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Treatment and outcomes of patients with metastatic spinal cord compression: a double-center study

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Abstract. – OBJECTIVE: Spinal metastases may only affect the bone tissue and result in spinal instability or may additionally result in epidural compression, leading to neurological deficits. Surgery has emerged as a popular method in treating metastatic epidural spinal cord compression (MESCC) due to the advances in surgical techniques and instrumentation. In this study, we evaluated patients with MESCC regarding neurological status, pain status, and survival rates, and presented our experience managing MESCC.

PATIENTS AND METHODS: Clinical and radiographic records of 53 patients diagnosed with MESCC between January 2011 and March 2017 were retrospectively evaluated. The study included patients with a pathological diagnosis of primary cancer, those who complained of spinal metastasis, and those who had indications of MESCC on Magnetic Resonance Imaging (MRI). Bone structure and spinal stability were evaluated using assessed Computed Tomography (CT), and metastatic spread was considered using assessed Positron Emission Tomography (PET) in suitable cases. For each patient, the presence of a tumor compressing the spinal cord, age, gender, preoperative, and postoperative American Spinal Injury Association scores (ASIA), Tokuhashi prognostic score (TPS), affected spinal segment, pathological diagnosis, preoperative, and postoperative Visual Analog Scale (VAS), the status of spinal stability, follow-up period, and complications were evaluated.

RESULTS: Forty-five patients (82.2% of them were women) underwent surgery with a mean age of 58.29 ± 15.14 years. The most frequent type of primary tumor was multiple myeloma (33.9%), followed by lung (24.6%), gastric (7.5%), and prostate (5.7%). The most common site of metastasis was the thoracic region (43.4%), followed by lumbar (24.5%), multiple (24.5%), and cervical (5.7%). The analysis indicated that a significant difference was found between the survival rates of the TPS categories.

CONCLUSIONS: Common symptoms of MESCC include spinal pain and neurological deficit below the level of the injury. Prompt surgical treatment followed by oncological treatment leads to significant neurological recovery, more prolonged survival, pain relief, and improved quality of life in patients with a short survival time. Oncological treatments, including radiotherapy (RT), should be recommended after surgical treatment.

Key Words:
Metastasis, Spine, ASIA, MESCC, TPS.

Abbreviations
MESCC: Metastatic Epidural Spinal Cord Compression; ASIA: American Spinal Injury Association; VAS: Visual Analog Scale; TPS: Takuhashi Prognostic Score; MRI: Magnetic Resonance Imaging; CT: Computer Tomography; PET: Positron emission tomography; RT: Radiotherapy.

Introduction

The incidence of spinal metastases increases in line with the improvements in survival rates associated with the advances in tumor treatment. Approximately 30-50% of patients with tumors are considered to have spinal metastasis[1]. Moreover, these rates can be as high as 70% in autop-

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sy studies[2,3]. Spinal metastasis mainly occurs in the epidural space, primarily attacking the spine in 94-98% of the patients. However, intradural spinal metastasis is only observed in 0.5% of patients with spinal metastasis[4]. Metastatic epidural spinal cord compression (MESCC) is an oncologic emergency occurring in 5-14% of patients with tumors, leading to acute neurological deficits and spinal pain[5]. MESCC is also defined as radiographic evidence of an epidural metastatic lesion leading to the displacement of the spinal cord from its normal position in the spinal canal[6]. MESCC occurs in approximately 5-10% of patients with tumors, and this rate can be up to 40% in patients with extraspinal bone involvement[7-9]. In addition, MESCC is a neurological emergency that, if not treated promptly, and effectively, particularly in the early stages of the disease, may result in neurological deficits, including motor, sensory, and sphincter dysfunction, as well as severe pain and instability and may harm patient function and quality of life[10,11]. However, the effect of prompt diagnosis and successful treatment with surgery and radiotherapy (RT) on overall survival remains controversial. Nevertheless, advances in surgical techniques and instrumentation have allowed effective decompression and stabilization of the spine, ensuring spinal stability, eliminating spinal cord compression, and leading to pain relief.

This study aimed to investigate the effectivity of preoperative and the postoperative American Spinal Injury Association (ASIA) Impairment Scale, Visual Analog Scale (VAS), and the Tokuhashi Prognostic Score (TPS) in the prediction of the prognosis and to determine whether there is a relationship among these measures and whether there is a relationship between the pathological diagnosis and survey, and also to explore the factors affecting survival, such as extraspinal bone involvement in 45 patients with MESCC that underwent surgical treatment.

Patients and Methods

Fifty-three patients who received MESCC treatment between January 2011 and November 2017 at the Neurosurgery departments at Yuzuncu Yil University Medical School and Bagcilar Training and Research Hospital were included in this retrospective study. Patients with a pathological diagnosis of a primary tumor (with no central nervous system or spinal origin), those presenting with complaints of spinal metastasis, and the indications of MESCC on Magnetic Resonance Imaging (MRI) were included in the study. In addition, the cases of MESCC caused by hematological diseases (e.g., multiple myeloma and lymphoma) were also included in the study.

The evaluations were performed on the basis of the medical and radiological records of the patients, including their diagnosis, treatment, and clinical outcomes. For each patient, the presence of a tumor compressing the spinal cord, age, gender, preoperative, and postoperative scores, TPS scores, affected spinal segment, pathological diagnosis, preoperative, and postoperative VAS scores, statute spinal stability, follow-up period, and complications were evaluated. In addition, the local, and systemic complications that occurred within the first postoperative month were also assessed. Spinal instability was determined based on Denis'3-Co theory under the guidance of spinal Computed Tomography (CT). The diagnosis of the tumors causing MESCC was established using contrast and non-contrast MRI.

