ORIGINAL ARTICLE

Surgical management of recalcitrant peripheral bronchopleural fistula with empyema: A preliminary experience

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ABSTRACT

Background: Peripheral bronchopleural fistula (BPF) and empyema from necrotising infections of the lung and pleural is difficult to treat resulting in increased morbidity and mortality rates. The aim of this study was to show the effectiveness of the Latissimus Dorsi muscle (LDM) flap and patch closure techniques in the management of recalcitrant peripheral BPFs with the aid of thoracotomy. **Materials and Methods:** Five patients with BPF and empyema out of 26 patients who were initially treated for empyema thoracis by single or multiple chest tube insertions and/or ultrasound-guided drainage were prospectively identified and followed up for 2 years, postoperatively. The postoperative hospital stay, dyspnoea score, function of the ipsilateral upper limb and any deformity of chest wall were assessed at follow-up visits by asking relevant questions. **Results:** The mean age was 46.8 years (23-69 years) (4 males and 1 female). The cause of the BPF in 18 patients was *Mycobacterium tuberculosis* and 8 was pneumonia. The mean total months of the chest tube insertions was 1.5 months (range 2.5-6 months) prior to the thoracotomy and closure of fistula procedures performed on the 5 patients (with LDM flap in 4 patients and pleural patch in 1 patient). The complications recorded were: subcutaneous emphysema, residual pus and haemothorax in three patients. The mean postoperative hospital stay was 20.8 days (13-28 days);There was improved dyspnoea score to 1 or 2 in the 5 (19.2%) patients. There was no recurrence of BPF or residual pus in all the patients; no loss of function or deformity of the chest wall. **Conclusion:** The use of LDM Flap was effective in treating peripheral BFP without any adverse long-term outcome.

Key words: Latissimus dorsi muscle flap, peripheral bronchopleural fistula, recalcitrant

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INTRODUCTION

Bronchopleural fistula (BFP) which is an abnormal connection between the bronchus and the pleural space can be divided into central BFP and the peripheral BPF. In the central type, there is direct communication between a large bronchus and the pleural space, whereas in the peripheral type, the air leak is from a peripheral bronchus or from the lung parenchyma into the pleural space.[1,2] The common causes of peripheral BPF are necrotising infections such as pulmonary tuberculosis, pneumonia and even empyema.[2,3] The incidence of BPF resulting from these suppurative lung and pleural diseases has not been clearly documented in the literature; however, the incidence following pulmonary or lobar resection ranges between 4-20%.[4,5] The management of this condition is very challenging as recurrences are common leading to incomplete removal of the pus; failure of closure of the fistula and inability to obliterate the residual pleural cavity; and equally, the treatment by the technique of insertion of Closed Tube Thoracostomy Drainage (CTTD) is also attended by the above enumerated problems.[6-8] with aggravated inflammatory reaction.

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Most studies stated the different methods for the treatment of the central BPF, which is commonly caused by pulmonary resection[3,4] but failed to specifically state the peripheral form being treated or the establishment of a protocol being managed. Hence, no established formats prevailed on the management of the peripheral BPF other than from wide personal experiences and oral communications. It is also important to note that the presence of BPF leads to

increased hospital state, poor quality of life and mortality.[3]

The purpose of this report is to show the effectiveness of the Latissimus Dorsi muscle (LDM) flap and patch closure technique, when needful to treat recalcitrant BPFs with the aid of thoracotomy.

Surgical technique

The initial evaluation of the patient with chest radiograph and thoracocentesis will lead to the initial insertion of chest tube and on failure to achieve the complete drainage of the pus, re-expansion of the lung and the closure of the fistula [Figure 1] are the indications for the surgical intervention via thoracotomy, which is followed in our centre.

