Management of Postpneumonectomy Bronchopleural Fistulae

Postpnömonektomik Bronkoplevral Fistül Yönetimi

Management of Fistulas

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Özet

Amaç: Postpnömonektomik bronkoplevral fistül (PPBPF), pnömonektomi sonrası görülebilen, tedavisi zor ve uzun soluklu bir komplikasyondur. Tedavide sabit görüş olmamakla birlikte resütüre edilemeyen fistüllerin fleb ile örtülmesi genel prensiptir. Omentumun fleb olarak seçimi tedavi başarısını arttırabilir.Çalışmamızın amacı kliniğimizde tedavi edilmiş PPBPF'lü hastaların değerlendirilmesi ve omentopeksinin önemini tartışmaktır. Gereç ve Yöntem: Göğüs cerrahisi kliniğinde 2011-2014 yılları arasında yapılan 162 pnömonektominin 12'sinde PPBPF gelişti. Bu hastaların demografik özellikleri, fistül tedavi stratejileri, morbidite ve mortaliteleri geriye dönük ameliyat kayıtları ve hastane bilgi bankasından incelendi. Bulgular: Çalışmamızdaki PPBPF oranı % 7,4 olarak tespit edildi. On hastada bronkoplevral fistülü bir dizi tedavi ile kapatılabilmiştir. Sekiz hastaya omentopeksi'nin temelinde olduğu bir dizi tedavi uygulanmıştır. Biri haricinde fistül tedavisi başarılı olmuştur. Başarıya ulaşan diğer hastalarda erken dönemde stapler ile resütürasyon ve erken dönemde vakum yardımlı kapama yapılabilmiştir. Bronkoplevral fistül kapatılamadığı için başarısız kabul edilen hastalardan birinde ARDS nedeniyle hasta kaybedildiği için tüm tedavi seçenekleri denenememiş, diğerinde ise tüm tedavi seçenekleri (elosser flebi, trakeal stent, omentopeksi, torakomyoplasti, vakum yardımlı kapama) denenmiş olmasına rağmen başarı sağlanamamıştır. Tartışma: PPBPF göğüs cerrahisi kliniklerinin en önemli morbidite ve mortalite sebeplerinden biridir. Tedavisi uzun sürebileceği için iyi planlanmalı ve bu tedaviler bu konuda tecrübeli klinikler tarafından uygulanmalıdır. Omentumun kanlanması iyi olduğu için göğüs cerrahları tarafından sık olarak tercih edilmektedir. Tecrübeli ellerde yapılan omentopeksi ve j tipi trakeal stent uygulamasının fistül tedavisinde başarılı olduğunu düşünmekteyiz.

Anahtar Kelimeler

Postpnömonektomik; Bronkoplevral; Fistül

Abstract

Aim: Postpneumonectomy bronchopleural fistula (PPBPF) is a hard-to-treat complication that may develop after pneumonectomy. It follows a persistent course. Although there is no commonly adopted method, closure of the fistula with flaps is the general principle. The use of the omental flap may provide higher success rates in the treatment. Material and Method: PPBPF developed in 12 out of 162 pneumonectomies performed at the department of thoracic surgery between 2011 and 2014. The demographic characteristics, fistula management strategies, morbidity, and mortalities were retrospectively studied by analysis of operative reports and a digital database. Results: The rate of PPBPF was 7.4%. The bronchopleural fistulae could be closed by various treatments in 10 patients; omentopexy constituted the basis of treatment in 8 of them. In the other patients with successful results, resuturing with staplers and vacuum assisted closure were performed during the early period. One of the patients who failed treatment died due to ARDS; therefore, it was not possible to apply all the treatment alternatives. In the other patient, despite the use of all treatment alternatives (eloesser flap, tracheal stent, omentopexy, thoracomyoplasty, vacuum assisted closure), the treatment failed. Discussion: PPBPF is one of the most significant causes of morbidity and mortality in thoracic surgery units. Because its treatment may be long, a good plan and its execution by experienced units are necessary. The omental flap is increasingly popular due to good perfusion. We believe that omentopexy and j type tracheal stent performed by experienced teams will provide successful results in fistula treatment.

