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Original Article

Routine Clinical Data Predict Survival after Palliative Radiotherapy: An Opportunity to Improve End of Life Care

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Abstract

Aims: Estimating the prognosis of cancer patients with incurable disease remains an important and difficult task for clinicians. Radiotherapy is a commonly used modality for palliation of symptoms, and we investigated whether we could predict differences in overall survival after the first course of palliative radiotherapy using routinely available data.

Materials and methods: We examined variations in survival in 1226 patients after their first course of palliative radiotherapy in relation to cancer type, site treated, age, gender and socioeconomic status, and developed a multivariate model based on these.

Results: The median overall survival after the first course of palliative radiotherapy was 5.2 months. Large differences in survival were seen, depending on the primary tumour and the site treated. Survival was much better in those with breast (median overall survival 11.4 months) or prostate cancer (8.4 months, hazard ratio = 1.3) than in those with oesophageal/gastro-oesophageal junctional tumours (4.6 months, hazard ratio = 2.3) or lung (3.9 months, hazard ratio = 2.5). The treated site was an important prognostic factor (primary tumour versus bone metastases, hazard ratio = 1.3; versus brain metastases, hazard ratio = 2.1).

Conclusions: The median overall survival after a first course of palliative radiotherapy was less than 6 months. Simple data, provided as part of routine radiotherapy practice, clearly discriminate between patients with very different prognoses. Such data could therefore be used to trigger appropriate end of life care.

Key words: Cancer; palliative care; prognosis; radiotherapy; survival rate

Introduction

Five year survival rates for patients with cancer in the UK are less than 60% [1]. Estimating prognosis, and the expected length of survival, for those with incurable disease is important, but clinicians have repeatedly been shown to be poor at predicting survival [2], and the provision of appropriate end of life care is often variable. Current national guidelines for primary care suggest identifying patients who are within their last 6–12 months of life, but much of the previous literature has concentrated on studying hospice patients during their last weeks of life. Therefore, the ability to use routine data to identify patients with life expectancies in the order of months and years might allow us to improve the provision of end of life care for such patients.

Many patients with incurable cancer will receive palliative oncological treatment before their death, and radiotherapy is an important element of this [3–5]. The legal and technical frameworks around radiotherapy have resulted in centres in wealthy countries using automatic treat and record systems, ensuring that data are accurately and comprehensively collected, and in the UK, all deaths are recorded centrally.

The aims of palliative radiotherapy are to alleviate symptoms and improve quality of life, and there is good evidence of its efficacy [6]. It can provide effective symptomatic improvements for modest cost and toxicity in both

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locally advanced and metastatic cancer [7]. There is a wide variation in dose and fractionation regimens [8] across the world, with many patients receiving prolonged courses of palliative radiotherapy, despite being near the end of their lives.

Longer regimens are both inconvenient for patients and inefficient for healthcare services, and clinicians often choose radiotherapy schedules based on expected survival. Unfortunately, the data to guide these decisions are often either missing or have been developed in highly selected groups of patients, although guidelines have been developed to guide clinicians [9,10]. In addition, provision of appropriate end of life care measures (including medical, nursing, financial measures and others) is often inadequate, and understanding the length of survival after palliative radiotherapy would allow it to be used as a trigger for end of life care measures.

In order to answer these question, we carried out a cohort study to determine the extent to which routinely collected clinical data could predict survival for patients receiving their first course of palliative radiotherapy.

The objectives of this study were to investigate patterns of overall survival in patients receiving their first course of palliative radiotherapy in a single regional cancer centre and to investigate whether there was evidence of systematic variation in the length of survival according to disease and treatment characteristics, including the primary cancer, the interval between curative and palliative treatment, the site of radiotherapy treatment, the age at treatment and socioeconomic status.

Materials and Methods

We conducted a cohort study to analyse the relationship between disease and treatment characteristics and overall survival. We included all patients with cancer who received palliative radiotherapy at a single cancer centre (the Mount Vernon Cancer Centre, UK) between 1 January and 31 December 2005 (inclusive) and who had not received palliative radiotherapy at that centre before 1 January 2005. We excluded patients for whom we either had no data on the date of treatment or dose, or who could not be matched to the National Health Service national demographic database service (NNDS), and we excluded treatments for superficial (non-melanomatous) skin cancers. The definition of palliative radiotherapy was based on a combination of the receipt of an identified palliative dose and fractionation regimen and the treating clinician's indication; a radiotherapy course was defined as one or more fractions of external beam radiotherapy, delivered to a defined area.

For each identified patient we retrieved their entire radiotherapy treatment history. For the purposes of this analysis, we considered their first course of palliative radiotherapy, and any preceding radical/adjuvant radiotherapy. We also extracted data on date of birth and death, gender, National Health Service number, area of residence, primary tumour, dose and fractionation. Data on the site treated were held as free text transcribed from the booking form. Raw data were collected prospectively, as part of the process of referring a patient for and prescribing radiotherapy, but we extracted and analysed data in a retrospective manner. Data for this analysis were extracted on 30 April 2010 by MW, using retrieval strategies designed by MW and the departmental information analyst. We checked all the patients against local information and the NNDS to check if they were still alive, and if neither source had any record of death they were assumed to still be alive. To allow for administrative delays in reporting deaths, we censored all follow-up at 7 weeks before data extraction, and survival was calculated from the date of the first fraction of palliative radiotherapy to death or censoring. We did not include any data on the receipt of systemic chemotherapy or performance status.

Data on socioeconomic status were provided as a deprivation quintile, based on the deprivation measures for local super output areas (geographical regions of about 1500 people). Data on the primary site of disease were coded using ICD-10 and the treated site was categorised using the Office of Population and Censuses and Surveys Classification of Surgical Operations and Procedures coding scheme version 4.5, in line with the guidelines developed for the national radiotherapy data set. For radiotherapy to metastatic disease, the site of treatment was coded from free text by MW and DW; to check for errors in coding, all data were cross-checked and discrepancies resolved by discussion. Data on the primary site were grouped by similar ICD-10 codes, and data on the treated metastatic site were grouped by anatomical location and tissue type (e.g. lung, bone, brain). Based on a preliminary analysis of the data, we used an approximation of the median age (70 years) as a cut-off, and chose a clinically relevant time point (12 months) as a cut-off for the treatment-free interval (TFI). We chose not to treat either as a continuous variable due to small numbers (TFI) and to aid clinical usability (age).

Overall survival was calculated from the date of the first fraction of palliative radiotherapy. For patients who had radical or adjuvant radiotherapy before their palliative radiotherapy, we also calculated the TFI from the date of the first radical/adjuvant fraction to the date of the first palliative fraction. The analysis was carried out using the statistical package R [11]. We used Kaplan–Meier estimates of survival; statistical significance was assessed using the Log-rank method for survival data and chi-squared analysis for proportions. All tests for statistical significance were two-sided. To analyse the effects of combining multiple variables we used the Cox proportionate hazards method. We assessed proportionality through calculation of both per-variable and global chi-squared tests for proportionality [12] and inspection of plots of time-dependent residuals. Where there was evidence of non-proportionality, we conducted stratified analyses for these variables. Although we did not aim to develop a formal model to predict survival, we followed the approach outlined by Harrell [13] and Steyerberg [14] because of the methodological rigour that their approach provides, particularly in terms of preventing over-fitting. Multivariate models were developed using a step-backwards approach, using Akaike's information