General anaesthesia was administered with the use of double-lumen endotracheal tube and the patient placed in lateral decubitus position with adequate padding of the appropriate places. A posteriolateral skin incision was done which was deepened to the subcutaneous tissue along the same line of incision. The LDM was harvested devoid of the fatty layer below the fascia to reduce bulk and overall volume thereby creating a volume deficient Latissimus muscle flap [Figure 2] that will achieve limited thoracoplasty without undue compressive atelectasis. The inferior border of the LDM was detached from its origin, trimmed, and protected by gently paddling with wet abdominal gauze. Sub-periosteal 5th rib resection was done to gain access into the thoracic cavity [Figure 1]. Limited decortication was done. The fistula was identified by insufflations method, which entails filling the cavity with saline and the Anaesthetist giving a positive pressure of about 24 mmHg. Areas of bubbling were visualised and noted with concomitant suctioning of the saline to cone down on the specific points of air leaks. The flap was attended again by further securing haemostasis and then tunnelling and redirecting it through the 5th rib bed into the chest cavity. The detached muscle end is sutured with vicryl 2/0 around the already identified fistulae. [Figure 3].

MATERIALS AND METHODS

The patients who had BPF and empyema were prospectively and postoperatively, followed-up for a period of 2-4 years. The selection criteria for the adoption of the Muscle flap technique are:

1. Failure of previous drainage methods such as CTTD,
2. Failure of complete drainage with ultrasound-guided drainage of loculated empyema.
3. No evidence of malignancy as confirmed by both cytological analysis of pleural aspirate and/or histological analysis of pleural tissues.
4. Patients treated for pulmonary tuberculosis and subsequently had no evidence of active tuberculosis.

Figure 1: Intraoperative located fistula and resected 5th rib

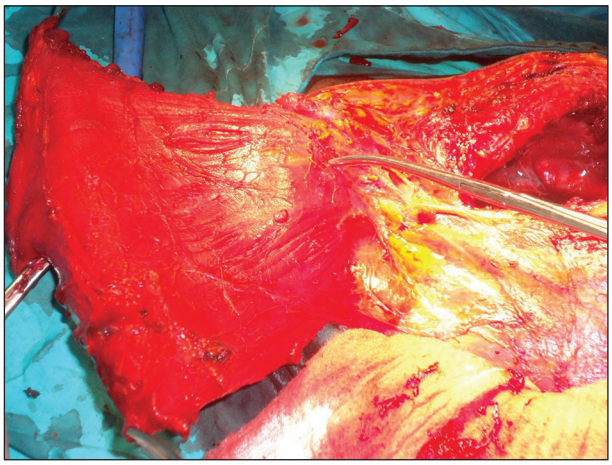

Figure 2: The Latissimus dorsi muscle flap after harvest

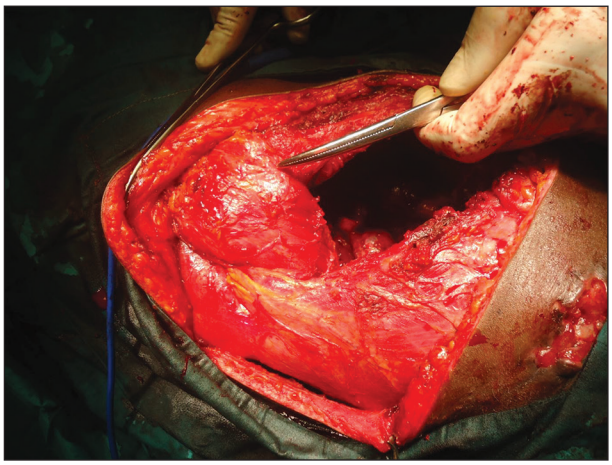

Figure 3: The fistula closed with the Latissimus dorsi flap passed through the resected 5th rib

The length of hospital stay and complications were evaluated. Further, the dyspnoea score, function in the use of the ipsilateral upper limb and evidence of deformity were assessed during the follow-up visits.

