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Systematic review

Palliative radiation therapy in the last 30 days of life: A systematic review

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ABSTRACT

Purpose: To investigate the utilization of palliative radiation therapy (RT), predictors for the use of RT, and symptom palliation following RT during the last 30 days of life through systemic review of literature.
Materials/methods: A systematic search of available medical literature databases was performed on patients receiving palliative RT in the last 30 days of life. A total of 18 studies were evaluated.
Results: The overall palliative RT utilization rates during the last month of life were in the range of 5–10% among patients who died of cancer and 9–15.3% of patients who received palliative RT. The most commonly used regimen was 30 Gy in 10 fractions (36–90%). Single fraction RT utilization ranged from 0% to 59%. ECOG performance status 3–4 was significantly associated with patients receiving RT in the last 30 days of life and shorter survival. Twenty-six percent of patients who survived less than 1 month were reported to show symptom palliation following RT.
Conclusion: Palliative RT was performed in approximately 10% of patients who died of cancer near their end of life, with the most commonly used regimen of 30 Gy in 10 fractions. This study suggests that greater use of shorter or single fraction regimens may be beneficial, especially in patients with poor performance status.
 Radiotherapy and Oncology 125 (2017) 193–199

Radiation therapy (RT) is one of the pivotal treatment options in the palliative management of symptomatic disease from advanced cancer. While palliative RT undoubtedly benefits patients with cancer in various stages of the disease, its use during the last month of life has recently been questioned, both in terms of symptom improvement and survival [1–4]. When survival is short, palliative RT may have minimal clinical benefit for patients, delay referral to hospice, and impede optimal end-of-life (EOL) planning and care delivery [5]. It is well-recognized that even experienced oncologists tend to overestimate patient prognosis [4,6,7]. As radiation oncologists incorporate life expectancy estimates into treatment decision-making, including selection of dose-fractionation prescription [8], overestimation of life expectancy may contribute to inappropriate use of longer fractionation regimens. This subjects patients and caregivers to longer active treatment at the EOL [4]. Little is known regarding the frequency of palliative RT use and patterns of palliative RT in the last 30 days of life, despite its frequent utilization.

The primary aim of the present study was to investigate the utilization of palliative RT, fractionation schedules, predictors for, and efficacy of palliative RT during the last 30 days of life through a systematic review of published literature. Results from this study would help build guidelines for palliative RT in patients at their EOL.

Methods

Online literature search of PubMed, CINAHL, and the Cochrane Review databases was performed to identify all original articles from January 1960 to December 2016. The search terms queried were 'palliative radiation' or 'palliative radiotherapy' and 'end-of-life', 'last 30 days', 'last 1 month', 'terminally ill', and 'hospice'. The reference sections of the selected papers were manually searched for relevant publications.

For this systematic review, we included studies published in English and reporting (1) RT utilization in the last 30 days of life (death within 1 month of completing RT), (2) risk variables associated with receiving RT during the last 30 days of life, and/or (3) the efficacy of RT in the last 30 days of life. Editorials and commentaries were excluded. Articles were screened on the basis

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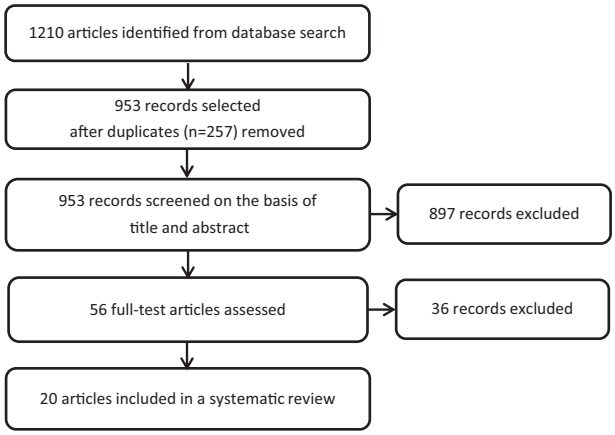

Fig. 1. The PRISMA flow diagram.

of title and abstract, and then selected through reading the complete articles by two authors (Fig. 1). Independent data extraction from articles was made by two authors using predefined data template.

