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Review

Descriptors and factors affecting patients' symptom experiences for symptom self-management throughout palliative radiotherapy for advanced lung cancer: A systematic review

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ABSTRACT

Objective: Palliative thoracic radiotherapy is a key treatment option for symptom management in advanced lung cancer. Continuous symptom monitoring is critical to ensuring optimal therapeutic outcomes and preserving patients' well-being. This systematic review aimed to explore patients' symptom experiences during palliative thoracic radiotherapy for advanced lung cancer.

Methods: Following PRISMA guidelines, we conducted a comprehensive search of MEDLINE, EMBASE, CINAHL, Cochrane, and PsycINFO from database inception through August 31, 2023. Eligible studies included those examining the prevalence and severity of symptoms and side effects experienced by adult patients undergoing palliative thoracic radiotherapy for advanced lung cancer, regardless of treatment duration or dosage. Methodological quality was assessed using the standardized QualSyst tool, and data were synthesized narratively.

Results: A total of 8 studies met the inclusion criteria. Thirteen symptoms were reported prior to radiotherapy, with cough being the most common (62%). Symptom severity ranged from mild to severe, with dyspnoea recording the highest average score. Distress was not measured during this phase. Post-radiotherapy, fatigue was the most prevalent symptom (69%), followed by cough (64%) and dyspnoea (50%). Symptom severity varied across studies, with improvements noted in cough, dyspnoea, chest pain, and haemoptysis. Moderating factors influencing symptom prevalence and variation included performance status, weight loss, cancer stage, objective tumour response, and radiation-induced pulmonary changes.

Conclusions: Symptom control through palliative thoracic radiotherapy demonstrates variability in both frequency and severity of symptoms. Systematic monitoring is essential for identifying persistent symptoms and determining the need for more targeted supportive care interventions.

Introduction

Palliative thoracic radiotherapy is a well-established treatment option for managing advanced lung cancer, particularly stage IV non-small cell lung cancer (NSCLC). The aim is to relieve disease-related symptoms such as cough, dyspnoea, haemoptysis, and pain by shrinking the tumour, by reducing its impact on surrounding tissues and vascular damage, and by stimulating immune system activation.[1,2] The timeframe to experience symptom relief after palliative thoracic radiotherapy typically ranges from weeks to months.[3,4]

How effective palliative thoracic radiotherapy is depends on the dose, fractionation, and duration, which are tailored to the extent of the disease, the observed palliation benefit, and the grade of radiotherapy-related side effects.[5] Side-effects can be either acute or late. Acute side effects, like fatigue and skin irritation, typically occur during or shortly after treatment and usually subside within a few weeks to three months. In contrast, late side effects, such as scarring and lung fibrosis, may develop months after treatment, with a gradual onset and potential long-term persistence.

Despite tailored radiotherapy protocols, patients may still experience both residual disease-related symptoms and treatment-related side-effects, which can lead to adverse impact on health-related quality of life [6] and unplanned hospital visits if symptoms and side-effects are not adequately managed.[7] Symptoms and side-effects may vary throughout palliative thoracic radiotherapy.[3] In addition, patient-specific factors contribute to variations in symptom relief and experience of side-effects, underscoring the need for individualised care and monitoring for optimal

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outcomes.[8] For instance, lower performance status (PS) has been linked to higher physical symptom burden,[9,10] while radiotherapy dose and completion of radiotherapy are the predictors of symptom relief.[4]

Providing high-quality care to support patients with advanced lung cancer and to enhance patient care and outcomes is key. It is essential for multidisciplinary teams to gain a comprehensive understanding of how patients experience symptoms and side-effects, as well as what manifestation patterns exist. This can help highlight time-points for clinical intervention in a proactive way,[11,12] while patient education can be customised to help patients become more involved in their own care. Crucially, patients will report symptoms and side-effects as they perceive them and usually describe them as 'problems'. This purports that several unseen radiotherapy-related side-effects, e.g., lung fibrosis, will only be reported based on the perceivable problem they cause to the patient. As such, a focus on symptoms and side-effects that are patient-reported is warranted in the context of supportive cancer care.

To the best of our knowledge, no evidence synthesis exists to bring together current evidence on patient-reported symptoms and side-effects throughout palliative thoracic radiotherapy for advanced lung cancer, and possible moderating factors of patients' symptomatic experiences. Therefore, we conducted a systematic review that aimed to address the following research questions: What is the prevalence and severity of patient-reported symptoms and side-effects during palliative thoracic radiotherapy for advanced lung cancer? How do patient-reported symptoms and side-effects change during palliative thoracic radiotherapy for advanced lung cancer? Do patient-reported symptoms and side-effects vary according to patients' demographic and/or clinical characteristics?

Methods

Design

This was a Synthesis Without Meta-Analysis[13] reported according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[14]

Search strategy

A systematic search strategy was developed comprising search terms grouped in the following areas: a) lung cancer, b) palliative thoracic radiotherapy, and c) symptoms. We used the Patient (advanced lung cancer), Intervention (palliative thoracic radiotherapy), and Outcome (prevalence of, severity of, and change in symptoms; and factors influencing symptoms) (PICO) framework to develop our search terms.[15] The search strategy included a combination of Boolean operators, truncation markers, and MeSH headings, as well as keywords, phrases, and synonyms to increase the inclusiveness and sensitivity of the searches. The searches were devised and run separately on the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PsycINFO (accessed via EBSCO), MEDLINE, EMBASE (accessed via Ovid), and Cochrane. A university librarian was consulted to validate the search strategies. Initial electronic searches search period as from 2000 were run in 2022 and updated on 31 December 2023 to capture more recent publications. An example database search is provided in Supplementary file 1.