RESULTS

During the period, 26 patients who presented with empyema thoracis and required initial drainage with CTTD were identified. Five (19.2%) out of the 26 patients had BPF and empyema and required thoracotomy and closure with LDM flap in 4 patients and pleural patch in 1 patient (the fistula was observed to be well localised intraoperatively and not multiple). The mean age was 46.8 years (23-69 years) (4 males and 1 female); three of the patients were Traders; 1 was an undergraduate student; and 1 was an artisan. The mean total months of CTTD insertion was 1.5 months (range 2.5-6 months), three patient had repeated CTTD as follows: One was three times (initially to drain a loculated empyema and re-passage because of dislodgment) and 2 had CTTD inserted twice (1 from the referral hospital and the other was to drain another loculation). One had concomitant ultrasound-guided drainage of loculated empyema fluid that was not being drained by chest tube *in situ*. The cause of BPF and empyema was due to pulmonary tuberculosis in 18 patients 8 (44.4%) were seropositive to HIV 1 and 2) and due to parapneumonic conditions in 8 patients. Four of the patients had the BPF and empyema from pulmonary tuberculosis while one patient had complication of pneumonia. They were treated for pulmonary tuberculosis (PTB) for over 1 year and confirmed sputum analysis negative for *Mycobacterium tuberculosis*. The mean postoperative length of hospital stay was 20.8 days (13-28 days). The complications in two patients with PTB were subcutaneous emphysema and the drainage of a residual pus, which resolved after 5 and 3 days, respectively. The patient with parapneumonic had haemothorax, which resolved after 4 days. There was no recurrence of BPF or the empyema in all the patients and no loss of function in the use of the ipsilateral upper limb. Their respiratory symptoms improved in all the patients with the dyspnoea score up to 1 and 2 (using the Medical Research Council grading). The use of flap for the closure of the fistula was able to achieve effective closure of all the fistulae without any need for re-intervention in any of the patients.

DISCUSSION

In our experience, the incidence of BPF was common with necrotising lung infections than malignant conditions; this is contrary to the findings of Lois *et al.* in their review in which they observed that the incidence was lower for benign conditions compared to malignant conditions. Furthermore, necrotising lung infections causing BPF such as PTB and pneumonia were always associated with empyema.[8] The application of CTTD for the patient with BPF and empyema is to initially drain copious pleural fluid collection[3,7] and to make the diagnosis of persistent BPF that may require further intervention. However, using it to achieve closure of the fistula and subsequent lung re-expansion has not been proven to be efficient in the patients with both BPF and empyema.[6,7] This is because the tube could act as foreign body in the pleural cavity and may therefore elicit more inflammatory reaction.[6] The use of negative pressure, to drain the pus, increase flow through the fistulous track.[3,6] Equally, the use of ambulatory drainage in other to treat empyema thoracis to reduce length of hospital stay has the potential problem of being carried about by the patient for a long time in other to achieve adequate drainage[7] besides the previous enumerated drawbacks for the use of chest tubes.

The need to visually identify the fistulae and close them has made surgical interventions a necessity. This is because the demonstration and localisation of the fistula has been a subject of great debate. Preoperatively, the suspicion of BPF can be confirmed by the inhalation of Kr-81m gas. This technique was hailed as been harmless, repeatable, and very convenient for the assessment and follow-up of patients with BPF of any cause.[9] The procurement of the technology for this investigation will be expensive to our patients here.So, to make a diagnosis of BPF using a computerised tomography (CT) scan requires identifying a distinct channel between the lung or a peripheral bronchus and the pleura in the lung windows of the films. With this, BPFs were able to be identified and localised in the 55% of patients requiring surgery. However, it was not likely to identify fistulae caused by bullae.[2] The drawbacks with the use of CT scan is that it should be of thin slices,[10] which is more elaborate and expensive to accomplish for our patients here. Identifying fistulae, intraoperatively, in patients undergoing thoracotomy for persistent BPF can be difficult.[11] In our centre, we identified the fistulae by adopting the saline insufflations technique. This technique is cheap, easy to conduct and can be repeated without any adverse effect and the fear of the fluid tracking in retrograde direction through the tracheobronchial tree with possibly soilage of the contralateral lung is taken care by using a double-lumen endotracheal tube.