A comprehensive systematic review using the PISMA guideline was conducted. However, a formal meta-analysis was not feasible because of the heterogeneity of patient cohort in published studies and the lack of minimal standards in reporting results.

Results

A total of 20 publications met our inclusion criteria were evaluated, of which 9 studies were from single institutions [4,9–16] and 11 studies from population registries (Table 1) [1–3,17–24]. The patient populations included in these studies varied significantly across different studies. Ten studies examined patients who died of cancer (Table 2) [1,3,9,10,17–21,23], 6 studies presented the frequency of palliative RT among patients receiving specifically palliative RT [2,4,11–13,22], and 2 studies evaluated for patients receiving any RT (Table 3) [14,15]. Most single institution studies examined patients who received palliative RT or any RT and most population based studies evaluated patients who died from cancer.

Utilization of RT during the last 30, 14, and 7 days of life

The overall palliative RT utilization rate in the last 30 days of life widely varied from 0.7% to 33% depending on the study cohort, region (country), and cancer type. The frequency of palliative RT use in the last 30 and 14 days of life ranged between 5% and 10% (mean ± standard deviation [STDEV] = 7.5 ± 2.1), and between 2.2% and 4.6% (mean ± STDEV = 3.5 ± 1.1) among patients who died from cancer, respectively (Table 2) [10,17,19,23]. The range of palliative RT use rates in the last 30 days of life was 9–15.3% (mean ± STDEV = 12.1 ± 3.2) among patients receiving palliative RT, and 6.2–7.2% among patients receiving any RT (Table 3) [4,11,12,14]. The frequency of RT use in the last 30 days for pediatric patients receiving any RT with protons and photons was 0.7% and 1.6%, respectively [15]. Palliative RT was most frequently utilized in patients with lung cancer (Tables 2 and 4) [1,3,9,11,14,17–19,22,23].

Regarding the proportion of time spent on treatment relative to the remaining life span, 33 (52%) of 63 patients who received RT within 30 days of death died during their treatment course, and 43 patients (69%) had their last treatment within 10 days before their death in a single institution study [16]. Half of the patients spent greater than 60% of their remaining life span on therapy in a population based study [4]. Two single intuition studies reported that 6 (10%) of 63 patients who died within 30 days of receiving RT and 12 (4%) of 339 patients whose final RT course was for bone metastases had their final RT on the days of their deaths [13,16].

Table 1
Publications on palliative radiation therapy in the last 30 days of life.

Classification of articles	No. of articles	Country	No. of articles
Single Institution Study	9	China	1
		Germany	1
		Norway	3
		USA	4
Population Based Study	11	Dutch	1
		Norway	1
		Swiss	1
		Canada	3
		USA	5
Total	20		

Radiation treatment

All results associated with radiation treatment procedure are shown in Table 5. The most common indication for RT was metastatic disease, involving bone (33–54%), brain (11–42%), central airway (16%), or spine (11–14%) for all cancer type [4,12,17,23].

Ten fractions of RT was most commonly used (30–90%) [1,4,11,12]. Single fraction radiotherapy (SFRT) utilization ranged from 0% to 59% depending on the treatment center with reported rates of 8–9.4% in the US and 19–59% in Canada [3,13,17,22]. A study of a single institution in Germany showed that SFRT was never applied [4]. The proportions of patients receiving >10 fractions were 17–17.8%, 12%, and 11% in studies from the US, Canada, and Norway, respectively [1,3,13,17,23].

For RT technique, single field (74%) or 3-dimensional treatment planning (17%) was used in a population based study [17]. A study using the NCCN database of NSCLC reported that RT techniques used included conventional 2-dimensional RT (33%), 3-dimensional conformal RT (42%), intensity modulated RT (5%), stereotactic radiosurgery (37%), while 17% of cases did not report the RT technique [1].

