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Endoscopic bronchopleural fistula repair using autologous fat graft

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Endoscopic bronchopleural fistula repair using autologous fat graft

Running head: lipofilling for bronchopleural fistula

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Abstract

Bronchopleural fistula represents a not rare catastrophic complication of pulmonary resection with high mortality rates. While surgical treatments of BPF are often technically difficult and can only be tolerated by a limited number of patients, less invasive endoscopic approaches showed variable success rates, mainly related to the size of the fistula. With this report, we describe for the first time the successful treatment of large BPF by means of endoscopic autologous fat implantation and we discuss the surgical technical details of the procedure.

Introduction

Bronchopleural fistula (BPF) occurs in 4.5-20% of patients who underwent pneumonectomy and in 0.5-15% of patients after lobectomy, thus constituting a catastrophic complication burdened by high mortality rates(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 showed variable success rates (30-80%), being these related to the size and the timely diagnosis of the fistula(3). Autologous fat grafting (AFG) is used as a successful approach 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 (ASC), derived by autologous fat (lipofilling), was reported effective in fistulas smaller than 6 mm(5). Also, grafting with fragmented pieces of fat harvested from the anterior abdominal wall, is used for reconstructing skull base defects, and preventing cerebrospinal fluid leakage, even in cases of extended dural defects and via endoscopic trans-nasal approach(6). In this report, we describe the use of abdominal free fat to BPF repair via endoscopic approach in two patients suffering from large fistulas in whom a previous endoscopic treatment had failed, and we discuss the surgical technical details of the procedure.

Technique

A 77-years-old Caucasian male affected by non-small lung carcinoma underwent a right inferior lobectomy complicated with a small BPF at the lateral segment of the middle lobar bronchus and a large BPF (7mm) in the bronchial stump. Similarly, a 72-years-old Caucasian female developed recurrent large fistula (7mm) located at the surgical bronchial stump one year after right lower lobe for non-small lung cancer. Both patients presented BPF recurrence despite endobronchial valve positioning and the insertion of expandable polyvinyl alcohol and cyanoacrylate glue. They were thus candidate to 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 used 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 30-40% higher than the estimated amount needed to fill BPF size.

Graft placement

In the same surgical session, endoscopic interventional procedures were performed with a Dumon rigid bronchoscope (Efer Medical, La Ciotat, Cedex, France) under general anesthesia. After locating the BPF, the mucosa surrounding the lumen of the fistula was ablated with argon plasma coagulator (APC 50W) to obtain an inflammatory de-epithelized area suitable for receiving fat transplantation. The harvested abdominal fat wrapped in a thin strip of absorbable oxidized

regenerated cellulose (Tabotamp®; Ethicon, Johnson & Johnson, respectively Surgicel® as its brand name in the USA) was placed *en bloc* into the prepared area through endoscopic forceps. Particular attention was paid to check that the graft was well seated and immobilized, completely occupying the fistula with a graft fat part facing into the pleural side. High molecular weight hyaluronic acid (Hyalubrix, Fidia Farmaceutici S.p.A., Abano Terme, Padova, Italy) was injected into the submucosa upstream of the fistula at three separate points to obtain a stable swelling of the wall and subsequent closure and further stabilization of the graft into the BPF. Synthetic biodegradable cyanoacrylate glue (Glubran 2, GEM Srl, Viareggio, Italy) was injected in the transplanted area and into the plug to expand it and to create an elastic film in the bronchial side to guarantee strong adhesion of the fat graft to the surrounding tissue. Figure 1 and 2 summarize the different 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 showed that lipofilling might be effective in the treatment of medium-size BPF, the use of a piece of abdominal free fat to replace a large bronchial defect due to BPF had not been described yet(5). Subcutaneous fat tissue consists predominantly of adipocytes, ASC_S, connective tissue, and it is rich in capillary network. Grafted non-vascularized adipose tissue is placed under ischemia and requires a suitable recipient bed which allows nutrient diffusion from surrounding host tissue until revascularization occurs(7). Large pieces of devascularized fat undergo partial necrosis and volume loss up to 50% before revascularization is established, limiting the size of the defect to fix through AFG. Among cellular components of adipose tissue, ASC_S can survive in severe hypoxic environment even for 3 days contributing to the repairing process and to angiogenesis. In our two cases, intervention success 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. Finally, the use of synthetic glue and hyaluronic acid are critical factors to maintain fat graft at the fistula site. Despite the success reported in our two cases, the gradual decrease in graft size over time because of necrosis and apoptosis of fat cells represents a limitation(7). Such atrophy can potentially re-open a successfully occluded fistula. However, both patients kept fistula closure on endoscopic and radiographic evaluation performed 3 months after surgery. In conclusion, we described for the first time 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.

