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Original Research Article

Study of diagnostic and therapeutic utility of video assisted thoracoscopic surgery

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ABSTRACT

Background: Video-assisted thoracoscopic surgery (VATS) is rapidly becoming a popular method for diagnostic and therapeutic purposes. Many diseases of the chest can now be diagnosed by VATS due to ease of look and biopsy. Hence the present study was undertaken to determine diagnostic and therapeutic utility of VATS in different chest pathologies.
Methods: In this prospective study, total 36 patients of different age group were subjected to VATS procedure, to measured operative time, intra and post- operative complications, post-operative pain and hospital stay. Then patient was followed up at 15 days, at 1 month, 3 month and at 6 months.
Results: VATS was successfully carried out in 28 patients as the only procedure whereas 8 patients required conversion to thoracotomy. Average operative time for patients operated by VATS only was 94.9 minute and for patients operated by VATS converted to thoracotomy was 175.5 minute. Most common intraoperative complication was bleeding (16.66 %) followed by anaphylactic shock observed in only one patient. Most common postoperative complication was prolonged air leak (5.55%) followed by port site infection (2.77%) and postoperative bleeding (2.77%). At 24 hours postoperatively, average pain score observed in VATS group was 3.73 and in thoracotomy group was 6.28. The mean postoperative hospital stay for patients operated by VATS was 7.28 days and for patients operated by VATS converted to thoracotomy was 10.36 days. There was significant difference observed in diagnosis of various chest pathologies by radiological investigations and VATS.
Conclusions: VATS should be offered as the first approach to various chest pathologies requiring surgical intervention and preferred over thoracotomy when feasible.

Keywords: Chest pathology, Lung hydatid disease, Pleural empyema, Radiological investigation, Video-assisted thoracoscopic surgery

INTRODUCTION

Traditionally, thoracic surgery performed for diagnosis or treatment of chest conditions has required access to the chest through thoracotomy or sternotomy incisions. But, both incisions have the potential for causing significant pain that may last for extended periods and both result in bony fractures that require a minimum of six weeks to heal during which time patients must refrain from heavy lifting or strenuous activity.[1] Now, many diseases of the chest can be diagnosed by VATS due to ease of look and biopsy.[2] The great advantage of VATS over sternotomy or thoracotomy is avoidance of muscle division and bone fractures that allows for diminished duration and intensity of pain and a shorter time to return to full activity.[1]

Video assisted thoracoscopic surgery, describes an area of surgery that crosses all traditional disciplines and has

changed the face of general surgery. The goal of thoracoscopic surgery is to perform standard, classical open surgical procedures via the thoracoscope to make the operative procedure more patients friendly. Thoracoscopy provides access to the thoracic cavity for diagnosis and also for many surgical interventions previously only possible by thoracotomy. The growth of this technique and its applications has developed exponentially, and it currently accounts for a large proportion of all surgical procedures previously addressed through thoracotomy. The growing interest in thoracoscopy is mostly attributable to cumulative evidence suggesting a reduction in patient morbidity, shortening in hospital stay and early return to normal activity.[3-5]

VATS has enjoyed widespread use for technically straightforward operations such as pulmonary decortication, pleurodesis and lung or pleural biopsies, while more technically demanding operations such as esophageal operations, mediastinal mass resections or pulmonary lobectomy for early stage lung cancer, have been slower to catch on and have tended to remain confined to selected centers.[6,7] It is expected that advanced VATS techniques will continue to grow in numbers spurred by patient demand and greater surgeon comfort with the techniques.[1] In present study of diagnostic and therapeutic utility of VATS, we intend to study advantages, disadvantages and outcomes of VATS procedure in various chest pathologies.

METHODS

After obtaining approval from institutional ethics committee and Maharashtra University of Health Sciences, Nashik, as well after obtaining written inform consent from all patients/parents, this prospective study was conducted in 36 patients of various chest pathologies, operated by VATS.

