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Best evidence topic - Thoracic non-oncologic

Is video-assisted thoracoscopic surgical decortication superior to open surgery in the management of adults with primary empyema?

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Summary

A best evidence topic in thoracic surgery was written according to a structured protocol. The question addressed was whether video-assisted thoracoscopic surgical decortication (VATSD) might be superior to open decortication (OD) (or chest tube drainage) for the management of adults with primary empyema? Altogether 68 papers were found using the reported search, of which 14 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. We conclude that VATSD has superior outcomes for the treatment of persistent pleural collections in terms of postoperative morbidity, complications and length of hospital stay, and gives equivalent resolution when compared with OD. One study comparing VATSD and chest tube drainage of fibrinopurulent empyema found video-assisted thoracoscopic surgery (VATS) had higher treatment success (91% vs. 44%; $P<0.05$), lower chest tube duration (5.8 ± 1.1 vs. 9.8 ± 1.3 days; $P=0.03$), and lower number of total hospital days (8.7 ± 0.9 vs. 12.8 ± 1.1 days; $P=0.009$). Eight studies comparing early and late empyema report conversion rates to OD of 0–3.5% in early, 7.1–46% in late stage and significant reductions in length of stay with VATSD compared with OD both postoperatively (5 vs. 8 days; $P=0.001$) and in total stay (15 vs. 21; $P=0.03$). Additionally VATS resulted in reduced postoperative pain ($P<0.0001$) and complications including atelectasis ($P=0.006$), prolonged air-leak ($P=0.0003$), sepsis ($P=0.03$) and 30-day mortality ($P=0.02$). Five studies considered only chronic persistent empyema of which two directly compared VATSD to tube thoracostomy (TT). VATS resolved 88% of cases and had mortality rates of 1.3% compared with 62% and 11%, respectively, for TT. Moreover, conversion to OD was 10.5–17.1% with VATS and 18–37% with TT ($P<0.05$). In agreement with mixed stage empyema, hospital stay was reduced both postoperatively (8.3 vs. 12.8 days; $P<0.05$) and in total (14 ± 1 vs. 17 ± 1 days; $P<0.05$), and when compared with OD (one study), pain ($P<0.0001$), postoperative air-leak ($P=0.004$), hospital stay ($P=0.020$) and time to return to work ($P<0.0001$) were all reduced with VATS. Additionally, re-operation (4.8% vs. 1%; $P=0.09$) and mortality (4/123% vs. 0%) were lower in VATS vs. OD.

Keywords: Pleural empyema; Parapneumonic effusion; Video-assisted thoracoscopic surgery

1. Introduction

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

2. Clinical scenario

You are called to see a 65-year-old patient who has become pyrexial on your ward. He is being treated for a parapneumonic effusion which has not responded to antibiotics or simple chest tube drainage and you feel surgical intervention is required for resolution. The patient has already been admitted for 14 days and while open surgery is the standard treatment in your hospital you have access to video-assisted thoracoscopic surgery (VATS) and feel that minimally-invasive decortication would be effective, may decrease the patients hospital stay and provide less morbidity postoperatively. You carry out a review of the literature.

3. Three-part question

In [adults with empyema] is [VATS decortication] superior to [open decortication or chest tube drainage] in terms of [resolution of disease and postoperative morbidity]?

4. Search strategy

Medline search 1950–February 2010 was performed using the OVIDSP interface [exp Empyema, Pleural/OR empyema.mp OR parapneumonic effusion.mp] AND [decortication.mp OR exp Pulmonary Surgical Procedures/OR exp Thoracic Surgery, Video-Assisted/OR VATS.mp] AND [exp Randomized Controlled Trials as Topic/OR exp Clinical Trial/OR exp Cohort studies/OR exp 'Review Literature as Topic'/OR systematic review.mp].

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5. Search outcome

Sixty-eight articles were identified. From these, 14 papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

6. Results

We must acknowledge first that there are different stages of empyema which may determine the most suitable treatment, from the exudative stage 1, to the fibrinopurulent and loculated stage 2, to the more chronic organizational phase of stage 3.

Highlighted by Coote and Kay [16] in a systematic review, Wait et al. [2] considered stage 2 empyema only. They randomised 20 patients to either video-assisted thoracoscopic surgical decortication (VATSD) ($n=11$) or chest tube drainage (with streptokinase) ($n=9$). VATSD had higher treatment success (10/11, 91% vs. 4/9, 44%; $P<0.05$), lower chest tube duration (5.8 ± 1.1 vs. 9.8 ± 1.3 days; $P=0.03$), and decreased total hospital days (8.7 ± 0.9 vs. 12.8 ± 1.1 days; $P=0.009$). Each group suffered one mortality ($P=$NS).

