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Usefulness of Tokuhashi Score in Survival Prediction of Patients Operated for Vertebral Metastatic Disease

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Abstract

Study Design: Retrospective study.

Objective: Spinal metastasis can produce pain, deformity, neurological compromise and can decrease life expectancy. Surgical management is usually indicated for pain control, neurological decompression, and to avoid deformity progression. Tokuhashi et al created a scoring system to estimate survival and stratify surgical treatment based on established parameters. Our objective was to evaluate the usefulness of Tokuhashi scoring (TS) system by comparing the predicted and real survival times and analyze the survival time according to the type of tumor.

Methods: From 2004 to 2014, 105 patients with vertebral metastasis who underwent surgical treatment were enrolled and retrospectively analyzed. Preoperative TS was performed in all cases. Patients were classified into 3 groups according to TS; group 1 (TS 0-8), group 2 (TS 9-11), and group 3 (TS 12-15). Patients' average age was 61.5 years, main primary tumor site were as follows: kidney (23%), lung (19%), and breast (18%).

Results: The Tokuhashi general concordance was 67.6%. Per group concordance was as follows: group 1 80%, in group 2, only 33% of concordance was observed. In group 3, 100% of concordance was observed. In group 2, the most common primary sites were breast and kidney and the mean survival was 20 and 22.3 months, respectively, both longer than that expected for this group.

Conclusions: Tokuhashi concordance was acceptable in our study, particularly in lower and higher scores. The lesser concordance observed in group 2 (33.3%) was observed in almost all tumors. For our practice, TS constitutes an acceptable tool to define survival, particularly in lower and higher scores.

Keywords

revised Tokuhashi score, spinal metastases, metastatic survival, vertebral metastatic disease

Abbreviations

VM	Vertebral Metastases
TS	Tokuhashi Score
CT	Computed Tomography
MRI	Magnetic Resonance Image

Introduction

Spinal metastases are the most frequent location of skeletal metastatic disease.[1,2] Approximately 75% of vertebral metastases (VM) originate from breast, prostate, lung, thyroid, and kidney tumors.[3-5] Metastases of unknown primary tumors account for only 3% to 4%.[6] Vertebral metastases can produce pain, deformity, and neurological involvement by compressing spinal cord or nerve roots.[7,8]

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Table 1. Revised Tokuhashi Scoring System for the Prognosis of Metastatic Spine Tumors.

Characteristic	Score
General condition (performance status [PS])	
Poor (PS 10%-40%)	0
Moderate (PS 50%-70%)	1
Good (PS 80%-100%)	2
No. of extraspinal bone metastases foci	
≥3	0
1-2	1
0	2
No. of metastases in the vertebral body	
≥3	0
1-2	1
0	2
Metastases to the major internal organs	
Unremovable	0
Removable	1
No metastases	2
Primary site of the cancer	
Lung, osteosarcoma, stomach, bladder, esophagus, pancreas	0
Liver, gallbladder, unidentified	1
Others	2
Kidney, uterus	3
Rectum	4
Thyroid, breast, prostate, carcinoid tumor	5
Palsy	
Complete (Frankel A, B)	0
Incomplete (Frankel C, D)	1
None (Frankel E)	2

[a]Criteria of predicted prognosis: Total score (TS) 0-8, <6 mo; TS 9-11, 6-12 mo; TS 12-15, ≥1 y.

Surgical management can be performed as an oncologic radical or palliative procedure for pain control, neurologic decompression and to prevent deformity progression.[9,10]

Treatment option should be considered according to different factors, such as primary tumor, predicted survival, general medical condition, and so on.

Several scoring systems have been developed in order to predict survival in patients with VM.[11-15] Tokuhashi et al[11] first proposed a preoperative score (TS) to predict survival in 1990, the score was also utilized to define surgical plan with an algorithm for the type of resection. This score was modified in 2005 by adding more options to define the primary tumor diagnosis.[12]

This revised score is based on 6 parameters: (1) general condition according to Karfnosky performance status,[13] (2) the number of extra spinal bone metastases, (3) the number of vertebral metastases, (4) the number of metastases to the major internal organs, (5) primary site of cancer, and (6) palsy. Each parameter is rated between 0 and 2 except for primary tumor (0 to 5) (Table 1). According to TS, life expectancy is predicted and different treatment options are proposed; treatment can vary from palliative management, decompression procedures with or without fixation up to radical en bloc excision.

Our objectives were to evaluate the general concordance between expected and real survival of patients operated for vertebral metastases and the mean survival per tumor and survival prediction per group.

