

Long-term results after concomitant cardiac surgery and pulmonary resection

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Abstract

Background: Concomitant lesions of the heart and lung are uncommon, but when present they pose a challenge for cardiac and thoracic surgeons. Patients with lung cancer and heart disease are at a high risk for postoperative death or severe cardiovascular complications.

Aim of the study: To report our results of concomitant cardiac surgery and lung resection.

Material and methods: From 1994 to 2012, 18 patients with cardiac disorders and lung cancer or another lung disease were operated on. Twelve patients underwent coronary artery bypass grafting, 3 patients underwent aortic valve replacement and 3 patients underwent another cardiac surgery procedure. The pulmonary resections consisted of pneumonectomy in 1 patient, lobectomy in 6 patients and wedge excision in 10 patients. Follow-up was obtained for all 18 patients (mean follow-up 70.6 months; range 224 to 0.7 months).

Results: The pathologic examination confirmed lung malignancy in 12 patients. Five patients were operated on due to a non-oncologic pathology and 1 patient underwent lung volume resection. Overall late survival was 88% and 67% at 1 and 5 years, respectively.

Conclusions: Lung resection carried out concomitantly with cardiac surgery is safe and effective. A combined procedure avoids the need for a second major thoracic procedure and may improve clinical outcome.

Key words: cardiac surgery; thoracic surgery; concomitant surgery.

Streszczenie

Wprowadzenie: Jednoczesowe zmiany chorobowe serca i płuc nie są częste, jednakże ich występowanie stanowi wyzwanie dla kardo- i torakochirurgów. Pacjenci z rakiem płuca i chorobą serca narażeni są w wysokim stopniu na pooperacyjną śmierć lub poważne powikłania sercowo-naczyniowe.

Cel: Celem pracy było przedstawienie uzyskanych przez autorów wyników stosowania jednoczesowych operacji kardiologicznych i resekcji płucnych.

Materiał i metody: Od 1994 do 2012 roku 18 pacjentów z zaburzeniami sercowymi i rakiem płuc lub innymi chorobami płuc zostało poddanych operacji. 12 pacjentów przeszło pomostowanie aortalno-wieńcowe, 3 pacjentów przeszło wymianę zastawki aortalnej, a 3 pacjentów – inne zabiegi kardiologiczne. Wykonano następujące resekcje płucne: pneumonectomię u 1 pacjenta, lobektomię u 6 pacjentów oraz resekcję klinową u 10 pacjentów. Zebrano dane dotyczące obserwacji wszystkich pacjentów (średni czas obserwacji: 70,6 miesięcy; zakres od 224 do 0,7 miesięcy).

Wyniki: Badanie patologiczne potwierdziło obecność złośliwych zmian płucnych u 12 pacjentów. Pięć pacjentów było operowanych ze względu na patologie nieonkologiczne, a u jednego pacjenta wykonano operacyjne zmniejszenie objętości płuc. Całkowite późne przeżycia wyniosły 88% i 67% odpowiednio dla przeżyć jednorocznych i 5-letnich.

Wnioski: Wykonywanie operacji płucnych jednoczesowo z zabiegami kardiologicznymi jest bezpieczne i skuteczne. Połączenie dwóch zabiegów pozwala na uniknięcie konieczności przeprowadzenia kolejnego poważnego zabiegu torakologicznego i może owocować lepszymi wynikami klinicznymi.

Słowa kluczowe: kardiologia, torakochirurgia, jednoczesowe zabiegi chirurgiczne.

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Introduction

Concomitant lesions of the heart and lung are uncommon [1], but when present they pose a challenge for cardiac and thoracic surgeons. Patients with lung cancer and heart disease are at high risk of postoperative death or severe cardiovascular complications. The optimal treatment for these patients is unclear and controversial. In 1978 Dalton [2] reported the first experience with a one-stage cardiac operation and lung resection. Several studies have found that either a combined or staged procedure is effective [3]. Regarding safety, cost, hospital stay, and delay in tumor management, each technique has its own benefits and drawbacks in treating these high-risk patients.

Aim of the study

The aim of this study was to review the early and long-term results of concomitant lung resection for cancer and other pulmonary diseases with simultaneous cardiac surgery.

Material and methods

This was a retrospective, observational study, which included prospectively collected data from consecutive patients who had undergone concomitant cardiac surgery and lung resection at a large tertiary university hospital during the 18 years between 1994 and 2012. The data collection forms were entered into a computerized department database, and the Ethics Committee of our Medical Center approved the use of our database as a source of information. In this period, 18 patients (14 men and 4 women, aged 49 to 85 years, mean age 69.6 years) with lung cancer or another lung disease and coronary disease and/or valve disorders were operated on.