Acknowledgments and disclosures

None.

Figure legend

Figure 1. **AFG for BPF 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.

Figure 2. **Surgical endoscopic technique**

A: BPF in the bronchial stump. **B:** After ablation of the margins of the BPF with 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

Figure 3. *Upper part:* CT scan of patient 1. A: CT scan showing large right hydropneumothorax due to BPF in the bronchial stump of right inferior lobectomy. **B:** CT scan two weeks after endoscopic treatment showing resolution of hydropneumothorax. ***Lower part:*** **CT scan of patient 2**. CT scan showing BPF in the bronchial stump of right inferior lobectomy. **D:** CT scan two months after endoscopic treatment showing persistent closure of the fistula

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Figure

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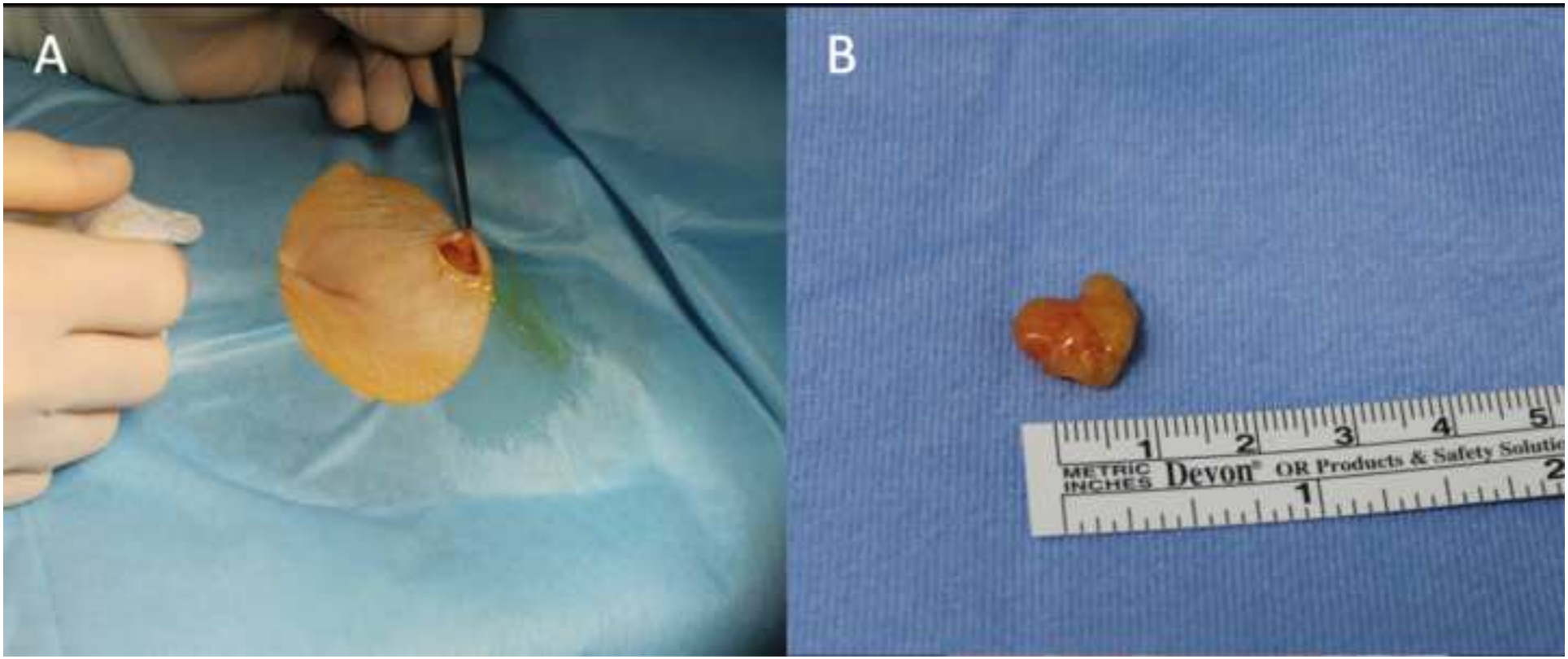

