



Physiotherapy Theory and Practice

An International Journal of Physical Therapy

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/iptp20

Physiotherapy provided for patients undergoing thoracic surgery in Sweden – a national survey of practice

Marcus Jonsson, Elisabeth Westerdahl & Julie Reeve

To cite this article: Marcus Jonsson, Elisabeth Westerdahl & Julie Reeve (2024) Physiotherapy provided for patients undergoing thoracic surgery in Sweden – a national survey of practice, Physiotherapy Theory and Practice, 40:10, 2179-2185, DOI: [10.1080/09593985.2023.2233596](https://doi.org/10.1080/09593985.2023.2233596)

To link to this article: <https://doi.org/10.1080/09593985.2023.2233596>



© 2023 The Author(s). Published with license by Taylor & Francis Group, LLC.



[View supplementary material](#)



Published online: 14 Jul 2023.



[Submit your article to this journal](#)



Article views: 1898



[View related articles](#)



[View Crossmark data](#)

RESEARCH REPORT



Physiotherapy provided for patients undergoing thoracic surgery in Sweden – a national survey of practice

Marcus Jonsson PT, PhD^a, Elisabeth Westerdahl PT, PhD^{a,b}, and Julie Reeve PT, PhD^c

^aDepartment of Physiotherapy, Faculty of Medicine and Health, Örebro University, Örebro, Sweden; ^bFaculty of Medicine and Health, University Health Care Research Center, Örebro, Sweden; ^cSchool of Clinical Sciences, Faculty of Health and Environmental Sciences, AUT University, Northcote, Auckland, New Zealand

ABSTRACT

Introduction: Patients undergoing thoracic surgery commonly receive perioperative physiotherapy, typically consisting of education, mobilization, breathing exercises, and mobility exercises. To date, no study has described physiotherapy practice for patients undergoing thoracic surgery in Sweden.

Purpose: To investigate physiotherapy interventions for patients undergoing thoracic surgery in Sweden.

Methods: All physiotherapists currently working in thoracic surgery units in Sweden ($n = 8$) were eligible to participate. A survey was e-mailed to the physiotherapists, to determine physiotherapy interventions offered to patients undergoing thoracoscopy or open thoracic surgery. Of 21 physiotherapists, 13 (62%) responded, representing seven hospitals.

Results: Physiotherapists reported routinely providing preoperative education and postoperative treatment for all patients undergoing thoracic surgery. Breathing exercises and mobilization were usually initiated on the day of surgery or the first postoperative day. Common treatments were deep breathing exercises, with or without positive expiratory pressure, and airway clearance techniques. Upper limb and shoulder exercises were typically initiated on the first or second day after surgery. The most important factor reported to influence treatment choice was personal experience of the attending physiotherapist. No routine post-discharge rehabilitation was provided.

Conclusion: Physiotherapists in Sweden reported routinely treating patients scheduled for thoracic surgery, both pre and postoperatively. Prehabilitation or post-discharge rehabilitation was not routinely provided.

ARTICLE HISTORY

Received 22 March 2023

Revised 30 June 2023

Accepted 30 June 2023

KEYWORDS

physiotherapy; lung cancer; surgery



Introduction


Thoracic surgery is performed for a wide variety of conditions, but primarily in those with suspected or confirmed lung cancer, where surgical resection is the primary approach for curative treatment of non-small-cell lung cancer (Howington et al., 2013). Surgery can be performed through an open thoracotomy or via minimally invasive techniques, commonly video-assisted thoracoscopy (VATS).

Pre- and postoperative physiotherapy may be provided to patients undergoing thoracic surgery. Previous surveys have established that it is common for patients undergoing thoracic surgery to be offered some form of physiotherapy during their in-hospital stay (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve,

Denehy, and Stiller, 2007). Cavalheri, Jenkins, and Hill (2013) reported that preoperative education before lung cancer surgery was provided by physiotherapists in 44% of the hospitals in Australia and New Zealand. Postoperative physiotherapy treatment is more widely provided and typically consists of early mobilization, breathing exercises, and upper limb and shoulder exercises, with treatment techniques varying between hospitals and across countries (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve, Denehy, and Stiller, 2007; Schweltnus, Roos, and Naidoo, 2017).

