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Endoscopic Bronchopleural Fistula Repair Using Autologous Fat Graft

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Bronchopleural fistulas (BPFs) represent a rare catastrophic complication of pulmonary resection and carry a high mortality rate. Surgical treatments of BPF are often technically difficult and can be tolerated only by a limited number of patients, while less invasive endoscopic approaches show variable success rates, mainly related to the size of the fistula. In this report, we describe the successful treatment of a large BPF by means of endoscopic autologous fat implantation; we also discuss the technical details of this surgical procedure.

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Bronchopleural fistula (BPF) is a major complication of pulmonary resection procedures and carries a high mortality rate. It occurs in 4.5% to 20% of patients who have undergone pneumonectomy and in 0.5% to 15% of patients after lobectomy.[1] Open surgical approaches to BPF are often technically difficult and can only be tolerated by a limited number of patients.[2] Less invasive endoscopic techniques have showed variable success rates (30%-80%), these being related to the size and the timely diagnosis of the fistula.[3] Autologous fat grafting is successfully being used to restore deficient tissue in esthetic and reconstructive surgery.[4] Fat tissue is a source of mesenchymal stem cells with regenerative potential.[4,5] Endoscopic injection of adipose tissue-derived stromal cells (ASCs), derived by autologous fat (lipofilling), was reported to be effective in fistulas smaller than 6 mm.[5] Also, grafting with fragmented pieces of fat harvested in the anterior abdominal wall is effective in reconstructing skull base defects and preventing cerebrospinal fluid leakage, even in cases of extended dural defects and via endoscopic transnasal approach.[6] In this report, we describe the use of abdominal free fat to repair BPF via endoscopic approach in 2 patients with large fistulas in whom a previous endoscopic treatment had failed, and we discuss the technical details of the procedure.

TECHNIQUE

A 77-year-old Caucasian male patient affected by non-small cell lung carcinoma underwent a right lower lobectomy complicated with a small BPF at the lateral segment of the middle lobar bronchus and a large BPF (7 mm) in the bronchial stump. Similarly, a 72-year-old Caucasian female patient developed recurrent large fistulas (7 mm) located at the surgical bronchial stump 1 year after a right lower lobe resection for non-small cell lung cancer. Both patients presented BPF recurrence despite endobronchial valve positioning and the insertion of expandable polyvinyl alcohol and cyanoacrylate glue. Hence, they were eligible for endoscopic autologous fat implantation to restore deficient tissue. Written informed consent regarding publication was obtained from both patients.

GRAFT HARVESTING. A curvilinear, periumbilical incision was made to expose the abdominal fat pad. Valid hemostasis was obtained with electrocautery at surgical site. Care was taken to limit the dissection to the superficial section of the abdominal muscular fascia. To avoid errors in volume estimation, the fat harvest for grafting was 30% to 40% higher than the estimated amount needed to fill the BPF size.

GRAFT PLACEMENT. In the same surgical session, endoscopic interventional procedures were carried out using

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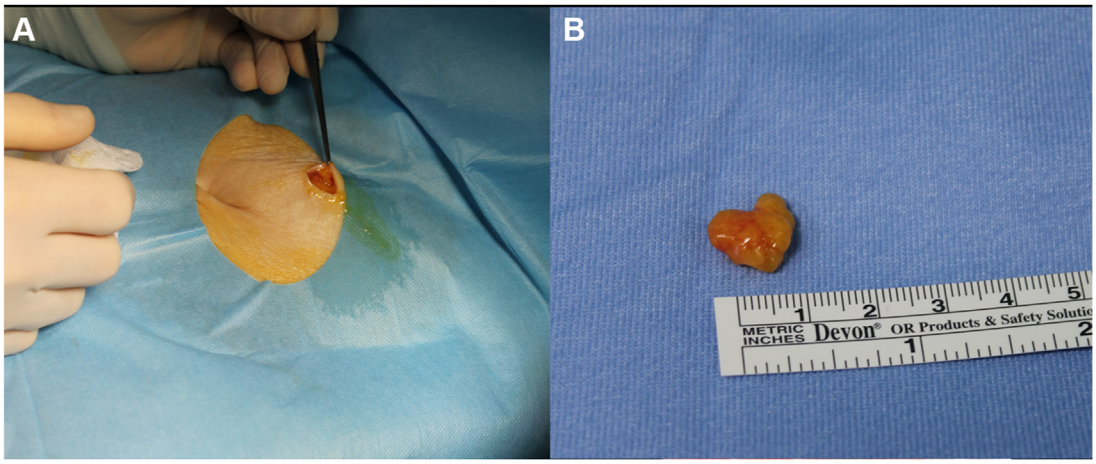

FIGURE 1 Autologous fat grafting for bronchopleural fistula treatment. (A) Periumbilical incision and exposition of abdominal fat pad for fat harvest. (B) Fat graft size is chosen based on the size of the fistula.

