



Original Article

Factors Affecting the Use of Single-Fraction Radiotherapy for the Palliation of Bone Metastases in Australia

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Abstract

Aims: Palliative radiotherapy for bone metastases remains an important treatment in patients with metastatic malignancy. Previous studies have indicated a reluctance to adopt single-fraction treatment despite considerable evidence. This study aims to describe the factors determining the use of palliative radiotherapy in patients with bone metastases and assess whether fractionation patterns have changed over time with emerging evidence.

Materials and methods: A retrospective review of radiotherapy databases at Liverpool/Macarthur Cancer Therapy Centre and the Royal Brisbane and Women's Hospital was conducted for the period 1997–2009. Patients receiving palliative radiotherapy for bony metastases were identified and treatment sites were grouped into 'spine', 'limb', 'multiple' or 'other'. Treatment courses were divided into single- or multiple-fraction treatments. The effects of socioeconomic and geographical factors on radiotherapy utilisation and fractionation were assessed.

Results: In total, 5683 patients were identified in the cohort; they received a total of 8211 bone treatments. The overall proportion of single-fraction radiotherapy was 29%, with significant variation over the study period ($P < 0.001$). Age under 70 years and spine or multiple treatment sites were all associated with lower usage of single-fraction radiotherapy on multivariate analysis. Prostate and lung primary sites were associated with higher usage of single-fraction treatment. The proportion of single-fraction treatment remained low (35%), even for patients who survived less than 22 days from their last treatment. Socioeconomic and geographical factors had little effect on the number of fractions used.

Conclusions: The rate of single-fraction radiotherapy for bone metastases has remained low in two large Australian institutions, despite considerable evidence that single-fraction treatment provides equivalent pain relief to fractionated therapy. This trend towards fractionated treatment was largely maintained, even in patients with limited life expectancy. Further measures to increase the rate of single-fraction therapy are needed.

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Key words: Bone; fractionation; metastasis; palliative; radiotherapy

Introduction

Radiotherapy is an important palliative treatment modality for patients with bony metastases. Previous work has shown that radiotherapy to bone sites accounted for over 16% of all radiotherapy treatment courses in several Australian centres [1].

Many randomised controlled trials [2–9] and two subsequent systematic reviews [10,11] have shown no

significant difference between single-fraction radiotherapy (SFRT) (typically 8–10 Gy) and multiple-fraction courses (typically 20 Gy in five fractions or 30 Gy in 10 fractions) in terms of overall pain response and complete response. Furthermore, no significant difference between the treatment groups was seen in terms of toxicity, time to pain response or durability of analgesic effect. The most recent meta-analysis from Chow *et al.* [12] included 5000 patients from 16 randomised trials and confirmed the findings of the earlier data. SFRT is strongly supported over multiple-fraction radiotherapy (MFRT) for uncomplicated bone metastases in most practice guidelines [13–15].

SFRT has several potential benefits for patients, their care givers and the health system. It offers significant logistical

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advantages, particularly in patients with limited life expectancy or geographical factors precluding fractionated treatment [16,17]. Previous studies have shown wide variety in the utilisation of palliative radiotherapy for bone metastases, with evidence that both patient and health care system-related factors affect patterns of care [16,18]. Practice surveys of clinicians have also revealed marked variance in practice and choice of fractionation regimen for various clinical scenarios [19–22].

The aims of our study were to assess the effect of various clinical and demographic factors on radiotherapy utilisation and fractionation for the palliation of bony metastases in Australia, and to assess whether fractionation patterns have changed over time with emerging evidence and practice guidelines.

Materials and Methods

Sources of Data

A retrospective review was conducted using routinely collected administrative data from two large Australian public cancer centres, the Liverpool and Macarthur Cancer Therapy Centres (LM, New South Wales, Australia) and the Royal Brisbane and Women's Hospital (RBH, Queensland, Australia). The databases used for the analysis contained details of all patients undergoing radiotherapy treatment in these institutions between 1997 and 2009, including patient demographics, diagnosis date and primary cancer site. Treatment date, site and dose information were collected for each individual treatment. Variables extracted for analysis were standardised across both institutions to allow direct comparison.

Study Population

Patients aged 18 years and older with a histologically proven malignancy who had received palliative radiotherapy to a bone site at one of the two treatment institutions between 1997 and 2009 were included in the study. ICD-10 and morphology codes were used to identify the primary cancer diagnosis and morphology. Primary bone tumours were excluded from the analysis to exclude potentially curative treatments.

Treatment sites were grouped into five categories: primary, bone, brain, soft tissue and multiple. Treatments assigned to the 'multiple' treatment code that consisted of at least one identified bone site were selected for the cohort, along with all 'bone' category treatments. Where radiotherapy dose was available, any treatment dose over 40 Gy was excluded, to avoid potentially curative treatments from being included in the analysis. Patients with cutaneous primaries and ambiguous treatment site information (for example, 'thigh' or 'shoulder') were also excluded to avoid any skin treatments being included. Due to difficulty ascertaining which malignancy a treatment course was assigned to, patients with multiple primary cancers were not included in the study.

Study Variables

Patient variables extracted for analysis included age, gender, primary cancer diagnosis, diagnosis date and death date. Treatment year, treatment site and number of bone treatments were also determined.

Treatment site was categorised into spine, limb, other or multiple (a combination of a bone and non-bone site treated simultaneously). Treatment start and end dates were used to classify treatment episodes as either single- or multiple-fraction treatments (i.e. if a treatment episode started and finished on the same day it was considered a single-fraction treatment). Subsequent bone treatments were also identified in patients selected for the study. If treatment start and end dates were more than 7 days apart, they were considered separate treatment episodes. Treatment end dates and patient death date were used to determine the time from the last bone treatment to death. The effect of these variables on fractionation regimen was assessed.

Geographical data were collected on the patient cohort, using the postcode of the patient's residential address. This was used to determine the Socioeconomic Index for Areas (SEIFA) score, which is determined for each postcode using Australian census data. This score was then used to divide the cohort into five quintiles based on the Index of Relative Socioeconomic Disadvantage (IRSD) [23]. The patient's postcode data were used to determine geographical remoteness using the Accessibility/Remoteness Index of Australia (ARIA). The ARIA scores were grouped into five groups, ranging from highly accessible to very remote.

Statistical Analysis

Statistical Package for Social Science (SPSS) version 21 was used to carry out a data analysis [24]. Categorical variables were compared using Pearson chi-squared tests, and *P* values were determined. Logistic regression analysis was used to determine variables independently associated with fractionation choice. The patient's street address or postcode and hospital address were geocoded to allow calculation of the travelling distance from the patient's postcode to the nearest treatment facility using ArcGIS software [25]. Road distance was subsequently used to analyse whether travelling distance was associated with fractionation regimen.

Results

Study Population

Between 1997 and 2009, 5683 patients received at least one course of palliative bone radiotherapy, and among them 8211 individual bone treatment episodes were identified.

Table 1 presents the baseline patient characteristics of the cohort. Fifty-nine per cent of the patients were men and the median age of the study population was 67 years, with a range of 18–97 years. Patients diagnosed with lung (30%),

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