Keywords

Postpneumonectomy; Bronchopleural; Fistulas

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Introduction

Bronchopleural fistula (BPF) is the presence of a communication between the bronchial system and the pleural space. It is a difficult condition to treat, with a postoperative mortality between 15-75%.[1]

The most common cause of BPF is lung surgery (especially pneumonectomy). Less common causes include alternative treatment methods such as radiofrequency ablation, infection, inflammatory diseases, or trauma. The rate of postpneumonectomic bronchpleural fistula (PPBPF) is 1-12% [2-5]. In recent years, the decrease in the number of operations performed due to inflammatory diseases such as tuberculosis, better support of the bronchial stump during surgery, improved suture options and quality, and increased surgical experience have decreased the incidence of BPF [3,6]. Although there is no commonly agreed method for the treatment of BPF, basic principles include resuturing the bronchus if possible, covering the fistula with vascularized tissues, and constriction of the operative cavity [7,8]. Primary resuturing is effective in the early period (1-7 days) BPF. In late phase (>30 days) fistulae, the treatment options differ according to the institution and experience [8].

Myoplasty, pericardial flap, muscular flap, diaphragm flap, or omentopexy may be used for the treatment of BPF [7-10]. Most authors prefer the omentum as a vascularized coverage [8,10].

The aim of this study was to evaluate the PPBPF patients who were treated in our department and to discuss the role of omentopexy (OMN) in the treatment of BPF.

Material and Method

In the thoracic surgery department of our hospital, 1529 patients were operated on between January 2011 and January 2014. Pneumonectomy was performed in 172 patients, and lobectomy was performed in 425 patients for benign or malignant causes. Ten patients with pneumonectomies were excluded from the study due to insufficient data. Among 162 patients with pneumonectomies, 12 developed BPF and were managed with a series of treatments. BPF developed in only one patient with a lobectomy. The lobectomy group was not analysed because this study focuses on PPBPF. These patients were all males, their ages were between 47-68 (mean 58.25), and they mostly had right sided lobectomies (10/12). Patients who developed BPF were analysed retrospectively with respect to whether the operation was performed under elective or emergency setting, indications, the operated side, type of operation (standard or complete pneumonectomy), time of BPF, BPF treatment strategy, treatment success, comorbidity, oncology treatment received, morbidity, and mortality. The bronchus was generally closed with a bronchial stapler. In endobronchial tumors, to ensure negative margins, the bronchus was cut with a scalpel under direct vision, and closed with 3/0 continuous prolene sutures. In both stapler or prolene closures, the bronchus was covered with parietal pleura or mediastinal fatty tissues. The procedures applied in patients with bronchopleural fistulae are described below.

Surgical Technique

Patients with PPBPF undergo primary resuturing in the early (<7 days) period. The treatments in the moderate and late terms depend on the patient's condition. According to the overall experience of the department, PPBPF patients are treated as follows:

1. A tube thoracostomy is applied: The liquid causing the air fluid level is drained and diagnosis is confirmed by observing the escape of air. The liquid is sent for microbiologic examination.
2. A fiberoptic bronchoscopy (FOB) is performed. The length of the main bronchus is calculated, and the width of the fistula is determined. The contralateral bronchial tree is aspirated to increase oxygenation. The bronchial lavage sample is sent for microbiological examination.
3. COPD patients, in particular, may be unable to tolerate a fistula; increasing the ventilation should be attempted by inserting a tracheobronchial stent.
4. If a primary revision is not considered (beyond 7-14 days), an eloesser flap (open window thoracostomy) is performed.
5. A transpericardial bronchial revision can be made if the right main bronchial stump is longer than 1 cm.
6. The left main bronchial fistula is revised with a right thoracotomy.
7. If the right main bronchial stump is shorter than 1 cm, an open window thoracostomy (OWT) is opened. Approximately 3 months is required for the infection to subside and for adequate granulation to develop.
8. While revision of the bronchus with primary sutures is often possible, this is not an obligation.
9. The bronchial stump is supported with omentopexy. If the omentum does not fill the thoracic cavity, the size of the cavity is reduced by the addition of a thoracomyoplasty.
10. A conservative follow up is performed in patients with persistent BPF if they can tolerate it; otherwise, a tracheobronchial stent is applied.
11. Vacuum assisted closure (VAC) is applied to the thoracic cavities of patients with closed BPFs [17].
12. After a significant decrease in size, the thoracic cavity can be closed either primarily or with skin and muscle flaps by plastic surgeons.

An institutional review board approval was not considered necessary because the study was retrospective, and the applied treatment had been described previously.