a Dumon rigid bronchoscope (Efer Medical) under general anesthesia. After locating the BPF, the mucosa surrounding the lumen of the fistula was ablated with argon plasma coagulator (50 W) to obtain an inflammatory de-epithelized area suitable for receiving fat transplantation. The harvested abdominal fat wrapped

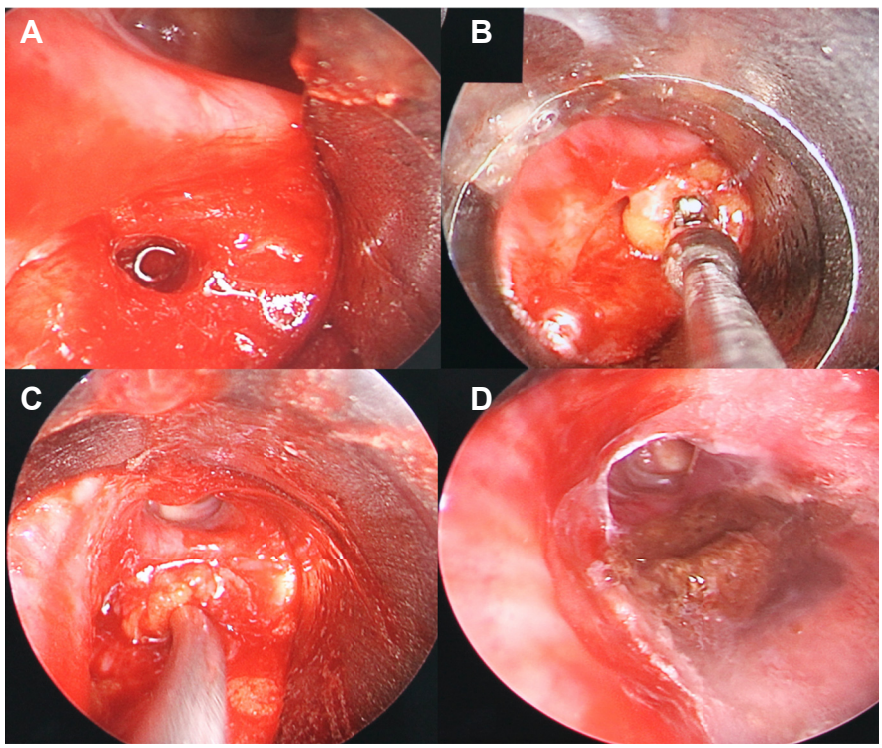

FIGURE 2 Surgical endoscopic technique. (A) Bronchopleural fistula (BPF) in the bronchial stump. (B) After ablation of the margins of the BPF with an argon plasma coagulator, fat graft is placed into the fistula through endoscopic forceps. (C) Using a laser holder wand, the fat graft is pushed into the fistula until it is immobilized. After this procedure, high-molecular-weight hyaluronic acid was injected into the submucosa upstream of the fistula to obtain further stabilization of the graft into the BPF. (D) Synthetic biodegradable cyanoacrylate glue was injected in the transplanted area and into the plug, achieving strong adhesion of the fat graft to the surrounding tissue.

in a thin strip of absorbable oxidized regenerated cellulose (Tabotamp [Surgicel is its brand name in the United States]; Ethicon) was placed en bloc into the prepared area using endoscopic forceps. Special attention was paid to check that the graft was well seated and immobilized, completely occupying the fistula with a part of it facing into the pleural side. High-molecular-weight hyaluronic acid (Hyalubrix; Fidia Farmaceutici) was injected in the submucosa upstream of the fistula at 3 separate sites to obtain a stable swelling of the wall and subsequent closure to further stabilize the graft in the BPF. Synthetic biodegradable cyanoacrylate glue (Glubran 2; GEM) was injected in the transplanted area and into the plug to expand it and create an elastic film on the bronchial side to guarantee strong adhesion of the fat graft to the surrounding tissue. Figures 1 and 2 summarize the steps of the surgical procedure used to achieve BPF closure.

For both patients, air leak stopped immediately after interventional bronchoscopy (Figure 3) and did not recur in the following 3 months.

