

Original Article

The morbidity and mortality rates following surgery in metastatic spine disease patients

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Abstract

Background

Metastasis is one of the most frequent causes of cancer-related deaths globally. Several studies have investigated the surgical outcome of a metastatic spine; however, the results are discordant. This research aims to study the mortality and morbidity rates of surgical intervention for metastatic spine disease and the predictors of postoperative complications in a tertiary care center.

Materials and Methods

A retrospective chart review was conducted. The population consisted of patients who underwent surgical intervention for metastatic spine disease in a tertiary-care hospital from 2016 to 2020. The primary outcomes were intraoperative and postoperative complications, 30-day mortality, 90-day mortality, and the 1-year survival rates.

Results

A total of 47 patients underwent a surgical intervention during the period. Breast cancer was the most frequent primary lesion for the metastasis, followed by multiple myeloma and lung cancer. Postoperative surgical complications occurred in 34% of the sample, and 41% reported marked neurological improvement following surgery. The 30-day and 90-day mortality rates were 2% and 12%, respectively. The overall one-year survival rate was 64%.

Conclusion

The current study indicated that despite the risk and complexity of the surgical intervention to the metastatic spine, the surgery resulted in an acceptable rate of morbidity and mortality.

Keywords: *Spine metastasis, Spine surgery, Outcome, Mortality and morbidity, Metastasis, Saudi Arabia.*

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1. Introduction

Metastasis is one of the most frequent causes of cancer-related deaths globally. The skeletal system is the third most frequent system affected by metastasis after the lungs and liver, with the spine being the most frequent site (1). Metastatic spine disease, in particular, results in severe morbidity for patients with cancer, often causing significant spinal pain and neurological dysfunction, depending on the severity of the spine involvement and the consequences, such as pathological fractures or cord compression. It has been estimated that 70% of the patients diagnosed with metastatic cancer have evidence of spinal involvement (2). The tumor can spread to the spine through a hematogenous route, direct extension, or through the venous plexus (3). Several modalities have been employed to manage spinal metastasis, including chemotherapy, radiotherapy, and surgical intervention (4).

Despite significant advances in medical therapy, surgery remains the mainstay of treatment for many patients (5). The role of surgery in spinal metastasis has been a palliative measure to allow stabilization of the spine and restore or protect neurological functions (6). An en-bloc resection may be performed in case of a solitary spine tumor. Historically, surgical intervention was considered detrimental due to its association with increased risk of intraoperative and postoperative complications, but with major advancements in surgical technique, recent studies indicated that favorable outcomes are possible (7). The effects of the surgical treatment due to spinal metastasis from non-small cell lung carcinoma increased the nine-month survival rate compared to the non-surgical group. Surgical treatment also improved the quality of life, as well as the physical, emotional, and functional well-being (8). Literature indicates an increasing trend for surgical treatment and postoperative complications, and the in-hospital mortality remained the same (9). No study has

previously examined the rates of mortality and morbidity of surgical intervention for metastatic spine disease and the predictors of postoperative complications in the region, and this study aimed to raise awareness of these findings.

2. Materials and Methods

This retrospective cohort study, which included patients who underwent spinal surgical intervention for biopsy confirmed metastatic spine disease in a tertiary-care hospital from January 2016 to May 2020. The primary outcomes included the intraoperative and postoperative complications, 30-day mortality, 90-day mortality, and 1-year survival rates. The secondary outcomes included the need for readmission, reoperation, postoperative neurological improvement, and 30-day ER visits.

Data collection was done through BestCare 2.0 by postgraduate medical trainees under the supervision of one consultant. The inclusion criteria included all patients who presented with spine metastasis that required surgical intervention during the period. The patients with spine metastasis receive surgical intervention for the following indications: progressive neurological deficit, spine instability due to the destruction of the vertebral column with the spine metastasis, or intractable pain preventing the ability to ambulate. The treatment protocol included an evaluation by the medical and radiation oncologist for possible adjunct chemotherapy or radiotherapy after complete wound healing from the surgery with Bisphosphonate therapy.

The exclusion criteria were primary spine tumors, non-surgical patients, and patients lost to the one-year follow-up. Intraoperative complications were defined as any event labeled in the surgical dictation as a complication. Postoperative complications were measured using the standardized Clavien-Dindo classification (10), classifying complications from class

1 to 5, depending on the severity. Neurological status and mobilization were documented during admission and later during the follow-up appointments.

2.1. Statistical analysis

The demographic information and clinical variables are presented as a mean (median), standard deviation, and inter-quartile range for continuous variables, and the categorical variables in frequency and percentage (%). The association between the categorical variables was done using a Pearson's Chi-square or Fisher's Exact test. Parametric and non-parametric statistical tests are applied for continuous outcome variables such as a *t*-test, independent two samples for two groups, and analysis of variance for more than two groups. Statistical significance was considered as *p*-value < 0.05, with a confidence interval of 95%. The statistical analyses are done using the Statistical Package SAS version 9.4 (SAS Institute Inc. Cary, NC (USA)).