Eligibility criteria

Reports were included if:

- They were conducted with patients treated with palliative thoracic radiotherapy for advanced lung cancer (stage III or IV), including primary lung tumours and other tumour types that had spread to the lung, irrespective of treatment duration, dosage, or the time point in the illness trajectory.
- They investigated patient-reported disease-related symptoms and treatment-related side-effects (prevalence, severity, and distress), and possible moderating factors of the patient's symptom experience (demographic and/or clinical).
- They employed quantitative and/or qualitative methods, irrespective of study design.
- They reported on primary or secondary research.
- They were conducted with male and female adult patients (18 years old and over);
- They were published in English with readily available abstracts.
- They were published as original articles in peer-reviewed journals between January 2000 and December 2023.

Reports were excluded if:

- They were conference abstracts, tool development studies, commentaries, and case studies.
- They involved participants with a mixed cancer diagnoses or mixed treatment, except if analyses of subgroups were reported.
- They only involved clinician evaluation of symptoms and side-effects.
- They investigated radiotherapy for lung cancer with a curative aim.

Study selection and data extraction

One reviewer screened the retrieved papers based on their titles and abstracts. Three reviewers were involved in retrieving the full text of the articles and assessing their eligibility against predetermined criteria, retaining articles until a consensus was reached. The information extracted from the final sample comprised methodological characteristics of the reviewed studies, participants' demographic and clinical characteristics, symptom assessment measures, and reported metrics of prevalence, severity and distress of patient-reported symptoms and side-effects. Identifying symptom experiences before and after palliative radiotherapy and finding related factors is the main findings of this study.

Evaluation of the methodological quality of the study

An evaluation of each study's methodological quality was performed by three reviewers independently and in parallel with the data extraction. The standardised QualSyst tool was used for methodological quality evaluation.[16] QualSyst provides two separate scoring systems: one is quantitative, and one is qualitative. A score of 0 was assigned if the study did not meet the criteria, 1 when it partially met them, and 2 when it fully met them. Items not applicable to a particular study design were marked 'not applicable' and excluded from the summary of score calculations. Summary quality scores (SQS) were calculated and reported as percentages, ranging from 0% to 100%. A higher SQS indicated better methodological quality, as follows: SQS $>$ 95% = high quality; SQS 90% to 95% = very good quality; SQS 80% to 89% = good quality; SQS 65% to 79% = moderate quality; SQS 40% to 64% = low quality. Disagreements were resolved by consensus as necessary.

Data synthesis

Data extracted from the included studies were organised into evidence tables, and the narratives, one for each research question, were integrated, linking the outcomes to the methodological quality of the underlying research. The evidence tables for each study were put into Excel, facilitating the description of study characteristics in terms of counts [*N* (%)]. Symptom/side-effect prevalence was graphically represented for each study, where a count of 0 indicated the absence of symptoms/side-effects, and a count of 1 indicated the presence of a symptom/side-effect. To calculate prevalence, the total number of participants who reported a given symptom/side-effect across all studies was divided by the total number of participants considered across all studies. Symptom/side-effect prevalence was presented both numerically and as a percentage for each period, i.e., before, during, and after treatment. In terms of severity of symptoms/side-effects, seven of the 8 included studies used some

