysis to make the scoring system suitable for each patient who presented with a spinal metastasis, i.e. even for patients who had not yet received radiotherapy.

Scoring system

Based on the outcome of the univariate and multivariate analyses for surviv al, a scoring system for prediction of survival was developed that included the Karnofsky Performance Score, primary tumor, and visceral involvement. The scoring system was structured as follows *(Table 3)*:

1. For Karnofsky Performance Score: 2, 1 and 0 points were allocated to a score 80-100, 50-70, and 10-40, respectively.
2. For primary tumor: 3, 2, 1 and 0 points were allocated to breast cancer, prostate cancer, lung cancer, and other types of cancer, respectively.
3. For visceral involvement: 1 and 0 points were allocated to absence and presence of visceral metastases, respectively.

There was a minimum of 0 total points and a maximum of 6 total points. Three prognostic groups were formulated: group A with total scores of 0-3, group B with total scores of 4-5, and group C with total scores= 6. Table 4 lists the distribution of the 342 patients into the 3.0 prognostic groups, and fi gure 2 shows the survival curves. The median overall survival was 3.0 months in group A, 9.0 months in group B, and 18.7 months in group C. At the end of the 32-month study period, 95% of the patients in group A and 70% in group B had died. In group C, 47% of the patients remained alive. Surviving patients had a mean follow-up of 16 months (range, 3-32).

Discussion

The present study showed that median overall survival of patients in the Dutch Bone Metastasis Trial who had Harrington' Class I and II spinal metastases was limited, only 7 months. Non-invasive radiotherapy provided adequate palliation in these patients, with 73% of patients responding to pain, and only 3% of patients reporting spinal cord palsies during follow up. In addition, we were able to put together a scoring system in which survival was estimated accurately using the Karnofsky Performance Score, the type of primary tumor, and visceral involvement as prognostic factors for survival.

In general, the treatment of patients with symptomatic spinal metastases should be directed towards optimal palliation and a minimum of treatment related morbidity. When deciding on treatment, physicians often refer to the scoring systems of Tokuhashi et al, Enkaoua et al, and Tomita et al as guidelines for choosing the type of treatment to the spine.[10-12] These scoring systems used retrospective surgical data and were based upon survival in a limited number of patients with lesions varying from Harrington' Class I to V *(Table 1)*. Table 5 shows the 3 scoring systems: points were allocated to a number of prognostic factors and were added up to produce a prognostic score. Mean overall survival varied between 3 months and 50 months*(Table 6)*. In the studies by Enkaoua et al and Tomita et al, as many as 50% of the patients had a mean overall survival of 24 months or more. In their discussions, the authors of all three scoring systems recommended that surgery should be performed not only in the patients with an expected good prognosis, but also in patients with a limited survival. Surprisingly, they suggested an important role for surgery

TABLE 4 PREDICTING SURVIVAL USING THE SCORING SYSTEM IN 342 PATIENTS WITH SPINAL METASTASES TRE WITHIN THE DUTCH BONE METASTASIS STUDY

Group	Total points	N	%	Mean OS	(95% CI)[a]	Median OS	P-value[b]	HR	95%
A	0-3	116	34	4.8	(3.8-5.7)	3.0		1	
B	4-5	164	48	13.1	(11.3-14.8)	9.0	< 0.001	0.3	0.2-0.4
C	6	62	18	18.3	(15.2-21.4)	18.7	< 0.001	0.2	0.1-0.3

a OS= overall survival in months, 95% confi dence interval between brackets

b Cox proportional hazards model for univariate analysis with P-value, hazard ratio and 95% confi dence interval Prognostic were Karnofsky Performance Score, type of primary tumor, and visceral involvement

in the primary treatment of Class I-III patients. The value of palliative radiotherapy for these patients was not discussed. Compared to the present study, their reported overall survival was much longer, probably due to the selection of patients for surgical treatment. Consequently, when these scoring systems were to be applied on every new patient who presented with a spinal metastasis, as those authors recommended, patients with a limited life expectancy would be assigned to undergo a surgical procedure with associated morbidity and even mortality. We believe the survival data and scoring system presen ted in the present paper provide a more realistic indication of prognosis in patients with spinal metastases.