Eight studies looked at empyema of mixed stage (stages 2/3). In 1996, Landreneau et al. [3] reviewed 76 patients treated with VATSD, of which 26 had chronic pleural infection >3 weeks. Seventeen percent ($n=13$) required conversion to open decortication (OD), wherein 12/13 (46% of chronic empyema) had chronic infections. Mean postoperative hospital stay was 7.4 ± 7.2 days and mortality was 6.6% ($n=5$) related to progressive sepsis.

Kim et al. [4] demonstrated that VATSD was effective in 65/70 patients (five converted to OD) with empyema thoracis of mixed stage. Mean postoperative stay was 5 ± 0.7 days with no reported complications. Solaini et al. [5] reported their experience of VATS in 120 patients with pleural empyema (all stages) with 8.2% ($n=9$) conversion to OD, and complications in 11% ($n=12$) (prolonged air-leak 50%).

In 2005, Luh et al. [6] compared VATSD in treating complicated parapneumonic effusion (stage 2) ($n=145$) and loculated empyema (stage 3) ($n=89$). Those with empyema had a conversion rate to OD of 21.3% compared with 3.5% with complicated effusion ($P<0.05$). There was also significant reductions in postoperative length of stay (effusion 9.1 vs. 18.5 days; $P<0.05$), perioperative morbidity (effusion − 6.2% vs. empyema − 11.2%; $P<0.05$) and perioperative mortality (effusion − 2.1% vs. empyema − 5.6%; $P<0.05$).

Shahin et al. [7] reported a conversion rate to OD of 3.5% (1/28) of patients with fibrinopurulent empyema (stage 2) and 19% ($n=6/32$) with advanced organized empyema. Postoperative stay was shorter with VATS than OD (5 vs. 8 days; $P=0.001$) and no mortality was reported in either group.

Chan et al. [8] compared 71 cases of empyema thoracis (75% stage 3), treated with either VATSD ($n=41$) or OD ($n=36$). VATS had shorter operative time (2.5 vs. 3.8 h; $P<0.001$), less postoperative pain ($P=0.04$), greater satisfaction with the wounds ($P<0.0001$), and greater satisfaction with the operation overall ($P=0.006$). No patients were converted from VATS to OD and re-intervention was 0% in both groups. Most recently, Tong et al. [9] also compared VATSD ($n=326$) and OD ($n=94$), in 420 patients with empyema, of which 11.4% of VATS cases were converted to thoracotomy. The VATSD group had reduced hospital stays (15 vs. 21 days; $P=0.03$) and significantly reduced postoperative complications and 30-day mortality ($P=0.02$).

Six studies consider VATSD for stage 3 organizing empyema. Mandel et al. [10] conducted a prospective longitudinal analysis of 179 patients of which 76 underwent VATSD (primary $n=60$, secondary $n=16$) with a cure rate of 88% ($n=67$) and mortality of 1.3% ($n=1$), compared with 90% ($n=18$) and 0% following thoracocentesis and 62% ($n=56$) and 11% ($n=10$) following tube thoracostomy (TT), respectively. In the VATSD group, 10.5% ($n=8$) required conversion to OD. Additionally, VATS significantly reduced length of hospital stay vs. TT (14 ± 1 vs. 17 ± 1 days; $P<0.05$).

Two studies compare VATSD with OD in chronic parapneumonic pleural empyema. A prospective study by Waller and Rengarajan [11] found VATS to be successful in 58% of cases ($n=21$) (compared to open surgery; $P=0.001$) and significantly reduced hospital stay (mean 2.9 days; $P=0.004$). Cardillo et al. [13] report VATS ($n=185$) having significantly better results than OD ($n=123$) in terms of operative time ($P<0.0001$), pain ($P<0.0001$), postoperative air-leak ($P=0.004$), hospital stay ($P=0.020$) and time to return to work ($P<0.0001$). Conversion rate to open surgery was 11/185 (5.9%). Additionally, re-operation [6/123 (4.8%) vs. 2/185 (1%); $P=0.09$] and mortality [4/123 (3.25%) vs. 0%] were lower in VATS vs. OD.

In a prospective randomised study by Bilgin et al. [12], VATSD and chest tube drainage (Group I) were compared to TT alone (Group II). In Group I, 17.1% ($n=6$) of patients were converted to formal thoracotomy for decortication compared with 37.1% ($n=13$) in Group II, ($P<0.05$). Hospital stay was also significantly reduced in Group I vs. Group II (8.3 vs. 12.8 days; $P<0.05$).

