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Is the trocar technique for tube thoracostomy safe in the current era?

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Abstract

A best evidence topic in thoracic surgery was written according to a structured protocol. The question addressed was, 'in adult patients who require a tube thoracostomy, is the trocar technique comparable to blunt dissection in terms of rate of tube malposition or complications?' Altogether more than 258 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 were tabulated. The articles included two retrospective reviews, three prospective observational studies and two prospective randomized studies. Of these, four papers concluded that the trocar technique was associated with a significantly higher rate of tube malposition and complications. One retrospective review found that the rate of tube malposition was similar in both groups; however, the trocar technique was abandoned due to the occurrence of severe complications like lung and stomach injury. Another study found that blunt dissection into the pleural space followed by the use of a trocar to direct the chest tube was as safe as and even more effective than blunt dissection alone. A randomized prospective study in cadavers comparing blunt vs sharp tip trocars reported that the use of blunt tip trocars resulted in less complications. We conclude that the trocar technique for chest tube placement should be avoided in adult patients as it is associated with a higher incidence of malposition and complications. The blunt dissection technique with digital exploration of the pleural cavity prior to chest tube placement is the safest technique and should be considered standard practice.

Keywords: Chest tubes • Complications • Blunt dissection • Trocar

INTRODUCTION

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

THREE-PART QUESTION

In [adult patients who require a tube thoracostomy] is the [trocar technique] comparable with [blunt dissection] in terms of [rate of tube malposition or complications]?

CLINICAL SCENARIO

A thoracic surgery consult is requested from the emergency room for a 42-year old gentleman with sudden onset shortness of breath and left-sided chest pain for 4 h. His vital signs and oxygen saturation are normal. Clinical examination reveals absent breath sounds with hyperresonance in the left hemithorax and chest X-ray shows a large left pneumothorax. You decide to place a left intercostal drainage tube and are offered a 24-F trocar thoracostomy kit. You have been taught previously that the trocar technique is unsafe and should not be used. You decide to research the current evidence on this topic.

SEARCH STRATEGY

A Medline search using the Ovid interface from 1946 to September 2013 with the keywords [exp chest tubes/or exp thoracostomy/or inter-costal drainage tube.mp.] and [techniques or complications].mp. and [trocar or blunt hemostat dissection].mp.

An Embase search from 1947 to September 2013 using the keywords 'chest'/exp OR chest AND ('tube'/exp OR tube) OR thoracostomy OR (inter-costal AND drainage) AND (techniques OR complications) AND ('trocar'/exp OR 'trocar' OR (blunt AND hemostat AND dissection)).

A Medline search using the PubMed interface from 1950 to September 2013 using the keywords (((((chest tube) OR thoracostomy) OR intercostal drainage)) AND ((techniques) OR complications)) AND ((trocar) OR blunt hemostat dissection).

SEARCH OUTCOME

The OVID search identified 20 papers, the Embase search yielded 90 papers and the PubMed search returned 148 papers. From these,

Table 1: Summary of best evidence papers

Author, date, journal and country Study type (level of evidence)	Patient group	Outcome	Key result	Comments
Remerand *et al.* (2007), Anesthesiology, France [2] Prospective observational (level 2b)	75 intensive care unit patients requiring thoracostomy for pneumothorax or sterile pleural effusion 122 chest tubes placed (88.5% trocar) 106 tubes assessed by CT Insertion site: not mentioned	Tube malposition (TM)	Trocar: 29.6% Blunt dissection: 0% (P = 0.03)	Use of trocar only factor significantly linked to TM
Baldt *et al.* (1995), Radiology, Austria [3] Retrospective review (level 2b)	51 patients with blunt chest injury haemothorax or pneumothorax 77 chest tubes inserted Trocar (n = 48) Blunt dissection (n = 21) Unknown (n = 8) Insertion site: dorsal/ventral to mid-axillary line (MAL)	TM	Trocar: 29% Blunt dissection: 19%	No comment made on safety profile of either technique
Millikan *et al.* (1980), Am J Surg, USA [4] Retrospective review (level 2b)	1249 patients with thoracic trauma requiring thoracostomy for haemothorax, pneumothorax, penetrating injury or major thoracic trauma Insertion site: fifth intercostal space (ICS) anterior to MAL	Empyema Visceral organ injury	Trocar: 2.2% Blunt dissection: 2.7% 1%	The trocar technique abandoned due to severe complications-lung/stomach injury
Cha *et al.* (2013), Yonsei Med J, Korea [5] Prospective observational (level 2b)	92 patients with spontaneous pneumothorax Trocar (n = 44) Blunt dissection (n = 48) Insertion site: not mentioned	Re-expansion pulmonary oedema (REPO)	Trocar: 86% Blunt dissection: 63% (P = 0.0009)	The trocar technique only factor associated with the rate of REPO Ultimate outcomes similar between two groups
Al-Tarshihi *et al.* (2008), Rawal Med J, Jordan [6] Prospective observational (level 2b)	224 patients requiring thoracostomy for various aetiologies (including post-thoracic surgery) 339 chest tubes inserted Insertion site: not mentioned	Complications	No complications in post-thoracic surgery patients Trocar: n = 23 Blunt dissection: n = 0	Complications only seen in trocar group Unclear of how many patients in each group
Dural *et al.* (2010), J Cardiothorac Surg, Turkey [7] Prospective, randomized (level 1b)	180 patients requiring thoracostomy for various aetiologies Randomized into 2 groups (90 patients each) Group A: Surgical technique (blunt dissection) Group B: Modified combined technique (blunt dissection + trocar) Insertion site: 5th–7th ICS at anterior axillary line/MAL	TM Ineffective drainage Complications	Group A: 25.5% Group B: 0% Group A: 4.4% Group B: 0% Group A: 13.3% Group B: 7.8% (P < 0.05)	Combined technique of blunt dissection followed by the use of trocar to direct chest tube superior to blunt dissection alone