2.2. Ethical Approval

The study protocol was approved by the Institutional Review Board of King Abdullah International Medical Research Center, Riyadh, Saudi Arabia (protocol number RC20/008/R).

2.3. Informed Consent

Informed consent was not required as the research is a retrospective review study and does not involve human subjects.

3. Results

A total of 47 patients underwent spinal surgical intervention from 2016 to 2020. The male to female ratio was 44% to 56%. The mean age at

presentation was 56 ± 14 years. Breast cancer was the most frequent primary lesion for the metastasis, followed by multiple myeloma and lung cancer. The main surgical treatment performed was posterior decompression with segmental internal fixation of the spine in 82% of the sample, and 12% underwent an intralaminar resection of bone tumor. In total, 37 patients Received adjunct chemotherapy, while 33 Received adjunct radiotherapy. The full descriptive analysis is summarized in Table I.

The average estimated blood loss was 618 cc. Preoperatively, the mean albumin level was 35.7 g/L (34 to 54 g/L). There were no reports of intraoperative complications. Postoperative surgical complications occurred in 34% of the sample. Preoperative neurological deficits were associated with 22 patients (44%), decreasing postoperatively to 13 patients (26%). Almost a third (27%) of the sample could not ambulate preoperatively, which reduced to 19%. Table II displays the Frankel classifications of the preoperative and postoperative status.

Revision surgeries were indicated for seven patients. The primary reason was wound dehiscence in six patients, and one patient was due to failure of a construct. The need for readmission occurred in 59% of the patients, and ER visits occurred in 14% of patients post-surgery. The majority of the readmissions and ER visits were related to the complications described. The 30-day and 90-day mortality rates were 2% and 12%, respectively. The overall one-year survival rate was 64%. Details of the postoperative outcomes are presented in Tables III and IV and Figure 1.

Old age was identified as a predictor of an increased risk of 90-day mortality ($P < 0.05$). Low albumin levels preoperatively, postoperative complications, reoperation, and a high ASA score were also predictors of an increased risk of 90-day mortality ($P < 0.05$). Postoperative complications were also a poor

Table I. Basic demographic information

Variable	Category	N (%)
Gender	Male	21 (44)
	Female	27 (56)
Age (yr)		Mean: 56 ± 14.75
BMI kg/m ²		Mean: 27 ± 6.7
Primary site	Breast	16 (34)
	Multiple myeloma	8 (17)
	Lung	7 (14)
	Sarcoma	5 (10)
	Renal	4 (8)
	Lymphoma	2 (4)
	Colon	2 (4)
	Liver	1 (2)
	Larynx	1 (2)
	Prostate	1 (2)

Table II. Frankel Grading for preoperative and postoperative status

Frankel Grading	Preoperative	Postoperative
A	3	1
B	4	3
C	3	4
D	12	14
E	25	24
Total	47	46*

*One early mortality case

Table III. Postoperative outcomes

Variable	N (%)
Intraoperative complications	0 (0)
Postoperative complications	16 (34)
Reoperation	7 (14)
Neurological improvement	9 (41)
Ability to ambulate	38 (80)
30-day mortality rate	1 (2)
90-day mortality rate	6 (12)
30-day ER visit	7 (15)
Readmission	28 (59)
One-year survival rate	30 (64)

prognosticator of one-year mortality and the ASA score ($P < 0.05$).

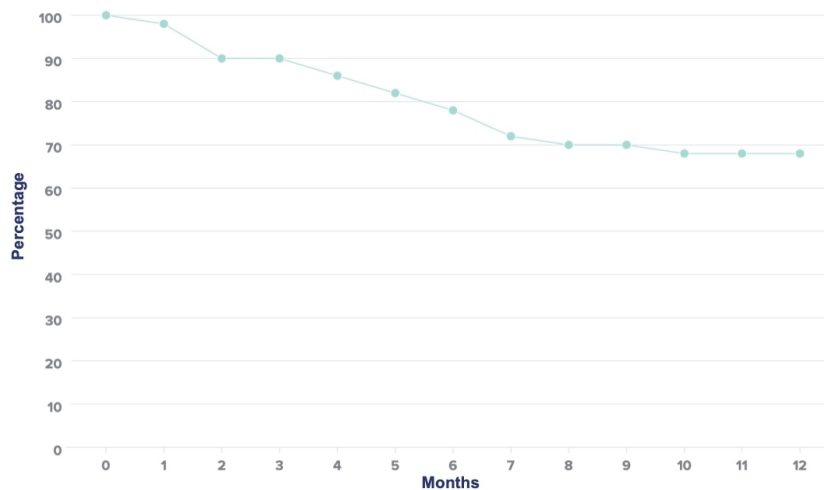
4. Discussion

Recently, there have been significant advances in the medical and surgical treatment of cancer patients, increasing the survival rate of patients with

spinal metastasis (9–11). This led to a significant increase in surgical interventions for patients with metastatic spinal lesions. The current study reported the outcomes and complications of 47 patients who underwent surgical management for spinal metastasis from 2016 to 2020 in a tertiary-care hospital. The male-to-female ratio was 44:56%, inconsistent with literature indicating a higher male prevalence (12–14).

