Hong Kong J Radiol. 2013;16:261-9 | DOI: 10.12809/hkjr1313171

ORIGINAL ARTICLE

Patterns of Practice in the Prescription of Palliative Radiotherapy for the Treatment of Thoracic Symptoms of Lung Cancer at the Rapid Response Radiotherapy Program between 2006 and 2012

N Thavarajah, K Wong, L Zhang, E Wong, G Bedard, N Lauzon, L Holden, M Tsao, C Danjoux, E Barnes, A Sahgal, E Chow

Rapid Response Radiotherapy Program, Odette Cancer Centre, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada

ABSTRACT

Objective: *Radiation therapy can often be used for palliation of thoracic symptoms in patients presenting with locally advanced lung cancer or lung metastases. The aim of this study was to examine whether patterns of practice in prescription of palliative thoracic radiation therapy have changed over time in the Rapid Response Radiotherapy Program. Secondary outcomes were factors that may have influenced the treatment regimen prescribed, including patient, disease, and organisational factors.*

Methods: *This study was a retrospective review of a prospective database of patients with locally advanced lung cancer or lung metastases referred to the Rapid Response Radiotherapy Program for thoracic symptoms between 1 July 2006 and 30 April 2012. Patient demographics, and organisational and disease factors were descriptively analysed. Differences in proportions between unordered categorical variables were examined using chi-squared test. Univariate logistic regression analysis and backward stepwise selection procedure were used to determine the most significant factors in prescription practice.*

Results: *A total of 175 courses of palliative thoracic radiation therapy were prescribed. The median age of the patients was 71 years, and the median Karnofsky Performance Status was 60. The most commonly prescribed treatment regimen was 20 Gy in 5 fractions (20 Gy/5), which made up 64% of all the courses prescribed. There was a significant increase in frequency of the prescription of 20 Gy/5 over time ($p = 0.02$). The site of radiation (disease factor) and years of certification for independent practice of the treating radiation oncologist (organisational factor) were also significant factors in the prescription of 20 Gy/5 over time (both $p = 0.02$).*

Conclusion: *A significant increase in the prescription of 20 Gy/5 was observed over time. However, the prescription of a higher dose fractionation schedule for patients with a higher performance status, as seen in other clinical trials and guidelines, was not observed. Future studies should further explore other possible factors such as patient survival, preference, comorbidities, and disease burden that may influence the dose fractionation prescribed.*

Key Words: *Dose fractionation; Lung neoplasms; Palliative care; Physician's practice patterns*

Correspondence: *Dr Edward Chow, Department of Radiation Oncology, Odette Cancer Centre, Sunnybrook Health Sciences Centre, 2075 Bayview Avenue, Toronto, ON, Canada M4N 3M5.*
Tel: (416) 480 4998; Fax: (416) 480 6002; Email: Edward.Chow@sunnybrook.ca

Submitted: 21 Feb 2013; Accepted: 11 Jul 2013.

中文摘要

2006年至2012年間的「快速反應放射治療計劃」中姑息性放療治療肺癌胸部症狀的實踐模式

N Thavarajah, K Wong, L Zhang, E Wong, G Bedard, N Lauzon, L Holden, M Tsao, C Danjoux, E Barnes, A Sahgal, E Chow

目的：對於局部晚期肺癌或肺轉移患者，放射治療一般可緩解胸部症狀。本文研究在實施「快速反應放射治療計劃」（Rapid Response Radiotherapy Program）期間，姑息性胸部放射治療的模式是否有變化。其次是研究可能會影響治療方案的因素，包括病人、疾病和組織方面。

方法：本研究回顧性分析一前瞻性數據庫中2006年7月1日至2012年4月30日期間局部晚期肺癌或肺轉移病人資料，他們因胸部症狀而被轉介參與「快速反應放射治療計劃」。對病人的人口學資料、組織和疾病因素進行描述性分析。採用卡方檢驗觀察無序性分類變量之間的比例差異。運用單元邏輯回歸分析和後退逐步選擇法來確定治療中最重要的因素。

結果：總計175個姑息性胸部放射治療療程處方給研究病例。患者年齡中位數為71歲，Karnofsky氏體能表現狀態中位數為60。最常用的治療方案為分5次劑量的20 Gy（20 Gy/5），佔所有療程的64%。處方20 Gy/5的頻率隨時間明顯增加（p = 0.02）。放射部位（疾病因子）和放射治療科醫生擁有獨立執業牌照的年期（組織因子）是處方20 Gy/5的重要因素（兩者的p值均為0.02）。

