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CLASSIFICATION OF METASTATIC SPINAL TUMORS

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ABSTRACT

The vertebral spine is the most common location for bone metastases. Its incidence has been increasing due to increasing expectation of life and the amount of elderly in our population. Around 70 % of cancer patients shows evidence of spinal metastasis and 10% of these lesions put pressure on the spinal cord. Prognostic indicators were defined for most beneficial surgical approach and indication for surgery. Metastatic tumor classifications were designed and several clinics have commenced to use them for treatment modality choice.

Key words: Metastatic spinal tumor, spinal tumor classification, spinal metastasis

Level of Evidence: Review article, Level V

INTRODUCTION

The vertebral spine is the most common location for bone metastases [27]. Its incidence has been increasing due to increasing expectation of life and the amount of elderly in our population [1]. Around 70 % of cancer patients shows evidence of spinal metastasis and 10 % of these lesions put pressure on the spinal cord [4]. The most common causes of spinal metastasis are cancers of the breast, lung, kidney, prostate, thyroid, colorectal, as well as melanomas, myelomas and lymphomas [28].

Parallel to the development in technology, the effective improvements in tumor surgery have also contributed to an increased quality of life. Before, decompressive surgery was performed and upon receiving bad results, radiotherapy was supported as the superior treatment option [7,18,25]. New technologies allow metastatic spinal tumor surgeries to stabilize better, to release the pressure on the spinal cord, and to decrease the pain. However, its effect on the prolongation of the average life expectancy is debatable. By anterior and anterolateral stabilization approach, the benefit of surgery plus post-operative radiotherapy instead of only radiotherapy has been proven by various studies [4,15].

Currently, surgical treatment modalities for metastatic tumors are dominating.

Prognostic indicators were defined for most beneficial surgical approach and indication. For patients whose life expectancy is over 3 month surgery is recommended. Other than, the life expectancy prediction by oncologists, additional factors such as, tumor spread and degree, preoperative life standard, postoperative expectations must be categorized and planned by surgeons [17]. For this reason, some classifications were designed and several clinics have commenced to use them.

SCORING SYSTEM FOR METASTATIC SPINAL TUMORS

It was tried to classify metastatic tumors according to symptomatic, anatomic and prognostic data and results of treatment strategies were obtained.

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Tomita prognosis score

Tomita analyzed several prognostic values and developed a prognostic scoring system based on 3 factors [23]. These factors are growth rate of a primary tumor, number of metastasis and internal organ metastasis. According to this system, data rated between 2 and 10 were considered as good prognosis, rates higher than 10 were considered as poor prognosis. Tomita created this system based on a retrospective study of 67 patients from 1987 and 1991. The primary tumor was identified and a relation between their kind and the survival rate was established, hence Tomita tried to respect the primary type of tumor in his classifications. According to this data, the survival rate of patients suffering from metastasis due to primary foci of the breast, prostate, thyroid, as well as myeloma presented to be longer compared to the other causes of spinal metastasis [23,29].

Tokuhashi prognosis score

Tokuhashi has created an evaluation system, based on 6 different parameters [20]. After observing the strong relation between the type of the primary cancer and the average survival rate, he restructured his scoring system [21]. The parameters include primary cancer type, existence of paralysis, Karnofsky performance status, number of extra spinal metastasis,vertebral corpus metastasis and internal organ metastasis. The grading system goes from 0-15, 0 representing the worst and 15 the best prognosis. The most important factor for the grading system is the primary cancer type; hence, thyroid, breast, and prostate cancer and carcinoid tumors receive 5 points, whereas lung cancer, osteosarcoma, gastric cancer, bladder cancer, esophagus cancer, and pancreas cancer receive 0 points. Tokuhashi et al. reported the prognostic factors not to be significant if alone but rather more meaningful when grouped [21].

