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SUBXIPHOID VIDEO ASSISTED THORACOSCOPIC SURGERY (VATS) FOR CHEST TRAUMA AND COMPLICATIONS

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ABSTRACT **Introduction:** Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) is a minimally invasive surgical technique which can applied to variety of thoracic procedures with unanimous results even in emergency conditions such as chest trauma. **Aim:** This paper presents uniport-subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) used in chest trauma and its detailed analysis. **Material and Methods:** In this study, a total of 30 patients from November 2022 to March 2023 underwent Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) for the management of haemothorax and complications post chest trauma. **Result:** In a total of 30 patients from November 2022 to March 2023, Single port subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) was used to successfully conclude the surgery essential in all these patients presenting to Teerthanker Mahaveer Medical College and Hospital, post chest trauma. Additionally, 3 patients who developed bronchopleural fistula post chest trauma also underwent correction using uniport subxiphoid Video Assisted Thoracoscopic Surgery (VATS). No postoperative wound infection was noted. Complete Haemothorax removal was achieved in all these patients. There was no case noted of post operative wound infection. All the patients were discharged early. **Conclusion:** Classical Median Sternotomy is the standard approach for haemothorax evacuation as indicated in previous studies. However, access through classical median sternotomy is associated with a higher risk of local infection and sternal instability. Additionally, it may sometimes be burdened with a high perioperative risk due to massive mediastinal adhesions in the late postoperative period. The uniport subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) is an effective procedure for evacuating haemothorax and correcting chest complications post trauma. Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) intervention is also associated with decreased rates of chest infections and superior cosmesis. Moreover, it significantly reduced the duration of ventilator dependency. The clinical outcomes were significantly better for patients undergoing uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS).

KEYWORDS :

Introduction

Road Traffic Accidents and falls are frequent causes of chest trauma. Blunt trauma chest is a common injury found in trauma patients. A large amount of energy is transmitted to the entire chest cavity during such injuries. Deep injuries to the chest post blunt trauma may present with chest wall destruction and lung parenchyma injuries. Further severe injury to intrathoracic organs can also be found, such as intrathoracic vascular injury, diaphragm rupture, and Esophageal injury. All these injuries may cause haemothorax or pneumothorax, the most common complication that can occur immediately after blunt chest trauma. Moreover, some may develop retained pleural collections.

Appropriate management of blunt chest trauma depends on patient's vitals on clinical examination. Primary aim is to stabilise the patient's vitals which may require intervention inform of intercostal chest drain (ICD) insertion or open thoracotomy in individuals depending upon the extent of the injury. A large majority of the patients can be successfully treated with appropriate analgesia or simple tube thoracostomies. In majority of patient intercostal chest drain (ICD) is sufficient to treat haemodynamically stable patients but small amounts of residual blood might accumulate in the pleural cavity after this procedure. These blood effusions are occasionally entirely resorbed after 4–6 weeks without causing infection. However, patients may experience retained haemothorax because of malposition or poor drainage of chest tubes. Retained haemothorax is defined as residual clots at least 500 ml or large, or in which at least one-third of the blood in the pleural space cannot be drained by a chest tube after 72 h of initial treatment revealed by a computed tomography (CT) scan. Several studies have suggested that, once the volume of retained haemothorax accumulates to 300 ml, surgical intervention should be considered. Similarly, in remaining patients with extensive impact of trauma with retained pleural collections require further surgical interventions to prevent early complication such as empyema in early phase or fibrothorax in late phase. These complications increase mortality and morbidity. Owing to the advances in endoscopic instruments and technology, minimally invasive surgery is now being widely applied to manage chest trauma. The purpose of this article is to understand the complications caused by haemothorax and the benefits of minimally invasive surgery in form of subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) for patient's victim of chest trauma. Uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is highly advanced and newly emerging method for diagnosis and treatment of intra-thoracic lesions as a form of further development in this surgical technique. It is also widely used in treating retained pleural collections because it is barely invasive and has been shown as a simple technical alternative to open thoracotomy. Recent studies have shown that the earlier the interventions of injured chest are performed, the better the prognosis of patients. However, there exist wide variations in the exact recommended time for operation after trauma in the studies, especially when complicated with associated injuries. The main reasons for prolonging the hospitalisation of trauma patients are infections and respiratory failure. Early intervention in form of uniport-subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) may play a role in preventing post-traumatic infections and decrease the duration of acute respiratory failure, which in turn can shorten the whole treatment course. The study reflects the importance for timely implementing subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) to treat pleural collection and associated complications and its effects on respiratory failure in patients with chest trauma.