Pain intensity and neurological function were assessed 3 months before and after surgery. Pain intensity was scored using the VAS-based point numeric scale, where 0 represents no pain, and 10 illustrates severe pain. The preoperative and postoperative mean VAS scores were used for the evaluations. Neurological function was assessed using American Spinal Injury Association (ASIA) scores that were analyzed retrospectively from the patient records. ASIA-A: The impairment is complete. There is no motor or sensory function left below the level of injury. ASIA B: The impairment is incomplete. Sensory function, but not motor function, is preserved below the neurologic level (the first normal level above the level of injury), and some sensation is preserved in the sacral segments S4 and S5. ASIA-C: The impairment is incomplete. Motor function is preserved below the neurologic level, but more than half of the key muscles below the neurologic level have a muscle grade less than 3. ASIA-D: The impairment is incomplete. Motor function is preserved below the neurologic level, and at least half of the key muscles below the neurologic level have a muscle grade of 3 or more. ASIA- E: The patient's functions are normal. All motor and sensory functions are unhindered. The ASIA scores were obtained before surgery 3 months after assessments. All the surgical, medical, and radiological procedures were performed based on the preferences of the surgical and oncological teams. A preliminary diagnosis of the tumors was established based on the neurological examination, patient history, and radiographic images, whereas a definitive diagnosis was confirmed

by pathological examination. A radiological examination was performed to evaluate the patients with MESCC. Bone structure and spinal stability were evaluated using assessed CT, and metastatic spread was considered using assessed Positron Emission Tomography (PET) in suitable cases.

Statistical Analysis

Data were analyzed using SPSS 20.0 for Windows (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean, standard deviation, minimum, and maximum. Categorical variables were expressed as frequencies and percentages. Preoperative and postoperative VAS and ASIA scores were compared using the Wilcoxon rank sum test. Survival analysis was performed using the Kaplan-Meier method. Binary comparisons of binary survival periods were performed using the log-rank test. A p-value of < 0.05 was considered significant.

Results

The 53 patients included 42 (79.2%) men and 11 (20.8%) women with a mean age of 58.79 ± 14.75 (range, 14-81) years. Of these, 45 patients underwent surgery, including 8 (17.8%) men and 37 (82.2%) women with a mean age of 58.29 ± 15.14 (range, 14-81) years (Table I).

The most frequent type of primary tumor was multiple myeloma (33.9%), followed by lung (24.6%), gastric (7.5%), renal (7.5%), prostate (5.7%), and other tumors (20.8%). The most common site of metastasis was the thoracic region (43.4%; upper thoracic region, 26.4%; and lower thoracic region, 17.0%), followed by lumbar (24.5%), multiple (24.5%), cervical (5.7%), and sacral (1.9%) regions (Table I).

Preoperative ASIA scores indicated that the neurological function of the patients was completely impaired (ASIA-A) in 10 (18.9%) patients, incompletely impaired (ASIA-B, ASIA-C, and ASIA-D) in 27 (50.9%) patients, and regular (ASIA-E) usual 16 (30.2%) patients. However, these rates changed to 5 (11.1%) for ASIA-A; 22 (48.8%) for ASIA-B, ASIA-C, and ASIA-D; and 18 (40.1%) for ASIA-E, postoperatively, indicating that the number of patients with normal neurological function (ASIA-E) increased from 13 preoperatively to 18 postoperatively. In addition, a significant difference was observed between the preoperative and postoperative ASIA scores ($p < 0.001$) (Table I).

All the patients had spinal pain at varying degrees due to spinal metastasis. The mean VAS score decreased from eight preoperatively to three postoperatively. Moreover, a significant difference was found between preoperative and postoperative median VAS scores ($p < 0.001$), and the VAS scores decreased significantly after the surgery (Table I).

Prognostic scoring of the spinal metastases was achieved using a frequent system known as TPS. The analysis indicated a significant difference between the survival rates about categories. Moreover, 26 (81.3%) of the non-surviving patients had a TPS score of 0-8 ($p = 0.001$). Twenty-one (61.9%) of the living patients had a TPS score of 9-12. These values showed that the use of TPS in the score in the prognosis was influential in the literature (Table II).

In our study, a significant difference was found between the survival rates of the TPS categories. In addition, 26 (81.3%) of the non-surviving patients had a TPS score of 0-8. Of the 10 patients that had metastases to other organs and died within the first month after diagnosis, eight (80%) of them had a TPS score of 0-8, and two (20%) of them had a score of 9-12 (Table III).

Extraspinal metastasis was detected in 10 patients, in whom the lung was the most commonly affected site. Ten (18.9%) patients received no oncological treatment and died within the first month after diagnosis. Surgical complications occurred in eight (17.7%) patients, of which 4 developed wound site infections and were treated by medical treatment, and three died from postoperative pulmonary complications. One patient developed right recurrent nerve palsy (Table IV).

Of the 45 patients who underwent surgery, 22 (48.9%) patients underwent internal stabilization followed by tumor excision due to a tumor-causing MESCC with spinal instability associated with spinal metastasis. In contrast, the remaining 23 (51.1%) patients underwent tumor excision without needing stabilization.

