

Scientific Article

Timing of Urgent Inpatient Palliative Radiation Therapy



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Abstract

Purpose: Urgent indications for palliative radiation therapy (RT) include malignant spinal cord compression, symptomatic brain metastases, pain, airway obstruction, and bleeding. Data on the timing of palliative RT in the inpatient setting are limited. We report our experience with inpatient palliative RT at a tertiary academic center and evaluate the effect of a dedicated inpatient palliative RT nurse practitioner (NP) on treatment timelines.

Methods and Materials: We performed a retrospective, single-institution review of 219 inpatients consulted for RT to sites of metastatic disease between May 2012 and May 2018. We compared time-to-treatment intervals before and after integrating an NP for palliative RT in August 2017.

Results: The median age of the 219 patients receiving RT was 61 years (interquartile range [IQR], 51-69 years). The most frequent indications were symptomatic brain metastases (73 patients [33%]), pain (61 patients [28%]), and cord/cauda compression (48 patients [22%]). The median time from consultation request to consult was 1 day (IQR, 0-2 days), and the median time from consultation request to first RT fraction was 3 days (IQR, 2-6 days). The median time from consultation request to RT was shorter for cord compression (2 [IQR, 1-4] days) than for pain (5 [IQR, 2-7] days) ($P = .001$) or symptomatic brain metastases (3 [IQR, 1-6] days; $P = .037$). With an NP, patients were more likely to undergo same-day consultation and simulation (75% vs 60%; $P = .045$), which was associated with shorter median duration from consultation to initiation of RT (1 [IQR, 0-3] days vs 4 [IQR, 2-7] days; $P < .001$). After the integration of an NP for palliative RT, patients had a higher median Karnofsky Performance Score (70 [IQR, 60-80] vs 50 [IQR, 40-60]; $P < .001$) and were more likely to complete their prescribed RT course (93% vs 82%; $P = .05$).

Conclusions: Time from consultation request to RT is necessarily short for urgent inpatient palliative RT. Advanced practice providers may facilitate and potentially expedite treatment, with significantly shorter times to treatment among patients who undergo same-day consultation and simulation.

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Introduction

Approximately half of patients undergoing radiation therapy (RT) do so with palliative intent.¹ Urgent RT indications may include neurologic compromise, pain,² or bleeding. Although there are consensus guidelines for palliative RT dose and fractionation,³⁻⁵ recommendations

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for the timing of palliative RT vary depending on treatment indication and practice location, ranging from 2 working days to 2 weeks after consultation.⁶⁻⁸ As increasing attention has focused on improving access,⁸ expediency,^{7,9} and quality¹⁰ of palliative RT, programs dedicated to palliative RT have been developed, but they are still limited to a few large academic medical centers.^{11,12}

The timing of outpatient palliative RT has been described,^{6,7,11-13} but not the timing of inpatient palliative RT. When symptoms warrant admission, expediting evaluation and RT initiation on the order of 1 to 2 months is preferred,¹⁴⁻¹⁷ particularly as life expectancy among inpatients undergoing palliative RT may be limited. Delays in RT not only may prolong suffering but also increase treatment intensity at the end of life.¹⁸

Integration of advanced practice providers (APPs) has the potential to streamline workflow in the setting of palliative RT. A dedicated APP for inpatient palliative RT would be able to independently see urgent consultations and coordinate complex inpatient care. One such position, an inpatient RT nurse practitioner (NP), has been described at the University of Pennsylvania.¹⁹ In addition to roles that have been described for radiation oncology APPs who treat other disease sites,²⁰ an NP for inpatient palliative RT also has unique responsibilities surrounding transitions in care,¹⁹ with the goal of minimizing treatment breaks. Inpatient palliative RT presents unique needs in an otherwise outpatient specialty; however, to our knowledge, the effect of dedicated APPs on delivery of palliative RT has not been previously described. We report our institutional experience with inpatient palliative RT, as well as a dedicated NP's effect on interval to treatment.

