Outcomes of the Uniportal Video-Assisted Thoracoscopic Surgery in the Treatment of Pleural Empyema- An Innovative and Less Invasive Thoracoscopic Approach

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Abstract

Objective: To determine the postoperative outcomes of video-assisted thoracoscopic single port surgery (VATS) in the treatment of pleural empyema.

Methods: This case series was conducted at Department of thoracic Surgery, Karachi. It was 16 months study from September 2020 to January 2022. Total 170 patients of both genders were included. Informed and written consent was taken from all included patients. Complete history and thorough clinical examination of patients were obtained. All operations were employing one lung ventilation, general anesthesia, and a double-lumen endotracheal tube. Each and every patient was followed up till 4 weeks to assess the postoperative outcomes. Data was compiled and analyzed using SPSS-21.

Results: In this study mean age was 56.9±17.7 years. Out of 170 patients, 97 (57%) were male and 73 (43%) female. The postoperative outcomes of U-VATS in the treatment of pleural empyema were determined, mean operation time was 130.0±64.6minutes, mean pain score at first post-operative day was 2 ± 1.6, the mean duration of pain was 2.5±2.1 days, mean pain score after removal of chest tube was 0.33±0.9 and mean cosmetic score was 2.45±0.4. Postoperative paresthesia was observed in 9 (5.3%) cases, no wound infection was observed and satisfactory re-expansion of lung was noted in 154 (90.5%) cases.

Conclusion: Even in stages 1 and 2 of the condition, pleural empyema can be effectively treated with U-VATS, and the procedure has relevant postoperative outcomes in terms of reduced discomfort, less complications, and aesthetic improvements.

Keywords: Uniportal video-assisted thoracic surgery, (U-VATS), empyema thoracic, Pleural empyema, decortication.

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Introduction

It can result from a variety of conditions, including infected clotted hemothorax, deep chest trauma, and pneumonia. tuberculosis, ruptured lung abscess, ruptured pulmonary hydatid cyst, ruptured liver abscess, or iatrogenic during pleural fluid aspiration or tube thoracostomy[2]. In the majority of cases, bacterial pneumonia results in considerable mortality and morbidity of 2–30%[3]. The prevalence and incidence of empyema thoracic varies according on a person's immunity, age, location, and other factors[4]. Successful treatment of these cases depends on determination of its exact etiology[5]. There are three stages of empyema thoracic and these stages determine the suitable treatment options. Stage-I (exudative stage) in this stage there is protein rich >3g/l effusion with no loculations on imaging studies, routinely managed by pleural tap or tube thoracostomy along with appropriate antibiotics (Fig-1).

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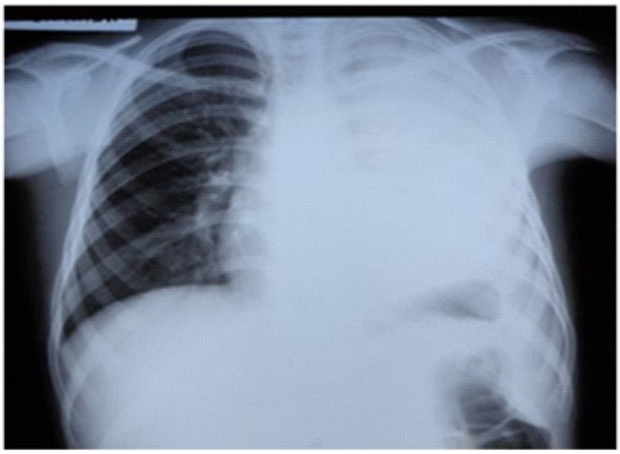

Fig 1. Chest X –ray of a patient suggesting left sided empyema thoracic.

Stage II (fibrinopurulent stage) in this there is accumulation of thick opaque fluid and deposition of thin fibrin layer over the pleura with loculations and pockets in the pleura on imaging studies, it can be managed by fibrinolytic therapy or VATS decortication under cover of appropriate Antibiotic therapy (Fig- II).

