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Chapter

The Role of Minimally Invasive Surgery in Management of Chest Trauma

Tuba Apaydin

Abstract

The role of minimal invasive surgery in management of chest trauma should not be underestimated. The amount of data for video-assisted thoracoscopic surgery (VATS) management in chest-trauma patient is rare. Nevertheless the on-going acceptance and use of VATS for major thoracic resections has led to advanced techniques for management of major bleedings in the elective-surgery-patient. VATS as a procedure for pleural space management in the non-critical, non-massive-transfusion patients can be of great assistance. Its value in persistent non-major-vessel-bleeding hemothorax in terms of pleural space debridement is unchallenged. In some cases VATS is considered to be related to lower ARDS-rates in comparison to open thoracotomy patients, whereby an obvious bias for the non-massive-injury-patients exist. Jin et al. could prove a significant advantage for stable thoracic trauma patients treated through VATS in a randomised trial vs. open thoracotomy.

Keywords: chest trauma, minimal invasive surgery, video-assisted thoracoscopic surgery

1. Introduction

Video-assisted thoracic surgery (VATS) has a standart role in diagnosis and therapy in thoracic surgery. It has gained a wider spectrum of indications with the improvement in technology and methods. Literature has reported data about its use. Injuries related to the thoracic cage constitutes 25% of mortality in trauma patients. Some of these deaths are ascribable to acute bleeding or cardiac tamponade. However, most of these are because of ARDS, pulmonary contusion, ventilatory associated pnemonia or systemic inflammatory syndrome from empyema or mediastinitis [1].

Patients with chest trauma can be classified in four groups. First group die in the incident or undergo resuscitative thoracotomy in the emergency or operating room due to emergent fatal injuries like cardiac tamponade or acute hemorrage. Secondly, those patients who require emergent thoracotomy for potentially fatal injuries. These patients come to thoracotomy for on-going haemorrage related to non-aortic great vessel, lung parenchymal or chest wall injuries. Also, aortic, oesophageal injuries are in this group. The third group is treated with resuscitation and tube thoracostomy, which is %85 of all chest injured patients. However, retained hemothorax, persistent pneumothorax, on-going haemorrage and empyema will necessitate thoracotomy in %20–30 of these initially non-operatively treated patients. Surgical

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treatment is also needed for missed injuries of diaphragm, oesophagus and vascular injuries. The fourth group constitutes of patients requiring surgery for complications of hemo- or pneumothoraces or missed injuries [1].

In the past, most patients necessiating surgical treatment secondary to chest trauma was exposed to open thoracotomy, which was the most morbid of surgical incisions. This made way for open thoracotomy as a less invasive method to diagnose and treat thoracic injuries, originally reported by Branco in 1943. The implementation of VATS in trauma was originally reported in a series evaluating diaphragmatic injuries. Afterwards, numerous other indications have been reported [2].

Video-assisted thoracoscopic surgery has become a popular and acceptable method for diagnosis of intra-thoracic lesions since 1990s with the developments in surgical techniques. It is also used for treatment of retained pleural collections, it is a simple alternative to open thoracotomy. Although it's multiple advantages, timing of surgery and its effects on patients' results are not well elucidated. Multiple studies report that prognosis of patients is better with the earlier interventions in injured chest. However, there is so much differences for the optimal time for surgery in these studies [3].

In this chapter, we reported the role of VATS in the management of chest trauma describing characteristics of injury, indications for surgery, methods performed and results in terms of postoperative length of stay, morbidity and mortality [2].

2. Indications of VATS in management of chest trauma

Indications of VATS have been extended for management of diagnosis and treatment of chest trauma since 1990. This approach has multiple advantages as chest tube setting, minimally invasive surgery, less postoperative pain and chest exploration. Today, VATS is used for empyema, persistent pneumothorax, retained haemothorax, mediastinal and diaphragmatic exploration, pleuro-pericardial ruptures, surgery for thoracic duct injury and aspiration of symptomatic foreign bodies. [4].

Persistent pneumothorax is defined as persistent air leak and pneumothorax observed in radiology within 72 hours after chest tube setting. Nearly 23% of pneumothoraces will have a peristent air leak. Several studies reported the effectiveness of VATS in this indication [4–6]. Retained hemothorax is persistent effusion after chest tube insertion on radiographic tools. Retained hemothorax over 300 ml should be an indication for surgery due to its' complications like empyema or pneumonia [7, 8]. 40% of these undrained hemothoraces result in fibrothorax. VATS is also reported that it's useful in the removal of clotted hemothorax. However, procedures performed after 10th. day are hard due to the extensive pleural adhesions.