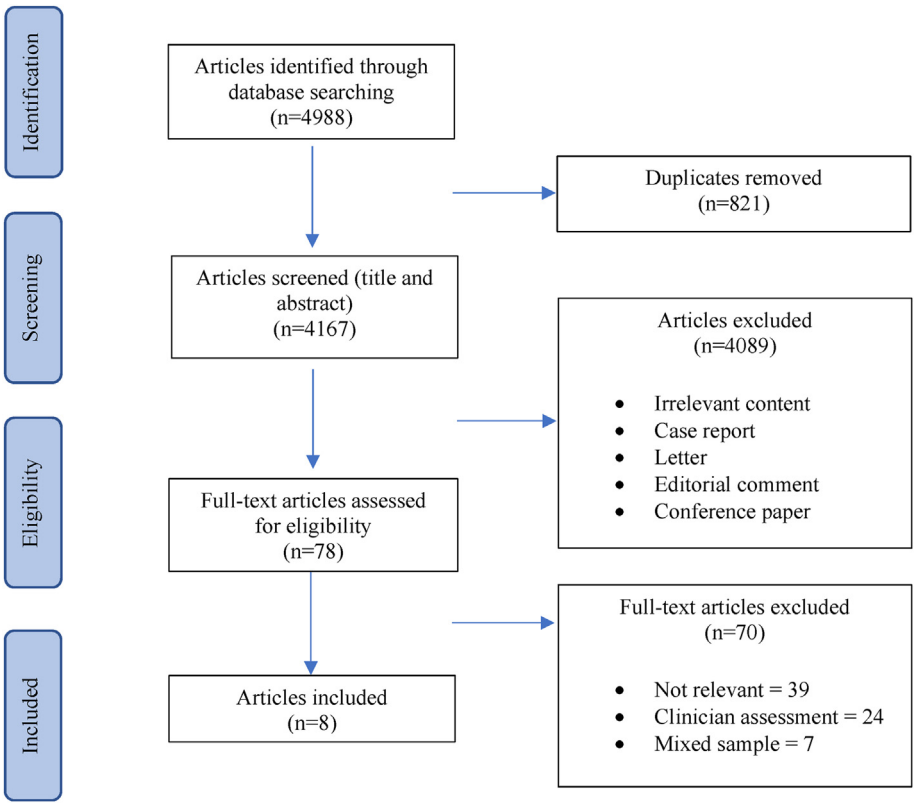

Fig. 1. PRISMA flowchart of the article selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

European Organisation for Research and Treatment of Cancer (EORTC) measure, thus allowing severity scores to be transformed and reported on a 0–100 scale (formula: [(average − 1)/ range] × 100), whereby labels assigned to specific score ranges were as follows: 0 = no symptom/side-effect, 1 to 34 = mild symptom/side-effect, 35 to 67 = moderate symptom/side-effect, 68 to 100 = severe symptom/side-effect. Application of the formula allowed for comparability across studies. The last study used a different measurement tool, for which no equivalent formula exists, and therefore this study was omitted from comparison.

Results

Search results

Following an initial screening of 4988 references, 78 potentially eligible articles were selected and retrieved in full-text form. Subsequently, 70 articles were excluded (Supplementary file 2), and the detailed reasons for exclusion are depicted in Fig. 1. The final sample included eight studies.[17–24] All eight studies employed a quantitative approach; six (75%) are descriptive prospective repeated-measures studies, while the remaining two studies (25%) have a randomised controlled trial design. The sample sizes ranged from 30 to 407 participants, and the total number of participants across all 8 studies was 1156. Five studies were conducted in Europe (63%), two in North America (25%), and one in Egypt (12%). Five articles (63%) were published between 2000 and 2005, and three articles (37%) were published between 2014 and 2018 (Table 1). Methodological quality scores ranged from 86% to 96% with a mean SQS of 91% (Supplementary file 2).

Patients' characteristics across the included studies

Across all studies, age ranged from 30 to 99 years, although most patients were in the 60–71 years age category. Over 70% of participants were male (73%, 847 individuals). Most participants had been diagnosed with stage III cancer 796 (69%), while 299 (26%) were reported with stage IV cancer. Four percent of all participants (41 individuals) had stage I or II cancer (tumours with a diameter larger than 4 cm and considered inoperable because of comorbid diseases and inadequate pulmonary function), while 19 participants (2%) were at an extensive clinical stage. Regarding tumour types, 1137 (98%) were NSCLC and 19 (2%) were small cell lung cancer (SCLC). In the NSCLC group, 397 (34%) were squamous cell carcinoma, 390 (34%) were unknown, 171 (15%) were adenocarcinoma, 114 (10%) were undifferentiated carcinoma, and 84 (7%) were large cell carcinoma. In the SCLC group, 19 (100%) of the patients were at an extensive stage. The most prevalent radiotherapy protocol was 20 Gy delivered in 5 fractions (24%). This was followed by 30 Gy in 10 fractions (18%), and 17 Gy in 2 fractions (18%) (Table 1). PS varied depending on the measurement scale (Supplementary file 3):

- The World Health Organization[25] PS scale was used in three studies. [19–21] Among 329 patients, 138 (42%) were PS 1, 84 (25%) were PS 2, 69 (21%) were PS 0, 35 (11%) were PS 3, and 3 (1%) were PS 4.
- The Karnofsky PS (KPS) scale was employed in two studies.[17,18] KPS was scored as 70–80 in 254 (57%) cases, 90–100 in 141 cases (32%), and ≤ 60 in 47 cases (11%).
- The Eastern Cooperative Oncology Group (ECOG) PS scale was used in two studies.[22,23] Forty percent of participants were graded as ECOG PS 1, 32% were graded as ECOG PS 2, 23% were graded as ECOG PS 3, and 5% were graded as ECOG PS 0.
- The Palliative Performance Status (PPS) scale was used in one study.[24] A mean PPS of 50 was reported, with a range of 10–100.

Before radiotherapy, weight loss was reported in four studies that involved a total of 827 participants: 367 individuals (44%) had ≤ 10% weight loss, 286 individuals (35%) had > 10% weight loss, and 174 individuals (21%) did not experience any weight loss.[17,19,22,24]

Table 1
Characteristics and key findings of the eight studies included in the analysis.

