Journal of Clinical Neuroscience xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical commentary

Effect of surgical decompression of spinal metastases in acute treatment – Predictors of neurological outcome

Christoph Hohenberger [a,*], Corinna Schmidt [a], Julius Höhne [a], Alexander Brawanski [a], Florian Zeman [b], Karl-Michael Schebesch [a]

[a] Department of Neurosurgery, University Regensburg Medical Center, University of Regensburg, Germany
[b] Center for Clinical Studies, University of Regensburg, Germany

ARTICLE INFO

Article history:
Received 30 January 2018
Accepted 11 March 2018
Available online xxxx

Keywords:
Spinal metastases
Functional outcome
Neurosurgery
Spinal surgery
Laminectomy
Tumor debulking

ABSTRACT

Objective: Space-occupying spinal metastases (SM), commonly diagnosed because of acute neurological deterioration, consequently lead to immediate decompression with tumor removal or debulking. In this study, we analyzed a series of patients with surgically treated spinal metastases and explicitly sought to determine individual predictors of functional outcome.

Patients and methods: 94 patients (26 women, 68 men; mean age 64.0 years) with spinal metastases, who had been surgically treated at our department, were included retrospectively. We reviewed the pre- and postoperative charts, surgical reports, radiographic data for demographics, duration of symptoms, histopathology, stage of systemic disease, co-morbidities, radiographic extension, surgical strategy, neurological performance (Frankel Grade Classification), and the Karnofsky Performance Index (KPI).

Results: Emergency surgery within <24 h after discharge had been conducted in 33% of patients. Prostate carcinoma (29.5%) and breast carcinoma (11.6%) were the most common histopathologies. Median KPI was 60% at admission that had significantly improved at discharge (KPI 70%; p = 0.01). The rate of complications without revision was 4.3%, the revision rate 4.2%. From admission to discharge, pain had been significantly reduced (p = 0.019) and motor deficits significantly improved (p = 0.003). KPI had been significantly improved during in-hospital treatment (median 60 vs 70, p = 0.010). In the multivariable analysis, predictors of poor outcome (KPI < 70) were male sex, multiple metastases, and pre-existing bowel and bladder dysfunction. Median follow up was 2 months.

Discussion: In our series, surgery for spinal metastases (laminectomy, tumor removal, and mass reduction) significantly reduced pain as well as sensory and motor deficits. We identified male sex, multiple metastases, and pre-existing bowel and bladder dysfunction as predictors of negative outcome.

1. Objective

Basically, the development of spinal metastases (SM) with subsequent spinal cord compression can be a devastating complication in patients with cancer. Autopsy series confirmed SM in 30% to 90% of patients with cancer, mainly in the thoracic spine [14,22,29]. Up to 20% of cancer patients with pre-existing spinal disease and up to 10% of all patients with cancer develop symptomatic spinal cord compression (SCC) [18]. Most recently, a population-based study has shown that 3.4% of patients with cancer in the United States are hospitalized for treatment of SM [21]. Statistically, treatment of symptomatic SM in patients in their last year of life results in significantly prolonged hospitalization [19].

SM most frequently develop from the osseous components of the vertebral column (85%), from paravertebral connective tissue and muscles (10%–15%), and, rarely, from intramedullary bones (5%). Metastatic deposits may invade the epidural space and subsequently compress the spinal cord and nerves, resulting in local or radiating pain, severe motor and sensory deficits, and, at worst, in cauda equine syndrome with bowel-and bladder dysfunction [6].

In most cases, surgical and adjuvant treatment is aimed at restoring spinal stability and at releasing SCC. Generally, treatment of symptomatic SM does not directly affect the overall prognosis. However, the restoration of functional integrity substantially improves quality of life (QoL) [3]. On the other hand, surgery-related morbidity and life expectancy must always be weighed

* Corresponding author at: Department of Neurosurgery, University Regensburg Medical Center, Franz-Josef-Strauss Allee 11, 93053 Regensburg, Germany.
E-mail address: christoph.hohenberger@ukr.de (C. Hohenberger).

https://doi.org/10.1016/j.jocn.2018.03.031
0967-5868/

against each other [11]. Thus, identification of eligible patients for palliative surgery is challenging. In patients with refractory pain, progressive neurological impairment, or imminent risk of fracture or instability, surgical treatment must be balanced against the presumed tumor response rate to radio- or chemotherapy. Further important indicative determinants are the general condition of the patient, the dissemination of the disease, and the postoperative palliative treatment options available [17].

We reviewed and analyzed our series of patients who had been neurosurgically treated at our comprehensive cancer center, irrespective of the histopathology of SM. We explicitly sought to determine individual predictors of the short-term postoperative functional outcome for the acute treatment phase.

2. Patients and methods

We screened the database of patients with spinal tumors who had undergone spinal decompressive surgery at our department between 2006 and 2016. In a first step, 440 patients with an ICD-10 code for a spinal decompressive procedure were included in the study. In a second step, we reviewed all surgical protocols and histopathological reports and excluded all patients without spinal metastasis, e.g. spinal tumors. Finally, 94 patients with SM were included who had been operated on in our neurosurgical department.