As much as Tokuhashi's study supported the importance of paralysis, other studies did not find the pressure on the spinal cord caused by metastatic diseases or neurologic symptoms to be relevant regarding life span. Paralysis, which is due to compression of the tumor mass and the rapid growing of tumor mass, is also described as a parameter for a negative prognosis [16]. Zou et al report the Tokuhashi score to be successful in estimating short term survival rates, as well as the Tomita score to be meaningful regarding long term survival rates [29].

Harrington Spine Metastasis Scoring System

Harrington has established a classification system based on spinal instability and neurologic involvement, grading it with points going up to 5 [8]. According to Harrington, spinal instability, neurologic involvement, and mechanic pain are indications for surgical intervention. He stresses the superiority of surgery above radiotherapy. However, his scoring classification is not widely used due to different types of diseases being graded equally.

Anatomic Scoring System of Metastatic Spinal Tumors

Primary tumor progression is said to lead a major role in anatomical scoring of metastasis [19]. When planning a surgical intervention, more data is required concerning the anatomic location of the tumor.

CLASSIFICATIONS

Tomita Anatomical Surgery Classification

Tomita specified internal/external involvement and spreading of the vertebrae (metastasis) [22-23]. His classifications described the tumoral involvement of the vertebra starting from the corpus leading to the pedicules, the posterior columns, the extradural and paravertebral area, the neighboring vertebra, and finally to non-neighboring vertebrae. This scoring system allows for easily memorable tumor spreading as it follows a systematic description. However, the tumor may not always spread according to this course. Surgeons mostly face pathologies between type 4 and type 7 (Figure-1).

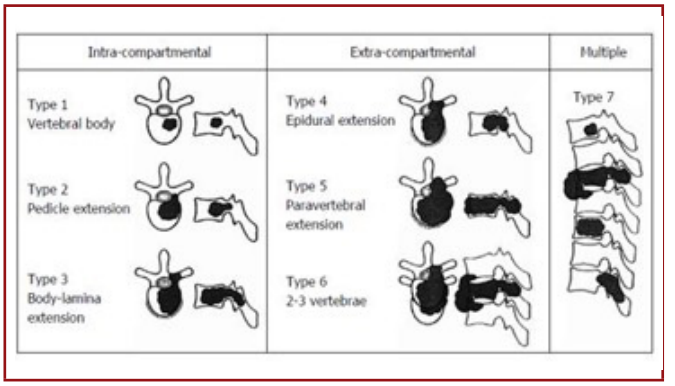

Figure-1. Tomita Anatomical Surgery Classification

McLain-Weinsteins Classification

The McLain-Weinstein classification divides the vertebral anatomy into 4 parts and 2 concentric levels [14]. Using this classification is very easy; however, it lacks detailed classifications in tumors of the third and fourth category.

Enneking Classification:

Enneking had classified primary long bone tumors and transcribed that classification to spinal tumors [6]. In this classification, benign tumoral involvement were described in 3 degrees, malignant tumor localizations in 4 levels, and metastatic high graded tumors in 2 levels. For this classification, histologic data and expansion of tumor throughout the body must be specified. Not being able to give a prognosis and involving extradural spreading and pressure signs when evaluating the patient are disadvantages of this classification (Figure-2) [6].