COMMENT

Despite initial observations showing that lipofilling might be effective in the treatment of medium-size BPF, there are few accounts of the use of a piece of abdominal free fat to replace a large bronchial defect caused by a BPF.[5] Subcutaneous fat tissue consists predominantly of adipocytes, ASCs, and connective tissue, and it is rich in capillary networks. Grafted nonvascularized adipose tissue is put under ischemia and requires a suitable recipient bed, which allows nutrients diffusion from surrounding host tissue until revascularization is restored.[7] Large pieces of devascularized fat undergo partial necrosis and volume loss up to 50% before

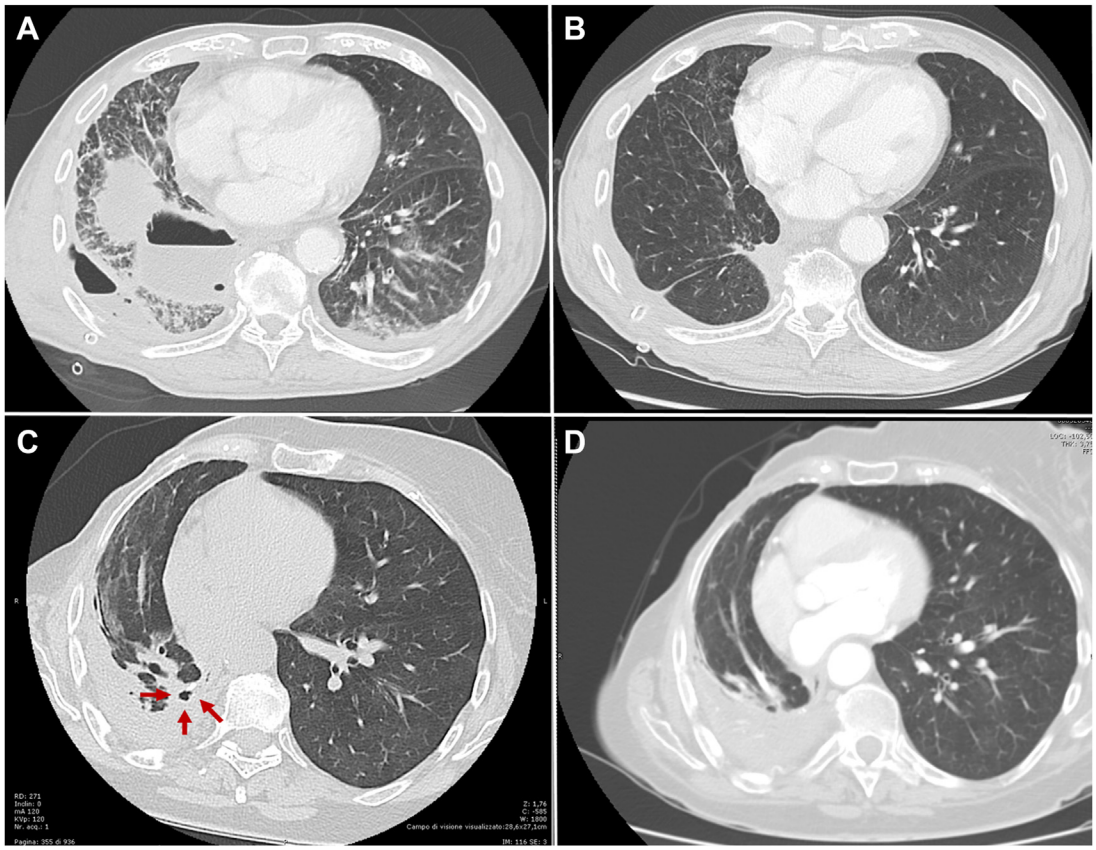

FIGURE 3 (Top) Computed tomography (CT) scan of patient 1. (A) CT scan showing large right hydropneumothorax owing to bronchopleural fistula in the bronchial stump of right lower lobectomy. A chest drainage was placed in the intrathoracic collection. (B) CT scan 2 weeks after endoscopic treatment showing resolution of hydropneumothorax. (Bottom) CT scan of patient 2. (C) CT scan showing bronchopleural fistula (red arrow) in the bronchial stump of right lower lobectomy. (D) CT scan 2 months after endoscopic treatment showing persistent closure of the fistula.

revascularization, limiting the size of the defect to fix through autologous fat grafting. Among cellular components of adipose tissue, ASCs can survive in severe hypoxic environment for up to 3 days, contributing to the repairing process and to angiogenesis. In our 2 cases, the success of the interventional procedures could depend on several factors. First, both patients underwent a previous ineffective endoscopic treatment, which usually results in an inflammatory response of the stump. Second, the use of argon plasma coagulator to scarify the fistula could have amplified tissue inflammation and neovascularization from the surrounding tissue. Third, the use of synthetic glue and hyaluronic acid is critical to maintain fat graft at the fistula site. Despite the success reported in our 2 cases, the gradual decrease in graft size over time caused by necrosis and apoptosis of fat cells represents a limitation.[7] This process results in progressive atrophy and can potentially reopen a successfully occluded fistula. However, both patients kept fistula closure on endoscopic and radiographic evaluation performed at 3 months. In conclusion, we have described the successful treatment of large BPF through autologous fat implantation, discussing the technical peculiarities and the limits of the procedure. Further studies are needed to confirm this preliminary report.

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