Drain et al. [14] report the successful management of stage 3 empyema by two-window VATSD in 52 patients. The mean drainage time was 3.9 days (range 2–10 days; median − 4 days), and the median time to hospital discharge was 10 days. There were no reported complications and resolution occurred in 94% ($n=49$) with three patients requiring computed tomography-guided drainage. This compares with OD, where a drainage time of four to seven days, a mean hospital stay of 10 days (range 5–31) and 87.5% ($n=35$) resolution are reported by Melloni et al. [15].

7. Clinical bottom line

In early stage empyema British Thoracic Society (BTS) guidelines recommend chest tube drainage, antibiotics and fibrinolytic drugs, however, failure of these in the presence of persistent pleural collection usually requires surgical intervention. No consensus is currently in place on which the surgical option is first line; however, here several studies have shown that VATSD offers superior outcomes when compared with TT and equivalent outcomes in terms of resolution of disease when compared with open surgery. Moreover, VATS decreases the length of hospital stay, post-

Table 1. Best evidence papers

Author, date, journal, country Level of evidence	Patient group	Outcome	Key results	Comments
Wait et al., (1997), Chest, USA, [2]	Single centre, prospective, non-blinded study over two years VATS decortication vs. chest tube drainage $n=20$	Mortality	Each group suffered one mortality (P=NS)	Loculated, complex fibrinopurulent parapneumonic empyema thoracis is better treated with a primary treatment strategy of VATS
Randomized control trial (level 1b)		Treatment success	10/11, 91% vs. 4/9, 44%; $P<0.05$	
		Chest tube duration	5.8±1.1 vs. 9.8±1.3 days; $P=0.03$	VATS is associated with a higher efficacy, shorter hospital duration, and less cost than a treatment strategy that utilizes catheter-directed fibrinolytic therapy
		Lower number of total hospital days	8.7±0.9 vs. 12.8±1.1 days; $P=0.009$	
		Cost	\$16,642±2841 vs. \$24,052±3466; $P=0.11$	
			All the CT-SK treatment failures could be salvaged with VATS, and none needed thoracotomy	
Landreneau et al., (1996), Chest, USA, [3]	Seventy-six patients with complex empyemas (including 26 chronic) were approached with VATS after inadequate chest tube drainage	Chest tube removal	3.3±2.9 days postoperatively in 67 patients	VATS has been highly successful in the early management of empyemas and haemothoraces in this study. Conversion to open thoracotomy must always be anticipated, especially when approaching chronic empyemas
		Mean hospital stay	7.4±7.2 days	
Retrospective cohort study (level 2b)		Mortality	$n=5$	
	Sixty-three patients (83%) were treated with thoracoscopic drainage±decortication alone			
Kim et al., (2004), Am J Surg, South Korea, [4]	VATS debridement and decortication in 70 consecutive patients presenting with pleural space infections was performed with endoscopic shaver system	Success rate	65/70	Video-assisted thoracoscopic decortication with endoshaver system is a simple and effective method in the management of the fibropurulent or organic pleural empyema
		Mean duration of preoperative symptoms	23±1.8 days	
Retrospective cohort study (level 2b)		Blood loss	330±200 ml	
		Chest tube drainage	5±3 days	
		Postoperative stay	5±0.7 days	
		Mortality	0	
Solaini et al., (2007), Surg Endosc, Italy, [5]	Retrospective single centre experience over 12 years $n=120$	Conversion rate	Only VATS in 101 patients (91.8%), $n=9$ (8.2%) converted	VATS is technique of first choice for the treatment of pleural empyema when the disease is advanced or tube thoracostomy fails
Retrospective cohort study (level 2b)	VATS $n=38$, thoracotomy $n=82$	Complications	$n=1$ persistent empyema (0.9%) treated by thoracotomy	Excellent results with a low level of invasiveness and considerably reduces the need for thoracotomy
		Chest tube duration	6 days (range 3–25 days) VATS 7.1 days (range 5–17 days) thoracotomy	
		Hospital stay	$n=80$ (6-month follow-up): the clinical results were considered good for 72, moderately good for 8, and less than satisfactory for two patients	
Luh et al., (2005), Chest, Taiwan, [6]	Retrospective single centre experience over 8 years $n=234$	Procedure time	64.3±22.5 min (range 26–244 min). Sixteen patients (6.8%) needed further surgery	Authors concluded that VATS is safe and effective for treatment of complicated parapneumonic effusion