The percentage of patients who did not complete RT was 53–82% [1,4,16,17,23]. The causes for not completing RT were poor performance status (47%), patient's death (17–27%), cancer progression, comorbidity, and patient/family preference [1,4,23].

Efficacy of palliative RT in the last month of life

Only 2 studies reported the efficacy of RT during the last month of life. Of 31 patients who died within 30 days after referral for palliative RT, despite palliative RT, condition worsened in 16 (51.6%) patients, and improved or remained stable in 8 (26%) patients. The remaining patients died before they could be assessed [4]. The Dutch Bone Metastasis Study observed that the efficacy of RT for painful bone metastases during the last 12 weeks of life varied by time from death; 25%, 52%, 65%, and 81% for 1–4, 5–8, 9–12, and >12 weeks from death, respectively. Longer survival was associated with higher response rate, while 26% of patients that survived less than 1 month showed symptom response [24].

Predictors for RT and prognostic variables

Table 6 demonstrates the predictors for the use of RT in the last month of life and prognostic variables. Among single institution studies, the patients who had Eastern Cooperative Oncology Group (ECOG) performance status (PS) 3–4, primary lung or bladder cancer, multiple metastases, and evidence of progressive disease

Table 2
Receipt of radiation therapy in the last 7, 14 and 30 days of life among patients who died from cancer.

Data source (Author, publication year) [Reference]	Total no. of patients and study cohort	Primary cancer type	EOL period	No. of patients† (%)
Shanghai Cancer Center* (Zhang, Zhe et al. 2016) [10]	410 decedents with cancer between 2007 and 2013	All	30 days	28 (6.8%)
Nordland Hospital* (Nieder, Carsten et al. 2014) [9]	266 decedents with NSCLC between 2006 and 2013	NSCLC	30 days	65 (24.4%)
The Norwegian Cause of Death Registry** (Anshushaug, Malin et al. 2015) [23]	723 decedents with cancer in 2005 & 2009	All	30 days 14 days	61 (8%) 29 (4%)
Alberta Cancer Registry** (Grendarova, Petra et al. 2015) [17]	9863 decedents with cancer etween 2003 and 2010	All	30 days 14 days	988 (10%) 542 (4.6%)
Cancer Registry of Four Swiss Cantons** (Matter-Walstra, Klazien W. et al. 2015) [18]	2,086 decedents with cancer in hospitals between 2006 and 2008	All	30 days	244 (11.7%)
BC Cancer Registry** (Huang, Jin et al. 2014) [19]	12,300 decedents with cancer between 2010 and 2011	All	30 days 14 days	614 (5%) 268 (2.2%)
SEER Medicare Database** (Guadagnolo, B. Ashleigh et al. 2013) [3]	202,299 decedents with cancer between 2000 and 2007	Lung, Breast, Prostate, Colorectal, Pancreas	30 days	15,287 (7.6%)
SEER Medicare Database** (Kress, Marie-Adele Sorel et al. 2015) [20]	39,619 decedents with cancer between 2004 and 2011	Breast, Prostate, Colorectal	14 days	5,723 (14%)
8 NCCN Member Institutes** (Kapadia, Nirav S. et al. 2012) [1]	1098 decedents with NSCLC between Jan. 2001 and March 2010	NSCLC	30 days 14 days	209 (19%) 115 (10%)
SEER Medicare Database** (Huo, Jinhai et al. 2015) [21]	816 decedents with metastatic melanoma between 2000 and 2007	Melanoma	30 days 7 days	88 (10.8%) 11 (1.4%)

* Single institution study.
** Population based study.
† Number of patients who received RT at the end of life, EOL: End of life, NSCLC: Non-small cell lung cancer.

Table 3
Receipt of radiation therapy in the last 7, 14 and 30 days of life among patients receiving radiation therapy.

