ORIGINAL ARTICLE

Open-window thoracostomy in empyema thoracis: A retrospective review

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ABSTRACT

Introduction: Open-window thoracostomy offers a chance of treatment for cases of empyema thoracis not amenable for closed drainage or decortication. We review herein a collection of 12 cases based on our five years' experience in Kuala Lumpur Hospital, Malaysia performing this procedure.

Materials and Methods: Medical records of open-window thoracostomy cases performed from March 2018 till February 2023 were reviewed retrospectively. Data extracted included demographic information, indication for surgery, surgical approach, perioperative parameters, complications, and 18-months outcome. The primary end point for this study is sepsis resolution. Secondary endpoints are length of stay and spontaneous closure.

Results: 12 patients with mean age of 50.6 years underwent open-window thoracostomy. Five cases of empyema thoracis caused by bronchopleural fistula, five cases of destroyed lung and two recurrent empyema thoracis following unsuccessful decortication. All patients were extubated post-operatively except for two who required postoperative ventilatory support for two days. The primary end point was reached in all cases except one. Three complications were encountered in which blood loss exceeded 750mls.

Conclusions: Open-window thoracostomy may be performed safely in cases of empyema thoracis not amenable for closed drainage or decortication. Preoperative planning, preparation and counselling are vital to ensure good outcome and to manage patient's expectation.

KEYWORDS:
Empyema thoracis, sepsis, open-window thoracostomy

INTRODUCTION

Empyema thoracis, characterised by the accumulation of pus in the pleural cavity, remains a significant public health concern, especially in the context of delayed diagnosis and suboptimal management. It is a progressive pleural disease classically staged into exudative, fibrinopurulent, and organising phases. The transition from conservative therapy to surgical intervention often hinges on clinical judgement, imaging findings, and response to initial management. The morbidity associated with delayed surgical management underscores the need for a stratified and evidence-based approach.

Empyema thoracis typically evolves from a parapneumonic effusion and is classified into three stages:

1. Stage I (Exudative): Free-flowing sterile fluid.
2. Stage II (Fibrinopurulent): Loculated fluid with inflammatory debris.
3. Stage III (Organised): Dense fibrous pleural peel formation.

Failure of nonoperative therapy in stages II–III often necessitates surgery.

Early surgical consultation was advised to pre-empt treatment failure. Louis M, Vivekanandan DD, Grabill N, et al. (2024), in a retrospective-to-prospective transition study, highlighted predictors of tPA/DNase failure, advocating early surgical intervention in high-risk profiles.[1]

Historical data collectively support early surgical referral, especially in cases unresponsive to medical therapy within 48–72 hours. Video-assisted thoracoscopic surgery is increasingly recognised as the preferred surgical modality due to its minimally invasive nature and favourable recovery profile. Furthermore, delayed surgery is associated with increased complications, prolonged hospitalisation, and greater healthcare costs.

In septic patients with persistent space and large bronchopleural fistula, an open-window thoracostomy (OWT) would be required. OWT involves resection of a segment of ribs(s) with suturing of skin flaps to the empyema cavity. This technique is combined with repeated dressing changes to allow complete drainage.

Four separate studies by Ferguson AD, Prescott RJ, Selkon JB, Watson D, Swinburn CR in 1996, Davies CW, Kearney SE, Gleeson FV, Davies RJ. In 1999, Maskell NA, Davies CW, Nunn AJ, et al. in 2005 and Desai G, Amadi W. in 2001 respectively, came to an agreement that rapid recognition of the development of empyema is crucial to successful treatment; even with appropriate therapeutic attempts, the mortality of patients with empyema is 15–20% and higher in immunocompromised patients.[2-5]

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Findings by
a. Eerola S, Virkkula L, Varstela E
b. Shamji FM, Ginsberg RJ, Cooper JD, et al.
c. Van Raemdonck D, Kesteman J, Roekaerts F, Jadoul P
d. Postmus PE, Kerstjens JM, de Boer WJ, Homan van der Heide JN, Koëter GH
e. Shirakusa T, Ueda H, Saito T, Matsuba K, Kouno J, Hirota N.

