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Review article

Contemporary spinal oncology treatment paradigms and outcomes for metastatic tumors to the spine: A systematic review of breast, prostate, renal, and lung metastases

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ABSTRACT

Metastatic spinal disease most frequently arises from carcinomas of the breast, lung, prostate, and kidney. Management of spinal metastases (SpM) is controversial in the literature. Recent studies advocate more aggressive surgical resection than older studies which called for radiation therapy alone, challenging previously held beliefs in conservative therapy. A literature search of the PubMed database was performed for spinal oncology outcome studies published in the English language between 2006 and 2016. Data concerning study characteristics, patient demographics, tumor origin and spinal location, treatment paradigm, and median survival were collected. The search retrieved 220 articles, 24 of which were eligible to be included. There were overall 3457 patients. Nine studies of 1723 patients discussed parameters affecting median survival time with comparison of different primary cancers. All studies found that primary cancer significantly predicted survival. Median survival time was highest for primary breast and renal cancers and lowest for prostate and lung cancers, respectively. Multiple spinal metastases, a cervical location of metastasis, and pathologic fracture each had no significant influence on survival. Survival in metastatic spinal tumors is largely driven by primary tumor type, and this should influence palliative management decisions. Surgery has been shown to greatly increase quality of life in patients who can tolerate the procedure, even in those previously treated with radiotherapy. Surgery for SpM can be used as first-line therapy for preservation of function and symptom relief. Future studies of management of SpM are warranted and primary tumor diagnosis should be studied to determine contribution to survival.

1. Introduction

Metastatic spinal disease arising from metastases of cancer to the spine occurs in around 5–30% of cases of primary cancers [1–3], most commonly originating from carcinomas of the breast, lung, prostate, and kidney [4–6]. With the advent of modern imaging techniques and rapid improvements in medical and surgical treatment, cancer patients are experiencing significantly prolonged life expectancy [2,4,6]. This extended longevity has consequently corresponded with a greater number of metastatic cases. Metastatic spinal disease is considered to be the terminal stage of primary cancers, and generally treatment, is palliative and not curative [7]. Management of spinal metastases (SpM) is widely debated in the literature, with the primary debate focused upon the use of surgical treatment versus radiation therapy and/or conservative treatment.

As the incidence of spinal metastases continues to increase alongside increasing prevalence of primary tumors, a number of treatment modalities have been proposed accordingly [1,3,8]. Specific indications for surgery are controversial, and these modalities employ established preoperative scoring systems to determine the benefit of surgical intervention and predict postoperative survival time, based on preoperative factors such as primary tumor histology, neurological deficits, and presence of spinal cord compression [8,9]. These scoring systems have been criticized for failing to determine outcomes in pathology-specific subgroups, and some authors seeking to validate these scoring systems particularly emphasize the prognostic value of primary cancer histology in predicting postoperative survival [7].

Recent studies advocate the use of aggressive resection for patients able to tolerate surgery, challenging the previously held belief in conservative therapies [1,3,7,10]. However, some studies group all different tumor histologies into one study group, which overlook the differential effect of varying primary tumor pathology. The existing literature has a relative dearth of consensus

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among the authors, and the conflicting reports of the effectiveness of surgery versus conservative treatment for spinal metastases over the past decade are of varying quality. This is predominantly due to study limitations, poor followup, or a highly selective study design that predisposed the patient cohort to certain outcomes, and difficult types of surgical treatments offered.

There is a need for a detailed summary and analysis of the success of the differing treatment paradigms in patients with metastatic spinal disease. The aim of this review is to summarize the current spinal oncology treatment modalities, assess outcomes for the four most common metastases (breast, lung, prostate, and renal), and to ascertain if surgery improves the predicted survival and quality of life in patients with metastatic spinal disease.