Data source (Author, publication year) [Reference]	Study cohort	Primary cancer type	EOL days	No. of patients† (%)
University Hospital Dusseldorf* (Gripp, Stephan et al. 2010) [4]	216 patients receiving palliative RT between Dec 2003 and July 2004	All	30 days	30 (13.9%)
Nordland Hospital, Norway* (Angelo, Kent et al. 2014) [11]	579 patients receiving palliative RT during 2010 and 2011	All	30 days	53 (9%)
Johns Hopkins University School of Medicine* (Ellsworth, Susannah et al. 2014) [13]	339 patients receiving RT for bone metastases between 2007 and 2012	All	30 days	89 (26%)
Indiana University and Howard University* (Patel, Anand et al. 2014) [14]	852 (713‡, 139§) patients receiving RT in 2010 179 patients died in 2012	All	30 days 7 days	44(6.2%)‡, 10 (7.2%)§ 16 (2.2%)‡, 4 (2.9%)§
Nordland Hospital, Norway* (Nieder, Carsten et al. 2015) [12]	873 patients receiving palliative RT between 2007 and 2011	All	30 days	105 (12%)
University of Miami* Indiana University Health Proton Therapy Center* (Panoff, Joseph et al. 2015) [15]	464 patients receiving photon therapy at age ≤21 between June 2000 and June 2014 272 patients receiving proton therapy at age ≤21 between June 2008 and June 2013	All	30 days	7 (1.6%) 2 (0.7%)
BC Cancer Agency** (Tiwana, Manpreet S. et al. 2016) [22]	8301 patients (16,898 courses) receiving RT for bone metastases between 2007 and 2011	All	30 days 14 days	2443 (14.5%) 709 (4.2%)
SEER Medicare Database** (Murphy, James D. et al. 2013) [2]	21,279 patients receiving palliative RT between 2000 and 2007	Lung, Breast, Prostate, Colorectal	30 days 14 days	7,022 (33%) 4,043 (19%)

EOL, End of life.
* Single institution study.
** Population based study.
† Number of patients who received RT at the end of life.
‡ Indiana University Hospital.
§ Howard University Hospital.

were more likely to receive RT in the last month of life [10,11,13]. In population based studies, significant predictors for the use of RT in the last month of life included ECOG PS 3–4, earlier year of death, lung cancer cause of death, younger age, male sex, lower comorbidity score, shorter time from diagnosis to death, multiorgan involvement at diagnosis, urban residence (vs. rural), hospital type (highest in university hospitals), acute care admission, and higher income [1–3,17,18,20,22,23].

Table 4
Receipt of radiation therapy (%) in the last 7, 14 and 30 days of life according to cancer type.

Data source (No. of patients) [Reference]	SEER-Medicare* (39,619) [20]	SEER-Medicare* (202,299) [3]	BC Cancer Registry* (12,300) [19]		Alberta Cancer Registry* (9863) [17]		Norwegian Cause of Death Registry* (723) [23]		Swiss Cancer Registry* (2,086) [18]	BC Cancer Registry† (16,898) [22]	Nordland Hospital‡ (579) [11]	Indiana University§ (63) [14]
EOL days	14	30	14	30	14	30	14	30	30	14	30	30
Lung		11.2	5.4	11.3	8.3	17.6	9	16	16.8	7.9	SCLC 16.1 NSCLC 17.1	38
Breast	15	5.8	1.5	3.5	3.9	10.2	5	8	9.9	1.3	0	4.8
Prostate	15	5.4	1.4	3.0	4.5	10.3	3	6	12.5	2.2	7.6	
Colorectal	14	2.4	1.0	1.9	1.2	4.1	3	7	9.3	6.9	8.1	
Non-colorectal GI			1.6	4.1	1.9	3.9						
Pancreas		2.3					3	6			11.1	
Head & neck					5.9	14.7						
Hematologic			1.0	3.6	4.3	8.1			10.7	3.0	Lymphoma 14.3 Myeloma 4.2	Lymphoma 11
CNS/Brain			1.6	3.1	4.2	7.3		7				
GYN			0.8	2.4	2.6	5.4	4	4				
Urinary			1.7	5.5	3.4	7.2	3	6			Bladder 12.5	
Melanoma				4.9				6				
Sarcoma												7.9
Others			1.9	4.1	7.3	14.4		12	10.5	5.1	7.4	
Overall	14	7.6	2.2	5.0	4.6	10	4	8	11.7	4.2	9	

Study cohort: EOL: End of life, SCLC: Small cell lung cancer, NSCLC: Non-small cell lung cancer, GI: gastrointestinal, GYN: Gynecology.
* Patients died from cancer.
† Patients receiving palliative RT for bone metastasis.
‡ Patients receiving palliative RT.
§ Patients receiving any RT.

