CASE REPORT

Endoscopic sealing of bronchopleural fistulas with submucosal injection of a tissue expander: A novel technique

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The occurrence of a bronchopleural fistula (BPF) continues to represent a challenging management problem, and is associated with high morbidity and mortality. A novel and successful technique that uses submucosal injection of a tissue expander for bronchoscopic occlusion of BPFs has been designed. This method may be used either alone or in combination with bronchoscopic instillation of n-butyl-cyanoacrylate glue. The occlusion technique is described, with a presentation of two patients who were successfully treated with this method. The submucosal injection of a tissue expander is an effective, economical and minimally invasive technique for managing BPFs.

Key Words: *Bronchoscopy/bronchus; Endoscopic procedures; Fistula; Pleura*

Fermeture endoscopique de fistules bronchopleurales par injection sous-muqueuse d'un expanseur tissulaire : Nouvelle technique

La formation de fistules bronchopleurales (FBP) continue de poser un défi thérapeutique et est associée à une morbidité et à une mortalité élevées. Une nouvelle technique efficace qui repose sur l'injection sous-muqueuse d'un expanseur tissulaire pour l'occlusion bronchoscopique des FBP a vu le jour. Cette méthode peut servir soit seule, soit en association avec l'instillation bronchoscopique de colle de n-butyl-cyanoacrylate. On décrit ici la technique d'occlusion et on présente le cas de deux patients qui ont pu être traités avec succès. L'injection sous-muqueuse d'un expanseur tissulaire est efficace, économique et minimalement effractive en tant que technique pour la prise en charge des FBP.

A bronchopleural fistula (BPF) is defined as a communication between a main bronchus or a lobar bronchus, and the pleural space. It continues to represent a challenging management problem, and is associated with high morbidity and mortality. More than two-thirds of BPFs occur after major lung resection, including pneumonectomy. Other common causes include pulmonary infections, mechanical ventilation, spontaneous pneumothorax and chest trauma (1-3). In recent years, a variety of flexible bronchoscopic techniques have been used to help seal BPFs (4). These methods are particularly applicable in patients at high surgical risk or in small-sized BPFs (less than 0.5 cm in diameter). Many materials have been suggested as BPF sealants. They include cyanoacrylate-based glues (5), fibrin compounds (6), absorbable gelatin sponge (7), chemical cautery agents (ethanol [8], trichloroacetic acid, tetracycline [9] and silver nitrate), vascular embolization devices (10), submucosal injection of polidocanol (11) and endobronchial silicon spigots (12). In the current report, we present a novel and successful technique using the submucosal injection of a tissue expander for bronchoscopic occlusion of a BPF. The tissue expander was a biocompatible agent composed of pyrolytic carbon-coated beads suspended in a water-based carrier gel containing beta glucan (Durasphere, Carbon Medical Technologies, USA). Bronchoscopic instillation of n-butyl-cyanoacrylate glue (Glubran 2, General Enterprise Marketing, Italy) mixed with iodized oil (Lipiodol Ultra Fluide, Guerbet, France) was performed when necessary. Accordingly, we describe two patients with BPFs who were successfully treated with this method.

CASE PRESENTATIONS

Case 1

A 47-year-old man was diagnosed with small cell lung cancer of the left upper lobe (LUL). During the course of the patient's chemotherapy, he developed a left pleural empyema with spontaneous drainage through the thoracic wall. His clinical picture did not resolve with an antibiotic regimen and chest tube drainage; subsequently, a persistent BPF was diagnosed. At flexible bronchoscopy, a stenosis 4 mm in diameter in the LUL bronchus was evident. Balloon catheter occlusion (Escort II double-lumen extraction balloon [12 mm diameter], Cook Medical Inc, USA) was used to block the leaking bronchus, confirming the LUL bronchus as the origin of the fistula. Using a 21-gauge transbronchial aspiration needle (Transbronchial cytology needle, Bard Endoscopic Technologies, USA), Durasphere (1 mL) was injected submucosally into four points surrounding the stenosis to occlude the bronchial lumen. The air leak stopped and closure of the BPF was bronchoscopically confirmed. The total duration of the procedure was 1 h. The chest tube was removed on postbronchoscopy day 7, after chest wall drainage ceased. Unfortunately, the patient died of another disease-related cause (pulmonary embolism) two months after the procedure.

Case 2

A 55-year-old man was diagnosed with primary right lower lobe nonsmall cell lung cancer, stage IB (T2N0M0). The patient underwent a right lower lobectomy. Fourteen days after the procedure, he developed an empyema due to a *Serratia marcescens* infection. His clinical picture did not resolve with an antibiotic

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regimen and chest tube drainage; subsequently, a persistent 3 mm BPF was diagnosed. Endobronchial occlusion of the fistula was attempted via bronchoscopy. At bronchoscopy, the fistula was detected at the lobectomy stump and confirmed by direct instillation of methylene blue. Durasphere was injected submucosally into three points surrounding the fistula. The air leak stopped and closure of the BPF was bronchoscopically confirmed. The total duration of the procedure was 1 h. However, only a temporary closure of the fistula was accomplished on this occasion, with a persistent, small air leak occurring within a few hours of the procedure. Once the patient was anesthetized using intravenous midazolam, bronchoscopy showed that the stump had not healed well. Using a 21-gauge cytology needle inserted through the working channel of the flexible bronchoscope, 1 mL of n-butyl-cyanoacrylate mixed with 2 mL of iodized oil was applied around the fistula orifice. The total duration of the second bronchoscopy session was 30 min. The closure of the BPF was bronchoscopically confirmed without any complication. After the second session, definitive clearance of empyema and complete re-expansion of the lung were achieved. The patient died six months after the procedure, with no relapse of the BPF.

