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ORIGINAL ARTICLE

Video assisted thoracoscopy in Management of stable penetrating chest trauma. (Running title: thoracoscopy in penetrating chest trauma)

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Abstract

Background: Although most of traumatic chest injuries do not require major operative interference and chest tube insertion remains the essential treatment, any patients who need thoracotomy in previous can benefit from less invasive surgical procedures as diagnostic or therapeutic procedures

This study aims to evaluate usage of video assisted thoracoscopy for Management of penetrating chest trauma in hemodynamically stable patients. **Methods:** This is a retrospective study including all patients who underwent video assisted thoracoscopy for management of penetrating chest injuries in hemodynamically stable patients from January 2020 to December 2021. **Results:** This study was carried out on 42 patients who underwent video assisted thoracoscopy for management of hemodynamically stable penetrating chest trauma. The overall mean age was 28.86 ± 8.45 and all patients were males. The most frequent surgical procedure was video assisted thoracoscopy evacuation of hematoma which was performed for 21 patients (50%), other procedures were 6 patients (14.29%) underwent video assisted thoracoscopy bullet extraction, 6 patients (14.29%) underwent video assisted thoracoscopy lung repair, and 6 patients (14.29%) underwent video assisted thoracoscopy diaphragmatic repair and 3 patients (7.14%) video assisted thoracoscopy bleeder control. Mean Operative time was 73.57 ± 11.51 minutes, postoperative duration of chest tube insertion was 2.71±0.83 days, postoperative length of hospital stay was 3± 1.04 days and interval between trauma and surgery was 9±7.84 days. **Conclusion:** Video assisted thoracoscopy is a safe and effective way for management of hemodynamically stable patients with penetrating chest trauma in subacute and chronic conditions.

Keywords: diaphragmatic Injury, hemothorax, Penetrating chest injuries, pneumothorax, video assisted thoracoscopy.

Introduction

Trauma is considered the most common cause of death among middle age people **[1].** Traumatic chest injuries are responsible for 30–40% of hospital admissions and 20–25% of deaths caused by trauma **[2].** 1–13% of all traumatic chest injuries are penetrating chest injuries **[3].** Chest injuries have several complications such as clotted hemothorax, unresolved pneumothorax, entrapped lung, and pyothorax, which had great morbidity and mortality if the management is delayed or improper **[1].**Although most of traumatic chest injuries do not require major operative interference and chest tube insertion remains the essential treatment, any patients who need thoracotomy in previous can benefit from less invasive surgical procedures as diagnostic or therapeutic procedures **[4].** Rapid recovery in endoscopic surgical procedures and good new instruments encourage use of thoracoscopy as diagnostic and therapeutic tool, but its indications for trauma remains controversial **[5, 6].** Recently, studies encouraged the benefit of thoracoscopy for the diagnosis or treatment of many traumatic conditions like diaphragmatic injuries, clotted hemothorax, or continued hemothorax if patients are hemodynamically stable **[7, 8].**

This study aims to evaluate usage of video assisted thoracoscopy (VATS) for Management of penetrating chest trauma in hemodynamically stable patients.

Methods

This is a retrospective study including all patients who underwent VATS for management of penetrating chest injuries in hemodynamically stable patients from January 2020 to December 2021. This is a study approved by the local Research Ethics Board. Written informed consent was obtained from all participants. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. Gathered information included demographic characteristics (age and gender), mortality, coexisting comorbid conditions, indication of surgery, mode of penetrating trauma, side of trauma, surgical procedure, mean operative time, postoperative duration of chest tube insertion, ICU admission, postoperative hospital stay and time interval between onset of trauma and surgical interference.

Surgical procedures of VATS: Under general anesthesia and bronchoscopic guided double-lumen endotracheal intubation, patients were put in the contralateral decubitus position. At first, a 2cm incision was made at Sixth or seventh intercostal space in mid-axillary as thoracoscopic port to the pleural cavity. Then another 1-2 incisions were made under thoracoscopic vision to avoid lung injury as working ports. The pleural space was carefully visualized and examined.

Different surgical procedures were done by VATS According to indication of surgery.

For clotted heamothorax, any fluid was aspirated, and all clots were removed ensuring well inflated lung. For bullet retention, after localization of bullet by preoperative radiological studies bullet was extracted with or without the C-arm fluoroscopy usage.

For diaphragmatic Injury, the repair of the diaphragm was done by a non-absorbable interrupted suture. For persistent pneumothorax, persistent pneumothorax was considered if air leak is persistent for more than 7 days or collapsed lung in chest X-ray despite of good position functioning chest tube. Lung parenchymal laceration was identified and repaired by endoscopic stapler or absorbable continues sutures according to site and size of laceration.

