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Postoperative Symptom Burden in Patients Undergoing Lung Cancer Surgery

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Abstract

Context.—Previous studies on quality of life (QOL) after lung cancer surgery have identified a long duration of symptoms postoperatively. We first performed a systematic review of QOL in patients undergoing surgery for lung cancer. A subgroup analysis was conducted focusing on symptom burden and its relationship with QOL.

Objective.—To perform a qualitative review of articles addressing symptom burden in patients undergoing surgical resection for lung cancer.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jpainsymman.2022.05.016.

Methods.—The parent systematic review utilized search terms for symptoms, functional status, and well-being as well as instruments commonly used to evaluate global QOL and symptom experiences after lung cancer surgery. The articles examining symptom burden (n = 54) were analyzed through thematic analysis of their findings and graded according to the Oxford Centre for Evidence-based Medicine rating scale.

Results.—The publication rate of studies assessing symptom burden in patients undergoing surgery for lung cancer have increased over time. The level of evidence quality was 2 or 3 for 14 articles (cohort study or case control) and level of 4 in the remaining 40 articles (case series). The most common QOL instruments used were the Short Form 36 and 12, the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire, and the Hospital Anxiety and Depression Score. Thematic analysis revealed several key findings: 1) lung cancer surgery patients have a high symptom burden both before and after surgery; 2) pain, dyspnea, cough, fatigue, depression, and anxiety are the most commonly studied symptoms; 3) the presence of symptoms prior to surgery is an important risk factor for higher acuity of symptoms and persistence after surgery; and 4) symptom burden is a predictor of postoperative QOL.

Conclusion.—Lung cancer patients undergoing surgery carry a high symptom burden which impacts their QOL. Measurement approaches use myriad and heterogenous instruments. More research is needed to standardize symptom burden measurement and management, with the goal to improve patient experience and overall outcomes.

Keywords

Symptoms; quality of life; lung cancer; surgery; pulmonary resection

Introduction

Lung cancer is the second most common malignancy, affecting over 2 million new people every year, and it is the leading cause of cancer death worldwide.¹ A primary modality of curative intent treatment in early stage non-small cell lung cancer is pulmonary resection through minimally invasive or open surgery. Due to the invasiveness of these approaches and common underlying patient comorbidities, lung cancer surgery patients' quality of life (QOL) is negatively impacted, largely by reductions in physical and pulmonary functioning as well as residual symptom burden.² In particular, symptom burden has been shown to last for extended durations postoperatively.³ Therefore, strategies for assessing and addressing symptom burden in clinically meaningful ways are exceedingly important.

As outcomes including short term morbidity and long term survival after surgical resection for lung cancer improve,^{4–8} the focus of care is shifting to designing interventions for optimizing perioperative QOL. Patient-reported outcomes (PROs) and other survey instruments have been developed and tested for the purpose of symptom monitoring in this group.⁹ However, widespread use of PROs for improvement of clinical care in lung cancer surgery patients is hampered by lack of consensus on standardized instruments and delivery modes,^{10–12} despite pilot trials demonstrating feasibility of routine electronic PRO assessments.¹³

One reason for this implementation gap may be a lack of knowledge of how symptom burden impacts lung cancer surgery patients and their QOL. In the modern era, minimally invasive lung resections have become standard of care¹⁴ and earlier discharges are increasing the priority for overburdened health systems.¹⁵ Prior systematic reviews on the topic of QOL lung cancer surgery were completed before 2016 and have focused on studies using a select number of QOL instruments.^{3,10,16,17} Each of the prior systematic reviews had a relatively small (<20) number of included articles. Therefore, we sought to broadly define our questions and explore major categories of work for emerging themes.

This study presents the findings of a subgroup analysis of articles examining postoperative symptom burden identified from a larger systematic review evaluating QOL of patients undergoing surgery for lung cancer. The analysis of these 54 selected articles helps us to answer the questions “what is the prevalence of symptom burden in lung cancer surgery patients?” and “how does this symptom burden relate to quality of life postoperatively?” and provides an important frame-work to better understand the interplay between lung cancer surgery, symptoms, and quality of life.

Methods

Parent Systematic Review

Primary research articles on patients undergoing pulmonary resection for lung cancer who were assessed using QOL instruments were evaluated for inclusion. A medical librarian developed search terms for lung cancer, surgical procedures, and QOL domains including symptoms, functional status, and well-being using subject headings and keywords (Supplemental File 1). These terms were used to search PubMed via the National Library of Medicine, Embase via Elsevier, Web of Science, PsycINFO (via EBSCO), and CINAHL Plus (via EBSCO) from the date of database inception through August 2020. A total of 4253 unique citations were found in all database searches. Every citation was assessed by two authors in an unblinded standardized manner to identify articles (n = 286) focused on the role of QOL in outcomes of lung cancer surgery patients as summarized in the parent study PRISMA diagram. These articles were further grouped by surgical care phases: immediate perioperative management, intraoperative approaches, and long-term postoperative phases (Fig. 1).

For this work, the postoperative phase grouping (n = 153) was examined further, and these articles were categorized by two members of the study team using thematic analysis (A. M.; G. N. M.; Fig. 2). The identified categories centered on how QOL was framed and examined: 1) the longitudinal trajectory of QOL (n = 34); 2) risk factors for poor postoperative QOL (n = 49); 3) relationship of perioperative QOL with other outcomes (n=4), 4) validation of QOL instruments and other topics (n = 12) and 5) symptom burden in lung cancer surgery patients (n = 54). This study evaluates those 54 articles on symptom burden and its relationship with QOL after lung cancer surgery.

Subset Analysis of Articles Focused on Symptoms

Articles focused on symptoms in patients undergoing surgery for lung cancer were analyzed iteratively through qualitative narrative synthesis of their finding and discussion by two investigators (A.M.; G.N.M) until dominant themes or meanings emerged. In addition, these articles were graded according to the Oxford Centre for Evidence-based Medicine rating scale.¹⁸ In brief the Oxford Centre for Evidence-based Medicine rating scale is a hierarchical scale. Studies that are randomized and blinded have a lower grade (grade 1) than randomized unblinded trials (grade 2), than cohort studies (grade 3) than do case control studies or case series (grade 4). In addition, the ROBINS-I tool was used to assess risk of bias for the included studies that were not case series.¹⁹

Results

Overall Results

Full text articles (n = 54) assessing symptom burden and QOL in patients undergoing surgery for lung cancer are presented in Table 1, organized by date. The level of evidence quality was 2 or 3 for 14 articles (cohort study or case control) and level of 4 in the remaining 40 articles (case series). There were no studies on symptom burden and QOL with level of evidence quality 1 (randomized control trial or metaanalysis). The trajectory for article publication is in Fig. 3. There is an exponential increase in the number of articles addressing this topic starting in year 2010. There was notable diversity in the QOL instruments used across the studies. A total of 48 different symptom and/or QOL measures were used. The most commonly used measures were SF-36 (n = 12), Hospital Anxiety and Depression Score (n = 11), and the EORTC QLQ-LC13 or EORTC QLQ-C30. (n = 11) The detailed list of QOL and symptom measurement tools used in all studies is listed in Table 2.

The findings of the articles according to the primary symptoms are discussed below. The frequency of articles addressing each symptom are visually depicted in a word cloud (Fig. 4). We opted to present these findings qualitatively given the overlap of some studies discussing more than one symptom or how symptoms related to each other.