Materials and Methods

The present study was based on 111 cases with confirmed vertebral metastases that underwent surgical treatment by the same team between January 2004 and May 2013. Primary spinal tumors and lymph proliferative lesions were not considered in this study.

Six patients without defined time of death were excluded; in addition, patients not considered candidates for surgery were also excluded.

Finally, for retrospective analysis we included 105 patients (61 males and 44 females) with an average age of 61.5 years (16-86 years). Parameters such as demographics, type of primary tumor, initial symptoms, neurological involvement, Tokuhashi score, surgical treatment, perioperative complications, and survival were analyzed. The last evaluation was performed in May 2014.

The study protocol was approved by the ethics review board of Hospital Italiano de Buenos Aires and in concordance with the Helsinki Declaration.

In almost all cases, X-rays, computed tomography (CT) scans and magnetic resonance imaging (MRI) of the spine were assessed in order to define the number of metastases, location, and presence of cord or root compression. MRI was not assessed in 3 cases because of heart pacemaker devices.

Patients were classified into 3 groups according to the TS; in group 1, there were 50 cases with a score between 0 and 8, and an expected survival of less than 6 months. Group 2 with 36 cases had a score between 9 and 11 and an expected survival between 6 and 12 months, and group 3, with 19 cases, a score between 12 and 15 and an expected survival of more than 1 year.

Type of Surgical Procedures

Palliative: Simple posterior decompression (laminectomy), posterior decompression and instrumentation, anterior decompression, and instrumentation.

Excisional: Spondylectomy by single or combined approaches.

Palliative procedures were performed in all patients included in group 1; among them, 33 patients were treated with posterior decompression and stabilization; 10 patients with posterior stabilization and 7 received laminectomies.

Regarding group 2, 29 patients were considered candidates for palliative procedures as posterior decompression and instrumentation and 7 patients were treated with en bloc spondylectomies.

Twelve patients from group 3 were candidates for en bloc spondylectomy and 7 patients were treated with decompression and stabilization with palliative intention.

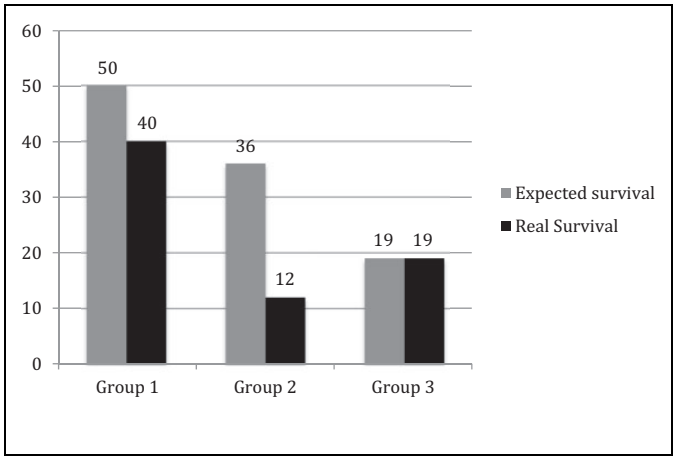

Figure 1. Comparison concordance in the different groups. The *x*-axis shows 2 bars in each group reflecting patients real (black) and expected (gray) survival.

Statistical Analysis

Mean and per group percentage of concordance with confidence interval were analyzed.

A Kaplan-Meier analysis was done to study the survival according to Tokuhashi groups. The group's estimated survival (groups 1, 2, and 3 survival function) was compared with the log rank test. Probability values of less than .05 were considered statistically significant.

All the statistical analysis was performed with Stata 13 program (StataCorp, College Station, TX, USA).

Results

Of the 105 patients, 15 were alive at the time of the final follow-up and 90 had confirmed death date.

Average patient survival at the final follow-up was 16.9 months (1-92 months).

No death occurred during the surgical procedure.

The most common primary tumors were kidney (23.8%), lung (19%), and breast (18%) (Table 4).

Vertebral Metastatic Location and Clinical Findings

Vertebral metastatic location was thoracic in 62% of cases (65 cases), lumbar in 28% (29 cases) and cervical in 10% (11 cases).

Neurological involvement (paresthesias, paraparesis, and paraplegia) was present in 59 (56%) cases at the time of referral. Twenty cases (19%) required surgery within 12 hours because of progressive neurological compromise.

Survival, General, and Group Concordance

Among the 105 patients evaluated, we found a general concordance of 67.6% (95% confidence interval [CI] = 66%-84%.

