Clinical Study

Modeling 1-year survival after surgery on the metastatic spine

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Abstract

BACKGROUND CONTEXT: Choosing appropriate surgical patients in the setting of spinal metastases can be challenging. Existing scoring systems focus primarily on patient selection or operative techniques. These scores are limited in their capacity to predict postoperative survival.

PURPOSE: The aim was to model survival after spine surgery for metastatic disease.

STUDY DESIGN: This was a retrospective multicenter study.

PATIENT SAMPLE: All patients who had undergone surgery for the treatment of metastatic spinal disease at one of four tertiary care centers between 2007 and 2013 were included.

OUTCOME MEASURE: The outcome measure was 1-year survival after surgery.

METHODS: Demographic, medical, oncologic, surgical, and survival data were abstracted from medical records. The effect of predictor variables on survival was evaluated alone and in combination using stepwise logistic regression. Multivariable logistic regression was subsequently used to adjust for confounders. A predictive score was then developed and compared against that of the modified Bauer score alone in terms of prognosticating 1-year survival after surgery.

RESULTS: In the time period under investigation, 318 patients underwent surgical intervention for metastatic disease involving the spine, with 307 having data available for analysis. The survival rate at 1 year was 48% (n=142), with a median survival of 10 months. In final adjusted analysis, preoperative modified Bauer score (odds ratio [OR] 3.00; 95% confidence interval [CI] 1.80–5.01; p<.001), ambulatory status (OR 2.47; 95% CI 1.48–4.14; p=.001), and serum albumin (OR 2.80; 95% CI 1.66–4.72; p<.001) were all independent predictors of 1-year survival. The most parsimonious model weighted the modified Bauer score with 2 points and intact ambulatory status and normal serum albumin level with 1 point each, with a ceiling score of 3. The final model using the predictive score was able to explain 74% of the variation in 1-year survival. In contrast, the modified Bauer score alone was only able to explain 64% of the variation in 1-year survival.

CONCLUSIONS: This study demonstrates the importance of including factors related to the overall health of a patient, in addition to parameters surrounding their cancer diagnosis, to better prognosticate survival. Our predictive score performed better than the modified Bauer alone and may be used to predict survival after surgical intervention for metastatic disease.

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Keywords: Metastases; Spine surgery; Survival; Modified Bauer score; Ambulatory status; Serum albumin

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EVIDENCE & METHODS

Context

Operative intervention for patients with spinal metastases has become increasingly common in recent years. Current scoring systems and prognostic tools are unable to identify patients who will most benefit from surgery with a high degree of accuracy. The authors present a novel prognostic utility, developed from the surgical experience of four tertiary academic centers in New England.

Contribution

This study was performed using case-specific data from 318 patients. The survival rate at one year was 48% (n=142), with a median survival of 10 months. The authors identified the modified Bauer score, preoperative ambulatory status and preoperative serum albumin as significant independent predictors of one-year survival in this cohort. Their final scoring system was able to explain 74% of the variation in one-year survival and outperformed the prognostic capacity of the modified Bauer system alone.

Implications

The prognostic utility presented in this work may have the capacity to better identify patients who can maximally benefit from surgical intervention with a lower risk of mortality in the setting of metastatic spinal disease. As the metric on which the prognostic score was developed was one-year survival, the tool should not currently be used as a means of informing short-term mortality. Further, the translational capacity of the authors' model is predicated on comparable outcomes between their four academic centers and other hospitals across the US. If this is not the case, the prognostic tool cannot be considered generalizable. As the authors appropriately recognize, validation studies and prospective confirmatory analyses in other clinical settings are necessary.

—The Editors

Introduction

Spinal metastases are a frequent occurrence: approximately 1 of 3 patients with malignancies will develop metastases to the spine, and as many as 70% of patients with metastatic disease demonstrate spinal involvement [1,2]. Historically, surgical management was not advocated because of high complication and perioperative mortality rates [1,3–5]. Modern spinal equipment and enhanced understanding of spinal biomechanics have expanded the role for surgical intervention, which is now frequently performed in patients with spinal metastases presenting with progressive neurologic deficits, intractable pain, or mechanical instability [6–12].

In preoperative discussion, the surgeon, patient, and family must often weigh the likelihood of improved outcomes, including pain relief, preservation of function, and survival against the potential for postoperative morbidity and mortality. Choosing optimal candidates for surgical intervention in the setting of spinal metastases is difficult, however, and existing scoring systems [7–9,13] do not reliably address postoperative survival [5,10]. Although the modified Bauer score [13] is frequently used by spine surgeons and has been shown to be useful for surgical decision-making [13], the variables it considers are limited to the cancer diagnosis itself, the number of skeletal metastases, and the presence of visceral metastases (Appendix 1). The modified Bauer score does not take into account the general health of the patient, including ambulatory and nutritional status, such as serum albumin, which may be critical in surgical decision-making.

We evaluated survival among a large series of patients surgically treated for spinal metastases at one of four northeastern academic medical centers between 2007 and 2013. Using these data, we determined clinical variables that might more successfully model 1-year postoperative survival in this patient population. The results of this analysis could provide useful information, not only for choosing surgical candidates but also for highlighting modifiable risk factors that may be targeted in the perioperative period to decrease morbidity and improve outcomes.

Materials and methods

A query of the surgical registries at four participating institutions (Beth-Israel Deaconess Hospital, Boston, MA, USA; Brigham and Women's Hospital, Boston, MA, USA; Dartmouth-Hitchcock Medical Center, Lebanon, NH, USA; Massachusetts General Hospital, Boston, MA, USA) was performed by International Classification of Disease 9th revision and Current Procedural Terminology codes (available from the authors by request) to identify patients who had undergone spine surgery for metastatic disease between 2007 and 2013. Eligible patients had to have received all their postoperative care at one of the four participating centers, with the capacity to definitively determine survival at the 1-year time point. Pediatric patients (aged less than 18) were excluded, as were those with benign spinal tumors, primary spinal tumors, and individuals whose surgical intervention was solely limited to a biopsy or similar percutaneous palliative procedure. The complete medical records for all individuals identified for inclusion were reviewed and abstracted by four authors (AKG, DAL, ES, NS). Patient demographics including age, gender, and race were obtained, as were the cancer diagnosis and the number of medical comorbidities using modified Charlson criteria [14]. Ambulatory status at the time of surgical intervention and preoperative