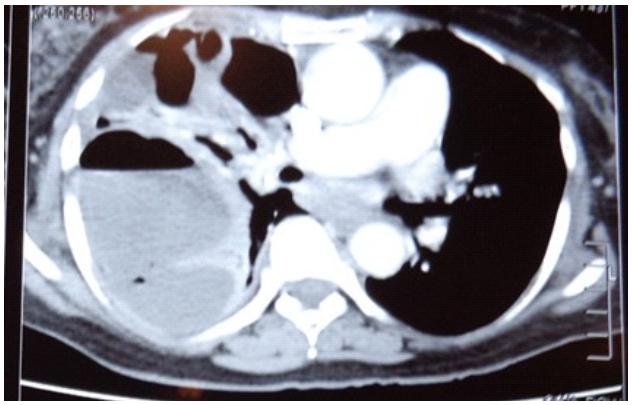

Fig 2. CT scan chest of a patient shows right sided Multiloculated empyema

Stage- III (organized stage) in this there is accumulation of very thick pus and scaring of pleural space lead to lung entrapment by thick peel or cortex, it needs more invasive treatment than tube thoracostomy to remove the pleural rind and allow lung re-expansion thus required U-VATS, VATS, thoracotomy decortication with appropriate antibiotic cover but sometimes pleurocutaneous window or thoracoplasty required depending on patients condition (Fig 3,4).

There isn't just one effective treatment, though, due to the complexity of the illness process[6]. Empyema treatment aims to eliminate infectious debris, fully expand the lung, and address the infection's underlying cause. The first two goals are accomplished surgically with either debridement or tube thoracostomy. The earliest and most effective treatment for early empyema is the placement of chest drains properly[7]. After inserting a chest drain, if the clinical state does not improve, a CT scan should be done to check for loculated effusion. Loculatio ns on a CT scan are a sign that VATS is needed[8]. It may be possible to stop the disease from progressing with definitive fluid drainage and the insertion of chest drains in advantageous areas under clear visibility[9].

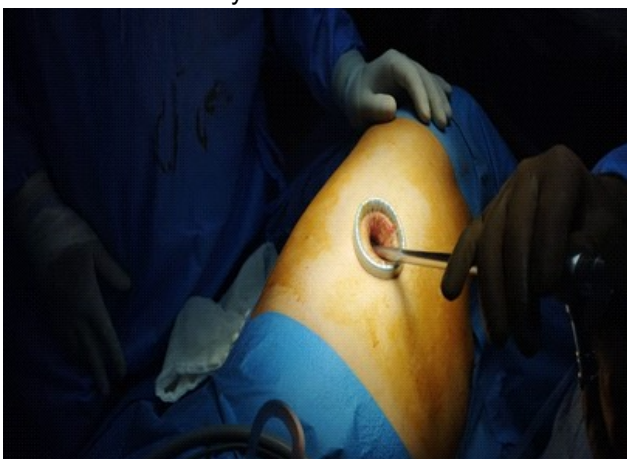

Fig 3. Single port with wound protector

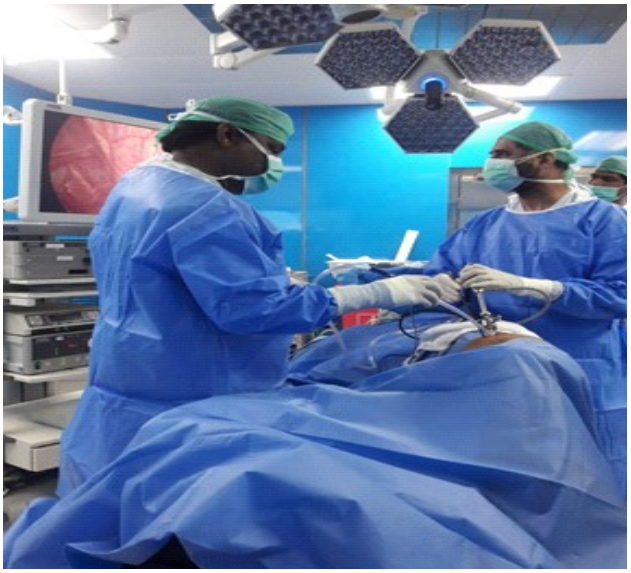

Fig 4. Uniportal VATS with intruments in pleural cavity through single port and tower placement.