The notable methods, after thoracotomy or Video Assisted Thoracoscopy (VAT), to tackle the fistula are: Simple closure with parietal pleural patch[12], the closure with muscle or omental flap and the use of sealants. The use of parietal pleural patch is useful in simple and singly localised fistula as was noted in the 5th patient in our review [Table 1] and may not be helpful in multiple fistulas and, after decortications in which further fistulas are inadvertently created. The flap has the added advantage of obliterating the cavity whereas the omental flap has the responsibility of taking care of local sepsis.[13] However, Chichevatov *et al.* who used omental flap stated it was effective in taking

care of local sepsis and closure of fistula but recorded a high mortality rate of 8.3%[14] and the use of omental flap for thoracic surgeries will require opening the abdomen.[15,16] The tissue-welding procedure is easy to perform through VATS with leak-proof sealing achieved and thereby allowing the repair of fistula with no need of lung resections.[17]

The muscle flaps that can be used are: Serratus anterior,[8] intercostals,[18] rotator cuff muscles,[19] the Latissimus dorsi muscles,[20] pectoralis muscle.[21] The use of serratus anterior muscle digitations flap is said to be effective, safe and avoids morbidity associated with necrotic lung resection surgery[8] but the obvious danger of winging of the scapular when the innervation is compromised. Use of intercostals muscle may be inadequate; on contrary, the use of pectoralis major muscle may reduce great deformity of the chest wall and bulky as thoracoplasty.[16,18,21] The use of the rotator cuff muscle will require resection of multiple ribs with attended chest wall deformity and a two-stage procedure[19] and the rotator cuff muscles that maintain the stability of the shoulder joint may be affected with the theoretical presence of shoulder joint dislocation.

Thoracomyoplasty after prior posterolateral thoracotomy (PLT) remains a challenge for the thoracic Surgeon as the thoracodorsal artery may be divided after PLT impairing the vascularisation supply of the LDM resulting in muscle mass reduction due to distal atrophy.[19] The method we adopted to avoid the above stated complications was by achieving the harvest with a Plastic surgeon and doing a single rib resection to prevent the constriction of the vessels and the muscle. It was on the basis of the complication that may result from the devascularisation of the LDM Flap that an alternative approach using a four-muscle flap technique to include the infraspinatus, the subscapularis and the teres major muscle group, all pedicled on the subscapular artery as a part of a modified thoracomyoplasty technique for managing of BPF was suggested.[19]

We were able to achieve 100% fistula closure using the LDM flap with no mortality recorded. The success rate of surgical closure of BPF by open thoracotomy has been reported between 80% and 95% and reported mortality has been as low as 0%.[3,15,18,22] The limited thoracoplasty occasioned by the use of the flap clearly avoided compressive atelectasis. Hankins et al in the study recorded a high rate of fistula closure with the lowest mortality in patients who had myoplasty with a limited thoracoplasty during surgery.[23] However, the LDM flap can be used with little or no chest wall deformity [Figure 4] and no loss of functions at all. The other advantages of the use of the LDM flap are that it effectively closed the fistula without the need for extensive resection of necrotic lung,[20] which would have created more air-leak; satisfactory resolution of local sepsis and no compromise of respiratory functions.

CONCLUSION

The management of peripheral bronchopleural fistula complicating empyema thoracis using chest tubes, leads neither to complete evacuation of the pus nor the resolution of the fistula; whereas using the LDM flap was effective in the closure of the BPF without adverse complications. However, further multicentre study needs to be done to assess the efficacy of the use of this flap in the closure of recalcitrant or persistent BPF.

Figure 4: Chest wall with no deformity-anterior view

Table 1: Biodata, initial drainage technique, closure technique and outcome

Age (yr)	Sex	Aetiology	Drainage technique	Duration of CTTD (Months)	Closure technique	Complication	LoH (Days)	Loss of func-tion	Dyspnoea (MRC)	Defor-mity
40	M	PTB	CTTD×2	3	LDM Flap	—	21	None	1	None
23	M	PTB	CTTD×3	6	LDM Flap	—	28	None	1	None
35	M	PTB	CTTD USS	3	LDM Flap	Subcutaneous	28	None	1	None
67	M	PTB	CTTD×1	3	LDM Flap	Empyema	14	None	1	None
69	F	Pneumonia	CTTD×2	2.5	Parietal patch closure	Haemothorax	13	none	2	None

PTB – Pulmonary tuberculosis; CTTD – Closed tube thoracostomy drainage; USS – Ultrasound-guided drainage; LoH – Length of hospital stay; LDM – Latissimus dorsi muscle; MRC – Medical research council grading

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