Inclusion criteria

- patients presented with indications of primary spontaneous pneumothorax
- loculated pleural effusions (including empyema, hemothorax, chylothorax, exudative pleural effusion of unknown cause)
- lung cancer
- intra-pulmonary mass,
- mediastinal mass, lung hydatid disease
- patients with diaphragmatic eventration
- trauma to chest
- with pleural space collection
- suspected lung injury or persistent bleeding
- intra-thoracic foreign body
- suspected diaphragmatic injury
- patients with diseases of esophagus including carcinoma of esophagus, esophageal diverticula, esophageal motility disorders
- severe primary hyperhidrosis requiring upper dorsal sympathicolysis
- patients with myasthenia gravis requiring thymectomy.

Exclusion criteria

- patients with major hemodynamic instability
- evidence of cardiac or great vessel injury
- major tracheobronchial injury
- with recent myocardial infarction
- coagulopathy
- inability to tolerate single lung ventilation
- acute or chronic severe respiratory insufficiency
- visceral and parietal pleural symphysis and
- patients with secondary pneumothorax.

A detail history, thorough general and systemic examination and all relevant laboratory investigations were done for all the patients. SpO_2 was measured in each patient. Electro-cardiogram was done for anesthetic fitness. In all patients, plain X ray chest and ultrasonography of thorax was done. CT scan of thorax was done in patients with appropriate indications. Based on history, clinical examination, blood investigations and radiological investigations, a preoperative diagnosis was made, and management plan was decided.

Preoperatively, patients with low SpO_2 were given oxygen supplementation, patients with infective pathology were started on appropriate antibiotics and hydration of patient was ensured. Evaluation of patients by anesthetist was done.

Patients declared unfit for thoracoscopic surgery were excluded from the study. All patients were given in right or left lateral decubitus or supine position depending on the side of chest pathology, with midsection at central break of operation table. Then all patients received general anesthesia with double lumen endotracheal tube intubation for adults and use of endotracheal tube with selective endobronchial blocker for pediatric patients.

The single lumen endotracheal tube with dual lung ventilation was used in patients with pleural empyema. Patient's ventilation and oxygenation were monitored by capnography and pulse oximetry by anesthesiology team.

VATS was performed in patients, who were declared fit by anesthetist for the procedure. A standard thoracotomy set was kept ready if conversion to open procedure was required. Depending on the procedure 3 or more ports were used.

A 10 mm (for adults) or 5mm (for pediatric patients) port was used for telescope and other ports (5mm or 10 mm) for dissection, suturing purpose and for suction and irrigation. CO_2 insufflation (4-6 mm Hg pressure at a

flow rate of 1 liter per minute) was used only for patients with pleural empyema.

Intraoperative findings were noted. Intraoperative complications and operative time were also recorded. If there was any difficulty during VATS, then procedure was converted to open thoracotomy. Cause for conversion to thoracotomy was noted.

Procedures performed were listed below and shown in Figure 1-10:

1. For pleural empyema, drainage of pleural collection done.
2. For diaphragmatic injury, repair of diaphragm by suturing done (Figure 1a).
3. For carcinoma of esophagus, thoracoscopices ophagectomy had done (Figure 1b).
4. For lung hydatid, excision of lung hydatid cyst done was showing below (Figure 1c[1,2,3]).
5. For diaphragmatic eventration, plication of diaphragm had done (Figure 1d[1,2]).
6. For multi loculated pleural collection, breaking the loculi and drainage of fluid and/or decortication had done, (Figure 1e[1,2,3]).
7. For esophageal diverticula, diverticulectomy and esophagomyotomy done.

At the end of procedure, a thoracostomy tube was kept in pleural space and connected to underwater seal drainage bag. Port sites were sutured with vicryl and skin with non-absorbable suture.