The evidence in regard to thoracic surgery and physiotherapy provision in this patient group is continuously evolving (Granger and Cavalheri, 2022; Himbert et al., 2020; Whish-Wilson et al., 2023) and therefore it is important to constantly update knowledge of current

CONTACT Marcus Jonsson PT, PhD  marcus.jonsson@oru.se  Department of Physiotherapy, Faculty of Medicine and Health, Örebro University, L2, Örebro University Hospital, Örebro SE-70185, Sweden

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/09593985.2023.2233596>

© 2023 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

physiotherapy practice. The physiotherapy service provided for patients undergoing lung cancer surgery, or other thoracic surgery procedures, has not been previously described in Sweden. Therefore, the aim of the present study is to investigate physiotherapy treatment provided for patients undergoing thoracic surgery in Sweden, and to describe differences in physiotherapy regimens for open surgery versus thoracoscopic procedures.

Methods

All hospitals performing thoracic surgery in Sweden ($n = 8$) were eligible for this cross-sectional survey of clinical practice. Physiotherapists working with patients undergoing thoracic surgery at these hospitals were identified through the Swedish Thoracic Surgery Physiotherapy Network or through direct contact with the Department of Cardiothoracic Surgery at each hospital. This ensured that all physiotherapists working with patients undergoing thoracic surgery were invited to participate. The rationale for identifying and including all physiotherapists in the field was to check for practice differences within and between centers. The Swedish Ethical Review Authority approved the study (Dnr 2019-05080). The reporting of this survey follows the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) (Sharma et al., 2021).

The survey was a translated and culturally adapted version, based on a previous survey performed in Australia and New Zealand (Reeve, Denehy, and Stiller, 2007). Permission to translate and use the survey was provided by the original author. The adaptations included removal of questions that were not applicable to Swedish practice, such as privately financed health care. No additions were made. The translation was performed by a professional translator service, specializing in editing and translation for academics and researchers. The survey consisted of six sections with a total of 28 items. The questions referred to the physiotherapy treatment of patients undergoing thoracic surgery, with questions for open thoracotomy and VATS separated for clarity. All questions were closed, but the respondents had the opportunity to leave open comments.

The survey was sent to the potential participants by e-mail, as an attached Word format survey, in February 2020 (Supplemental Information). A cover letter was also attached, with information about the study and an invitation to participate. Two reminders were sent, the first in March 2020 and the second after another 4 weeks. Respondents completed the survey electronically and returned it, as an attached Word file, via e-mail to the research responsible physiotherapist (MJ). The Word-format was deemed the most

feasible way of administering the survey, considering the sample size. Potential participants were informed in the cover letter that their response was deemed as their informed consent. Absolute anonymity was not possible due to the nature of e-mail administration. All surveys were individually coded, with the codes kept locked-up separately and accessible only to the primary researcher, and confidentiality was assured by omitting identification of the physiotherapist and name of hospital during data analysis and presentation. Data are presented on a population level ensuring that the results of individual respondents are not identifiable. Statistical analysis was performed with SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Data were analyzed via descriptive statistics, with frequencies and percentages, or medians with ranges. Open comments were noted and cited where applicable. Testing for differences within centers was performed with the Wilcoxon signed-rank test.

Results

Eight hospitals performing thoracic surgery, and a total of 21 physiotherapists, working in these centers, were identified and individually sent the survey. Of these, 13 (62%) responded, with seven of the eight (88%) hospitals in Sweden represented in the final analysis. Of the non-responders ($n = 8$, 38%), two (10%) replied with the explanation of being unable to respond due to time pressure with the ongoing COVID-19 pandemic. Testing all questions with the Wilcoxon test revealed no statistically significant differences regarding answers within centers. All the results presented here are as a percentage of the total number of respondents ($n = 13$).