All cardiac procedures were performed on cardiopulmonary bypass (CPB). Before initializing CPB, systemic heparinization was accomplished with a heparin dose of 400 U/kg. Additional heparin was administered during CPB to maintain an activated coagulation time of > 480 seconds. The mean arterial pressure was maintained between 60 and 80 mm Hg using boluses of phenylephrine as required. Serum glucose levels were controlled with intermittent administration of insulin. Hematocrit was maintained at 22% with the administration of packed red blood cells as necessary. Cardiac arrest was achieved by antegrade and/or retrograde blood cardioplegia. Topical cooling was not used, and core temperature was between 33° and 35°C. Prior to discontinuation of CPB patients were warmed to 37°C. Lung resection was performed immediately after completion of the cardiac procedure and after reversal of heparin. The approach to the heart and lung were through a median sternotomy.

Results

Twelve patients underwent coronary artery bypass grafting, 3 patients underwent aortic valve replacement, 2 patients underwent combined valve replacement and coronary artery bypass grafting, and 1 patient underwent aortic surgery. In all operations the cardiac procedure on extracorporeal circulation was followed by lung resection after reversing

heparin. The pulmonary resections consisted of pneumonectomy in 1 patient, lobectomy in 6 patients, and a wedge excision in 11 patients. One patient underwent a completion lobectomy 3 weeks after the concomitant procedure [coronary artery bypass graft (CABG) + wedge resection]. Three patients with N2 disease received adjuvant chemotherapy.

Pathologic examination confirmed lung malignancy in 12 patients, adenocarcinoma (*n* = 7), squamous cell carcinoma (*n* = 3) and carcinoid (*n* = 2). Five patients were operated on for a non-oncologic pathology and 1 patient underwent lung volume reduction surgery (Table I).

One patient died 20 days after pneumonectomy due to multisystem organ failure. No patient needed re-exploration because of bleeding. Five patients (29%) developed atrial fibrillation in the early postoperative period. Mean ventilator support was 14.6 ±32.4 hours (range 4 to 480 hours) and mean ICU stay was 26.6 ±26.6 hours (range 14 to 480 hours). Mean hospital stay was 6.6 ±2.6 days (range 5 to 22 days).

Follow-up was obtained on all 18 patients. For the whole group of patients mean follow-up was 70.6 ±61.4 months (range 224 to 0.7 months) and the survival rate was 88% and 47% at 1 and 5 years, respectively. In the group of 12 patients with malignant lung disease mean follow-up was 56.2 ±43.8 months (range 120 to 0.7 months) and the survival rate was 92% and 42% at 1 and 5 years, respectively (Fig. 1). Three patients died because of recurrence of malignant disease, 1 after lobectomy and 2 after wedge resection.

Discussion

Concomitant operations are surgical procedures performed simultaneously on two or more sites for different unrelated diseases. The main purpose of these operations is to free the patient from several diseases simultaneously and to achieve a long-lasting remission or cure. Advances in surgical techniques, resuscitation and anesthesiology support over the years have allowed concomitant cardiac operations and lung resections to be performed for simultaneous heart and pulmonary disease. Danton and coworkers [4] presented their own results and reviewed 290 patients

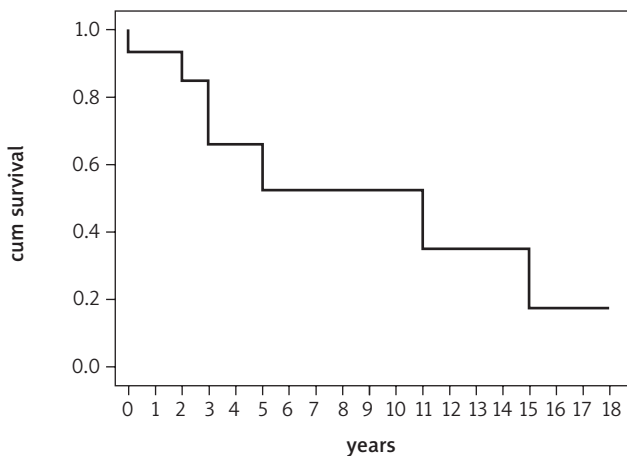


Fig. 1. Survival of patients after concomitant cardiac surgery and pulmonary resection