All strongly assert that these conditions cannot be managed by closed drainage procedures or decortication. Taken together inclusively, they encompass cases of postpneumonectomy empyema, recurrent empyema thoracis post decortication (in which no intact pleural surface is left), mycotic empyema as well as in cases where combination of circumstances renders the patient inoperable.[6-10]

OWT is an option available in the management of such cases. This article is intended to review outcomes of OWT in Kuala Lumpur Hospital, Malaysia between March 2018 till February 2023. The primary endpoint for this study is sepsis resolution, while secondary endpoints are lengths of stay and spontaneous closure.

MATERIALS AND METHODS

Medical records of all patients who underwent OWT at the Thoracic Surgery Unit, Kuala Lumpur Hospital, Malaysia from March 2018 till February 2023 were reviewed retrospectively. All patients who underwent OWT in Kuala Lumpur Hospital, Malaysia within the study period were included in this review. Observational analysis was performed. Informed consent for usage of clinical data was obtained from all patients in this study.

Each and every one of the twelve cases reviewed in this study were determined to have exhausted all other avenues of treatment other than OWT on the basis of following criteria:
- Patient was septic despite on antibiotics and pleural drainage, and too frail to undergo decortication surgery
- Lungs not expanding after decortication with significant space >50% thoracic cavity
- Symptomatic recurrent empyema thoracis following unsuccessful decortication

In all cases, Clagett procedure was used for the OWT, 2 ribs were removed in each case.

Patients' demographic information, indication for surgery, surgical approach, perioperative parameters, and 18 months outcome were reviewed. This study had prior approval of the National Medical Research Register of Malaysia dated 20th of February 2024 (NMRR ID: NMRR ID-23-03712-F80).

Preoperative preparations

Generally, all patients for OWT have undergone contrast-enhanced computed tomography (CT) scan of thorax to assess the severity, bronchopleural fistula, destroyed lungs and the potential space post-surgery. All patients were covered with antibiotics which were targeted according to their respective culture and sensitivity. Those patients who had no culture growth was started on intravenous amoxicillin and clavulanic acid. Of the 12 OWT procedures, one was done under monitored sedation without intubation. Two cases were ventilated via a pre-existing tracheostomy. The rest underwent general anaesthesia with single lung ventilation. Figure 1 depicts the sequential anatomical and procedural steps of OWT.

Treatment of the open cavity

During the first three to four days the dressings were changed under sedation in operation theatre. In the further course, no analgesics or sedative medications were needed. Subsequent treatment was adapted to the individual case.

Closure of the thoracostomy

The wound was allowed to heal by secondary intention considering all the cases have chest wall defects at the thoracostomy site. Information was given about the probability of suboptimal cosmetic result and the possibility of a later myoplastic procedure.

Spontaneous closure following OWT in empyema thoracis

Spontaneous closure of the thoracic window is defined as:
"Complete and sustained obliteration of the thoracostomy wound through native tissue contraction and epithelialisation, occurring without the use of surgical flap reconstruction, thoracoplasty, or secondary closure procedures, and maintaining pleural sterility and structural integrity."

This process must meet the following criteria:
- Wound contraction and epithelialisation: No residual defect communicating with the pleural cavity, confirmed by clinical inspection and, when appropriate, radiological imaging (CT or contrast sinogram).
- Absence of persistent drainage: No evidence of pus or serous fluid output for at least four consecutive weeks.
- Clinical stability: Resolution of systemic signs of infection (e.g., afebrile, normal inflammatory markers).
- Radiological consolidation: CT showing cavity obliteration, lung re-expansion or stabilisation of residual pleural space without loculated effusion.

Spontaneous closure is determined through a combination of clinical, radiological, and microbiological assessments:
1. Clinical Wound Monitoring:
o Weekly evaluation for reduction in wound diameter, depth, and granulation.
o Complete epithelial coverage noted by 3 consecutive assessments over a 4-week period.

2. Radiological Confirmation:
o Chest CT or contrast-enhanced imaging confirms no residual communication with pleural cavity.
o Used particularly in patients with prior bronchopleural fistula or multiloculated cavities.
3. Microbiological Surveillance:
o Serial wound cultures to exclude subclinical infection.
o C-Reactive Protein (CRP) and White Blood Cell Count (WBC) used adjunctively to confirm absence of systemic inflammation.