結論：20 Gy/5的放療方案隨時間明顯增加。其他臨床試驗和指引中一般會給予身體功能狀態較好的病人一個較高的劑量，可是這現象並未在本研究中觀察到。未來研究應進一步探討影響劑量分割的其他可能因素，如患者生存率、偏好、合併症和疾病負荷。

INTRODUCTION

Radiation therapy can often be used for palliation of thoracic symptoms in patients presenting with locally advanced lung cancer or lung metastases.[1] Thoracic radiation therapy results in palliation in 60 to 91% of patients with cough, 77 to 92% of patients with haemoptysis, 70 to 78% of patients with pain, and 40 to 97% of patients with dyspnoea.[2]

Despite the considerable role that palliative thoracic radiation therapy plays in treatment of patients with lung metastases or locally advanced lung cancer, there is no clear consensus concerning the optimal fractionation schedule or dose. Treatment schemas have evolved empirically over time, but were not critically analysed in a clinical trial setting until the late 1980s and early 1990s.[1,3] Since then, numerous randomised controlled trials have analysed various dose fractionation schedules in patients receiving thoracic radiation therapy. These trials compared patient outcomes and symptom relief from a variety of different treatment schemas. Fractionation schedules tended to range from 1 fraction to as many as 30 fractions and doses ranged from 10 Gy to 60 Gy.[4-17]

These studies have shown that among specific endpoints for symptom control, there were no significant differences in overall symptom relief. However, improved survival was found for patients receiving a higher dose of radiation therapy, especially in those with a higher performance status.[4-17] Longer courses of radiation therapy that administer a higher biological effective dose of radiation can increase survival by up to 5%; however, the risk of oesophagitis in patients is also increased in comparison to lower doses of radiation treatment.[2,16] Similarly, the American Society for Radiation Oncology evidence-based clinical practice guideline for palliative thoracic radiation therapy recommends that patients with a good performance status may benefit from a higher dose and fractionation of radiation therapy (i.e. 30 Gy in 10 fractions [30 Gy/10]) with the intent of moderately improved survival.[18] Various other clinical practice guidelines have recommended a shorter dose

fractionation schedule for treating thoracic symptoms overall.[1,19-23]

The Rapid Response Radiotherapy Program (RRRP) is an outpatient palliative radiation therapy clinic established in 1996 at the Odette Cancer Centre in Toronto, Canada. The RRRP was initiated with the intention of providing timely palliative radiation therapy for symptom relief in patients with locally advanced or metastatic cancers.[24] This retrospective study of a prospective database examined whether patterns of practice in prescribing palliative thoracic radiation therapy to patients treated at the RRRP have changed over time from 2006 to 2012.

METHODS

General demographic and treatment data have been recorded in a database of all patients treated at the RRRP for thoracic symptoms, including cough, chest pain, haemoptysis, or superior vena cava obstruction, and who received palliative thoracic radiation therapy between 1 July 2006 and 30 April 2012. Every course of thoracic radiation treatment administered within the study period, including retreatment to the same area, was independently analysed. This timeframe was chosen to update a previous study conducted in the RRRP that reviewed patients treated for thoracic symptoms in 1999, 2003, and between 1 July 2005 and 30 June 2006.[25]

The primary outcome for this study was the treatment schema prescribed for patients receiving thoracic radiation therapy, including the fractionation and dose. Secondary outcomes included factors that may have influenced the treatment regimen prescribed, including patient, disease, and organisational factors.

A total of 11 factors were examined for their relationship with the dose and fractionation schedule prescribed. Six were patient or demographic factors of age, sex, Karnofsky Performance Status (KPS), where the patient came from (i.e. home, hospital, nursing home), whether the patient arrived via ambulance, and whether the patient had received previous radiation. There were two organisational factors of number of years that the treating radiation oncologist had been certified for independent practice by the Royal College of Physicians and Surgeons of Canada (RCPSC), and time from consultation to treatment. The remaining three factors were disease factors of primary cancer site, reason for referral, and site of radiation.

KPS and Palliative Performance Scale were not collected in 2005, 2006, and 2007 due to changes in data collection forms used. Because of the same reason, the site of radiation was also not collected in 2005 and 2006, and there were very few records collected in 2007.

Statistical Analyses

Descriptive statistics were calculated for all data captured as percentages of the total; means, standard deviations, medians, and ranges for continuous variables were also calculated. Analysis was conducted across the period of 1 July 2006 to 30 April 2012 to identify whether there were significant differences in patient, organisational, and disease factors over time, and whether these factors influenced the dose fractionation schedule administered. Dose fractionation schedules were categorised as 20 Gy/5 or other dose fractionation schedules when conducting the analysis. Other common dose fraction schedules included 30 Gy/10, 8 Gy/1, and 20 Gy/10.

