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# Perioperative complication and surgical outcome in patients with spine metastases: Retrospective 200-case series in a single institute☆

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ABSTRACT

*Objective:* Metastatic spinal disease requires a multidisciplinary approach with advanced surgical techniques which improve longevity and the quality of life. The purpose of this study is to compare the surgical outcomes and perioperative complications and mortality among en bloc, debulking, and palliative surgeries in patients with spinal metastasis.
*Methods:* From 2005 to 2010, 200 patients who underwent surgical treatment for spinal metastases were enrolled retrospectively. Clinical analysis included primary cancer type, survival following the diagnosis of cancer, postoperative survival, Tokuhashi score, postoperative functional status, postoperative complications and mortality depending on the surgery type. Enrolled patients were divided into 3 groups: en bloc excision, debulking curettage, and palliative surgery. Surgical outcomes including perioperative complication and mortality were compared based on the surgery type.
*Results:* The mean age was 59.9 years (range 21–87). The major types of primary cancer were lung (42 cases), liver (27 cases), and colorectal cancer (27 cases). 62 surgeries (31.0%) were en bloc excisions, 82 (41.0%) were debulking, and 56 (28.0%) were palliative operations. The mean Tokuhashi score was $9.2 \pm 3.3$ in the en bloc group, $7.2 \pm 3.0$ in the debulking group and $8.2 \pm 2.6$ in the palliative group ($p = 0.001$, ANOVA). Mean postoperative survivals were $17.9 \pm 22.1$ months in the en bloc group, $7.0 \pm 11.7$ months in the debulking group and $8.5 \pm 10.8$ months in the palliative group ($p = 0.022$, ANOVA). There were 8 (12.9%) postoperative complications in the en bloc group, 17 (20.7%) in the debulking group, and 8 (14.3%) in the palliative group ($p = 0.016$, chi-square). Three patients (4.8%) in the en bloc group had multiple complications, as did 5 (6.1%) in the debulking group and 2 (3.6%) in the palliative group ($p = 0.925$, chi-square). Among 21 total perioperative deaths, 6 (28.6%) were in the en bloc group, 10 (47.6%) in the debulking group, and 5 (23.8%) in the palliative group ($p = 0.618$, chi-square).
*Conclusion:* Postoperative complications were most common in the debulking group compared to the en bloc and palliative groups, despite the fact that there were no differences in the improvement of neurologic deficits after surgery. Therefore, selecting the proper surgery based on the patients' symptoms and neurologic status is of great significance in the planning stage of the surgery.


## 1. Introduction

Geriatric populations are at increased risk for cancer, and as their population increases worldwide, so does the incidence of spinal metastasis [1]. Thus, spine specialists are encountering patients with spinal metastasis more often. Advanced multi-modular treatments have improved the life expectancies of these patients [1,2]. Many authors have reported the results of various surgical techniques on progressed spinal metastases [3–5]. The high complication rates of surgical techniques must be weighed against the benefits, otherwise patients can undergo unnecessarily massive procedures, shorten the patients' lifespan, and lower their quality of life [6]. Therefore, surgical outcomes including postoperative survival, perioperative complications and mortality should be analyzed and compared to the various surgical techniques, from the less aggressive palliative method to an en-bloc excision, which is the most aggressive. With this vital information, spinal surgeons can choose the optimal surgical techniques in treating patients with spinal metastasis by weighing the risks and benefits. Accordingly the purpose of this particular study is to compare the surgical outcomes; i.e., postoperative

☆ All the experimental protocols involving human subjects were approved by the Institutional Review Board of each participating institution.

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survival, perioperative complications and mortality among the available surgical options, such as en bloc, debulking, and palliative surgeries in patients with spinal metastasis.

## 2. Materials and methods

From 2005 to 2010, 200 patients who underwent surgical treatment for spinal metastases were listed based on the World Health Organization (WHO) International Statistical Classification of Diseases and Related Health Problems, 10th Revision, 2007, known as ICD-10. Secondary malignant neoplasm of bone and bone marrow code (C79.5) were searched by an electronic medical record search program. The medical records for all enrolled patients were reviewed thoroughly to confirm spinal metastasis and surgery type following approval by the Institutional Review Committee (IRB No. 4-2010-0614). Based on Tokuhashi's strategy for treatment of spinal metastases [4] and oncologists' suggested life expectancy of patients, we decided the method of surgery or conservative treatment. Then, after a discussion with oncologists and radio-oncologists, the best operations for those patients were reconsidered. Finally, patients were divided into 3 groups based on the surgery type: en bloc excision, debulking curettage, and palliative surgery [7].

The en bloc surgery consisted of (1) total corpectomy and posterior pedicular screw fixation with cage insertion, and (2) cage alone and anterior plate and screws. The debulking/curettage surgery included (1) partial corpectomy with anterior column reconstruction using cage or bone cement block plus pedicular screw fixation, (2) posterior screw fixation with decompressive laminectomy and removal of tumor mass from the posterior only and (3) posterior decompressive laminectomy and removal of tumor without pedicle screw insertion.

Palliative surgery mostly consisted of (1) decompressive laminectomy alone, (2) decompressive laminectomy and posterior pedicular screw insertion and (3) posterior pedicular screw instrumentation alone for mechanical instability.

Additional exclusion criteria included (1) patients with spinal metastasis but treated only for benign compression fracture with osteoporosis, (2) patients who underwent surgery only for a pathological biopsy, and (3) patients under 18 years of age.