Thoracotomy incision was closed by approximating ribs with prolene/ethibond, muscles sutured with vicryl and skin with non-absorbable suture. Incision sites were infiltrated with 0.5% Bupivacaine, just before closure. Cleaning and dressing was done. All patients >7 years received an intra-operative dose of 75 mg Diclofenac and patients <7 years received 10mg/Kg paracetamol and the next dose was scheduled 8 hours later.

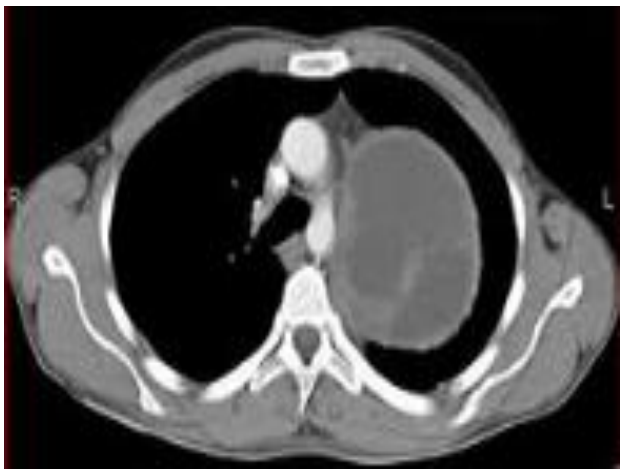

Figure 1: CT showing left sided lung tumour mimicking hydatid cyst.

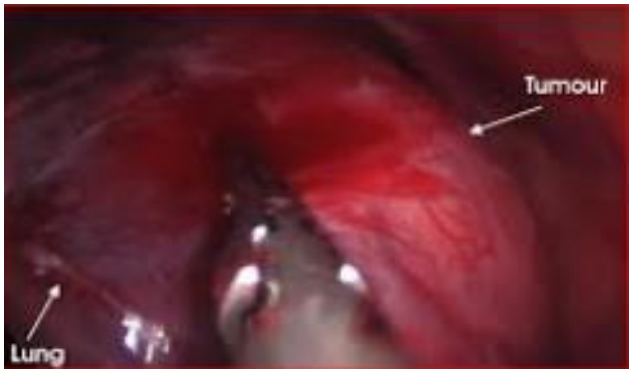

Figure 2: Intraoperative-lung tumour.

Figure 3: Specimen of lung tumour.

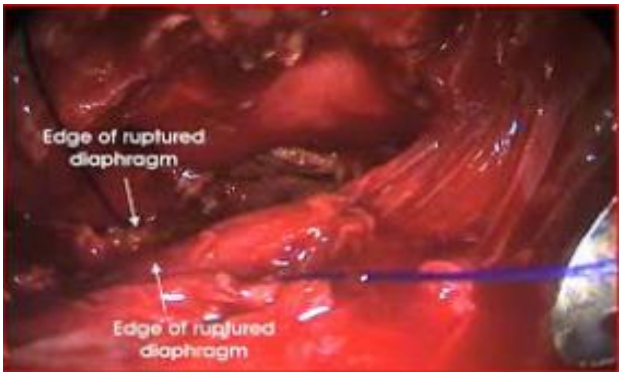

Figure 4: Intraoperative- repair of diaphragmatic rupture by VATS.

Figure 5: Intraoperative-esophageal dissection during esophagectomy by VATS.

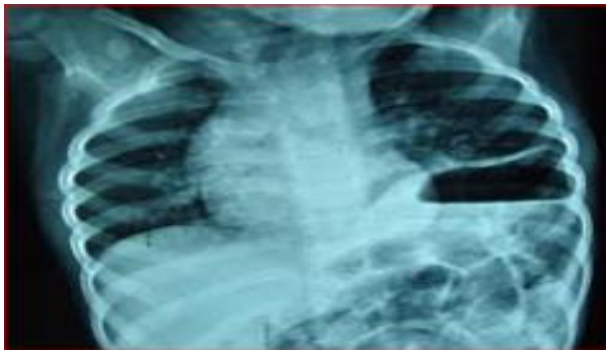

Figure 6: Pre-operative X-ray-left diaphragmatic eventration.