Results

The rate of PPBPF was 7.4% (12/162). Clinical charasteristics of the patients are given in Table 1.

Mean age was 58.25 (47-68) years, all patients were men, and most had comorbidities. The most common cause of BPF was pneumonectomy. Because the PPBPF had developed after the 7th postoperative day and the main bronchus distance was shorter than 5 mm, rethoracotomy and resuturing in the early phase were not performed. The cause of the fistula was empyema except for one patient (patient 7). In this patient, the main bronchus was cut at the tracheal junction to achieve negative margins, and then it was sutured. Only one patient (patient 9) underwent a transpericardial bronchial revision together with OWT on postoperative day 15. The treatment for PPBPF was successful in 10 patients. Regardless of treatment success or failure, all patients were managed with the same protocol: a 3

Table 1. Clinical characteristics of the patients with PPBPF

	Age	PPBPFT (days)	SIDE	TREATMENT	TS	COMORB	MORB	MORT
1	62	10	R	EF,OMN,S	+	-	-	-
2	56	30	R	EF,OMN,S ,VAC	+	-	-	-
3	68	180	R	EF ,OMN	+	ADJCT	-	20.M CM
4	52	20	R	EF,BR,OMN,TRMYPL,VAC	+	NEOCRT	-	-
5	47	20	R	EF, VAC	+	DM,HT	-	6.M CM
6	60	15	R	EF	-	DM,RF	AP	ARDS
7	65	8	R	EF,S,OMN,TRMYPL,VAC,S	-	OPLCA,		
RT	-	15.M LR						
8	60	60	R	EF,OMN,TRMYPL,S	+	-	MI	-
9	63	10	R	EF,TPBR	+	-	PER, HF	3.M VM
10	57	15	R	EF,S,BR,OMN,TRMYPL	+	-	-	-
11	50	90	R	OMN,BR,TRMYPL	+	ADJCRT	-	-
12	59	30	L	R-BR, L-EF	+	NEOCRT	AP	ARDS

PPBPFT (days): Postpneumonectomy bronchopleural fistula time (days), SIDE : Side with pneumonectomy, TREATMENT: treatment strategy in patients with bronchopleural fistula, TS: Treatment success, COMORB: comorbidity, MORB: morbidity, MORT: mortality, R: right, L: left, EF: eloesser flap, OMN: omentopexy S:tracheobronchial stent, VAC: vacuum assisted closure, BR: bronchial revision, TRKMYPL: thoracomyoplasty, TPBR: transpericardial bronchial revision, R-BR:revision of the left main bronchus with right thoracotomy, L-EF: left eloesser flap, ADJCT: Adjuvant chemotherapy, NEOCRT: Neoadjuvant chemoradiotherapy, DM: Diabetes mellitus, HT: hypertension, RF: renal failure, OPLCA: operated laryngeal cancer, RT: radiotherapy, AP:aspiration pneumonia, M:month, PER: pericarditis, HF: heart failure, CM: cranial metastasis, LR: local recurrence, VM: vertebral metastasis, ARDS: adult respiratory distress syndrome

month period elapsed after the eloesser flap, and an omentopexy was performed after fistula revision whenever possible. A thoracomyoplasty was generally added. Except for one patient, the bronchial stump was supported with an omentopexyin all the patients who had successful treatments. Two patients did not respond to BPF treatment. The treatment in one of these patients could not be completed due to the development of ARDS after OWT. In the other patient, the fistula did not close completely due to insufficient omentum. However the ventilation improved because of the decreased fistula size, and the stent was removed. Three of our patients received neoadjuvant therapy. The first and second patients did not receive adjuvant therapy because it was not seen as necessary. The third patient died shortly after bronchial revision, and therefore could not receive adjuvant therapy. One patient developed a fistula during the 3rd month of chemotherapy. He was able to complete his treatment after the BPF was treated. Two patients (16.6%) died due to postoperative pneumonia and ARDS.

The right sided PPBPF remains the most significant surgical problem in thoracic surgery [11,12]. The incidence of PPBPF in previous studies ranges between 1-12% [4,5]. In our series the PPBPF was 7.4%, and was found to be within a reasonable range compared to other series. PPBPF is a difficult-to-treat condition, carrying a high mortality ranging between 15-75%[1]. In our series two (16.6%) patients died because of ARDS secondary to pneumonia, similar to previous reports [5,13]. Therefore PPBPF, which may have severe consequences, requires a good treatment plan.