The indications for surgical treatment were intractable pain, paralysis, or both due to spinal metastases despite medical treatment. To stage spinal metastases, the Tomita classification system was used to describe the number and position of metastatic vertebrae, in which, stage 1–5 indicate spinal metastasis limited to single vertebra, but stage 6 and 7 mean multiple widespread spinal metastases to adjacent or distant vertebrae [5]. To minimize surgeon-specific bias including surgical skills and perioperative complication rate, patients who underwent surgery by two of the most experienced spine surgeon at our hospital were enrolled.

### 2.1. Survival and surgical outcome measures

We measured the survival periods from the time of the primary cancer diagnosis to the time of death and postoperative survival periods based on electronic medical record review. Follow-up was considered to be terminated when patient deaths were confirmed or if patients were still alive at the end of the study. The end date of survival was death or the completion of the study. Patients' deaths were investigated through databases from the Health Insurance Review and Assessment Service, the Central Cancer Registry Centre, and the National Health Insurance Corporation.

All of our patients had at least 2 imaging studies to confirm spinal metastasis, including a F-18-fluorodeoxyglucose positron emission tomography (PET) scan, a full body bone scan, CT scan, and an MRI. Therefore, we were able to collect all the necessary data on the metastases, even though this study was retrospective. The revised Tokuhashi prognostic score system [8] was used to compare the characteristics between surgery groups. All surgical and medical morbidities were investigated. Perioperative death (within 30 days of surgery) was determined based on the WHO definition. The outcome measures were based on neurological function and survival periods. We defined Frankel grades D and E as functionally independent. We compared the preoperative and postoperative changes in functional independence in order to determine the surgical outcome.

We investigated the cumulative hospital stays based on the hypothesis that long-term hospital stays toward the end of life could affect the patient's quality of life [9]. Only admissions for treatments involving the surgery and the adjuvant therapy, not hospice care, were counted as hospital stays.

In addition to these, we estimated the effects of adjuvant therapy (both chemotherapy and radiotherapy, chemotherapy or radiotherapy alone, and no adjuvant therapy) on the mean survival period and surgical outcome.

### 2.2. Statistical analysis

All collected data were analyzed by a commercially available statistical software package (SPSS version 12.0.1 Apache Software Foundation). For survival analysis between surgery groups, the date of the index surgery was established as the starting date. The date from the diagnosis of primary cancer was also measured. The end date was either death or the completion of the study. The Kaplan–Meier analysis and log rank test were used to analyze and compare survival periods between groups. Cox regression analysis and the proportional hazard model were used to evaluate the impact of clinical outcomes. Other basic statistics to compare the means and distribution value depending on the type of surgery including ANOVA, Pearson chi-square tests and additional non-parametric Mann–Whitney *U* test for the local recurrence rate between en bloc and debulking groups were also used.

## 3. Results

This study enrolled 200 patients comprising 118 males and 82 females. The major primary cancers were lung cancer in 42 cases (21.0%), liver cancer in 27 (13.5%), colorectal cancer in 27 (13.5%), renal cancer in 22 (11.0%), breast cancer in 15 (7.5%), thyroid cancer in 11 (5.5%), stomach cancer in 7 (3.5%), prostate cancer in 6 (3.0%), and multiple myeloma in 6 (3.0%) (Table 1). The mean age was $59.7 \pm 12.4$ (range 21–87). There were no differences in

**Table 1**
Distribution of primary cancer origins depending on the surgery type.

| Primary cancer | En bloc | Debulking | Palliative | Total |
|---|---|---|---|---|
| Lung | 15 (24.2%) | 14 (17.1%) | 13 (23.2%) | 42 (21.0%) |
| Liver | 9 (14.5%) | 11 (13.4%) | 7 (12.5%) | 27 (13.5%) |
| Colorectal | 10 (16.1%) | 9 (11.0%) | 8 (14.3%) | 27 (13.5%) |
| Renal | 6 (9.7%) | 9 (11.0%) | 7 (12.5%) | 22 (11.0%) |
| Breast | 8 (12.9%) | 5 (6.1%) | 2 (3.6%) | 15 (7.5%) |
| Thyroid | 4 (6.5%) | 6 (7.3%) | 1 (1.8%) | 11 (5.5%) |
| Stomach | 2 (3.2%) | 5 (6.1%) | 0 (0.0%) | 7 (3.5%) |
| Multiple myeloma | 0 (0.0%) | 1 (1.2%) | 5 (8.9%) | 6 (3.0%) |
| Prostate | 1 (1.6%) | 2 (2.4%) | 3 (5.4%) | 6 (3.0%) |
| Gynecologic organ | 2 (3.2%) | 3 (3.7%) | 1 (1.8%) | 6 (3.0%) |
| Cholangiocarcinoma | 0 (0.0%) | 3 (3.7%) | 1 (1.8%) | 4 (2.0%) |
| Skeletal system | 0 (0.0%) | 1 (1.2%) | 3 (5.4%) | 4 (2.0%) |
| Unknown origin | 1(1.6%) | 3 (3.7%) | 1 (1.8%) | 5 (2.5%) |
| Others | 4(6.5%) | 10 (12.2%) | 4 (7.1%) | 18 (9.0%) |
| Total | 62 (100%) | 82 (100%) | 56 (100%) | 200 (100%) |

There was no difference in the distribution of primary cancers depending on surgery types ($p = 0.194$, chi-square).