Table IV. Detailed postoperative complications

Postoperative complications	Number of patients
Delirium	1
Spikes of fever without a source	1
Low hemoglobin	1
Pneumothorax	1
Electrolytes Imbalances	1
Pneumonia	1
Failure of Implants	1
Atrial fibrillation	1
Wound dehiscence	5
Urosepsis	1
Wound infection	1
Atrial fibrillation + Thromboembolism event	1
Wound infection + Thromboembolism event	1

Survival Curve**Figure 1.** The Kaplan Meier survival curve of surgical intervention to the metastatic spine disease.

Breast cancer was the most frequent primary lesion for metastasis, followed by lung cancer and multiple myeloma. Breast cancer was also the dominant primary tumor, followed by lung cancer in other studies (14, 15).

Our criteria for spinal surgical intervention were progressive neurological deficit, spine instability, and intractable pain (16–18). Improving the patients' neurological function and quality of life are the main aims of surgical intervention. A preoperative

neurological deficit occurred in the current study in 44% (22 patients). Ten recovered neurologically at the last follow-up, which decreased the percentage of patients suffering from a significant neurological deficit to 26% of the sample. Two studies done by Liang and Abdelbaky reported some elements of neurological improvement in 88% and 83%, respectively, in the form of pain relief after the surgery (7, 16). A study by Jansson with 255 patients with motor deficits reported that 12 patients deteriorated

postoperatively, with 179 improving at least one Frankel grade. He also reports that 100 of the 144 patients, who were non-ambulant, were able to walk at the time of discharge (19). At the final follow-up, our case series indicated that only 13 patients (26%) remained unable to ambulate following the spine surgery for metastatic spine disease. All had a significant neurological deficit preoperatively. The majority (74%) of our sample remained ambulatory until the final follow-up. Literature reported similar findings, with the ambulatory status at the last follow-up ranging from 42% to 70% (20–23).

Postoperative surgical complications occurred in 34% of our sample. A similar result was found in a study by Paulino Pereira, reporting that in 647 patients undergoing primary surgery for metastatic spine disease, the postoperative complication rate was 32% 30-days postoperative. In the same study, 18% had revision surgery, compared with our study at 12% (22). Similar to the literature, wound-related complications were the most frequent cause of the revision (24–27).

The current study's 30-day and 90-day mortality rates were 2% and 12%, respectively. Similar to other studies, increased age was statistically significant for increasing the risk of 90-day mortality ($P < 0.05$) (28, 29). A study by Hussain found that malnourishment and low albumin levels preoperatively correlated with a higher risk of postoperative morbidity and mortality (28). Similarly, lower albumin levels in our study were a positive predictive factor for 90-day mortality ($P < 0.05$). Whenever feasible, improving the patient's nutrition status before the surgical intervention is an important step to reducing postoperative complications. However, the majority of metastatic spine disease surgeries are done on an urgent basis to control the pain and treat neurological deficits. Often there will not be sufficient time to improve the nutrition status of these individuals.

The current study had several limitations. Firstly, selection bias and the retrospective, nonrandomized nature of the study design may have contributed to and affected the study results. Secondly, the study sample was small, mainly due to the nature of the metastatic spine disease and the inclusion criteria. In addition, many patients with metastatic spine disease present to our hospital at a later stage, which may deem them unfit for surgical procedures intervention. Finally, not all patients Received adjunct chemotherapy following the surgical intervention, which might have affected the one-year survival rates. Nevertheless, the study's main strength is being the first study investigating surgery due to metastatic spine disease in our region, with good results in terms of neurological recovery and a relatively low mortality rate, especially during the early stages following the surgical intervention.

In conclusion, despite the increased complication risk and complexity of spinal surgical intervention to the metastatic spine, surgery provided an essential reduction in morbidity and mortality. Age and poor nutrition status are the main risk factors for postoperative complications. The authors suggest larger, national-wide cohort studies to further examine the effect of spinal surgery on the metastatic spine.

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None.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Authors' Contribution

All authors contributed to data analysis, drafting, editing, and revising the article, and approved the final version to be published.

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