Chi-square test was used to determine whether the treatment regimen prescribed (20 Gy/5 vs all other treatment regimens) changed over time. This test was also used to detect differences in proportions between unordered categorical variables, including sex, primary cancer site, whether the patient arrived by ambulance, whether the patient had received previous radiation, where the patient attended from, site of radiation, reason for referral, and treating radiation oncologists over time. Analysis of variance was used to test continuous variables over time, such as age, KPS, and treatment waiting time in days. Natural log-transformation was also applied for treatment waiting time to normalise its distribution.

Univariate logistic regression analysis was conducted to detect which demographic and clinical characteristics were significantly related to the prescription of a 20 Gy/5 treatment regimen. This analysis resulted in a binary variable model of 20 Gy/5 or other treatment regimens. Multiple logistic regression analysis was employed to examine the effect of the year of treatment on the use of 20 Gy/5 after adjusting for independent variables (i.e. age, sex, treatment time). Since there were very few patients treated in 2012 (n = 6), the years 2011 and 2012 were combined into one group of treatment years within the analysis. The referent group used for multiple logistic regression analysis was 2011 to 2012. The final procedure conducted in logistic regression

Table 1. Patient demographics, organisational, and disease factors over time.

	Total (n = 175)	2006 (n = 11; 6%)	2007 (n = 33; 19%)	2008 (n = 39; 22%)	2009 (n = 36; 21%)	2010 (n = 24; 14%)	2011 (n = 26; 15%)	Jan-Apr 2012 (n = 6; 3%)	p Value*
Radiotherapy dosage									0.01
20 Gy/5	112 (64%)	7 (64%)	19 (58%)	21 (54%)	18 (50%)	18 (75%)	23 (88%)	6 (100%)	
Others	63 (36%)	4 (36%)	14 (42%)	18 (46%)	18 (50%)	6 (25%)	3 (12%)	0 (0%)	
Single vs multiple fractions of radiotherapy									0.51
Single	32 (18%)	1 (9%)	7 (21%)	9 (24%)	8 (22%)	5 (21%)	2 (8%)	0 (0%)	
Multiple	142 (82%)	10 (91%)	26 (79%)	29 (76%)	28 (78%)	19 (79%)	24 (92%)	6 (100%)	
Age (years)									0.58
Mean ± SD	70 ± 13	77 ± 10	67 ± 14	69 ± 12	72 ± 12	69 ± 12	69 ± 14	66 ± 13	
Median (range)	71 (34-96)	81 (61-89)	71 (37-86)	71 (38-91)	70 (48-96)	68 (45-87)	71 (34-88)	67 (50-79)	
Sex									0.64
Female	65 (37%)	5 (45%)	13 (39%)	13 (33%)	15 (42%)	7 (29%)	8 (31%)	4 (67%)	
Male	110 (63%)	6 (55%)	20 (61%)	26 (67%)	21 (58%)	17 (71%)	18 (69%)	2 (33%)	
KPS score									0.93
Mean ± SD	60 ± 18	63 ± 18	61 ± 19	60 ± 18	55 ± 18	63 ± 18	61 ± 18	60 ± 11	
Median (range)	60 (20-90)	60 (30-90)	60 (20-90)	60 (30-90)	60 (20-90)	70 (30-90)	65 (30-90)	60 (50-80)	
Treatment time (days)†									0.91
Mean ± SD	2 ± 3	2 ± 3	2 ± 3	1 ± 2	1 ± 2	1 ± 2	3 ± 4	1 ± 2	
Median (range)	0 (0-15)	0 (0-7)	0 (0-7)	0 (0-7)	0 (0-7)	0 (0-6)	0 (0-15)	0.5 (0-5)	
Radiation oncologist									0.002
1 (6 years' certification)	12 (7%)	0 (0%)	0 (0%)	8 (21%)	3 (8%)	1 (4%)	0 (0%)	0 (0%)	