Table 5
Summary of radiation treatment.

Data source [Reference] (Primary cancer type)	RT Site	RT Fractionation/Duration	% of patients not completing RT	Causes for not completing RT	Response of RT
Nordland Hospital* [11] (All cancer type)	N/A	The most common RT regimen: 10 fractions of 3 Gy (36%), Other common regimens: 8 Gy SFRT (bone metastases), two fractions of 8.5 Gy (lung cancer), five fractions of 4 Gy (various indications)	N/A	N/A	N/A
Johns Hopkins University* [13] (All cancer type)	N/A	SFRT: 8%, 2–5 fractions: 19%, 6–10 fractions: 56%, >10 fractions: 17%	N/A	N/A	N/A
Indiana University* [16] (All cancer type)	N/A	NA	54%	N/A	N/A
University Hospital Dusseldorf* [4] (All cancer type)	Brain: 42% (most common site)	The median duration of RT: 15 days, Regimens of at least 30 Gy with fractions of 2–3 Gy in 90% of RT, RT Duration; 0–7 days: 20%, 7–14 days: 23%, 14–21 days: 43%, >21 days: 13%, Dose/Fraction; 2 Gy: 13.3%, 2–3Gy: 80%, 3.1–4 Gy: 6.7%	58.1%	Early death or deteriorating health status	Worsened: 51.6% Improved or stable: 25.8% Died before assessed: 22.6%
Nordland Hospital* [9] (NSCLC)	Chest: 54%, Brain: 25% Spine: 14%, Other: 7%	NA	N/A	N/A	N/A
Nordland Hospital, Norway [12] (All cancer type)	Bone: 54%, Brain: 15%, Chest resulting from lung cancer: 12%	The most common fractionation regimen was 3 Gy x 10 (43%), followed by 5–7 fractions of 4 Gy (22%).	N/A	N/A	N/A
BC Cancer Agency** [22] (All cancer type)	Bone	% of SFRT; Survival <2 weeks: 64.2%, Survival 2–4 weeks: 54.5%, Survival >4 weeks: 47.9%	N/A	N/A	N/A
Alberta Cancer Registry** [17] (All cancer type)	Bone (most common site) followed by lung/mediastinal and brain	SFRT: 19%, 2–5 fractions (mostly 5): 42%, 6–10 fractions (mostly 10): 21% , >10 fractions: 12% Unclear: 6%	66%	N/A	N/A
The Norwegian Cause of Death Registry** [23] (All cancer type)	Bone: 33% Central airways: 16% Spinal cord: 11% Brain: 11%	1–2 fractions: 33% 3–5 fractions: 31% 6–10 fractions: 25% >10 fractions: 11%	82%	Death: 27% Poor performance status : 45% Perforation of esophagus: 9% Progressive disease: 9% Septicemia: 9%	N/A
SEER Medicare Database** [3] (Lung, Breast, Prostate, Colorectal, Pancereas)	N/A	SFRT: 9.4% >10 days of treatment: 17.8% >5 days of treatment: 53.7%	N/A	N/A	N/A
SEER Medicare Database** [2] (Lung, Breast, Prostate, Colorectal)	N/A	The median duration of palliative RT: 16 days	N/A	N/A	N/A
8 NCCN Member Institutes** [1] (NSCLC)	Brain: 28%, Chest: 27% Spine: 25% Bones other than spine: 13%, Other: 8%	1–3 fractions: 19%, 5 fractions: 9%, 6–9 fractions: 24%, 10 fractions: 30%, 11–15 fractions: 15%, >15 fractions: 2%	53%	Patient died: 17%, Patient/family preference: 21%, Cancer progression: 11%, Comorbidity: 9%, Toxicity: 6%, Other: 17%	N/A

* Single institution study, ** Population based study,
NSCLC, Non-small cell lung cancer; SFRT, Single fraction RT; N/A, Not applicable (not documented in study).