Continued

Table 1: (*Continued*)

Author, date, journal and country Study type (level of evidence)	Patient group	Outcome	Key result	Comments
Ortner *et al.* (2012), Scand J Trauma Resusc Emerg Med, Austria [8] Prospective randomized (level 1b)	100 cadavers Trocar thoracostomy Kit 1: Blunt tip Kit 2: Sharp tip Insertion site: 4th–5th ICS at MAL	TM Visceral organ injury	Kit 1: 8% Kit 2: 14% Kit 1: 2% Kit 2: 5% ($P < 0.05$)	Blunt tip trocar associated with the lower rate of complications

seven papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

RESULTS

The trocar technique for tube thoracostomy has the potential advantages of speed of insertion and ability to direct the chest tube. However, it has fallen out of favour largely due to reports of severe organ injury [9–13]. The current British Thoracic Society and Advanced Trauma Life Support guidelines recommend against the use of the trocar for chest tube placement [14, 15].

Papers that included chest catheter placement by the Seldinger technique were not taken into consideration. All chest tubes were inserted without the assistance of radiological marking of the incision site. Chest tubes were inserted for various indications as mentioned in Table 1.

Remerand *et al.* [2] prospectively evaluated 106 chest tubes placed in 75 critically ill patients using computerized tomography. The only factor significantly associated with increased tube malposition (TM) was use of a trocar ($P = 0.03$). However, the duration of thoracic drainage, mechanical ventilation, need for tracheostomy and mortality were not increased by the TM.

Baldt *et al.* [3] reviewed the CT scans of 51 patients who underwent tube thoracostomy following trauma. TM was detected in 26% of chest tubes. Twenty-nine percent of patients who underwent trocar thoracostomy had TM, compared with 19% in the blunt dissection group. Four patients developed intraparenchymal lung haematoma, but no mention was made about the technique of insertion used in these patients. The location of chest tube insertion also had an effect on the rate of TM—33 vs 9% for tubes placed dorsal vs ventral to the mid-axillary line.

Millikan *et al.* [4], in their review of chest tube placement for thoracic trauma, advised against the use of trocar thoracostomy, citing cases of lung and stomach injury. Empyema developed in ~2% of patients, whether the tubes were inserted by the trocar or blunt haemostat technique.

Cha *et al.* [5] prospectively studied the development of re-expansion pulmonary oedema (REPO) following chest tube placement. The use of a trocar was associated with a higher rate of REPO when compared with the haemostat dissection (OR: 5.73, 95% CI: 1.5–21.4; $P < 0.009$). The ultimate outcomes, however, were similar in the trocar and blunt dissection groups.

Al-Tarshihi *et al.* [6] looked at 339 chest tube insertions for varied indications and reported a complication rate of 7.4%. All of the complications were seen with trocar thoracostomy. The authors did not state how many patients were in the trocar or blunt dissection groups.

Dural *et al.* [7] suggested a modification of the trocar technique for chest tube placement. The pleural cavity is entered by blunt dissection followed by digital exploration and release of adhesions. The thoracostomy tube with trocar is then inserted into the pleural cavity and directed towards the apex. With this technique, the rates of TM (0 vs 25%), ineffective drainage (0 vs 4.4%) and complications (7.8 vs 13.3%) were less than the blunt dissection group ($P < 0.05$).

Ortner *et al.* [8] performed a prospective randomized study on 100 cadavers comparing tube thoracostomy using a blunt tip vs sharp tip trocar. The rates of TM (8 vs 14%) and visceral organ damage (2 vs 5%) were significantly less with the blunt tip ($P < 0.05$).

Clinical bottom line

The trocar technique for chest tube placement should be avoided in adult patients as it is associated with a higher incidence of TM and severe complications. The blunt dissection technique with digital exploration of the pleural cavity prior to chest tube placement is the safest technique and should be considered standard practice.

Conflict of interest: none declared.

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