Author, country	Aim of the study	Study design, outcome measures, and time points	Number of participants, demographic, clinical data, radiotherapy dose, area, symptomatic findings, and quality rating [*N* (%)]
Bezjak *et al.* (2002) Canada	To compare 10 Gy/1F radiotherapy with 20 Gy/5F regarding the palliation of thoracic symptoms caused by lung cancer and to add to the evidence comparing 10 Gy/1F with 20 Gy/5F in terms of the palliation of thoracic symptoms, toxicity of radiotherapy, QoL, and survival	**Design:** Multi-centre RCT **Outcome measure:** Daily diary card LCSS EORTC-QLQ-C30 **Time points:** Two (baseline, then week 5 post-radiotherapy)	**Number of participants:** 230 **Demographic:** Male/female 145/85 (63%/37%), median age 70.4 **Clinical data:** ECOG1 = 10 (45%)[a] **Radiation doses:** 10 Gy/1F and 20 Gy/5F **Area of RT:** thoracic **Symptoms before radiotherapy:** Cough 55 (24%), shortness of breath 69 (30%), chest pain 51 (22%), coughing up blood 25 (11%), fatigue 23 (10%), loss of appetite 7 (3%), difficulty swallowing 2 (1%) **Quality rating:** Very good
Eldeeb *et al.* (2014) Egypt	To compare symptom control in patients with inoperable, locally advanced, or metastatic NSCLC using two different regimens of palliative radiotherapy. To determine toxicity profile, HRQOL, tumour control, and overall survival	**Design:** Single-centre prospective repeated measures study **Outcome measure:** EORTC-QLQ-C30 EORTC-QLQ-LC13 CTCAE version 3.0 **Time points:** Four (baseline, then 1 week, 6 weeks, and 16 weeks postradiotherapy)	**Number of participants:** 30 **Demographic:** Male/female 28/2 (93%/7%), median age (range) 59.3–60.9 (30–80) **Clinical data:** Smoker 25 (83%), ECOG3 = 19 (63%)[a] **Radiation doses:** 30 Gy/10F and 17 Gy/2F **Area of RT:** Thoracic **Symptoms before radiotherapy:** Dyspnoea 30 (100%), cough 30 (100%), chest pain 20 (67%), haemoptysis 19 (63%) **Quality rating:** Good
Langendijk *et al.* (2000) Netherlands	To investigate changes in respiratory symptoms and QoL in patients with locally advanced and metastatic NSCLC who receiving thoracic radiotherapy and the correlation between the level of symptom relief and objective tumour response	**Design:** Single-centre prospective repeated measures study **Outcome measure:** EORTC-QLQ-C30 EORTC-QLQ-LC13 **Time points:** Four (baseline, then 2 weeks, 6 weeks, and 3 months post-radiotherapy)	**Number of participants:** 65 **Demographic:** Male/female 59/6 (91%/8%), mean age (range) 65 (39–88) **Clinical data:** stage IIIb 37 (57%), squamous cell 32 (49%), WHO PS3 22 (34%)[a] **Radiation doses:** 30 Gy/10F **Area of RT:** Thoracic **Symptoms before radiotherapy**: Fatigue 63 (94%), cough 60 (89%), dyspnoea 59 (88%), pain 58 (86%), appetite loss 48 (71%), chest-wall pain 41 (62%), insomnia 38 (57%), haemoptysis 31 (46%), arm/shoulder pain 29 (43%), nausea and vomiting 23 (34%), constipation 21 (31%), dysphagia 17 (25%) **Quality rating:** Good
Langendijk *et al.* (2001) Netherlands	To investigate changes in respiratory symptoms and QoL in patients with NSCLC who are receiving radical radiotherapy (60 Gy) and the association between the level of symptom relief and objective tumour response, as well as the association with radiation-induced pulmonary changes	**Design:** Single-centre prospective repeated measures study **Outcome measure:** EORTC-LC13 EORTC-QLQ-C30 CT for tumour response CXR for radiotherapy pulmonary changes **Time points:** Six (baseline, then 2 weeks, 6 weeks, 3 months, 6 months, and 12 months post-radiotherapy)	**Number of participants:** 164 **Demographic:** Male/female 138/26 (84%/16%), median age 68 (37–84) **Clinical data:** stage IIIb 79 (48%), squamous cell 95 (58%), WHO PS1 79 (48%)[a], median survival of patients 8.5 months **Radiation doses:** 45 Gy/20F boost plus 15 Gy/6F: Total 60 Gy/26F **Area of RT:** Thoracic **Symptoms before radiotherapy:** Cough 149 (91%), fatigue 138 (84%), dyspnoea 128 (78%), insomnia 92 (56%), pain 87 (53%), appetite loss 72 (44%), chest pain 62 (38%), arm/shoulder pain 59 (36%), nausea and vomiting 39 (24%), haemoptysis 36 (22%), dysphagia 30 (18%), constipation 30 (18%) **Quality rating:** High
Author, country	**Aim of the study**	**Study design, outcome measures, and time points**	**Number of participants, demographic, clinical data, RT dose, area, symptomatic findings, and quality rating [*N* (%)]**
Lefresne et al. (2017) Canada	To prospectively evaluate the outcomes of the patients assessed at the vancouver rapid access (VARA) clinic. Particular aspects of interest included performance status, patient-reported overall health, and	**Design:** Single-centre prospective repeated measures study and retrospective chart review. **Outcome measure:** The edmonton symptom assessment system (ESAS)	**Number of participants:** 125 (109 received palliative radiotherapy) **Demographic:** Male/female 68/57 (54%/46%), median age 71 (45–99) **Clinical data:** stage IV 84 (67%), median

(*continued on next page*)

Table 1 (*continued*)

