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Does video-assisted thoracic surgery provide a safe alternative to conventional techniques in patients with limited pulmonary function who are otherwise suitable for lung resection?

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Abstract

A best evidence topic in thoracic surgery was written according to a structured protocol. The question addressed was: does video-assisted thoracic surgery provide a safe alternative to conventional techniques in patients with limited pulmonary function who are otherwise suitable for lung resection? Altogether, more than 280 papers were found using the reported search, 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. One of the largest studies reviewed was a retrospective review of the Society of Thoracic Surgeons database. The authors compared 4531 patients who underwent lobectomy by video-assisted thoracic surgery (VATS) with 8431 patients who had thoracotomy. In patients with a predicted postoperative forced expiratory volume in 1 s (ppoFEV$_1$%) of <60, it was demonstrated that thoracotomy patients have markedly increased pulmonary complications when compared with VATS patients ($P = 0.023$). Another study compared perioperative outcomes in patients with a ppoFEV$_1$% of <40% who underwent thoracoscopic resection with similar patients who underwent open resection. Patients undergoing thoracoscopic resection as opposed to open thoracotomy had a lower incidence of pneumonia (4.3 vs 21.7%, $P < 0.05$), a shorter intensive care stay (2 vs 4 days, $P = 0.05$) and a shorter hospital stay (7 vs 10 days, $P = 0.058$). A similar study compared recurrence and survival in patients with a ppoFEV$_1$% of <40% who underwent resection by VATS or anatomical segmentectomy (study group) with open resection (control group). Relative to the control group, patients in the study group had a shorter length of hospital stay (8 vs 12 days, $P = 0.054$) and an improved 5-year survival (42 vs 18%, $P = 0.02$). Analysis suggested that VATS lobectomy was the principal driver of survival benefit in the study group. We conclude that patients with limited pulmonary function have better outcomes when surgery is performed via VATS compared with traditional open techniques. The literature also suggests that patients in whom pulmonary function is poor have similar perioperative outcomes to those with normal function when a VATS approach to resection is adopted.

Keywords: Video-assisted thoracic surgery • Evidence-based medicine • Lobectomy • Pulmonary function • Lung cancer

INTRODUCTION

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

THREE-PART QUESTION

Does [video-assisted thoracic surgery] provide a safe alternative to conventional techniques in patients with [limited pulmonary function] who are otherwise suitable for [lung resection]?

CLINICAL SCENARIO

A 64-year old male, smoker, is referred to the thoracic surgery outpatient clinic with non-small-cell lung cancer currently staged as T1aN0M0. The lesion measures 1.9 cm in diameter on computed tomogarphic imaging and meets anatomical considerations for either video-assisted thoracic surgery or conventional open techniques. During preoperative assessment, the patient is found to have a predicted postoperative forced expiratory volume in 1 s (ppoFEV$_1$%) of 35%. You tell the patient that guidelines suggest that individuals with this level of lung function are considered high risk for surgery, but the patient is keen to proceed. You have recently read reports that video-assisted thoracic surgery may be a safer alternative to conventional techniques in patients with limited pulmonary function. To guide your decision, you turn to the literature to review the best evidence available.

Search strategy

Medline 1990 to November 2012 using OVID interface [video assisted thoracic surgery.mp OR VATS.mp OR minimally invasive.