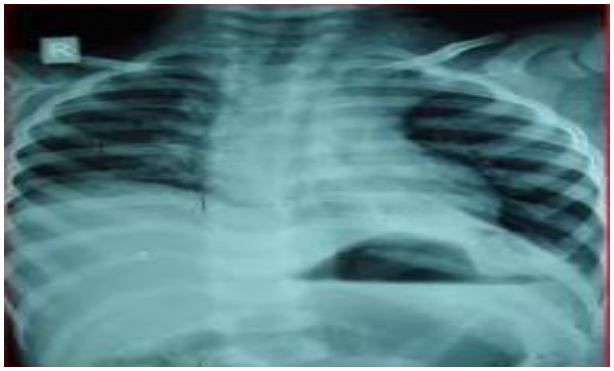

Figure 7: Pre-operative X-ray after diaphragmatic plication by VATS.

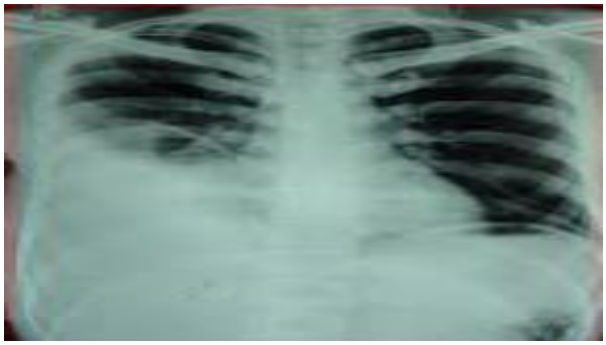

Figure 8: Pre-operative X-ray of right sided multiloculated pleural effusion.

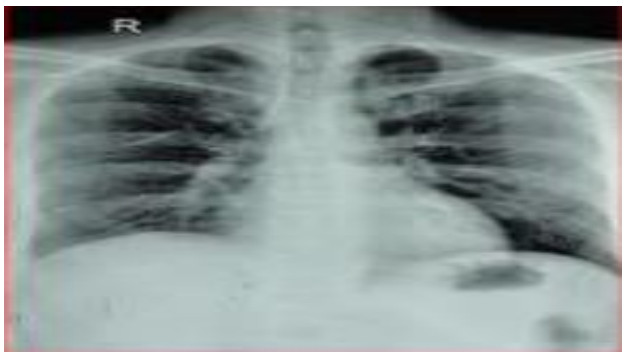

Figure 9: Pre-operative X-ray after decortication by VATS.

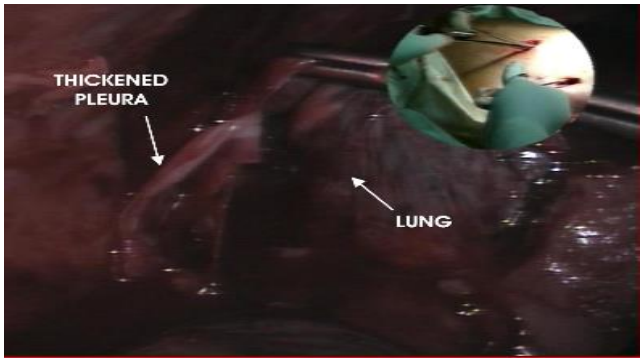

Figure 10: Intraoperative photograph during decortication by VATS.