Material and Methods

Setting and patients

After necessary approval from Institutional Ethical Committee (IEC) and proper written and informed consent the study was conducted in Teerthanker Mahaveer Medical College and Hospital from November 2022 to March 2023. All the patients presenting to the Emergency department with chest trauma were included in the study. Patient data including demographics, mechanism of injury, numbers of rib fractures, associated injuries, pulmonary contusion, respiratory failure were all collected.

Patients older than 14 years of age presenting to Teerthanker Mahaveer Medical College and Hospital from November 2022 till March 2023, that were admitted to the respective general surgery units in our hospital with blunt chest trauma alone or with other associated injuries in different anatomic regions were included in this study. All patients with haemothorax needing to be drained were treated with a intercostal chest drain (ICD) at the time of initial evaluation. All patients underwent chest Computed Tomography (CT) in the emergency department. Chest Xray was performed routinely after admission. If the chest X-ray showed increasing density, secondary chest CT was performed to diagnose and estimate the retained pleural collections. There are two indications for Video Assisted Thoracoscopic Surgery (VATS) first is the retained volume exceeding 300 mL and the second is

formation of para-pneumonic effusion which appeared in Computed Tomography (CT) as separate lobulated pleural collection. Often, retained pleural collection do not happen immediately; hence, all secondary Computed Tomography (CT) and Video Assisted Thoracoscopic Surgery (VATS) are performed at least 48 hours after trauma. Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) was performed in the operating room under general anaesthesia with the patients in supine position. All patients received prophylactic antibiotic before surgical intervention. A double-lumen endobronchial tube was used for one lung procedure which provided a better view for the assessment of the chest and its contents. Single port subxiphoid approach was used for inserting all instruments, respectively. All patients had collections evacuated, clots removed, the pleura decorticated, and were irrigated with normal saline solutions. In three patients there was development of bronchopleural fistula post trauma which was repaired via subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) using 6-0 prolene. Complete haemostasis was achieved during each step. Thereafter, the lung was re-expanded. Finally, drainage tubes were fixed to the pleural cavity and the patient was transferred Intensive care unit (ICU) for further postoperative care. Routine chest X-rays were performed after operations. The drainage tubes were removed depending upon the nature of effusion and when the drainage was less than 100 mL/ 24 hours and no air leak was present. Post operative period was uneventful and all the patients were discharged and returned to work early.

Statistical analysis

An initial descriptive analysis was performed for every variable, and the frequencies and averages in the groups were determined. Numerical variables were presented as mean and standard deviation (SD) or median and quartiles. The chi-square or Fisher's test was employed to evaluate the categorical or proportional variables between groups. The continuous variables were compared between groups using tests of analysis of variance. A $P < 0.05$ was considered statistically significant. All data were analysed using the SPSS 16.0 statistical software.

Mechanism of Injury	Number of patients
Four-Wheeler	5
Motorcycle	21
Cycle	1
Pedestrian/Standing	2
Fall	1

Age group	Number of patients
15-20 years	11
20-30 years	13
30-40 years	5
50- 60 years	0
60-70 years	1
70- 80 years	0

Gender	Number of patients
Male	23
Female	7
Total number of patients	30
Patients with haemothorax	30
Patients with bronchopleural fistula post trauma	3
Mortality	0

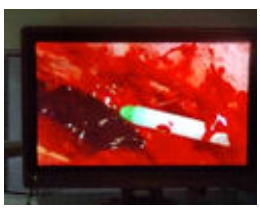
Results

Total of 30 patients with chest trauma were admitted to Teerthanker Mahaveer Medical College and Hospital from November 2022 to March 2023 who underwent subxiphoid Video Assisted Thoracoscopic Surgery (VATS). Out of the 30 patients 3 patients developed traumatic bronchopleural fistula. The characteristics of the patients is mentioned in the tables provided. There were 23 males and 7 female patients. The mechanism of the injury is also mentioned in the table provided. All the patients underwent intercostal chest drain (ICD) insertion on presentation to emergency department before undergoing subxiphoid Video Assisted Thoracoscopic Surgery (VATS). However, such drainage procedure proved unsuccessful in evacuating haemothorax in the patients who underwent Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) in this study. No patient had their uniport Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) converted to thoracotomies during the surgical intervention. Nor was the subxiphoid approach changed intraoperatively. Complete haemothorax removal was achieved in all the patients. The mean duration was hospital stay was 4 days. There was no case of post trauma infections cultured from sputum, pleural effusion and blood.