The time to spontaneous closure post-OWT is highly variable and influenced by patient age, comorbidities, nutritional status, and presence of residual disease. Based on existing cohort studies:

- Median closure time: 4 to 12 months
- Range: 3 months to 2 years

Sepsis resolution in empyema thoracis

Establishing accurate and reproducible criteria for sepsis resolution is essential to inform therapeutic de-escalation, determine discharge readiness, and facilitate longitudinal clinical surveillance. Although significant advances have been made in antimicrobial therapy and surgical management of empyema thoracis, a standardised definition of sepsis resolution remains elusive across diverse clinical settings. Guidelines by Singer M, Deutschman CS, Seymour CW, et al. as well as Mandell LA, Wunderink RG, Anzueto A, et al. are helpful. They are currently, the most widely adopted framework for defining sepsis resolution in empyema thoracis integrating principles from established infectious disease and critical care guidelines, emphasising a tripartite approach encompassing clinical, laboratory, and radiological parameters.[11,12]

1. Clinical Criteria for Sepsis Resolution
   Resolution of sepsis in empyema thoracis from a clinical standpoint entails:

- Afebrile status: Sustained body temperature <38°C for >48 hours without antipyretics.
- Haemodynamic stability: Mean arterial pressure ≥65 mmHg without vasopressor support.
- Improved respiratory parameters: Reduction in dyspnoea, respiratory rate <22/min, and improved oxygen saturation (SpO_2 ≥94% on room air or baseline supplemental O_2).
- Return of gastrointestinal function: Tolerance of enteral feeding.
- Neurological status: Glasgow Coma Scale ≥14 in previously altered mental state patients.

2. Laboratory Biomarkers of Resolution
   Laboratory evidence of resolving systemic inflammation includes:

- WBC: Normalisation or trend toward normal range (4,000–11,000 cells/mm³). A decrease of ≥25% from peak WBC is suggestive of resolution according to Bone RC, Balk RA, Cerra FB, et al.[13]
- CRP: A ≥50% reduction in CRP levels from baseline or peak levels within 72–96 hours post-intervention is indicative of a positive response.
- Procalcitonin (PCT) (optional): When available, PCT <0.5 ng/mL or >80% reduction from peak values reinforces resolution.
- Lactate normalisation: Serum lactate <2 mmol/L.

3. Radiological Indicators of Improvement
   Serial imaging, typically via chest radiograph or CT, should demonstrate:

- Reduction in pleural collection size: Measurable decrease in fluid loculation or cavity volume.
- Re-expansion of adjacent lung: Improved aeration and reduction in atelectasis.
- Resolution of air-fluid levels: Suggestive of cessation of ongoing purulent production.
- Absence of new pleural septations or empyema progression.

Imaging should be obtained post-OWT and ideally within 5–7 days.

a) Empyema Thoracis: Accumulation of purulent material within the pleural cavity causing compression of the underlying lung parenchyma. This stage often correlates with advanced fibrinopurulent or organising-phase empyema.
b) OWT Procedure: A segment of the rib and chest wall is resected to create a sustained opening into the infected pleural cavity, facilitating continuous drainage and aeration. The cavity is packed or irrigated, and secondary closure is delayed.
c) Post-Thoracostomy Cross-Section: A coronal section demonstrates the open communication between the pleural cavity and the external environment through the chest wall defect, enabling effective drainage of infected material.
d) Wound Dressing and Maintenance: Postoperative care includes sterile dressing changes and wound inspection to prevent superinfection and promote granulation tissue formation as part of delayed wound healing strategies.

This figure supports the clinical decision-making process and anatomical considerations inherent to the OWT technique, often employed in cases of chronic or refractory empyema thoracis.

Statistical Analysis

Quantitative variables namely; age, BMI, duration of surgery and blood loss were expressed in mean, median and interquartile ranges. Qualitative variables on the other hand specifically gender and comorbidity were expressed as frequency (%).