Post-Operative Care

Patients were kept Nil by oral for 6 hrs. Patients operated for esophageal pathology were kept nil by mouth for 5 days. It was supplemented by intra venous fluids. Post-operative pain was measured by using 0-10 Numeric Pain Rating Scale at post-operative time of 24 hour for more than 7 years patients and Wong-Baker FACES Pain Rating Scale was used for patients between 3 to 7 years. All patients >7 years received injectable Diclofenac 75 mg post operatively once at 8 hours and then oral diclofenac 50mg for 3 days in bid dosage and patients <7 years received injectable paracetamol 10 mg / kg post operatively once at 8 hours and then oral paracetamol 10 mg/ kg for 3 days in bid dosage. Post-operative dressing was done on day 3. Suture removal was done on day 7 or 8.Patients were assessed for post-operative complications like pleural space collection, prolonged air leak (air leak >7 days), postoperative bleeding, wound infection, wound gape, scar pain, scar hypertrophy and any mortality. Patient was discharged when he/she was suitable for discharge which was evaluated clinically, radiologically and postoperative hospital stay was calculated in days. Patient was followed up at 15 days, at 1 month, 3 month and at 6 months.

RESULTS

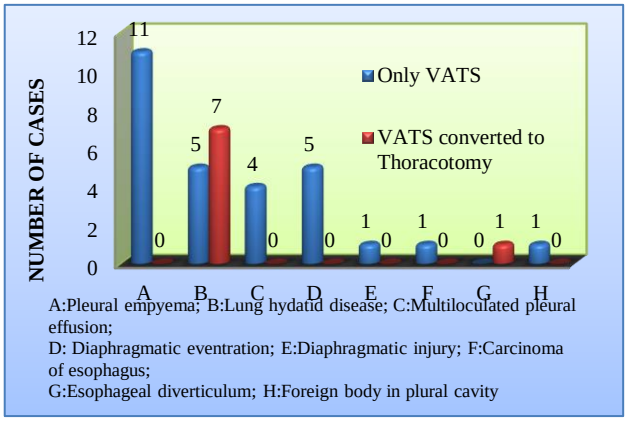

Figure 11: Distribution of patients according to procedure carried out for given indications.

A total of 36 patients were enrolled in the study, among them twenty-eight were male and eight were female.

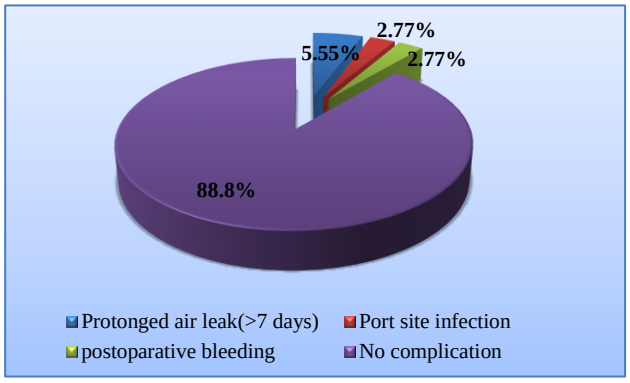

Figure 12: Distribution of patients according to postoperative complications.

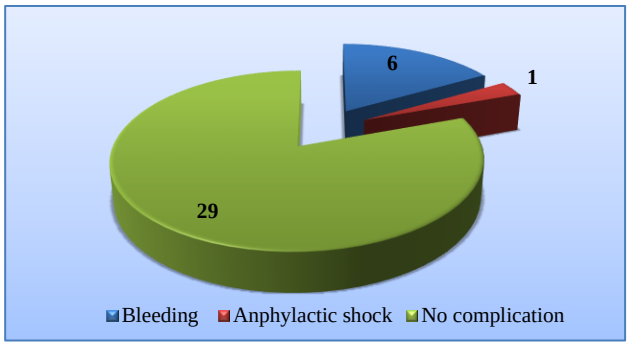

Figure 13: Distribution of patients according to intraoperative complications in 36 patients.

Table 1 show the distribution of patients according to indication of VATS and mean age in years. Lung hydatid disease as a preoperative diagnosis was most common indication in 33.33% of patients followed by pleural empyema in 30.55 % patients for VATS. Figure 2 show the surgical procedures carried out for given indications. VATS was successfully carried out in 28 patients as the only procedure whereas 8 patients required conversion to thoracotomy.