Acute and Chronic Pain.—Acute postoperative pain is expectedly extremely common and increases in the first 1–3 months postoperatively when compared to baseline, but then decreases variably over time.^{20,21} Two studies report an eventual return to baseline pain in an approximately 6 month time frame,^{13,22} whereas other studies report that pain persists in as many as 55% of patients at 12 months.²³ Chronic pain (typically lasting >2–3 months and known as post-thoracotomy pain syndrome) was discussed in 9 articles.^{20,21,23–29} Chronic pain may be incisional, radiating (often to the shoulder)³⁰ or neuropathic and affects ~30% of patients after pneumonectomy²⁹ and, in some reports, up to 40% of patients after minimally invasive surgery.²⁰ Patients at risk for chronic postoperative pain are those undergoing posterior lateral thoracotomy compared to those undergoing anterior thoracotomy²⁸ or minimally invasive surgery²⁷ as well as in patients with more comorbidities and preoperative pain.^{23,31}

Chronic pain impacts physical HRQOL and is clinically important in 18% of patients.²⁷ In fact, symptoms such as pain have a greater impact on postoperative QOL than patient's understanding of treatment plan, involvement in decision making,³² and trust in their physicians.³³ Symptoms of pain are associated with anxiety,³⁴ and poorly controlled postoperative pain may impact mental HRQOL through development of post-traumatic stress disorder (PTSD) related symptoms.^{35,36} Indeed, up to 50% of patients undergoing surgery for lung cancer experience PTSD.³⁷

Respiratory Symptoms.—Respiratory symptoms (dyspnea and cough) are extremely common and long lasting in lung cancer patients. These symptoms negatively impact physical and emotional QOL more so than objective measures of pulmonary function.^{38–40} A majority (60%) of patients experience dyspnea even several years after surgery.⁴¹ More than a third (37%) of patients develop a cough after surgery that persists for greater than one month.^{42,43} Predictors of postoperative cough include preoperative COPD.⁴⁴ Respiratory symptoms may appear in clusters with other symptoms; for example, cough is commonly associated with sleep disturbance.⁴³ Bando et al report that dyspnea and chest pain had a negative influence on emotional HRQOL, specifically by impacting hope.⁴⁵

Mental Health Symptoms.—The impact of lung cancer diagnosis and surgery on mental health is often not anticipated by patients.⁴⁶ Mental health impacts outcomes both pre- and postoperatively. Preexisting depression is associated with higher rates of receiving non-operative therapy⁴⁷ and anxiety and depression are associated with worse postoperative QOL,⁴⁸ specifically emotional QOL,⁴⁹ and a higher complication rate.⁵⁰ Patients with pre-existing anxiety tend to experience mental health symptoms more frequently postoperatively,⁵¹ as do patients who continue to smoke.⁵²

Postoperatively, 30% of patients experience depression⁵³ and 19% have anxiety,⁵⁴ though anxiety is reported to then decrease once surgery is complete.⁵⁵ Lung cancer surgery patients experience anxiety and depression at higher rates than those after other thoracic procedures such as coronary artery bypass grafting,⁵⁶ and those who experience these symptoms report lower rates of self-efficacy.⁵⁷ As psychiatric symptoms tend to appear in clusters with other somatic symptoms⁵⁸ mental health symptoms may best be treated as a part of comprehensive cancer support programs. It does seem true that social support has an impact on self-efficacy and related concepts, which in turn has an impact on quality of life.⁵⁹

Sleep and Fatigue.—Fatigue and sleep disturbance are common in lung cancer surgery patients, including preoperatively due to disease-associated respiratory symptoms and psychiatric symptoms,^{60–62} but can also last over five months postoperatively.⁴³ Preoperative sleep disturbance is a risk factor for postoperative sleep disturbance.⁶³ Greater than 50% of lung cancer patients experience fatigue⁶⁴ and 80% poor sleep quality.⁶³ Sleep disturbance worsens until 1 month postoperatively and then returns to preoperative levels.^{65,66} Fatigue negatively impacts emotional HRQOL (self-efficacy).⁶⁷

Symptom Clusters.—Lung cancer surgery patients often develop more than one symptom after surgery.⁶⁸ Symptom clusters may be an important driver of postoperative quality of health. Risk factors for higher interference of symptoms are younger age, more

comorbidities, and worse functional status.⁶⁹ The occurrence of two or more clinically significant symptoms has an adverse impact on HRQOL and functioning,⁷⁰ and dyspnea, fatigue, cough, pain, and reduced appetite symptom occurrence is linked to declines HRQOL.⁷¹ Pain, fatigue, disturbed sleep, and distress co-occur commonly and negatively impact QOL and functional status.⁷²

Symptom burden severity also may be predictive of postoperative health care needs.⁷³ Patients who have a prolonged length of stay report decreased satisfaction upon discharge and also report a lower quality of life postoperatively.⁷⁴ While 50% of patients undergoing surgery for lung cancer think that the surgery may alleviate cancer related symptoms, only 44% think the surgery may result in side effects or complications.⁷⁵ Mindfulness programs have been implemented as an attempt to alter the relationship between somatic symptoms and development of anxiety and depression and can be implemented across a broad aspect of lung cancer surgery patients,⁷⁶ although the impact on QOL is not yet clear. It does seem true that social support has an impact on self-efficacy, which in turn has an impact on quality of life.⁵⁹

Discussion

Overall, the included studies demonstrate that: 1) lung cancer surgery patients have a high symptom burden both before and after surgery; 2) pain, dyspnea, cough, fatigue, depression, and anxiety are predominant; 3) presence of symptoms prior to surgery is an important risk factor for higher acuity of symptoms and persistence after surgery; and 4) symptom burden is a predictor of postoperative QOL. Importantly, the findings verify the frameworks proposed to evaluate lung cancer patient HRQOL domain priorities from other works.⁷⁷ This study also demonstrates the rapid increase in the last decade of studies examining symptom burden in patients undergoing lung cancer surgery.

These findings suggest several opportunities to develop programmatic strategies with targeted interventions to improve perioperative symptom burden. First, pain remains a major concern for patients for many months postoperatively, and pain is tied with longer length of stay and costs.⁷⁸ While 50% of patients undergoing surgery for lung cancer believe that the surgery may alleviate cancer related symptoms, only 44% think the surgery may result in side effects or complications.⁷⁵ Preoperative counseling about anticipated pain levels and durations should be routinely delivered in order to align expectations and improve outcomes.^{79–81} Next, Our findings support the pressing need for research to establish the clinical application of validated questionnaires (e.g., the lung cancer specific EORTC LC-29^{67,68} or shorter symptom inventories such as the MD Anderson Lung Cancer module⁸² particularly as surgical societies move toward routine patient-reported outcome reporting⁸³ and clinical trialists seek to determine the impact of their therapies on HRQOL.¹⁴ The association of residual postoperative symptoms with permanent declines in QOL, the importance of symptom clustering, and the best to prognosticate and tailor interventions to preoperative symptoms is not clear and all are areas for future work.

The major limitation to this study, as with all qualitative reviews, relates to the biases introduced through selection of search terms and review of articles. We did use standard

search terms and two reviewers for each stage of the review to mitigate bias but did face a challenge with the large number of found studies, requiring us to further group and categorize articles to improve our focus. There were no studies found on symptom burden with level of evidence quality 1 (randomized control trial or meta-analysis), which limits our ability to draw conclusions that would be generalizable. There was notable heterogeneity in the QOL instruments used across the studies precluding our ability to perform a quantitative analysis. In addition, the majority of studies had a level of quality 4, resulting in a high level of bias in the studies. For this reason, only a qualitative analysis was able to be performed.

Conclusion

Symptom burden has been demonstrated to have an important impact on patients undergoing surgery for lung cancer, and my influence quality of life in this group. Pain, respiratory symptoms, mental health symptoms, and fatigue contribute to lung cancer surgery patients' symptom burden. While the increased focus on QOL should lead toward a more patient-centered practice, challenges remain in implementation due to the inconsistent use of standard QOL instruments. More research is needed to apply symptom and QOL assessment after lung cancer surgery in a way that is clinically relevant for both patients and surgeons.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Disclosures and Acknowledgments

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Abbreviations:

EORTC QLQ-C30	European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire - Core 30
EORTC QLQ-LC13	European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire - Lung Cancer 13
HADS	Hospital Anxiety and Depression Scale
MOS SF-36 (SF-36)	Medical Outcomes Study – Short Form 36
NSCLC	Non-Small Cell Lung Cancer
PROMIS	Patient-Reported Outcomes Measurement Information System
QOL	Quality of Life
VAS	Visual Analogue Scale

