

# Does getting smokers to stop smoking before lung resections reduce their risk?

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## Abstract

A best-evidence topic in thoracic surgery was written according to a structured protocol. The question of whether the incidence of major pulmonary morbidity after lung resection was associated with the timing of smoking cessation was addressed. Overall 49 papers were found using the reported search outlined below, of which 7 represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. In most studies, smoking abstinence was shown to reduce the incidence of post-operative pulmonary complications (PPCs) such as pneumonia, respiratory distress, atelectasis, air leakage, bronchopleural fistula and re-intubation. The timing of cessation is not clearly identified, although there is some evidence showing reduction in risk of PPCs with increasing interval since cessation. Two studies suggested that smoking abstinence for at least 4 weeks prior to surgery was necessary in order to reduce the incidence of major pulmonary events. Furthermore, it was also shown that a pre-operative smoke-free period of >10 weeks produced complication rates similar to those of patients who had never smoked. We conclude that smoking cessation reduces the risk of PPCs. All patients should be advised and counseled to stop smoking before any form of lung resection.

**Keywords:** Review • Smoking cessation • Lung resection • Pulmonary complications

## INTRODUCTION

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

## THREE-PART QUESTION

In [patients undergoing a lung resection] does [timing of smoking cessation] predict [incidence of major pulmonary morbidity]?

## CLINICAL SCENARIO

You are in clinic with a 55-year-old man with a history of heavy smoking who has been listed for a right upper lobectomy. After explaining the procedure, including the risks and benefits it may carry, you advise the patient to give up smoking. He responds by asking whether delaying surgery to increase the interval of smoking cessation pre-operatively will have a significant impact on the outcome of his surgery. You decide to check the literature yourself.

## SEARCH STRATEGY

A Medline search 1950 to July 2011 using OVID interface: (pulmonary resection/OR wedge resection/OR lung resection/OR

non-small cell carcinoma resection/OR lobectomy/OR pneumonectomy.mp) AND (smoking cessation.mp) AND (post-operative pulmonary complication.mp).

## SEARCH OUTCOME

Forty-nine papers were found using the reported search. From these, seven papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

## RESULTS

Multiple studies have demonstrated a relationship between smoking and post-operative pulmonary complications (PPCs), yet timing of cessation and its impact remain questioned.

Some smaller studies have addressed cessation and relation of PPCs with timing of cessation before lung resection. A large prospective review of the Thoracic Surgery Database including 7990 patients by Mason *et al.* [2] studied the outcome of smoking cessation on primary resections for lung cancer. They found that the risk of pulmonary complications and hospital death declined with a longer interval of smoking cessation. However, no optimal interval of smoking cessation could be identified from the results.

