Is it safe and worthwhile to perform pulmonary resection after contralateral pneumonectomy?

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Abstract
A best evidence topic was written according to a structured protocol. The question addressed was whether pulmonary resection is safe and worthwhile in patients who have undergone previous pneumonectomy. A total of 141 studies were identified using the reported search, of which 8 represented the best evidence to answer the clinical question. Studies on multiple lung cancers with patients undergoing subsequent pulmonary resection after previous pneumonectomy, without outcome data specifically for this group of patients and case reports, were not included in this analysis. The authors, date, journal, country, study type, population, outcomes and key results are tabulated. All studies were retrospective. In total, 102 patients underwent pulmonary resection after contralateral pneumonectomy, of which 96 had sublobar resections and 6 had lobectomies. Postoperative complications, reported in four of the eight studies, ranged from 21 to 44% (mean from four studies 36.8%). Four of the eight studies reported no mortality after pulmonary resection following pneumonectomy, whereas the other four reported mortality rates from 6.7 to 43%. For patients undergoing sublobar resections, the postoperative mortality was 6.2% (6/96), while for those submitted to lobectomy, mortality was 33.3% (2/6). Five-year survival rates ranged from 14% for metastatic disease to 50% for metachronous lung cancer. Due to the infrequent situation of a patient being considered for a pulmonary resection after contralateral pneumonectomy, this analysis was based on a limited number of patients from eight reports. Nevertheless, analysis of the data suggests that pulmonary resection for metastatic or metachronous disease can be performed with acceptable morbidity and low mortality in appropriately selected patients who have previously undergone a pneumonectomy. Sublobar resection is the treatment of choice whenever possible, for which long-term results are rewarding especially for patients with metachronous lung cancer.

Keywords: Lung cancer • Pneumonectomy • Multiple lung cancers • Metastatic disease

INTRODUCTION
A best evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

THREE-PART QUESTION
In patients who [have undergone previous pneumonectomy] is [contralateral pulmonary resection] safe in terms of [postoperative convalescence] and worthwhile in terms of [oncological outcome]?

CLINICAL SCENARIO
A 62-year old male patient underwent left pneumonectomy for a centrally located squamous cell carcinoma 4 years ago. His post-operative course had been uneventful and he has been living a near-normal life ever since, being able to carry out most of his daily activities. Now, he presents with a well-circumscribed 1.3-cm nodule, peripherally located in the right upper lobe, presumed to be a metastasis from his cancer. His therapeutic options include surgical resection, radiosurgery or radiofrequency ablation and/or chemotherapy. Given his good performance status you prefer to proceed with surgery to reduce the possibility of future recurrence, but he expresses concerns regarding his ability to undergo pulmonary resection with his left lung absent. You resolve to check the literature.

SEARCH STRATEGY
Medline (R) using the Ovid interface from 1946 to August 2014. Search strategy employed: exp Pneumonectomy/ AND (exp Neoplasm Metastasis/ OR exp Neoplasms, Multiple Primary/) AND pulmonary resection.mp.

SEARCH OUTCOMES
The search yielded 141 results. All relevant papers were screened and their reference lists were cross-checked. This process extracted eight papers that were deemed to offer the best evidence. The papers are detailed in Table 1.
Table 1: Best evidence papers