Table 1: Distribution of patients according to indication of VATS and mean age in years.

Indication	No. of patients	Mean age in years
Pleural empyema	11(30.55%)	5.09
Lung hydatid disease	12 (33.33%)	29.91*
Multiloculated pleural effusion	4 (11.11%)	29.5
Diaphragmatic eventration	5 (13.88%)	10.14
Diaphragmatic injury	1 (2.77%)	43
Carcinoma of esophagus	1 (2.77%)	59
Esophageal diverticulum	1 (2.77%)	47
Foreign body in pleural cavity	1 (2.77%)	48

The intraoperative bleeding observed in 6 (16.66 %) patients who obscured the vision despite of suctioning and anaphylactic shock in 1 (2.77%) patient, all of which later required conversion to thoracotomy. Operative time varied according to the pathology for which VATS was carried out (Table 2). Average operative time for patients operated by VATS only was 94.9 minute and for patients operated by VATS converted to thoracotomy was 175.5 minute.

Table 2: Average operative time for the indication according to the procedure performed.

Indication	Only VATS (Average time in minutes)	VATS converted to Thoracotomy (Average time in minutes)
Pleural empyema	76.72	-
Lung hydatid	85.4	168.43
Multiloculated pleural effusion	90.5	-
Diaphragmatic eventration	118.4	-
Diaphragmatic injury	110	-
Carcinoma of esophagus	245	-
Esophageal diverticulum	-	225
Foreign body in pleural cavity	79	-

Most common postoperative complication was prolonged air leak (>7 days) observed in 2 (5.55%) cases. Port site infection in one patient (2.77 %) and postoperative bleeding was noted in another one patient (2.77 %).

Table 3: Average postoperative pain score for given indication and procedure for patients more than 7 years.

Indication	Only VATS	VATS converted to thoracotomy
Pleural empyema	3.5	-
Lung hydatid	4	6.33
Multiloculated pleural effusion	3.25	-
Diaphragmatic eventration	5	-
Diaphragmatic injury	3	-
Carcinoma of esophagus	5	-
Esophageal diverticulum	-	6
Foreign body in pleural cavity	3	-

The average pain score for VATS group was 3.73 and for thoracotomy group was 6.28. Average postoperative pain score for given indication and procedure for patients more than 7 years were shown in Table 3. While in case of patients between 3 to 7 years, the median Wong-Baker faces pain rating scale score in VATS group was hurts

little bit (HLB); where as in a patient of lung hydatid which required conversion to thoracotomy the pain score was hurts even more (HEM).

The mean duration of thoracostomy tube drainage in patients subjected to VATS was 5.21 days and that for patients subjected and converted to thoracotomy was 8.12 days. Mean hospital stay for patients operated with only VATS was 7.28 days and for patients operated by VATS converted to thoracotomy was 10.36 days. The mean postoperative hospital stays for given indication and procedures were given in Table 4.

Table 4: Mean postoperative hospital stay for given indication and procedure.

Indication	Only VATS	VATS converted to thoracotomy
Pleural empyema	7.36	-
Lung hydatid	9	10.43
Multiloculated pleural effusion	6.5	-
Diaphragmatic eventration	5.6	-
Diaphragmatic injury	8	-
Carcinoma of esophagus	12	-
Esophageal diverticulum	-	10
Foreign body in pleural cavity	4	-

There was significant difference (p value <0.05) in diagnosis of various chest pathologies by radiological investigations and VATS (Table 5). Direct visualization of the pathology by VATS offers significant advantage in diagnosis of chest pathology. All the patients of only VATS group were satisfied with the cosmetic outcome of the procedure as compared to thoracotomy patients.

Table 5: Comparison of Diagnosis by Radiological investigations and VATS.