Preliminary analysis and retrospective observational study were specific to each category starting from demographic to outcomes. (Refer Tables I -III)

RESULTS

From March 2018 till February 2023, 12 patients with mean age of 50.6 years (range: 36 - 65 years) presented with empyema thoracis of which 11 were males and one female. Out of the 12 cases, 11 were active smokers. Mean body mass index was 22.3, ranging from 17 to 35.2. (refer Table II a.) With respect to comorbidities (table II b.), eight cases had underlying active pulmonary tuberculosis, six were diabetics, two were hypertensive and two were hepatitis C carriers. Preoperative ventilation status ranges from room air to face mask. None of the cases had invasive respiratory support preoperatively.

The most consistent presenting symptom seen was dyspnoea (nine cases). Chronic cough was seen in seven cases. Seven cases experienced significant unintentional weight loss. Fever was seen in four cases together with anorexia. Two had reduced effort tolerance and pleuritic chest pain. Pleurocutaneous fistula was seen in two cases in which there was purulent discharge from previous thoracotomy scar or chest tube site. Other symptoms encountered includes night

Table I: Multiple study comparative analysis of empyema thorcis indication, complication rate, recovery time and length of hospital stay

SURGICAL METHOD	INDICATION STAGE	HOSPITAL STAY	COMPLICATION RATE	RECOVERY TIME
VATS*	Stage II-III	Shorter	Lower	Faster
Open Decortication	Stage III	Longer	Higher	Slower
Conservative (tPA/DNase)	Stage I-II	Variable	High in non-responders	Variable

✶ VATS: Video-assisted thoracoscopic surgery

Table II:

a. Study patients' demographic characteristics data collated: (means, ranges, numbers, % where applicable)
b. Study patient comorbidities collated data (number, %)
c. Study patient presented symptoms collated data

a. DEMOGRAPHIC CHARACTERISTICS

Age, mean in years (range)	50.6 (36 - 65 years)	
Gender, n (%)	Male 11 (92)	Female 1 (8)
Smoking, n (%)	Smoker 11 (92)	Non-smoker 1 (8)
Body mass index, mean (range)	22.3 (17 - 35.2)	
Laterality, n (%)	Right thorax 6 (50)	Left thorax 6 (50)

a. COMORBIDITIES, n (%)		b. PRESENTING SYMPTOMS, n (%)	
Pulmonary tuberculosis	8 (67)	Dyspnoea	9 (75)
Diabetes mellitus	6 (50)	Chronic cough	7 (58)
Hypertension	2 (17)	Significant unintentional weight loss*	7 (58)
Hepatitis C	2 (17)	Fever	4 (33)
Chronic obstructive airway disease	1 (8)	Anorexia	4 (33)
Autoimmune haemolytic anaemia	1 (8)	Reduced effort tolerance	2 (17)
Ulcerative colitis	1 (8)	Pleuritic chest pain	2 (17)
Lower limb deep vein thrombosis	1 (8)	Pleurocutaneous fistula	2 (17)
Active meliodosis	1 (8)	Night sweats	1 (8)
Metastatic lung adenocarcinoma	1 (8)	Chest swelling	1 (8)
		Headache	1 (8)

✶ Weight loss is considered significant if more than 10% weight loss over a period of 6 months or less

Table III:

(a) Study patients' indications/aetiology collated data
(b) Study patient bacteriology study records collated
(c) Study perioperative parameters data collated (means, ranges, numbers, % where applicable)
(d) Study outcome parameters data collated.

(a) INDICATIONS/ AETIOLOGY, n (%)		(b) BACTERIOLOGY, n (%)	
Empyema thoracis caused by bronchopleural fistula	5 (42)	Tuberculosis	3 (25)
Destroyed lung	5 (42)	Pseudomonas aeruginosa	2 (17)
Recurrent empyema thoracis post decortication	2 (17)	Staphylococcus aureus	1 (8)
(c) PERIOPERATIVE PARAMETERS		Streptococcus pneumoniae	1 (8)
Duration of surgery, mean in minutes (interquartile range)	104.7 (63 - 127)	Klebsiella pneumonia	1 (8)
Blood loss, mean in mls (interquartile range)	366.7 (50 - 400)	Serratia marcescens	1 (8)
ICU/PACU admission post operation, n (%)	3 (25)	Bukholderia pseudomallei	1 (8)
Duration of ICU/ PACU stay, mean in days (range)	2 (1 - 3)	Bukholderia cepacia	1 (8)
Post op ventilation, n (%)	2 (17)	Mixed growth with no predominant colonies isolated	3 (25)
Duration length of stay, median in days (interquartile range)	22.8 (6 - 24)		