Methods

We performed a retrospective, single-institution review of inpatients who were consulted for and treated with external beam radiation therapy to a site of metastatic disease between May 2012 and May 2018. Patients were identified in the electronic health record using International Classification of Diseases codes for secondary malignant neoplasms (196-198, C78, and C79). Patients consulted for postoperative RT and Gamma Knife radiation surgery for brain metastases were excluded, given that an interval from consultation to treatment would be expected in those scenarios. Patients with metastatic disease who were undergoing palliative RT to their primary tumor were also excluded from this analysis. We did not exclude patients based on treatment indication.

From May 2012 to July 2017, rotating outpatient attending physicians staffed inpatient consultation requests. Typically, one physician staffed requests received during business hours, and another weekly rotating

physician staffed requests received overnight and on weekends. Our institution does not have a dedicated palliative RT service. In August 2017, an NP dedicated to palliative RT was on-boarded to help expedite urgent RT by seeing consultations, interfacing with referring teams, placing orders, scheduling simulation and treatment, and attending oversight of RT planning and delivery. The NP worked four 10-hour shifts per week, generally with Thursdays off owing to the physician staffing schedule and a higher volume of consults on Mondays, Tuesdays, and Fridays. The workflow for triaging urgent inpatient consults received between 5 PM and 8 AM, as well as on weekends, remained unchanged—these patients were staffed by a rotating resident and attending physician in 1-week blocks. However, our NP was involved in overnight or weekend sign-out to improve continuity of care; this also helped prepare the on-call team by anticipating potential issues with known inpatients. Our NP independently saw approximately three-fourths of inpatient consults, although this varied based on the preference of the attending physician who would assume responsibility for treatment planning and delivery. To date, the NP generally has not seen patients on-treatment or in follow-up; these are independently staffed by the attending physician and his or her resident. However, there are plans in place to establish a dedicated NP follow-up clinic. We also note that although this article focuses on urgent inpatient palliative RT for patients with metastatic disease, our inpatient NP also consults on inpatients requiring treatment to their primary malignancy as well as on patients who will be treated in the outpatient setting—this includes patients with primary central nervous system malignancies, postoperative orthopedic or neurosurgery patients, and patients who are stable for discharge.

Patient characteristics such as age, primary diagnosis, performance status documented at the time of consultation, RT dose and fractionation, as well as dates of simulation and treatment were abstracted from the electronic medical record. Time stamps for RT consultation requests were obtained through the electronic medical record and service pager log. This study was approved by the UCSF.

Statistical analysis

Mann-Whitney *U* and chi-square tests were used to compare intervals between consultation request, consultation, simulation, and RT based on treatment indication as well as before and after the integration of an NP. A 2-sided *P* value $\leq .05$ was considered statistically significant. Statistical analysis was performed using IBM SPSS statistical software, version 26 (IBM, Chicago, Illinois). Multivariable regression analysis was used to evaluate the association between time to RT and clinical variables.

