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SCIENTIFIC ARTICLE - CASE REPORT

BALANCED GENERAL ANESTHESIA FOR STEM CELL MEMBRANE INSERTION IN A BRONCHOPLEURAL FISTULA: A CASE REPORT

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ABSTRACT

Bronchopleural fistula is a multifactorial pathological condition that remains difficult to resolve and is associated with high morbidity. With advances in medical science, there has been a growing number of studies on the use of stem cell therapy in the treatment of diseases that previously had few alternatives to achieve a cure. Mesenchymal stem cells have emerged as a promising therapeutic component, primarily due to their intrinsic ability to secrete pro-angiogenic cytokines and modulate the tissue microenvironment, thereby directing recruited cells toward effective wound healing. This case report describes an elderly female patient with multiple comorbidities who underwent closure of a bronchial fistula using a platelet-rich fibrin and leukocyte membrane (PRFL), obtained via centrifugation of mesenchymal cells through a one-step technique during the surgical procedure. The intervention was performed under balanced general anesthesia and required heightened vigilance due to several episodes of apnea needed for membrane placement. The procedure was completed successfully, with favorable outcomes observed in all phases.

Keywords: Bronchial fistula, Stem cells, Thoracic surgery; Wound healing, Lung.

INTRODUCTION

Bronchopleural fistula (BPF) is a serious and life-threatening complication in pulmonary medicine and intensive care, characterized by high morbidity and mortality rates. This pathological communication establishes a direct tract between the bronchial tree and the pleural space, and its etiology is multifactorial. Among the most prevalent causal factors are iatrogenic injuries related to invasive thoracic procedures such as lung biopsy, pleural drainage, and thoracentesis, as well as distinct pathologies such as pneumonia complicated by empyema, pulmonary neoplasms, and blunt or penetrating chest trauma.[1] However, the incidence of BPF is most frequently observed in the postoperative context of pulmonary resections, typically as a consequence of inadequate bronchial stump healing.[1]

In the field of regenerative medicine, mesenchymal stem cells (MSCs) have emerged as a promising therapeutic agent. This potential is primarily attributed to their intrinsic ability to secrete pro-angiogenic cytokines and to modulate the tissue microenvironment, directing recruited cells toward an effective resolution of wound healing processes.[2] Furthermore, MSCs exhibit remarkable immunomodulatory and anti-inflammatory properties, which are crucial attributes for mitigating tissue damage and facilitating repair in various experimental injury models.[2]

The application of cell-based therapies, particularly those involving MSCs, has shown potential to modulate the local inflammatory response and promote angiogenesis. These processes are critical for tissue repair in complex scenarios such as BPF.[2] The ability of MSCs to interact with immune system cells—modulating their phenotype and the secretion of mediators—suggests a relevant role in orchestrating the cellular events necessary for fistula closure and the restoration of tissue integrity.[3]

The objective of the present study is to evaluate the therapeutic potential of applying products derived from autologous MSCs and growth factors in the resolution of a persistent BPF.

CASE REPORT

This A 72-year-old female patient presented with a complex medical history of comorbidities, including rheumatoid arthritis, systemic arterial hypertension, type 2 diabetes mellitus, hypothyroidism, and lung carcinoma. Her regular medications included levothyroxine, pantoprazole, multivitamin, metoprolol, ferrous sulfate, acetylsalicylic acid, extended-release metformin, methotrexate, alendronate, and zolpidem. Her surgical history included hysterectomy, cholecystectomy, and left upper lobectomy for adenocarcinoma.

In the surgical setting, the anesthesiology team instituted standard monitoring, including noninvasive blood pressure, pulse oximetry, electrocardiography, body temperature, capnography, and urinary output measurement. After obtaining peripheral venous access with an 18G catheter, preoxygenation was performed with a fraction of inspired oxygen (FiO□) of 100% for 5 minutes. Intravenous anesthesia induction consisted of 2% lidocaine (without vasopressor), 20 mcg of sufentanil, 30 mg of rocuronium, and 120 mg of propofol. Orotracheal intubation was performed using a 7.0 mm cuffed tube under atraumatic direct laryngoscopy, with verification of correct placement and protection of the eyes and bony prominences. Balanced general anesthesia was maintained with controlled mechanical ventilation using 2% sevoflurane and continuous infusion of remifentanil. Adjuvant medications administered included 10 mg of dexamethasone, 2 g of dipyrone, 8 mg of ondansetron, and 10 mg of aramine.