(d) OUTCOMES, n (%)

Resolution of sepsis	11 (92)
Spontaneous closure	8 (67)
Readmission	4 (33)
Premature closure before adequate drainage	3 (25)
Attained closure post revision	3 (25)
Mortality within 30 days	1 (8)
Mortality after 30 days	1 (8)
Malignant lesion	2 (17)

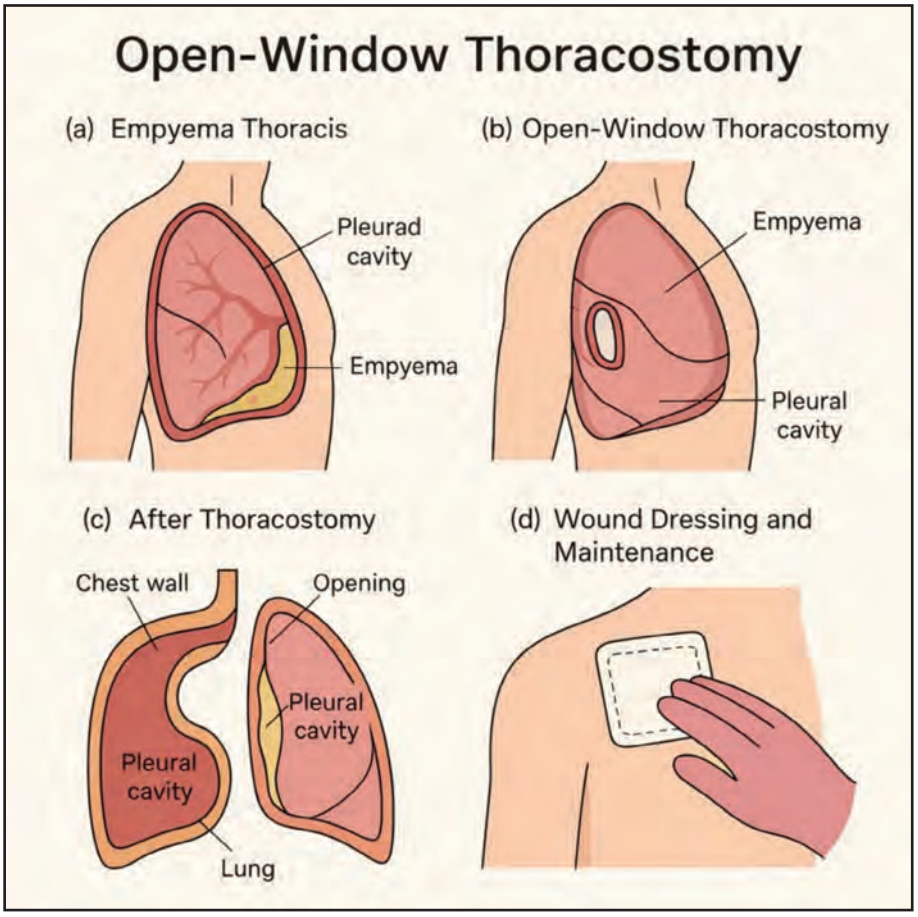

Fig. 1: Sequential anatomical and procedural depiction of OWT

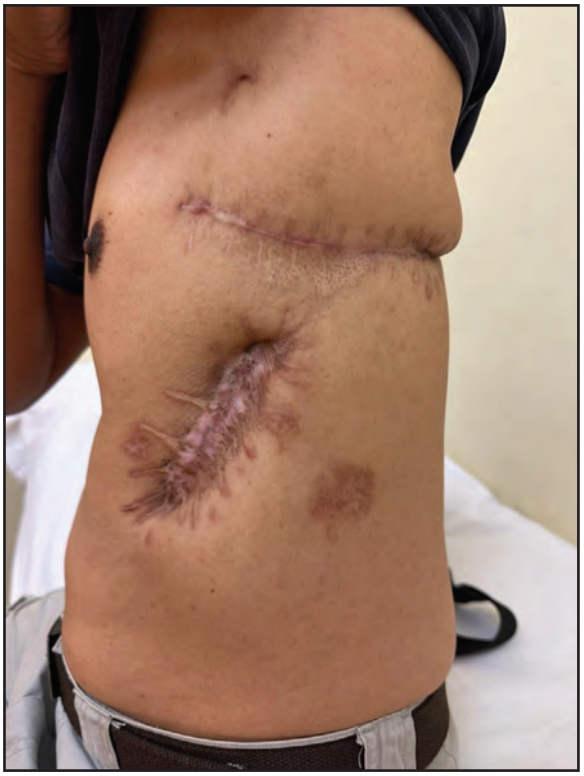

Fig. 2: Spontaneous closure after tuberculous empyema thoracis after 18 months in a 49-year-old male. The previous cavity is closed and almost totally covered by skin. The cosmetic result was acceptable to the patient

sweats, chest swelling and headache seen in one case each. (Table II b.)

OWT was performed for these cases for the following indications: (Table III a.)

1. Empyema thoracis caused by bronchopleural fistula (five patients),
2. Destroyed lung (five patients) and
3. Recurrent empyema thoracis following unsuccessful decortication (two patient).

Bacteriology yielded three patients with tuberculous empyema, six cases of non-tuberculous empyema and mixed growth with no predominant colonies were isolated in three cases. (refer Table III b.) With respect to perioperative parameters (refer Table III c.), duration of surgery ranged from 30 minutes to 240 minutes (mean: 104.7 minutes, interquartile range 63 - 127). Mean blood loss was 366.7mls with range of 50mls to 2000mls and interquartile range from 50 to 400mls. Nine cases were discharged to level one care (general surgical ward) post operatively while three cases required post operative monitoring in level three care; intensive care unit (ICU) or post-operative acute care unit (PACU). Mean duration length of hospital stay was 22.8 days ranging from 4 to 96 days with interquartile range of 6 to 24 days. All cases were extubated postoperatively with the exception of two needed postoperative ventilatory support for two days due to type two respiratory failure and metabolic acidosis secondary to hypovolaemic shock.