The survival analysis indicated that 32 patients died, and 21 remained alive when the study ended. The most common causes of death included lung tumors (n = 17; 53.1%) and malignant melanoma (n = 7; 21.9%). The Kaplan-Meier method was used to predict postoperative survival and the survival time from the initial diagnosis of the metastatic disease to death. The analysis revealed that 19 (90.5%) of the 21 surviving patients had no extraosseous metastasis, while 2 (9.5%) had extraosseous metastasis. However, no significant

Table I. Demographics and clinical characteristics of study subjects.

	Characteristics	Total n (%)	Operated n (%)
Mean age (years) (min-max = 14-81)		58.79 ± 14.75	58.29 ± 15.14
Gender	Male	42 (79.2)	37 (82.2)
	Female	11 (20.8)	8 (17.8)
Tumor main histology origin	Lung	13 (24.6)	9 (20)
	Multiple myeloma	18 (33.9)	14 (31.1)
	Gastric	4 (7.5)	4 (8.8)
	Renal	4 (7.5)	4 (8.8)
	Prostate	3 (5.7)	3 (6.6)
	Other	11 (20.8)	11 (24.4)
	Total	53 (100.0)	45 (100)
Metastasis's location	Cervical	3 (5.6)	2 (4.4)
	Upper thoracic	14 (26.4)	12 (26.6)
	Lower thoracic	9 (16.9)	8 (17.7)
	Lumbar	13 (24.5)	13 (28.8)
	Sacral	1 (1.8)	1 (2.2)
	Multiple	13 (24.5)	9 (20)
	Total	53 (100)	45 (100)
ASIA preoperatively	A	10 (18.9)	8 (17.8)
	B-D	27 (51)	24 (53.3)
	E	16 (30.2)	13 (28.9)
ASIA postoperatively	A	-	5 (11.1)
	B-D	-	22 (48.8)
	E	-	18 (40)
VAS preoperatively	Median	8	7.8
	Mean	7.8	8
VAS postoperatively	Median	3	2.91
	Mean	2.91	3
Takuashi prognostic scale	TPS 0-8	33 (62.2)	27 (60)
	TPS 9-12	18 (34)	16 (35.6)
	TPS 13-15	2 (3.8)	2 (4.4)
Status	Death	32 (60.3)	26 (57.8)
	Survival	21 (39.7)	19 (42.2)
	Total	53 (100)	45 (100)

VAS: Visual Analog Scale; ASIA: American Spinal Injury Association Scores.

difference was established between these two rates ($p = 0.282$).

Figures 1 and 2 show the preoperative and postoperative radiological images of the two patients who underwent surgery.

Discussion

The incidence of MESCC increases with an increasing population of older adults and consequent increased tumor incidence, resulting in new treatment modalities. In the past, surgical decompression without instrumentation was the method of choice in treating MESCC, but this method did not obtain favorable outcomes. Moreover, it has been long believed that RT alone is superior to decompressive laminectomy, followed by RT for treating MESCC[12-14]. However, this belief has been losing ground since the 1980s due to the advances in surgical techniques, improvements in spinal instrumentation, and the emergence of novel methods for treating pain and neurological deficits associated with spinal instability[15-17].

Palliative treatment is the mainstay treatment for MESCC. However, surgery is mandatory in

Table II. Relationship between TPS and survival.

		Survival (%)		
		Exitus	Live	Total
TPS	0-8	26 (81.3%)	7 (33.3%)	33 (62.3%)
	9-12	5 (15.6%)	13 (61.9%)	18 (34.0%)
	13-15	1 (3.1%)	1 (4.8%)	2 (3.8%)
Total	32 (100%)	21 (100%)	53 (100%)	

TPS: Takuhashi Prognostic Score.

Table III. The relationship between TPS and the presence of cancer in different organs with MESCC.

		The presence of metastases in other regions		
		Yes	No	Total
TPS	0-8	8 (80%)	25 (58.1%)	33 (62.3%)
	9-12	2 (20%)	16 (37.2%)	18 (34%)
	13-15	0	2 (4.6%)	2 (3.8%)
Total	10 (100%)	43 (100%)	53 (100%)	

TPS: Takuhashi Prognostic Score.

patients with neurological deficits and spinal pain, with a predicted survival of over 3 months. In such patients, the primary aim of surgery is to improve their quality of life in their remaining life[18,19].

The cause of MESCC is complex and associated with multiple factors, although two prominent mechanisms are reported in the literature. However, if the compression has a short duration, the effects are reversible, and remyelination and recovery of neurological function are possible[8,20].

The addition of surgical treatment to oncological treatment has led to significantly improved logical recovery, survival, and quality of life compared with oncological treatment alone[5,21,22]. In addition, it has also been shown that decompressive spinal surgery alone or followed by RT is associated with improved ambulatory status[5,23,24].

Table IV. Complications.

Complications	Yes	8 (22%)
	No	36 (78%)
	Total	45 (100%)

TPS: Takuhashi Prognostic Score.