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Table 1. *(Continued)*

Author, date, journal, country Level of evidence	Patient group	Outcome	Key results	Comments
Retrospective cohort study (level 2b)	Interventions: septal lysis and debridement irrigation through one port (31 patients, 13.2%)		for empyema ($n=9$) required open drainage or thoracoplasty, and $n=7$ needed redecortication or repair of bronchopleural fistula	and pleural empyema Earlier intervention with VATS can produce better clinical results
	Decortication and debridement through two or three ports (179 patients, 76.5%)			
	Rib resection or larger utility incision for decortication and drainage (24 patients, 10.3%)	Mortality	0	
		Perioperative deaths (<30 days)	8 (3.4%)	
		Success with VATS	202/234 (86.3%) Patients requiring open decortication (OD) or repeat procedures ($n=40$) had a longer mean duration of preoperative symptoms, longer mean duration of preoperative hospitalization, and a higher ratio of pleural empyema (vs. complicated parapneumonic effusion) than patients undergoing simple VATS	
Shahin et al., (2010), Interact CardioVasc Thorac Surg, UK, [7] Retrospective cohort study (level 2b)	Single centre three years experience $n=106$ 81/106 (76%) had primary empyema, 24% had secondary empyema Stage III patients underwent VATS decortication	Conversion rate	19%	VATS debridement or decortication had a lower hospital stay Conversion rate to open procedure for stage III empyema was only 19% The authors conclude that we should consider VATS debridement and decortication as a first choice treatment for primary empyema
		Mortality	0	
		Length of hospital stay (mean)	VATS debridement six days VATS decortication five days OD 8 days	
Chan et al., (2007), Ann Thorac Surg, China, [8] Retrospective cohort study (level 2b)	Retrospective single centre experience over five years $n=77$ VATS $n=41$, thoracotomy $n=36$ (Both groups matched for demographics and clinical features/severity)	Conversion rate	0	VATS is as effective as OD for empyema VATS approach gives less pain and greater patient satisfaction
		Mean operative time	2.5 vs. 3.8 h, $P<0.001$ Decortication using both approaches gave similar degrees of postoperative radiological and functional improvements	
		Postoperative pain reduction	$P=0.04$	
		Greater satisfaction with the wounds	$P<0.0001$	
		Greater satisfaction with the operation overall	$P=0.006$	
Tong et al., (2010), Ann Thorac Surg, USA, [9] Retrospective cohort study (level 2b)	Single centre 10 years experience $n=420$ 326 VATS decortication (VATSD) 94 OD	Conversion rate	11.4%	VATS decortication for complex pleural effusions, haemothorax and empyema yields results that are at least equivalent to OD VATSD had fewer postoperative complications The conversion and re-operation rates are low
		Operative time	97 vs. 155 min ($P<0.001$)	
		Median in-hospital length of stay	15 vs. 21 days ($P=0.03$), respectively	
		The median postoperative length of stay	Seven days for the VATSD group vs. 10 days for the OD group ($P<0.001$)	

