Editorial

A customized, covered metallic stent to repair a postoperative bronchopleural fistula: a promising endobronchial approach

Masahide Oki[1], **Yukio Seki**[2]

[1]Departement of Respiratory Medicine, [2]Departement of Thoracic Surgery, Nagoya Medical Center, Nagoya, Japan

Correspondence to: Masahide Oki, MD. Department of Respiratory Medicine, Nagoya Medical Center, 4-1-1 Sannomaru, Naka-ku, Nagoya 460-0001, Japan. Email: masahideo@aol.com.

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The development of bronchopleural fistula (BPF) after thoracic surgery is a rare but well-known complication that is often life threatening. Although the incidence has decreased, BPFs remain a challenging management problem and are associated with high mortality. More than two decades ago, Hollaus *et al.* reported their 13-year experience on the outcomes of patients with BPFs developing after pneumonectomy (1). Of 798 patients, BPFs developed in 96 (12%), of whom 42 (44%) died within 90 days of operation. In recent large surveys, the frequency of post-operative BPF ranged from 0.3% to 0.9% (2-4). In a French national database including information on 34,000 patients treated via pulmonary resection, the incidence of post-operative BPF was 0.9% (318 patients), and the associated mortality was 22% (70 patients) (2). In a Japanese national database including information on 78,594 patients who underwent lung cancer resection, the incidence of post-operative BPF was reportedly only 0.3% (259 patients), but mortality within 30 days of surgery was 19% (4). In patients with BPFs, infectious pleural effusions in the thoracic cavity flow into the healthy lung through the fistulae, triggering intractable infectious conditions including pneumonia and sepsis. Thus, prompt diagnosis and treatment including antibiotic administration, chest tube drainage, and fistulae blockage are essential to counter the infection. Conventional surgical treatments include open-window thoracotomy and/or stump reclosure via suturing, anastomosis, or coverage (using a muscle or omental flap) combined with necrotic tissue debridement (5). However, these (invasive) procedures are often impractical for severely compromised patients.

Recently, bronchoscopic closure of BPFs has become possible; this is less invasive than surgery. The various techniques and devices include adhesives/glues (6,7), agents promoting the formation of granulation tissue (8), coils (9), silicone spigots (10), one-way valves (11), Amplatzer devices (12,13), and stents (14,15). Hollaus *et al.* retrospectively studied 29 patients with postoperative BPFs who underwent bronchoscopic treatment (6). For patients with fistulae less than 3 mm in diameter, fibrin sealant was injected into the fistulae channel either intraluminally or via the submucosa. Fibrin and spongy calf bone were used to close fistulae from 3 to 8 mm in diameter. Closure was successful in 16 patients (55%) with fistulae no greater than 5 mm in diameter. Scappaticci *et al.* performed bronchoscopic gluing employing methyl-2-cyanoacrylate. Fistulae were successfully closed in 14 of 20 patients (70%): in 12 of 13 patients (92%) with fistulae less than 5 mm in diameter and in 2 of 7 (29%) with wider fistulae (7). Thus, bronchoscopic glue injection effectively closed small, but not large, fistulae; the glue became displaced in the latter cases. Varoli *et al.* retrospectively investigated bronchoscopic submucosal injection of polidocanol (which stimulates granulation tissue growth) (8). The closure rate of fistulae 2–10 mm in diameter was 66% (23 of 35 patients). Failed cases exhibited "total" dehiscence of very short bronchial stumps that could

not be healed. Recently, some investigators have reported promising outcomes after placement of Amplatzer devices originally developed to treat atrial septal defects (12,13). Fruchter *et al.* reported an immediate, bronchoscopic closure success rate of 96% (30 of 31 patients), leading to disappearance of BPF symptoms (12). Mortality within 30 days after surgery was 13% (4 of 31). Seventeen patients (55%) died during an average follow-up period of 17.6 months; ten from sepsis. Amplatzer devices can be used to treat BPFs of varying diameters and lengths; the devices come in many sizes. Stenting has also been used to treat BPFs, but almost all relevant literature consists of case reports or small case series (14,15).

Recently, in *Surgical Endoscopy*, Han *et al.* reported a large, single-center retrospective study on the utility of customized, covered metallic stents in 148 consecutive patients with postoperative BPFs (16). The expanded stent sealed the bronchial orifice leading to the fistulae by appressing its walls or wedging the blind-ended stent limb. Such stents can be used to treat fistulae of any size in any location. As the stents are covered, they can be readily removed or repositioned. The two limbs of the stent (tracheal and bronchial) form a "modified Y", preventing stent migration. The results were impressive. Stents were radiologically inserted with the patients under conscious sedation after induction of local anesthesia. Fistulae were successfully occluded in 97% of patients (143 of 148), as confirmed by cessation of air leakage from the chest drainage and no contrast spillover evident on tracheobronchography. No complication was noted. Thirty days later, 95% of patients (141 of 148) reported symptom relief, and only 3% of patients (5 of 148) died. Stents were finally removed from 132 patients at a mean of 112 days post-stenting because BPFs were cured in 73 patients, granulation tissue had proliferated (compromising breathing) in 51, and the stents had fractured in 8. Stent removal was performed safely in all but 2 patients who developed hemorrhage and dyspnea during removal. At both 30 days post-insertion and at the time of stent removal, both the cavity size and extent of cavity drainage had significantly decreased compared to the values prior to stenting. A total of 75 patients had died at the time of data collection, 39 (52%) from lung infection/respiratory failure. Although stent-related complications including granulation tissue formation and stent fracture were not uncommon, the high fistulae occlusion rate was impressive. Thus, stenting may be a useful, alternative endobronchial treatment.

However, certain issues remain. The first is stent customization. The patient's condition can deteriorate from when the order is placed with the stent manufacturer to the day of stenting (15). In addition, custom-made stents are costly. Thus, many stents of different sizes, lengths, and shapes must always be available. Another issue is the technique. Han *et al.* performed stent insertion/removal radiologically in patients under conscious sedation, with a high technical success rate (16). However, these were extremely experienced radiologists and such excellent results may not be duplicated by less experienced physicians. In addition, some specialists prefer to perform covered-metallic Y-stenting using both flexible and rigid bronchoscopes in patients under general anesthesia (17). Questions remain of who should perform the procedure, and how it should be conducted. This promising treatment should be generalized and standardized.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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