Surgical option for management of advanced stage empyema traditionally was open thoracotomy decortication with postero lateral approach[10]. Muscle sparing techniques and Mini-thoracotomy then created with the intention of cutting down on hospital stays and post-operative pain[11]. The two surgical procedures that are used the most frequently today are thoracotomy and video-assisted thoracic surgery (VATS). When compared to thoracotomy, the VATS had better outcomes in stage II and occasionally stage III empyema[12]. In the past, three or four ports were used to operate VATS, however a recent innovation in the technology called Uniportal VATS allows for one port to perform VATS.Figures 3 and 4. Because there is a high conversion rate from VATS when more thorough decortication is required, thoracotomies are still done in a lot of stage III cases[13].

This study's objective was to evaluate the postoperative results of Uniportal video-assisted thoracic surgery (U-VATS) for the management of thoracic empyema. To the best of our knowledge very limited data at national and international level is available. Besides, the study did in past had small sample size. In this study large sample size was used, which would give more accurate results regarding the clinical outcome of the minimal invasive technique.

Patients and Methods

All 170 patients of either gender, 15-70 years of age, who were diagnosed as empyema thoracic stage-I, II & III had not responded on medical treatment were included in the study.

Patients with coagulopathy ,severe cardiovascular disease, subjected to combined operation as empyema and lung resection those who refused for VATS, unfit patients for general anesthesia, stage 111 empyema with loss of intercostal spaces due to overcrowding of ribs, TB empyema patients recently diagnosed and took ATT for less the 2 months were excluded from study. This case series was conducted at the department of thoracic surgery, Ojha institute of chest diseases, DUHS, Karachi for the period of 10 months.

This sample size was calculated using the WHO sample size calculator, taking the prevalence of post-operative paresthesia i.e. (P) = 5.7% (14) margin of error = 3.5% and confidence level 95%. Non-Probability consecutive sampling were used.

The study was conducted after approval from ethical review committee. Patients meeting inclusion criteria were enrolled in the study. Informed and written consent was taken from all included patients. The history and clinical examination of patients were obtained. All operations were performed under general anesthesia and one lung ventilation, using a double-lumen endotracheal tube. The patient was then kept in lateral decubitus position with the flexed and stretched arms toward the head. A muscle-sparing single incision of 3–4 cm was performed. The exact location of incision over intercostal space depends on the location of loculus or loculi seen on radiology images chest x-ray or CT scan but it is between posterior and anterior axillary line. Incision widened and protected by the wound protector for the development of a 10 mm, 0°, or 30° thoracoscope, as well as VATS equipment. In order to produce a single pleural cavity free of septa and loculations and to restore the lung's natural expansion, the procedure was preceded by debridement, breaking of septa, and removal of all adhesions and effusions from the parietal pleura, diaphragm, and apex of hemithorax. Multiple instruments might be utilized simultaneously through a single incision thanks to the long, curved tools' design and twin pivot points. These samples included histological and microbiological ones. There was minimal lung parenchymal harm from the many irrigations with warm physiological solution that were used to remove all organized pus and the remaining effusion from the visceral pleura. Decoration made possible by the achieved through the removal of fibrous thick peel over visceral pleura or through its multiple incisions with an electrocautery device. Lung expansion was checked under thoracoscopic control. An extrapleural para-vertebral intercostal nerve block was performed, infiltrating 0.5% bupivacaine 3 ml, in 3–4 intercostal spaces above and below the incision, under endoscopic view. The

procedure was ended when a full lung re-expans was accomplished and with the placement a positioning of one or two chest drains 24 or French through the same incision. The timing chest drain removal was determined by surgi (termination of air leak, when drained fluid v cleared and the amount in 24 hours was less th 100 ml), clinical (apyrexia, lower levels of in mmatory mediators), and radiological (full lung expansion) factors. All patients were followed ti weeks to assess the postoperative outcomes. T findings of variables as mentioned above w entered in predesigned proforma (Annexure- Confounding variables and biasness was control by strictly following inclusion and exclusion crite-ria.