The surgical procedure was divided into four distinct phases. Initially, the plastic surgery team performed liposuction of the pubic region and abdominal flanks, with the patient in the supine position, to collect mesenchymal cells (stem cells) using the one-step technique. Subsequently, the lipoaspirated material was subjected to centrifugation to isolate the mesenchymal cells (Figure 1). Concurrently, peripheral blood was drawn from the patient to prepare an Injectable Platelet-Rich Fibrin (i-PRF) membrane and a Platelet- and Leukocyte-Rich Fibrin (PRF-L) membrane (Figure 2).

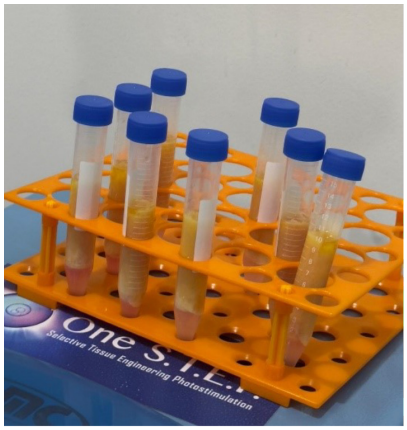

Figure 1: Material subjected to centrifugation for mesenchymal cell separation.

Figure 2: Preparation of i-PRF (Injectable Platelet-Rich Fibrin) and PRF-L (Platelet- and Leukocyte-Rich Fibrin) membranes

In the third phase, the thoracic surgery team performed rigid bronchoscopy, identifying the BPF (Figure 3). PRF-i and ADSVF (autologous adipose-derived stromal vascular fraction) were then implanted in two layers, along with PRF-L on the bronchial stump fistula (Figure 4). During this critical phase, the patient experienced episodes of apnea lasting several minutes due to disconnection from mechanical ventilation in order to optimize surgical material placement. At the end of this stage, a control flexible bronchoscopy revealed the final appearance of the bronchial stump.

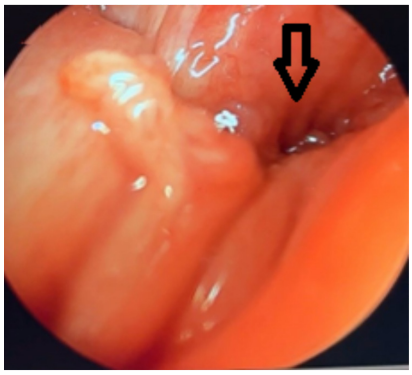

Figure 3: Bronchopleural fistula.

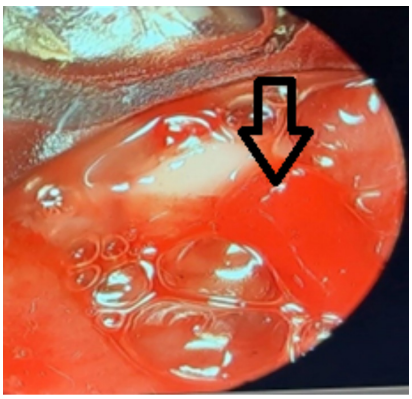

Figure 4: PRF-L membrane (Platelet- and Leukocyte-Rich Fibrin) inserted into bronchopleural fistula.

Subsequently, during thoracic surgery, a thoracostomy was performed at the level of the left fourth intercostal space, followed by the insertion of a small-caliber chest drain. At the end of the procedure, neuromuscular blockade reversal was achieved with the administration of 200 mg of sugammadex. The patient was then extubated and transferred to the post-anesthesia care unit, where she remained for approximately 60 minutes. After reaching the maximum score (10) on the Aldrete and Kroulik scale, she was transferred to a hospital room.

Two months after the initial surgical procedure, a follow-up bronchoscopy was performed, confirming complete closure of the bronchopleural fistula (BPF).

