

The single-center experience described hereby is limited due to a small number of patients, not allowing for firm statistical evaluation. However, our data support the feasibility of surgical therapy with CPB for pulmonary malignancies invading cardiac structures. We would like to encourage radical resections with support of CPB. Selected patients benefit from radical, complete resections with significantly improved long-term survival rates, especially patients presenting with advanced sarcoma. It may be anticipated that if pulmonary resection is limited to lobectomy and the time of CPB is kept short, no major increase in pulmonary complications will have to be expected. However, extended pneumonectomies with CPB support remain to be associated with a substantial risk of pulmonary complications.

## References

- [1] Pitz CCM, de la Riviere AB, v Swieten HA, Westermann CJJ, Lammers JWJ, van den Bosch JMM. Results of surgical treatment of T4 non-small cell lung cancer. *Eur J Cardiothorac Surg* 2003;24:1013–8.
- [2] Martini N, Yellin A, Ginsberg RJ, Bains MS, Burt ME, McCormack PM, Rusch VW. Management of non-small cell cancer with direct mediastinal involvement. *Ann Thorac Surg* 1994;58:1447–51.
- [3] Baron O, Jouan J, Sagan C, Despins P, Michaud JL, Duveau D. Resection of bronchopulmonary cancers invading the left atrium—benefit of cardiopulmonary bypass. *Thorac Cardiovasc Surg* 2003;51:159–61.
- [4] Shirkusa T, Kimura M. Partial atrial resection in advanced lung carcinoma with and without cardiopulmonary bypass. *Thorax* 1991;46:484–7.
- [5] Duque JL, Ramos G, Castrodeza J, Cerezal J, Castanedo M, Yuste MG, Heras F. Early complications in surgical treatment of lung cancer: a prospective multicenter study. *Ann Thorac Surg* 1997;63:944–50.
- [6] Ulicny KS, Schmelzer V, Flege JB, Todd JC, Mitts DL, Melvin DB, Wright CB. Concomitant cardiac and pulmonary operation: the role of cardiopulmonary bypass. *Ann Thorac Surg* 1992;54:289–95.
- [7] Miller DL, Orszulak TA, Pairolo PC, Trastek VF, Schaff HV. Combined operation for lung cancer and cardiac disease. *Ann Thorac Surg* 1994;58:989–93.
- [8] Butler J, Rocker GM, Westaby S. Inflammatory response to cardiopulmonary bypass. *Ann Thorac Surg* 1993;55:552–9.
- [9] Edmunds LH. Inflammatory response to cardiopulmonary bypass. *Ann Thorac Surg* 1998;66:S12–6.
- [10] Vaporciyan AA, Rice D, Corraera AM, Walsh G, Putnam JB, Swisher S, Smythe R, Roth J. Resection of advanced thoracic malignancies requiring cardiopulmonary bypass. *Eur J Cardiothorac Surg* 2002;22:47–52.
- [11] Byrne JG, Leacche M, Agnihotri AK, Subroto P, Bueno R, Mathisen DJ, Sugarbaker DJ. The use of cardiopulmonary bypass during resection of locally advanced thoracic malignancies. *Chest* 2004;125:1581–6.