Data was compiled and analyzed using statistical package for social sciences (SPSS) version 21. Mean and standard deviations was calculated for the quantitative variables like age, height, weight, BMI, operation time, pain on first post-operative day (VAS scale), duration of pain in days, pain after chest tube removal, & Cosmetic result. Frequencies and percentages were calculated for the qualitative variables like gender, stage of pleural empyema, pain after removal of chest tube (yes/ no), postoperative paresthesia, wound infection and Re-expansion of lung. The study outcomes were compared across categories of age, gender, BMI and stage of the empyema. Post stratification chi square test was applied by taking p-value of d" 0.05 as statistically significant.

Results

Age range of the patients in this study was 18 to 70 years with mean age was 56.9±17.7 Years, mean height was 155.9 ± 14.1cm, mean weight was 73.7 ± 21.9 and mean BMI was 30.9 ± 4.1 kg/m^2.Out of 170 patients, 97 (57%) were male and 73 (43%) were female (Fig 5). 20 (11.7%) had stage-I empyema, 51 (30%) had stage-II, 99 (58. 2%) had stage-III empyema(Fig 6).

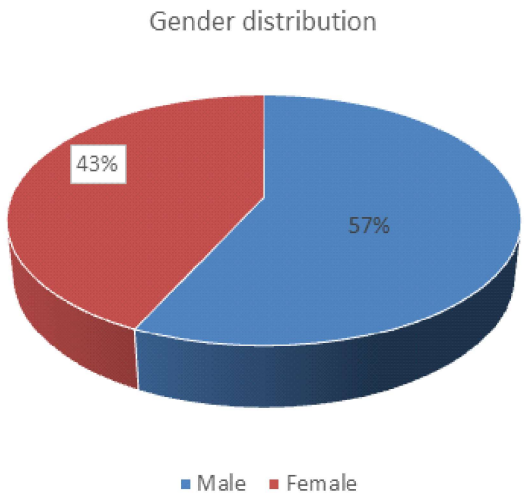

Fig 5. Gender distribution of the patients

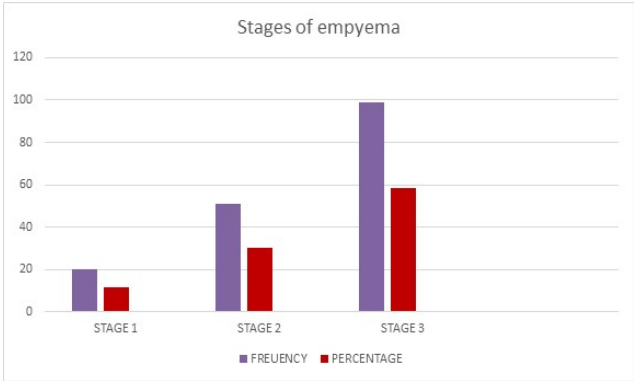

Fig 6. Frequency and percentage of stages of empyema

The postoperative outcomes of Uniportal video-assisted thoracoscopic surgery (U-VATS) in the treatment of pleural empyema were determined, mean operation time was 130.0 ± 64.6 minutes, me-an pain score at first post-operative day was 2 ± 1.6 , mean pain duration was 2.5 ± 2.1 days, mean pain score after removal of chest tube was 0.33 ± 0.9 and mean cosmetic score was 2.45 ± 0.4. Postoperative paresthesia was observed in 9 (5.3%) cases, no wound infection was observed and satisfactory re-expansion of lung was observed in 154 (90.5%) cases, shown in table 1.

The postoperative outcomes were also stratified with respect to age, gender, BMI and stage of empyema, no significant difference was observed except when postoperative paresthesia was stratified in relation to age and satisfactory re-expansion of

lung according to stage of empyema, shown in table 2-5.