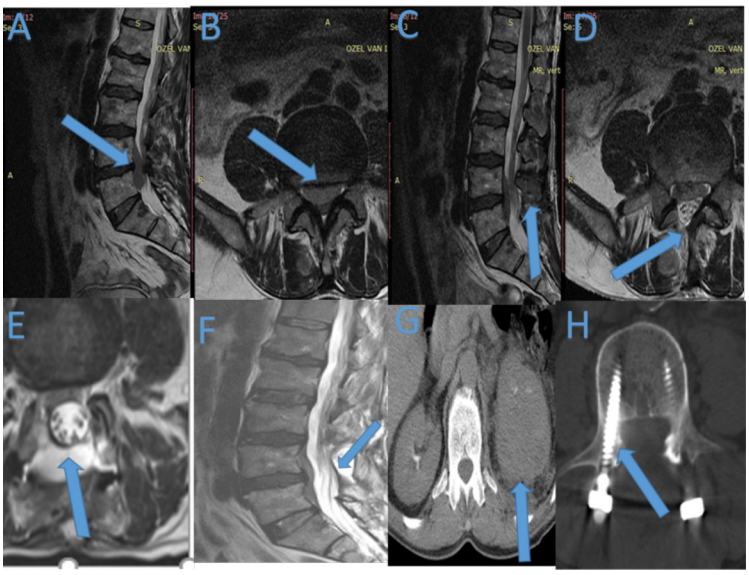

Figure 1. **A-B**, A 61-year-old male patient with primary renal cell carcinoma. First preoperative lumbar axial and sagittal T2 MR images. Epidural mass compressing the spinal canal. The patient was operated on considering the lumbar disk hernia in the external center (arrow). **C-D**, First postoperative axial and sagittal lumbar T2 MR images. Right L4-5 hemilaminectomy defect (arrow). **E-F**, Second postoperative lumbar sagittal and axial T2 MR images. Removal of tumor tissue with total laminectomy (arrow). **G-H**, Second postoperative vertebra CT images. Pedicle screw and a giant mass in the left kidney (arrows).

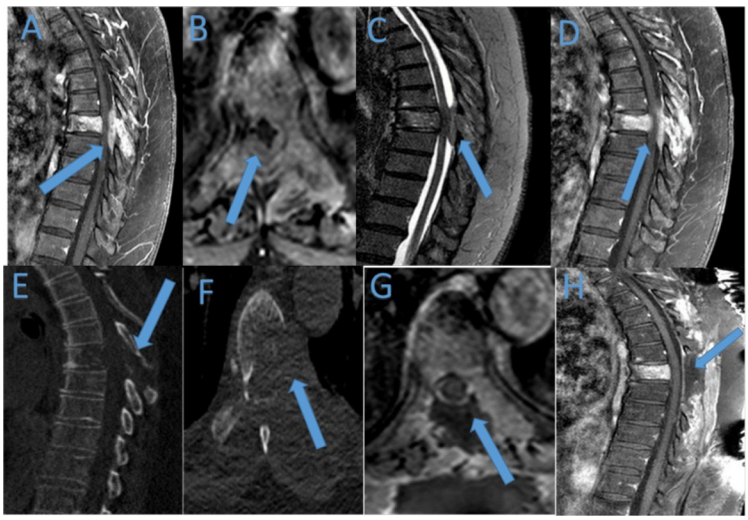

Figure 2. **A-D**, A 74-year-old female patient with primary lung cancer. Preoperative thoracic sagittal and axial MR images (T1-T2 image and contrast unenhanced). Metastatic mass causing pressure on spinal cord epidural space at the T7 level. **E-F**, Thoracal CT and CT sagittal reconstruction images. In addition to spinal cord compression in the epidural area, a mass erodes in the bone tissue (arrows). **G-H**, Postoperative axial and sagittal T1 MR images. The mass was removed with total laminectomy, and the spinal cord pressure was released (arrow).

However, Patchell et al[5] reported that surgery is the primary method of choice in the treatment of MESCC, and RT is often performed after surgery. Compared with patients who underwent decompressive surgery alone, patients who underwent radiation therapy had a more significant improvement in ambulatory status, retained the ability to walk at the last follow-up, and had a lower need for postoperative steroids and analgesics.

RT alone is often performed in the cases of MESCC resulting from radiosensitive tumors such as myeloma, lymphoma, and small-cell lung carcinoma without spinal instability. Moreover, RT alone can be administered in patients with a cancer spinal canal intrusion and with progressive neurological deficits or a predicted survival of fewer than 3 months. However, surgical decompression and stabilization are often performed in the cases of MESCC resulting from radioresistant tumors and the tumors recurring after radiation therapy, in patients with cord compression due to bone, and spinal instability, in patients experiencing rapid neurological decline during radiation, and in cases where tissue diagnosis is mandato-

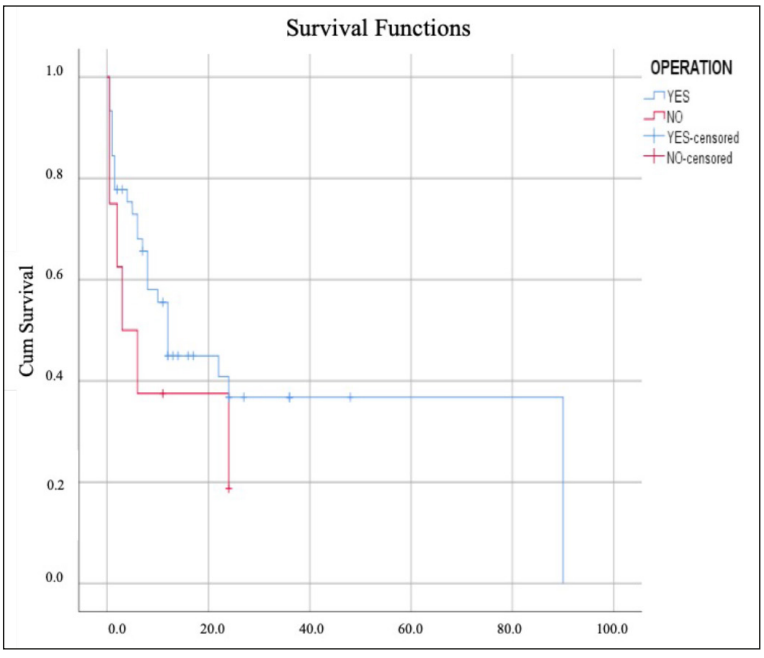

Figure 3. Survivor and operation between relationship.

