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SHORT COMMUNICATION

Onsite *versus* offsite radiation treatment of malignant spinal cord compression: lessons from a safety net health system

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Objective: Metastatic spinal cord compression (MSCC) is an oncologic emergency that often warrants emergent treatment; but, it is unclear whether radiation treatment (RT) can be optimally managed from an offsite radiotherapy facility.

Methods: Patient charts from consecutive patients with MSCC who were treated with radiotherapy alone at either an onsite hospital radiation department (from 2008 to 2012) or an offsite radiotherapy centre (2012–2015) were reviewed. Patient clinical parameters were compared across groups with either the χ^2 test or Fisher's exact test, while survival curves were compared with the log-rank test. The primary end points were ambulatory rate over time, overall survival and cancer-specific survival.

Results: A total of 45 patients were identified, with 19 patients treated onsite in the hospital department

and 26 patients treated at the offsite radiotherapy centre with median follow-up of 42 days vs 48.5 days, respectively. The ambulatory rate over time, overall survival and cancer-specific survival were not significantly different between the two eras. Patients treated in-hospital were more likely to start treatment the same day as the consult ("sim and treat") (79% vs 27%, $p = 0.006$) and were more likely to not complete treatment (26% vs 4%, $p = 0.029$) as compared with those treated in the off-site centre.

Conclusion: Patients with MSCC can be feasibly treated at an offsite radiotherapy centre with outcomes similar to those treated in-hospital.

Advances in knowledge: This is the first study in literature to compare outcomes between onsite and offsite RT of MSCC.

INTRODUCTION

Metastatic spinal cord compression (MSCC) can lead to debilitating sequelae in patients with cancer and is considered an oncologic emergency, requiring immediate intervention given the risk of permanent spinal cord injury or death. MSCC generally warrants inpatient management and monitoring, given the possibility of acute change in patient status. Based on a prospective randomized controlled trial, the standard of care for MSCC in most cases is rapid initiation of corticosteroids followed by surgical decompression (if an operable candidate) followed by adjuvant radiation treatment (RT).¹ Ambulatory status has been found to be an important prognostic factor for patients with MSCC.² A multinational risk score has been proposed that has been shown to predict ambulatory status using multiple patient prognostic factors: primary tumour diagnosis, time interval between cancer diagnosis and MSCC, presence of visceral metastases, pre-treatment motor function and time to developing motor deficits before RT.³ This risk

score has been validated prospectively to predict patient return to ambulation: I (low chance), II (moderate chance) and III (high chance) in patients who were treated with radiation therapy alone. While many hospitals have onsite radiation departments, others are affiliated with freestanding radiation centres located offsite, some requiring ambulance transportation of inpatients. The consequences on outcomes of patients with MSCC treated at an offsite vs onsite radiotherapy centre are not well studied.

Our institution staffs a safety net health system that includes two full-service hospitals and serves a diverse catchment area that includes over four and a half million people. Prior to 2012, patients at one of the main hospitals were primarily treated at an onsite radiation oncology department. In the fall of 2012, the radiation oncology department moved to a brand new state-of-the-art ambulatory centre that is located offsite and treats patients from both full-service hospitals, requiring

ambulance transport of 3 miles and 12 miles from the 2 hospitals. The transition allows for an interesting comparison of the two treatment eras to evaluate whether any detrimental effect on MSCC outcomes with the shift from an onsite to an offsite radiotherapy centre can be observed.

METHODS AND MATERIALS

The study protocol was reviewed and approved by the Institutional Review Board and eProtocol committee. Patient charts with International Classification of Diseases (ICD)-9 codes of 198.5 or 198.3 from 2008 to 2015 were reviewed from the department radiation oncology electronic medical record (EMR). These charts were further assessed in the clinical EMR to include only those who had radiographic evidence of spinal cord compression based on MRI and were treated with radiotherapy alone. A total of 63 consecutive patients with spinal cord compression were identified during the study period, with 18 patients treated with surgery excluded from this study. All patients were treated on megavoltage linear accelerators treated with conventional or three-dimensional conformal RT techniques. Patient ambulatory status was determined by review of clinical notes documenting ambulatory status (by provider assessment) prior to RT and at last clinical follow-up. Survival status was determined from the last follow-up note in the EMR and was also verified whenever possible through the social security mortality database.

Statistical analysis was performed with R statistical software⁴ using the *survival* and *KMplot* packages. Patients' clinical parameters were compared across groups with either the χ^2 test or Fisher's exact test when appropriate. Survival curves were plotted by the Kaplan–Meier method and compared with the log-rank test. A $p < 0.05$ was considered statistically significant.

RESULTS

A total of 45 patients were identified, with 19 patients treated onsite in the hospital department and 26 patients treated at the offsite radiotherapy centre. The patient characteristics of these two cohorts are described in Table 1. The median age (59 vs 56 years old) was similar between the two groups, while the gender, primary diagnoses, initial ambulatory status and ambulatory risk categories were well balanced between the two groups. The mean follow-up was longer for patients treated onsite compared with those treated offsite (256.8 vs 101.3 days), but this difference was not significant ($p = 0.19$) and the median follow-up was similar between the two groups (42 vs 48.5 days).