In all patients, the septic condition subsided immediately after OWT except in one. There were two mortalities (17%, 95% Confidence Interval: 4.3% – 44.2%). One had bronchopleural fistula post lower bilobectomy for right lung abscess and necrotising pneumonia. Patient succumbed on day 36 post-operation due to unresolved sepsis. The other patient was diagnosed with metastatic lung adenocarcinoma. She received palliative chemotherapy and died 23 days post operation. Three patients developed surgery related complications where blood loss exceeded 750 mLs. There were four (33%, 95% Confidence Interval: 13.6% – 61.2%) cases of readmissions. One case was readmitted after 60 days due to partially treated pneumonia. Three cases were readmitted due to premature closure of OWT before adequate drainage. The aforementioned three cases underwent refashioning to maintain patency. Two cases were diagnosed with metastatic lung adenocarcinoma based on their pleural cortex histopathological examination result and they received palliative chemotherapy. Table III d. displays collated data regarding study patient outcomes. All surviving cases were allowed to heal by secondary intention and cosmetic results were fair and tolerable. (Figure 2) Despite their initial size, all cavities closed spontaneously after periods of between 11 and 22 months. Ten patients survive to date and remain available for further follow-up.

DISCUSSION

OWT remains a cornerstone surgical option for managing chronic, refractory, or complicated empyema thoracis—especially in patients with failed decortication, persistent bronchopleural fistula (BPF), or immunocompromised states. The current retrospective review contributes to this domain by reporting a cohort of 12 patients, predominantly male (92%), with significant infectious comorbidities, notably pulmonary tuberculosis (67%) and diabetes mellitus (50%). This case mix is consistent with other high-burden cohorts from endemic regions.