Group concordance analysis was as follows (Figure 1). In group 1 (50 cases) with an expected survival of less than 6 months, there was 80% (40 cases) of TS concordance (95% CI = 68%-91%), with a mean survival of 4.9 months. Ten patients survived more than 6 months ($P = .49$), 3 of them survived more than 12 months—1 had lung adenocarcinoma, 1 nondifferentiated lung carcinoma, and 1 breast carcinoma.

In group 2 (36 cases) with an expected survival between 6 months and 1 year there was a mean survival of 20.8 months. We found a low 33.3% (12 cases) of concordance; in this group, 5 patients survived less than 6 months and 19 patients more than 12 months. The difference between expected and real survival in this group was significant ($P = .01$).

Group 3 (19 cases), with an expected survival of more than 1 year, resulted in a 100% concordance (19 cases), with an average survival of 40 months (Tables 2 and 3).

Mean Survival per Tumor

The mean survival per tumor was as follows: lung, 5.6 months (SD 5.3); breast, 20.1 months (SD 20.2); and kidney, 22.3 months (SD 18.3) (Table 4).

A Kaplan-Meier survival analysis was made showing the three different groups according to survival (Figure 2).

Concordance per Primary Tumor

The general concordance per tumor is presented in Table 5.

Discussion

When treating patients with vertebral metastases, surgical strategy is mainly based on life expectancy, primary site of tumor, and staging. This helps determine which patients will benefit from surgery and the type of procedure.

Tokuhashi et al[11] developed a score to determine life expectancy in order to facilitate the treatment modality decision. With the revised Tokuhashi scoring system published in 2005, these authors retrospectively evaluated 246 patients, finding a concordance between the expected and final survival rate of 82.5%.[12]

Riegel et al[16] also found a high correlation between TS prediction and final survival in 139 patients. Similar results were found by Ulmar et al,[17] Mollahoseini et al,[18] and Yamashita et al.[19]

Wibmer et al[20] compared the survival rates utilizing seven different scores systems, among these groups; TS showed an acceptable rate of concordance. These authors stated that "TS (original and revised) analyses are reliable."

The concordance of Tokuhashi score in our series of 105 patients was 67.6%, lower than the obtained by the authors of the score. Similar to our results; Pointillart et al[21] and Quraishi et al[22] observed an accuracy rate of 60% and 66%, respectively. Finally, Gakhar et al[23] reported the lowest rate with a 33.3% concordance.

Even though our general concordance rate was acceptable, it was quite heterogeneous among the different groups, the concordance was particularly low (33%) in group 2; opposite to

Table 2. Detailed Surgical Treatment and Adjuvant Therapy per Group.

Features		Main Tumor	Laminectomy	Stabilization	Surgical Treatment: Decompression and Stabilization	Surgical Treatment: En Bloc Resection	Adjuvant Therapy: Radiotherapy	Adjuvant Therapy: Chemotherapy	Adjuvant Therapy: Both
Total score TS 0-8 (N = 50)									
Age, years	63.5								
Sex (female/male)	24/26								
Concordance	40	Lung	6	7	17	0	30	5	5
No concordance	10	Kidney	1	3	16	0	5	2	3
Total score TS 9-11 (N = 36)									
Age, years	60.2								
Sex (female/male)	19/17								
Concordance	12	Breast	0	0	14	3	—	—	12
No concordance	24	Breast	0	0	15	4	—	—	24
Total score TS 12-15 (N = 19)									
Age, years	61								
Sex (female/male)	10/9								
Concordance	19	Kidney	0	0	7	12	6	1	12
No concordance	—	—	—	—	—	—	—	—	—

Table 3. Group Relationship Between Expected and Real Survival.

Tokuhashi Scoring Groups	Total No. of Patients	Mean Survival (mo)	Real Survival, n (%) 0-6 mo	6-12 mo	>12 mo
0-6 mo	50	4.9	40 (80)	7 (14)	3 (6)
6-12 mo	36	20.8	5 (13)	12 (33)	19 (53)
>12 mo	19	40	0 (0)	0 (0)	19 (100)
Total	105				

Table 4. Survival Data for Each Primary Tumor Site.