2 (35 years' certification)	31 (18%)	5 (45%)	7 (21%)	7 (18%)	3 (8%)	3 (13%)	6 (23%)	0 (0%)	
3 (11 years' certification)	30 (17%)	4 (36%)	2 (6%)	8 (21%)	10 (28%)	1 (4%)	4 (15%)	1 (17%)	
4 (15 years' certification)	39 (22%)	2 (18%)	10 (30%)	5 (13%)	6 (17%)	5 (21%)	9 (35%)	2 (33%)	
5 (14 years' certification)	63 (36%)	0 (0%)	14 (42%)	11 (28%)	14 (39%)	14 (58%)	7 (27%)	3 (50%)	
Primary cancer site									0.28
Lung	130 (74%)	7 (64%)	23 (70%)	30 (77%)	28 (78%)	18 (75%)	18 (69%)	6 (100%)	
Gastrointestinal	13 (7%)	0 (0)	2 (6%)	4 (10%)	5 (14%)	2 (8%)	0 (0)	0 (0)	
Renal cell	11 (6%)	2 (18%)	4 (12%)	2 (5%)	1 (3%)	2 (8%)	0 (0)	0 (0)	
Breast	9 (5%)	1 (9%)	3 (9%)	0 (0)	1 (3%)	0 (0)	4 (15%)	0 (0)	
Others	9 (5%)	1 (9%)	1 (3%)	2 (5%)	1 (3%)	2 (8%)	2 (8%)	0 (0)	
Unknown	3 (2%)	0 (0)	0 (0)	1 (3%)	0 (0)	0 (0)	2 (8%)	0 (0)	
Ambulance									0.87
No	115 (69%)	8 (80%)	21 (68%)	28 (72%)	23 (66%)	13 (59%)	17 (71%)	5 (83%)	
Yes	52 (31%)	2 (20%)	10 (32%)	11 (28%)	12 (34%)	9 (41%)	7 (29%)	1 (17%)	
Patients coming from									0.31
Home	102 (61%)	8 (80%)	18 (58%)	25 (64%)	19 (54%)	10 (45%)	17 (71%)	5 (83%)	
Hospital	62 (37%)	1 (10%)	13 (42%)	13 (33%)	15 (43%)	12 (55%)	7 (29%)	1 (17%)	
Others	3 (2%)	1 (10%)	0 (0)	1 (3%)	1 (3%)	0 (0)	0 (0)	0 (0)	
Previous radiation									0.24
No	126 (75%)	8 (89%)	23 (70%)	29 (74%)	28 (80%)	18 (82%)	18 (75%)	2 (33%)	
Yes	42 (25%)	1 (11%)	10 (30%)	10 (26%)	7 (20%)	4 (18%)	6 (25%)	4 (67%)	
Radiation site									0.09
Lung	112 (64%)	6 (55%)	17 (52%)	32 (82%)	20 (56%)	14 (58%)	18 (69%)	5 (83%)	
Chest	41 (23%)	2 (18%)	9 (27%)	3 (8%)	12 (33%)	9 (38%)	6 (23%)	0 (0)	
Mediastinum	14 (8%)	2 (18%)	5 (15%)	3 (8%)	2 (6%)	1 (4%)	0 (0)	1 (17%)	
Chest wall	6 (3%)	1 (9%)	0 (0)	1 (3%)	2 (6%)	0 (0)	2 (8%)	0 (0)	
Sternum	2 (1%)	0 (0)	2 (6%)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
Referral reasons									0.14
Mass / lung metastases	104 (59%)	5 (45%)	18 (55%)	23 (59%)	22 (61%)	17 (71%)	16 (62%)	3 (50%)	
SOB	23 (13%)	0 (0)	6 (18%)	6 (15%)	5 (14%)	3 (13%)	3 (12%)	0 (0)	
SVCO symptoms	21 (12%)	3 (27%)	7 (21%)	4 (10%)	3 (8%)	1 (4%)	3 (12%)	0 (0)	
Bleeding — lung	11 (6%)	1 (9%)	2 (6%)	3 (8%)	1 (3%)	2 (8%)	0 (0)	2 (33%)	
Haemoptysis	7 (4%)	0 (0)	0 (0)	2 (5%)	3 (8%)	0 (0)	2 (8%)	0 (0)	
Pain	4 (2%)	0 (0)	0 (0)	1 (3%)	1 (3%)	0 (0)	1 (4%)	1 (17%)	
Others	5 (3%)	2 (18%)	0 (0)	0 (0)	1 (3%)	1 (4%)	1 (4%)	0 (0)	

Abbreviations: 20 Gy/5 = 20 Gy in five fractions; SD = standard deviation; KPS Karnofsky Performance Status; SOB = shortness of breath; SVCO = superior vena cava obstruction.

* Statistical significance using chi-square test for proportions and analysis of variance for continuous variables, defined as $p < 0.05$.

† Natural log-transformation was applied for normalising distribution.

analysis was a backward stepwise selection procedure, which was used to search for the most significant factors related to the prescription of 20 Gy/5. All analyses were performed using the Statistical Analysis System version 9.2 for Windows (SAS Institute Inc, Cary, NC, USA).

