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TRAUMA SURGERY

Video-assisted thoracoscopic surgery in a high-volume urban trauma centre

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Background: Tube thoracostomy (TT) is the standard treatment for haemothorax, but 5–30% of cases may result in retained haemothorax. Video-assisted thoracoscopy surgery (VATS) is a recognised treatment for retained haemothorax, although its timing and feasibility can be challenging in resource-limited settings with restricted theatre access. The objective was to evaluate and describe our experience with VATS at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), South Africa.
Methods: This was a retrospective study over seven years (1 January 2017 – 31 December 2023). All adult trauma patients with retained haemothorax who underwent VATS were included. Data were collected from hospital databases, focusing on patient demographics, mechanism of injury, vital signs, radiological findings, indications for VATS, and clinical outcomes.
Results: A total of 71 patients underwent VATS, with 98.6% being male and an average age of 34 years. The procedure was performed for retained haemothorax in 97% (n = 69) of cases and empyema in two patients. Penetrating trauma was the most common cause, with 82% of patients suffering stab wounds and 18% gunshot wounds. The median time to surgery was 5 days, with a median operating time of 77 minutes.
Conversion to thoracotomy occurred in 14% (n = 10) of cases. Intraoperative findings included clots (42%), retained blood (42%), and pus (2.8%). Postoperative complications occurred in 12.7% (n = 9), including pneumonia (2.8%), drain site infections (5.6%), and recurrence of haemothorax (4.2%). The median length of hospital stay after VATS was 6 days, with no in-hospital mortalities.
Conclusions: VATS is a safe and feasible option for managing penetrating chest trauma in resource-constrained environments, with low complication rates and low in-hospital mortality rates.
Keywords: retained haemothorax, video-assisted thoracoscopic surgery, trauma centre

Introduction

Trauma is the leading cause of death among young patients.[1] Chest trauma poses a challenge in trauma care due to the wide spectrum of injuries it can encompass.[1] Chest injuries range from life-threatening thoracic bleeds and rib fractures to potentially less severe soft tissue injuries.[1,2]

Chest trauma is the second most common frequently occurring trauma injury and the third most common cause of death in polytrauma patients.[1-3] In patients with severe trauma, 25% of deaths are due to chest trauma.[2,3] Traumatic haemothorax can be due to penetrating or blunt trauma.[2] Blunt thoracic trauma occurs more frequently in high-income countries.[1-3] Chest trauma disproportionately impacts low- to middle-income countries (LMICs), resulting in high morbidity and mortality rates.[1,2] Additionally, penetrating trauma is more prevalent in LMICs, where it is associated with a significantly higher mortality rate.[2]

Tube thoracoscopy is essential to address pneumothoraces and haemothoraces, which may arise from penetrating or blunt injuries.[2-4] Most pneumothoraces and haemothoraces are managed successfully with a thoracostomy tube.[3,4] Patients with chest trauma can develop complications such as retained haemothorax and emphysema.[3,4] Traumatic haemothorax poses a diagnostic and therapeutic challenge both in the acute and chronic phases.[2] A retained haemothorax is defined as blood occupying at least one-third of the pleural space, which cannot be drained by tube thoracostomy (TT) after 72 hours or clots of at least 500 ml.[1-4]

Early identification of patients with retained haemothorax decreases morbidity and mortality.[5,6] The incidence of retained haemothorax is reported to be 1–30%.[5,6] Video-assisted thoracoscopy surgery (VATS) is the gold standard for managing retained haemothorax.[5-7] VATS is performed to evacuate retained haemothorax and restore lung function. The utilisation of VATS in LMICs varies due to resource constraints and expertise availability.[5-7]

Despite the widespread usage of VATS in trauma in developed countries, there are a few studies that report outcomes of trauma VATS in Africa.[5-7] Our institution has an elective list on Mondays, which sometimes must accommodate emergencies when the emergency board is overwhelmed.

We aimed to describe our experience and outcomes of VATS in an urban trauma centre in Johannesburg, South Africa. The study will add to the body of literature of VATS in LMICs.

Methods

This was a retrospective review over 7 years (1 January 2017 to 31 December 2023) at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) – a level 1 trauma centre in Johannesburg, South Africa.

We included all adult trauma patients with retained haemothorax (a minimum of 500 ml of blood) who were offered video-assisted thoracoscopy. All patients with retained haemothorax treated with a thoracotomy were excluded, as they are part of a separate study.

Patients were identified using the Medibank form, REDCap and hospital database. The patients' demographics, mechanism of injury (MOI), vital signs in the emergency department (ED), blood gas results, radiological investigation findings, injury severity score (ISS), new injury severity score (NISS), indication for VATS, findings, length of hospital stay, and in-hospital morbidity (complications) were collected.