Importantly, the ambulatory rates over time, overall survival and cancer-specific survival were not significantly different between the two eras (Figure 1). When comparing treatment parameters between these two treatment eras, there were some interesting differences (Table 2). While there was no difference in the time from consult to radiation simulation appointment, there was a notable difference in time from consult to treatment start. Patients treated in-hospital were more likely to start treatment the same day as the consult ("sim and treat") compared with those treated offsite (79% vs 27%, $p = 0.006$). The number of patients who did not

Table 1. Patient characteristics by centre type

Category	Onsite (<i>n</i> = 19)	Offsite (<i>n</i> = 26)	<i>p</i> -value
Median age (years)	59.1	56.6	0.54
Diagnosis			
Prostate	6 (32%)	6 (23%)	0.88
Breast	2 (11%)	4 (15%)	
NSCLC	2 (11%)	4 (15%)	
Other	9 (47%)	12 (46%)	
Gender			
Female	7 (37%)	9 (35%)	1.0
Male	12 (63%)	17 (65%)	
Initial ambulatory status			
Without assistance	9 (50%)	13 (50%)	0.38
With assistance	1 (6%)	6 (23%)	
Bedbound	4 (22%)	4 (15%)	
Paraplegic	4 (22%)	3 (12%)	
Unknown	1		
Risk category			
I	2 (11%)	5 (19%)	0.67
II	9 (50%)	10 (39%)	
III	7 (39%)	11 (42%)	
Unknown	1		
Follow-up			
Mean (days)	256.8 days	101.3 days	0.19
Median (range) (days)	42 days (0–1777)	48.5 days (0–516)	

NSCLC, non-small-cell lung cancer.

complete treatment was higher in those treated in-hospital compared with those treated offsite (26% vs 4%, $p = 0.029$). These onsite patients ($n = 5$) had discontinuation of RT (either self-refusal or clinical deterioration) vs a single patient stopping treatment after being admitted to the intensive care unit in the offsite cohort, with all six of these patients being non-ambulatory at the start of RT. The mean dose of radiation delivered prior to stopping treatment was 17.4 Gy (range 9–27 Gy) in the onsite group vs 9 Gy in the offsite group. The thoracic spine was the most common site of spinal cord compression and patients treated offsite were more likely to have multiple areas of compression, but the difference was not statistically significant. The vast majority of patients (96%) treated in-hospital were treated with 30 Gy in 10 fractions compared with 71% in the offsite centre, but this difference was not significant. In patients who were initially non-ambulatory prior to the start of RT, onsite patients had 38% return to ambulation after RT compared with 14% in the offsite group, but the results are not statistically significant.

Figure 1. (a) Ambulatory status, (b) overall survival and (c) cancer-specific survival based on treated location.

A previous study shows that consults for MSCC are more likely to occur on a Friday.⁵ In this study, there was no significant difference in consult frequency based on the day of

the week (data not shown). The number of patients who received surgical consultation and the rate of surgical intervention were not significantly different between the two eras (data not shown).

DISCUSSION

MSCC is a debilitating event that can occur in patients with cancer and requires urgent if not emergent intervention. Multiple studies have shown the clinical utility of rapid implementation of corticosteroids, although there is no demonstrated survival benefit.^{6–8} Corticosteroids have the benefit of decreasing overall inflammation and potentially provide a window of time to obtain tissue diagnosis for patients who initially present with MSCC without prior cancer diagnosis. This additional time window could also potentially mitigate the need for emergent

Table 2. Treatment parameters by centre type

Category	Onsite (<i>n</i> = 25)	Offsite (<i>n</i> = 38)	<i>p</i> -value
Time to sim	Median 0 days	Median 0 days	0.68
0 days	18 (95%)	24 (92%)	
≥1 day	1 (5%)	2 (8%)	
Time to treat	Median 0 days	Median 1 day	0.006
0 days	15 (79%)	7 (27%)	
1 day	2 (11%)	14 (54%)	
≥2 days	2 (10%)	5 (19%)	
Completed treatment			
Yes	14 (74%)	25 (96%)	0.029
No	5 (26%)	1 (4%)	
Field			
C-spine	1 (5%)	2 (8%)	0.37
T-spine	15 (79%)	13 (50%)	
L-spine	0 (0%)	1 (4%)	
Overlapping	1 (5%)	3 (11%)	
Multiple isocentres	2 (11%)	7 (27%)	
Scheduled fractionation			
30 Gy in 10 fractions	18 (95%)	19 (73%)	0.42
20 Gy in 5 fractions	0 (0%)	3 (11%)	
8 Gy in 1 fractions	0 (0%)	1 (4%)	
Other	1 (5%)	3 (11%)	
Regain ambulation after radiation ^a			
Yes	3 (38%)	1 (14%)	0.31
No	5 (63%)	6 (86%)	
Unknown	2		

^aDoes not include 10 onsite patients and 19 offsite patients who were ambulatory prior to radiation.

“sim and treats” in some select cases. While there were some limitations of the type of patients treated at the offsite radiotherapy centre (no intensive care unit or telemetry patients), which could explain why the onsite patients did not complete treatments as often, the ambulatory risk score categories were similar between the two groups, making them comparable in their functional status. This study shows that while patients with MSCC treated at the offsite centre often have a lower rate of “sim and treats” when compared with those treated in-hospital, these patients were able to receive similar rates of ambulation and survival. Patients who were treated onsite did not complete treatment more often to those treated offsite, which may be due

to poorer clinical condition in patients who were non-ambulatory. MSCC can be feasibly treated at an offsite centre without worsened outcomes, but close monitoring is warranted given their potential for clinical deterioration.

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