<table>
<thead>
<tr>
<th>Author, date, journal and country, Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grodzki et al. (2008), Eur J Cardiothorac Surg, Poland [2]</td>
<td>Retrospective cohort study (level 2b)</td>
<td>Study period: 1981–2002</td>
<td>Operative mortality</td>
<td>Nil</td>
</tr>
<tr>
<td>Terzi et al. (2004), Eur J Cardiothorac Surg, Italy [3]</td>
<td>Retrospective cohort study (level 2b)</td>
<td>Study period: 1990–2002</td>
<td>Operative mortality</td>
<td>Nil</td>
</tr>
<tr>
<td>Spaggiari et al. (1996), Ann Thorac Surg, France [5]</td>
<td>Retrospective cohort study (level 2b)</td>
<td>Study period: 1989–1995</td>
<td>Operative mortality</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Author, date, journal and country, Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
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<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massard et al. (1995), J Thorac Cardiovasc Surg, France [6] Retrospective cohort study (level 2b)</td>
<td>Study period: 1988–1995 Four patients with a previous pneumonectomy (1 right and 3 left) Single wedge resection ((n = 1)) Segmental resection ((n = 1)) Lobectomy (right middle) ((n = 2)) Metachronous lung cancer ((n = 4))</td>
<td>Operative mortality Long-term survival</td>
<td>Nil Two patients are alive and well 67 and 5 months after surgery. One patient died 29 months after surgery from unrelated causes. One patient died 5 months after surgery from brain metastases</td>
<td>To decrease as far as possible postoperative parietal restriction, median sternotomy or muscle sparing anterolateral thoracotomy should be employed The resection should be as economic as possible and should probably be restricted to patients with (T_1) lesions</td>
</tr>
<tr>
<td>Westermann et al. (1993), J Thorac Cardiovasc Surg, Netherlands [7] Retrospective cohort study (level 2b)</td>
<td>Eight patients with a previous pneumonectomy Metachronous lung cancer ((n = 8)) Wedge resection ((n = 2)) Segmental resection ((n = 5)) Lobectomy ((n = 1))</td>
<td>Operative mortality Long-term survival</td>
<td>(n = 1) (12.5%) (due to pulmonary embolism; patient submitted to lobectomy) Three patients alive and doing well without evidence of disease 16, 17 and 40 months after surgery. Two patients died 3 and 5 months after surgery due to disease recurrence. Two patients alive 18 and 21 months after surgery but with evidence of disease recurrence</td>
<td>Patients with a previous pneumonectomy may be good candidates for additional resection of a second primary bronchogenic carcinoma</td>
</tr>
<tr>
<td>Levasseur et al. (1992), Eur J Cardiothorac Surg, France [8] Retrospective cohort study (level 2b)</td>
<td>Study period: 1962–1992 Seven patients with a previous pneumonectomy (5 right and 2 left) Single wedge resection ((n = 5)) Bi-segmentectomy ((n = 1)) Lobectomy ((n = 1); right upper) Metachronous lung cancer ((n = 6)) Synchronous lung cancer ((n = 1))</td>
<td>Operative mortality</td>
<td>(n = 3) (43%) (acute respiratory failure in 2 and pulmonary embolism in 1 after right upper lobectomy, bi-segmentectomy and single wedge resection, respectively)</td>
<td>Wedge and segmental resection, when feasible, may be undertaken in patients with a single lung and a reasonable life expectancy The fact that lobectomy is not tolerated in such patients emphasizes the importance of early diagnosis when minimal local excision can be undertaken</td>
</tr>
<tr>
<td>Kittle et al. (1985), Ann Thorac Surg, USA [9] Retrospective cohort study (level 2b)</td>
<td>Fifteen patients with a previous pneumonectomy (8 right and 7 left) Single wedge resection ((n = 3)) Multiple wedge resections ((n = 5)) Single segmental resection ((n = 1)) Multiple segmental resections ((n = 4)) Segmental resection and multiple wedge resections ((n = 1)) Lobectomy ((n = 1); right middle) Primary lung malignancy ((n = 5)) Metastatic disease ((n = 10))</td>
<td>Operative mortality Long-term survival</td>
<td>(n = 1) (6.7%) (cardiac related; in a patient with segmental and multiple wedge resections) Three patients alive and well 18, 35 and 70 months after surgery with no evidence of disease recurrence. Three patients alive 26, 41 and 73 months after surgery with evidence of disease recurrence. The other 8 patients died 2–33 months after surgery (mean: 13.6 months, median: 9 months)</td>
<td>Patients who have had a previous pneumonectomy can undergo subsequent pulmonary resection for primary or metastatic disease with acceptable mortality rates</td>
</tr>
</tbody>
</table>
RESULTS

Postoperative mortality ranged from 0 to 43%. Of 102 patients, 96 underwent sublobar resections and 6 underwent lobectomies. The mortality rate in these two groups was 6.2% (6/96) and 33.3% (2/6), respectively. Four of the eight studies reported postoperative complications in 21–44% of the patients. The mean morbidity calculated from these four studies was 36.8%.