VATS

Video-assisted Thoracoscopic Surgery

References

1. Global Burden of Disease Cancer Collaboration Fitzmaurice C, Allen C, et al. Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: a systematic analysis for the global burden of disease study. *JAMA Oncol* 2017;3:524–548. [PubMed: 27918777]
2. Moller A, Sartipy U. Long-term health-related quality of life following surgery for lung cancer. *Eur J Cardiothorac Surg* 2012;41:362–367. [PubMed: 21733714]
3. Poghosyan H, Sheldon LK, Leveille SG, Cooley ME. Health-related quality of life after surgical treatment in patients with non-small cell lung cancer: a systematic review. *Lung Cancer* 2013;81:11–26. [PubMed: 23562675]
4. Yang C-FJ, Sun Z, Speicher PJ, et al. Use and outcomes of minimally invasive lobectomy for Stage I non-small cell lung cancer in the national cancer data base. *Ann Thorac Surg* 2016;101:1037–1042. [PubMed: 26822346]
5. Paul S, Altorki NK, Sheng S, et al. Thoracoscopic lobectomy is associated with lower morbidity than open lobectomy: a propensity-matched analysis from the STS database. *J Thorac Cardiovasc Surg* 2010;139:366–378. [PubMed: 20106398]
6. Boffa DJ, Dhamija A, Kosinski AS, et al. Fewer complications result from a video-assisted approach to anatomic resection of clinical stage I lung cancer. *J Thorac Cardiovasc Surg* 2014;148:637–643. [PubMed: 24529729]
7. Yan TD, Black D, Bannon PG, McCaughan BC. Systematic review and meta-analysis of randomized and nonrandomized trials on safety and efficacy of video-assisted thoracic surgery lobectomy for early-stage non-small-cell lung cancer. *J Clin Oncol* 2009;27:2553–2562. [PubMed: 19289625]
8. Kent M, Wang T, Whyte R, et al. Open, video-assisted thoracic surgery, and robotic lobectomy: review of a national database. *Ann Thorac Surg* 2014;97:236–242. discussion 242–244. [PubMed: 24090577]
9. Cleeland CS, Wang XS, Shi Q, et al. Automated symptom alerts reduce postoperative symptom severity after cancer surgery: a randomized controlled clinical trial. *J Clin Oncol* 2011;29:994–1000. [PubMed: 21282546]
10. Fitzsimmons D, Wheelwright S, Johnson CD. Quality of life in pulmonary surgery: choosing, using, and developing assessment tools. *Thorac Surg Clin* 2012;22:457–470. [PubMed: 23084610]
11. Pompili C, Koller M, Velikova G. Choosing the right survey: the lung cancer surgery. *J Thorac Dis* 2020;12:6892–6901. [PubMed: 33282392]
12. Pompili C, Basch E, Velikova G, Mody GN. Electronic patient-reported outcomes after thoracic surgery: toward better remote management of perioperative symptoms. *Ann Surg Oncol* 2021;28:1878–1879. [PubMed: 33479865]
13. Khullar OV, Rajaei MH, Force SD, et al. Pilot study to integrate patient reported outcomes after lung cancer operations into the society of thoracic surgeons database. *Ann Thorac Surg* 2017;104:245–253. [PubMed: 28483154]
14. Lim E, Batchelor T, Shackcloth M, et al. Study protocol for VIdeo assisted thoracoscopic lobectomy versus conventional Open LobEcTomy for lung cancer, a UK multicentre randomised controlled trial with an internal pilot (the VIOLET study). *BMJ Open British Med J Publishing Group* 2019;9:e029507.
15. Tipton K, Leas BF, Mull NK, et al. Interventions To Decrease Hospital Length of Stay. *AHRQ Comparative Effectiveness Technical Briefs*. Rockville (MD): Agency for Health-care Research and Quality (US); 2021.
16. Gazala S, Pelletier J-S, Storie D, et al. A systematic review and meta-analysis to assess patient-reported outcomes after lung cancer surgery. *Scientific World J* 2013;2013:789625.
17. Pompili C. Quality of life after lung resection for lung cancer. *J Thorac Dis* 2015;7:S138–S144. [PubMed: 25984359]

18. OCEBM Levels of Evidence Working Group: Howick J, Chalmers Iain (James Lind Library), Glasziou Paul, Greenhalgh Trish, Heneghan Carl, Liberati Alessandro, Moschetti Ivan, Phillips Bob, Thornton Hazel, Goddard Olive and Hodgkinson Mary. "The Oxford Levels of Evidence 2," OCEBM Levels of Evidence — Centre for Evidence-Based Medicine (CEBM), University of Oxford. Available at: <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebml-levels-of-evidence>. Accessed February 3, 2021.
19. Sterne JA, Hernan MA, Reeves BC, et al. ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ* 2016;355:i4919. [PubMed: 27733354]
20. Takenaka S, Saeki A, Sukenaga N, et al. Acute and chronic neuropathic pain profiles after video-assisted thoracic surgery: a prospective study. *Medicine* 2020;99:e19629. [PubMed: 32221089]
21. Yoon S, Hong W-P, Joo H, et al. Long-term incidence of chronic postsurgical pain after thoracic surgery for lung cancer: a 10-year single-center retrospective study. *Regional Anesthesia Pain Med* 2020;45:331–336.
22. Golder HJ, Papalois V. Enhanced recovery after surgery: history, key advancements and developments in transplant surgery. *J Clin Med* 2021;10:1634. [PubMed: 33921433]
23. Gjeilo KH, Oksholm T, Follestad T, et al. Trajectories of pain in patients undergoing lung cancer surgery: a longitudinal prospective study. *J Pain Symptom Manag* 2020;59:818–828.e1.
24. Wildgaard K, Ravn J, Nikolajsen L, et al. Consequences of persistent pain after lung cancer surgery: a nationwide questionnaire study. *Acta Anaesthesiol Scand* 2011;55:60–68. [PubMed: 21077845]
25. Balduyck B, Hendriks J, Lauwers P, Van Schil P. Quality of life evolution after lung cancer surgery: a prospective study in 100 patients. *Lung Cancer* 2007;56:423–431. [PubMed: 17306905]
26. Guastella V, Mick G, Soriano C, et al. A prospective study of neuropathic pain induced by thoracotomy: Incidence, clinical description, and diagnosis. *Pain* 2011;152:74–81. [PubMed: 21075523]
27. Kinney MAO, Hooten WM, Cassivi SD, et al. Chronic postthoracotomy pain and health-related quality of life. *Annals of Thoracic Surgery* 2012;93:1242–1247. [PubMed: 22397986]
28. Grosen K, Laue Petersen G, Pfeiffer-Jensen M, et al. Persistent post-surgical pain following anterior thoracotomy for lung cancer: a cross-sectional study of prevalence, characteristics and interference with functioning. *Eur J Cardiothorac Surg* 2013;43:95–103. [PubMed: 22522981]
29. Skrzypczak PJ, Roszak M, Kasprzyk M, et al. Pneumonectomy – permanent injury or still effective method of treatment? Early and long-term results and quality of life after pneumonectomy due to non-small cell lung cancer. *Polish J Cardio-Thoracic Surg* 2019;16:7–12.
30. Balduyck B, Hendriks J, Lauwers P, Van Schil P. Quality of life after lung cancer surgery: a prospective pilot study comparing bronchial sleeve lobectomy with pneumonectomy. *J Thorac Oncol* 2008;3:604–608. [PubMed: 18520798]
31. Gryglicka K, Białek K. The patient's readiness to accept the changes in life after the radical lung cancer surgery. *Współczesna Onkologia* 2020;24:42–50. [PubMed: 32514237]
32. Mokhles S, Nuyttens J, de Mol M, et al. Treatment selection of early stage non-small cell lung cancer: the role of the patient in clinical decision making. *BMC Cancer* 2018;18:79. [PubMed: 29334910]
33. Golden SE, Thomas CR, Deffebach ME, et al. It wasn't as bad as I thought it would be": a qualitative study of early stage non-small cell lung cancer patients after treatment. *BMC Res Notes* 2017;10:642. [PubMed: 29187237]
34. Malinowska K. The relationship between chest pain and level of perioperative anxiety in patients with lung cancer. *Polish J Surgery* 2018;90:23–27.
35. Ni J, Feng J, Denehy L, et al. Symptoms of posttraumatic stress disorder and associated risk factors in patients with lung cancer: a longitudinal observational study. *Integrative Cancer Ther* 2018;17:1195–1203.
36. Li X, Che S, Zhang J, et al. Resilience process and its protective factors in long-term survivors after lung cancer surgery: a qualitative study. *Supportive Care Cancer* 2021;29:1455–1463.
37. Jeantieu M, Gaillat F, Antonini F, et al. Postoperative pain and subsequent PTSD-related symptoms in patients undergoing lung resection for suspected cancer. *J Thorac Oncol* 2014;9:362–369. [PubMed: 24496000]