RESULTS

A total of 175 courses of thoracic radiation therapy were prescribed at the RRRP during the study period. The most commonly prescribed treatment regimen was 20 Gy/5, comprising 64% of all courses of radiation therapy administered. The next most common regimen was 8 Gy/1 (17%), followed by 30 Gy/10 (10%), and others (9%).

Demographics and patient factors are presented in Table 1. The median age of the cohort was 71 (range, 34-96 years); 63% of the patients were men. The median KPS score was 60 (range, 20-90), which remained fairly consistent across each individual year. Of the patients, 37% were inpatients at a hospital and 31% arrived at the RRRP by ambulance. One-fourth (25%) of the patients had received radiation therapy, but not necessarily to the thoracic region, prior to their palliative thoracic radiation therapy in this study.

Disease-related factors are also presented in Table 1. For the primary cancer site, 74% of patients had a primary lung cancer, followed by gastrointestinal, renal cell, and breast cancers. The most common reason for referral was for the treatment of a lung mass or lung metastases (59%), followed by specifically stated symptoms of shortness of breath (13%), superior vena cava obstruction (12%), bleeding (6%), haemoptysis (4%), or pain (2%).

For organisational factors, the mean (± standard deviation) time from consultation to treatment was 2 (± 3) days (range, 0-15 days) [Table 1]. Five different radiation oncologists administered palliative thoracic radiation treatment at the RRRP during the study period. The number of years certified for independent practice by the RCPSC of the radiation oncologists ranged from 6 to 35 years.

The prescription of 20 Gy/5 was more likely to be used in recent years, rising from 50% of patients in 2009 to 91% of patients in 2011 to 2012 (p = 0.03) [Figure and Table 2]. There were significant differences in the prescription of 20 Gy/5 or other regimens based on the site of radiation (p = 0.02) [Table 3]; patients receiving radiation to the chest wall or mediastinum were less likely to be prescribed a treatment regimen of 20 Gy/5 than those receiving treatment to the lung (p = 0.02 or p = 0.04, respectively). There was a significant difference in the prescription of 20 Gy/5 or other regimens based on the radiation oncologist prescribing the treatment. Radiation oncologist 4, with 15 years of certification, was more likely to prescribe a course of 20 Gy/5 than the remaining four radiation oncologists (p = 0.01) [Table 2].

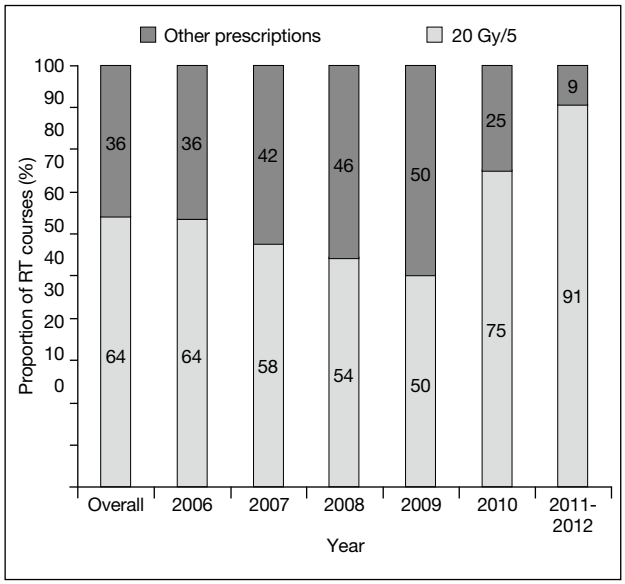

Figure. Prescription of 20 Gy/5 versus all other prescriptions of palliative throracic radiation therapy (RT) administered in the Rapid Response Radiotherapy Program over time.

DISCUSSION

The pattern of practice in the prescription of palliative thoracic radiation therapy was previously examined by Fairchild et al[25] between 1999 and 2006. Our current study remains fairly consistent with Fairchild et al's study.[25] For example, the most commonly prescribed dose fractionation schedule in the previous study was also 20 Gy/5, which comprised a total of 65% of courses prescribed in 1999, 68% in 2003, and 60% in 2005 to 2006.[25] The results of this study have shown a significant increase in the frequency of prescription of a 20 Gy/5 treatment regimen since 2009. The frequent prescription of 20 Gy/5 was also reflected in a recent Canadian study by Han et al,[26] examining the patterns of practice among radiation oncologists for locally advanced and metastatic non–small-cell lung cancer. The study was conducted as an electronic survey sent to radiation oncologists, which consisted of three

Table 2. Factors influencing the use of 20 Gy/5* based on multivariate analysis.