Table 1: Postoperative outcomes of Uniportal video-assisted thoracic surgery (UVATS) (n=170)

Postoperative outcomes	**Mean ±Sd**
Mean operation time (minutes)	130.0 ± 64.6
Mean pain score at first post-operative (days)	2 ± 1.6
Mean duration of pain (days)	2.5 ± 2.1
Mean pain score after removal of chest tube	0.33 ± 0.9
Mean cosmetic score	2.45 ± 0.4
Postoperative paresthesia	
Yes	9 (5.3%)
No	161 (94.7%)
Wound infection	
Yes	0 (0%)
No	170 (100%)
Satisfactory re-expansion of lungs	
Yes	154 (90.5%)
No	16 (9.5%)

Table 2: Postoperative outcomes of Uniportal video-assisted thoracic surgery (UVATS) with respect to age groups (n=170)

Postoperative outcomes	**Age groups (years)**		**P-value**
	15-35(n=31)	**35 -70(n=139)**	
Mean operation time (minutes)	130.1 ± 64.0	129.9 ± 64.4	0.98
Mean pain score at first post-operative day	2 ± 1.4	2 ± 1.5	0.9
Duration of pain (days)	2.47 ± 2.3	2.5 ± 2.1	0.94
Mean pain score after removal of chest tube	0.33 ± 0.8	0.34 ± 0.9	0.95
Mean cosmetic score	2.5 ± 0.5	2.45 ± 0.4	0.55
Postoperative paresthesia			
Yes	01	08	0.037
No	30	131	
Wound infection			
Yes	0	0	NA
No	31	139	
Satisfactory re-expansion of lungs			
Yes	25	129	0.081
No	06	10	

Table 3: Postoperative outcomes of Uniportal video-assisted thoracic surgery (UVATS) with respect to gender (n=170)

Postoperative outcomes	Gender		P-value
	Male(n=97)	**Female(n=73)**	
Mean operation time (minutes)	130.0 ± 63.9	130.0 ± 65	0.9
Mean pain score at first post-operative day	2 ± 1.7	2 ± 1.6	0.9
Duration of pain (days)	2.5 ± 2.0	2.5±2.1	0.9
Mean pain score after removal of chest tube	0.33 ± 0.8	0.33 ± 0.9	0.9
Mean cosmetic score	2.45 ± 0.4	2.5 ± 0.48	0.49
Postoperative paresthesia			
Yes	06	03	0.734
No	91	70	
Wound infectionYes			
No	00	00	
00	97	73	NA
Satisfactory re-expansion of lungs			
Yes	84	70	0.061
No	13	03	

Table 4: Postoperative outcomes of Uniportal video-assisted thoracic surgery (UVATS) with respect to BMI (n=170)

Postoperative outcomes	**BMI**		**P-value**
	≤ 30kg/m² **(n= 91)**	**>30kg/m²** **(n=79)**	
Mean operation time (minutes)	130.0 ± 65	130.0 ± 64.9	0.9
Mean pain score at first post-operative day	2 ± 1.5	2 ± 1.6	0.9
Duration of pain (days)	2.5 ± 2.1	2.5 ± 2.1	0.9
Mean pain score after removal of chest tube	0.33 ± 0.9	0.33 ± 0.9	0.9
Mean cosmetic score	2.45 ± 0.5	2.45 ± 0.4	0.9
Postoperative paresthesia			
Yes	05	04	1.000
No	86	75	
Wound infection			
Yes	00	00	
No	91	79	NA
Satisfactory re-expansion of lungs			
Yes	82	72	
No	09	07	1.000

Table 5: Postoperative outcomes of Uniportal video-assisted thoracic surgery (UVATS) with respect to stage of empyema (n=170)

Postoperative outcomes	**Stage of empyema**			**P-value**
	Stage-I (n=20)	**Stage-II (n=51)**	**Stage-III (n=998)**	
Mean operation time (minutes)	130.0 ± 64.4	130.0 ± 64.6	130.0 ± 63.7	1.0
Mean pain score at first post-operative day	2 ± 1.4	2 ± 1.	2 ± 1.6	1.0
Duration of pain (days)	2.5 ± 2.1	2.5 ± 2.1	2.5 ± 2.1	1.0
Mean pain score after removal of chest tube	0.33 ± 0.9	0.33 ± 0.9	0.33 ± 0.9	1.0
Mean cosmetic score	2.45 ± 0.4	2.45 ± 0.4	2.45 ± 0.4	1.0
Postoperative paresthesia				
Yes	01	03	05	
No	19	48	94	0.975
Wound infection				
Yes	00	00	00	
No	20	51	99	NA
Satisfactory re-expansion of lungs				
Yes	16	50	88	
No	104	01	11	0.041

