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Clinical Study

Single-stage posterior decompression and stabilization for metastasis of the thoracic spine: prognostic factors for functional outcome and patients' survival

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Abstract

BACKGROUND CONTEXT: There are limited data analyzing radiological and clinical factors for the functional outcomes of surgery for spinal metastasis. Also, there are few studies to investigate the relationship between the functional outcome and the patients' survival. Thus, analysis of both functional outcomes and the survival with their relationship in a possibly homogenous group of patients is worth being reported.

PURPOSE: To assess treatment outcomes of single-stage posterior decompression and stabilization (PDS) with or without corpectomy for thoracic vertebral metastases and to analyze factors affecting both the functional outcome and the patients' survival after the surgical intervention.

STUDY DESIGN: Retrospective observational study.

PATIENT SAMPLE: A consecutive series of 105 patients, who underwent the previously stated surgery for metastatic spinal cord compression (MSCC) of thoracic spine, were included and retrospectively analyzed.

OUTCOME MEASURES: The postoperative functional outcomes were evaluated using visual analog scale and Frankel grade at postoperative 2 weeks, and all patients were followed for survival analysis.

METHODS: An institutional database was searched to identify all patients who underwent single-stage PDS for thoracic metastatic spinal tumors between March 2002 and June 2010. Demographic data as well as preoperative and postoperative medical conditions were collected from medical records. Radiological findings were confirmed on electronic archive. Survival data were obtained either on medical records or with a reference to governmental cancer registry system.

RESULTS: Postoperative pain improvement was more evident in patients receiving anterior column reconstruction and four or more levels of fixation ($p=.02$ and <0.01, respectively). Twenty-one patients (20%) showed improvement of the Frankel grade, and 10 of 21 Frankel C patients became ambulatory. The preoperative Karnofsky Performance Scale (≥ 70) and ambulatory status were significant predictors for the postoperative ambulatory function. After surgery, the median overall survival of the patients was 6.0 months. In the univariate analysis, the patient's age (younger than 60 years), type of primary cancer (ie, moderate and slow growth), no visceral metastases, less than three levels of spinal metastases, and postoperative adjuvant therapy were positively significant for the patients' survival ($p<.05$). In the multivariate analysis, limited (less than three levels) spinal metastases and postoperative adjuvant therapy were proven to significantly prolong the patient's survival (hazard ratios of 0.53 and 0.48, respectively, $p<.05$). Although the functional

FDA device/drug status: Approved for these indications (pedicle screw; metallic cage for anterior reconstruction; wire and bone cement for anterior reconstruction).

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outcomes did not directly influence the patients' survival, the patients with better functional outcome showed increased chance of receiving postoperative adjuvant therapy ($p<.01$).
CONCLUSIONS: Single-stage PDS with or without corpectomy effectively improved the functional status of patients with MSCC of the thoracic spine and also afforded the patients to have more chances of postoperative adjuvant therapy, which was significant for patients' survival. Therefore, we suggest that the role of surgery in the management of MSCC could be not only a symptomatic palliation but also a strategy to prolong patients' survival.

Keywords: Metastasis; Surgical decompression; Survival; Thoracic vertebrae; Treatment outcome

Introduction

The spine is one of the most common locations of metastasis in patients with systemic malignancy [1,2]. Spinal metastasis usually occurs in disseminated cancer and is associated with dismal prognosis [1–4]. Furthermore, it devastates the patient's function, especially in cases of metastatic spinal cord compression (MSCC) [5–7]. Surgical intervention can afford both prompt restoration of the neurologic function and immediate stability of the unstable spinal column [8–10]. Furthermore, it has been proven that the surgical approach could provide better restoration of the neurologic deficit than radiation therapy alone [9]. In spite of the improvement of pain and neurologic deficits from surgical intervention, the functional outcome had not significantly affected the overall survival of the patients with spinal metastasis, and the role of surgery has been considered to be palliative. Although most studies reported functional outcomes of surgery for spinal metastases, analyses of radiological and clinical factors for the functional outcomes are rare. And also, there are few studies to investigate the relationship between the functional outcome and the patients' survival. Recent findings from the literature indicate the tendency of longer postoperative survival of patients with better functional outcome provided by means of radical excision of the tumor and rigid fixation of the spinal column [11,12]. However, to give concrete evidence, the factors related to these outcomes need to be confined, and a prospective case-control study is necessary.

In this context, it is worthwhile to analyze the prognostic factors of surgery for patients with spinal metastases, regarding both the survival rate and the functional outcome, and to report the results from possibly homogenous patients treated with the same surgical approach. The thoracic spine is known to be the most common site of MSCC, and at the same time, it includes the most vulnerable spinal segments to the compression [6,13,14]. Hence, to evaluate the factors predicting both the functional outcome and the survival, and to clarify whether the improved functional outcome could influence the overall patients' survival, we retrospectively analyzed the clinical results of 105 consecutive patients with thoracic MSCC, who underwent single-stage posterior decompression and stabilization (PDS), with or without corpectomy, in a single institution.

Materials and methods

Analysis of clinical and radiological data

Between March 2002 and June 2010, a total of 105 consecutive patients, who had received single-stage PDS with or without corpectomy for MSCC of thoracic spine at the National Cancer Center of Korea, were enrolled. Retrospective review of the medical records and radiographic images was done. Indications of surgery were considered for the patients who had MSCC with progressive neurologic deficits, spinal instability, incapacitating pain resistant to conservative care, or combination of the aforementioned symptoms. We assessed age, gender, preoperative and postoperative Karnofsky Performance Scale (KPS), primary cancer, time from the diagnosis of cancer to metastasis, metastases to the visceral organs, preoperative and postoperative visual analog scale (VAS) of pain, preoperative and postoperative Frankel grade, and the survival after operation. The type of primary cancer was classified into slow, moderate, and rapid growth, according to Tomita's classification [15]. We also used the revised scoring system of Tokuhashi et al. for the primary cancer type, which was not specified in the Tomita's classification, and reclassified the colon cancer from rapid growth of Tomita et al. [15] to slow growth based on the suggestion of Tokuhashi et al. [16,17]. The neurologic deficit was assessed using the Frankel grades [18]. Preoperative images were analyzed for both the number of involved segments and the axial extent of the three-column involvement at the most affected level, as previously described [19]. The existence of visceral organ metastases and number of spinal metastases in the whole spine were evaluated based on preoperative imaging studies, including positron-emission tomography, abdominal or chest computed tomography scans, and bone scan, which was performed within 3 months of the surgery.

Measurement of outcomes

The functional outcome was assessed at 2 weeks postoperatively, and the long-term status was measured at 3 months after operation. For evaluation of the functional outcome, we used the Frankel grade and grouped as nonambulatory (Frankel grades A, B, and C) or ambulatory (Frankel grades D and E). A change of the Frankel grade was defined as improved or worsen outcome, whereas