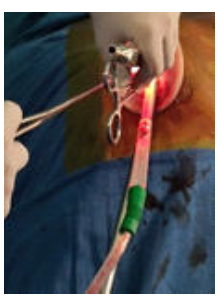
Blunt trauma chest can cause haemothorax which can induce retained pleural collections. With technological advancement there has been a shift from classical median sternotomy to minimally invasive Video Assisted Thoracoscopic Surgery (VATS) as the primary choice to manage the retained haemothorax. Moreover, uniport subxiphoid approach can be applied for broad spectrum of thoracic interventions as the standard technique. Additionally, as seen in this study more severe and complex lung lacerations can be safely repaired by subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) which has shown to reduce post traumatic complications and period of ventilator dependence. Addedly, Early Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) can also decrease the incidence of post traumatic empyema and pneumonia as well shown in this study.

Uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) Incision

Uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) intraoperative view in one of a patient. Note the organised collection in the upper pole of the pleura restricting lung inflation.



Uniport Subxiphoid Approach Video Assisted Thoracoscopic Surgery (VATS) intraoperative picture. The intercostal tube lying in thorax. Note is made of the retained organised haemothorax lying above the intercostal drainage tube after blunt dissection for adequate exposure.



Dr Ayush Srivastava and Team performing uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS). Through a single port note the number of instruments introduced and manoeuvred as per the demand of the procedure.

Preoperative Xray of one of a young patient presented to emergency with chest trauma. Note the Intercostal drainage tube in situ.

Postoperative Xray of the same patient who underwent uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS). Note the complete evacuation of the space occupying lesion in left hemithorax. The patient recovered well and discharged early with stable vitals.

Discussion

Uniport subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) has been widely applied in the diagnosis and treatment of chest trauma patients. Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) provide excellent visualisation of the pleural cavity, which is more beneficial for evacuating pleural collections compared to secondary tube thoracostomies. Additionally, Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is also much less invasive than exploratory thoracotomy, thus providing shorter recovery time for trauma patients. In this study, we found that intervention by subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) reduces the Length of stay in hospital and Intensive Care Unit, duration of ventilator use, and postoperative complications with better clinical outcomes and superior cosmesis.

Haemothorax evacuation with surgical methods (classic or Video Assisted Thoracoscopic Surgery VATS) is recommended when drainage is unsuccessful and the diagnosis is confirmed by chest tomography. Minimally invasive subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is a widely used treatment modality in thoracic surgery. Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) when compared to thoracotomy with regard to lobectomies; it was characterized by lower perioperative risk associated with the procedure, shorter hospitalization period, lesser pain, earlier recovery lower costs, and better lung function. As indicated in this study Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) proved to be an effective procedure for haemothorax evacuation in patients. The main advantage of this method appears to be the use of a minimally invasive approach free of the sternotomy wound and better visualisation of the anatomy. Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) ensures the evacuation of fluid and clots within the mediastinum and both pleural cavities. It can also be used when haemothorax is accompanied by mediastinal hematomas or sternal instability due to chest trauma. The standard management includes routine workup of the patients along with performance of echocardiography and Computed Tomography (CT). These examinations should be used to supplement the clinical picture. Thus, Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) is effective for repair of injuries due to chest trauma. Managing retained haemothorax is one of the most critical treatments for blunt chest trauma. Previously, removal of traumatic haemothorax by using a sterile suction catheter was found to be an effective and relatively simple intervention technique which minimised the possibility of retained haemothorax. Although it is seen that retained haemothorax may be spontaneously reabsorbed 4–6 weeks after trauma, excessively retained haemothorax complicates the picture. Initially, the haemothorax collapses the lung parenchyma. Accompanied by lung contusions and posttraumatic pneumonia, the collapse produces entrapped lung which can lead to acute respiratory failure in the initial phase. Progressively, fibrothorax may develop in later phase, further reducing pulmonary function. Secondarily, when the haemothorax is contaminated with microbes, empyema occurs. The empyema increases the incidence of respiratory failure and sepsis, both of which increase the length of hospital stay and adds to patient morbidity and mortality. Appropriate surgical management and specific antibiotic therapy should be arranged to ensure superior clinical outcomes. Earlier, the primary method for treating retained haemothorax was to perform an additional tube thoracostomy or exploratory thoracotomy. However, additional chest tubes might be mispositioned, resulting in inadequate drainage and prolonged hospital stay. Although an exploratory thoracotomy affords a clear view for locating lesions, this procedure is very invasive. These surgical procedures cause further destruction to already injured chest wall and accentuates morbidity and mortality. Due to advances in techniques and instruments of Video Assisted Thoracoscopic Surgery (VATS), it is now being widely accepted worldwide. As seen in this study Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) provides excellent visualization of the pleural cavity which is more useful for evacuating the haemothorax than using additional tube thoracostomies. The wound caused by Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is much smaller than those caused by a thoracotomy and even multiport approach Video Assisted Thoracoscopic Surgery (VATS). Therefore, this procedure prevents additional injury to the chest wall. This procedure is found to be suitable for use in elderly patients also. The main functions of Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) include evaluation and control of bleeding, early evacuation of retained haemothorax, evacuation and decortication of posttraumatic empyema, minimally invasive treatment of suspected diaphragmatic injuries, treatment of persistent air leaks in form of bronchopleural fistulas, and deep evaluation of mediastinal injuries. Pertaining to single and smaller incision, the cosmetic results are superior.