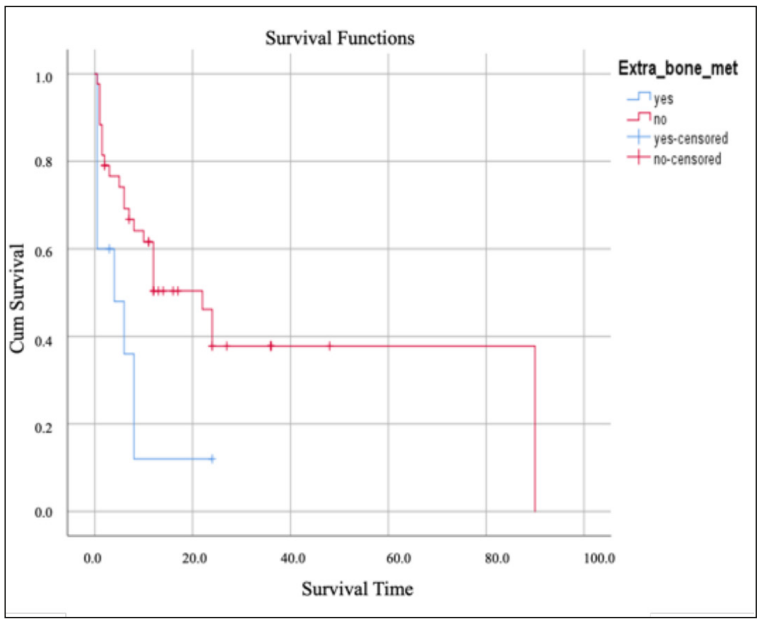

Figure 4. Extra bone metastasis and survivor between relationship.

ry[25,26]. In addition, surgical decompression also leads to increased survival time and decreases the need for corticosteroid and analgesic drugs[5]. In our study, 10 patients received no oncological treatment, and all died within the first month after diagnosis.

In our study, neurological impairment was evaluated using the ASIA impairment scale. Neurological function was scored as complete deficits (ASIA-A), incomplete deficits (ASIA-B to ASIA-D), and neurologically intact (ASIA-E). Neurological recovery was achieved in 12 (26.6%) operated patients according to ASIA scores. The proportion of patients with ASIA-A scores decreased from 17.8% to 11.1% preoperatively, and the total rate of patients with ASIA-B, ASIA-C, ASIA-D, and ASIA-E scores increased from 82.2% preoperatively to 88.8% postoperatively.

Patients with MESCC often present severe mechanical pain with spinal involvement. This pain usually is not alleviated by medical treatment and resting and thus requires surgical treatment[27]. On the other hand, in patients with isolated MESCC, neurological deficits tend to be more prominent than pain. Moreover, this pain is significantly reduced after surgical treatment[28,29]. Our study's mean VAS scores decreased significantly after surgery, from 7.89 to 2.91 postoperatively.

Literature indicates that the lung is the most frequent primary tumor site in patients diagnosed with MESCC. Furthermore, it has been shown that patients with lung and prostate tumors accompanied by MESSC have lower survival times than patients with other types of solid primary tumors accompanied by MESCC[30,31]. On the other hand, another study[10,32] showed that MESCC was attended mainly by myeloma, prostate, and nasopharyngeal tumors, followed by lung, breast, and gastrointestinal tumors. In line with the literature, if the patients with hematopoietic tumors were ruled out, lung tumor was the most common primary tumor in our patients. In addition, mortality occurred in 92.3% of the patients with MESCC caused by lung tumor metastasis and in 38.9% of the patients with malignant melanoma, the second most common primary tumor in our patients. However, no significant difference was found between mortality and survival in patients with other tumors. Fehlings et al[31] reported that the median survival time was 7.7 months, and 30-day and 12-month mortality rates were 9% and 62%, respectively. Similarly, Cavalcante et al[33] reported that the mortality rates at postoperative months 1, 3, and 12 were 10%, 36%, and 67%, respectively. In our study, the mortality rates at postoperative months 1, 3, 12, and 12+ were 28.9%, 25%, 34.3%, and 12.5%, respectively (Figure 3). Literature shows that the mortality rates at postoperative month 1 vary between 4% and 22%. In our study, this rate was 28.9% in our patients, which was remarkably higher than those reported in the literature[16,28,29].

MESCC is also an oncologic emergency that may lead to irreversible spinal cord injury unless treated promptly. Moreover, no remarkable recovery can be achieved once this type occurs. In patients with MESCC, the effect of surgical decompression is often immediate, whereas RT takes several days to exert its effect[34,35]. On the other hand, some malignancies manifest as MESCC in 20% of patients with no prior tumor diagnosis, among which one-third of lung tumors present as MESCC[32,36]. Common malignancies that present as MESCC include multiple myeloma, lung tumor, non-Hodgkin lymphoma, and renal cell carcinoma, which account for almost 80% of the cases. Livingston et al[37] reported this rate as 10%, whereas we found 16.9% in our study.