Preoperative physiotherapy

The majority of respondents ($n = 12$, 92%) reported that the patients routinely had an in-hospital physiotherapy session preoperatively, including both patients undergoing open thoracotomy surgery and VATS. The preoperative physiotherapy session was performed either individually ($n = 11$, 85%) or as a group session ($n = 8$, 62%) and included education on breathing exercises with positive expiratory pressure (PEP) ($n = 12$, 92%); coughing/huffing technique ($n = 11$, 85%); and deep breathing exercises without PEP ($n = 9$, 69%). No respondents reported instructing active cycle of breathing technique (ACBT) or incentive spirometry (IS) preoperatively. Six (46%) of the respondents explicitly reported that their preoperative education included information about the importance of early mobilization. The most important factors influencing

Table 1. Factors influencing physiotherapists ($n = 13$) choice of preoperative treatment for patients undergoing thoracic surgery.

	Influence rated on a 1–5 likert scale
Personal experience	4 (1–5)
Scientific literature	4 (1–5)
Colleagues preferences	4 (1–4)
Resource/financial considerations	3 (1–5)
Established practice	4 (1–5)
Staffing numbers	3 (2–5)
Number of patients	1 (1–5)

Data presented as median (range). 1 = no influence, 5 = large influence.

the choice of preoperative physiotherapy were reported to be personal experience, scientific literature, colleagues' preferences, and established clinical practice (Table 1). All respondents reported that no form of organized prehabilitation in the form of exercise training was routinely provided.

Postoperative physiotherapy

All respondents ($n = 13$, 100%) reported treating all patients undergoing thoracotomy postoperatively and the majority ($n = 12$, 92%) also reported routinely treating all patients undergoing VATS postoperatively. There were differences in the timing of commencement of postoperative treatment, with eight (62%) respondents reporting usually initiating treatment on the day of surgery for patients undergoing open thoracotomy, and four (31%) of the respondents reported initiating treatment on the first day after surgery. Following VATS, fewer respondents ($n = 4$, 31%) reported initializing treatment on the day of surgery.

The most prevalent postoperative physiotherapy intervention reportedly utilized during treatment sessions was deep breathing exercises with PEP ($n = 12$, 92%). Airway clearance techniques were utilized by all respondents ($n = 13$, 100%) (Table 2). Information on when different types of postoperative mobilization were initialized is presented in Table 3. Factors influencing the choice of postoperative physiotherapy are presented

in Table 4. The most important factor influencing choice of treatment was personal experience.

For patients with excessive air leaks in the pleural drainage, all 13 (100%) respondents reported adapting their treatment, primarily by not utilizing PEP ($n = 8$, 62%). Three (23%) respondents consulted the responsible surgeon for management guidance in the case of excessive air leaks, and the remaining two (15%) respondents did not state in what way the treatment was altered.

All respondents reported that postoperative rehabilitation was not routinely offered to all patients after hospital discharge. Four respondents (31%), all from the same center, reported that occasionally some patients were referred to postoperative rehabilitation. None of the respondents reported participating in any postoperative follow-up or pain management after discharge.

Discussion

This national survey is the first to describe in-hospital physiotherapy treatment for patients undergoing thoracic surgery in Sweden. The sample size is small, due to the fact that there are only eight centers performing thoracic surgery in Sweden and a limited number of physiotherapists working with such patients. The response rate was 62%, which is somewhat lower than

Table 2. Postoperative respiratory treatments reported by physiotherapists ($n = 13$) to be provided for patients undergoing thoracic surgery.

	Thoracotomy	VATS
Deep breathing exercises	77%	77%
PEP	92%	92%
Sustained Maximal Inspiration	0%	0%
Sniffing	0%	0%
Incentive spirometry	0%	0%
Bi-level CPAP	0%	0%
CPAP	15%	8%
Coughing/huffing	100%	92%
Forced expiratory technique	8%	8%
Endotracheal suction	0%	0%

PEP: positive expiratory pressure, CPAP: continuous positive airway pressure, VATS: video-assisted thoracoscopic surgery.

Table 3. Type of first mobilization reported by physiotherapists ($n = 13$) to be performed during the first postoperative days after thoracic surgery.

	Day 0	Day 0–1	Day 1	Day 1–2	Day 2
Thoracotomy					
Sitting on the side of the bed	7	2	3		
Sitting in a chair	3	3	5	1	
Walking	1	1	8	1	1
VATS					
Sitting on the side of the bed	4	4	2		
Sitting in a chair	2	3	4	1	
Walking	1	3	3		1

Day 0 = the day of surgery. VATS: video-assisted thoracoscopic surgery.

