Variation in the Length of Radiation Therapy among Men Diagnosed with Incident Metastatic Prostate Cancer

E Onukwugha[1], Y Kwok[2], C Yong[1], CD Mullins[1], B Seal[3], A Hussain[2,4]

[1] University of Maryland School of Pharmacy, Baltimore, MD; [2] University of Maryland School of Medicine, Baltimore, MD; [3] Bayer HealthCare Pharmaceuticals, Inc., Wayne, NJ; [4] Veterans Affairs Medical Center, Baltimore, MD

UNIVERSITY of MARYLAND SCHOOL OF PHARMACY

ABSTRACT

Purpose/Objectives: Skeletal-related events (SRE) among prostate cancer (PCa) patients with bone metastasis (BM) include pathological fracture (PF), spinal cord compression (SCC), bone surgery (BS), and radiation to the bone (RttB). Studies using healthcare claims have reported that RttB is the most common SRE among men diagnosed with PCa. Codes available in claims data cannot distinguish RttB from radiation to the prostate gland (RttP) and prior studies have not been limited to external beam radiation therapy (EBRT). Estimates may therefore overestimate RttB. Recognizing that the course of therapy for RttB is typically shorter than the course for RttP, we investigated sources of variation in the length of radiation treatment episodes measured using claims data.

Materials/Methods: We analyzed data for PCa cases identified in the Surveillance, Epidemiology, and End Results registry linked with Medicare claims. Individuals diagnosed with incident metastatic PCa from 2000 to 2007 were identified. External beam radiation therapy episodes were identified and defined relative to the first occurrence of PF, SCC, or BS (i.e., SRE1) as follows, T1: EBRT pre-SRE1; T2: EBRT post-SRE1; T3: EBRT with no SRE1. EBRT episodes were grouped according to the presence of codes on the EBRT claim as follows, M1: BM code only; M2: PCa code only; M3: BM + PCa code; M4: other metastasis code; M5: no PCa/metastasis code. EBRT episode lengths were calculated using the start and end dates for claims in a given episode. The outcome of interest was the EBRT episode length grouped according to L1: less than 14 days (d); L2: 14-30 d; L3: 31-41 d; L4: 42-61 d; L5: greater than 61 d.

Results: Application of inclusion criteria resulted in 9,826 PCa cases: 7,301 M1 cases with 3,363 EBRT episodes, and 2,525 M0 cases with 1,364 EBT episodes. The EBRT proportions based on timing were as follows: 11% were T1, 16% were T2, and 73% were T3. The EBRT proportions based on length were as follows: 27% were L1, 52% were L2, 9% were L3, 8% were L4, and 3% were L5. In the T1 group, 24% of EBRT episodes were less than 2 weeks in duration (L1), 52% of EBRT episodes were 2-4 weeks long (L2), 10% were 4-6 weeks long (L3), and 10% were 6-8 weeks long (L4). In the T2 group, 39% of EBRT episodes were L1, 49% were L2, 6.8% were L3, and 3.7% were L4. In the T2 group, the proportion of EBRT episodes less than 4 weeks in duration was highest among M1 (93%) and M4 (93%) followed by M3 (88%), M2 (84%) and M5 (64%). Among the T3 group, 25% of EBRT episodes were L1, 53% were L2, 10% were L3, and 9% were L4.

Conclusions: In a population of men with incident metastatic PCa, nearly eight out of ten EBRT episodes were less than 4 weeks long (L1 or L2). The length of the EBRT episode varied with the timing of the EBRT episode and with an ICD 9 diagnosis code for metastasis on the EBRT claim.

PURPOSE AND OBJECTIVES

- Skeletal-related events (SRE) among prostate cancer (PCa) patients with bone metastasis (BM) include:
  - Pathological fracture (PF)
  - Bone surgery (BS)
  - Spinal cord compression (SCC)
  - Radiation to the bone (RttB)
- NOTE: SREs were defined as PF, SCC or BS in this study.
- Objective: To examine the variation in the length of radiation treatment episodes among patients diagnosed with metastatic (M1) PCa, comparing to patients with stage 4 non-metastatic (M0) PCa.