When juxtaposed against Eloesser flap and Clagett procedure, OWT offers distinct advantages in patients with ongoing contamination, complex fistulae, or necrotic lung tissue. For instance:

- Eloesser flap, which involves creating a long-term pleurocutaneous drainage tract with a skin-lined tunnel, is better suited for frail patients but demonstrates lower spontaneous closure rates (30–40%).
- Clagett procedure, incorporating obliteration of the empyema space with antibiotic irrigation and delayed closure, is superior for sterile, post-pneumonectomy empyema but contraindicated in active infection or residual fistulae as asserted by Clagett OT, Geraci JE.[14]

In this study, the predominant indication for OWT—bronchopleural fistula and destroyed lung (each 42%)—aligns more closely with indications for traditional OWT rather than Clagett, reinforcing its selection here.

The largest OWT review thus far was published by Thourani et al. in 2003 involving 78 patients.[15] The author adopted Modified Eloesser Flap technique in which a U-shaped incision was made to create a flap of skin and subcutaneous tissue over the empyema cavity. The base of the flap is two to four inches wide and lies over the most dependent part of the cavity; its length is two to three inches or equal to the width of two to three ribs and their intercostal spaces. Portions of the two or three ribs just beneath the U-shaped incision are dissected subperiosteally and removed. The soft tissue portion of the chest wall overlying the abscess cavity was then resected completing the unroofing of the empyema cavity. The U-shaped skin flap was reflected onto the most dependent portion of the abscess cavity and sutured to the cavity's floor. The edges of the skin are marsupialised onto the surrounding soft tissue and sterile dressing applied.

In our study, empyema thoracis and its sequelae such as bronchopleural fistula and destroyed lung are more prevalent in the male population. This is attributed to smoking habit as the only non-smoker in our study is a female. The most common immune cell in lung tissue is alveolar macrophage. Alveolar macrophages appear to have multiple functions in the lung. Its primary function is to scavenge particles and remove debris from the lung parenchyma maintaining the sterility of the airway. Smoking habit impairs the function of alveolar macrophages.[16] The author concluded smokers had a higher pulmonary complication rate (19% versus 8%) post thoracotomy and a higher pneumonia rate (11% versus 3%). Patients with tuberculous empyema thoracis are usually underweight with poor nutritional status as a sequalae of catabolic state and chronicity of the disease. On the other hand, obese patients are anticipated to have prolong post operative ventilation due to concomitant obstructive sleep apnoea. However, we did not find body mass index to have any significant

outcome in our series. The only obese patient with body mass index of 35 was extubated immediately post operation with uneventful perioperative recovery.

Three indications for OWT in our study includes empyema thoracis caused by bronchopleural fistula, destroyed lung and recurrent empyema thoracis following unsuccessful decortication. Late presentation or in cases of delayed diagnosis or treatment of pleural infection can lead to spontaneous drainage of pus through the bronchial tree resulting in bronchopleural fistula. Airway commensal contaminates the sterile pleural space, and this results in a vicious circle and rapid spread of infection throughout the whole pleural space. Air leak results in residual pleural space and persistent empyema. OWT is performed in most patients with empyema thoracis caused by bronchopleural fistula since closed drainage fails to achieve control of a permanently contaminated space. Likewise, as asserted by Halezeroglu S, Keles M, Uysal A, et al., destroyed lung most often would require OWT and is characterised by total and irreversible destruction of one lung due to chronic bronchopulmonary infections.[17] Most common causes are tuberculosis, aspergilloma, idiopathic bronchiectasis, and recurrent pneumonia. Radiological findings typically show a very small and fibrotic lung tissue, mediastinal displacement, and compensatory enlargement of the contralateral lung. Asymptomatic patients are followed up conservatively, while frequent bronchopulmonary infections and empyema requires OWT considering the destroyed lung parenchyma fails to expand leaving a potential pleural space. Recurrent empyema thoracis after decortication is another indication of note for OWT. In such cases, re-decortication is no longer feasible and a large part of the pleural cavity contain necrotic debris which for practical reasons cannot be removed. The lungs are thus not stabilised against collapse.