The preferred treatment in PPBPF remains controversial [6-11,14,15]. The general tendency in our series was, if the bronchus would not be revised, to perform an OWT as soon as possible after the PPBPF was fixed with a tube thoracostomy. We believe that OWT provides better infection control compared to the less invasive methods like the Clagett procedure [1]. In our opinion, performing an omentopexy and a thoracomyoplasty after the infection is under control is a more widely accepted approach. As reported in previous studies, the omentum is a well-perfused tissue ideal for infected areas, and it protects the bronchial stump [10,16]. Once the BPF is closed, the treatment we have recently applied in postpneumonectomic empyema is vacuum assisted closure [17]. Depending on the surgical experience, deviations from this procedure are possible. Bronchial revision is suggested during the early period of PPBPF [7].

Based on our clinical experience, primary repair of a BPF is feasible within the first 14 days, provided that the length of the main bronchus is greater than 5 mm on FOB. In our study, one patient with a BPF on the 8th day (patient 7) had a main bronchial length of 1-2 mm and therefore revision was not considered. On the other hand, there were patients (patients 4, 10,11) who underwent successful bronchial revisions after bronchial dissection although they were on the postoperative 3rd month.The thoracotomies in two of these patients could be closed completely with omentopexy and without a need for VAC (patients 10,11). Patient number 10 had a BPF on the postoperative third month and during adjuvant chemotherapy. The BPF in this patient was accepted as an early period fistula, and omentopexy could be performed as suggested by Chichevatov et al. [8]. Sarkar et al. reported that bronchial revision could be performed with an anterior transpericardial approach [11]. One patient with a right pneumonectomy and a bronchial stump longer than 1 cm underwent successful bronchial revision with an anterior transpericardial approach (patient 9). Thoracomyoplasty (TRYMPL) or muscle transposition was avoided in this patient due to cachexia. This patient developed pericarditis and heart failure in the postoperative period, and discharged home after treatment. Jablonski et al. reported that pericardial flap and fibrin glue were superior to omentopexy and myoplasty [9,14]. We believe that opening the pericardium within an infected site will increase the risk of pericarditis. Billie et al. reported that the simultaneous application of a tracheal j stent for closing the BPF and omentopexy for controlling the infection was a promising approach [10]. TRYMPL is a viable option in the treatment of BPF [8,9]. In our series, TRYMPL was necessary in 5 patients to decrease the size of the cavity and reduce the rate of re-infection after omentopexy when the omentum was insufficient to totally obliterate the thoracic cavity.

In our patients, stents were applied to support the ventilation prior to the surgical treatment of BPF, especially in patients who could not tolerate the fistula (patients 7,10). The j stent could be applied successfully in 3 patients whose fistulae persisted after the surgical treatment of BPF (patients 1,2,8). The j stent was applied to another patient who could tolerate the fistula, but had a tracheoesophageal tumor recurrence (patient 7). There were two unexpected morbidities; patient 8 sustained a myocardial infarction during placement of the j stent, and patient 9 developed heart failure after pericarditis. We believe

that patients who will be treated for BPF need a good preoperative assessment for cardiac risks.

According to Sarkar et al. a j stent may be applied in patients who appear to be unsuitable for a second operation [11]. In the same study the authors reported that there should be no infections in the pleural cavity. However,we believe this is not necessary because a well placed stent will prevent aspiration of the infection.We therefore prefer to open an OWT immediately when BPF develops, and thus aim to decrease the infection. It is our experience that the infections subside significantly on the third month of fistula [17]. An omentopexy during the third month will have a higher likelihood of closing the fistula without infecting the omentum, which is a vital organ. In the absence of a fistula, VAC therapy rapidly decreases the size of the thoracic cavity and enables primary closure. Two patients died because of aspiration pneumonia related to intubation and subsequent ARDS. In order to prevent this complication, we agree with Slinger, who suggested routine application of selective intubation with FOB [18].

Conclusion

In conclusion, while performing a right pneumonectomy, the bronchial stump must be supported with a viable tissue. Omentopexy is a viable option in the management of PPBF. VAC is successful in PPA, and the tracheal j stent must always be kept in mind as a support for omentopexy.

Competing interests

The authors declare that they have no competing interests.

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