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Table 1. *(Continued)*

Author, date, journal, country Level of evidence	Patient group	Outcome	Key results	Comments
			Significantly fewer postoperative complications occurred in the VATSD group in the following categories: atelectasis, prolonged air-leak, reintubation, ventilator dependence, need for tracheostomy, blood transfusion, sepsis, and 30-day mortality	VATS approach is an effective and reasonable first-line option for most patients with complex pleural effusions and empyema
Mandal et al., (1998), Ann Thorac Surg, USA, [10]	Single centre, prospective longitudinal, non-blinded study over 25 years $n=179$	Mortality rate	11% (10 patients) and 24 patients (26.6%) required a secondary procedure	42% of patients with primary empyema thoracis ultimately needed decortication
Cohort study (level 2b)	20/179 (11.1%) had thoracentesis as the primary procedure and 18 (90%) were cured	Cure rate	76 had decortication as either the primary or secondary procedure with a cure rate of 88% (67 patients) and a mortality rate of 1.3% (1 patient)	Decortication is more frequently necessary in anaerobic, tuberculous, staphylococcal, and pneumococcal infections Overall mortality in this study was low; mortality remained high in elderly patients with multiple co-morbidities
		Conversion rate	8 patients required conversion to open thoracostomy. Hospital stay for decortication was 14 ± 1 days and for closed thoracostomy, 17 ± 1 day ($P<0.05$)	
			Decortication was necessary in 55% of patients with anaerobic infections and in 50% with aerobic infections	
			The overall mortality rate in this study was 6.7% (12/179 patients)	
Waller and Rengarajan (2001), Ann Thorac Surg, UK, [11] Cohort study (level 2b)	Single centre prospective study over 3 years $n=48$ Before VAT decortication 12 patients were treated by thoracotomy (Group T) Subsequently 36 patients had VAT decortication attempted with success in 21 (Group VS). Lung expansion was not observed in 15 patients (Group VF) who required thoracotomy	Operating time	Longer in Group T vs. VS, mean difference 30.3 min ($P=0.001$)	The authors conclude: 'VAT decortication is a feasible new technique to achieve lung re-expansion in chronic postpneumonic pleural empyema and has perioperative benefits over thoracotomy'
		Postoperative hospital stay	Group T vs. VS, mean difference 2.9 days ($P=0.004$)	
		Success rate	Success of VAT decortication was not related to either the delay between onset of symptoms or hospital admission and surgery	
		Operating time	Decreased with increasing preoperative delay. Success was related to increasing operative experience ($P=0.0001$)	
Bilgin et al., (2006), ANZ J Surg, Turkey, [12] Prospective randomized control trial (level 1b)	Single centre, prospective longitudinal, non-blinded study over 7 years $n=70$ Patients randomized to chest drainage followed by VATS decortication (Group I) or chest drainage without VATS (Group II)	Conversion rate	In Group I, 17.1% of the patients underwent OD, whereas in Group II, 37.1% of the patients underwent the same procedure ($P<0.05$)	VATS decortication and chest tube drainage shortened hospital stay and reduces the necessity of OD
		Average hospital stay	Group I was 8.3 days (range, 7–11 days), 12.8 days in Group II(range 10–18 days;) $P<0.05$	

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Table 1. *(Continued)*

Author, date, journal, country Level of evidence	Patient group	Outcome	Key results	Comments
	No statistically significant difference between the groups: age and sex ($P>0.05$)	Complications	There was one bronchopleural fistula in Group I, and there was one bronchopleural fistula and one death in Group II	
Cardillo et al., (2009), Eur J Cardiothorac Surg, Italy, [13] Retrospective cohort study (level 2b)	Single centre 10 years experience $n=308$ OD performed in 123/308 (39.9%) VATS in 185/308 (60.1%)	Mortality	1.29% (4/308)	VATS decortication appears as the surgical treatment of choice for chronic post pneumonic pleural empyema
		Morbidity	21.1% (65/308)	
		At six months follow-up	Three VATS patients showed recurrent empyema and underwent re-do surgery by VATS ($n=1$) or by thoracotomy ($n=2$)	
		Pain	(day 1 and day 7) ($P<0.0001$)	
		Postoperative air-leak	($P=0.004$)	
		Operative time	($P<0.0001$)	
		Hospital stay	($P=0.020$) ($P<0.0001$)	
		Time to return to work	11/185 (5.9%)	
		Conversion rate to open surgery	OD 6/123 (4.8%) vs. VATS 2/185 (1%) ($P=0.09$)	
		Re-operation rate	Empyema recurrence only occurred in VATS group 3/185 (1.6%)	
			The analysis of postoperative pain at six months follow-up showed no significant differences	
Drain et al., (2007), Asian Cardiovasc Thorac Ann, UK, [14] Retrospective cohort study (level 2b)	Fifty-two consecutive patients with stage III empyema between 1998 and 2004 after failure of alternative therapy, including tube thoracostomy and intrapleural streptokinase. Forty-nine (94%) had stage III empyema based on preoperative computed tomography and intraoperative assessment	Conversion rate	0%	This study utilised two-window VATS decortication compared to three in all other studies reported. Two-window VATS decortication and lung mobilization may add a further refinement to a growing area of thoracic surgery
		Mean drainage time	3.9 days (range 2–10 days; median 4 days)	
		Mean time to discharge	10 days	
		% Resolution	94% ($n=49$)	
Melloni et al., (2004), World J Surg, Italy, [15] Cohort study (level 2b)	From 1993 to 2000 a total of 40 patients underwent OD for chronic parapneumonic empyema	Mortality	0%	
		Mean hospital stay	10 days	
		% Resolution	100% ($n=40$)	
		Complications	12.5% ($n=5$) two prolonged febrile syndromes, three cases of sepsis requiring mechanical respiratory assistance	

VATS, video-assisted thoracoscopic surgery.

operative complications and patient morbidity and should be considered before an open procedure in patients with chronic empyema who are fit for surgery.

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