Table 1: Best evidence papers

Author, date, journal and country, Study type (level of evidence)	Patient group	Outcomes	Key results	Comments
Ceppa *et al*. (2012), Ann Surg, USA [2] Retrospective cohort study (level 3)	12 970 patients from the (STS) database who underwent lung resection VATS: $n = 4531$ Thoracotomy: $n = 8431$	Pulmonary complications (atelectasis, pneumonia, acute respiratory distress syndrome, broncho-pleural fistula, ventilatory support >48 h, reintubation and tracheostomy)	Overall incidence: 21.7% in the thoracotomy group compared with 17.8% in the VATS group In ppoFEV_1% <60%, thoracotomy patients had increasing complications with decreasing ppoFEV_1% compared with VATS ($P = 0.023$)	In this large retrospective review, the authors conclude that respiratory complications increase at a significantly greater rate in lobectomy patients with poor pulmonary function after thoracotomy compared with VATS
Kachare *et al*. (2011), J Thorac Cardiovasc Surg, USA [3] Retrospective cohort study (level 3)	70 lung resection patients with ppoFEV_1% <40% VATS: $n = 47$ Thoracotomy: $n = 23$	Pneumonia Hospital stay Intensive care stay	Incidence: VATS: 4.3% Thoracotomy: 21.7% ($P = 0.035$) VATS: 7 days Thoracotomy: 10 days ($P = 0.058$) VATS: 2 days Thoracotomy: 4 days ($P = 0.05$)	The authors conclude that patients with marginal lung function tolerate thoracoscopic resection well
Lau *et al*. (2010), Eur J Cardiothorac Surg, UK [4] Retrospective cohort study (level 3)	84 lung resection patients with ppoFEV_1% <40% *Study group:* VATS: $n = 22$ Open segmentectomy: $n = 27$ *Control group:* Open lobectomy: $n = 35$	Five-year survival Median length of hospital stay	Study group: 42% Control group: 18% ($P = 0.030$) Study group: 8 days (range 3–31) Control group: 12 days (range 4–91) ($P = 0.054$)	The authors conclude that patients undergoing open lobectomy have a worse outcome despite adjusting for confounders
Endoh *et al*. (2009), Eur J Cardiothorac Surg, Japan [5] Retrospective cohort study (level 3)	155 lung resection patients VATS: $n = 70$ Posterolateral thoracotomy (PLT): $n = 55$ Anterolateral thoracotomy (AL): $n = 30$	Baseline to postoperative (Day 7) FEV_1 ratio Baseline to postoperative (Day 7) VC ratio	VATS: 94.7% PLT: 87.6% AL: 90.4% VATS: 96.5% PLT: 87.4% AL: 90.1%	The authors conclude that with respect to respiratory function VATS lobectomy was superior to thoracotomy
Kaseda *et al*. (2000), Ann Thorac Surg, Japan [6] Retrospective review (level 3)	204 VATS lung resection patients evaluated *Study group*: VATS: $n = 44$ Open: $n = 77$	% decrease in FEV_1 pre- to postoperatively	VATS = 15% Open = 29%	The authors conclude that pulmonary function and prognosis were far better after VATS than after open thoracotomy
Garzon *et al*. (2006), Ann Thorac Surg, China [7] Retrospective cohort study (level 4)	25 lung resection patients with ppoFEV_1% <50% VATS lobectomy: $n = 13$ VATS wedge resection: $n = 12$	Morbidity Survival	Complications occurred in 28% Respiratory complications in 20% 80% at 1 year 69% at 2 years	The authors conclude that VATS resection for lung cancer patients with poor lung function can achieve morbidity and survival rates comparable with patients with adequate lung function

Continued

Table 1: (*Continued*)

Author, date, journal and country, Study type (level of evidence)	Patient group	Outcomes	Key results	Comments
Linden *et al.* (2005), Chest, USA [8]	100 lung resection patients with preoperative FEV_1 <35%	Prolonged air leak	Incidence: 22%	The authors conclude that lung resection is feasible in patients with FEV_1 <35% with acceptable rates of morbidity and mortality
Retrospective review (level 4)		New oxygen requirement	Incidence: 11%	
	Thoracoscopic wedge resection: $n = 65$	Respiratory failure	Incidence: 4%	
	Thoracotomy: $n = 10$ VATS lobectomy: $n = 4$ Others: $n = 21$	Pneumonia	Incidence: 4%	Prolonged air leak was the most common complication in those with limited lung function

mp] AND [lung function.mp OR pulmonary function.mp OR FEV_1.mp] AND [lobectomy.mp OR lung resection.mp].