Diagnosis	Disease diagnosed correctly	Disease not diagnosed correctly
Radiological investigations	32	4
VATS	36	0

DISCUSSION

The present study was done over a period of 2 years and 6 months, in which 36 patients of different age group were subjected to VATS procedure with youngest of 4 months and oldest of 62 years. The most common indications for VATS procedure were lung hydatid disease followed by patients with pleural empyema. Mean age of patients with true lung hydatid disease was 24.37 years; this was closer to study done by Ghoshal et al [8] and Dakak et al.[8,9] Similarly, mean age of patients with pleural empyema was 5.09 years; this mean age incidence was approaching to that with Pappalardo et al series.[10]

Patients with pleural fluid problems included patients of pleural empyema (30.55%) and cases of multi loculated pleural effusion (11.11%). 12 Patients (33.33%) of lung hydatid as a preoperative diagnosis were subjected to VATS and intraoperatively 4 patients had lung mass (11.11%), not consistent with lung hydatid. 8 patients (22.22%) patients had true lung hydatid disease and were operated by VATS. Hydatid disease of lung is endemic in India. Out five patients of diaphragmatic eventration, 4 were pediatric patients (11.11%) and 1 adult (2.77%). This difference is mainly related to differences in regional hospital admissions. Other 4 patients having diagnosis of diaphragmatic injury, carcinoma esophagus, esophageal diverticulum and foreign body in pleural cavity were included in the study.

VATS was carried out in 28 patients (77.77%) and in rest 8 patients (22.22%) VATS was converted to open thoracotomy. Out of 8 patients converted to thoracotomy, 4 patients (11.11%) had lung mass, 3 patients (8.33%) had lung hydatid disease, and one patient (2.77%) had esophageal diverticulum. The most common indication for conversion to thoracotomy was intraoperative bleeding (75 %) which obscured the vision despite suctioning and in one patient (12.5%) conversion to thoracotomy was done for intraoperative rupture of hydatid cyst and anaphylactic shock. In one patient (12.5%) of Hydatid cyst conversion to thoracotomy was done because of inability to visualize the cyst properly. These results were correlated with the other studies.[11,12] Intraoperative complication was observed in 7 patients (19.44%). Most common intraoperative complication was bleeding in 6 patients (16.66%). Most commonly bleeding occurred during separation of adhesions between lung and pleura or between mass or cyst and pleura. In one patient (2.77%) anaphylactic shock was observed, which was comparable to study done by Jakubowski et al.[13] The average operative times for the indication were shown in Table 6 and compared with other studies.

Postoperative complications were noted in 4 patients (11.11%), which included prolonged air leak in 2 patients (5.55%), which was comparable to study by Dominioni et al whereas, postoperative bleeding in 1 patient (2.77%) and port site infection in one patient (2.77%), which was comparable to study by Kaiser et al and Hazerlrigg et al.[23-25]

At 24 hours average postoperative pain score in VATS group was 3.73 and thoracotomy group was 6.28 in patients more than 7 years, this result was correlated with the study of Tschernko et al.[26] Total 6 patients between age group 3 to 7 years were subjected to VATS procedure with conversion to thoracotomy required in 1 patient. Median pain score in this age group (3-7 years) was hurts little bit (HLB) in VATS group and in VATS converted

to thoracotomy patient, it was hurts even more (HEM). Thus, there was significantly less pain in VATS group as compared to thoracotomy group.

Table 6: Average operative time for the indication compared with previous studies.

Indication	Present study (in min)	Previous comparable studies
Pleural empyema	76.72	Podbielski et al and Grewal et al[14,15]
Lung hydatid	85.4	Alpay et al and Oak et al[16,17]
Multiloculated pleural effusion	90.5	Muhammad et al[18]
Diaphragmatic eventration	118.4	Freeman et al[19]
Diaphragmatic injury	110	Parelkar et al[20]
Carcinoma of esophagus	245	Collard et al[21]
Esophageal diverticulum	225	-
Foreign body in pleural cavity	79	Liu et al[22]

The mean duration of postoperative thoracostomy tube drainage for indication were shown in Table 7 and compared with previous studies. There was difference in postoperative thoracostomy tube drainage for cases of lung hydatid disease, diaphragmatic injury and for cases of esophageal diverticula in our study and other studies is mainly related to small number of patients in our study. 4 patients, in our study diagnosed preoperatively as lung hydatid disease had a different intraoperative finding, not consistent with hydatid disease.