Factor	OR (95% CI) for use of 20 Gy/5	p Value
Year of treatment (vs 2011-2012)		0.03
2006	0.23 (0.03-1.98)	0.18
2007	0.07 (0.01-0.44)	0.004
2008	0.07 (0.01-0.43)	0.004
2009	0.07 (0.01-0.39)	0.003
2010	0.19 (0.03-1.31)	0.09
Radiation oncologist (vs 4)		0.01
1	0.27 (0.06-1.31)	0.10
2	0.12 (0.03-0.45)	0.002
3	0.39 (0.10-1.50)	0.17
5	0.64 (0.20-2.06)	0.45
First radiation site (vs lung)		0.03
Chest / sternum	0.47 (0.18-1.20)	0.11
Chest wall	0.06 (0.005-0.61)	0.02
Mediastinum	0.39 (0.11-1.38)	0.14

Abbreviations: OR = odds ratio; CI = confidence interval.
* 20 Gy/5 = 20 Gy in five fractions.

unique locally advanced or metastatic non–small-cell lung cancer patient scenarios. The survey results revealed that a dose fractionation schedule of 20 Gy/5 was recommended by 76% of radiation oncologists. The authors concluded that most Canadian radiation oncologists practised evidence-based medicine, which was shown by the congruence in dose fractionation schedules prescribed with those of various randomised control trials.

Han et al[26] also concluded in their study that the beliefs of radiation oncologists regarding the effects of palliative thoracic radiation therapy still vary, which may have affected their choice of dose fractionation schedule. These findings of varying dose fractionation schedules prescribed by radiation oncologists reflect the results of this study, which also found a significant difference among radiation oncologists in the prescription of 20 Gy/5 versus other dose fractionation schedules. This significant difference could also be attributed to the number of years for which the treating radiation oncologist has been certified for independent practice by the RCPSC.

Another study by Duncan et al[27] was conducted using a questionnaire to determine the patterns of practice in the prescription of palliative radiation therapy among radiation oncologists across Canada by presenting various palliative cancer case reports. Analysis of the case of a patient with locally advanced lung cancer showed that radiation oncologists younger than 46 years selected a shorter dose fractionation schedule than radiation oncologists older than 46 years. The authors speculated that these differences may be observed because of changing workloads with age, initial training, subsequent work experience, and altered perceptions of management due to experience.[27] Similarly, these factors could potentially account for the observed differences in the dose fractionation schedules prescribed among radiation oncologists in this study, considering that the most significant difference observed was between a radiation oncologist with 35 years of certification and a radiation oncologist with 15 years of certification.

This study found that there were significant differences in treatment regimens according to the site of radiation. A dose fractionation schedule of 20 Gy/5 was more likely to be prescribed to patients receiving radiation to the lung than to those receiving radiation to the chest wall or mediastinum (Table 3). These differences in the site of radiation can also be reflected in the results of other patterns of practice audits. Coia et al[28] examined the patterns of practice in palliative radiation therapy among 49 different institutions in the United States. Their study showed that a greater mean number of fractions of palliative radiation therapy were prescribed to the lung or mediastinum than to any other site. The authors attributed this variation to the possibility of disparities in underlying symptoms according to the treatment site.[28] Similarly, individual symptoms associated with a specific site of radiation among patients in this study population may have ultimately affected the type of dose fractionation schedule prescribed.

Table 3. Patient demographics, organisational, and disease factors by dose fractionation prescribed.