Table 1: Best-evidence papers

Author, date, journal and country. Design duration study type (level of evidence)	Patient group	Outcome(s)	Results	Comments/Weaknesses
Barrera et al., (2005), Chest, USA, [3]  Prospective observational cohort study (level 2b)	n = 300 (144 males, 156 females). Average age: 64 ± 12 years  (a) Current smokers: 13 (4%) (b) Stopped 1 week-2 months pre-op: 39 (13%) (c) Stopped >2 months pre-op: 184 (62%) (d) Non-smokers: 64 (21%)  Exclusions: <18 years, second surgery during admission, undergoing concomitant rib, chest wall, diaphragmatic, pericardial or pleural resections	(1) Respiratory failure requiring ICU admission and/or intubation (2) Pneumonia (3) Atelectasis requiring bronchoscopy (4) Pulmonary embolism (5) Need for supplemental oxygen therapy at discharge	Overall complications: (a) 3 (23%) (b) 9 (23%) (c) 34 (19%) (d) 5 (8%)  Overall more pulmonary complications noted in smokers compared to non-smokers (P = 0.03) but no difference among the subgroup of smokers (P = 0.76)	- Single centre, small sample size (especially number of current smokers), relied on questionnaire rather than chemical confirmation for determination of smoking status, results reflect complications which may not be associated with smoking (i.e. pulmonary embolism)
Groth et al. (2009), Lung Cancer, USA, [4],  Retrospective cohort study (level 2b)	n = 121 (all male patients, mean age: 67.4 years)  (a) Current smokers: 23 (b) Quit smoking <1 month before surgery: 16 (c) Quit smoking >1 month before surgery: 81  Excluded: 1 patient (lifetime non-smoker)	(1) Air leak (2) Reintubation (3) Pneumonia (4) Any complications	(1) (a) 8.0% (b) 6.3% (c) 8.5%  (2) (a) 0% (b) 6.3% (c) 4.9%  (3) (a) 12.0% (b) 6.3% (c) 12.2%  (4) (a) 44% (b) 18.8% (c) 42.7%	- Rate of PPC incidence not affected significantly by smoking status across three groups  - Single centre, retrospective, only male patients, lack of statistical power, small sample size, patients self-reporting of smoking status
Mason et al. (2009), Ann Thorac Surg, USA, [2]  Multicentre prospective cohort study (level 2b)	n = 7990 (3862 males, 4128 females),  Analysed = 7965 (25 died on day of op)  (a) Current smokers: 1595 (23%) (b) Quit 14 days-1 month pre-op: 404 (6%) (c) Quit 1-12 month pre-op: 940 (12%) (d) Quit smoking >1 year pre-op: 4026 (58%) (e) Never smoked: 1025 (13%)  Exclusions: patients aged <18, emergency operations, or missing data on age, gender, operation date	(1) Hospital mortality—death occurring within hospitalization period (2) Pulmonary complications—prolonged ventilation (>48 h post-op), reintubation, atelectasis requiring bronchoscopy, tracheostomy, pneumonia, and ARDS	(1) (a) 24 (1.5%) (b) 7 (1.7%) (c) 12 (1.3%) (d) 62 (1.5%) (e) 4 (0.39%)  (2) (a) 110 (6.9%), P = 0.03 (b) 25 (6.2%), P = 0.14 (c) 60 (6.4%), P = 0.2 (d) 234 (5.8%), P = 0.3 (e) 27 (2.6%)	- Mortality was lower with longer intervals of smoking cessation before resection  - Risk of major pulmonary complications steadily decreased as interval between cessation and operation increased. No sharp transition suggesting optimal timing of cessation  - Self-reported and voluntary data collection that lacks formal auditing may predispose to underreporting of outcomes, smoking status based on self-reporting (bias)
Nakagawa et al. (2001), Chest, Japan, [5]  Retrospective cohort study (level 2b)	n = 288 (167 males, 121 females)  (a) Never smoked: 117 (b) Quit > 4 weeks before operation: 121	(1) Atelectasis prompting bronchoscopy (2) Pneumonia (3) PaCO <sub>2</sub> > 50 mmHg 24 h post-op	Total complications in each patient group: (a) 28 (23.9%) (b) 42 (34.7%) (c) 7 (53.8%) (d) 16 (43.2%)	- Incidence of pulmonary complications amongst current/recent smokers was higher than never smokers (P < 0.05)  - Risk for developing PPCs declined in patients who

Continued

Table 1: Continued

Author, date, journal and country. Design duration study type (level of evidence)	Patient group	Outcome(s)	Results	Comments/Weaknesses
	(c) Quit 2–4 weeks before operation: 13 (d) Current smoker: 37	(4) Air leak or effusion requiring intercostals tube drainage for > 7 days (5) Bronchopleural fistula with large air leak or infection (6) Empyema (7) Chylothorax (8) Hemothorax requiring drainage/reoperation (9) Tension pneumothorax (10) Pulmonary embolism (11) Lobar gangrene (12) Mechanical ventilation > 72 h (13) Intercostal tube drainage > 14 days (14) Required fraction of inspired oxygen > 0.6 post-op		stopped smoking 5–8 weeks prior to surgery, and risk for complication in patients whose pre-operative smoke-free period was >10 weeks was similar to that in the never-smokers group - Self-reporting of smoking status, retrospective study, single centre, small sample size
Sawabata <i>et al.</i> (2007), Gen Thorac Cardiovasc Surg, Japan, [6] Multicentre Retrospective cohort study (level 2b)	<i>n</i> = 169 (89 males, 80 females) (a) Never smoked: 66 (b) Ex-smoker (stopped >1 year prior to cancer diagnosis): 36 (c) Current smoker: 67	(1) 5-year survival rate	(1) (a) 91% (b) 88% (c) 72%	- Current smokers showed a worse survival rate than those in other two groups, although the difference was only statistically significant between the never-smoked group and current smokers ( <i>P</i> = 0.02) - Retrospective, small sample size, self-reporting of smoking status
Shimizu <i>et al.</i> , (2008), Interact CardioVasc Thorac Surg, Japan, [7] Retrospective cohort study (level 2b)	<i>n</i> = 194, (123 males, 71 females, average age: 68.8 ± 10 years) (a) Non-smokers: 70 (b) Ex-smokers (quit > 12 months before surgery): 40 (c) Current smokers (smoked within 12 months of surgery): 84	(1) Respiratory complications— pneumonia, atelectasis, prolonged air leakage, bronchopleural fistula (2) Cardiac event	(1) (a) 7 (10%) (b) 9 (23%) (c) 16 (19%)	- Current smokers/ex-smokers did not show a significant difference in respiratory complications ( <i>P</i> = 0.65) - Retrospective, small sample size, self-reporting of smoking status
Vaporciyan <i>et al.</i> (2002), Ann Thorac Surg, USA, [8] Retrospective cohort study (level 2b)	<i>n</i> = 261 (179 males, 78 females, average age: 60 ± 10 years) (a) Never smoked: 34 (13.2%) (b) Quit >1 month before operation: 163 (63.4%) (c) Quit <1 month before operation: 60 (23.3%)  Excluded: patients who died within 12 h of op from cardiac or haemorrhagic cause	(1) Major pulmonary event— pneumonia, ARDS (2) Mortality (3) Length of stay (LOS) in hospital	(1) (a) 5 (14.7%) (b) 15 (9.2%) (c) 13 (21.7%) (2) (a) 1 (2.9%), b + c 15 (6.7%) (3) (a) 10.35 ± 11.85 days, b + c 11.87 ± 14.57 days	- Timing of smoking cessation increased the incidence of pulmonary complications ( <i>P</i> = 0.013) - The mortality rates were significantly higher in non-smokers compared to smokers ( <i>P</i> = 0.40), however, the LOS was not ( <i>P</i> = 0.57) - Also, mortality and LOS were much higher in those with PPCs compared to those without ( <i>P</i> < 0.001) - Retrospective, small sample size, single centre