Table 7: Mean duration of postoperative thoracostomy tube drainage compared with previous studies.

Indication	Present study (in days)	Previous comparable studies
Pleural empyema	5.27	Paolo et al[27]
Lung hydatid	7	Mehta et al [28]
Multiloculated pleural effusion	4.5	Shivachev et al[29]
Diaphragmatic eventration	3.6	Mouroux et al[30]
Diaphragmatic injury	6	Parelkar et al[20]
Carcinoma of esophagus	8	Yen et al[31]
Esophageal diverticulum	8	Fernando et al[32]
Foreign body in pleural cavity	3	Liu et al[22]

All of these cases were converted to thoracotomy and in this group, duration of postoperative thoracostomy drainage was 8.14 days which was related to drain output and prolonged air leak (>7 days).

Table 8: Mean postoperative hospital stay for indication compared with other studies.

Indication	Present study (in days)	Previous comparable studies
Pleural empyema	7.36	Shahin et al[34]
Lung hydatid (VATS /thoracotomy group)	9/10.43	Mehta et al[28]
Multiloculated pleural effusion	6.5	Laisaar et al[35]
Diaphragmatic eventration	5.6	Khanday et al[36]
Diaphragmatic injury	8	Freeman et al[37]
Carcinoma of esophagus	12	Wu et al[38]
Esophageal diverticulum	10	Varghese et al[33]
Foreign body in pleural cavity	4	Dinka T et al[39]

Table 8 show the mean postoperative hospital stay for indication and which were compared with other studies. In a study by Varghese et al mean postoperative hospital stay for patients of esophageal diverticulum operated by thoracotomy was 7 days.[33] In present study, while operating this patient, we encountered adhesions during the procedure and separation of which lead to bleeding and obscured the vision despite suctioning and hence conversion to thoracotomy was done.

Postoperative hospital stay was longer as compared to study by Varghese et al because of longer postoperative thoracostomy tube drainage in this patient.[33] In present study, radiological investigations (X-ray, ultrasonography of thorax and CT) were used to make a preoperative diagnosis. Patients were subjected to VATS procedure depending on preoperative diagnosis made by radiological investigations. It was observed that in 4 patients, intraoperative diagnosis was different than the preoperative diagnosis and in rest of patients' diagnosis was same as that was made preoperatively by radiological investigations and it was later confirmed by histopathological examination report.

Authors assume a hypothesis that there is no significant difference between diagnosis by radiological investigations and by VATS for applying Chi square test. Using Chi square test on table number 5, the Chi square value was 4.203. Value of Chi square for a probability of 0.05 is 3.84. In present study chi square value was greater than 3.84, thus a probability value is lower than 0.05 according to probability value table (in present study, p value is <0.05). Hence the hypothesis was wrong and

there was significant difference between diagnosis by radiological investigations and by VATS as noted in our study..

CONCLUSION

VATS should be offered as the first approach to various chest pathologies requiring surgical intervention and preferred over thoracotomy when feasible. Also, VATS offer significant diagnostic advantage over radiological investigations for various chest pathologies.

When faced with intraoperative complication during VATS, conversion to thoracotomy should be prompt. VATS is a method of a surgical procedure and should not be the ultimate goal, conversion to thoracotomy should be done without hesitation whenever necessary. During our study period we did not encounter patients of spontaneous pneumothorax, myasthenia gravis and primary hyperhidrosis, so a longer study period is required to assess outcomes of VATS for these indications.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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