Prehabilitation: Prevention is better than cure

Karen J. Dickinson, MBBS, and Shanda H. Blackmon, MD, MPH

See related article on pages 569-73.

The benefit of pulmonary rehabilitation for patients undergoing lung resections for non-small cell lung cancer (NSCLC) or, indeed, any thoracic surgery is well established.¹ Gaining momentum in many surgical specialties, often as part of enhanced recovery pathways, is the concept of prehabilitation.²⁻⁶ This describes presurgical exercise interventions used in an attempt to reduce morbidity and mortality. With so much emphasis being placed on smoking cessation to prevent lung cancer, one may wonder why prehabilitation before thoracic surgery is not routine practice.

Patients with surgically resectable lung cancer often smoke and may have an abnormal forced expiratory volume in 1 second and diffusing capacity for carbon monoxide due to background parenchymal disease. Diffusing capacity for carbon monoxide may be further reduced by alveolar damage during administration of preoperative induction chemoradiotherapy.⁷ Chemoradiotherapy regimens also may have a global negative impact on a patient's mobility and impede surgical recovery. In patients undergoing neoadjuvant chemotherapy for rectal cancer, fitness levels were restored to baseline with the institution of a prehabilitation regimen.⁸ In this issue of the *Journal*, the effects of pulmonary prehabilitation during induction chemotherapy⁹ for stage IIb-IV lung cancer before surgical resection are reported by Tarumi and colleagues.¹⁰ Their prehabilitation regimen included smoking cessation, relaxation, respiratory and cough training, lower-extremity exercise, and training in activities of daily living. Patients received this throughout their induction chemoradiotherapy, and pulmonary function was measured before and 2 weeks after its completion. Patients underwent lobectomies and pneumonectomies (including bilobectomy, sleeve resections, and chest wall resections), with an incidence of respiratory complications of 6.1% overall. In smokers and those patients with respiratory impairment (forced expiratory volume in 1 second/forced vital capacity <70% or forced vital capacity <80% predicted), lung function improved significantly after prehabilitation.

Tarumi and colleagues¹⁰ provide evidence for improved pulmonary function in patients undergoing prehabilitation during chemoradiotherapy with subsequent lung resection for NSCLC. This is an important patient group to study, because the patients are classically associated with increased surgical morbidity. We recognize that this was an observational study without randomization or matching, and therefore translation into improved clinical outcome is less clear.¹¹ There was no significant difference between the rate of complications between those patients with and without respiratory impairment (6.1% vs 6.1%, $P = .9908$). Berry and colleagues¹² demonstrated that in patients with impaired pulmonary function, preoperative pulmonary function tests predicted complications after open lobectomy but not thoracoscopic lobectomy.¹² Tarumi and colleagues¹⁰ admit all patients for their induction chemoradiotherapy (8 weeks), therefore permitting an intensive in-hospital prehabilitation scheme that may not be reproducible at other institutions. Despite this, their study demonstrated prehabilitation to be associated with improved pulmonary function in arguably the highest risk groups, the smokers and those with respiratory impairment. Institution of a prehabilitation regimen can be associated with relatively low cost, particularly if rehabilitation schemes are already in place. If this observation translates into improved clinical outcome, the savings in terms of patient morbidity and institutional costs may be significant.

Randomized controlled trials of prehabilitation exist in colorectal surgery,^{2,13} elective coronary artery bypass grafting,¹⁴ and spinal surgery¹⁵; however, these trials are small and do not always comprehensively correlate the improved functional status perioperatively with complications and long-term outcome. We await with interest the results of the Perioperative Rehabilitation in Operation for Lung Cancer (PROLUCA) trial,¹⁶ in which 380 patients with stage I to IIIa NSCLC undergoing surgical resection will be randomized to 4 groups including combinations of prehabilitation and early and standard rehabilitation. A second randomized clinical trial at the Mayo Clinic is enrolling up to 200 patients to 10 sessions of prehabilitation or none before surgery and is based on a previously published randomized clinical trial.¹⁷ This is an exciting area of research that may have a tangible impact on patient outcomes. Most interesting, prehabilitation may particularly benefit those patients at high risk for thoracic surgical intervention.

References

1. Glatki GP, Manika K, Sichletidis L, Alexe G, Brenke R, Spyrtos D. Pulmonary rehabilitation in non-small cell lung cancer patients after completion of treatment. *Am J Clin Oncol*. 2012;35:120-5.

From the Division of Thoracic Surgery, Department of Surgery, Mayo Clinic, Rochester, Minn.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication Oct 16, 2014; accepted for publication Oct 17, 2014.