When we examined the cases where only MESCC mass excision was performed, and no stabilization was applied (23 patients), the hematopoietic system was found to be present in 11 patients (especially nine cases of multiple myeloma), mainly including multiple myeloma followed by lung tumor metastasis. On the other hand, Cavalcante et al[33] reported that lung, breast, and digestive tract tumors had an osteolytic nature and were associated with mechanical instability, fractures, and pain. In our study, lung and digestive tract tumors causing instability and MESCC were the most common cases among those that underwent tumor excision; however, no patient had a breast tumor causing instability or MESCC. This finding could be attributed to the high incidence of digestive tract tumors in the geographical region where our study was conducted too[38]. On the other hand, it has also been shown that patients with breast tumors have the most prolonged delay from diagnosis of the primary tumor to development of spinal cord compression[39]. This can be attributed to the relatively lower incidence of breast tumors and the somewhat higher birth rate in the regions where our study was conducted compared with the other areas, implicating that parity has a protective effect on a breast tumor. Moreover, the absence of MESCC in our patients with breast tumors could also be explained by the fact that there are ubiquitous screening programs for breast tumors, and cases of breast tumors are often diagnosed at early stages in the regions where our study was conducted. Spinal metastasis is caused by a breast tumor or usually takes a long time to manifest within the course of the breast tumor.

Extraspinal metastasis in patients with MESCC is a crucial factor affecting treatment and survival. A previous study[33] evaluated 79 patients with MESCC and reported that 93.6% were with visceral metastasis. These patients had an overall survival of 13 months, which was lower than the overall survival in patients without visceral metastases. Similarly, in our study, 10 patients had metastases to other organs and died within the first month after diagnosis (Figure 4).

The TPS is a scoring system consisting of six items related to patient outcome (type of the primary tumor, number of bone metastases other than spinal metastases, number of spinal metastases, general condition, state of paralysis, and presence or absence of metastases to major organs)[40]. Tokuhashi et al[40] suggested aggressive tumor excision for patients with a TPS score of ≥ 9 and a predicted survival of ≥ 1 y. They suggested palliative treatment instead of surgery in patients with a TPS score of 0-8 and an expected survival of ≤ 6 months. Yamashita et al[41] showed that the TPS helped predict the actual survival periods in 67 (79%) of 85 patients that were followed up for 12 months or longer and also noted that the success of TPS was independent of the selected treatment.

Another study[42] examined the relationship between MRI findings and ambulatory function after RT. This study revealed that the MRI findings of grade 3 MSCC were significantly associated with poor mobile function post-RT. This may be a determining indication for RT based on MRI findings, and physicians need to pay attention to patients with MSCC and perform RT before progressing to grade 3 MRI findings.

Our study found a significant difference between the survivals of patients regarding the TPS categories. In addition, 26 (81.3%) of the non-surviving patients had a TPS score of 0-8. Of 10 patients that had metastases to other organs and died within the first month after diagnosis, 8 (80%) of them had a TPS score of 0-8, and 2 (20%) of them had a score of 9-12 (Table III). These findings, in line with the literature, indicate that TPS is a valuable prognostic marker in patients with MESCC.

Surgical complications have been reported in 20%-30% of patients with MESCC, with wound site infection reported in up to 30% of the patients[29]. A study[33] reported that the complication rate was 27% in their patients, among whom wound infection occurred in 11.4% of the patients. In another study[19], the surgical complication rate was 26%; the wound infection was reported as 7%. In another study[43], two surgical methods were applied to patients with metastatic epidural spinal metastases, and their complications were

compared. It has been reported that patients who were operated on with the posterior approach had lower surgical complication rates and less length of stay in the intensive care unit compared with those treated with the anterior approach. In our study, of the 45 patients that underwent surgery, 9 (20%) patients had postoperative complications, including wound infection (n = 3), dyspnea associated with pneumonia (n = 3), bilateral pleural effusion (n = 1), pedicular screw malposition after stabilization (n = 1), and recurrent nerve paralysis (n = 1). Of these nine patients, two died due to pneumonia during treatment, and seven were even treated with appropriate treatment methods.

Our study could have been more extensive in several ways. First, there was no algorithm for the treatment in our hospital. Thus, the treatment procedures were performed based on the clinical features of each patient and the references of the surgical and oncological teams and the specialist physician treating the primary disease. Second, since our hospital's medical services related to radiation oncology and medical oncology were limited, no proper evaluation was performed for the treatment procedures in other health centers. The type of primary tumors in our patients was heterogeneous. Therefore, all the patients with different types of primary tumors were evaluated together in the same study population. Finally, the study was a retrospective observational study. On the other hand, the main strength of our work was partly to explain the surgical outcomes for a series of consecutive patients.

The primary aim of the present study was to present the clinical features of patients with MESCC diagnosed consecutively in two different health centers within a short period and also to report on the surgical outcomes of the patients that underwent surgical treatment. We contribute to the literature by presenting the differences between patients with MESCC and patients with different primary tumors. Moreover, we also gave the relationship among the ASIA, VAS, and TPS methods. We predicted survival, which may help determine the indications for surgery and whether to perform decompression alone or with stabilization.

Conclusions

Spinal pain and neurological deficit below the level of the injury are common manifestations of MESCC, particularly in cases with spinal involvement. Prompt surgical treatment followed by oncological treatment leads to significant neurological recovery, more prolonged survival, pain relief, and improved quality of life in patients with a short survival time (particularly those with low ASIA and TPS scores, neurological dysfunction, and high VAS scores). Nevertheless, it is worth noting that although surgical treatment plays a vital role in the survival of patients with MESCC, survival in these patients is closely associated with the type of primary tumor. Therefore, oncological treatment should be advised after surgical treatment.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Funding

None.