For persistent bleeding, persistent bleeding defined as an initial drainage of blood from chest tube is less than 1,500 ml and bleeding continues (more than 250ml/h over four hours), hemostasis was done after identification the source of bleeding by VATS. The usual cause of bleeding is lung parenchyma or intercostal vessels.

After hemostasis was done and VATS finished, one or two chest tubes were inserted using the port sites. The positions of chest tubes were confirmed by thoracoscopy. The thoracic cavity was then closed by closures remaining wounds in layers.

Statistical analysis of the collected data: Statistical analysis was done via Statistical Package for Social Sciences (SPSS) Computer Software (Version 20; IBM Software, Chicago, Illinois, USA). Mean and standard deviation were used as Descriptive statistics for numerical variables, and for categorical variables were frequencies and percentages.

Results

A total of 42 patients who underwent VATS for management of penetrating chest trauma in hemodynamically stable condition were involved in the study. The mean age was 28.86 ± 8.45 and all cases were males (100%) **(Table1).**

Table1: Demographic data

Variables	Number
Age (mean ± SD, years)	28.86 ± 8.45
Sex	
Male (%)	42 (100%)
Female (%)	0 (00%)
Total	42 (100%)

SD *standard deviation*

All cases had no co-morbidities. No mortality was found in our patients, and no one needed ICU admission. **(Table 2).**

Table2: Mortality, Co-morbidities, and ICU admission

Variables	Number
Mortality	0 (00%)
ICU admission	0 (00%)
No co-morbidities	42 (100%)
Co-morbidities	0 (00%)
Total	42 (100%)

Regarding indication for surgery, there were 21 patients (50%) operated for clotted heamothorax, 6 patients (14.29%) for bullet retention, 6 patients (14.29%) for persistent pneumothorax, 6 patients (14.29%) diaphragmatic Injury and 3 patients (7.14%) for Persistent bleeding. There were 30 patients (71.43%) with stab wounds and 12 patients (28.57%) with gunshots. Right side trauma was in 27 cases (64.29%) and left side trauma was in15 cases (35.71%) **(Table3).** Regarding surgical procedure, there were 21 patients (50%) underwent VATS evacuation of hematoma, 6 patients (14.29%) underwent VATS bullet extraction, 6 patients (14.29%) underwent VATS lung repair, and 6 patients (14.29%) underwent VATS diaphragmatic repair (4 cases in right side and 2 cases in left side) and 3 patients (7.14%) VATS bleeder control **(Table 3).**

Table 3: clinical data.

Variables	Number
Indication for surgery	
Clotted heamothorax	21 (50%)
Bullet retention	6 (14.29%)
Persistent pneumothorax	6 (14.29%)
Diaphragmatic Injury	6 (7.14%)
Persistent bleeding	3 (7.14%)
Trauma	
Stab wound	30 (71.43%)
Gun shot	12 (28.57%)
Total	42 (100%)
side of trauma	
Right side	27 (64.29%)
Left side	15 (35.71%)
Total	42 (100%)
Surgical procedure	
VATS evacuation of hematoma	21 (50%)
VATS bullet extraction	6 (14.29%)
VATS lung repair	6 (14.29%)
VATS diaphragmatic repair	6 (14.29%)
VATS bleeder control	3 (7.14%)
Total	42 (100%)

Mean Operative time was 73.57 ± 11.51 minutes, postoperative duration of chest tube insertion was 2.71±0.83 days, postoperative length of hospital stay was 3± 1.04 days and interval between trauma and surgery was 9±7.84 days **(Table 4).**

Table 4: Preoperative delay stay, Duration of chest tube insertion and Operative time

Variables	Number
Mean Operative time (mean ± SD, minutes)	73.57 ± 11.51
Postoperative duration of chest tube insertion (mean ± SD, Days)	2.71±0.83
Postoperative hospital stay **(**mean ± SD, Days)	3± 1.04
interval between trauma and surgery **(**mean ± SD, Days)	9±7.84

(SD) *standard deviation*

Discussion

Chest trauma is responsible for 25% of all deaths caused by trauma. 85% of traumatic chest injuries can be treated conservatively **[9].** Most traumatic chest injuries can be managed only by chest tube insertion as it can drain simple hemothorax and pneumothorax **[10].**

The drawbacks of management of penetrating chest trauma by chest tube alone are inability to control bleeding, drain clotted blood and to remove foreign body also diaphragmatic defects cannot be diagnosed. Other problem, blockage of chest tube by blood clots may miss continuous bleeding or causing accumulation of blood clots causing entrapped lung **[11].** Thoracotomy for penetrating chest trauma can be replaced by thoracoscopy in any cardiorespiratory stable patients with penetrating thoracic trauma. VATS can give a clear-cut diagnosis if intrathoracic

injuries cannot be excluded and it enables suturing of lung tears, foreign body removal and bleeder control **[12].** This study was carried out on 42 patients who underwent VATS for management of hemodynamically stable patients with penetrating chest trauma.

