Radiotherapy and Oncology 118 (2016) 552–556

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Bone metastases

Incidence and treatment patterns of complicated bone metastases in a population-based radiotherapy program

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ARTICLE INFO

Article history:
Received 14 August 2015
Received in revised form 18 October 2015
Accepted 18 October 2015
Available online 26 October 2015

This research will be presented at the Canadian Association of Radiation Oncology 2015 Annual Meeting, and the American Society of Radiation Oncology 2015 Annual Meeting.

Keywords:
Complicated bone metastases
Palliative radiotherapy
Radiation therapy fractionation
Population-based

ABSTRACT

Introduction: There is abundant evidence in support of single fraction (SF) radiation therapy (RT) for uncomplicated bone metastases (BoM). We sought to determine the proportion of BoM that is complicated in a population-based RT program in order to act as a potential guide for assessing SFRT utilization rates.

Materials and methods: A total of 3200 RT courses were prescribed to 1880 consecutive patients diagnosed with BoM in 2013. Associations between choice of RT fractionation and BoM characterization, whether complicated or not, were assessed with logistic regression.

Results: The incidence of complicated BoM was 34.4%, resulting most often from adverse features of actual pathological fracture (42.1%), and neurological compromise (36.3%). Complicated BoM were most common in lung cancers (24.2%) and in the spine (68.5%), followed by extremity (15.2%) and pelvis (14.4%). SFRT was prescribed less commonly in complicated versus un-complicated BoM (39.4% vs. 70.4%; $p < 0.001$), which was confirmed on multivariable analysis (OR 0.32; 95% CI 0.28–0.61; $p < 0.001$).

Conclusions: This study found that 34.4% of BoM are complicated by fracture, or neurological compromise (i.e. 65.6% were un-complicated), and that they were less likely to receive SFRT. A reasonable benchmark for SFRT utilization should be at least 60%.

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Palliative external beam radiotherapy (RT) provides successful pain relief, preservation of skeletal function and integrity in patients with bone metastases (BoM) [1,2]. Palliative RT in patients with BoM is guided by clinical status, life expectancy, and quality of life. Local RT to the painful BoM sites can provide pain relief in approximately 60–85% of patients, with complete pain response reported in 15– 58% [3].

Multiple randomized trials and guidelines have confirmed that single-fraction (SF) radiotherapy (RT) is equivalent at relieving pain and maintaining quality of life as multiple fractions (MF) in patients with BoM [3–5], and our group has already demonstrated an effective method to improve the evidence-based use of SFRT for BoM in British Columbia [6]. The standard RT schedule for uncomplicated bone metastases is a single 8 Gy treatment [7–10].

The definition of complicated BoM varies, but usually includes features suggestive of confirmed fracture, impending fracture, associated soft tissue mass, or neurological compromise (e.g. spinal cord compression, SCC) [11–12]. Although there is no consensus, most guideline authors recommend fractionated radiotherapy in a patient with an impending or established complicated BoM, who are otherwise not candidates for surgical intervention [13–15].

Multiple groups have reported their rates of SFRT utilization, though it is difficult to determine how appropriate these rates may be, due to limited knowledge of the incidence of complicated BoM [3–5]. We sought to determine the proportion of BoM that is complicated in a population-based RT program in order to act as a potential guide for assessing SFRT utilization rates. In addition, we sought to evaluate the usage of SFRT in these patients. This research will help us in determining the appropriate rate of SFRT in a population, and will be useful in future research and advocacy to improve the utilization of evidence based prescription of SFRT for BoM.

Materials and methods

Clinical data source

The BC cancer Agency's (BCCA) Cancer Agency Information System (CAIS) database was used to abstract patient, provider and treatment characteristics of patients who received palliative RT for BoM during 2013. This study was approved by the joint University of British Columbia and BCCA Research Ethics Board. Patient

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http://dx.doi.org/10.1016/j.radonc.2015.10.015
0167-8140/

Table 1
Patient, treatment, and provider characteristics.