38. Sarna L, Evangelista L, Tashkin D, et al. Impact of respiratory symptoms and pulmonary function on quality of life of long-term survivors of non-small cell lung cancer. *Chest* 2004;125:439–445. [PubMed: 14769722]
39. Janet-Vendroux A, Loi M, Bobbio A, et al. Which is the role of pneumonectomy in the era of parenchymal-sparing procedures? early/long-term survival and functional results of a single-center experience. *Lung* 2015;193:965–973. [PubMed: 26411589]
40. Pompili C, Brunelli A, Xiume F, et al. Prospective external convergence evaluation of two different quality-of-life instruments in lung resection patients. *Eur J Cardiothorac Surg* 2011;40:99–105. [PubMed: 21159520]
41. Feinstein MB, Krebs P, Coups EJ, et al. Current dyspnea among long-term survivors of early-stage non-small cell lung cancer. *J Thorac Oncol* 2010;5:1221–1226. [PubMed: 20592631]
42. Lin RJ, Che GW. Risk factors of cough in non-small cell lung cancer patients after video-assisted thoracoscopic surgery. *J Thorac Dis* 2018;10:5368–5375. [PubMed: 30416784]
43. Oksholm T, Rustoen T, Cooper B, et al. Trajectories of symptom occurrence and severity from before through five months after lung cancer surgery. *J Pain Symptom Manage* 2015;49:995–1015. [PubMed: 25593100]
44. Xie M, Zhu Y, Zhou M, et al. Analysis of factors related to chronic cough after lung cancer surgery. *Thoracic Cancer* 2019;10:898–903. [PubMed: 30875149]
45. Bando T, Onishi C, Imai Y. Treatment-associated symptoms and coping of postoperative patients with lung cancer in Japan: development of a model of factors influencing hope: Developing a model influencing hope. *Japan J Nursing Sci* 2018;15:237–248.
46. Goodman H. Meeting patients' post-discharge needs after lung cancer surgery. *Nurs Times* 2000;96:35–36.
47. van Dams R, Grogan T, Lee P, et al. Impact of health-related quality of life and prediagnosis risk of major depressive disorder on treatment choice for Stage I lung cancer. *JCO Clin Cancer Informatics* 2019;3:1–8.
48. Rodríguez-Quintana R, Hernando-Trancho F, Cruzado JA, et al. Assessment of quality of life, emotional state, and coping skills in patients with neoplastic pulmonary disease. *Psicooncologia* 2012;9:95–112.
49. Sarna L, Cooley ME, Brown JK, et al. Women with lung cancer: quality of life after thoracotomy: a 6-month prospective study. *Cancer Nurs* 2010;33:85–92. [PubMed: 20142740]
50. Erol Y, Çakan A, Ergönül AG, et al. Psychiatric assessments in patients operated on due to lung cancer. *Asian Cardiovasc Thorac Ann* 2017;25:518–521. [PubMed: 28776419]
51. Rolke HB, Bakke PS, Gallefoss F. HRQoL changes, mood disorders and satisfaction after treatment in an unselected population of patients with lung cancer. *Clin Respir J* 2010;4:168–175. [PubMed: 20565496]
52. Myrdal G, Valtysdottir S, Lambe M, Stahle E. Quality of life following lung cancer surgery. *Thorax* 2003;58:194–197. [PubMed: 12612291]
53. Walker MS, Zona DM, Fisher EB. Depressive symptoms after lung cancer surgery: their relation to coping style and social support. *Psychooncology* 2006;15:684–693. [PubMed: 16302291]
54. Park S, Kang CH, Hwang Y, et al. Risk factors for postoperative anxiety and depression after surgical treatment for lung cancer. *Eur J Cardiothorac Surg* 2016;49:e16–e21. [PubMed: 26410631]
55. Oh S, Miyamoto H, Yamazaki A, et al. Prospective analysis of depression and psychological distress before and after surgical resection of lung cancer. *Gen Thorac Cardiovasc Surg* 2007;55:119–124. [PubMed: 17447510]
56. Antoniu SA, Mititiuc I. Quality of life following lung cancer surgery: What about before? *Expert Rev Pharmacoecon Outcomes Res* 2003;3:375–377. [PubMed: 19807448]
57. Huang FF, Yang Q, Zhang J, et al. The structural equation model on self-efficacy during post-op rehabilitation among non-small cell lung cancer patients. *PLoS One* 2018;13:e0204213. [PubMed: 30235301]
58. Lin S, Chen Y, Yang L, Zhou J. Pain, fatigue, disturbed sleep and distress comprised a symptom cluster that related to quality of life and functional status of lung cancer surgery patients. *J Clin Nurs* 2013;22:1281–1290. [PubMed: 23574291]

59. Banik A, Luszczynska A, Pawlowska I, et al. Enabling, not cultivating: received social support and self-efficacy explain quality of life after lung cancer surgery. *Ann Behav Med* 2017;51:1–12. [PubMed: 27418357]
60. Hugoy T, Lerdal A, Rustoen T, Oksholm T. Predicting postoperative fatigue in surgically treated lung cancer patients in Norway: a longitudinal 5-month follow-up study. *BMJ Open* 2019;9:e028192.
61. Berman AT, DeCesaris CM, Simone CB 2nd, et al. Use of survivorship care plans and analysis of patient-reported outcomes in multinational patients with lung cancer. *J Oncol Pract* 2016;12:e527–e535. [PubMed: 27048615]
62. Fagundes CP, Shi Q, Vaporciyan AA, et al. Symptom recovery after thoracic surgery: measuring patient-reported outcomes with the MD Anderson Symptom Inventory. *J Thorac Cardiovasc Surg* 2015;150. 613–9.e2. [PubMed: 26088408]
63. Ida M, Onodera H, Yamauchi M, Kawaguchi M. Preoperative sleep disruption and postoperative functional disability in lung surgery patients: a prospective observational study. *J Anesthesia* 2019;33:501–508.
64. Huang X, Zhou W, Zhang Y. Features of fatigue in patients with early-stage non-small cell lung cancer. *J Res Med Sci* 2015;20:268–272. [PubMed: 26109974]
65. Halle IH, Westgaard TK, Wahba A, et al. Trajectory of sleep disturbances in patients undergoing lung cancer surgery: a prospective study. *Interact Cardiovasc Thorac Surg* 2017;25:285–291. [PubMed: 28486702]
66. Koczywas M, Williams AC, Cristea M, et al. Longitudinal changes in function, symptom burden, and quality of life in patients with early-stage lung cancer. *Ann Surg Oncol* 2013;20:1788–1797. [PubMed: 23143593]
67. Chen H-L, Liu K, You Q-S. Self-efficacy, cancer-related fatigue, and quality of life in patients with resected lung cancer. *Euro J Cancer Care* 2018;27:e12934.
68. Oksholm T, Miaskowski C, Solberg S, et al. Changes in symptom occurrence and severity before and after lung cancer surgery. *Cancer Nurs* 2015;38:351–357. [PubMed: 25254409]
69. Shi Q, Wang XS, Vaporciyan AA, et al. Patient-reported symptom interference as a measure of postsurgery functional recovery in lung cancer. *J Pain Symptom Manage* 2016;52:822–831. [PubMed: 27521528]
70. Lowery AE, Krebs P, Coups EJ, et al. Impact of symptom burden in post-surgical non-small cell lung cancer survivors. *Support Care Cancer* 2014;22:173–180. [PubMed: 24018910]
71. Yang P, Chevillat AL, Wampfler JA, et al. Quality of life and symptom burden among long-term lung cancer survivors. *J Thorac Oncol* 2012;7:64–70. [PubMed: 22134070]
72. Lin YY, Wu YC, Rau KM, Lin CC. Effects of physical activity on the quality of life in taiwanese lung cancer patients receiving active treatment or off treatment. *Cancer Nurs* 2013;36:E35–E41. [PubMed: 23095854]
73. Wang KY, Chang NW, Wu TH, et al. Post-discharge health care needs of patients after lung cancer resection. *J Clin Nurs* 2010;19:2471–2480. [PubMed: 20920075]
74. Grigor EJM, Ivanovic J, Anstee C, et al. Impact of adverse events and length of stay on patient experience after lung cancer resection. *Ann Thorac Surg* 2017;104:382–388. [PubMed: 28669503]
75. Kim Y, Winner M, Page A, et al. Patient perceptions regarding the likelihood of cure after surgical resection of lung and colorectal cancer. *Cancer* 2015;121:3564–3573. [PubMed: 26094729]
76. Shiyko MP, Siembor B, Greene PB, et al. Intra-individual study of mindfulness: ecological momentary perspective in post-surgical lung cancer patients. *J Behav Med* 2019;42: 102–110. [PubMed: 29992367]
77. Brown LM, Gosdin MM, Cooke DT, et al. Health-related quality of life after lobectomy for lung cancer: conceptual frame-work and measurement. *Ann Thoracic Surg* 2020;110:1840–1846.
78. Huang L, Kehlet H, Petersen RH. Reasons for staying in hospital after video-assisted thoracoscopic surgery lobectomy. *BJS Open* 2022;6:zrac050. [PubMed: 35511502]
79. Gehring MB, Lerret S, Johnson J, et al. Patient expectations for recovery after elective surgery: a common-sense model approach. *J Behav Med* 2020;43:185–197. [PubMed: 31512105]
80. Mancuso CA, Duculan R, Cammisa FP, et al. Concordance between patients' and surgeons' expectations of lumbar surgery. *Spine (Phila Pa 1976)* 2021;46: 249–258. [PubMed: 33156286]