Table 1 Patient characteristics

Characteristic	Median (IQR) or No. (%)	Before NP Median (IQR) or No. (%)	With NP Median (IQR) or No. (%)	<i>P</i> value
Age, y				
At diagnosis	59 (48-67)	58 (46-67)	61 (52-66)	.22
At palliative radiation therapy	61 (51-69)	60 (51-69)	64 (55-68)	.25
Sex				.41
Male	93/219 (43)	67/164 (41)	26/55 (47)	
Female	126/219 (58)	97/164 (59)	29/55 (53)	
KPS	60 (40-70)	50 (40-60)	70 (60-80)	<.001
Race				<.001
White	131/219 (60)	108/164 (66)	23/55 (42)	
Black	25/219 (11)	20/164 (12)	5/55 (9)	
Asian	48/219 (22)	33/164 (20)	15/55 (27)	
Other/declined	15/219 (7)	3/164 (2)	12/55 (22)	
Primary histology				<.001
Lung	55/219 (25)	46/164 (10)	9/55 (16)	
Breast	28/219 (13)	22/164 (13)	6/55 (11)	
Myeloma	26/219 (12)	9/164 (5)	17/55 (31)	
Liver	14/219 (6)	11/164 (7)	3/55 (6)	
Head and neck	12/219 (6)	10/164 (6)	2/55 (4)	
Colorectal	10/219 (5)	10/164 (6)	0/55 (0.0)	
Skin	8/219 (4)	7/164 (4)	1/55 (2)	
Renal	8/219 (4)	8/164 (5)	0/55 (0)	
Bladder/urothelium	7/219 (3)	35/164 (3)	2/55 (5)	
Endometrium	6/219 (3)	5/164 (3)	1/55 (2)	
Melanoma	5/219 (2)	4/164 (2)	1/55 (2)	
Other*	40/219 (18)	27/164 (16)	13/55 (24)	
Treatment indications				.001
Symptomatic brain metastasis/LMD [†]	73/219 (33)	65/164 (40)	8/55 (15)	
Cord/cauda compromise	48/219 (22)	37/164 (23)	11/55 (20)	
Cranial neuropathy owing to skull base metastases	11/219 (5.0)	5/164 (3)	6/55 (11)	
Other neurological indications [‡]	4/219 (1.8)	1/164 (1)	3/55 (6)	
Pain	61/219 (28)	45/164 (27)	16/55 (29)	
Bleeding	8/219 (3.6)	3/164 (2)	5/55 (9)	
Other [§]	10/219 (4.6)	5/164 (3)	5/55 (9)	
Asymptomatic bone metastases	4/219 (1.8)	3/164 (2)	1/55 (2)	
Treatment site				.001
Bone	52 (113/219)	51 (84/164)	53 (29/55)	
Brain	34 (74/219)	40 (65/164)	16 (9/55)	
Intrathoracic	4.1 (9/219)	3.0 (5/164)	7.5 (4/55)	
Lymph nodes	3.2 (7/219)	1.2 (2/164)	9.1 (5/55)	
Other	7.3 (16/219)	4.9 (8/164)	15 (8/55)	
Prescribed fractions	6 (3-13)	6 (3-13)	6 (3-11)	.21
Fractions received	5 (5-10)	5 (5-10)	5 (4-10)	.28
RT modality				.45
2D/3D	84 (183/219)	84 (138/164)	80 (44/55)	
IMRT	15 (32/219)	14 (23/164)	20 (9/55)	
SBRT	1.8 (4/219)	1.2 (2/164)	3.6 (2/55)	

Abbreviations: IMRT = intensity modulated radiation therapy; IQR = interquartile range; KPS = Karnofsky Performance Score; LMD = leptomeningeal disease; NP = nurse practitioner; RT = radiation therapy; SBRT = stereotactic body radiation therapy.

Bold *P* values indicate statistically significant.

* Includes pancreas, ovary, primary central nervous system, thyroid, esophageal, stomach, mesothelioma, lymphoma, soft tissue sarcoma, and unknown primary.

[†] Seen in 15 of 67 patients.

[‡] Includes brachial plexopathy and neurologic symptoms from calvarial metastasis.

[§] Includes superior vena cava syndrome and airway obstruction.

^{||} Includes visceral and cutaneous lesions.

Table 2 Time between radiation therapy (RT) components

RT indication	Days from consultation request to consult (IQR)	Days from consultation to simulation (IQR)	Days from simulation to RT (IQR)	Days from consultation request to RT (IQR)
Cord/cauda compression	1 (0-2)	0 (0-0)	0 (0-1)	2 (1-4)
Symptomatic brain metastases	1 (0-2)	0 (0-1)	1 (0-3)	3 (1-6)
Cranial neuropathy owing to skull base metastases	1 (0-1)	0 (0-1)	3 (1-4)	3 (2-6)
Pain	1 (1-2)	0 (0-2)	2 (1-4)	5 (2-7)
Bleeding	2 (0-3)	0 (0-2)	1 (0-2)	3 (2-7)
Airway obstruction	2 (1-2)	2 (1-2)	5 (5-5)	9 (7-9)

Abbreviation: IQR = interquartile range.

Treatment indications included symptomatic brain metastases, spinal cord/cauda equina compression, cranial neuropathy owing to skull base metastases, pain, bleeding, and airway compromise.