Grodzki et al. [2] reported on 18 patients who had undergone previous pneumonectomy and were submitted to contralateral wedge resections for metachronous or metastatic disease. The authors reported no mortality and acceptable percentage of morbidity (n = 7, 38.5%), while the 5-year survival in this group of patients reached 44%. A significant difference in mean survival was found between patients operated within 12 months of their pneumonectomy (19 months) compared with those operated more than 12 months later (89 months) (P < 0.004).

Terzi et al. [3] studied 14 patients, of whom 12 had metachronous lung cancer and 2 had metastatic lesions, and had previously been submitted to pneumonectomy. Resections included single (n = 10) or multiple wedge excisions (n = 2) and segmentectomies (n = 2). Femoro-femoral cardiopulmonary bypass was used for 3 cases. The authors reported no operative mortality and minimal morbidity (n = 3, 21%). Five-year survival was 45% for those with metachronous lung cancer, whereas no patient with metastatic disease survived longer than 1 year (P = 0.03).

Donington et al. [4] reported on 24 patients who underwent pneumonectomy for lung cancer and subsequently were submitted to contralateral lung resection for either metachronous lung cancer (n = 14) or metastatic disease (n = 11). Resections included single (n = 14) and multiple wedge resections (n = 7), segmentectomies (n = 3) and one lobectomy. Postoperative mortality was 8.3% (n = 2) in 1 patient with multiple wedge resections and 1 who underwent segmentectomy. Morbidity was 44% (n = 11), 6 patients were discharged with supplemental oxygen, of whom only 2 required long-term oxygen therapy, while 5-year survival was 50% for patients with metachronous disease and 14% for those with metastatic disease.

Spaggiari et al. [5] reported on 12 patients who underwent pneumonectomy for metachronous lung cancer after a previous contralateral pneumonectomy. Resections included single (n = 7) or multiple wedge excisions (n = 2), and segmentectomies (n = 3). The authors reported no operative mortality, 31% postoperative morbidity (n = 4) and a 3-year survival of 46%.

Massard et al. [6] reported on 4 patients with previous pneumonectomy who underwent subsequent contralateral lung resection (wedge resection, segmentectomy and two right middle lobectomies) with no operative mortality.

Westermann et al. [7] studied 8 patients who were submitted on lung resections for metachronous lung cancer after contralateral pneumonectomy. One patient died in the immediate post-operative period, while 3 patients were alive and well at 16, 17 and 40 months after the second procedure, 2 patients died at 3 and 5 months due to disease recurrence and 2 patients were alive but with evidence of metastatic disease 18 and 21 months after the second procedure.

Levasseur et al. [8] reported on 7 patients with previous pneumonectomy who underwent subsequent pulmonary resection for either metachronous (n = 6) or synchronous (n = 1) lung cancer. The authors reported a high operative mortality (n = 3, 43%) due to either respiratory failure (n = 2) or pulmonary embolism, after right upper lobectomy, bi-segmentectomy and single wedge resection.

Kittle et al. [9] reported on 15 patients who had undergone previous pneumonectomy and were submitted subsequently to contralateral pulmonary resection for either primary lung malignancy or metastatic disease from their initial cancer. These patients underwent single (n = 3) or multiple wedge resections (n = 5), segmentectomies (n = 6) and middle lobectomy (n = 1). Operative mortality was 6.7%.

Finally, there are papers studying the management of synchronous or metachronous lung cancers, which include patients undergoing subsequent contralateral pulmonary resection after previous pneumonectomy, without however presenting outcome data specifically for this group of patients [10–14]. These studies, as well as case reports of successful lung resection after previous pneumonectomy, were not included in this analysis.

CLINICAL BOTTOM LINE

Owing to the infrequent situation of a patient being considered for a pulmonary resection after contralateral pneumonectomy, this analysis was based on only 102 patients from 8 reports. Nevertheless, analysis of the data suggests that pulmonary resection for metastatic or metachronous disease can be performed with acceptable morbidity and low mortality in appropriately selected patients who have previously undergone a pneumonectomy. Sublobar resection is the treatment of choice whenever possible, for which long-term results are rewarding especially for patients with metachronous lung cancer.

Conflict of interest: none declared.

REFERENCES