Variable		Entire Cohort (RT courses, n = 3200) n (%)	Complicated Bone Metastases (RT courses, n = 1102) n (%)
Age (years)	<51	436 (14)	155 (14)
	51–70	1838 (57)	647 (59)
	>70	926 (29)	300 (27)
Male		1715 (53)	565 (51)
Complicated bone metastases		1102 (34)	1102 (100)
SFRT		1911 (60)	434 (39)
Radiation therapy dose prescription	8 Gy/1 fraction	1750 (55)	402 (37)
	20 Gy/5 fractions	992 (31)	509 (46)
	30 Gy/10 fractions	63 (2)	32 (3)
Primary tumor	Prostate	637 (20)	179 (16)
	Breast	641 (20)	230 (21)
	Lung	801 (25)	267 (24)
	Hematological	342 (11)	151 (14)
	Gastrointestinal	266 (8)	93 (8)
	Others	513 (16)	182 (17)
Skeletal metastasis	Spine	1454 (45)	755 (69)
	Pelvis	838 (26)	159 (14)
	Extremity	570 (18)	167 (15)
	Ribs	253 (8)	14 (1)
	Sternum	50 (2)	1 (0.1)
	Skull	35 (1)	6 (0.5)
BCCA center	Abbotsford	266 (8)	127 (12)
	Kelowna	606 (19)	206 (19)
	Surrey	461 (14)	143 (13)
	Vancouver	971 (30)	323 (29)
	Victoria	703 (22)	239 (22)
	Centre for the North	193 (6)	64 (6)

SFRT: Single fraction radiation therapy; RT: radiation therapy.

chart reviews, and review of RT plans where necessary, were performed to identify the various patient and physician related parameters associated with palliative RT in BoM.

Clinical characteristics and classification of bone metastases

All patients who received palliative RT for BoM from any primary tumor were included in the study. The treated skeletal sites were classified into the following categories: spine, pelvis, rib, extremity, sternum, and 'skull' which included orbit and jaw. Patients who received re-irradiation or surgical fixation for BoM were included. BoM were classified as "complicated" if clinico-radiological features are suggestive of: actual or impending pathological fracture, and/or neurological compromise (e.g. spinal cord compression) [11,12]. Independent reviewers KR, EY, MT and RO audited all the patient charts, radiological imaging, and RT plans to characterize the BoM.

Statistical analysis

For descriptive analyses, RT fractionation was classified into two categories: single fraction (SF) or multiple fractions (MF). Descriptive association between the type of BoM and the variables were analyzed through χ^2 and t-tests. Subsequently, univariable and multiple logistic regression analyses were performed to assess these associations. P values were two-sided, and values less than .05 were considered statistically significant. Analyses were conducted using the SPSS statistical software package, version 19.0 (Chicago, IL).

Results

Clinical characteristics

A total of 3200 RT courses were prescribed to 1880 patients during this study period, with a median age of 64 years. Table 1

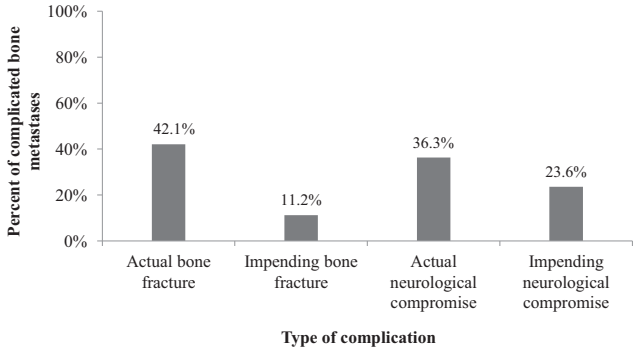

Fig. 1. Clinical and radiological features of complication in complicated bone metastases (BoM).

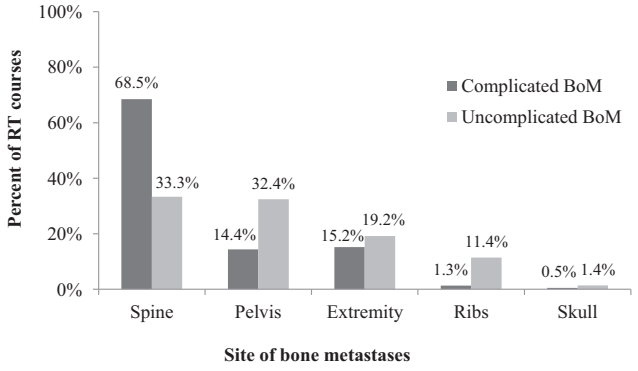

Fig. 2. Percentage (%) of radiation therapy (RT) courses, by site of bone metastases (BoM) in complicated and uncomplicated BoM.