Table 4. Factors influencing physiotherapists ($n = 13$) choice of treatment after thoracic surgery.

Factor	Influence rated on a 1–5 likert scale
Personal experience	5 (1–5)
Scientific literature	4 (2–5)
Colleagues preferences	3 (1–5)
Resource/financial considerations	3 (1–4)
Established practice	4 (1–5)
Staffing numbers	4 (2–5)
Number of patients	3 (1–5)

similar studies previously published (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve, Denehy, and Stiller, 2007; Whish-Wilson et al., 2023) but higher than studies surveying physiotherapy practice in India (Sultanpuram, Alaparathi, Krishnakumar, and Ottayil, 2016) and South Africa (Schwellnus, Roos, and Naidoo, 2017). The response rate in the present study may to some extent be explained by the unfortunate timing, with the survey coinciding with the coronavirus pandemic. The previous surveys in the field were sent to one physiotherapist per surgical unit (often the senior), which could lead to the responses reflecting the institutional preference, and not individual physiotherapist preferences; the possibility of these preferences differing directed the targeting in the present study to all physiotherapists working in these units. Despite the lower response rate in the present study, seven of the eight centers were represented, likely making the results representative for in-hospital physiotherapy in the thoracic surgery setting in Sweden. The results could therefore be interpreted as reflecting clinical practice in Sweden. A direct observation study design, where each physiotherapist is observed during practice, would likely better reflect the actual physiotherapy practice provided for the patients, but this type of study design requires significant resources and lack of funding prevented this across a multicenter setting. The strength of the present survey is that it is an adapted and professionally translated version of a previous survey (Reeve, Denehy, and Stiller, 2007) making the results possible to compare between countries. Such a comparison would be useful in ensuring that physiotherapy interventions utilized in future clinical trials reflect practice across different countries.

The respondents in this study reported that the most important factor influencing choice of physiotherapy treatment was personal experience. The influence of personal experience and established practice has been consistently reported to rank highly as the factors most influencing physiotherapy practice in patients undergoing thoracic surgery (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve, Denehy, and Stiller, 2007; Whish-Wilson et al., 2023). It is possible that the reason for this is that the evidence supporting the postoperative

physiotherapy management in this patient group remains limited, suggesting further studies of high quality investigating physiotherapy management for patients undergoing thoracic surgery are necessary before physiotherapists change established practice for those not currently clearly substantiated by the scientific literature. It is of interest that in the present study, respondents reported the scientific evidence for patients receiving preoperative physiotherapy interventions to be as influential as personal experience. While there is considerable emerging evidence regarding the benefits of preoperative exercise or prehabilitation for patients scheduled for lung cancer surgery (Granger and Cavalheri, 2022; Lai et al., 2019; Laurent et al., 2020; Sebio García et al., 2017; Voorn et al., 2023; Zhou et al., 2020) and preoperative exercise training has been shown to result in a large reduction in the risk of developing postoperative pulmonary complications compared to no preoperative exercise training in this population (Granger and Cavalheri, 2022) currently no service offers prehabilitation programs for patients undergoing thoracic surgery. It is interesting that personal experience remains highly ranked and superseding scientific evidence as an influencing factor over time and across countries. The barriers to incorporating science into clinical practice need further evaluation.

Preoperative physiotherapy education has been shown to reduce the incidence of postoperative pulmonary complications in patients undergoing upper abdominal surgery (Boden et al., 2018; Fagevik Olsén et al., 1997); however, the impact of these interventions in patients undergoing lung cancer surgery is less clear. All of the physiotherapists in the present study reported meeting all patients preoperatively, individually or in a group session, including both those scheduled for thoracotomy or VATS. This differs from the results reported previously (Reeve, Denehy, and Stiller, 2007), where only 35% of the respondents reported that all patients were seen on a face-to-face basis preoperatively. Further, both Agostini et al. (2013) and Cavalheri, Jenkins, and Hill (2013) reported that not all patients received preoperative physiotherapy (10% and 60% receiving physiotherapy, respectively). The reason for these differences remains unclear, but part of it could be due to the fact that thoracic surgery in Sweden is often performed in the same setting as cardiac surgery, and the clinical pathway seems to follow that of cardiac surgery patients which involves 90% of all patients receiving preoperative physiotherapy education (Westerdahl and Moller, 2010; Westerdahl and Olsen, 2011). Physiotherapy interventions preoperatively were reported to be primarily focused on education to prevent postoperative pulmonary complications, teaching

