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Implementation of VATS and NIVATS in Thoracic Trauma

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Abstract

Background: *Thoracic injuries occur in 20% to 25% of trauma patients and results in 16,000 deaths annually in the United States. In hospital mortality of isolated thoracic trauma is 49, 2%: 57, 1% in first 6h, 699% in 24h after admission. Minimally invasive exploration of pleural cavity in the trauma settings can make a diagnosis, decrease the number of missed injuries, be a treating tool to stop the bleeding and repair damaged intrathoracic organs.*

Methods: *We perform a prospective study of all patients with thoracic trauma who were admitted to Kyiv City Hospital # 17, Polytrauma department from 2017 to 2025. 1345 patients with thoracic trauma (blunt 995, penetrating 350). Of these 11 patients underwent VATS/NIVATS.*

Results: *All 11 patients received uniportal surgery 5 VATS, 6 NIVATS. Emergency surgery was performed in 4 patients (2 VATS, 2 NIVATS), early surgery in 7 patients (3 VATS, 4 NIVATS). In all emergency cases ongoing bleeding was the cause of surgery. There was no intra- or postoperative mortality*

Conclusion: *Correct anestesiological assessment of the patient's condition and compensatory capabilities, as well as rapid surgical diagnosis of the extent of thoracic trauma and the possibility of VATS/ NIVATS to eliminate the problem (stop the bleeding...), makes them a possible alternative to open surgery.*

Keywords: penetrating thoracic trauma, severe thoracic bleeding, thoracic emergency, enhanced recovery after surgery (ERAS), non-intubated Video Assisted Thoracic Surgery (NIVATS), Video Assisted Thoracic Surgery (VATS)

Introduction

Thoracic injuries occur in 20% to 25% of trauma patients and results in 16,000 deaths annually in the United States (Chang, 2016). Thoracic trauma could be from benign condition to a life-threatening bleeding, which requires Emergency Department Thoracotomy (EDT) or emergency surgery. In hospital mortality of isolated thoracic trauma is 49, 2%: 57, 1% in first 6h, 69, 9% in 24h after admission (Matsushima et al., 2017). Since 1946 year VATS was introduced in thoracic trauma as a diagnostic tool. Nowadays there are few reports of patients with successful VATS done in trauma with a cure role.

Aim

The aim of this study was to describe and analyze the possibility of minimally invasive surgery in thoracic trauma in emergency and early cases based on our 8 years of experience.

Material and Methods

Study Design and Setting

This was a retrospective cohort study conducted at Kyiv City Clinical Hospital No. 17 over an 8-year period (2017 –2025). The study included adult patients presenting with thoracic trauma. Reporting follows the STROBE guidelines for observational studies.

Ethical Approval

The study protocol received approval from the Health Research Ethics Committee of Shupyk National Healthcare University of Ukraine (Protocol #3/10 January 31, 2025). All procedures adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained when applicable, recognizing that many critically unstable patients were unable to provide consent due to life-threatening conditions.

Funding and Conflict of Interest

The authors report no conflicts of interest related to this publication. This study received no external financial support

Use of Artificial Intelligence

No artificial intelligence tools were used in any stage of this study, including data collection, analysis, interpretation, or manuscript preparation. All research procedures and documentation were carried out exclusively by the author.

Data Sources

Clinical data were extracted from hospital medical documentation, including emergency department notes, eFAST reports, chest radiographs, operative reports, perioperative anesthetic charts, ICU monitoring sheets, and discharge summaries.

Study Population and Eligibility Criteria

A total of 11 consecutive adult patients (≥18 years) with thoracic trauma met the inclusion criteria. All patients were managed in the polytrauma department according to ATLS principles.

During emergency operation, the mean estimated blood loss was 700-1000 ml. In 1 case of early surgery it's role was a diagnostic in pericardial rupture. 4 patients who had emergency surgery (during first hour after admission). 7 patients had early surgery (after 24 h after admission).

Outcome Measures

Primary Outcomes

- Mortality
- ICU length of stay (ICU-LOS)
- Conversion to thoracotomy
- Total hospital length of stay (LOS)

Statistical Analysis

Data were analyzed retrospectively using R software (version 4.3.3).

Normality was assessed using the Shapiro–Wilk test.

- Continuous variables were expressed as **mean ± SD or median (IQR)** as appropriate.

Results

Over an 8-year period, 11 patients sustained thoracic trauma and required surgery in emergency or in the earlier period and met the inclusion criteria. 1345 patients were treated in our hospital with thoracic trauma 2017 and 2025 years. 11 of these patients (0, 8%) undergone minimally invasive thoracic surgery (VATS/NIVATS). Blunt mechanism of trauma was in 3 patients, penetrating in 8 patients.