81. Oshima Lee E, Emanuel EJ. Shared decision making to improve care and reduce costs. *N Engl J Med* 2013;368: 6–8. [PubMed: 23281971]
82. Xu W, Dai W, Gao Z, et al. Establishment of minimal clinically important improvement for patient-reported symptoms to define recovery after video-assisted thoracoscopic surgery. *Ann Surg Oncol* 2022. Online ahead of print.
83. Pompili C, Novoa N, Balduyck B. ESTS Quality of life and Patient Safety Working Group. Clinical evaluation of quality of life: a survey among members of European Society of Thoracic Surgeons (ESTS). *Interact Cardiovasc Thorac Surg* 2015;21:415–419. [PubMed: 26105771]

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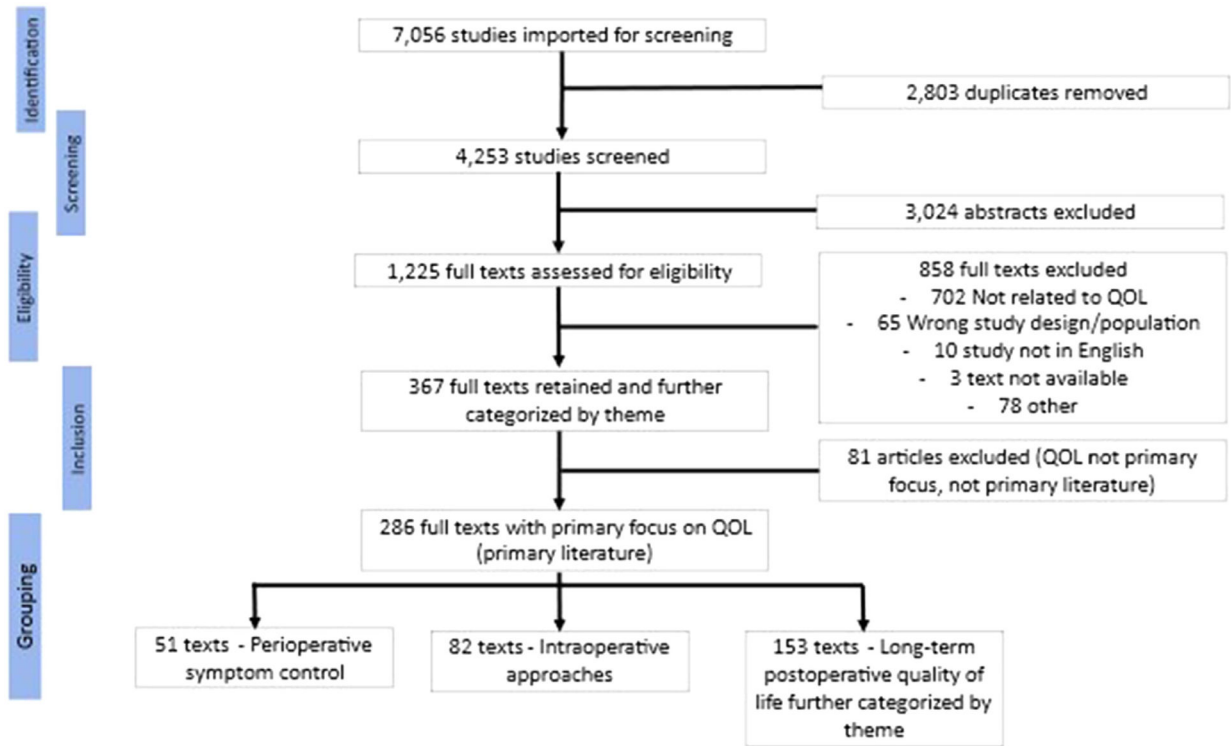


Fig. 1.
Parent systematic review PRISMA diagram.

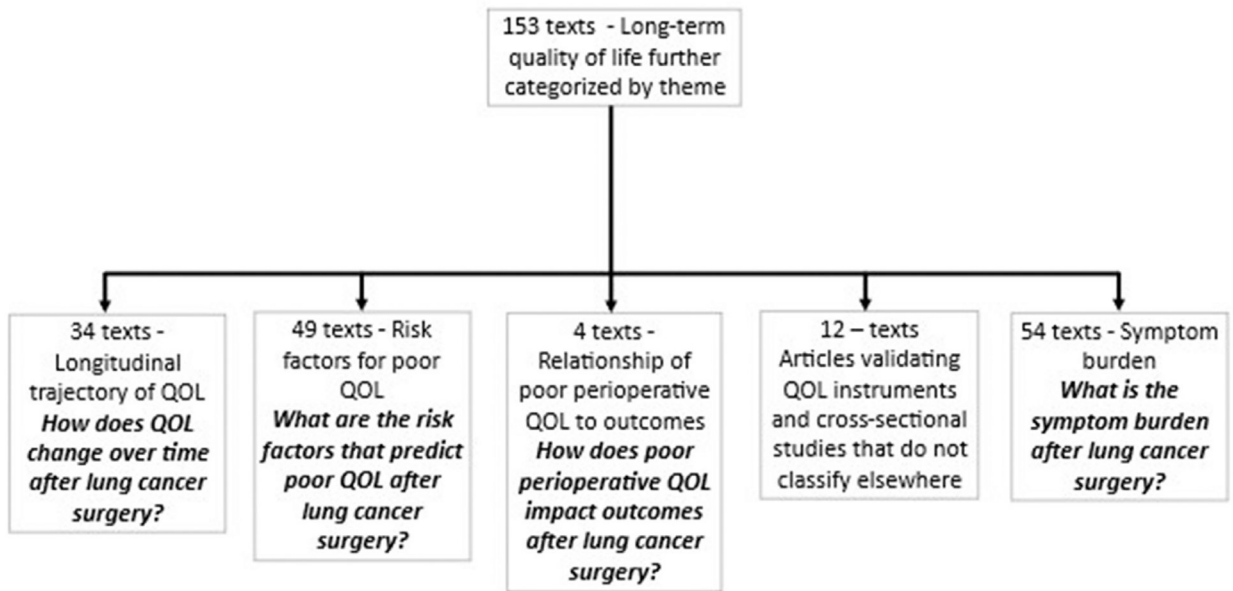


Fig. 2. Categorization of postoperative QOL articles.