Barrera *et al.* [3] in 2005 carried out a prospective study investigating the effect of timing of smoking cessation on PPCs. They reported, in patients undergoing a thoracotomy for primary or secondary lung cancer, there was no evidence for the development of PPCs in patients who were active smokers compared with those who had <2 months of smoking cessation and those who had >2 months of smoking cessation.

Groth *et al.* [4] retrospectively reviewed 121 patients, investigating the impact of pre-operative smoking status on post-operative complication rates in patients undergoing non-small-cell lung cancer (NSCLC) resection. They concluded that the timing of smoking cessation relative to surgery did not significantly affect PPCs.

Nakagawa *et al.* [5] studied 288 patients undergoing pulmonary resections to examine the duration of pre-operative smoking-free period on the development of PPCs. They found that smoking cessation prior to surgery reduced the risk of developing pulmonary complications, and that at least 4 weeks of smoking abstinence was necessary for a marked reduction. They also noticed that the incidence of PPCs in patients who had a smoke-free period of 9–12 weeks or longer approached the same incidence as those in the never-smoked group.

Sawabata *et al.* [6] found that current smoking was an adverse prognostic factor in patients undergoing resection of NSCLC after conducting a multicentre review containing 169 patients. The 5-year survival rate was reduced in patients who were current smokers when compared with ex-smokers and non-smokers. However, the difference in survival rates was only statistically significant between current smokers and non-smokers ( $P=0.02$ ), suggesting that the interval of smoking cessation did not impact on long-term survival.

Shimizu *et al.* [7] retrospectively reviewed the records of 194 patients to explore the influence of cigarette smoking on post-operative complications in patients with lung cancer. Smokers were sub-classified by their smoking status, and in comparison with non-smokers, smoking patients did not have a higher rate of PPCs. Furthermore, the study did not find any significant difference in the incidence of complications among the sub-groups of smokers either ( $P=0.65$ ).

Vaporciyan *et al.* [8] evaluated pulmonary complications (acute respiratory distress syndrome, ARDS, pneumonia) after pneumonectomy and came to the conclusion that patients who smoked within 1 month of their operation had the highest risk. Mortality after pneumonectomy was also found to increase significantly with the development of a PPC ( $P < 0.001$ ).

The incremental cost-effectiveness of a formal smoking cessation programme was evaluated by Slatore *et al.* [9]. The model included the cost and effectiveness of the cessation programme, cost and incidence of perioperative complications, post-

operative mortality and utility measured in quality-adjusted life years (QALY). The cessation programme was shown to be cost-effective at both 1 and 5 years post-surgery with the cost/QALY and cost/life year being \$16 415 and \$45 629 at 1 year after surgery, and \$2609 and £2703 at 5 years, respectively.

## CLINICAL BOTTOM LINE

Smoking cessation reduces the risk of PPCs; however, an optimal interval of cessation has not been clearly identified. There is evidence to show the risk declines with a longer smoke-free period. Patients should be advised and counseled to stop smoking irrespective of surgical timing before any form of lung resection.

**Conflict of interest:** none declared.

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