deep breathing exercises, most commonly with PEP, and airway clearance techniques. It was also reported that information about the importance of postoperative mobilization was part of the preoperative session. This result is similar to previous surveys (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve, Denehy, and Stiller, 2007). Interestingly, deep breathing exercises with PEP were the most reported type of breathing exercise utilized in Sweden and this differs from the previously published surveys. There are only a few studies, all performed in Sweden or Finland, investigating the effect of PEP to other types of deep breathing exercises (Lähtenmäki et al., 2020, 2021; Orman and Westerdahl, 2010) none of them showing superior effect of PEP. Future studies should focus on determining which types of breathing exercises, if any, are the most effective in improving postoperative outcomes, and this should help guide clinicians when choosing interventions for patients after lung cancer surgery.

The majority of the respondents in the present study reported that routine physiotherapy was provided for all patients postoperatively following thoracic surgery, both after open thoracotomy and VATS. This is similar to previous surveys (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Reeve, Denehy, and Stiller, 2007), and routine physiotherapy assessment for patients, including for those undergoing VATS, has been recommended (Agostini et al., 2020; Granell-Gil et al., 2022). In-hospital physiotherapy has been shown to increase physical activity during the first postoperative days after lung cancer surgery (Jonsson et al., 2018). Furthermore, a postoperative shoulder exercise program improves function and decreases pain after open thoracotomy (Reeve et al., 2010) and exercise during the first five postoperative days improves quadriceps strength (Arbane, Tropman, Jackson, and Garrod, 2011). The present survey found that the evidence regarding postoperative physiotherapy during the early postoperative period seems to be being followed in clinical practice.

While Enhanced Recovery After Surgery (ERAS) practices were not specifically covered within the scope of the present survey, the role of the physiotherapist within ERAS regimen is one of enhancing early mobilization/ambulation. ERAS protocols have been evaluated in patients undergoing lung cancer surgery and shown to improve outcomes, such as length of stay, postoperative pulmonary complications and costs (Tiberi et al., 2022; Wang et al., 2021). Guidelines recommend the use of ERAS protocols for patients undergoing thoracic surgery (Batchelor et al., 2019) but according to the authors' knowledge, the ERAS concept has not been

widely implemented for patients undergoing lung cancer surgery in Sweden. The findings from the present survey highlighted that all physiotherapists aimed for patients to be ambulated within 2 days of surgery, most frequently on the first postoperative day. The frequency, intensity, and duration of ambulation protocols were not, however, established, and this limits the ability to determine to what extent Swedish physiotherapist are implementing ERAS-style ambulation protocols in their units. Establishing which thoracic surgical units utilize ERAS protocols, and the physiotherapy input into such protocols, would be useful to ascertain.

Post discharge physical exercise after lung cancer surgery can improve: distance covered during a six-minute walk test (Klimczak et al., 2021; Liu et al., 2021); respiratory muscle strength (Liu et al., 2021); and health-related quality of life (Cavalheri et al., 2019; Klimczak et al., 2021; Sommer et al., 2020). Both inpatient (Klimczak et al., 2021) and outpatient (Liu et al., 2021; Sommer et al., 2020) rehabilitation after discharge has shown benefits, and it is recommended that the rehabilitation start early after discharge (Sommer et al., 2020). Despite the evidence for positive outcomes from post-discharge physical exercise following lung resection (Cavalheri et al., 2019; Klimczak et al., 2021; Liu et al., 2021; Sommer et al., 2020), few patients are offered rehabilitation following discharge from hospital after lung cancer surgery (Agostini et al., 2013; Cavalheri, Jenkins, and Hill, 2013; Whish-Wilson et al., 2023). Similar to previously published surveys, the physiotherapists in the present study reported that referral to post discharge rehabilitation was not routinely offered. This is concerning and raises questions regarding why the increasing amount of evidence for post-discharge rehabilitation does not carry over to the clinical setting. Reasons for this lack of translation of evidence into practice need to be further investigated. As discussed above, the strengths of the present study include the use of a previous survey and the invitation of all physiotherapists working with patients undergoing lung surgery. Limitations of the study include a low response rate and a small sample size.