	20 Gy/5 (n = 112; 64%)	Other fractions (n = 63; 36%)	Univariate logistic regression		Multivariate logistic regression	
			OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Year of treatment				0.02		0.05
2006	7 (64%)	4 (36%)	0.18 (0.03-1.00)	0.05	0.61 (0.04-9.02)	0.72
2007	19 (58%)	14 (42%)	0.14 (0.04-0.56)	0.01	0.08 (0.01-0.61)	0.02
2008	21 (54%)	18 (46%)	0.12 (0.03-0.46)	0.002	0.08 (0.01-0.55)	0.01
2009	18 (50%)	18 (50%)	0.10 (0.03-0.40)	0.001	0.08 (0.01-0.57)	0.01
2010	18 (75%)	6 (25%)	0.31 (0.07-1.40)	0.13	0.29 (0.03-2.65)	0.27
2011-2012	29 (91%)	3 (9%)	Reference	–	Reference	–
Age (years)			0.98 (0.96-1.01)	0.16	0.94 (0.90-0.99)	0.01
Mean ± SD	69 ± 12	71 ± 14				
Median (range)	70 (34-89)	73 (38-96)				
Sex			0.86 (0.45-1.64)	0.65	0.68 (0.26-1.82)	0.45
Male	69 (63%)	41 (37%)				
Female	43 (66%)	22 (34%)				
KPS*			1.02 (1.00-1.034)	0.19	0.98 (0.94-1.02)	0.29
Mean ± SD	62 ± 17	57 ± 19				
Median (range)	60 (30-90)	50 (20-90)				
Treatment time (days)			1.31 (0.86-1.98)	0.21	1.35 (0.66-2.73)	0.41
Mean ± SD	1 ± 1	1 ± 1				
Median (range)	0 (0-3)	0 (0-2)				
Primary cancer site				0.15		0.48
Gastrointestinal	10 (77%)	3 (23%)	1.77 (0.46-6.74)	0.41	2.73 (0.47-15.80)	0.26
Renal cell	3 (27%)	8 (73%)	0.20 (0.05-0.79)	0.02	0.21 (0.03-1.45)	0.11
Breast	6 (67%)	3 (33%)	1.06 (0.25-4.43)	0.94	0.69 (0.03-15.71)	0.81
Others	7 (78%)	2 (22%)	1.85 (0.37-9.29)	0.45	2.35 (0.24-23.16)	0.46
Unknown	1 (33%)	2 (67%)	0.27 (0.02-3.00)	0.28	0.47 (0.001-150.41)	0.80
Lung	85 (65%)	45 (35%)	Reference	–	Reference	–
Ambulance			0.70 (0.36-1.37)	0.30	0.35 (0.06-1.96)	0.23
Yes	30 (58%)	22 (42%)				
No	76 (66%)	39 (34%)				
Patients coming from				0.17		0.98
Home	70 (69%)	32 (31%)	1.69 (0.88-3.24)	0.12	1.12 (0.19-6.56)	0.90
Others	1 (33%)	2 (67%)	0.39 (0.03-4.48)	0.45	1.51 (0.03-91.81)	0.84
Hospital	35 (56%)	27 (44%)	Reference	–	Reference	–
Previous radiation			0.53 (0.26-1.08)	0.08	0.30 (0.07-1.20)	0.09
Yes	22 (52%)	20 (48%)				
No	85 (67%)	41 (33%)				
First radiation site*				0.02		0.08
Chest / sternum	25 (58%)	18 (42%)	0.56 (0.27-1.16)	0.12	0.46 (0.13-1.56)	0.21
Chest wall	1 (17%)	5 (83%)	0.08 (0.01-0.71)	0.02	0.04 (0.002-1.14)	0.06
Mediastinum	6 (43%)	8 (57%)	0.30 (0.10-0.93)	0.04	0.17 (0.03-0.90)	0.04
Lung	80 (71%)	32 (29%)	Reference	–		
Radiation oncologist				0.005		0.02
1 (6 years' certification)	6 (50%)	6 (50%)	0.22 (0.05-0.88)	0.03	0.14 (0.01-1.47)	0.10
2 (35 years' certification)	12 (39%)	19 (61%)	0.14 (0.05-0.41)	0.0004	0.05 (0.006-0.37)	0.004
3 (11 years' certification)	18 (60%)	12 (40%)	0.33 (0.11-0.98)	0.05	0.09 (0.01-0.80)	0.03
4 (15 years' certification)	44 (70%)	19 (30%)	0.51 (0.19-1.35)	0.17	0.26 (0.04-1.68)	0.16
5 (14 years' certification)	32 (82%)	7 (18%)	Reference	–		
First referral reason				0.98		0.87
Bleeding — lung	7 (64%)	4 (36%)	0.97 (0.27-3.52)	0.96	0.95 (0.14-6.68)	0.96
Haemoptysis	5 (71%)	2 (29%)	1.38 (0.26-7.47)	0.71	0.55 (0.06-4.97)	0.60
Pain	3 (75%)	1 (25%)	1.66 (0.17-16.49)	0.67	0.39 (0.02-6.39)	0.51
SOB	13 (57%)	10 (43%)	0.72 (0.29-1.80)	0.48	0.38 (0.09-1.58)	0.18
SVCO symptoms	14 (67%)	7 (33%)	1.10 (0.41-2.98)	0.84	1.25 (0.26-5.95)	0.78
Other	3 (60%)	2 (40%)	0.83 (0.13-5.18)	0.84	0.47 (<0.001 to >999.99)	0.85
Mass / lung metastases	67 (64%)	37 (36%)	Reference	–		

Abbreviations: 20 Gy/5 = 20 Gy in five fractions; OR = odds ratio; CI = confidence interval; SD = standard deviation; KPS Karnofsky Performance Status; SOB = shortness of breath; SVCO = superior vena cava obstruction.