Results

Of the 219 inpatients included in this analysis, 93 (43%) were female (Table 1). The median age at initial cancer diagnosis was 59 years (interquartile range [IQR], 48-67 years), whereas the median (IQR) age at the start of inpatient RT was 61 (51-69) years. The most frequent indications for RT were symptomatic brain metastases (73 patients [33%], of whom 15 had leptomeningeal disease), pain (61 patients [28%]), cord/cauda compression (48 patients [22%]), and cranial neuropathy owing to skull base metastases (11 patients [5.0%]). Four patients (1.8%) were asymptomatic at the time of inpatient consultation—all 4 were treated for bone metastases owing to concern for impending neurologic compromise or structural instability (provided that no operative plan was recommended by the orthopedic or neurological surgery department). The median (IQR) Karnofsky Performance Score (KPS) was 60 (40-70) overall and was lower in the cohort of patients seen before integration of an NP (median, 50; IQR, 40-60) versus after (median, 70; IQR, 60-80) ($P < .001$). After integrating an NP, there was a slight increase in the number of inpatients treated, aggregated over a 4-week period (median of 3 [IQR, 2-8] patients treated after integrating an NP vs 2.5 [IQR, 2-4] before; $P = .029$).

The median time from consultation request to consult was 1 day (IQR, 0-2 days), and the median time from consultation request to first RT fraction was 3 days (IQR, 2-6 days). The median time from consultation request to completion of RT was 10 days (IQR, 6-15 days), and the median time from consultation to completion of RT was 9 days (IQR, 6-14 days). The median time from consultation request to the start of RT was shorter for patients with

cord/cauda compression (median [IQR], 2 [1-4] days) compared with pain (median [IQR], 5 [2-7] days) ($P = .001$) and symptomatic brain metastases (median [IQR], 3 [1-6] days) ($P = .037$) (Table 2). Radiation therapy within 1 day of consultation was more common for cord compression (32 of 48 patients [67%]) than for symptomatic brain metastases (23 of 67 patients [34%]) or pain (20 of 61 patients [33%]) ($P < .001$). Duration between additional components such as consult to simulation and simulation to first RT fraction, as well as for other indications including pain, bleeding, and airway obstruction, are described in Table 2.

With an NP, patients were more likely to undergo simulation on the same day as consultation (41 of 55 patients [75%] vs 97 of 163 patients [60%]; $P = .045$). Patients who underwent same-day consultation and simulation showed shorter intervals from consult to initiation of RT at a median of 1 day (IQR, 0-3 days) compared with those who did not have same-day simulation (median [IQR], 4 [2-7] days) ($P < .001$). Same-day consultation and simulation decreased the total time from referral to initiation of RT from a median (IQR) of 6 (3-8) days to 4 (1-5) days ($P = .008$). With same-day consultation and simulation, the time to initiation of RT decreased from 4 days (IQR, 2-7 days) to 1 day (IQR, 0-3 days) ($P < .001$) for patients with cord compression, from 3 days (IQR, 2-5 days) to 2 days (IQR, 0-3 days) ($P = .001$) for patients with symptomatic brain metastases, and from 5 days (IQR, 4-10 days) to 1 day (IQR, 1-4 days) ($P < .001$) for patients treated for pain. On multivariable regression, treatment indication was associated with time from consultation to initiation of RT ($P = .05$) (Table 3).

Overall, 34 of 219 patients (16%) did not complete their prescribed RT course. Fewer patients were unable to complete RT after integration of an NP for palliative RT (4 of 55 patients [7%]) versus before integration of the NP (30 of 164 patients [18%]) ($P = .05$), with no difference in prescribed fractions (median [IQR], 5 [5-10] fractions, both with and without an NP) ($P = .21$). In the 30 patients with records documenting a cause of incomplete

Table 3 Multivariable regression analysis

Model component	Referral to consult (B, 95% CI)	P value	Referral to simulation (B, 95% CI)	P value	Consult to RT (B, 95% CI)	P value	Simulation to RT (B, 95% CI)	P value
Age at diagnosis	-0.03 (-1.94 to 2.60)	.58	-0.03 (-0.15 to 0.09)	.62	-0.01 (-0.12 to 0.10)	.85	0.013 (-0.07 to 0.09)	.74
Age at RT	0.04 (-0.12 to 0.07)	.43	0.06 (-0.07 to 0.19)	.37	0.04 (-0.08 to 0.16)	.47	-0.001 (-0.09 to 0.09)	.99
Gender	0.56 (-0.29 to 1.41)	.19	0.23 (-0.89 to 1.36)	.68	-0.47 (-1.74 to 0.80)	.68	0.24 (-0.69 to 1.17)	.61
KPS	0.01 (-0.02 to 0.02)	1.00	0.002 (-0.03 to 0.04)	.88	0.01 (-0.03 to 0.05)	.88	0.01 (-0.02 to 0.04)	.40
Indication	0.19 (-0.07 to 0.45)	.15	0.34 (-0.005 to 0.68)	.05	0.34 (-0.01 to 0.68)	.05	0.44 (0.14 to 0.74)	.004