Tab. I. Demographic and perioperative data

No. of patient	Sex	Age	Cardiac pathology	Lung pathology	Lung cancer stage	Cardiac surgery	Lung surgery	Follow-up (mo)
1	M	64	IHD, triple-vessel disease	squamous cell carcinoma	T2N2 (IIIA)	CABG	left upper lobectomy	18
2	M	85	IHD, triple-vessel disease	adenocarcinoma	T2N0 (IB)	CABG	left upper lobectomy	120
3	M	76	IHD, triple-vessel disease	squamous cell carcinoma	T2N1 (IIA)	CABG	left lower lobectomy	105
4	M	72	IHD, triple-vessel disease	squamous cell carcinoma	T2N2 (IIIA)	CABG	right upper lobectomy	98
5	M	76	IHD, severe left main stenosis	adenocarcinoma	T1Nx (IA)	CABG	wedge excision right upper lobe	120
6	M	56	IHD, triple-vessel disease	adenocarcinoma	T1N0 (IA)	CABG	left upper lobectomy	60
7	M	76	IHD + severe mitral insufficiency	carcinoid	T2N1 (IIA)	MVR + CABG	left pneumonectomy	0.6
8	F	84	severe aortic stenosis	adenocarcinoma	T1Nx (IA)	AVR	wedge excision left lower lobe	54
9	M	71	IHD, severe left main stenosis	adenocarcinoma	T2N0 (IB)	CABG	wedge excision left lower lobe	36
10	M	83	severe aortic stenosis	carcinoid	T1Nx (IA)	AVR	wedge excision right lower lobe	32
11	F	63	IHD, two-vessel disease, severe aortic stenosis	adenocarcinoma	T1Nx (IA)	AVR + CABG	wedge excision left upper lobe	16
12	F	75	ascending aortic aneurism	adenocarcinoma	T1N3 (IIIA)	aortic surgery	wedge excision right upper lobe	15
13	F	67	IHD, Triple-vessel disease	granuloma		CABG	wedge excision left upper lobe	224
14	M	69	IHD, severe left main stenosis	hamartoma		CABG	wedge excision left upper lobe	167
15	M	49	IHD, triple-vessel disease	hamartoma		CABG	wedge excision left upper lobe	67
16	M	56	IHD, severe left main stenosis	granuloma		CABG	wedge excision left lower lobe	56
17	F	61	severe aortic stenosis	bullous emphysema		AVR	left upper lobectomy	11
18	M	68	IHD, triple-vessel disease	hamartoma		CABG	wedge resection left upper lobe	11

IHD – ischemic heart disease; CABG – coronary artery bypass graft; MVR – mitral valve repair; AVR – aortic valve replacement

who were operated on in the years 1965-1997. Their study showed an immediate postoperative mortality between 0 and 6.7%, and 5-year survival for oncologic patients between 35% and 80%. More recently a number of nonrandomized studies [5, 6-15] have been published. In these studies (Table II) the results of 161 patients operated on in the years 1990-2011 were examined. Perioperative mortality and oncologic 5-year survival practically did not change, remaining at the level 0-6% and 9-86% respectively. As in our study, most operations [3, 10-16] were performed in one stage with the cardiac procedure followed by lung resection. Voets *et al.* [3] compared one-stage versus two-stage procedures and concluded that there was no difference between the two groups regarding mortality; however, greater perioperative risk makes concomitant procedures less attractive.

Ciriaco *et al.* [5] and Ambrogi *et al.* [6] reported 17 patients who had a two-stage procedure. Lung surgery was performed with a mean interval of 5 weeks after cardiac surgery. Ciriaco *et al.* [5] compared two-stage surgical revascularization with two-stage percutaneous coronary intervention (PCI) and pulmonary resection. There was no reported difference between the groups regarding mortality

or complication rate. The problem after PCI is the need to receive long-term aspirin and IIb/IIIa inhibitors which can cause excessive bleeding, during an invasive procedure or cardiovascular events in case of cessation. Albaladejo *et al.* [17] reported that patients after PCI undergoing operations are at high risk of major bleeding (9.5%) or perioperative myocardial infarction including stent thrombosis (10.6%) irrespective of the stent type.

In patients with a recently implanted drug-eluting stent and high risk for stent thrombosis (e.g. within the first weeks after implantation) needing surgery, a 'bridging strategy' using tirofiban or eptifibatide may allow temporary withdrawal of oral clopidogrel without increasing the risk of bleeding [7, 8]. Guidelines on Myocardial Revascularization [9] also advocated this approach and do not recommend using low-molecular weight heparin.