Table 6
Predictors for receipt of radiation therapy in the last 14 and 30 days of life and prognostic variables.

Data source [Reference] (Primary cancer type)	EOL Days	Significant co-variates for receiving RT
Shanghai Cancer Center* [10] (All cancer type)	30	ECOG PS <3 and cardiopulmonary resuscitation were associated with the decision to administer RT.
Nordland Hospital, Norway* [11] (All cancer type)	30	Lung or bladder cancer, Eastern Cooperative Oncology Group performance status of 3–4, low hemoglobin, opioid analgesic use, steroid use, and known progressive disease outside RT volume were significant predictors of receiving RT.
Johns Hopkins University* [13] (All cancer type)	30	Lower mean Karnofsky performance status and inpatients at the time of initial radiation oncology evaluation were more likely to live ≤30 days of completing RT.
Nordland Hospital, Norway* [9] (NSCLC)	30	Lack of documented resuscitation preference and the presence of superior vena cava compression were more likely to receive RT.
The Norwegian Cause of Death Registry** [23] (All cancer type)	30	ECOG PS 3–4, GPS 2, and synchronous metastases were more likely associated with receiving RT.
Alberta Cancer Registry** [17] (All cancer type)	30	Higher comorbidity scores and the second half of study period (2007–2010) were associated with less end-of-life RT.
Cancer Registry of Four Swiss Cantons** [18] (All cancer type)	30	Younger age, patients living in Ticino canton, and patients treated in university hospitals were significantly associated with receiving RT.
SEER Medicare Database** [3] (Lung, Breast, Prostate, Colorectal, Pancreas)	30	Earlier year of death, lung cancer, younger age, male sex, non-Hispanic white, Hispanic or other race (versus non-Hispanic black), married status, Charlson comorbidity index of 0, urban residence, higher income level, no receipt of hospice, and southern SEER region were significantly associated with receiving RT.
British Columbia Cancer Agency** [22] (All cancer type)	14	Site of primary, site of metastases, and treatment center were associated with receiving RT. Lung cancer patients and those with spinal metastases were more likely to receive RT.
SEER Medicare Database** [20] (Breast, Prostate, Colorectal)	14	All others versus non-Hispanic white, younger age, urban area, married status, receiving prior RT and chemotherapy, shorter time from diagnosis to death, and stage IV were significantly associated with receiving RT.
SEER Medicare Database** [2] (Lung, Breast, Prostate, Colorectal)	14	Tumor site (lung cancer), increased age, increased comorbidity, and male sex were significant predictors of death within 2 weeks of receiving RT.
8 NCCN Member Institutes** [1] (NSCLC)	14	Patients with stage IV disease or multiorgan involvement at diagnosis, and age <65 years at diagnosis were more likely to receive RT. There was significant interinstitutional variation in the EOL RT use.
		Prognostic variables
Nordland Hospital, Norway* [12] (All cancer type)	30	ECOG PS 3–4, Brain metastases, Liver metastases, Bone metastases, Progressive disease, >1 diagnosis of cancer, Opioid analgesics, C-reactive protein >30 mg/l, Steroids, Leukocytosis, Pleural metastases and/or effusion were significant independent prognostic factors.
University Hospital Dusseldorf* [4] (All cancer type)	30	Karnofsky performance status score <50%, dyspnea at rest, and brain metastases were independently associated with an unfavorable prognosis.

* Single institution study, ** Population based study.
EOL, End of life; NSCLC, Non-small cell lung cancer; ECOG PS, Eastern Cooperative Oncology Group Performance Status; GPS, Glasgow Prognostic Score.