Abbreviations: KPS = Karnofsky Performance Score; RT = radiation therapy.
 Bold P values indicate statistical significance.

RT course, the most common indication was a decline in performance status (14 of 30 patients [47%] overall; 12 of the 26 patients before integration of an NP and 2 of the 4 patients after; in the latter group, 1 patient had an aspiration event, and another developed pneumo-mediastinum unrelated to RT). Other indications for incomplete RT were discharge to hospice or comfort care without a decline in performance status and patient preference (6 of 30 patients [20%] for both indications; 5 of 26 before integration of an NP and 1 of 4 after integration of an NP). Two of the 30 patients (7%) had a change in treatment plan that deferred further RT, and 2 (7%) were unable to tolerate RT; all 4 of these patients were treated before integration of an NP. At the last follow-up, 10 of the 219 total patients (5%) were still alive; among these patients, the median survival from RT was 31 months (IQR, 24-32 months). Among the deceased patients, the median time from RT to death was 44 days (IQR, 22-82 days).

Discussion

The study findings show that the interval between consultation request and RT is short for inpatient palliative RT, particularly in the case of neurologic compromise. After integration of an NP for palliative RT, there was a significant increase in same-day consultation and simulation, which shortened the interval to initiation of treatment. With an NP, fewer patients did not complete treatment, which, combined with increased KPS in this group, suggests there may be an element of improved patient selection for palliative RT.

Data from established rapid-access palliative RT programs have shown that the interval from consultation to RT can be substantially shortened in the palliative setting compared with typical RT workflows, with many programs treating patients on the day of consultation.^{12,13} Delays in the outpatient setting may still occur between referral and consultation.¹² In the inpatient setting, information on specific intervals between referral to consult and start of palliative RT have not previously been published. At institutions without dedicated inpatient services, delays from referral to consultation may be owed to limited availability of providers during an already hectic clinic day, particularly because outpatient clinics at some institutions are some distance from inpatient units. Often, these consults occur at the end of a physician’s workday, which may delay simulation and treatment planning, particularly if computed tomography-based planning is preferred to a potentially sub-optimal clinical setup. The findings of this study suggest that improved coordination with same-day consultation and simulation leads to shorter intervals to treatment.

Our experience also identifies variations in time from the inpatient consultation request to RT, with longer

intervals for pain and airway management. With regard to painful bone metastases, this may reflect titration of analgesic regimens and potentially less urgency compared with cord compression or symptomatic brain metastases. Airway obstruction may entail greater management complexity, with multiple services offering different and potentially complementary treatment options.²¹ For patients presenting with symptomatic de novo metastatic disease, there may also be a delay owing to the need for tissue diagnosis; 12 of 218 patients (6%) in this study began RT within 1 week of initial tissue sampling. Additional time may also be required for more complex RT techniques, particularly in the setting of reirradiation.

The study's data suggest that a dedicated NP may improve patient selection, as evidenced by an improvement in patient KPS and a decrease in the rate of incomplete RT (which was most commonly caused by a decline in performance status). The number of fractions prescribed for inpatients in this cohort is lower than seen in prior series of inpatient palliative RT,¹⁴ which may reflect ongoing shifts in practice patterns to decrease treatment intensity at the end of life²²⁻²⁴ while continuing to offer effective palliation.^{25,26}