Author, country	Aim of the study	Study design, outcome measures, and time points	Number of participants, demographic, clinical data, radiotherapy dose, area, symptomatic findings, and quality rating [*N* (%)]
	palliation of symptoms requiring palliative radiotherapy	EORTC-QLQ-LC13 EORTC-QLQ-BM22 EORTC-QLQ-BN20 **Time points:** Two (baseline and 4 weeks post- radiotherapy)	PPS 50 (10–100)[a] **Radiation doses:** 20 Gy/5F, 30 Gy/10F, 8Gy/1F **Area of RT:** Thoracic 62 (57%), bone 40 (37%), and brain 22 (20%) (24 patients received radiotherapy to more than one anatomic site on their first visit) **Symptoms before radiotherapy:** Cough 51 (47%), dyspnoea 45 (41%), pain 36 (33%), chest pain 23 (21%), haemoptysis 23 (21%), dysphagia 12 (11%) **Quality rating:** High
McDermott *et al.* (2018) Ireland	To assess whether more technically advanced treatment techniques result in equivalent symptom relief and reduce the side effects of symptomatic oesophagitis in patients with locally advanced lung cancer	**Design:** Single-centre prospective repeated measures study **Outcome measure:** EORTC-QLQ-C15-PAL EORTC-QLQ-C30 EORTC-QLQ-L13 **Time points:** Four (baseline, during treatment, 2 weeks and 1-month post-radiotherapy)	**Number of participants:** 35 **Demographic:** Male/female 14/21 (40%/60%) **Clinical data:** Stage III 17 (49%), KPS80 13 (37%)[a] **Radiation doses:** 39 Gy/13F, 20 Gy/5F, 17 Gy/2F **Area of RT:** Thoracic **Symptoms before radiotherapy:** Cough 5 (14%), dyspnoea 16 (46%), haemoptysis 6 (17%), pain 5 (14%), dysphagia 2 (6%), hoarseness 1 (3%) **Symptoms during radiotherapy:** Fatigue 13 (37%), dyspnoea 12 (34%), cough 5 (14%) **Symptoms after radiotherapy:** Fatigue 9 (31%), dyspnoea 6 (27%), cough 5 (17%) **Quality rating:** Very good
Senkus-Konefka *et al.* (2005) Poland	To compare two palliative radiotherapy regimens in patients with NSCLC and to examine the degree and duration of symptomatic relief, treatment side effects, objective response rates and overall survival	**Design:** Single-centre prospective RCT **Outcome measure:** Self-reporting by both patients and physicians Four-point scale (none, mild, moderate, and severe) **Time points:** Minimum of twenty (once weekly until week 8, then monthly for 6 months, then bi-monthly for the next 6 months, and 3-monthly thereafter)	**Number of participants:** 100 **Demographic:** Male/female 90/10 (90%/10%), median age 67 (47–81) **Clinical data:** Locally advanced 84 (86%), squamous cell 65 (66%), WHO PS2 45 (46%)[a] **Radiation doses:** 20 Gy/5F and 16 Gy/2F **Area of RT:** thoracic **Symptoms before radiotherapy:** Cough 62 (63%), dyspnoea 61 (62%), chest pain 61 (62%), haemoptysis 32 (33%), dysphagia 9 (9%), SVCS 7 (7%) **Quality rating:** Good
Sundstrøm *et al.* (2005) Norway	To compare the course of symptoms and HR-QoL immediately after thoracic radiotherapy between symptomatic and non-symptomatic patients with advanced NSCLC	**Design: Single-centre** prospective study **Outcome measure:** EORTC-QLQ-C30 EORTC-QLQ-L13 Clinician symptom assessments **Time points:** Nine (baseline, 2 weeks, 6 weeks, 14 weeks, 22 weeks, 30 weeks, 38 weeks, 46 weeks, and 54 weeks post-radiotherapy)	**Number of participants:** 407 **Demographic:** Male/female 305/102 (75%/25%), median age: 69 (41–88) **Clinical data:** Squamous cell carcinoma 192 (47%), KPS70–80 = 233 (57%)[a], stage IIIb 258 (63%) **Radiation doses:** 17 Gy/2F, 42 Gy/15F, and 50 Gy/25F **Area of RT:** Thoracic **Symptoms before radiotherapy:** Cough 249 (61%), fatigue 232 (57%), dyspnoea 168 (41%), appetite loss 163 (40%), chest pain 148 (36%), haemoptysis 108 (27%), hoarseness 91 (22%), nausea 31 (8%), dysphagia 26 (6%), vomiting 22 (5%) **Symptoms after radiotherapy:** Fatigue 179 (78%), cough 171 (73%), dyspnoea 120 (43%), appetite loss 117 (51%), chest pain 90 (39%), hoarseness 64 (20%), haemoptysis 42 (13%), nausea 31 (8%), dysphagia 26 (6%), vomiting 22 (5%) **Quality rating:** High

CCRT, concurrent chemoradiotherapy; CFRT, conventionally fractionated radiation therapy; CT scan, computed tomography scan; CXR, chest X-ray; CTCAE, Common Terminology Criteria for Adverse Events scale; ECOG , Eastern Cooperative Oncology Group; EORTC, European Organisation for Research and Treatment of Cancer; F, fraction; Gy, gray; HADS, Hospital Anxiety and Depression Scale; HR-QoL, health-related quality of life; KPS, Karnofsky Performance Status; LC, lung cancer; LCSS, Lung Cancer Symptom Scale; NSCLC, non-small cell lung cancer; PS, performance status; QLQ, Quality of Life Questionnaire; QoL, quality of life; RCT, randomised controlled trial; RTOG, Radiation Therapy Oncology Group; SBRT, stereotactic body radiation therapy; SVCS, Superior vena cava syndrome; WHO, World Health Organization.