A remarkable fi nding in the scoring system of Tomita et al was that the performance status of the patient was not incorporated into the scoring system

TABLE 5 DESIGN OF SCORING SYSTEMS FOR THE SURGICAL TREATMENT OF SPINAL METASTASES BASED ON LIFE EXPECTANCY

Patient Characteristics	Tokuhashi [a]	Enkaoua [b]	Tomita [c]
Performance status			
Poor (10-40%)	0	0	-
Moderate (50-70%)	1	1	-
Good (80-100%)	2	2	-
No. of extraspinal bone metastases			
≥ 3	0	0	2 [e]
1-2	1	1	2
0	2	2	1
No. of metastases in the vertebral body			
≥ 3	0	0	-
1-2	1	1	-
0	2	2	-
Metastases to major internal organs			
Irremovable	0	0	4
Removable	1	1	2
No metastases	2	2	0
Primary site of the cancer			
Lung, stomach, unknown [d]	0	0	4
Kidney, liver, uterus, other, unknown	1	1	2
Thyroid, prostate, breast, rectum	2	2	1
Spinal cord palsy			
Complete	0	0	-
Incomplete	1	1	-
None	2	2	-

a Tokuhashi Y, Matsuzaki H, Toriyama S, Kawano H, Ohsaka S. Scoring system for the preoperative evaluation of metastatic spine tumor prognosis. Spine 1990; 15(11):1110-1113

b Enkaoua EA, Doursounian L, Chatellier G, Mabesoone F, Aimard T, Saillant G. Vertebral metastases: a critical appreciation of the preoperative prognostic tokuhashi score in a series of 71 cases. Spine 1997; 22(19):2293-2298

c Tomita K, Kawahara N, Kobayashi T, Yoshida A, Murakami H, Akamaru T. Surgical strategy for spinal metastases. Spine 2001; 26(3):298-306

d Patients with a metastasis from an unknown primary tumor received 1 point in the Tokuhashi scoring, and 0 points in the Enkaoua scoring

e Patients with multiple metastases (> 1) received 2 points in the Tomita scoring

TABLE 6 PROGNOSTIC GROUPS OF THE SCORING SYSTEMS BY TOKUHASHI[a] ENKAOUA,[b] AND TOMITA[c] IN RELAT TO SURVIVAL

Scoring systems	Prognostic group (Total score)		N	%	Mean OS[d] (range)		Suggested operative methods
Tokuhashi [a]	A	(0-5)	24	38	3	(0-5)	Palliative surgery
	B	(6-8)	24	38	6	(1-19)	
	C	(9-12)	15	24	22	(6-51)	
Enkaoua [b]	A	(0-7)	36	51	5	(SD 1.2[e])	Palliative surgery
	B	(8-12)	35	49	24	(SD 5.8)	Excisional surgery
Tomita[c]	A	(8-10)	17	25	6	(1-14)	Supportive care
	B	(6-7)	17	25	15	(5-33)	Palliative surgery
	C	(4-5)	13	19	24	(7-57)	Intralesional/marginal
	D	(2-3)	21	31	50	(18-84)	Excisional surgery

a Tokuhashi Y, Matsuzaki H, Toriyama S, Kawano H, Ohsaka S. Scoring system for the preoperative evaluation of metastatic s prognosis. Spine 1990; 15(11):1110-1113

b Enkaoua EA, Doursounian L, Chatellier G, Mabesoone F, Aimard T, Saillant G. Vertebral metastases: a critical appreciation of prognostic tokuhashi score in a series of 71 cases. Spine 1997; 22(19):2293-2298

c Tomita K, Kawahara N, Kobayashi T, Yoshida A, Murakami H, Akamaru T. Surgical strategy for spinal metastases. Spine 200 For a and b, prognostic factors used were performance status, number of extraspinal metastases, number of metastases within presence of visceral metastases, primary site, and presence of spinal cord palsy. For c, prognostic factors used were number of metastases, presence of visceral metastases, and primary site

d OS= overall survival in months

e SD= standard deviation

(Table 5) . Performance status generally is regarded as one of the strongest prognostic factors for survival, correlating with the ability to undergo medical treatment.[13] In 2001, Chow et al published a review on physicians' capability of predicting survival and concluded that the Karnofsky Performance Score was the most important factor. [14] Although the Karnofsky Performance Score was one of the major factors predicting survival in our study, when it was combined with the primary tumor type and the presence of visceral metastases, we were able to refi ne further the prediction of survival.