- [12] Park JB, Bacchetta M, Bains MS, Downey RJ, Flores R, Ruch VW, Girardi LN. Surgical management of thoracic malignancies invading the heart or great vessels. *Ann Thorac Surg* 2004;78:1024–30.
- [13] Algar JL, Alvarez A, Salvatierra A, Baamonde C, Aranda JL, López-Pujol FJ. Predicting pulmonary complications after pneumonectomy for lung cancer. *Eur J Cardiothorac Surg* 2003;23:201–8.
- [14] Asimakopoulos G, Smith PLC, Ratnatunga CP, Taylor KM. Lung injury and acute respiratory distress syndrome after cardiopulmonary bypass. *Ann Thorac Surg* 1999;68:1107–15.
- [15] Rao V, Todd TR, Weisel RD, Komeda M, Cohen G, Ikonomidis JS, Christakis GT. Results of combined pulmonary and cardiac operations. *Ann Thorac Surg* 1996;62:342–6.
- [16] Bacha EA, Wright CD, Grillo HC, Wain JC, Moncure A, Keel SB, Donahue DM, Mathisen DJ. Surgical treatment of primary pulmonary sarcomas. *Eur J Cardiothorac Surg* 1999;15:456–60.
- [17] Ruffini E, Parola A, Papalia E, Filosso PL, Mancuso M, Oliaro A, Actis-Dato G, Maggi G. Frequency and mortality of acute lung injury and acute respiratory distress syndrome after pulmonary resection for bronchiogenic carcinoma. *Eur J Cardiothorac Surg* 2001;20:30–7.
- [18] Kutlu CA, Williams EA, Evans TW, Pastorino U, Goldstraw P. Acute lung injury and acute respiratory distress syndrome after pulmonary resection. *Ann Thorac Surg* 2000;69:376–80.
- [19] Licker M, de Perrot M, Spiliopoulos A, Robert J, Diaper J, Chevalley C, Tschopp JM. Risk factors for acute lung injury after thoracic surgery for lung cancer. *Anesth Analg* 2003;97:1558–65.
- [20] Aldea GS, Dourounian M, O'Gara P, Treanor P, Shapira OM, Lazar HL, Shemin RJ. Heparin-bonded circuits with a reduced anticoagulation protocol in primary CABG: a prospective, randomized study. *Ann Thorac Surg* 1996;62:410–7.
- [21] Fromes Y, Gaillard D, Ponzio O, Chaffert M, Gerhardt MF, Bicalet OM. Reduction of the inflammatory response following coronary bypass grafting with total minimal extracorporeal circulation. *Eur J Cardiothorac Surg* 2002;22:527–33.
- [22] Tsuchiya R, Asamura H, Kondo H, Goya T, Naruke T. Extended resection of the left atrium, great vessels, or both for lung cancer. *Ann Thorac Surg* 1994;57:960–5.
- [23] Fukuse T, Wada H, Hitomi S. Extended operation for non-small cell lung cancer invading great vessels and left atrium. *Eur J Cardiothorac Surg* 1997;11:664–9.
- [24] Regnard JF, Icard P, Guibert L, de Montpreville VT, Magdeleinat P, Levasseur P. Prognostic factors and results after surgical treatment of primary sarcomas of the lung. *Ann Thorac Surg* 1999;68:227–31.
- [25] Porte HL, Metois DG, Leroy X, Conti M, Gossetin B, Wurzt A. Surgical treatment of primary sarcoma of the lung. *Eur J Cardiothorac Surg* 2000;18:136–42.