[a] Reporting only the most prevalent category as reported in the article.

Instrument used for symptom evaluation

The most prevalent data source was the European Organisation for Research and Treatment of Cancer (EORTC, 79%). The EORTC-QLQ-C30 was used in 32% of the studies,[17–20,22,23] the EORTC-QLQ-LC13 in 32%,[17–20,23,24] and 5% employed EORTC-QLQ-BN20,[24] EORTC-QLQ-BM22,[24] and EORTC-QLQ-C15-PAL.[18] The rest of studies used the Lung Cancer Symptom Scale (LCSS, 5%),[22] daily diary cards (5%),[22] and a four-point numerical scale (none, mild, moderate, severe) (5%).[21]

Symptom prevalence and severity during palliative thoracic radiotherapy

Before radiotherapy

Prevalence. Thirteen distinct symptoms were self-reported across the eight studies prior to palliative thoracic radiotherapy. Cough was the most prevalent symptom, affecting 62% of participants (721/1156). This was followed by fatigue at 58% (500/866), insomnia at 56% (129/229), dyspnoea at 51% (592/1156), pain at 47% (184/389), chest pain at 40% (434/1091), pain in the arm or shoulder at 38% (87/229), appetite loss at 35% (307/866), haemoptysis at 26% (295/1156), hoarseness at 24% (106/442), constipation at 21% (49/229), nausea and/or vomiting at 19% (122/636), and dysphagia at 9% (86/1001).

Severity. Dyspnoea had the highest mean score, which was within the 41–63 range, followed by cough at 40–57, haemoptysis at 9–57, fatigue at 40–54, appetite loss at 27–48, chest pain at 17–47, and dysphagia at 5–35.[17–21,24] Sundstrom et al.[17] reported that 300 patients (74%) were classified as with moderate to severe symptoms.

During radiotherapy

Prevalence. Seven symptoms were evaluated in only one study that reported prevalence during radiotherapy. Five symptoms were specifically associated with the chest (cough, dyspnoea, chest pain, haemoptysis, and difficulty swallowing), while the rest were fatigue and loss of appetite. In McDermott, Armstrong, Thirion, Dunne, Finn, Small, Byrne, O'Shea, O'Sullivan, Shannon, Kelly and Hacking,[18] fatigue was the most frequent symptom, at 37% (13/35) followed by dyspnoea at 34% (12/35), cough at 14% (5/35), and dysphagia at 11% (4/35).[18] Dyspnoea and haemoptysis reduced from the initial levels and cough occurrence remained steady, whereas dysphagia and fatigue increased compared to the baseline.[18]

Severity. Cough, dyspnoea, haemoptysis, chest pain, and dysphagia were self-reported for severity during radiotherapy. Over-time severity scores for cough were contradictory in two studies:[17,20] one study found that cough was as severe during radiotherapy as before the start of it,[17] while the second study showed increasing severity during treatment.[20] Similarly, severity of dysphagia decreased during radiotherapy in one study,[19] but remained unchanged according to another study.[21] In terms of severity of dyspnoea, response to radiotherapy was equally ambiguous: one study showed reduction from baseline,[17] whereas another study showed increase.[19] Two studies reported reduction in severity of haemoptysis,[17,20] while fatigue and appetite loss increased compared to baseline.[20]

After radiotherapy

Prevalence, severity and changes thereof were evaluated across 14 different timepoints post-treatment, i.e., 2, 4, 6, 14, 16, 22, 30, 38, 46, and 54 weeks after radiotherapy.

Prevalence. Two studies evaluated the prevalence of nine symptoms two weeks after radiotherapy.[17,18] Fatigue was most common (70%, 249/355), followed by cough (67%, 241/355), dyspnoea (46%, 164/355), appetite loss (45%, 147/326), dysphagia (38%, 135/355), chest pain (36%, 117/ 326), nausea and vomiting (27%, 88/326), hoarseness (19%, 64/324), and haemoptysis (13%, 42/326). Fig. 2 illustrates trends of symptom prevalence after radiotherapy at each time point. The overall pattern indicates an increase at 2 weeks post-radiotherapy, followed by a decrease.