Palliative RT administration, and quality and cost of EOL care

Receiving RT in the last 30 days of life was significantly associated with cardiopulmonary resuscitation [10], dying in hospital [9,17,23], hospital admission [3,17,23], intensive care unit stay [3], and emergency department visits [3]. The cost of care was significantly higher for patients who underwent RT in the last 30 days of life compared to those who did not [3,10].

Discussion

The overall palliative RT utilization rates in the last 30 days of life were in the range of 5–10% among patients who died of cancer [10,17,19,23], and 9–15.3% among patients receiving palliative RT [4,11,12]. Most patients received 10 fractions of RT [1,4,10–12], and SFRT use varied from 0 to 59% [3,4,13,17,22].

Poor performance status was the most significant predictor for receiving RT in the last month of life [10,11,13,23]. There was a high rate (53–82%) of incomplete treatment in this patient population with multifraction courses of RT mainly due to poor performance status, patient's death, progressive disease, and comorbidity [1,4,23]. Physicians consistently overestimate survival in patients with cancer at the EOL [4,6,7] and survival overestimates may have contributed to mismatched fractionation schedules and a high percentage of patients who have discontinued therapy [4]. Two weeks of daily irradiation for patients with poor performance status at the EOL may place considerable burden for these patients and their families. SFRT is likely equally effective [25] and will reduce the burden and costs to patients with a short life expectancy. Forty percent of patients with painful bone metastases experienced pain reduction and better quality of life as early as 10 days after a single 8-Gy radiotherapy [26]. Thus, patients with poor performance status should receive SFRT whenever possible to minimize the time spent on treatment and enhance the quality of remaining life outside of the health care at the EOL.

Practice patterns of palliative RT at the EOL widely varied across treatment centers, demographics, and geography. SFRT use is higher in Canada (19–59%) [17,22] than in the US (8–9.4%) [3,13]. The proportion of patients who spent >10 days receiving RT during the last 30 days of life was higher in the US (17–17.8%) [1,3,13] than in Canada and Norway (11–12%) [17,23]. A study from BC Cancer Agency postulated that higher SFRT use in Canada may stem from the fact that 100% of RT is provided as a publicly-funded service in which RT prescription is not influenced by physician remuneration or patient's ability to pay [22]. Medical training, departmental policies, the potential higher rate of retreatment, and toxicity profile are concerns for not offering SFRT [27,28]. Although likely multifactorial, the low frequency of SFRT use in the US is probably influenced by deeply rooted historical practice patterns favoring multifraction courses; additional contributing factors may include fraction-based reimbursement schemes in the US [13].

The reason why a considerable number of patients at the EOL spent their remaining life span on RT and some patients had their

final radiation treatment on the day of their death may be associated with survival overestimates [4,13,16]. Therefore, it is important to develop an objective survival prediction tool that allows life expectancy-adjusted therapeutic strategies at the EOL. Several objective tools have been developed to aid the clinician in formulating a prognosis of patients with poor survival, typically measured in days to weeks [29]. However, no simple prognostic model was capable of predicting mortality near EOL with high accuracy. Disease-specific models requiring larger databases may possess promising potential [11,12]. The present study provides important stimuli for further research towards the development of decision-making tools that may reduce subjectivity in assessing the potential benefit of palliative RT for patients at the EOL.

Despite the prescription of palliative RT during the last month of life, few studies have reported on the efficacy of RT in terms of symptom palliation or quality of life. Most patients with less than a 1 month life span may have been treated with little benefit [4,24]. Therefore, future study is needed to investigate the benefit of RT at the EOL, as reported by patients.

Careful consideration of the benefits of palliative RT in this patient population should be weighed and more research is needed to identify the patients who can benefit the most from palliative RT at the EOL. Lastly, further investigation is required to develop prognostic models that will improve the reliability of survival predictions, allowing more individualized life expectancy-adapted treatment planning.

Conflict of interest

None.

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