Voets *et al.* [3] and Hosoba *et al.* [16] reported that a number of patients underwent a lung resection through a separate thoracotomy after the sternum was closed. Dyszkiewicz *et al.* [10, 14] and Saxena *et al.* [11] advocate concomitant one-stage off-pump coronary revascularization and lung resection. However, Schoenmakers *et al.*

Tab. II. Concomitant cardiac operation and lung resection: review of literature

Author, year	Study date	Total patients	Oncological patients	Follow-up (mo)	Oncological survival	Non-oncological survival
Ciriaco <i>et al.</i> 2002 [5]	1993-2001	6	6 (100%)	NA	NA	
Ambrogi <i>et al.</i> 2003 [6]	1990-1997	11	11 (100%)	1-76 (range)	36% – 1-year 9% – 5-year	
Dyszkiewicz <i>et al.</i> 2004 [10]	1999-2002	13	13 (100%)	7-36 (range) 22 (median)	NA	
Saxena <i>et al.</i> 2004 [11]	2000-2003	6	5 (83%)	9-36 (range)	NA	
Shoenmakers <i>et al.</i> 2007 [12]	1994-2005	43	43 (100%)	56 (median)	58% – 2-year, 35% – 5-year	
Prokakis <i>et al.</i> 2008 [13]	2004-2006	5	5 (100%)	6-30 (range)	NA	
Dyszkiewicz <i>et al.</i> 2008 [14]	2001-2006	25	25 (100%)	8-60 (range)	50% estimated 3-year	
Cathenis <i>et al.</i> 2009 [15]	2000-2008	27	27 (100%)	30.7 (median)		
Hosoba <i>et al.</i> 2012 [16]	2008-2011	11	11 (100%)	19 ±11 (mean) 2-34 (range)	80% estimated 2-year	
Zhang <i>et al.</i> 2012 [18]	2004-2011	33	14 (42%)		44% – 5-year	86% – 5-year
Kogan <i>et al.</i> 2012	1994-2011	18	12 (71%)	70 ±61 (mean) 0.7-220 (range)	88% – 1-year 42% – 5-year	80% – 1-year 60% – 5-year

[12] found no significant difference in using an on-pump or off-pump technique to perform combined cardiac and lung surgery in relation to postoperative complications and hospital survival. In our series the decision to perform the operation off- or on-pump was made by the operating surgeon, but all isolated coronary artery bypass grafting (CABG) was performed on-pump, and it is not possible to compare the results, although off-pump technique may have advantages in this group of patients.

Zhang *et al.* [18] reported 86% 5-year survival in patients after concomitant resection of benign lung tumors, compared to 60% in our patients. One patient underwent AVR and lung volume reduction. Schmid *et al.* [19] reported 22% early postoperative mortality after concomitant cardiac surgery and lung volume reduction.

There are two main limitations of this study. First, we present observation retrospective analysis rather than a randomized control trial. This heterogeneous group of patients includes a mixture of pathologies such as coronary disease (13), valvular heart disease (5), aortic disease (1), lung cancer of different types (12), hamartoma (3), granuloma (2) and emphysema (1), and therefore our results must be interpreted with caution. Second, the difficulty with longitudinal studies such as ours is that overall mortality has been decreasing over time.

Conclusions

Lung resection carried out concomitantly with cardiac surgery is safe and effective. A combined one-stage procedure avoids the need for a second major thoracic procedure and may improve clinical outcome.

References

1. Johnson JA, Landreneau RJ, Boley TM, Haggerty SP, Hattler B, Curtis JJ, Hazelrigg SR. Should pulmonary lesions be resected at the time of open heart surgery? *Am Surg* 1996; 62: 300-303.

