European Journal of Cancer 77 (2017) 109–116

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.ejcancer.com

Original Research

The addition of whole-body magnetic resonance imaging to body computerised tomography alters treatment decisions in patients with metastatic breast cancer

Michael Kosmin [a,*], Andreas Makris [a], Priya V. Joshi [a], Mei-Lin Ah-See [a], David Woolf [b], Anwar R. Padhani [c]

[a] *Breast Cancer Research Unit, Mount Vernon Cancer Centre, Rickmansworth Road, Northwood, Middlesex HA6 2RN, UK*
[b] *The Christie NHS Foundation Trust, 550 Wilmslow Road, Manchester M20 4BX, UK*
[c] *Paul Strickland Scanner Centre, Mount Vernon Cancer Centre, Rickmansworth Road, Northwood, Middlesex HA6 2RN, UK*

Received 6 January 2017; received in revised form 21 February 2017; accepted 1 March 2017
Available online 5 April 2017

KEYWORDS
Whole-body magnetic resonance imaging;
Systemic anti-cancer treatment response assessment;
Metastatic breast cancer

Abstract ***Aim:*** Accurate evaluation of distribution of disease and response to systemic anti-cancer therapy (SACT) is important in the optimal management of metastatic breast cancer. Whole-body magnetic resonance imaging (WB-MRI) has increased accuracy over computerised tomography of the chest, abdomen and pelvis (CT-CAP) for detecting liver and bone disease, but its effect on patient management is largely unexplored. This study investigates the effects of using WB-MRI alongside CT-CAP on SACT decisions in standard clinical practice for patients with metastatic breast cancer.

Methods: Metastatic breast cancer patients who had undergone WB-MRI within 14 d of CT-CAP were studied. Data on distribution and extent of disease and SACT response assessment from original WB-MRI and CT-CAP reports were compared. Contemporaneous medical records provided data on therapy decisions at each time point.

Results: Analyses were performed on 210 pairs of WB-MRI and CT-CAP in 101 patients. In 53.3% of episodes, WB-MRI reported additional sites of disease not reported on CT-CAP. Differences in SACT assessment were found in 28.0% of episodes, most commonly due to progressive disease (PD) on WB-MRI being reported as stable disease on CT-CAP (18.9%). Discordant SACT assessments were less common in first-line SACT than in subsequent lines of SACT (15.0% versus 41.6%; $p = 0.0102$). In 34.7% of episodes when SACT was changed, PD had been reported on WB-MRI only.

* *Corresponding author.*
E-mail address: michael.kosmin@nhs.net (M. Kosmin).

http://dx.doi.org/10.1016/j.ejca.2017.03.001

Conclusions: SACT decisions in routine practice were altered by the use of WB-MRI. Further research is required to investigate whether earlier identification of PD by WB-MRI leads to improved patient outcomes.

1. Introduction

Evaluation of response to systemic anti-cancer therapy (SACT) in patients with metastatic breast cancer can be performed using several imaging modalities. The most widely used in standard clinical practice is computerised tomography (CT). CT examinations are routinely reported using the RECIST version 1.1 criteria to establish whether there is progressive disease (PD), stable disease (SD) or partial or complete response (PR; CR) [1]. Assessing response to SACT with CT has its benefits. Scans are quick to perform and images provide excellent spatial resolution, allowing for accurate and reproducible measurements of target lesions in soft tissues. However, there are disadvantages to restaging with CT, particularly in patients with bone-only or bone-predominant metastatic breast cancer. In RECIST version 1.1, bone metastases are considered non-measurable lesions [1]. Changes between osteolytic and sclerotic lesions can be difficult to establish on CT, particularly because there may be little or no change in size of the visualised abnormality in the bone.

Imaging using bone scintigraphy with technetium-99m-methylene diphosphonate (99mTc-MDP) has been a mainstay of evaluating bony metastatic disease since the 1960s. Bone undergoes constant remodelling. This involves the maintenance of a dynamic balance between osteoblastic and osteoclastic activity. 99mTc-MDP is bound as part of osteoblastic activity. The fact that both cell types can be active at the same time explains how 99mTc-MDP scintigraphy can image osteolytic, osteoblastic or mixed lesions. However, false negative findings can occur when pure osteolytic metastases are growing rapidly, or when bone turnover is slow, or at avascular sites [2]. In addition, use of bone scintigraphy for evaluation of response to SACT is limited by a temporary increase (flare reaction) of 99mTc-MDP in response to therapy. This flare reaction can have similar appearances to the changes associated with disease progression, risking an inappropriate change in patient management. The difficulty of interpreting serial bone scans in patients on SACT for metastatic breast cancer has been described in further detail elsewhere [3,4].

^{18}F-Fluorodeoxyglucose positron emission tomography (FDG-PET) is a functional imaging modality that displays changes in metabolic activity. This has a potential advantage in that it may display changes that occur within metastatic lesions before a change in size of a lesion becomes evident. However, international guidelines from the European School of Oncology—Metastatic Breast Cancer Task Force state that PET-CT is not recommended for routine restaging of metastatic breast cancer patients. This is due to the lack of robust data demonstrating cost-effectiveness relative to the use of CT and bone scans, which are generally less expensive and remain the recommended imaging modalities [5]. A meta-analysis of six studies comparing bone scans with FDG-PET showed no major differences in the pooled patient-based sensitivity of FDG-PET over bone scans (81% versus 78%) [6].

The most common site for metastases from breast cancer is bone, with over 70% of those who die from breast cancer having evidence of bone metastases [7]. Bone disease can significantly impact on quality of life, causing pathological fractures, pain, spinal cord compression and hypercalcaemia. These clinical consequences of uncontrolled metastatic breast cancer have significant health economic implications. This is due to the increased requirement for hospital admissions, orthopaedic or spinal surgery, emergency or palliative radiotherapy, increased use of supportive medications and management of malignant hypercalcaemia [8].

To optimally manage patients with advanced breast cancer with bone metastases, it is essential to have a reproducible, reliable and accurate method of assessing disease response to SACT in the bone. Disease progression evident on imaging can allow for a change in SACT before significant clinical evidence of disease progression becomes apparent.

Over the past few years, interest in the use of whole-body magnetic resonance imaging (WB-MRI) with diffusion-weighted sequences as a tool for assessing malignant disease of the bone has increased. It has become an established tool in the diagnosis and assessment of multiple myeloma due to its high sensitivity for the early detection of marrow infiltration, including identification of involved marrow before myeloma-related bone destruction [9]. A recently published consensus statement refers to the use of WB-MRI in multiple myeloma as 'the gold standard for imaging of axial skeleton, for evaluation of painful lesions and for distinguishing benign versus malignant osteoporotic vertebral fractures' [10]. National Institute of Health and Care Excellence guidelines for diagnosis and management of myeloma in England recommend that WB-