Discussion

VATS has a long history and has lately grown in popularity as a surgical option for thoracic illnesses (15).Less postoperative discomfort, fewer paresthe-sia, and better cosmetic results are some of the potential benefits of U-VATS. The first Uniportal VATS lobectomy fundamental achievement in the utilization of Uniportal VATS[16].

The goal of surgery for chronic pleural empyema is to remove the visceral cortex and remove infected collections from the pleural cavity, allowing for complete lung re-expansion. For advanced empyema, open thoracotomy or VATS decortication has been shown to be preferable to medical therapy (16).UVATS has been shown to allow for adequate drainage and elimination of empyema loculations in stage II[17], but its role in stage III (organising phase) is still being contested (17,18,19). Traditional decortication is done through a thoracotomy, altho-ugh UVATS has some advantages, including less surgical morbidity, better vision of the entire pleural cavity, and similar outcomes in terms of infection resolution and functional outcomes[3,20,21].

UVATS decortication was shown to be safe, effective, and functionally comparable to thoracotomy decortication in a comprehensive retrospective study of 420 patients undertaken by Tong et al in 2010[21].

The patients in our series were highly complicated, as the majority of them had stage III empyema (58.2%), followed by stage II (30%), and stage I (11.7%). The findings are consistent with those of Ismail M et al, who found that 57.1 percent of patients had stage III empyema, 11 patients (31.4 percent) had stage II empyema, and four patients (11.4 percent) had stage I empyema[14].

In this study, we looked at the pain level on the first postoperative day and after removal of chest tube, as well as the incidence of paresthesia 7 days later, and discovered that the pain was very low on the VAS scale and lasted only a few days (2.52.14 days), with almost complete resolution after chest tube removal. Furthermore, there was no evidence of a wound infection. Comparable investigations were carried out by Ismail et al. and Bongiolatti et al., who reported similar outcomes but also revealed that VATS had shorter chest tube duration, hospital stay, and problems in their series when compared to thoracotomy[14,6]. In line with research by Ismail et al., who found that 94.3 percent of patients (33 cases) had good re-expansion of the lung, with only two cases of trapped lung not responding to surgical treatment, our study found that 90.5 percent of patients had satisfactory re-expansion of the lungs.. According to a retrospective study conducted at the Combined Military Hospitals Lahore and Rawalpindi was checked, Pakistan, 8 (4.9 percent) individuals had unsatisfactory post-operative X-rays, while 154 (95 percent) cases had clinical and radiological lung expansion[22].

Based on our experience, we think that U-VATS has greater benefits than conventional VATS and thoracotomy. It gives the surgeon complete access to the pleural cavity and provides ample space for a range of surgical maneuvers with the highest level of safety, visibility, and practicability. Decortication and debridement are more precise and secure with this approach, as they are with thoracotomy. It also offers good postoperative benefits in terms of reduced discomfort and improved cosmetic results. The key strength of this study was the utilization of an evidence-based sample size, as well as the relatively large number of patients included and the fact that they were all treated by the same staff. To control bias, strict adherence to inclusion/exclusion criteria was maintained. And the outcome variables were clearly operationally defined, thus has a lower risk of biasness and missing data.

Limitations of the study were it was single hospital-based study. Because a non-probability consecutive sampling technique was utilized, the results may not be generalizable to the entire population. We did not look at the potential complications or mortality rate connected with U-VATS in this study. There is no comparison group (traditional VATS or thoracotomy).

Despite its limits, this study provides some useful information for establishing effective principles that are appropriate for the situation.

Conclusion

U-VATS for the treatment of pleural empyema is effective, even in stage II and III empyema, with relevant postoperative outcomes in terms of less pain, less complications and cosmetic results. Further comparative studies with larger sample size may be carried out in order to draw a concrete conclusion.

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