## Editorial comment

### Extended pulmonary resections of advanced thoracic malignancies with support of cardio-pulmonary bypass — is surgery justified?

Extended pulmonary resections of advanced thoracic malignancies with support of cardio-pulmonary bypass (CPB) are occasionally applied in many specialized thoracic surgical centers in order to achieve complete resection or to manage intraoperative complications. Several case series have described the technical possibilities in extended resections and have reported on morbidity, mortality, and long-term survivors over the last few years. What they all had in common was that the number of treated patients was small and included different tumor stages, various sites of infiltration

and hence different techniques of resection, and even different malignancies.

What can we learn from Wiebe et al. [1] and the other reports? Not surprisingly, surgery was associated with a high 30-day mortality of 15% in this report (Wiebe) which is comparable with the experience of Vaporciyan et al. [2] of 11%. However, can we use these numbers to counsel our patients? De Perrot et al. [3] and Park et al. [4] would certainly not agree, as they have observed no mortality in their small series. However, perioperative mortality has to be

taken in consideration in all patients who need the support of CPB for resection.

One can argue that perioperative mortality is of lesser importance in patients with locally advanced malignant tumors for which no therapeutic alternative except resection is available. Therefore, some risk is justified by the potential chance of long-term survival.

In fact, the key question is what is the gain of the patient in regard to quality and duration of life? The three patients with lung cancer operated in Wiebe's series lived for only 4, 6, and 16 months, which makes the justification for surgery somewhat difficult. On the other hand, a 5-year survival for lung cancer patients, operated on CPB because of a T4-stage, ranging between 20 and 40% [3,5,6] was reported, indicating that there are some individuals with locally advanced lung cancer who may profit from an extended indication for surgery.

More favorable and consistent in literature is the reported 5-year survival of 62% in patients with sarcomas reported by Wiebe, which was observed by others as well [2,4], indicating the importance of the tumor histology and stage for the selection of patients.

The potential side effects of CPB on lung function and other organ function is well described in the literature, but the oncological side effect is less known. The observation that some patients with carcinomas, sarcomas, and other tumors are disease-free survivors over many years, despite the resection which occurs on CPB, indicates that the use of CPB does not necessarily increase the risk of tumor dissemination although it has been observed occasionally. So what is the final message from Wiebe and other reports?

The key issue for a favorable outcome justifying extended resection of advanced thoracic malignancies on CPBP is patient selection. The current literature indicates that this has to occur on an individual basis and that there are no clear guidelines. We know it can work but there is always a but. The most important factor for selection addresses the biology of the tumor, currently best described by histology and stage. Resectability as well as local and distant extension has to be evaluated carefully including CT,

PET, mediastinoscopy, transesophageal ultrasound and echocardiography and bronchoscopy according to the situation. A patient with N2 disease and lung cancer is not a candidate for primary surgery. The question of induction chemo- and/or radiotherapy has to be discussed preferentially in a multidisciplinary board. Finally, patient performance and comorbidities as well as symptoms have to be taken into account for adequate selection. Despite a thoughtful evaluation, selection often remains a walk on the edge.

Nevertheless, based on these few case series, we are able to conclude that carefully selected patients with tumor involvement of the heart or great vessels may be resected on CPB with acceptable mortality and morbidity, which allows the achievement of good palliation and long-term survival in a few.

## References

- [1] Wiebe K, Baraki H, Macchiarini P, Haverich A. Extended pulmonary resections of advanced thoracic malignancies with support of cardiopulmonary bypass. *Eur J Cardiothorac Surg* 2006;29:571–8.
- [2] Vaporciyan AA, Rice D, Correa AM, Walsh G, Putnam JB, Swisher S, Smythe R, Roth J. Resection of advanced thoracic malignancies requiring cardiopulmonary bypass. *Eur J Cardiothorac Surg* 2002;22:47–52.
- [3] De Perrot M, Fadel E, Musso S, De Palma A, Chapelier A, Darteville P. Resection of locally advanced (T4) non-small cell lung cancer with cardiopulmonary bypass. *Ann Thorac Surg* 2005;79:1691–7.
- [4] Park BJ, Bacchetta M, Bains MS, Downey RJ, Flores R, Rusch VW, Girardi LN. Surgical management of thoracic malignancies invading the heart or the great vessels. *Ann Thorac Surg* 2004;78(3):1024–30.
- [5] Fukuse T, Wada H, Hitomi S. Extended operations for non-small cell lung cancers invading great vessels and left atrium. *Eur J Cardiothorac Surg* 1997;11:664–9.
- [6] Tsuchiya R, Asamura H, Kondo H, Goya T, Naruke T. Extended resection of the left atrium, great vessels, or both for lung cancer. *Ann Thorac Surg* 1994;57:960–5.

Walter Weder  
*Division of Thoracic Surgery, Zurich University Hospital,  
 Ramistrasse 100, 8091 Zurich, Switzerland*  
 Tel.: +41 12558801; fax: +41 12558805  
 E-mail address: walter.weder@chi.usz.ch