* Karnofsky Performance Status and Palliative Performance Scale were not collected in 2005, 2006, and 2007 due to changes in data collection methods. Radiation site was not collected in 2005 and 2006, and there were very few records in 2007, which was also due to changes in data collection methods. Patients with missing values were excluded from the multiple regression analysis.

Randomised controlled trials have shown that a higher dose of radiation administered to patients with a better performance status has resulted in modestly improved survival.[1,16] Consequently, it is surprising that the KPS score of patients in this study population was not related to the dose fractionation schedule prescribed by radiation oncologists. Hospitalisation is also often an indicator of a poorer performance status since this cohort of patients tend to require frequent medical care; however, this study did not show any significant difference between where the patient attended from and the dose fractionation schedule prescribed. An international practice survey of palliative thoracic radiation therapy conducted by Rodrigues et al[29] presented two patients with poor performance status and one patient with better performance status, and compared the differences in the dose fractionation schedules prescribed among radiation oncologists around the world. The study found that a smaller dose and shorter course of radiation therapy was suggested by more than 90% of respondents for a patient with poor performance status. This particular patient required frequent medical care, was in a bed or chair for 50 to 60% of the day, and presented with haemoptysis, chest pain, and shortness of breath.[29] The patient presented is not unlike many patients seen at the RRRP who have been treated with palliative thoracic radiation therapy. A potential reason as to why KPS score was not observed to be related to the dose fractionation schedule prescribed in this study could be the lack of reproducibility and standard of assigning an adequate KPS score to patients. A study by Hutchinson et al[30] found that there was a lack of accordance among pairs of physicians when rating the KPS of various patients. The authors attributed this problem to the lack of operational criteria to define the grade of elements, including normal activity, ability to care for self, and work.[30] Another possible reason for the discrepancy between the KPS score and dose fractionation schedule prescribed could be the grouping of treatment regimens. For instance, the 'other' fractionation category included both shorter (8 Gy/1) and longer (30 Gy/10) treatment regimens, which was compared with 20 Gy/5. Finding a relationship for KPS score using these broader treatment categories may have resulted in a lack of significance.

Limitations exist within this research design that could potentially be improved for future studies. There was a lack of information regarding patient survival, which appears to be an important outcome of the prescription of higher dose fractionation schedules based on previous randomised controlled trials.[4-15,17] Future studies may benefit from having radiation oncologists record the estimated survival of their patients to determine whether their estimated survival influenced their decision on the treatment schedule administered. Furthermore, patient survival based on patients who have died by the end of the study period would also be beneficial to examine whether the dose fractionation prescribed influenced overall survival. Other important factors that may have affected the treatment regimen administered and were not recorded within this study include disease burden, patient comorbidities, patient preference, and subsequent planned chemotherapy. Patient preference is a particularly important factor as radiation oncologists could involve patients in their decision to assist in adopting a suitable treatment regimen tailored to each individual patient.[25] A larger patient population would also be ideal in future studies to draw stronger inferences from the data. However, patients receiving palliative thoracic radiation therapy made up a small percentage of the total number of patients referred to the RRRP.

Based on the literature and these findings, it is impossible to account for all possible factors that may influence the treatment regimen prescribed for patients exhibiting thoracic symptoms. Some factors are beyond the scope of the information available in hospital records, including the motivations or beliefs of the radiation oncologists. However, future studies should further investigate patient survival, preference, comorbidities, and disease burden to better understand the roles these factors play in the treatment regimen prescribed.

Overall, the dose fractionation treatment regimens of palliative thoracic radiation therapy prescribed to patients by radiation oncologists at the RRRP between 1 July 2006 and 30 April 2012 appear to reflect similar patterns of practice to previous years. However, the frequency of prescribing 20 Gy/5 has significantly increased since 2009. The site of radiation and the specific radiation oncologist prescribing the treatment regimen also played a significant role in the dose fractionation schedule prescribed. However, the role of the patient's performance status did not reflect the results of other studies and clinical guidelines, which show a higher dose fractionation schedule prescribed for patients with higher performance status to modestly increase survival.

DECLARATION

The authors have no conflicts of interest to disclose.

ACKNOWLEDGEMENT

We thank the generous support of the Bratty Family Fund, Michael and Karyn Goldstein Cancer Research Fund, Joseph and Silvana Melara Cancer Research Fund, and Ofelia Cancer Research Fund.

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