2. Dalton ML Jr, Parker TM, Mistrot JJ, Bricker DL. Concomitant coronary artery bypass and major noncardiac surgery. *J Thorac Cardiovasc Surg* 1978; 75: 621-624.
3. Voets AJ, Joesoef KS, van Teeffelen ME. Synchronously occurring lung cancer (stages I-II) and coronary artery disease: concomitant versus staged surgical approach. *Eur J Cardiothorac Surg* 1997; 12: 713-717.
4. Danton MH, Anikin VA, McManus KG, McGuigan JA, Campalani G. Simultaneous cardiac surgery with pulmonary resection: presentation of series and review of literature. *Eur J Cardiothorac Surg* 1998; 13: 667-672.
5. Ciriaco P, Carretta A, Calori G, Mazzone P, Zannini P. Lung resection for cancer in patients with coronary arterial disease: analysis of short-term results. *Eur J Cardiothorac Surg* 2002; 22: 35-40.
6. Ambrogi V, Pompeo E, Elia S, Pistolesse GR, Mineo TC. The impact of cardiovascular comorbidity on the outcome of surgery for stage I and II non-small-cell lung cancer. *Eur J Cardiothorac Surg* 2003; 23: 811-817.
7. Savonitto S, D'Urbano M, Caracciolo M, Barlocco F, Mariani G, Nichelatti M, Klugmann S, De Servi S. Urgent surgery in patients with a recently implanted coronary drug-eluting stent: a phase II study of 'bridging' antiplatelet therapy with tirofiban during temporary withdrawal of clopidogrel. *Br J Anaesth* 2010; 104: 285.
8. Rassi AN, Blackstone E, Militello MA, Theodos G, Cavender MA, Sun Z, Ellis SG, Cho L. Safety of "bridging" with eptifibatidate for patients with coronary stents before cardiac and non-cardiac surgery. *Am J Cardiol* 2012; 110: 485-490.
9. Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS); European Association for Percutaneous Cardiovascular Interventions (EAPCI), Wijns W, Kolh P, Danchin N, Di Mario C, Falk V, Folliquet T, Garg S, Huber K, James S, Knuuti J, Lopez-Sendon J, Marco J, Menicanti L, Ostojic M, Piepoli MF, Pirelet C, Pomar JL, Reifart N, Ribichini FL, Schalij MJ, Sergeant P, Serruys PW, Silber S, Sousa Uva M, Taggart D. Guidelines on myocardial revascularization. *Eur Heart J* 2010; 31: 2501-2555.
10. Dyszkiewicz W, Jemielity MM, Piwkowski CT, Perek B, Kasprzyk M. Simultaneous lung resection for cancer and myocardial revascularization without cardiopulmonary bypass (off-pump coronary artery bypass grafting). *Ann Thorac Surg* 2004; 77: 1023-1027.
11. Saxena P, Tam RK. Combined off-pump coronary artery bypass surgery and pulmonary resection. *Ann Thorac Surg* 2004; 78: 498-501.
12. Schoenmakers MC, van Boven WJ, van den Bosch J, van Swieten HA. Comparison of on-pump or off-pump coronary artery revascularization with lung resection. *Ann Thorac Surg* 2007; 84: 504-509.
13. Prokakis C, Koletsis E, Apostolakis E, Panagopoulos N, Charoulis N, Velissaris D, Filos K, Dougenis D. Combined heart surgery and lung tumor resection. *Med Sci Monit* 2008; 14: CS17-CS21.
14. Dyszkiewicz W, Jemielity MM, Piwkowski C, Kasprzyk M, Perek B, Gasiorowski L, Kaczmarek E. The early and late results of combined off-pump coronary artery bypass grafting and pulmonary resection in patients with

- concomitant lung cancer and unstable coronary heart disease. *Eur J Cardiothorac Surg* 2008; 34: 531-535.
15. Catheris K, Hamerlijnck R, Vermassen F, Van Nooten G, Muysoms F. Concomitant cardiac surgery and pulmonary resection. *Acta Chir Belg* 2009; 109: 306-311.
 16. Hosoba S, Hanaoka J, Suzuki T, Takashima N, Kambara A, Matsubayashi K, Asai T. Early to midterm results of cardiac surgery with concomitant pulmonary resection. *Ann Thorac Cardiovasc Surg* 2012; 18: 8-11.
 17. Albaladejo P, Marret E, Samama CM, Collet JP, Abhay K, Loutrel O, Charbonneau H, Jaber S, Thoret S, Bosson JL, Piriou V. Non-cardiac surgery in patients with coronary stents: the RECO study. *Heart* 2011; 97: 1566-1572.
 18. Zhang R, Wiegmann B, Fischer S, Dickgreber NJ, Hagl C, Krüger M, Haverich A, Zardo P. Simultaneous cardiac and lung surgery for incidental solitary pulmonary nodule: learning from the past. *Thorac Cardiovasc Surg* 2012; 60: 150-155.
 19. Schmid RA, Stammberger U, Hillinger S, Vogt PR, Amman FW, Russi EW, Weder W. Lung volume reduction surgery combined with cardiac interventions. *Eur J Cardiothorac Surg* 1999; 15: 585-591.