While performing Subxiphoid Video Assisted Thoracoscopic Surgery (VATS), to obtain a laconic view of the pleural cavity, double lumen intubation is used for collapsing the ipsilateral lung. Patient is placed in supine position. The patient undergoing Subxiphoid approach Video Assisted Thoracoscopic Surgery (VATS) usually has intercostal chest drain (ICD) in situ. Initially, the adhesions are released by blunt digital dissection or sharp endoscopic electrocoagulation dissection. Full lung collapse is crucial for inspecting the entire pleural cavity. Blood and clots are removed by using a standard suction instrument or a suction– irrigator system. A sample of fluid and the mediastinal mass is routinely collected for microbiologic and histopathological assessment. In patients with organized thoracic collections, careful dissection and peeling of the outer layer with sponge sticks and ring forceps typically enables the outer layer to be removed from the visceral and parietal pleurae, thus completely releasing the trapped lung referred as decortication. Additional injuries in the chest wall; bronchopleural fistula as seen in this study is repaired using 6-0 prolene via Subxiphoid Video Assisted Thoracoscopic Surgery (VATS). After completion of this procedure, large bore chest tube is placed. The chest tube enables continual drainage until no evidence of air leak is present or till the amount of drainage from the thoracic cavity is less than 100 ml/day. The advantage of uniport Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is that only one incision is made. As seen in the current study, merely removing blood clot was occasionally insufficient. Lung laceration is also easily detected in blunt chest injuries. In certain instances, this laceration may produce continual oozing that causes retained haemothorax to accumulate. Addedly the edges of lacerated lung can also undergo necrosis. These necrotic lung tissues are ideal culture media which enable bacterial growth and increase the risk of infection. Therefore, in addition to facilitating removal of retained pleural effusion, Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) also affords the opportunity to repair lung lacerations. Blunt chest trauma typically coincides with ribs fractures and additionally cause and prolong inflammatory responses. The sharp tip of a fractured rib may penetrate the lungs or other vital organs in the chest. Additionally, Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) can be applied to resect fractured ribs. This method can be used to reduce infection rates and

improve clinical outcomes. Routine chest radiograph in post operative period is required daily. The volume of output from the chest tube and the colour of effusion should also be recorded daily to ensure that it is devoid of obstruction.

CONCLUSION

Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is a well-tolerated, reliable, and effective procedure that can be easily applied for decortication after a patient succumbs to blunt chest trauma with associated complications as seen in present study. As an alternative procedure to open thoracotomy, Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) is minimally invasive procedure with superior results. In addition to enable efficient visualisation, inspection of space occupying lesions, Subxiphoid Video Assisted Thoracoscopic Surgery (VATS) can be used to repair lung lesions and manage rib fractures.

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