Conclusion

In this small cross-sectional survey of national practice, it was reported that physiotherapists in Sweden routinely treat patients scheduled for thoracic surgery during the inpatient period, both pre- and post-operatively. The first postoperative physiotherapeutic interventions were reported to be initiated on the day of surgery or the first postoperative day. The most commonly utilized postoperative respiratory

physiotherapy intervention was reported to be deep breathing with PEP. Neither preoperative exercise interventions/prehabilitation nor post-discharge rehabilitation are currently reported to be implemented in the care of patients undergoing thoracic surgery in Sweden.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The work was supported by the Nyckelfonden [OLL-973688]; Region Örebro län [OLL-885191].

References

- Agostini P, Lugg ST, Adams K, Smith T, Kalkat M, Rajesh PB, Bishay E, Naidu B, Rushton A, Bishay E 2020 Video-assisted thoracoscopic lobectomy: Which patients require postoperative physiotherapy? *Physiotherapy*. 106: 87–93. doi:10.1016/j.physio.2019.01.001.
- Agostini P, Reeve J, Dromard S, Singh S, Steyn R, Naidu B 2013 A survey of physiotherapeutic provision for patients undergoing thoracic surgery in the U.K. *Physiotherapy*. 99: 56–62. doi:10.1016/j.physio.2011.11.001.
- Arbane G, Tropman D, Jackson D, Garrod R 2011 Evaluation of an early exercise intervention after thoracotomy for non-small cell lung cancer (NSCLC), effects on quality of life, muscle strength and exercise tolerance: Randomised controlled trial *Lung Cancer*. 71: 229–234. doi:10.1016/j.lungcan.2010.04.025.
- Batchelor TJ, Rasburn NJ, Abdelnour-Berchtold E, Brunelli A, Cerfolio RJ, Gonzalez M, Naidu B, Petersen RH, Popescu WM, Slinger PD et al. 2019 Guidelines for enhanced recovery after lung surgery: Recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS) *European Journal of Cardiothoracic Surgery*. 55: 91–115. doi:10.1093/ejcts/ezy301.
- Boden I, Skinner EH, Browning L, Reeve J, Anderson L, Hill C, Denehy L, Story D, Denehy L 2018 Preoperative physiotherapy for the prevention of respiratory complications after upper abdominal surgery: Pragmatic, double blinded, multicentre randomised controlled trial *BMJ*. 360: j5916. doi:10.1136/bmj.j5916.
- Cavalheri V, Burtin C, Formico VR, Nonoyama ML, Jenkins S, Spruit MA, Hill K 2019 Exercise training undertaken by people within 12 months of lung resection for non-small cell lung cancer. *Cochrane Database of Systematic Reviews* 6: CD009955.
- Cavalheri V, Jenkins S, Hill K 2013 Physiotherapy practice patterns for patients undergoing surgery for lung cancer: A survey of hospitals in Australia and New Zealand *Internal Medicine Journal*. 43: 394–401. doi:10.1111/j.1445-5994.2012.02928.x.
- Fagevik Olsén M, Hahn I, Nordgren S, Lönroth H, Lundholm K 1997 Randomized controlled trial of prophylactic chest physiotherapy in major abdominal surgery *British Journal of Surgery*. 84: 1535–1538. doi:10.1111/j.1365-2168.1997.02828.x.