Obviously, along with survival, the expected treatment outcome is an important factor when deciding on treatment. Radiotherapy for patients with Harrington' Class I-II metastases has been studied extensively. Several prospectively randomized trials and 2 recent meta-analyses on palliative radiotherapy in painful bone lesions including spinal metastases reported decrease of pain in 60% to 80% of patients. [5,6,15-29] In patients with Class III metastases, decrease of symptoms after radiotherapy doses of 16 - 24 Gy was reported in 10% - 90% of patients, depending on the severity of the pretreatment neurological symptoms.[30-34] Of the three reports on surgical scoring systems, Tokuhashi et al did not discuss treatment outcomes, although 80% of their 64 patients had neurological symptoms before surgery.[10] Enkaoua et al reported 79% relief of pain in 71 patients. [11] In 25 patients with neurological symptoms, the neurological status improved in 14% of patients postoperatively, remained unchanged in 72% of patients and deteriorated in 14% of patients. Tomita et al only reported treatment outcomes in a second group of 61 patients who were treated pro-

spectively in line with the proposed surgical strategy.[12] Similar overall survival rates were seen compared with the original 67 patients, and 78% of patients had less or no pain postoperatively. In the 65% of patients with neurological symptoms before surgery, neurological improvement of at least one Frankel grade[35] was seen in 75%.

A number of other papers on patient outcomes after spinal surgery have been published[36-40] Chataigner and Onimus studied 107 patients retrospectively who underwent surgery for Class I and II spinal metastases, [36] and reported improvement of pain in 98% postoperatively, but they also reported a 10% postoperative mortality rate. They allocated their patients to the Tokuhashi prognostic groups and observed a mean overall survival of 2 months for group A, 9.5 months for group B, and 8 months for group C. In another study, Hatrick et al reported a limited median overall survival of less than 5 months in 42 patients who underwent surgery after failure of radiotherapy. [37] Pain improved in 90% of the patients, and neurological symptoms in 69%. Hirabayashi et al studied the medical records of 81 patients who underwent palliative spinal surgery.[38] Fifty patients were non-ambulatory preoperatively. After surgery, 70% of these patients were ambulatory with a median overall survival of 16.5 months, and a median ambulation time of 13.8 months. Factors that significantly influenced survival were primary tumor (bone marrow, prostate cancer, or thyroid cancer vs. other sites) and postoperative ambulation (MV, P< 0.001). The authors called for caution because their study was restricted by its retrospective design: patients who were selected for surgery were generally in a better condition or had limited systemic disease.

Recently, at the 2003 annual meeting of the American Society for Therapeutic Radiation Oncology (ASTRO), Regine et al [41] presented the first results of a prospectively randomized trial on surgery plus radiotherapy versus radiotherapy alone for the treatment of spinal cord compression. Their patients had signs of spinal cord compression on MRI scans either with or without neurological symptoms. Regine et al showed that 50 patients who were treated with surgery plus radiotherapy retained the ability to walk significantly longer than 51 patients who were treated with radiotherapy alone (median 126 days versus 35 days, P= 0.006). Unfortunately, their data have not matured yet.

Compared with the three surgical scoring systems, there are some remarks to be made about the present study. First, no patient with a spinal metastasis within the Dutch Bone Metastasis Study had signs of spinal cord compression at randomization.[5] During follow up only 3% spinal cord palsies were reported. Although the scoring systems of Tokuhashi et al [10] and Enkaoua et al [11] incorporated the degree of spinal cord palsy, Tomita et al[12] left it out. Like Tomita et al, we believe that symptoms of spinal cord palsy are merely suggestive for the anatomical localization of the metastasis and the voluminous extent of the metastatic lesion and are not independent adverse prognostic factors. Second, patients with renal cell carcinoma, melanoma or multiple myeloma were excluded from randomization because of the expected different biological behavior of these entities. Therefore, no conclusions can be drawn from the present study for patients with those tumors. Finally, 48% of patients in the proposed scoring system group C remained alive at the end of follow-up, with a mean follow-up of 16 months. If follow-up had been extended beyond the maximum of 32 months, then it is possible that the mean survival in these patients would even greater than 18 months.

In conclusion, we propose a scoring system for prediction of survival in patients with Harrington' Class I and II spinal metastases. We believe radiotherapy is the primary treatment of choice in all patients with Class I-II lesions. Surgery should be considered only when pain is persistent despite radiotherapy or when spinal cord tolerance after radiotherapy has been reached, however, treating physicians should be aware of the limited life expectancy in the majority of patients. In patients with Class I and II lesions, extensive surgery, if any, must be reserved for those who have an expected good prognosis, perhaps for patients in the proposed scoring system group C, i.e. those with primary breast cancer who have a good performance status and a spinal metastasis without visceral involvement.

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