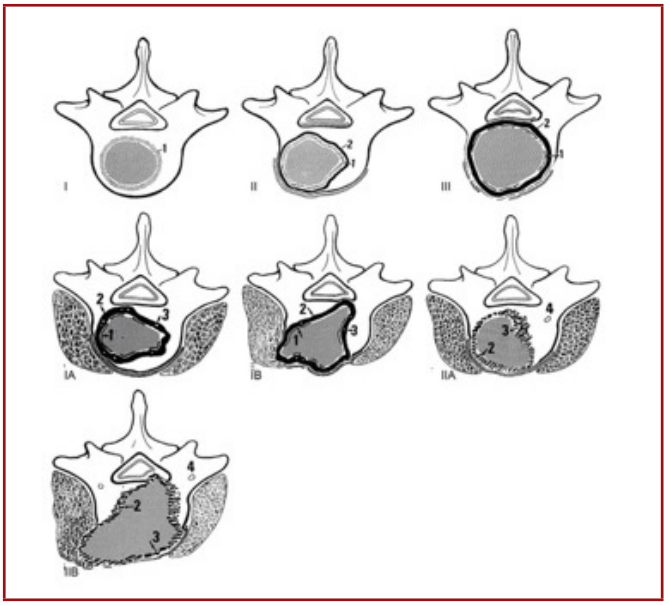

Figure-2. Enneking Classification

Weinstein-Boriani-Biagini (WBB) Classification

The WBB classification gives detailed information on the axial spreading of the tumor [2]. For this classification, a vertebra is viewed on axial cut, centering the spinal cord. The vertebra is then divided in a clock-wise manner and the areas involved are further broken down into sections. This classification is mostly chosen for surgical planning rather than prognosis establishment (Figure-3).

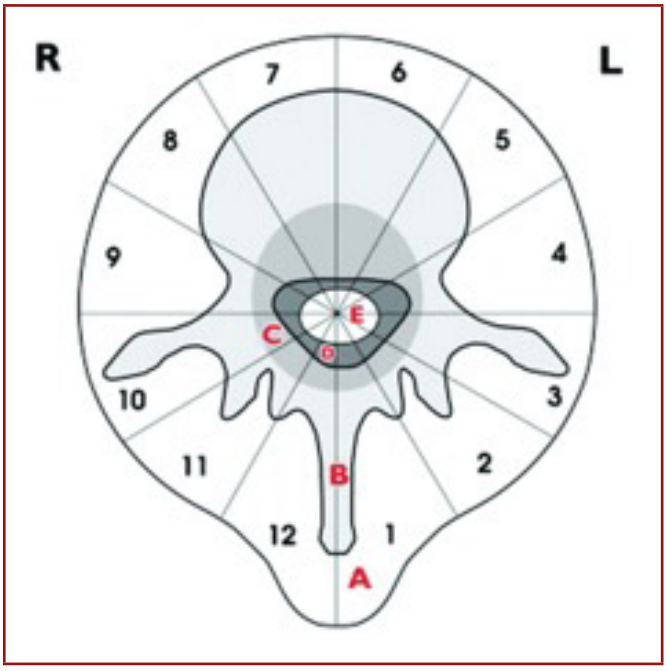

Figure-3. Weinstein-Boriani-Biagini Classification

Friedlander-Southwick Malignant Tumor Staging

As reported by the staging of Friedlander and Southwick, low grade tumors resting within the compartments present better prognosis comparing to higher graded tumors or tumors protruding outside of the compartment, which classified to show worse outcomes [27]. According to this staging, stage IA and IB require adjacent normal tissue to be removed with the entire tumor. In stage IIA, however, the entire removal of the compartment is advised. In case of a IIB lesion present in one extremity, radical amputation is advised, yet this normally used technique in other bone tumors can not be done in the spine due to following post-operative neurologic and stability issues. In this case, intralesional or marginal excisions may be advised.

USE OF CLASSIFICATIONS AND SURGICAL STRATEGIES

Although anatomic classifications are considered useful, Tomita and Tokuhashi classifications are the only long-term studies performed [20-22]. It is recommended to perform broad surgical resection on Tomita 2-3 scored patients, marginal or intralesion intervention for Tomita 4-5 scored patients, palliative surgery for Tomita 6-7 scored patients, supportive treatment for Tomita 8-10 scored patients [23].

The mean life expectancy of patients with good prognosis score and broad surgical resection was estimated to be 38,2 months, in patients with mild graded lesion approach mean life expectancy was estimated to be 21,5 months, and in patients with poor prognosis had only palliative treatment and stabilization, as their life expectancy was estimated to be 10,1 months according to Tomita et.al studies performed on 61 patients [22-23]. Due to these results, the Tomita classification was considered to be useful.