Ethics Approval

The Ethics Committee of the Yuzuncu Yil University Faculty of Medicine, Non-Interventional Clinical Research approved this research with decision No. 26, dated 11.2.2017.

Informed Consent

Not applicable due to the retrospective nature of the study.

Authors' Contributions

Study Design: A. Aycan, B. Eren; Data Collection: E. Saglam, F. Kuyumcu, M. E. Akyol, A. Tas; Methodological Design of the study: A. Aycan, B. Eren; Statistical Analysis: S. Celik, N. Aycan; Data Acquisition And Process: E. Saglam, A. Tas, M.E Akyol; Data Interpretation: A. Aycan, B. Eren, S. Celik, F.K. Guzey; Manuscript Preparation: A. Aycan, B. Eren; Literature Search: A. Aycan, B. Eren; Manuscript Writing: A. Aycan, B. Eren; Manuscript Review And Revision: A. Aycan, B. Eren.

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References

1) Walsh GL, Gokaslan ZL, McCutcheon IE, Mineo MT, Yasko AW, Swisher SG, Schrump DS, Nesbitt JC, Putnam JB Jr, Roth JA. Anterior approaches to the thoracic spine in patients with cancer: indications and results. Ann Thorac Surg 1997; 64: 1611-1618.
2) Ortiz Gomez JA. The incidence of vertebral body metastases. Int Orthop 1995; 19: 309-311.
3) Galasko CS. Skelatal metastases. Clin Orthop Relat Res 1986; 210: 18-30.
4) Schick U, Marquardt G, Lorenz R. Intradural and extradural spinal metastases. Neurosurg Rev 2001; 24: 1-5.
5) Patchell RA, Tibbs PA, Regine WF, Payne R, Saris S, Kryscio RJ, Mohiuddin M, Young B. Direct de-compressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: A randomized trial. Lancet 2005; 366: 643-648.
6) Witham TM, Khavkin YA, Gallia GL, Wolinsky JP, Gokaslan ZL. Surgery Insight: current management of epidural spinal cord compression from metastatic spine disease. Nat Clin Pract Neurol 2006; 2: 87-94.
7) Gerszten P and Welch W. Current surgical management of metastatic spinal disease. Oncology (Williston Park) 2000; 14: 1013-1024.
8) De Angelis LM, Posner JB. Spinal metastases. In: Neurologic Complications of Cancer. Philadelphia, PA: FA Davis Co, 1995; 111-142.
9) Morgen SS, Engelholm SA, Larsen CF, Søgaard R, Dahl B. Health-related Quality of Life in Patients with Metastatic Spinal Cord Compression. Orthop Surg 2016; 8: 309-315.
10) Cavaliere R, Schiff D. Epidural Spinal Cord Compression. Curr Treat Options Neurol 2004; 6: 285-295.
11) Vega RA, Traylor JI, Habib A, Rhines LD, Tatsui CE, Rao G. Minimally Invasive Separation Surgery for Metastases in the Vertebral Column: A Technical Report. Oper Neurosurg (Hagerstown) 2020; 18: 606-613.
12) Gokaslan ZL, York JE, Walsh GL. Transthoracic vertebrectomy for metastatic spinal tumors. J Neurosurg 1998; 89: 599-609.
13) Mazel C, Balabaud L, Bennis S. Cervical and Thoracic Spine Tumor Management: Surgical indications, techniques and Outcomes. Orthop Clin North Am 2009; 40: 75-92.
14) Sakaura H, Hosono N, Mukai Y, Ishii T, Yonenobu K, Yoshikawa H. Outcome of total en bloc spon-dylectomy for solitary metastasis of the thoracolumbar spine. J Spine Disord Tech 2004; 17: 297-300.
15) Tomita K, Kawahara N, Kobayashi T, Yoshida A, Murakami H, Akamaru T. Surgical strategy for spinal metastases. Spine 2001; 26: 298-306.
16) Patil CG, Patil TS, Lad SP, Boakye M. Complications and outcomes after spinal cord tumor resection in the United States from 1993 to 2002. Spinal Cord 2008; 46: 375-379.
17) Barzilai O, Fisher CG, Bilsky MH. State of the Art treatment of metastatic spinal disease. Neurosurgery 2018; 82: 757-769.
18) Wänman J, Grabowskı P, Nyström H, Gustafsson P, Bergh A, Widmark A, Crnalic S. Metastatic spinal cord compression as the first sign of malignancy Outcome after surgery in 69 patients. Acta Orthop 2017; 88: 457-462.
19) Quan GM, Vital JM, Aurouer N, Obeid I, Palussière J, Diallo A, Pointillart V. Surgery improves pain, function, and quality of life in patients with spinal metastases: A prospective study on 118 patients. Eur Spine J 2011; 20: 1970-1978.
20) Byrne TN, Benzel E, Waxman SG. The disease of the spine and spinal cord. Oxford University Press 2000; 166-205.
21) Laufer I, Bilsky MH. Advances in The Treatment of Metastatic Spine Tumors: the future is not what it used to be. J Neurosurg Spine 2019; 30: 299-307.
22) Moussazadeh N, Laufer I, Yamada Y, Bilsky M. Separation surgery for spinal metastases: Effect of spinal radiosurgery on surgical treatment goals. Cancer Control 2014; 21: 168-174.
23) Klimo P Jr, Thompson C J, Kestle J R, Schmidt MH. A meta-analysis of surgery versus conventional ra-diotherapy for metastatic spinal epidural disease. Neuro Oncol 2005; 7: 64-76.
24) Lee CH, Kwon JW, Lee J, Hyun SJ, Kim KJ, Jahng TA, Kim HJ. Direct decompressive surgery followed by radiotherapy versus radiotherapy alone for metastatic epidural spinal cord compression: a meta-analysis. Spine 2014; 39: 587-592.
25) Petteys RJ, Sciubba DM, Gokaslan ZL. Surgical management of metastatic spine disease. Semin Spine Surg 2009; 21: 86-92.
26) Dakson A, Leck E, Brandman DM, Christie SD. The Clinical utility of the spinal instability Neoplastic Score (SINS) system in spinal epidural metastases: a retrospective study. Spinal Cord 2020; 58: 892-899.
27) Maseda M, Uei H, Nakahashi M, Sawada H, Tokuhashi Y. Neurological treatment outcome for patients with impending paralysis due to epidural spinal cord compression by metastatic spinal tumor. J Orthop Surg Res 2019; 14: 291.
28) Jansson KA, Bauer HC. Survival, complications, and outcome in 282 patients operated for neurological deficit due to thoracic or lumbar spinal metastases. Eur Spine J 2006; 15: 196202.
29) Hirabayashi H, Ebara S, Kinoshita T, Yuzawa Y, Nakamura I, Takahashi J, Kamimura M, Ohtsuka K, Takaoka K. Clinical outcome and survival after palliative surgery for spinal metastases: Palliative surgery in spinal metastases. Cancer 2003; 97: 476484.
30) Sundaresan N, Steinberger AA, Moore F, Sachdev VP, Krol G, Hough L, Kelliher K. Indications and re-sults of combined anterior, posterior approaches for spine tumor surgery. J Neurosurg 1996; 85: 438-446.