DISCUSSION

In recent years, a number of nonsurgical techniques have been developed for attempting endobronchial closure of BPFs. It should be noted, however, that the efficacy of the endoscopic repair is reduced proportionally with increasing fistula diameter. Additionally, balloon catheter occlusion may not be sufficient to identify and block the leaking bronchus in the presence of a peripheral BPF, probably due to the collateral ventilation between adjacent bronchopulmonary segments. Thus, we recommend placement of methylene blue dye in the suspected bronchus for diagnostic confirmation.

Carbon-coated beads (Durasphere) are a United States Food and Drug Administration-approved injectable tissue expander. Pyrolytic carbon – a nonabsorbable and biocompatible substance of proven safety – has been used in the heart valve industry for more than 30 years. It has also been approved for the treatment of urinary stress incontinence, as well as for the endoscopic correction of vesicoureteral reflux (13).

In the current article, we presented our experience with the technique of thickening the wall of a leaking bronchus with Durasphere injection into the submucosal space surrounding the fistula. The possible mechanism of action for carbon-coated beads is the physical filling of the fistula to restore its normal contour, thus keeping it closed. In addition, the continuous collagen deposition around the area of injected Durasphere may contribute to the long-term durability of the treatment. Intriguingly, performing our method via flexible bronchoscopy may allow the physician to treat large peripheral fistulas, as in our first patient. When air leakage does not resolve completely with this treatment, we have successfully used endoscopic application of n-butyl-cyanoacrylate glue to treat the fistula.

We believe that our technique offers several advantages. It is an easy to perform, minimally invasive intervention, which can lead to complete resolution of a very serious complication. Furthermore, multiple treatments can be applied, making it possible to treat larger fistulas.

CONCLUSION

We suggest that the submucosal injection of a tissue expander could be used in small persistent BPFs to avoid morbidity and even death associated with such a high-risk condition. Our method may be an effective technique of managing BPFs, thereby avoiding hazardous surgical interventions in patients who are in poor general condition.

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REFERENCES

1. Sirbu H, Busch T, Aleksic I, Schreiner W, Oster O, Dalichau H. Bronchopleural fistula in the surgery of non-small cell lung cancer: Incidence, risk factors, and management. Ann Thorac Cardiovasc Surg 2001;7:330-6.
2. Algar FJ, Alvarez A, Aranda JL, Salvatierra A, Baamonde C, Lopez-Pujol FJ. Prediction of early bronchopleural fistula after pneumonectomy: A multivariate analysis. Ann Thorac Surg 2001;72:1662-7.
3. Sipple JM, Chesnutt MS. Bronchoscopic therapy for bronchopleural fistulas. J Bronchol 1988;5:61-9.
4. Lois M, Noppen M. Bronchopleural fistulas: An overview of the problem with special focus on endoscopic management. Chest 2005;128:3955-65.
5. Eckersberger F, Moritz E, Klepetko W, Muller MR, Wolner E. Treatment of postpneumonectomy empyema. Thorac Cardiovasc Surg 1990;38:352-4.
6. Matthew TL, Spotnitz WD, Kron IL, Daniel TM, Tribble GG, Nolan SP. Four years experience with fibrin sealant in thoracic and cardiovascular surgery. Ann Thorac Surg 1990;50:40-4.
7. McManigle JE, Fletcher OL, Tenholder MF. Bronchoscopy in the management of bronchopleural fistula. Chest 1990;97:1235-8.
8. Takaoka K, Inoue S, Ohira S. Central bronchopleural fistulas closed by bronchoscopic injection of absolute ethanol. Chest 2002;122:374-8.
9. Martin WR, Siefkin AD, Allen R. Closure of a bronchopleural fistula with bronchoscopic instillation of tetracycline. Chest 1991;99:1040-2.
10. Watanabe S, Watanabe T, Urayama H. Endobronchial occlusion method of bronchopleural fistula with metallic coils and glue. Thorac Cardiovasc Surg 2003;51:106-8.
11. Kanno R, Suzuki H, Fujiu K, Ohishi A, Gotoh M. Endoscopic closure of bronchopleural fistula after pneumonectomy by submucosal injection of polidocanol. Jpn J Thorac Cardiovasc Surg 2002;50:30-3.
12. Watanabe Y, Matsuo K, Tamaoki A, Komoto R, Hiraki S. Bronchial occlusion with endobronchial Watanabe spigot. J Bronchol 2003;10:264-7.
13. Lightner DJ. Review of the available urethral bulking agents. Curr Opin Urol 2002;12:333-8.