Tokuhashi on the other hand uses a different point of view, where patients with a good prognosis score of 12-15 were advised to undergo excisional surgery, intermediately well patients with a score of 9-11 to receive palliative surgery, and patients with a scoring of 8 or less to be given conservative treatment. His study on 118 patients revealed a statistically significant difference in the expected life span according to his classification and post-operative grading of life expectancy [20-21]. The obtained data was understood to aide in choosing surgical strategies and life span. Studies performed after the before mentioned model showed 80 % of the patients to be satisfied following surgical intervention as their treatment plan [5,26]. The best results were defined as the cessation of pain, nausea, fatigue, and anxiety. Long term results are expected to be obtained from polycentric studies, utilizing spinal metastasis prognosis, anatomic, and surgical classification [3-4,12,24].

The primary sources of the metastasis are of significant importance, as the primary cancers have very specific characteristics, which need to be evaluated. Breast cancer usually

spreads its metastasis to the cervical and upper thoracal area, being sensitive to radiotherapy [17]. They respond well to hormone and chemotherapy. In these cases, surgery is recommended if spinal instability, increasing neurologic deficits, and excruciating pain are present [13]. Metastasis due to prostate cancer also respond well to hormone treatment and radiotherapy, but if surgery is recommended, aggressive excision must be considered given the patient's overall situation as their average life expectancy is staged as high [11,27].

Metastasis caused by lung cancer are different, as adenocancer may respond well to radiotherapy. However, as much as Small Cell type, accepted to be more of systemic disease, reacts favorably to radiotherapy, Squamous Cell type destroys the bone creating a breakdown and is resistant to radiotherapy [17]. In these patients, palliative surgery is only advised if excruciating pain or rapidly increasing neurologic deficits are present [9-10].

A complication risk of 20 %-30 % is estimated for spinal metastasis surgeries [27]. Considering these facts, surgeries must be planned carefully. All prognostic factors and classifications must be analyzed and evaluated in order not to decrease the quality of life of the patient.

Table-1. Tomita Prognosis Scoring Table

	1 POINT	2 POINTS	4 POINTS
Primary tumor	Slowly growing	Intermediate growing	Rapidly growing
Internal organ met.	-	Can be treated	Can not be treated
Bone metastasis	Single	Multiple	-

Table-2. Renewed Tokuhashi prognosis scoring system

	0	1	2	3	4	5
Karnofsky Performance (%)	10-40	50-70	80-100	-	-	-
Mets outside of spine	3 or more	1-2	0	-	-	-
Mets in spine	3 or more	2	1	-	-	-
Internal organ met.	Not removable	Removable	None	-	-	-
Primary cancer	Lung	Liver	Others	Kidney	Rectum	Breast
Palsy	Frankel A,B	Frankel C,D	Frankel E	-	-	-

Table-3. Harrington Spinal Metastasis Score

1	No neurologic involvement
2	Bone involvement, no instability or collapse
3	Neurologic involvement without bone involvement
4	Pain at vertebra or instability with collapse, no neurologic involvement
5	Pain at vertebra or instability with collapse and neurologic involvement

Table-4. McLain and Weinstein spine metastasis anatomic classification

1. AREA	From spinous process to pars and inferior facet
2. AREA	From superior facet to transverse process and pedicle
3. AREA	¾ anterior of vertebral body
4. AREA	¼ posterior of vertebral body
LEVEL A	Intraosetal
LEVEL B	Extraosteal
LEVEL C	Tumor spreading to non-neighboring area

Table-5. Friedlander-Southwick malignant tumor staging

GRADE	STAGE	METASTASIS	AREA	SURGERY
IA	Low	None	Intracompartmantal	Block excision
IB	Low	None	Extracompartmantal	
IIA	High	None	Intracompartmantal	Excision of tm with compartment
IIB	High	None	Extracompartmantal.	Intralesional
III	Mixed	Yes	Mixed	

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