Statistical analysis

Median (interquartile range) and means (± SD) are presented for continuous variables, and frequencies (%) are presented for categorical variables. All analyses were done using STATA version 16. Continuous variables were first tested for normality using the Shapiro-Wilk test. Fisher's exact test was used to test the significance of the relationship between categorical variables. Univariate and multivariate analyses were conducted on the data. A *p*-value of < 0,05 was considered statistically significant.

Ethical approval was obtained from the University of the Witwatersrand Human Ethics Committee and the hospital's CEO, with ethics number M201134.

Diagnosis

Patients with haemothorax were given optimal chest physiotherapy and analgesia. If physiology and general condition allowed, patients were started on bicycle exercises to facilitate chest movement, even in the ED. If the lung has not expanded by 48–72 hours on a chest X-ray (CXR), a computerised tomography (CT) scan was booked for all cases with a suspected retained haemothorax on CXR. VATS was then performed in appropriate cases. VATS was performed in the next available emergency theatre or following available elective slate within 7–10 days. The unit policy is VATS first, unless 14 days have passed, then patients get a thoracotomy.

Video-assisted thoracoscopy technique

The patients were intubated with a double-lumen endotracheal tube and positioned in the lateral decubitus position with the side of the retained haemothorax upwards. An access port was placed at the previous TT site (10–12 mm). A two-port (+1) was used, and the contents of the pleural cavity were evacuated. The pleural cavity was washed out with saline, and two TT were inserted at the end of the procedure. We followed the same method described by Edu et al.[5]

Results

Seventy-one patients underwent VATS in the study period; 98.6% were men. The average age was 34 years. 97% (*n* = 69) had VATS for a retained haemothorax, and two (2.8%) patients had VATS for an empyema. Fifty-eight (82%) patients with retained haemothorax had stab wounds, and 13 (18.3%) patients had gunshot wounds. The median systolic blood pressure (BP) in the ED was 120 mmHg (IQR 103–140 mmHg), and a diastolic BP of 71 mmHg (IQR 62–85 mmHg). The median pulse was 90 beats per minute (85–110 beats per minute). The average base excess on presentation was minus 3.4 mmol/l (-8 to -1) and lactate of 2.1 mmol/l (1.5–4.7). The median ISS was 9, and the NISS was 9. The median TT output on insertion was 1000 ml (600–1000 ml). The diagnosis of a retained haemothorax was made on a non-contrasted CT chest in 71% of patients, and 29% based on a CXR.

The majority (*n* = 70) of patients were operated on the Monday elective slate. The median time to surgery was 5 days (3–8 days). The median operating time was 77 minutes (60–110 minutes). Our conversion rate to thoracotomy was 14% (*n* = 10). Reasons for conversion were dense adhesions (*n* = 7) and failure to isolate the affected lung (*n* = 3). The intraoperative findings included clots (42%), retained blood (42%) and pus (2.8%). The postoperative complications were 12.7 % (*n* = 9), pneumonia 2.8% (*n* = 2), surgical site infections (SSI)(drain site) 5.6 % (*n* = 4), recollection 4.2% (*n* = 3), one required a thoracotomy, and other two resolved with percutaneous drainage (pigtails).

The median time from VATS to discharge was 6 days. There were no in-hospital mortalities in this group of patients. Thirty-eight (53%) patients returned to the hospital for follow-up and repeat CXR. The X-ray was clear in all patients, and no further procedures were performed in these patients.

Discussion

VATS is a proven surgical strategy for retained haemothorax with few complications.[8] We had no mortalities in patients who underwent VATS. Careful patient selection, along with the fact that most of our patients are young, may explain our low mortality rate. SSI after thoracotomy can cause serious complications. Four patients developed SSI in our study. The rate of SSI in our VATS cohort was comparable to those reported in a systematic review in 2013.[8] Early identification of retained haemothorax might explain our low rate of morbidity and mortality.

The timing of VATS has been reported as 3–10 days.[5,9] Delays lead to more conversion or thoracotomy.[5-7] The conversion to thoracotomy in our study is comparable to that in the literature.[5-8] The reason for our comparable conversion rate might be due to the early timing of VATS (5 days). There were a few adhesions during the time of VATS.

The reoperation rate was lower than that reported in the 2013 systematic review.[8] The usage of prophylactic antibiotics and the sterile technique for inserting the TT may explain the low rate of reoperations with VATS in the study.[5-9] Our study has the same complication rates as previous studies in South Africa.[5-7] The patients were young men, which is the same as in other studies.[5-7] Most patients with retained haemothorax were from stab wounds, which is comparable with other results.[5,6] Stab wounds make up the majority of our patient population.