- Granell-Gil M, Murcia-Anaya M, Sevilla S, Martínez-Plumed R, Biosca-Pérez E, Cózar-Bernal F, Vicente R, Gallart L, Ubierna-Ferreras B, Sukia-Zilbeti I et al. 2022 Clinical guide to perioperative management for videothoracoscopy lung resection (Section of Cardiac, Vascular and Thoracic Anesthesia, SEDAR; Spanish Society of Thoracic Surgery, SECT *Revista Española de Anestesiología y Reanimación (English Edition)*. 69: 266–301. doi:10.1016/j.redare.2021.03.015.
- Granger C, Cavalheri V 2022 Preoperative exercise training for people with non-small cell lung cancer. *Cochrane Database of Systematic Reviews* 9: CD012020.
- Himbert C, Klossner N, Coletta AM, Barnes CA, Wiskemann J, LaStayo PC, Ulrich CM, Ulrich CM 2020 Exercise and lung cancer surgery: A systematic review of randomized-controlled trials *Critical Reviews in Oncology/Hematology*. 156: 103086. doi:10.1016/j.critrevonc.2020.103086.
- Howington JA, Blum MG, Chang AC, Balekian AA, Murthy SC 2013 Treatment of stage I and II non-small cell lung cancer: Diagnosis and management of lung cancer (3rd ed): American College of Chest Physicians evidence-based clinical practice guidelines *Chest*. 143: e278S–313S. doi:10.1378/chest.12-2359.
- Jonsson M, Hurtig-Wennlof A, Ahlsson A, Vidlund M, Cao Y, Westerdahl E 2018 In-hospital physiotherapy improves physical activity level after lung cancer surgery: A randomized controlled trial *Physiotherapy*. 105: 434–441. doi:10.1016/j.physio.2018.11.001.
- Klimczak M, Piekieny D, Antczak A, Śmigielski J, Tworek D 2021 Effectiveness of pulmonary rehabilitation in patients with chronic obstructive pulmonary disease after lobectomy due to non-small cell lung cancer - a single-center retrospective study *Advances in Respiratory Medicine*. 89: 247–253. doi:10.5603/ARM.a2021.0060.
- Lähteenmäki SI, Sioris T, Mahrberg H, Rinta-Kiikka I, Laurikka J 2020 Inspiratory training and immediate lung recovery after resective pulmonary surgery: A randomized clinical trial *Journal of Thoracic Disease*. 12: 6701–6711. doi:10.21037/jtd-20-1668.
- Lähteenmäki SI, Sioris T, Mahrberg H, Rinta-Kiikka I, Laurikka J 2021 A randomized trial comparing inspiratory training and positive pressure training in immediate lung recovery after minor pleuro-pulmonary surgery *Journal of Thoracic Disease*. 13: 4690–4702. doi:10.21037/jtd-21-473.
- Lai Y, Wang X, Zhou K, Su J, Che G 2019 Impact of one-week preoperative physical training on clinical outcomes of surgical lung cancer patients with limited lung function: A randomized trial *Annals of Translational Medicine*. 7: 544. doi:10.21037/atm.2019.09.151.
- Laurent H, Aubreton S, Galvaing G, Pereira B, Merle P, Richard R, Filaire M, Filaire M 2020 Preoperative respiratory muscle endurance training improves ventilatory capacity and prevents pulmonary postoperative complications after lung surgery *European Journal of Physical and Rehabilitation Medicine*. 56: 73–81. doi:10.23736/S1973-9087.19.05781-2.
- Liu JF, Kuo NY, Fang TP, Chen JO, Lu HI, Lin H-L, Lin HL 2021 A six-week inspiratory muscle training and aerobic