In this study, the mean age was 28.86 ± 8.45 and all patients were males. The most frequent surgical procedure was VATS evacuation of hematoma which was performed for 21 patients (50%), other procedures were 6 patients (14.29%) underwent VATS bullet extraction, 6 patients (14.29%) underwent VATS lung repair, 6 patients (14.29%) underwent VATS diaphragmatic repair and 3 patients (7.14%) VATS bleeder control. Mean Operative time was 73.57 ± 11.51 minutes, postoperative duration of chest tube insertion was 2.71±0.83 days, postoperative length of hospital stay was 3± 1.04 days and interval between trauma and surgery was 9±7.84 days.

Milanchi et al conducted retrospective study included All patients who underwent VATS for period from 2000 to 2007 to manage trauma. In this study all cases were haemo dynamically stable before and during the procedure. Most cases were male 20 (87%) cases. the cases mean age was 39 ± 15 years. The mode of trauma was a gunshot injury in 9 cases, 5 cases with stab wound, 8 cases with motor vehicle collision (MVC) and only one case with fallen from height. There was no mortality. Clotted hemothorax was the most common indication for VATS. This study concluded the safety and efficacy of VATS for management subacute sequels of blunt and penetrating chest trauma when patients are haemodynamically stable **[13].**

Manlulu et al conducted a retrospective study at a Level I trauma center and university teaching hospital for a period of six years. This is study included patients managed by VATS for both blunt and penetrating thoracic trauma. VATS were completed in 19 cases without needing to convert to thoracotomy. VATS was done for evacuation of clotted hemothorax, control of intra-thoracic bleeders, diaphragmatic tear repair, and decortication and wedge lung resections. Mean postoperative hospital length of stay was 5.86 days. The study concluded that VATS is a good tool for both diagnosis and management of chest trauma when patients are hemodynamically stable **[14].**

Ahmed et al conducted a retrospective study of penetrating thoracic injuries for 5 years. All hemodynamically stable patients with penetrating thoracic trauma managed with chest tube drainage alone if the drainage is incomplete and failure of evacuation of clot. The cases were divided into two groups according to the way of management, the first group "VATS group" patients underwent VATS within 48 hours. The second group, "control group" included patients who did not undergo VATS. Their study suggested that direct inspection by VATS early within 48 hours for continuous bleeding or failure of total lung expansion solves most of problems of chest tube drainages source of bleeding can be identified, hemostasis achieved, removal of foreign bodies and VATS can clearly visualize of diaphragmatic tears **[11].**

Massimiliano Paci et al reviewed 1270 cases that were admitted to hospital with chest trauma in a period between 1994 and 2004. In this study, 16 patients had penetrating chest injuries: 13 cases were explored by VATS and 3 cases explored with thoracotomy due to hemodynamic instability or possibility of cardiac or great vessels injuries. In the 13 cases who explored by VATS, 5 cases with diaphragmatic injuries, 3 cases with intercostal arteries injuries, and 1 case with injury to diaphragmatic artery. Also 12 cases had lung tears. Only one case converted to thoracotomy because of large diaphragmatic tear and to control bleeding from intercostal artery. In this study, no mortality happened intra- or postoperative, and the length of hospital stay was 5 days. The study showed that penetrating thoracic injuries can be managed by VATS safely and effectively and increasing use of VATS for management these cases will decrease the number of missed, potentially fatal lesions as well as in late sequelae **[3].**

Richardsen et al presented a design for the management of penetrating chest trauma in which VATS is essentially present. All penetrating chest injuries were managed according to this design by minimal invasive procedures. The most frequent indications for VATS were hemothorax then tears to pulmonary parenchyma.

CONCLUSION

The study concluded that most patients can managed by tube thoracostomy is alone and in case of surgical treatment is needed and patients are hemodynamically stable. VATS should be done as soon as possible, and thoracotomy should be done only for hemodynamically unstable patients **[15].**

We had some limitations of this study, firstly: its retrospective nature, secondly: it is a single-center experience, which may limit generalizability of the results. Lastly, small sample size.

VATS is a safe and effective way for management of hemodynamically stable patients with penetrating chest trauma in subacute and chronic conditions. Further multicenter randomized controlled trial studies with a larger number of cases should be done to study its safety and efficacy in acute conditions.

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