DISCUSSION

BPF consists of a pathological communication between the bronchus and the pleural space, with diverse etiologies. Notable causes include complications from surgical procedures such as lung biopsy, thoracic drainage, and thoracentesis, as well as clinical conditions such as pneumonia/empyema, pulmonary neoplasms, and blunt or penetrating chest trauma. However, BPF most frequently presents as a late complication of pulmonary surgeries, secondary to failed healing of the bronchial stump. This inadequate healing may be attributed to factors such as an initially

suboptimal surgical closure, insufficient blood supply, local infection, or the presence of residual malignant tumor at the bronchial stump.[1]

Clinically, BPF may present with cough, dyspnea, fever, and serosanguinous or purulent expectoration. Radiographically, changes in the air-fluid pattern in the chest may raise diagnostic suspicion. In cases of large fistulas, acute respiratory failure may occur due to aspiration into the contralateral lung or the development of tension pneumothorax.[1]

MSCs play a crucial role in modulating immune responses and suppressing inflammation. These cells exhibit significant anti-inflammatory properties, which are essential for minimizing tissue damage and promoting repair in various injury models. The involvement of MSCs in tissue regeneration is intrinsically linked to their ability to modulate inflammatory processes, including the efficient removal of cellular debris and activation of the MSCs themselves. However, chronic inflammation may impair the functionality of these cells by altering the cellular microenvironment or directly interfering with their differentiation mechanisms.[2]

MSCs are widely recognized for their dual role in promoting angiogenesis and vasculogenesis, while simultaneously exerting immunosuppressive and anti-apoptotic effects. Their ability to modulate the local immune response by altering the inflammatory phenotype of macrophages is particularly relevant in the context of BPF.[2]

The healing process is characterized by dynamic changes in macrophage subsets during the inflammatory phase, which differ from the cellular profiles observed in non-inflammatory conditions. A key component in the resolution of inflammation is the phenotypic transition of macrophages from a pro-inflammatory state to an anti-inflammatory profile, which not only suppresses inflammation but also promotes tissue regeneration. Additionally, macrophages play an essential role in the activation of stem cells in various tissues, significantly contributing to regenerative processes.[2,4]

A synergistic interaction is observed between macrophages and stem cells, similar to that described between macrophages and hematopoietic stem cells in the bone marrow, or with osteoblasts on bone surfaces. Previous evidence has shown that bone marrow–derived MSCs are capable of inducing macrophage polarization toward the M2 phenotype, an effect largely mediated by inhibition of the NF-κB signaling pathway.[2]

The treatment and resolution of the fistula require complex coordination among coagulation, inflammation, and angiogenesis processes. Inflammation, as an initial and essential response, plays a decisive role in the proper progression of healing. The duration and chronic nature of the inflammatory response directly influence the speed and effectiveness of healing, with persistent inflammation often associated with the development of chronic, hard-to-heal wounds, ultimately compromising the entire regenerative process.[2] There is evidence that stem cells may represent a new therapeutic option for severe pulmonary diseases.[5]

CONCLUSION

Given the relevance of the topic addressed, the importance of stem cells in the context of contemporary medicine is underscored. The PRF-L membrane represents a promising therapeutic option for the closure of BPF. It is evident that continued research on this subject will significantly expand the range of management possibilities for patients with this condition.

REFERENCES

1. Kalatoudis H, Nikhil M, Zeid F, Shweihat Y. Bronchopleural Fistula Resolution with Endobronchial Valve Placement and Liberation from Mechanical Ventilation in Acute Respiratory Distress Syndrome: A Case Series. Case Rep Crit Care. 2017;2017:6362879.

2. Cui J, Wang Y, Li S, Le Y, Deng Y, Chen J, Peng Q, Xu R, Li J. Efficacy of mesenchymal stem cells in treating tracheoesophageal fistula via the TLR4/NF-κb pathway in beagle macrophages. Heliyon. 2024 Jun 13;10(12):e32903.

3. Franco ML, Vieira F, Franco C, Pinheiro BV, Dias AS. Efeitos de diferentes volumes correntes e da pressão expiratória final positiva na fístula broncopleural. Rev Bras Ter Intensiva. 2010;22(4):342–9.

4. Aho JM, Dietz AB, Radel DJ, Butler GW, Thomas M, Nelson TJ, Carlsen BT, Cassivi SD, Resch ZT, Faubion WA, Wigle DA. Closure of a Recurrent Bronchopleural Fistula Using a Matrix Seeded With Patient-Derived Mesenchymal Stem Cells. Stem Cells Transl Med. 2016 Oct;5(10):1375–9

5. Zeng Y, Gao HZ, Zhang XB, Lin HH. Closure of Bronchopleural Fistula with Mesenchymal Stem Cells: Case Report and Brief Literature Review. Respiration. 2019;97(3):273–6.

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