American Association for the Surgery of Trauma published a significant study related to surgical treatment of retained hemothorax in 328 patients with blunt chest trauma [7]. 33% patients were treated with VATS, 25% required more than two interventions and 5% required more than 3 interventions for complete healing. Thoracotomy for unsuccessful VATS was required in 20% patients. Meyer et al. compared VATS vs. second chest tube setting including 39 patients in each group. VATS diminished duration of chest drainage, duration of hospital stay and hospital costs. Additionally, the second chest tube setting resulted in surgical treatment in 40% patients. VATS should be chosen over second chest tube setting for management of retained hemothorax [9].

Cobanoglu et al. compared chest tube setting vs. VATS as the first intervention for treatment of blunt chest trauma, including 60 patients [10]. VATS decreased duration of hospital stay and the number of reoperations. In the chest tube group,

indications for reoperation were clotted hemothorax (23%), empyema (13%), fibrothorax (6%) and continuing bleeding over 100 ml/h (3%). Besides, Smith et al. reported to perform the surgery in 5 days while Vassiliu et al. preffered this duration as 3 days [11, 12]. Nevertheless, Fabrucci et al. reported this duration as the first 48 h for both persistent pneumothorax and retained haemothorax with continuing bleeding over 100 ml/h (**Table 1**) [13].

In haemodynamically stable patients, early VATS should be preferred for retained haemothoraces.

Lazdunski et al. stated that early videotoracoscopic surgery is ideal for management of posttraumatic empyema because it can successfully control the fibrinopurulent phase of empyema and removes the infected hemothorax before the progression of fibrotic phase. However, if the procedure is realised late, a dense fibrotic pleural peel may result with trapped lung at least orient the surgeon to thoracotomy [15].

Traumatic injury to the toracic duct is a rare complication of chest trauma. Videothoracoscopy is a safe and minimally invasive method for ligation of thoracic duct. Lazdunski et al. reported that VATS can be useful for posttraumatic chylothorax if they still exist after 10 days of proper medical therapy and tube thoracostomy [16].

Although most of the patients with chest trauma is treated with chest tube insertion, this conservative method is insufficient in the minority of patients.

Over the last several years, VATS after trauma has been used as the first surgical intervention in hemodynamically stable patients who necessiated urgent thoracic exploration within 24 h after the first presentation.

References	Patients	Design	Outcomes	Key results	
				CT	VATS
Meyer *et al*. (1997) USA [9]	*n* = 39	RCT	Reoperation	42%	0%
	BCT = 15%		CT duration	4.5	2.53
	Indication: RH		LOS	8.13	5.4*
Schermer *et al*. (1999) USA [6]	*n* = 39	Prospective cohort study	Reoperation	22.2	0[a]
	BCT = 70%		CT duration	11.8	8.1*
	Indication: PP		LOS	16.5	8.4*
Fabbrucci *et al*. (2008) Italy [13]	*n* = 81	Retrospective cohort study	Reoperation	0	0
	BCT = 97%		CT duration	5.7	6,3
	Indication: PP, RH		LOS	7	7
DuBose *et al*. (2011) USA [14]	*n = 328*	Prospective cohort study	Reoperation	35.2	30
	BCT = 49%				
	Indication: RH				
Cobanoğlu U *et al*. (2011) Turkey [10]	*n = 60*	RCT	Reoperation	50	0
	BCT = 62%		CT duration	7.19	4.84*
	Indication: RH		LOS	7.19	4.84*

RH: retained haemothorax; PP: persistent pneumothorax; BCT: blunt chest trauma.
[a]Eleven patients with persistent air leak were excluded from VATS: 4 due to injuries requiring further ICU stay, 3 due to pneumonia, 2 patients were too small for dual lumen intubation and 2 needed further operations.
**P < 0.05.*

Table 1.
Table of evidence for VATS.

Goodman et al. reported that the use of post-trauma VATS is a safe and effective technique in acutely injured and proper trauma patients including 23 patients in their study [16].

Contraindications for VATS include: Hemodynamic instability, intolerance to lateral decubitus position or single-lung ventilation, suspected injuries to the heart or great vessels and severe adhesions due to prior thoracic interventions [16].

3. Conclusion

Videothoracoscopy is a safe and beneficial diagnostic and therapeutic device as an acute approach to selected patients with chest trauma with no indication for emergent thoracotomy or sternotomy. It is also beneficial in the acute or the retarded approach for patients with blunt chest trauma for treatment of clotted hemothorax, persistent pneumothorax, thoracic empyema, chylothorax and diagnosis of diaphragmatic injuries. However, in cases of suspected pericardial injury, videothoracoscopy should not be considered.

Acknowledgements

No contribution by any other author or no funding declared.

Conflict of interest

The authors declare no conflict of interest.

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