METHODS

Data sources:
Linked Surveillance, Epidemiology and End Results cancer registry and Medicare claims (SEER-Medicare) data

Study inclusion and *exclusion* criteria:
American Joint Committee on Cancer (AJCC) stage 4 prostate cancer from 2000-2007 with claims data from 1999-2009
Age 66+ at the time of diagnosis
Continuously enrolled in Medicare Parts A and B prior to diagnosis

Enrolled in an HMO prior to or at diagnosis of PCa
History of cancer within 5 years prior to diagnosis of PCa
Unknown PCa diagnosis month
PCa diagnosis at autopsy or death

Outcome of interest:
External beam radiation therapy (EBT) episode lengths were grouped according to the following categories:
- Less than 4 weeks
- 4-6 weeks
- 6-8 weeks
- Greater than 8 weeks

METHODS

EventFlow (University of Maryland College Park, Human-Computer Interaction Lab) was used to explore patterns of EBT episodes and other events including:

diag	Prostate cancer diagnosis date
tmtadt	Treatment initiation: Androgen deprivation therapy
tmtxrt	Treatment initiation: Radiation therapy
tmtchemo	Treatment initiation: Chemotherapy
tmtradio	Treatment initiation: Radiopharmaceutical
tmtbisp	Treatment initiation: Bisphosphonate
SRE	Skeletal-related event (PF, SCC, BS)

RESULTS

- Application of inclusion criteria resulted in 9,826 PCa cases: 3,363 EBT episodes among 7,301 patients with stage 4 M1 PCa, and 1,364 EBT episodes among 2,525 patients with stage 4 M0 PCa.
- The distribution of EBT episode lengths varied between M0 and M1 patients (Table 1).
- The timing of EBT episode lengths relative to PCa diagnosis was investigated among M0 and M1 patients (Figures 1 & 2). In addition, we reported the timing of EBT episodes relative to PF, SCC, or BS as well as treatment initiation.

Table 1. Distribution of EBT episode lengths among M1 and AJCC stage 4, M0 patients

EBT episode length	Proportion among M1 patients	Proportion among M0 patients
Less than 4 weeks	2,657 (79.0%)	528 (38.7%)
4-6 weeks	317 (9.4%)	110 (8.1%)
6-8 weeks	284 (8.4%)	454 (33.3%)
Greater than 8 weeks	105 (3.1%)	272 (19.9%)

RESULTS

Fig. 1a-b. Overview of events among M1 patients (N=7,301) and M0 patients (N=2,525)
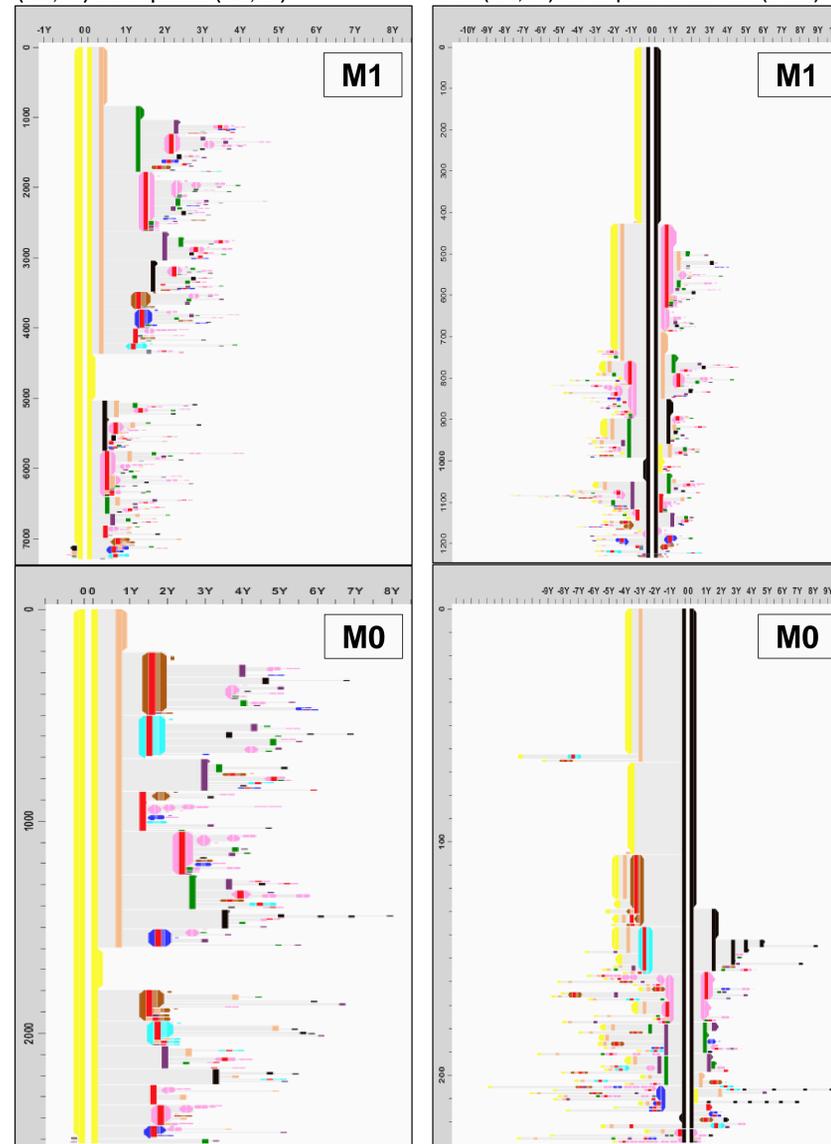
Fig. 2a-b. Pattern of events among M1 patients with SREs (N=1,234) and M0 patients with SREs (N=229)