Primary Site	n	%	Mean Survival (mo)	Standard Error	95% CI (mo)
Kidney	25	23.8	22.3	3.6	14.7-29.9
Lung	20	19	5.6	1.1	3.1-8.1
Breast	19	18.1	20.1	4.6	10.3-29.9
Colon and rectum	9	8.6	7.8	2	3.1-12.6
Sarcomas	8	7.6	6.1	2.4	0.2-11.7
Prostate	8	7.6	29.6	10.7	4.1-55.1
Thyroid	6	5.7	32.5	13.8	0-68
Others[a]	10	9.5	15.3	7.6	1.9-32.5

[a]Others includes skin, liver, and bladder.

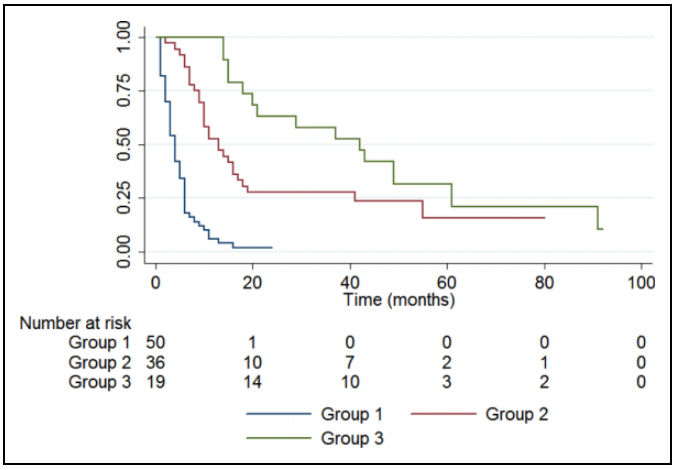

Figure 2. The Kaplan-Meier survival figures. Log rank test $P < .05$.

Table 5. General Concordance per Tumor.

Tumor Site	N	Concordance	%
Kidney	25	18	72
Lung	20	16	80
Breast	19	12	63.1
Colon and rectum	9	6	66.6
Prostate	8	5	62.5
Sarcomas	8	6	75
Thyroid	6	4	66.6
Others	10	8	80

this, groups 1 and 3 resulted in a more reliable rate of 80% and 100%, respectively.

Similar to us, Hernandez-Fernandez et al[24] found a moderate global concordance, higher for groups 1 and 3, as opposed to group 2 with an extremely low (16%) rate.

Gakhar et al,[23] who reported a very low general concordance (33%), also found a high concordance in group 3. This author found that the survival rate was better than predicted for breast, prostate, and renal cancers; this was similar to our findings, being the most important factor related to the low concordance rate in group 2.

In our series, the lower concordance in group 2 (33%) was observed for breast, kidney, prostate, colon, and thyroid tumors.

We found the best concordance in group 3 (100%); group 1 showed a lower but still good concordance (80%). It is worth mentioning that only patients having surgery were included. Tokuhashi et al in their work also included patients who did not undergo surgery.[12] Nevertheless, they did not find differences between patients treated conservatively or surgically in group 1.

Regarding to adjuvant therapy, the role of radiotherapy has been well established before[25]; in our series, we mentioned adjuvant treatment in all cases, even though it was not the objective of our study to analyze or compare survival rates based on different adjuvant treatment modalities, we consider it as a factor that would influence survival and probably should as important as surgery in the setting of a multidisciplinary management. Appropriate decision making in the treatment of spinal metastases requires a multidisciplinary approach (radiation, medical oncology, interventional radiology, and surgery); the NOMS (neurologic, oncologic, mechanical, and systemic) paradigm provides a decision framework to optimize patient care.[26]

Based on our results, it is clear that the TS is an effective tool to detect patients with a short life expectancy, that will either not benefit from surgery or in which a palliative surgery can be considered.

The TS was also effective for those patients falling in group 3 since all of them live more than 12 month benefiting with a more aggressive surgical procedure.

Noticeably, the TS undervalued the survival rate in our population of group 2. It is out of the scope of this study to find if the longer survival of this group has an impact on the surgical results (local recurrence, instrumentation failure, etc). Nevertheless, we believe that in the future, patients in group 2 need to be evaluated on a more case-by-case basis to better predict the survival rate when a more effective adjuvant can be applied.

Conclusion

Tokuhashi concordance was acceptable in our study, particularly in lower and higher scores. Lower concordance was observed in group 2 (33%). Probably the variability of results in general and per groups concordance of TS could be related to different population, distribution of primary tumors, and different therapeutic approach. The development of new strategies for cancer disease put the TS in a new scenario and probably a reassessment is required. Every patient needs to be evaluated case-by-case by a multidisciplinary team in order to receive the most appropriate treatment.

Declaration of Conflicting Interests

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