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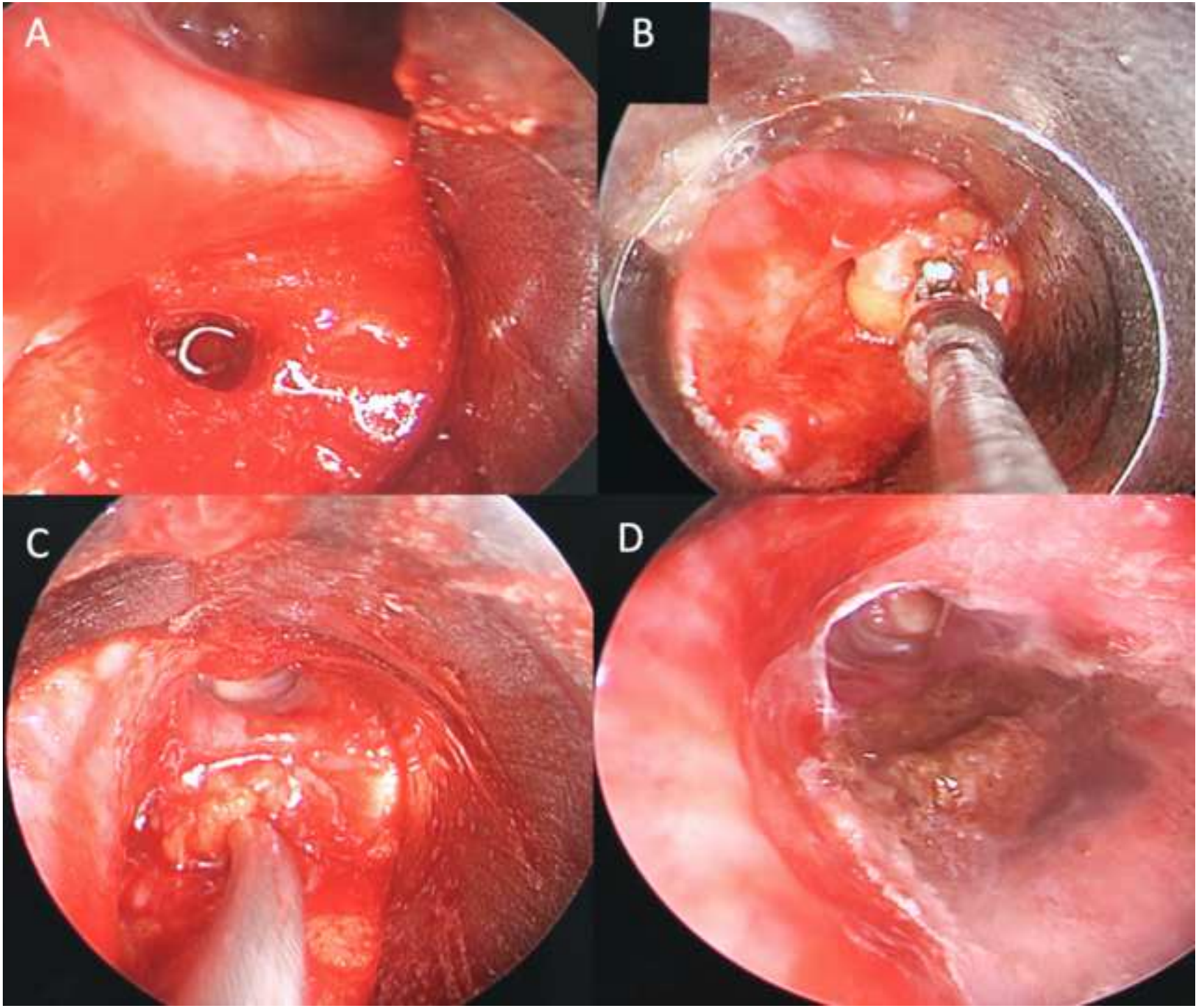

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