Severity. In one study, severity scores for dyspnoea, cough, and haemoptysis showed improvement at 1, 6, and 16 weeks after radiotherapy.[23] Notable reduction in severity of dyspnoea were demonstrated at week 4 after treatment,[18,19,22–24] although one study reported gradual worsening over time.[20] Slight reduction in chest pain was reported at week 4 in one study, albeit not statistically significant.[22] Haemoptysis consistently improved, becoming significantly less prevalent at 4 weeks after radiotherapy.[21–24] Swallowing difficulties, or dysphagia, became more pronounced during radiotherapy but returned to their initial levels after 6 weeks.[17,20–22] In terms of fatigue, Sundstrom et al.[17] reported a peak in fatigue 2 weeks after radiotherapy, which reduced to below baseline scores at week 14. Two studies showed increase in severity at 4 weeks post-radiotherapy,[18,22] whereas another study not only showed increase in severity above baseline scores at 2 and 6 weeks, but also persistent fatigue at 3, 6, and 12 months after treatment.[20] Appetite loss

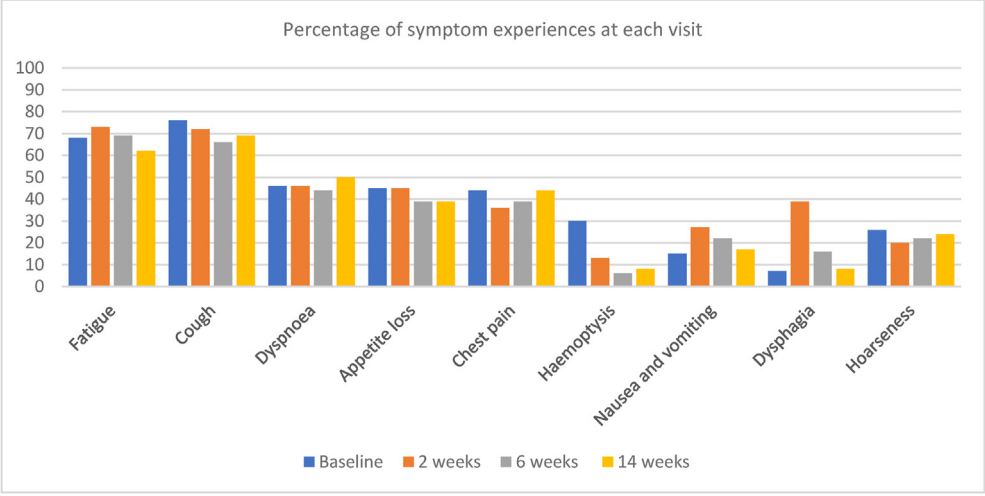

Fig. 2. Percentage of patients who self-reported symptoms at each visit.

significantly decreased to below baseline scores at both 6 weeks and 3 months after radiotherapy.[18]

Moderators of symptom prevalence/change

Three studies investigated moderators of symptom/side-effect prevalence or change, including PS, weight loss, cancer stage, objective tumour response (reduction measured by changes in tumour size before and after radiotherapy via CT scans), and radiation-induced pulmonary changes (changes in tissue assessed through chest radiographs obtained at 6 weeks and 3 months post-radiotherapy).[17,19,20] Poor PS, weight loss, and lung cancer stage were linked to greater symptom prevalence ($P < 0.001$).[17] Patients with objective tumour responses experienced statistically significant improvement in dyspnoea ($P = 0.02$),[19] chest pain ($P < 0.05$)[19] and arm/shoulder pain ($P < 0.01$).[20] Conversely, severe radiation-induced pulmonary changes were associated with increased dyspnoea post-radiotherapy ($P = 0.04$).[20]

Discussion

Summary and critique of evidence

Our analysis identified 13 symptoms before the start of palliative thoracic radiotherapy for lung cancer. This number is not surprising considering the underlying pathophysiology and link with obstructive pneumonia.[26] Before palliative thoracic radiotherapy for advanced lung cancer, cough appears to be most prevalent, followed by fatigue and insomnia. In line with earlier studies, we found that between 47% and 70% of patients with advanced lung cancer undergoing palliative radiotherapy presented with cough.[27] Lung cancer cells and respiratory secretions can act as foreign bodies, intensifying coughing in patients.[28] In advanced lung cancer, patients might develop restrictive lung disease, leading to symptoms such as cough, breathlessness, and chest discomfort, along with notable reductions in diffusion capacity and respiratory volume.[29] Dyspnoea, cough and haemoptysis were most severe at baseline.

During radiotherapy, fatigue is most prevalent, followed by dyspnoea and cough. Severity of dyspnoea and haemoptysis reduces during radiotherapy, unlike cough. Conversely, side-effects of dysphagia and appetite loss may increase. Symptomatic improvement ranges from 21% to 86%. Previous research indicates haemoptysis as one of the most responsive symptoms,[30,31] with improvement reported as early as 24–48 hours after radiation delivery.[32] Improvement in haemoptysis may stem from several factors, such as radiation specifically targeting the source of haemoptysis, for example a tumour or inflamed blood vessels, leading to its reduction.[33] After radiotherapy, symptoms remain prevalent for up two weeks, followed by subsequent reduction. However, cough and dyspnoea seem to recur quickly after radiotherapy, while fatigue and appetite loss may persist for about a year.

Poor PS, weight loss, advanced clinical stage, and radiation-induced pulmonary changes were linked to greater prevalence of symptoms and/or side-effects. Interestingly, no patient demographic characteristics were found in the studies to moderate the experience of symptoms or side-effects, and whether this is a true finding or a result of limitations in the reviewed studies remains to be answered by future research. In any case, patient sub-groups featuring those clinical characteristics should be evaluated regularly to maintain a balance between gains and losses from palliative thoracic radiotherapy. Patients who showed an objective response to treatment experienced improvements in dyspnoea, chest pain and arm/shoulder pain. Whether this benefit extends to other disease-related symptoms remains to be found.