Given that most radiation oncologists are outpatient providers, inpatient palliative RT poses unique needs that are well suited to APPs. Our NP, for example, coordinates care from the moment the consult is received by interfacing with referring providers, obtaining relevant records, reviewing imaging, independently seeing patients (with attending input as needed), scheduling simulation and treatment, and serving as a primary point person for the inpatient teams. One area of particular benefit is coordination of care around the time of discharge—to avoid treatment breaks, our NP works very closely with inpatient services to anticipate discharge in a way that ensures outpatient authorization and social-work services (ie, transport) are in place. Although there is an attending physician-of-the-day assigned to oversee simulation and treatment planning and also to help guide treatment decision-making, our NP is able to practice independently at a sufficiently high level and has professional development and research opportunities, which have been shown to be critical for retention.^{19,20} To ensure that the workflow improvements with our NP did not come at a cost to resident education, residents on service with the physician-of-the-day would review the case with both the attending physician and our NP and take ownership of contouring, treatment planning, and interfacing with the inpatient team as they would for any other patient on their service. As residents may cover multiple clinical sites and have additional educational obligations, an additional benefit was that our NP was in-house and available to provide continuity of care and address any urgent issues that might arise.

Although not specifically addressed by the data presented, we also note that the addition of an NP for inpatient RT has been viewed very favorably by the department as a

whole, by the rotating physicians-of-the-day who oversee urgent inpatient treatments, and by the on-call teams, who have noted improved communication and continuity of care. This NP role, with associated improvements in both clinic operations and patient care, has been used as a template to guide development of APP roles on other service lines in our department.

Indirect patient care has been estimated to occupy approximately 50% of APP time in radiation oncology,^{20,27} which may in turn allow physicians to focus on more complex tasks or see an increased volume of patients,¹⁹ thereby potentially improving the financial health of the department and institution.²⁰ Although not specific to APPs, there are data to suggest that dedicated palliative RT consult services also may be associated with shorter treatment courses, decreased lengths of stay, and cost savings on the order of almost \$21,000 per patient.²⁸ Importantly, almost all patients seen in collaborative-practice models are aware when their care is provided by a nonphysician provider, and based on surveys, they are extremely satisfied with their care, suggesting this is an acceptable model from a patient perspective.²⁹ Several practice models have been described to improve delivery of palliative RT, each with slightly different role distributions for physicians and other health care professionals that range from NPs to specialized radiation therapists and radiographers³⁰; this suggests that no single approach is the best way to improve the quality of palliative RT.

In addition to its retrospective nature, this analysis is limited owing to a small number of patients, which prevents further subset analysis. The relatively short period evaluated after introduction of an NP (9 months) is also a limiting factor, compared with the preceding 5-year period used for comparison. Changes seen over this time frame may be a result of factors we were unable to account for, such as turnover in attending providers at our institution, shifts in surgical practice, and development of a dedicated inpatient palliative care medicine service. Another limitation is that owing to changes in the way consultations were ordered through the electronic medical record during the study period and the way we generated our patient list (beginning with those treated to a site of metastatic disease and narrowed to only inpatients), we were unable to characterize the proportion of inpatient consultations that did not result in treatment. It must be noted that in some circumstances, optimizing supportive care may be more appropriate than initiating a course of RT.³¹ To this point, data from a large, integrated health care system showed that 46% of inpatients undergoing palliative RT for brain metastases from non-small cell lung cancer underwent RT within the 14 days before death.¹⁸

This study does not address additional potential benefits of having a dedicated NP for palliative RT, including improved patient experience,^{9,32} decreased burden on attending physicians to balance a busy clinic schedule with unpredictable inpatient needs,³³ improved

communication with inpatient teams or outpatient providers, and potentially decreased costs or increased clinical capacity.²⁸ An increase in requests for palliative RT for hematologic malignancies (6% of patients had multiple myeloma before our NP started, vs 31% of patients after) may have resulted from our NP's prior years of experience on the Bone Marrow Transplant service, showing the importance of developing a strong relationship with referring providers as well as improvements in systemic therapy for patients. The difference in inpatient RT for symptomatic brain metastases before and after integration of an NP for inpatient palliative RT may reflect improved workflows for outpatient Gamma Knife radiation surgery but also changes in criteria for treatment that may confound the findings.

Conclusion

The interval from inpatient consultation request to palliative RT is short, although it varies slightly depending on the indication. For medical practices without a dedicated palliative RT team, involvement of an APP can help streamline workflow and potentially expedite RT, although further work is needed to quantify the effect of APPs in this unique setting.

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