Number of articles by year

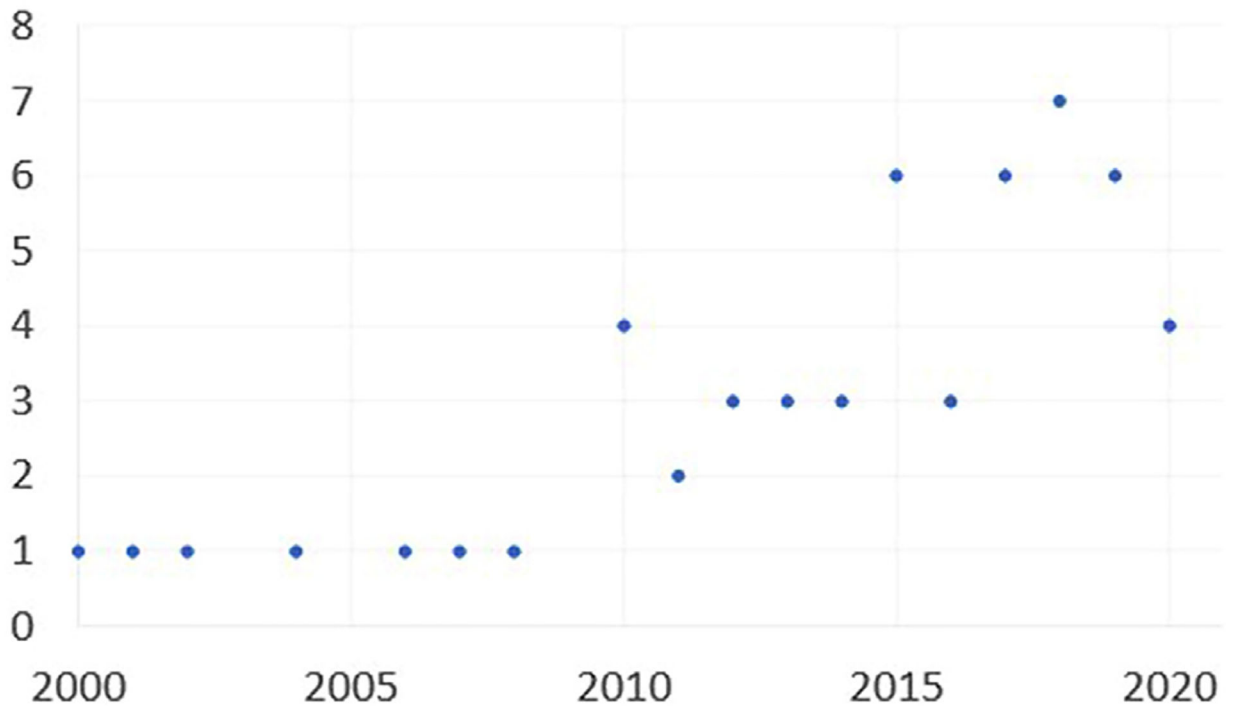


Fig. 3.
Number of articles by year analyzing symptom burden.

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Fig. 4. Word cloud demonstrating number of articles addressing each symptom concept.

Table 1
 Fifty-four Full Text Articles Assessing Symptom Burden in Patients Undergoing Surgery for Lung Cancer

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Shiho et al	Acute and chronic neuropathic pain profiles after video-assisted thoracic surgery: A prospective study	2020	Case series	4	NA	Not stated	Japan	27 patients undergoing thorascopic lung cancer resection	Numeric rating scale, Douleur Neuropathique 4 (DN4) questionnaire; and Douleur Neuropathique 2 questionnaire	thorascopic resection of lung cancer	pain	20
Yoon et al	Long-term incidence of chronic postsurgical pain after thoracic surgery for lung cancer: a 10-year single-center retrospective study	2020	Case control	4	Moderate	2007–2016	Korea	3200 patients who underwent thoracic surgery for lung cancer	numeric rating score	lung cancer surgery	pain	21
Gjeilo et al	Trajectories of Pain in Patients Undergoing Lung Cancer Surgery: A Longitudinal Prospective Study	2020	Case series	4	NA	2010–2012	Norway	307 patients undergoing surgery for presumed lung cancer divided by those with low baseline levels of pain and high baseline levels	Brief pain inventory; Self-Administered Comorbidity Questionnaire-19	lung cancer surgery	pain	23
Gryglicka et al	The patient's readiness to accept the changes in life after the radical lung cancer surgery	2020	Case series	4	NA	2016–2017	Poland	135 patients undergoing resection of lung cancer	Acceptance of illness scale; Mini-Mental State Examination (MMSE)	lung cancer surgery	acceptance	31
Van damms et al	Impact of Health-Related Quality of Life and Prognosis Risk of Major Depressive Disorder on Treatment Choice for Stage I Lung Cancer	2019	Cohort study	3	Moderate	2004–2013	United States	140 patients with stage I non small cell lung cancer who also had major depressive disorder	SF-36 and the Veterans RAND 12-Item Health Survey	140 patients with stage I NSCLC who have major depressive disorder	depression	47
Skrzypczak et al	Pneumonectomy – permanent injury or still effective method of treatment? Early	2019	Case control	4	Serious	2008–2011	Poland	192 patients who underwent pneumonectomy for lung cancer	EORTC QLQ-C30	pneumonectomy for lung cancer	cough, pain	29

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Hugoy	and long-term results and quality of life after pneumonectomy due to non-small cell lung cancer Predicting postoperative fatigue in surgically treated lung cancer patients in Norway: a longitudinal 5-month follow-up study	2019	Case series	4	NA	2010–2012	Norway	307 patients undergoing surgery for lung cancer	Lee Fatigue Scale; EORTC QLQ-LC13; Center for Epidemiologic Studies – Depression Scale; State-Trait Anxiety Inventory; General Sleep Disturbance Scale; Brief Pain Inventory	lung cancer surgery	fatigue	60
Xie et al	Analysis of factors related to chronic cough after lung cancer surgery	2019	Case control	4	Moderate	2017–2018	China	171 who underwent lobectomy for NSCLC	Leicester Cough Questionnaire, and visual analogue scale for cough	lobectomy for NSCLC	cough, fatigue, depression, sleep disturbance	44
Shiyko et al	Intra-individual study of mindfulness: ecological momentary perspective in post-surgical lung cancer patients	2019	Case series	4	NA	1999–2002	United States	59 patients undergoing surgery for lung cancer	Toronto Mindfulness Scale	lung cancer surgery	mindfulness	82
Ida et al	Preoperative sleep disruption and postoperative functional disability in lung surgery patients: a prospective observational study	2019	Case series	4	NA	2016–2017	Japan	24 patients undergoing surgery for lung cancer	12-item World Health Organization Disability Assessment Schedule 2.0; Pittsburgh Sleep Quality Index (PSQI)	lung cancer surgery	sleep	63
Huang et al	The structural equation model on self-efficacy during post-op rehabilitation among non-small cell lung cancer patients	2018	Case series	4	NA	2015	China	238 patients undergoing surgery for non small cell lung cancer	Self-Efficacy Scale for Postoperative Rehabilitation Management of Lung Cancer; FACT-L; HADS; Scale of Perceived Social Support; simplified face scale; Medical Coping Modes	lung cancer surgery	anxiety, depression	57

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Mokhles et al	Treatment selection of early stage non-small cell lung cancer: the role of the patient in clinical decision making	2018	Case series	4	NA	2012–2014	Netherlands	55 patients with NSCLC undergoing lung resection	Questionnaire; Athens Insomnia Scale; VAS; Posttraumatic Growth Inventory Decisional Conflict Scale (DCS) and Control Preferences Scale (CPS), and perceived understanding of information regarding their disease and the treatment, SF-36	lung resection for lung cancer	pain	32
Lin and Che	Risk factors of cough in non-small cell lung cancer patients after video-assisted thoracoscopic surgery	2018	Case series	4	NA	2016–2017	China	198 patients with non small cell lung cancer undergoing minimally invasive lung resection	Leicester Cough Questionnaire in Mandarin Chinese (LCQ-MC)	video assisted thoracoscopic lung resection	cough	42
Ni et al	Symptoms of Posttraumatic Stress Disorder and Associated Risk Factors in Patients With Lung Cancer: A Longitudinal Observational Study	2018	Case control	4	Moderate	2014–2015	China	93 patients newly diagnosed with lung cancer	Post Traumatic Stress Disorder Checklist Civilian Version and EORTC QLQ-C30 and QLQ-LC13	diagnosis of lung cancer	PTSD, fatigue	35
Bando et al	Treatment-associated symptoms and coping of postoperative patients with lung cancer in Japan: Development of a model of factors influencing hope	2018	Case control	4	Serious	Not stated	Japan	92 patients undergoing surgery for lung cancer	Herth Hope Index, EORTC QLQ-LC13, Japanese version of the Coping Inventory for Stressful Situations, and Social Support Scale for Cancer Patients	lung cancer surgery	Hope	45
Malinowska	The relationship between chest pain and level of perioperative anxiety in patients with lung cancer	2018	Retrospective cohort study	4	Moderate	Not stated	Poland	150 patients undergoing surgery for lung cancer divided into patients with chest pain preoperatively and those without	Non externally validated survey to assess chest pain and anxiety	lung cancer surgery	pain, anxiety	34