2. Methods

2.1. Literature search

A literature search of the PubMed database was conducted for relevant clinical studies. Only English publications from within the last ten years were eligible for inclusion. The key words used were a combination of *neoplasm metastasis, spinal oncology, metastasis, metastatic spinal disease, metastatic spine tumors, breast, prostate, lung, kidney,* and *renal*. The date of the last search was July 8, 2016. The inclusion criteria were review articles or comparative cohort studies that described outcomes following surgical and/or conservative treatment of metastatic spinal disease, specific studies of the four main metastases, and studies describing grading score systems and evaluations of tumor prognosis. Titles and abstracts were reviewed for the following exclusion criteria: 1) does not address spinal metastases; 2) non-human studies; 3) studies not written in English; and 4) studies that do not describe treatment paradigms or do not assess treatment response. After redundant titles were excluded, full text review was performed for publications that met these criteria. Reference lists of relevant studies were reviewed to identify additional studies and reviews.

2.2. Data Collection and statistical analysis

All studies that described treatment paradigms for spinal metastases were reviewed. The comparative cohort studies were reviewed for study characteristics (design, sample size, study period), patient demographics (age, gender, presenting symptoms, location of primary tumor), preoperative factors that significantly impacted survival, and median survival time following surgery or conservative treatment. Studies that focused on the four main metastases were reviewed individually for the same parameters. In studies that reviewed all primary tumors that metastasized to the spine, only the four major metastases (breast, lung, prostate, kidney) were included in the review. Only articles that reported statistics relevant to those displayed in the tables were included in the final analysis.

2.3. Parameters assessed

Parameters were assessed for their effect on median survival time for patients with SpM. Parameters included were age, sex, primary cancer origin, presence of adjuvant treatment, preoperative ambulatory status, presence of visceral metastases, multiple spinal metastases, extraspinal bone metastases, cervical location of spinal metastasis, presence of pathologic fracture, and preoperative neurologic deficit.

3. Results

Fig. 1 demonstrates a flow chart outlining the selection process for relevant studies. The literature search retrieved 220 articles, 24 of which were eligible to be included in this review. Two studies were prospective; the rest were retrospective. There were overall 3,457 patients included in this analysis. A summary of the articles reviewed is given in Table 1. Fig. 2 organizes the studies that were retrieved by the relevant outcome assessment.

All studies of spinal metastases found that primary tumor histology significantly influenced survival after diagnosis of the

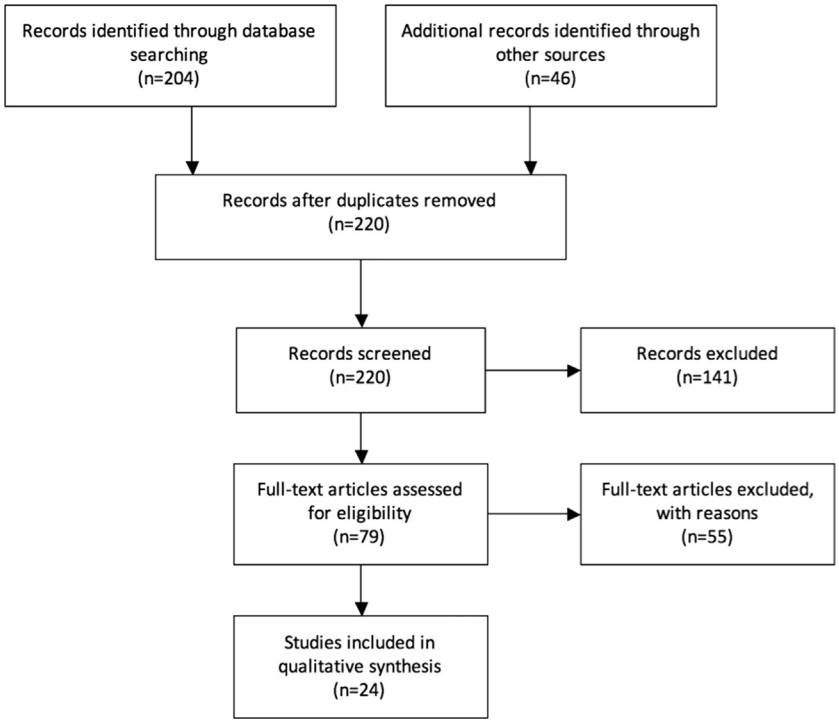

Fig. 1. Flow chart describing selection process for relevant studies.