31) Fehlings MG, Nater A, Tetreault L, Kopjar B, Arnold P, Dekutoski M, Mark B, Finkelstein JA, Fisher CG, France JC, Gokaslan Z. Survival and clinical outcomes in surgically treated patients with metastatic epidural spinal cord compression. Results of the prospective multicenter AO spine study. J Clin Oncol 2016; 34: 268-276.

32) Schiff D, O'Neill BP, Suman VJ. Spinal epidural metastasis as the initial manifestation of malignancy: Clinical features and diagnostic approach. Neurology 1997; 49: 452-456.

33) Cavalcante RA, Fernandes YB, Marques RA, Santos VG, Martins E, Zaccariotti VA, Arruda JB, Tatsui CE, Joaquim AF. Is there a correlation between the spinal instability neoplastic score and mechanical pain in patients with metastatic spinal cord compression? A prospective cohort study. J Craniovert Jun Spine 2017; 8: 187-192.

34) Zairi F, Karnoub MA, Vieillard MH, Bouras A, Marinho P, Allaoui M, Devos P, Assaker R. Evaluation of the relevance of surgery in a retrospective case series of patients who underwent the surgical treatment of a symptomatic spine metastasis from lung cancer. Eur Spine J 2016; 25: 4052-4059.

35) Cole JS, Patchell RA. Metastatic epidural spinal cord compression. Lancet Neurol 2008; 7: 459-466.

36) Bach F, Larsen BH, Rohde K, Borgesen SE, Gjerris F, Boge-Rasmussen T, Agerlin N, Rasmusson B, Stjernholm P, Sorensen PS. Metastatic spinal cord compression: occurrence, symptoms, clinical presenta-tions and prognosis in 398 patients with spinal cord compression. Acta Neurochir 1990; 107: 37-43.

37) Livingston KE, Perrin RG. Neurosurgical management of spinal metastases. J Neurosurg 1978; 49: 839-843.

38) Celik S, Yılmaz E.M, Ozden F, Kotan C, Okut H. The Relationship between Eating and Lifestyle Habits and Cancer in Van Lake Region: Another Endemic Region for Esophageal and Gastric Cancers. J Cancer Epidemiol 2015; 2015: 254823.

39) Helweg-Larsen S, Sorensen PS, Kreiner S. Prognostic factors in metastatic spinal cord compression: a prospective study using multivariate analysis of variables influencing survival and gait function in 153 pa-tients. Int J Radiat Oncol Biol Phys 2000; 46: 1163-1169.

40) Tokuhashi Y, Matsuzaki H, Oda H. A revised scoring system for preoperative evaluation of metastatic spine tumor prognosis. Spine 2005; 30: 2186-2191.

41) Yamashita T, Siemionow KB, Mroz T, Podichetty V, Lieberman IH. A prospective analysis of prognostic factors in patients with spinal metastases: Use of the revised Tokuhashi score. Spine 2011; 36: 910-917.

42) Yano N, Ono T, Suzuki T, Sugai Y, Yamada M, Kawashiro S, Harada M, Akamatsu H, Hagiwara Y, Ichikawa M, Sato H, Takagi M, Kanoto M, Nemoto K. MRI Grading Scale Predicts Ambulatory Function After Radiotherapy for Metastatic Spinal Cord Compression: A Prospective Single-Institution Observa-tional Study. Oncol Ther 2022; 10: 493-501.

43) Liao JC, Chen WJ, Chen LH. Surgery for metastatic epidural spinal cord compression in thoracic spine, anterior or posterior approach? Biomed J 2022; 45: 370-376.