The cohort consisted of 10 males (91%) and 1 female (9%), with a mean age of 27.41 ± 5.84 years (range 22–47). Time from injury to hospital admission ranged from 0.5 to 2 hours in emergency cases and 1h to 2 days in early cases.

The indications for emergency surgery was ongoing bleeding in all cases. In early surgery the indications were removal of foreign bodies, clotted hemothorax and diaphragm and pericardial rupture as confirmation of diagnosis.

All patients in emergency group underwent eFAST, chest X-ray and chest CT was added to the early group.

The time from admission to the operating room was exceptionally short in emergency cases (0.10-0, 25 hour).

All surgical interventions were done through one incision (uniportal) 3 to 5 cm long in the 4^{th} or 5^{th} intercostal space in midaxillary line.

Patients were examined by anesthesiologist for ASA and possible surgical operation for ongoing bleeding reason in non-intubated way.

Before VATS or NIVATS patients had IV infusions of crystalloids to restore circulating blood volume. After positioning the patient in lateral decubitus position anesthesia drugs were infused. Intraoperative monitoring included: ECG, noninvasive blood pressure, RR, $SatO_2$, capnography, BIS (bispectral index).

In the VATS settings, patients were intubated with left DLT 35 or 37. In the case of polytrauma and suspicion of pericardial rupture the patient was intubated with single tube #8 (on the day of admission) and surgery was performed with decreased ventilated lung volumes.

The cause of bleeding in all emergency cases was intercostal artery and was stopped with energy devices (monopolar, bipolar cautery or Ligasure).

In the early surgery group, NIVATS was performed for evacuation of clotted hemothorax in 2 cases, removal of foreign bodies in 2 cases. In 1 case of VATS in blunt trauma a right diaphragm rupture was found and sewn thoracoscopically.

In all cases 1 chest drain 18Fr was left after surgery and was took out on the 2^{nd}-4^{th} postoperative day.

We didn't observe any complications during and after surgeries and there was no mortality.

After surgery, patients received painkillers – paracetamol and NSAIDS.

Average LOS was 6 days.

The results were presented on The 3rd International Conference Surgery and Integrative Medicine" November 17-18, 2025 London, UK.

Conclusion

Correct anestesiological assessment of the patient's condition and compensatory capabilities, as well as rapid surgical diagnosis of the extent of thoracic trauma and the possibility of VATS/ NIVATS to eliminate the problem (stop bleeding...), makes them a possible alternative to open surgery.

Discussion

Thoracoscopy in trauma was introduced as diagnostic tool in 1976 (Jackson & Ferreira, 1976) and in 1981 a serial of 36 patients with hemothorax was treated under local anesthesia (Jones et al., 1981). These surgeries allowed to avoid thoracotomy in 44% of cases. The implementation of minimally

invasive thoracic surgery in trauma is useful for diaphragmatic injuries (especially in thoracoabdominal), mediastinal injuries, thoracic bleeding in stable patients, assessment of persistent air leak, evacuation of clotted hemothorax, removal of foreign bodies, lobectomy in some cases.

The time frames of VATS in trauma were divided into emergency (first 48 h), early (2-7 days), late (after 7 day) (Margulies et al., 2009).

Urgent VATS was done in 32 patients (57, 1%) among 56 patients with both blunt and penetrating trauma (Akkas et al., 2025).

VATS for stop the bleeding from intercostal artery was performed in 4 cases (Manlulu et al., 2004), 6 cases (Jin et al., 2015), 13 cases (Alshehab et al., 2022). In the Alshehab, D. et al., 2022 ……article among 21 patients who underwent VATS, only in 2 cases DLT was used.

In our 2 cases we performed VATS in urgent cases to stop the bleeding also with single lung ventilation with reduced volumes.

The data has shown that VATS possess for 0, 8% of missed injuries, 2% of complications and 62% of preventing thoracotomy or laparotomy (Manlulu et al., 2004; Jin et al., 2015; Alshehab et al., 2022; Villavicencio et al., 1999).

The comparison of minimally invasive thoracic surgery with traditional thoracotomy showed that performing of thoracoscopic surgery has less post-operative pain, shorter length of chest drainage and hospital stay, fewer complications, an enhanced recovery and a better postoperative quality of life (Shi et al., 2019).

We didn't find the use of NIVATS in the cases of penetrating thoracic trauma and ongoing bleeding in the literature.

Spreading of knowledge and translating science into action we implemented NIVATS into armamentarium of tools that could be used in emergency thoracic trauma cases.

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