- exercise improves respiratory muscle strength and exercise capacity in lung cancer patients after video-assisted thoracoscopic surgery: A randomized controlled trial *2021 Clinical Rehabilitation*. 35: 840–850. doi:10.1177/0269215520980138.
- Orman J, Westerdahl E *2010* Chest physiotherapy with positive expiratory pressure breathing after abdominal and thoracic surgery: A systematic review *Acta Anaesthesiologica Scandinavica*. 54: 261–267. doi:10.1111/j.1399-6576.2009.02143.x.
- Reeve J, Denehy L, Stiller K *2007* The physiotherapy management of patients undergoing thoracic surgery: A survey of current practice in Australia and New Zealand *Physiotherapy Research International*. 12: 59–71. doi:10.1002/pri.354.
- Reeve J, Stiller K, Nicol K, McPherson KM, Birch P, Gordon IR, Denehy L *2010* A postoperative shoulder exercise program improves function and decreases pain following open thoracotomy: A randomised trial *Journal of Physiotherapy*. 56: 245–252. doi:10.1016/S1836-9553(10)70007-2.
- Schweltnus L, Roos R, Naidoo V *2017* Physiotherapy management of patients undergoing thoracotomy procedure: A survey of current practice in Gauteng South African *Journal of Physiotherapy*. 73: 344. doi:10.4102/sajp.v73i1.344.
- Sebio García R, Yáñez-Brage MI, Giménez Moolhuyzen E, Salorio Riobo M, Lista Paz A, Borro Mate JM *2017* Preoperative exercise training prevents functional decline after lung resection surgery: A randomized, single-blind controlled trial *Clinical Rehabilitation*. 31: 1057–1067. doi:10.1177/0269215516684179.
- Sharma A, Duc NT, Thang TL, Nam NH, Ng SJ, Abbas KS, Huy NT, Marušić A, Paul CL, Kwok J et al. *2021* A Consensus-Based Checklist for Reporting of Survey Studies (CROSS) *Journal of General Internal Medicine*. 36: 3179–3187. doi:10.1007/s11606-021-06737-1.
- Sommer MS, Vibe-Petersen J, Stærkind MB, Langer SW, Larsen KR, Trier K, Quist M, Clementsen PF, Missel M, Christensen KB et al. *2020* Early initiated postoperative rehabilitation enhances quality of life in patients with operable lung cancer: Secondary outcomes from a randomized trial *Lung Cancer*. 146: 285–289. doi:10.1016/j.lungcan.2020.06.023.
- Sultanpuram S, Alaparathi GK, Krishnakumar SK, Ottayil ZCP, Ottayil ZC *2016* Physiotherapy practice patterns for management of patients undergoing thoracic surgeries in India: A survey *2016 Surgery Research and Practice*. 1–11. doi:10.1155/2016/9717489.
- Tiberi M, Andolfi M, Salati M, Roncon A, Guiducci GM, Falcetta S, Refai M, Refai M *2022* Impact of enhanced pathway of care in uniportal video-assisted thoracoscopic surgery *Updates in Surgery*. 74: 1097–1103. doi:10.1007/s13304-021-01217-x.
- Voorn MJ, Franssen RF, Hoogeboom TJ, van Kampen-van den Boogaart VE, Bootsma GP, Bongers BC, Janssen-Heijnen ML *2023* Evidence base for exercise prehabilitation suggests favourable outcomes for patients undergoing surgery for non-small cell lung cancer despite being of low therapeutic quality: A systematic review and meta-analysis *European Journal of Surgical Oncology*. 49: 879–894. doi:10.1016/j.ejso.2023.01.024.
- Wang C, Lai Y, Li P, Su J, Che G *2021* Influence of enhanced recovery after surgery (ERAS) on patients receiving lung resection: A retrospective study of 1749 cases *BioMed Central Surgery*. 21: 115. doi:10.1186/s12893-020-00960-z.
- Westerdahl E, Moller M *2010* Physiotherapy-supervised mobilization and exercise following cardiac surgery: A national questionnaire survey in Sweden *Journal of Cardiothoracic Surgery*. 5: 67. doi:10.1186/1749-8090-5-67.
- Westerdahl E, Olsen MF *2011* Chest physiotherapy and breathing exercises for cardiac surgery patients in Sweden - a national survey of practice *Monaldi Archives for Chest Disease*. 75: 112–119. doi:10.4081/monaldi.2011.223.
- Whish-Wilson GA, Edbrooke L, Cavalheri V, Denehy L, Sellar D, Granger CL, Parry SM *2023* Physiotherapy and exercise management of people undergoing surgery for lung cancer: A survey of current practice across Australia and New Zealand *Journal of Clinical Medicine*. 12: 2146. doi:10.3390/jcm12062146.
- Zhou K, Lai Y, Wang Y, Sun X, Mo C, Wang J, Che G, Li J, Chang S, Che G *2020* Comprehensive pulmonary rehabilitation is an effective way for better postoperative outcomes in surgical lung cancer patients with risk factors: A propensity score-matched retrospective cohort study. *Cancer Management and Research* 12: 8903–8912. doi:10.2147/CMAR.S267322.