It is important to enable monitoring and self-reporting of symptoms and side-effects throughout palliative thoracic radiotherapy for advanced lung cancer. This will help clinicians to be proactive when assisting patients through a formalised pathway of information and intervention. It is particularly relevant where there is a clinical pathway across a timeline for specific interventions so that clinicians can support self-care activities that aim to maintain patients' quality of life despite the distressing symptoms of the disease and the treatment.[34] Assessment at the initial presentation of symptoms and side-effects has been linked to improved self-care, emotional well-being, and functional status, better quality of life, and reduced morbidity in patients with cancer.[35,36] To measure the impact of palliative care interventions for advanced lung cancer, repeated investigation of patients' experiences of symptoms and side-effects is essential.[37] There is still a lack of sufficient empirical evidence regarding the symptom experience in this population during palliative radiotherapy, indicating a need for further investigation into the onset of symptoms and the distress they cause.[38] Conducting research to enable the tracking and monitoring of symptoms during and after palliative radiotherapy can provide valuable insights for tailoring interventions and delivering personalised care to patients.

Further investigation is warranted to identify effective methods that can lead to better treatment adherence and health outcomes. Patient education materials, mobile apps, and telehealth programmes provide accessible and personalised support. These methods improve health literacy and empower patients to make informed decisions. Furthermore, they facilitate care coordination and monitoring.[39] It is also essential to delve into how cultural and demographic factors influence symptom experience and management, with the goal of ensuring equitable care for all patient groups. Exploring the benefits of interdisciplinary collaboration among health care providers also holds promise regarding enhancing holistic symptom management approaches. Multidisciplinary teams in health care collaborate by establishing common objectives to guide patient care, maintaining open channels for communication and for sharing information and insights, defining the roles and responsibilities within the team, and coordinating efforts to ensure seamless patient care.[40] Relevant research emphasises the significance of cooperation, role perception, and interdisciplinary learning within such teams.[41]

Dynamic assessment focusing on real-time symptom assessment allows for an ongoing evaluation of patients' condition and ensures that health care providers receive real-time data, enabling timely interventions.[42,43] Strategic implementation of electronic patient-reported outcome measures (ePROMs) in radiotherapy practice can ensure accurate symptom/side-effect assessment and management, especially where patient access to health care services is limited. ePROM systems operate through technology-driven methods and work remotely by tracking and gathering information regarding patient-reports on health status, medication adherence, activity levels, and other vital health metrics. Patients often use health applications for scheduled follow-up visits, aiding in diagnosis and treatment.[42] Remote monitoring enhances patient outcomes by providing real-time insights, enabling prompt interventions.[44,45] Studies show reduced costs and better outcomes, especially for chronic conditions like lung cancer, when this type of monitoring is done.[46,47]

Strengths and limitations of the review

This is the first systematic review of patient-reported symptoms and side-effects in the context of advanced lung cancer and palliative thoracic radiotherapy, thus filling a gap in the existing literature. A comprehensive search strategy was employed using broad operational definitions to include all relevant studies. We nevertheless acknowledge a few limitations. Our conclusions are limited by the generally limited research conducted in this area of practice, which is evident by the limited number of included studies and that only three studies were conducted in the last 10 years. We found no qualitative research that met the inclusion criteria, although incorporating qualitative research could have provide additional insights into patients' lived experience of symptoms and side-effects. The review was limited to English-language articles, so it may have missed studies in languages other than English and diverse cultural contexts, although we believe this number is very small. The reviewed literature showed significant heterogeneity in prescribed doses and fraction sizes of palliative thoracic radiotherapy.[48] The differences in patient characteristics, methods and measures of

symptom assessment, and measured outcomes also challenged the synthesis and comparability of the findings, which prevented meta-analysis of this evidence.

Conclusions

Palliative thoracic radiotherapy may offer adequate palliation of lung cancer-related symptoms, but the degree of symptom control can be variable, while persistent radiotherapy-related side-effects can ensue. We have identified which symptoms seem to be more susceptible to being controlled with palliative thoracic radiotherapy, those that seem to persist in the short or longer term, and those side-effects that may complicate adherence and mask the net benefit of radiotherapy. Close and systematic monitoring is key. Our findings will be useful to multidisciplinary lung cancer teams and radiotherapy teams with specific directions for symptom/side-effect assessment efforts and development of management protocols for use in the clinic and at home via use of PROMs and ePROMs.

Ethics statement

Not required.

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CRediT authorship contribution statement

Conception and design of study: S. Thanthong, G. Kotronoulas, B. Johnston; Acquisition of data: S. Thanthong, G. Kotronoulas, B. Johnston; Analysis and/or interpretation of data: S. Thanthong, G. Kotronoulas, B. Johnston; Drafting the manuscript: S. Thanthong; Revising the manuscript critically for important intellectual content: G. Kotronoulas, B. Johnston; Approval of the version of the manuscript to be published: S. Thanthong, G. Kotronoulas, B. Johnston. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Data availability statement

The data that support the findings of this study are available from the corresponding author, Saengrawee Thanthong, upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Declaration of competing interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

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