SEARCH OUTCOME

Two hundred and eighty-three 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

Ceppa *et al.* [2] conducted a large retrospective review of the Society of Thoracic Surgeons database. They compared 4531 patients who underwent lobectomy by VATS with 8431 patients who had lobectomy with thoracotomy. The overall rates of complications were 21.7 and 17.8% in patients undergoing thoracotomy and VATS, respectively ($P < 0.0001$). Particular attention was given to patients with a ppoFEV_1% of <60%. In this sub-group, it was demonstrated that thoracotomy patients have markedly increased pulmonary complications when compared with VATS patients ($P = 0.023$).

Kachare *et al.* [3] compared perioperative outcomes in patients with a ppoFEV_1% of <40% who underwent thoracoscopic resection with similar patients who underwent open resection. Relative to patients undergoing open resection, patients undergoing thoracoscopic resection had a lower incidence of pneumonia (4.3 vs 21.7%, $P < 0.05$), a shorter intensive care stay (2 vs 4 days, $P = 0.05$) and a shorter hospital stay (7 vs 10 days, $P = 0.058$).

Lau *et al.* [4] compared recurrence and survival in patients with a ppoFEV_1% of <40% who underwent resection by VATS or anatomical segmentectomy (study group) with open resection (control group). Relative to the control group, patients in the study group had a shorter length of hospital stay (8 vs 12 days, $P = 0.054$) and an improved 5-year survival (42 vs 18% $P = 0.02$). Analysis suggested that VATS lobectomy was the principal driver of survival benefit in the study group.

Endoh *et al.* [5] looked at the data from patients who underwent resection by VATS, anterior limiting thoracotomy (AL) and posterolateral thoracotomy (PL). They measured FEV_1 and vital capacity (VC) on postoperative day 7 and compared this with preoperative values using the analysis of covariance. In the VATS group, the VC and FEV_1 ratios were 96.5 and 94.7%, respectively. This was significantly higher than the thoracotomy group (AL: 90.4 and 90.1%, respectively; PL: 87.4 and 87.6%, respectively).

Kaseda *et al.* [6] evaluated the postoperative to preoperative ratio of pulmonary function tests in 204 patients who underwent VATS lobectomy. The loss in pulmonary function was less in VATS lobectomy than in open thoracotomy (VC: 15 vs 23%, respectively, and FEV_1: 15 vs 29%, respectively, $P < 0.0001$).

Garzon *et al.* [7] analysed morbidity and mortality in 25 patients with a ppoFEV_1% of <50% who underwent either VATS lobectomy or VATS lung resection. They reported an overall complication rate of 28%, of whom 20% had respiratory complications. The actuarial survival rates at 1 and 2 years were 80 and 69%, respectively. They report that these morbidity and survival rates are comparable with patients in whom pulmonary function is adequate.

Linden *et al.* [8] performed a retrospective review of 100 patients who underwent lung resection in whom the preoperative predicted FEV_1% was <35%. Sixty-five patients underwent thoracoscopic wedge resection, eight VATS resection (VATS lobectomy $n = 4$ and segmentectomy $n = 4$), with the remaining 27 undergoing open resection (lobectomy $n = 10$, wedge resection $n = 5$, lung reduction $n = 8$ and segmentectomy $n = 4$). Complications were reported in 36% of patients. Prolonged air leak was the most common complication seen in 22% of patients. New oxygen requirement was reported in 11%, respiratory failure in 4% and pneumonia in 4%.

CLINICAL BOTTOM LINE

Several retrospective reviews have concluded that patients with limited pulmonary function have better outcomes when surgery is performed via VATS compared with traditional open techniques. The literature also suggests that patients in whom pulmonary function is poor have similar perioperative outcomes to those with normal pulmonary function when a VATS approach to resection is adopted.

Conflict of interest: none declared.

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