Address for reprints: Shanda H. Blackmon, MD, MPH, 200 First St SW, Mayo Clinic MA 12-W, Rochester, MN 55905 (E-mail: Blackmon.shanda@mayo.edu).

J Thorac Cardiovasc Surg 2015;149:574-5

0022-5223/\$36.00

Copyright © 2015 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2014.10.078>

2. Carli F, Charlebois P, Stein B, Feldman L, Zavorsky G, Kim DJ, et al. Randomized clinical trial of prehabilitation in colorectal surgery. *Br J Surg*. 2010;97:1187-97.
3. Furze G, Dumville JC, Miles JN, Irvine K, Thompson DR, Lewin RJ. 'Prehabilitation' prior to CABG surgery improves physical functioning and depression. *Int J Cardiol*. 2009;6:51-8.
4. Santa Mina D, Clarke H, Ritvo P, Leung YW, Matthew AG, Katz J, et al. Effect of total-body prehabilitation on postoperative outcomes: a systematic review and meta-analysis. *Physiotherapy*. 2014;100:196-207.
5. Tew GA, Weston M, Kothmann E, Betterham AM, Gray J, Kerr K, et al. High-intensity interval exercise training before abdominal aortic aneurysm repair (HIT-AAA): protocol for a randomized controlled feasibility trial. *BMJ Open*. 2014;4:e004094.
6. Nici L. Preoperative and postoperative pulmonary rehabilitation in lung cancer patients. *Thorac Surg Clin*. 2008;18:39-43.
7. Evans NR 3rd, Li S, Wright CD, Allen MS, Gaissert HA. The impact of induction therapy on morbidity and operative mortality after resection of primary lung cancer. *J Thorac Cardiovasc Surg*. 2010;139:991-6.
8. West MA, Loughney L, Lythgoes D, Barben CP, Sripadam R, Kemp GJ, et al. Effect of prehabilitation on objectively measured physical fitness after neoadjuvant treatment in preoperative rectal cancer patients: a blinded interventional pilot study. *Br J Anaesth*. October 1, 2014 [Epub ahead of print].
9. Yokomise H, Gotoh M, Okamoto T, Yamamoto Y, Ischikawa S, Nakshima T, et al. Induction chemotherapy (carboplatin-taxane and concurrent 50-Gy radiation) for bulky cN2 N3 non-small cell lung cancer. *J Thorac Cardiovasc Surg*. 2007;133:1179-85.
10. Tarumi S, Yokomise H, Gotoh M, Kasai Y, Matsuura N, Chang S, Go T. Pulmonary rehabilitation during induction chemoradiotherapy for lung cancer improves pulmonary function. *J Thorac Cardiovasc Surg*. 2015;149:569-73.
11. Barnett SA, Rusch VW, Zheng J, Park BJ, Rizk NP, Plourde G, et al. Contemporary results of surgical resection of non-small cell lung cancer after induction therapy: a review of 549 consecutive cases. *J Thorac Oncol*. 2011;6:1530-6.
12. Berry MF, Villamizar-Ortiz NR, Tong BC, Burfeind WR, Harpole DH, D'Amico TA, et al. Pulmonary function tests do not predict pulmonary complications after thoracoscopic lobectomy. *Ann Thorac Surg*. 2010;89:1044-52.
13. Gillis C, Li C, Lee L, Aswathi R, Augustin B, Gamsa A, et al. Prehabilitation versus rehabilitation: a randomized control trial in patients undergoing colorectal resection for cancer. *Anesthesiology*. 2014;121:937-47.
14. Sawatzky JA, Kehler DS, Ready AE, Lerner N, Boreskie S, Lamont D, et al. Prehabilitation program for elective coronary artery bypass graft surgery patients: a pilot randomized controlled study. *Clin Rehabil*. 2014;28:648-57.
15. Nielsen PR, Jorgensen LD, Dahl B, Pederson T, Tonnesen H. Prehabilitation and early rehabilitation after spinal surgery: randomized clinical trial. *Clin Rehabil*. 2010;24:137-48.
16. Sommer MS, Trier K, Vibe-Petersen J, Missel M, Christensen M, Larsen KR, et al. Perioperative rehabilitation in operation for lung cancer (PROLUCA) – rationale and design. *BMC Cancer*. 2014;14:404.
17. Benzo R, Wigle D, Novotny P, Wetzstein M, Nichols F, Shen RK, et al. Preoperative pulmonary rehabilitation before lung cancer resection results from two randomized studies. *Lung Cancer*. 2011;74:441-5.