The bacteriology data show Mycobacterium tuberculosis (25%) as the leading isolate, with diverse Gram-negative and opportunistic pathogens (e.g., *Pseudomonas aeruginosa, Burkholderia pseudomallei*), further substantiating the selection of OWT for complex and potentially relapsing infections. The presence of such organisms precludes early wound closure and demands sustained drainage—a clear advantage of the open technique over sealed irrigation approaches. Pseudomonas aeruginosa infection require the presence of neutrophils for elimination. Similarly, tuberculosis is resistant to alveolar macrophages especially in primary tuberculosis. In most individuals, the host immune response contains the infection within a few weeks, leaving a small granuloma that may calcify over time (Ghon lesion). However, in patients who cannot contain the initial infection because of impaired host immune system, poor nutrition, or in extremes of age, the infection may progress leading to lung injury and dense pleural adhesions. Chronic tuberculous empyema is frequently complicated by bronchopleural fistula, leading to a mixed empyema or complicated tuberculous pleural effusion, characterised by contamination with both mycobacterium tuberculosis and common pyogenes. As soon as empyema is confirmed, adequate drainage should be instituted. In this setting, our preference is OWT.

In our review, there is a wide range of duration of surgery (30 minutes to 240 minutes, interquartile range 63 - 127). One possible explanation for this might be due to an unforeseen intraoperative finding. Given that we are aware of the presence of bronchopleural fistula or destroyed lung hence, OWT is unavoidable, the duration of the surgery will be relatively short. On the contrary, a failed attempt at decortication (to achieve lung expansion) will invariably lead to extended duration of surgery.

In this series, spontaneous closure of the thoracostomy wound was achieved in 67% (95% Confidence Interval: 35.4% – 87.9%) of patients, with resolution of sepsis occurring in 92% (95% Confidence Interval: 62.1% – 99.6%). This aligns closely with published data by Regnard et al. (2000), who reported spontaneous closure in approximately 60% of cases, albeit over extended follow-up (median: 9 months).[18]

Importantly, this study reported a low incidence of prolonged postoperative ventilation (17%) and relatively modest perioperative blood loss (mean: 366.7 mLs), reflecting the procedural safety in experienced hands. Three complications were encountered in our practice in which blood loss exceeds 750mls. This value was used as the cut off limit for excessive blood loss as this reflects more than 15% of adult total blood volume beyond which there will be failure of normal compensatory physiologic response.[19] These were due to large diaphragmatic tear in two cases and one liver laceration. These patients received immediate adequate intraoperative fluid and blood resuscitation and no adverse event directly related to the blood loss was observed. Although our mortality rate was higher than the results published by Thourani et al. (17% vs 5%) this does not reflect the actual situation considering our smaller sample size (12 patients vs 78 patients).[15]

This series' findings are consistent with global retrospective OWT series from tuberculosis-endemic or low-resource settings. However, limitations such as small sample size and retrospective design preclude definitive comparative effectiveness conclusions.

Nevertheless, the high sepsis resolution rate (92%), substantial spontaneous closure proportion (67%), and relatively low morbidity affirm OWT as a viable and effective option in carefully selected patients, especially those with complex infections not amenable to flap closure or primary thoracoplasty.

CONCLUSIONS

OWT is an effective method for rapid control of severe life-threatening septic conditions. It is suitable even in severe cases of empyema thoracis with very low operative risk. Postpneumonectomy empyema and empyema in sick, elderly patients in whom drainage techniques have failed and who would not tolerate the stress of a decortication procedure responded most favourably.

The main shortcoming of the method, however, is the resulting granulating defect which necessitates either surgical correction or prolonged conservative treatment with the need for a long hospital stay in some cases.

This latter fact will certainly reduce the quality of life in cancer patients in whom recurrence or progression of the underlying malignancy is present. In these patients, OWT should remain the last option.

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ETHICAL APPROVAL

This study has been approved by the National Medical Research Register of Malaysia on 20th of February 2024 (NMRR ID: NMRR ID-23-03712-F80)

CONFLICT OF INTEREST

None.

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