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Chen et al	Self-efficacy, cancer-related fatigue, and quality of life in patients with resected lung cancer	2018	Case series	4	NA	2014–2015	China	452 patients with NSCLC answering questionnaires regarding QOL, fatigue, and self efficacy	General Self-Efficacy Scale (GSES), Multidimensional Fatigue Symptom Inventory–Short Form (MFSI–SF), and Short Form Health Survey (SF-36)	lung cancer surgery	fatigue	67
Erol et al	Psychiatric assessments in patients operated on due to lung cancer	2017	Case series	4	NA	2014	Turkey	25 patients undergoing lung resection for lung cancer	Experiences in Close Relationships Scale II, EORTC QLQ C-30, Perceived Family Support Scale, Stress Thermometer and Hospital Anxiety Depression Scale, Hospital Anxiety Depression Scale	lung resection for lung cancer	anxiety, depression	50
Grigor et al	Impact of Adverse Events and Length of Stay on Patient Experience After Lung Cancer Resection	2017	Case series	4	NA	2008–2015	Canada	288 questionnaires from patients who underwent resection for lung cancer	Picker Patient Experience Questionnaire	lung resection for lung cancer	satisfaction	74
Khullar et al	Pilot Study to Integrate Patient Reported Outcomes After Lung Cancer Operations Into The Society of Thoracic Surgeons Database	2017	Case series	4	NA	2014–2016	United States	127 patients undergoing lung resection for lung cancer	PROMIS instruments to assess pain intensity, anxiety, depression, sleep related impairment, ability to participate in social roles, informational and emotional support, cancer-fatigue, cancer-pain interference, and cancer-physical function and mobility	lung resection for lung cancer	pain, anxiety, depression	13
Halle et al	Trajectory of sleep disturbances in patients undergoing lung cancer surgery: a prospective study	2017	Case series	4	NA	Not stated	Norway	307 patients undergoing surgery for lung cancer	General Sleep Disturbance Scale (GSDS)	surgery for lung cancer	sleep disturbance	65

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Banik et al	Enabling, Not Cultivating: Received Social Support and Self-Efficacy Explain Quality of Life After Lung Cancer Surgery	2017	Case series	4	NA	Not stated	Poland	102 patients undergoing lung resection for NSCLC	EORTC QLQ-C30, EORTC QLQ-LC13, self efficacy scale	surgery for lung cancer	self efficacy	59
Golden et al	"It wasn't as bad as I thought it would be": a qualitative study of early stage non-small cell lung cancer patients after treatment	2017	Case series	4	NA	Not stated	United States	11 patients who underwent surgery or stereotactic body radiation therapy for early stage lung cancer	Subjective data	lung resection or stereotactic body radiation therapy	anxiety	33
Shi et al	Patient-Reported Symptom Interference as a Measure of Post-surgery Functional Recovery in Lung Cancer	2016	Prospective Cohort study	2	Moderate	not stated	United States	72 treatment-naïve patients with stage I or II NSCLC who were scheduled for thoracic surgery	MD Anderson Symptom Inventory (MDSI) and SF-12	lung resection for cancer	pain, nausea, anxiety, sleep, appetite	69
Park et al	Risk factors for postoperative anxiety and depression after surgical treatment for lung cancer	2016	Case control	3	Moderate	2010–2014	South Korea	278 patients undergoing curative lung resection for cancer	Hospital Anxiety and Depression Scale	lung resection for cancer	anxiety, depression	54
Berman et al	Use of Survivorship Care Plans and Analysis of Patient-Reported Outcomes in Multinational Patients With Lung Cancer	2016	Case series	4	NA	2010–2014	Worldwide	689 lung cancer survivors who created a survivorship care plan by logging into a public website (50% had undergone surgical treatment for their lung cancer)	patient reported outcomes	lung cancer diagnosis	dyspnea, fatigue	61
Kim et al	Patient perceptions regarding the likelihood of cure after surgical resection of lung and colorectal cancer	2015	Case series	4	NA	2003–2005	United States	3954 patients identified in the Cancer Care Outcomes Research and Surveillance Consortium undergoing colon or lung resection for cancer	Patient reported data collected in the Cancer Care Outcomes Research and Surveillance Consortium	lung and colon resection for cancer	hope	75

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Fagundes et al	Symptom recovery after thoracic surgery: Measuring patient-reported outcomes with the MD Anderson Symptom Inventory	2015	Case series	4	NA	2004–2008	United States	60 patients undergoing lung resection for presumed lung cancer	MD Anderson Symptom Inventory	lung resection for lung cancer	pain, nausea, anxiety, sleep, appetite	62
Huang et al	Features of fatigue in patients with early-stage non-small cell lung cancer	2015	Case series	4	NA	2005–2010	China	254 patients with early stage lung cancer who underwent pulmonary resection	Brief Fatigue Inventory, Physical Activity Questionnaire, Baseline Dyspnea Index, Hospital Anxiety and Depression Scale	lung cancer surgery	fatigue, dyspnea, anxiety, depression	64
Jane-Vendroux et al	Which is the Role of Pneumonectomy in the Era of Parenchymal-Sparing Procedures? Early/Long-Term Survival and Functional Results of a Single-Center Experience	2015	Case series	4	NA	2005–2012	France	398 patients undergoing pneumonectomy for lung cancer	SF-12	pneumonectomy	dyspnea	39
Oksholm et al	Changes in Symptom Occurrence and Severity Before and After Lung Cancer Surgery	2015	Case series	4	NA	Not stated	Norway	228 patients undergoing surgery for lung cancer	Self-administered Comorbidity Questionnaire (SCQ-19); Memorial Symptom Assessment Scale	lung resection for cancer	dyspnea, fatigue, pain	68
Oksholm et al	Trajectories of Symptom Occurrence and Severity From Before Through Five Months After Lung Cancer Surgery	2015	Case series	4	NA	Not stated	Norway	285 patients scheduled to undergo surgery for lung cancer	Memorial Symptom Assessment Scale; Self-Administered Comorbidity Questionnaire-19; EORTC QLQ-LC13	lung resection for cancer	pain, nausea, anxiety, sleep, appetite	43
Antoniu and Mititic	Quality of life following lung cancer surgery: what about before?	2014	Prospective cohort study	2	Critical	1997–2000	Sweden	132 patients undergoing lung resection compared to coronary artery bypass graft patients	SF-36, hospital anxiety and depression questionnaire, breathlessness questionnaire	lung resection	dyspnea	56
Jeaniteu et al	Postoperative pain and subsequent	2014	Case series	4	NA	2011	France	47 patients undergoing lung	Hospital Anxiety and Depression	lung cancer surgery	anxiety, depression	37

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Lowery et al	PTSD-related symptoms in patients undergoing lung resection for suspected cancer	2014	Case series	4	NA	Not stated	United States	183 patients post lung surgery for lung cancer	Scale; Impact of Event Scale - Revised to assess post traumatic stress disorder symptoms	lung cancer resection	fatigue, dyspnea, anxiety, depression	70
Grosen et al	Impact of symptom burden in post-surgical non-small cell lung cancer survivors	2013	Case series	4	NA	2000–2009	Denmark	702 patients undergoing thoracotomy for lung cancer resection	SF-36; brief pain inventory; brief fatigue inventory; baseline dyspnea index; Hospital Anxiety and Depression Scale	thoracotomy for lung cancer	pain	28
Koczywas et al	Persistent post-surgical pain following anterior thoracotomy for lung cancer: a cross-sectional study of prevalence, characteristics and interference with functioning	2013	Case series	4	NA	Not stated	United States	103 patients with NSCLC (70% underwent lung resection)	Brief pain inventory	lung cancer treatment	pain, dyspnea	66
Lin et al	Longitudinal changes in function, symptom burden, and quality of life in patients with early-stage lung cancer	2013	Case series	4	NA	Not stated in abstract	China	145 patients after lung cancer surgery	Distress thermometer, FACT-L, Lung Cancer Syndrome Index; Functional Assessment of Chronic Illness Therapy-Spirituality Tool, The Medical Outcomes Study Social Activity Limitations Scale; The MOS Social Support Survey; Memorial Symptom Assessment Scale	Lung cancer surgery	pain, fatigue	58
Kinney et al	Pain, fatigue, disturbed sleep and distress comprised a symptom cluster that related to quality of life and functional status of lung cancer surgery patients	2012	Prospective Case Control	3	Low	Not stated	United States	110 patients undergoing elective	MD Anderson Symptom Inventory, Kamofsky Performance Scale and Quality of Life Instruments for Cancer Patients - Lung Cancer	elective thoracotomy	pain	27