In all patients, SM with consecutive compression of the spinal cord, cauda equine, or nerve roots had been radiographically confirmed. All patients had been examined by magnetic resonance imaging (MRI) or computed tomography (CT).

Patient charts, pre- and postoperative neuroimages, and surgical reports were reviewed for demographic data and the functional neurological performance at admission and at discharge. We evaluated the preoperative duration of symptoms, the histopathological entities of the primary tumors, surgery-related complications, and adjuvant therapies. The stage of disease (singular, solitary, or multiple metastases) was recorded as well as the extent and location of the spinal masses and any relevant comorbidities.

Pre- and postoperative neurological performance was classified according to the Frankel Grade Classification and according to the Karnofsky Performance Index (KPI), see Tables 1a and 1b. We analyzed the pre- and postoperative grade of motor deficits (conventional paresis grading 1–5, see Table 1c.), the extent of sensory deficits, bowel- and bladder dysfunction, and local and radiating pain.

2.1. Statistical analysis

Categorical data are presented as absolute numbers and percentages. Continuous data are summarized as mean or median and range (min to max) and were compared by the non-parametric Mann-Whitney-U Test. Predictors of poor outcome were analyzed by means of univariable logistic regression models. A multivariable logistic regression model with clinical relevant predictors was built. Due to the small sample size and to avoid overfitting, the model was limited to 4 predictor variables. A p-value <0.05 was considered statistically significant.

Table 1a
Frankel grade classification.

Grade A	Complete paralysis
Grade B	Sensory function only below the injury level
Grade C	Incomplete motor function below injury level
Grade D	Fair to good motor function below injury level
Grade E	Normal function

Table 1b
Karnofsky Performance Index (KPI).

100	Normal; no complaints; no evidence of disease
90	Able to carry on normal activity; minor signs or symptoms of disease
80	Normal activity with effort; some signs or symptoms of disease
70	Cares for self; unable to carry on normal activity or to do active work
60	Requires occasional assistance, but is able to care for most of their personal needs
50	Requires considerable assistance and frequent medical care
40	Disabled; requires special care and assistance
30	Severely disabled; hospital admission is indicated although death not imminent
20	Very sick; hospital admission necessary; active supportive treatment necessary
10	Moribund; fatal processes progressing rapidly
0	Dead

Table 1c
Conventional paresis grading.

Grade	Ability to move
5	Normal power
4	Active movement against gravity and some resistance described as poor, fair, moderate strength
3	Active movement against gravity
2	Active movement with gravity eliminated
1	Flicker of contraction present
0	Complete paralysis

All analyses were done with SPSS 24.0 (IBM SPSS Statistics, Armonk, New York, USA).

The study was approved by our institutional review board (16-104-0228; Ethics Committee of the University of Regensburg).

3. Results

3.1. Baseline data, see Table 2

In our cohort, mean age was 64.1 years (range 38–82 years). In 24.6% (n = 23) of patients, SM was the initial manifestation of the disease. The most frequent primary tumors were adenocarcinoma of the prostate gland in 29.8% (n = 28) of patients, adenocarcinoma of the breast in 10.6% (n = 10), and renal cell carcinomas in 9.6% (n = 9); baseline data and other histopathological entities are summarized in Table 2.

Median preoperative duration of symptoms was 35 days for pain (range 1–365 days), 6 days for sensory deficits (range 1–100 days), and 3.5 days for motor deficits (range 1–90 days). Emergency surgery within 24 h after discharge was conducted in 33% of patients (n = 33).

72.3% (n = 68) of SM were localized in the thoracic spine, 14.9% (n = 14) in the lumbar spine, and 12.8% (n = 12) in the cervical spine, see Fig. 1. 65.9% of patients (n = 62) underwent laminectomy, 28.7% (n = 27) hemi-laminectomy, and 5.4% (n = 5) ventral vertebrectomy. In 67.1% (n = 63), the tumor was partially removed (debulking) to decompress the spinal cord, and gross total resection was achieved in 32.9% (n = 31).

In-hospital mortality was 4.3% (pulmonary embolism (n = 2), myocardial infarction, and systemic progression of primary disease) and surgery-related morbidity 8.5% (n = 8). 3 patients had wound healing disorders, 4 patients developed a spinal cerebrospinal fluid (CSF) leak, and 1 patient required re-resection due to persisting spinal compression.

3.2. Neurological performance, see Table 4

The most common preoperative symptoms were local or radiating pain (74%, n = 70), sensory deficits (66%, n = 62), and motor

Please cite this article in press as: Hohenberger C et al. Effect of surgical decompression of spinal metastases in acute treatment – Predictors of neurological outcome. J Clin Neurosci (2018), https://doi.org/10.1016/j.jocn.2018.03.031