The time from admission to VATS matches that of other studies.[5-7] Early identification of patients with retained haemothorax facilitates VATS within the 5–10-day period. The Monday elective slate also makes it possible to have patients operated on within that window in our setting, as we would cancel our elective slate to accommodate emergency operations.

Our VATS success rate is comparable to the study conducted at Groote Schuur Hospital.[5] Patients with conversion to thoracotomy had higher rates of chest recollections and increased need for percutaneous drainage.[5,6] The mean operating time is comparable to the study by Navsaria et al.[6] The times are reasonable, most likely due to the soft clots and minimal adhesions that result from early VATS.

Chest radiography is the initial tool in the ED as an adjunct to the primary survey.[10] The diagnosis of a retained haemothorax using a CXR can be challenging.[9-10] A CXR taken 48–72 hours after TT insertion is a useful screening tool. Failure to improve will raise suspicions for a retained haemothorax, followed by a non-contrast CT chest scan. In our setting, we use the second day CXR to assist with screening for a retained haemothorax. Twenty-nine per cent of patients who underwent VATS were operated on based on a CXR finding.

A bloody effusion with a haematocrit of greater than 50% in the peripheral blood has been described to diagnose a haemothorax.[10] The haematological diagnosis of retained haemothorax might be an area worth investigating, especially in LMICs.

Ultrasound has been used to evaluate pleural pathology in both trauma and non-trauma patients.[11] It can identify fluid in the chest better than a CXR.[11,12] Ultrasound is also a valuable tool in percutaneous guided procedures. Ultrasound for retained haemothorax has varying sensitivity and specificity.[12] In our setting, challenges include access to ultrasound, with long waiting periods, as it requires a trained radiologist.[13]

CT chest is the gold standard for diagnosis of retained haemothorax.[14,15] It can determine the nature of the fluid, the location and estimate the volume of the fluid.[15] We used a non-contrast CT to diagnose retained haemothorax in 71% of our patients. Contrast was used when we were concerned about complications such as empyema.

Current management of retained haemothorax includes expectant management, second TT insertion, thrombolytics, VATS and thoracotomy. VATS is associated with less morbidity and mortality when compared to thoracotomy.[5-7,16,17] We aim to identify retained haemothorax early to avoid the morbidity associated with thoracotomies for retained haemothorax. The unit protocol is to use a 28-36 Fr thoracostomy tube to manage haemothorax.

There are few high-quality studies examining the use of intrapleural thrombolytics in the management of retained haemothorax after penetrating trauma.[18,19] Tissue plasminogen activator (tPa) is expensive and needs repeated doses. The length of stay with tPa is longer compared to VATS.[9,19] Most of our trauma patients are young patients who are able to tolerate VATS. We would use thrombolytics for patients unfit for surgery.

LMICs experience several challenges in the management of retained haemothorax.[20] The availability of a CT scan might affect the pickup rates of retained haemothorax.[13] Most of our patients had a non-contrasted CT chest to diagnose retained haemothorax within 3-7 days. In settings without a CT chest, using a CXR to diagnose a retained haemothorax will be the next best thing; if possible, transfer to a facility that can manage the patient would be better.

Access to emergency theatre is a challenge we experience in LMICs. Almost all our patients have the VATS procedure on the Monday elective slate. The challenges with doing VATS in emergency surgical slates includes junior anaesthetist trainees at night, the time it takes to prepare for VATS and insert a double lumen tube. Other pressing emergencies are priorities on the emergency slate, such as children, airway procedures, bleeding and septic patients. To overcome these challenges, we used our elective slate to do VATS. This approach, however, disadvantaged our elective reversal of stoma patients, as they would be cancelled or pushed further down the list.

We propose that in LMICs, patients who have clinically retained haemothorax by 48–96 hours despite optimal chest care should undergo further radiological evaluation to confirm the retained haemothorax. Once confirmed, VATS should be performed to optimise outcomes.

Future research is needed to determine preventative strategies for retained haemothorax in LMICs. Studies to determine if screening for retained haemothorax and early diagnosis in penetrating chest trauma is cost-effective. Theres is a need for prospective randomised clinical trials on management of retained haemothorax from penetrating trauma in LMICs.

Limitations to the study

This was a retrospective study with several limitations. Selection bias to VATS until 10 days and thoracotomy after that time limit. There was no long-term follow-up, as patients were only followed up once every 1-2 weeks after VATS. The overall follow-up was low. Once they had settled on outpatient CXR review, there was no further follow-up to exclude delayed recurrence on the collection

Conclusion

VATS is a safe and feasible option for managing penetrating chest trauma in resource-constrained environments, with low complication rates and a low in-hospital mortality rate.

Conflict of interest

All authors declare that they have no conflicts of interest.

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Ethical approval

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