Fig. 1a-b:
- The majority of EBT episodes among M1 patients were of short duration (<4 weeks).
- In the majority of M0 patients, the initial EBT episodes following diagnosis of PCa were of longer duration (>6 weeks).
- SREs occurred sooner after PCa diagnosis among M1 patients compared to M0 patients.
- Among M1 patients, EBT episodes of shorter duration were more commonly seen following an SRE compared with EBT episodes that did not follow a SCC, BS, or PF.

Fig. 2a-b:
- Anchoring on the date of the first SRE, the short duration EBT (ebt_lt4) is more common around the time of the SRE compared to the long duration EBT.
- The SREs are further removed from the PCa diagnosis among the M0 compared to the M1.

Figure 3. Algorithm for identifying radiation to the bone from EBT claims data

[1] The short duration EBT is based on EBT episodes of less than 4 weeks in length.
[2] Do not consider EBT occurring without SRE.
[3] The narrow (i.e., conservative) window of 2 weeks reflects the greater uncertainty associated with identifying RttB when the EBT precedes a fracture, cord compression or bone surgery. There is less uncertainty about identifying RttB (given the short course) when the EBT occurs after the fracture, cord compression or bone surgery thus the longer window of 6 weeks.

Limitations of Algorithm

- The algorithm is based on billing codes available in claims data and has not been validated against chart review.
- The algorithm does not consider the timing of the EBT episode relative to a diagnosis of bone metastasis and can be further refined to incorporate this information.
- The algorithm does not include other treatments for delivering palliative radiation to the bone. The algorithm can be expanded to include other treatments for delivering palliative radiation to the bone, e.g. radiopharmaceutical therapies.

CONCLUSIONS

- The length of the EBT episode varied among stage 4 M0 and M1 patients: among M1 patients, 8 out of 10 EBT episodes were less than 4 weeks long; whereas among M0 patients, 4 out of 10 EBT episodes were < 4 weeks long.
- The length and timing of shorter duration EBT episodes in M1 and M0 patients was consistent with real-world expectations regarding *radiation to the bone*, with a similar result concerning longer duration EBT episodes and *radiation to the prostate gland*.
- Claims-based algorithm should consider the duration of the EBT episode as well as the timing of the EBT episode relative to pathological fracture, spinal cord compression, and bone surgery.
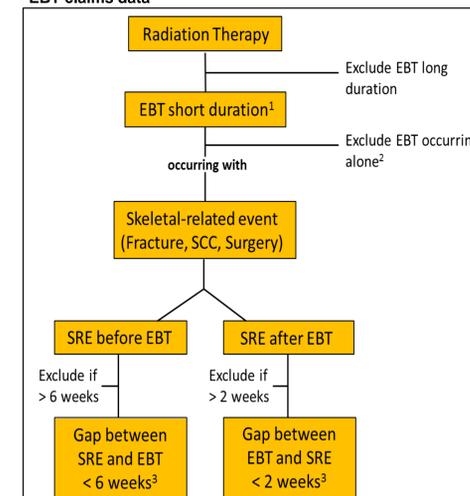
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CONTACT INFORMATION

Eberechukwu Onukwugha, PhD
eonukwug@rx.umaryland.edu

LEGEND FOR FIGURES:
- diag
- ebt_6to8
- tmtadt
- tmtradio
- ebt_lt4
- ebt_gt8
- tmtxrt
- tmtbisp
- ebt_4to6
- SRE
- tmtchemo