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
	and Health-Related Quality of Life							thoracotomy (83% for suspected neoplasm)	Symptoms and Signs (L-AINSS)			
Yang et al	Quality of life and symptom burden among long-term lung cancer survivors	2012	Case series	4	NA	1997–2003	United States	447 lung cancer survivors who are alive at least five years after diagnosis (68% underwent surgical resection; 27% combined surgery/chemoradiation)	LCSS	long term survivor of lung cancer	fatigue, pain, dyspnea, cough	71
Rodríguez-Quintana et al.	Assessment of quality of life, emotional state, and coping skills in patients with neoplastic pulmonary disease	2012	Case series	4	NA	Not stated	Spain	121 preoperative patients	EORTC QLQ-C30, EORTC-LC13, HADS and Maental adjustment to cancer scale	lung resection for cancer	anxiety, depression, fatigue, pain	48
Pompili et al	Prospective external convergence evaluation of two different quality-of-life instruments in lung resection patients	2011	Prospective cohort study	2	Low	2009	Italy	33 post surgical patients	EORTC QLQ-C30 with lung module 13 and SF-36	lung resection for cancer	fatigue, nausea, pain, dyspnea, insomnia	40
Guaastella et al	A prospective study of neuropathic pain induced by thoracotomy: incidence, clinical description, and diagnosis	2011	Case series	4	NA	Not stated	France	54 patients undergoing thoracotomy for surgical treatment of lung cancer	visual analogue scale, douleur neuropathique (DN4) questionnaire	thoracotomy for lung cancer	pain	26
Rolke et al	HRQoL changes, mood disorders and satisfaction after treatment in an unselected population of patients with lung cancer	2010	Prospective cohort study	2	Low	2002–2005	Norway	492 patients receiving NSCLC treatment (surgery, chemo, radiation, supportive care)	EORTC QLQ-C30/QLQ-LC13, sense of coherence, hospital anxiety and depression scale	NSCLC post first modality treatment	anxiety, depression	51
Sarna et al	Women with lung cancer: quality of life after thoracotomy: a 6-month prospective study	2010	Prospective Cohort study	2	Low	Not stated	United States	119 NSCLC female survivors between 6 and 6 years post-diagnosis and who received curative	SF-36	lung resection for cancer	depression, dyspnea	49

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Wang et al	Post-discharge health care needs of patients after lung cancer resection	2010	Prospective case control	3	Moderate	2005	China	62 patients undergoing lung resection for cancer (all thoracotomies)	Symptom Distress Scale-Chinese Modified Form, Social Support Scale, Health Needs Scale, visual analogue scale	lung resection for cancer	pain	73
Feinstein et al	Current dyspnea among long-term survivors of early-stage non-small cell lung cancer	2010	Case series	4	NA	2005–2007	United States	342 patients undergoing lung resection for stage I NSCLC	Baseline Dyspnea Index, Godin Leisure Time Exercise Questionnaire, Hospital Anxiety and Depression Scale	lung resection for lung cancer	dyspnea, anxiety, depression	41
Balduyck et al	Quality of life after lung cancer surgery: a prospective pilot study comparing bronchial sleeve lobectomy with pneumonectomy	2008	Prospective cohort study	2	Moderate	2003–2005	Belgium	10 patients undergoing sleeve lobectomy and 20 patients undergoing pneumonectomy	EORTC QOLQ-LC13	sleeve lobectomy or pneumonectomy for lung cancer	dyspnea, pain	30
Oh et al	Prospective analysis of depression and psychological distress before and after surgical resection of lung cancer	2007	Case series	4	NA	1997–2003	Japan	165 patients with lung cancer scheduled for surgical treatment	Profile of Mood States questionnaire	lung resection for cancer	depression	55
Walker et al	Depressive symptoms after lung cancer surgery: Their relation to coping style and social support	2006	Prospective Cohort study	2	Moderate	2001–2004	US	132 postsurgical patients with early stage NSCLC that smoked 3 months prior to surgery	Coping Orientation to Problems Experienced (COPE) scale, Social Support Inventory (SSI), Beck Depression Inventory (BDI)	lung resection for non small cell lung cancer	depression	53
Sarma et al	Impact of respiratory symptoms and pulmonary function on quality of life of long-term survivors of non-small cell lung cancer	2004	Cross Sectional	2	Moderate	not stated	United States	142 disease-free NSCLC survivors (5 years minimum)	SF-36, Division of Lung Disease/American Thoracic Society (ATS) questionnaire (respiratory symptoms)	NA	dyspnea	38

Author string	Title	Year	Study Type	Study grade	Bias	Year	Country	Patient population	QOL metric	Intervention	Symptom	Ref
Myrdal et al	Quality of life following lung cancer surgery	2002	Prospective Cohort study	2	Moderate	1997–2004	Sweden	194 patients undergoing open surgery for lung cancer compared to matched patients who underwent coronary artery bypass grafting for coronary artery disease	SF-36, Hospital Anxiety and Depression Scale	lung resection for cancer and coronary bypass	anxiety, depression	52
Wildgaard et al	Consequences of persistent pain after lung cancer surgery: a nationwide questionnaire study	2001	Retrospective Cohort study	3	Moderate	2005–2007	Denmark	546 patients undergoing lung resection for cancer divided into those who developed post thoracotomy pain syndrome and those who had not	subjective assessment of impact of pain on ADLs, sleep	lung resection for lung cancer (VATS and thoracotomy)	pain	24
Goodman	Meeting patients' post-discharge needs after lung cancer surgery	2000	Case series	4	NA	Not stated	United Kingdom	6 patients who held diaries perioperatively while undergoing surgery for lung cancer	Subjective data	surgery for lung cancer	pain	46

Table 2
Quality of Life Outcome Measures and Frequency Used in the 54 Included Articles

SF-36 or SF-12	12
EORTC QLQ-C30 or LC-13	11
Hospital Anxiety and Depression Score	11
Subjective data	6
Acceptance of Illness Scale; American Thoracic Society Questionnaire; Athens Insomnia Scale; Baseline Dyspnea Index; Breathlessness Questionnaire; Brief Fatigue Inventory; Brief Pain Inventory; Center for Epidemiologic Studies – Depression Scale; Control Preferences Scale; Coping Inventory; Decisional Conflict Scale; Douleur Neuropathique 2 or 4; Experiences in Close Relationships Scale II; Functional Assessment of Cancer Therapy – Lung; General Sleep Disturbance Scale; Godin Leisure Time Exercise Questionnaire; Herth Hope Questionnaire; Impact of Event Scale; Karnofsky Performance Scale; Lee Fatigue Scale; Leeds Assessment of Neuropathic Symptoms and Signs; Leicester Cough Questionnaire; Lung Cancer Symptom Questionnaire; MD Anderson Symptom Inventory; Medical Coping Modes Questionnaire; Medical Outcomes Study Social Activity Limitations Scale and Symptom Assessment Scale; Mental Adjustment to Care Scale; Mini-Mental State Examination; Multidimensional Scale of Perceived Social Support; Multidimensional Fatigue Symptom Inventory–Short Form; Numeric Rating Scale; Patient-Reported Outcomes Measurement Information System Tools; Perceived Family Support Scale; Physical Activity Questionnaire; Picker Patient Experience; Pittsburg Sleep Quality Index; Posttraumatic Growth Inventory; Post Traumatic Stress Disorder Checklist Civilian Version; Profile of Moods Questionnaire; Picker Patient Experience; Pittsburg Sleep Quality Index; Posttraumatic Thermometer; Social Support Scale; State-Trait Anxiety Inventory; Symptom Distress Scale; Toronto Mindfulness Scale; Veterans RAND 12-Item Health Survey; Visual Analogue Scale; 12-item World Health Organization Disability Assessment Schedule 2.0	<5