Airway Complications After Lung Transplantation

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KEYWORDS

• Lung transplant • Bronchoscopy • Bronchial stenosis • Airway dehiscence • Airway necrosis

KEY POINTS

- Airway necrosis has a broad spectrum, and mild forms are expected in the early time after transplant.
- Severe airway complications are later term events associated with infection, rejection, and persistent ischemia and necrosis.
- Bronchoscopy has a major role in the complex management and a wide array of techniques are used in maintaining airway patency.
- Airway stenting in lung transplant is an option of last resort and requires specific expertise and long-term management.

INTRODUCTION

Airway complications (AC) have had a significant impact on the morbidity and mortality in lung transplantation since the first human lung transplant in 1963. Early incidence of complications were exceedingly high at 60% to 80%, but improvement in many facets led complication rates to drop significantly into the 10% to 15% range with a related rate of mortality of 2% to 3%.[1–6]

AC have a variety of presentations and, although their treatments are often institution-dependent, they are all individualized to the type of AC (stenosis, dehiscence, and so on), timing, location, and severity. Although most early reports of AC dealt primarily with the anastomosis, complications distal to the suture line, such as the "vanishing bronchus syndrome," are now being noticed.[7]

AC can be grouped anatomically (anastomotic or distal to the anastomosis), descriptively (stricture, granulation tissue, infection, necrosis, dehiscence, and fistula formation), temporally (early or late), or by cause (ischemic, infectious, iatrogenic, or idiopathic). In addition to the associated mortality, patients with AC experience increased morbidity, most notably in quality of life. The number of procedures, repeated office visits, hospitalizations, and associated costs can all significantly affect one's satisfaction with lung transplant and, in some cases, minimize or completely negate benefits from this complicated undertaking.

The goals of this article include a brief description of the history of AC, transplant-specific anatomy, surgical techniques of lung transplantation, classification of AC, causes, management, and potential future directions for prevention and treatment.

The authors have nothing to disclose.

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HISTORICAL BACKGROUND

James Hardy performed the first human lung transplantation at the University of Mississippi in 1963. The patient had lung cancer and died 18 days after the transplant due to renal failure.[8]

The first successful lung transplant occurred at the University of Toronto in 1983. Before it, multiple attempts were performed around the world without success; many of those cases had deficient healing of the bronchial anastomosis.[8]

In the early days of lung transplantation, AC were a significant source of morbidity and mortality, making AC the "Achilles heel" of lung transplantation short-term survival.[1–3,8,9]

With improved surgical techniques, new immunosuppressant regimens, and overall better medical management, survival has significantly improved over the years.[1,10]

ANATOMY

Lung transplantation patients have a unique situation compared with other solid organ recipients. Human lungs contain dual blood supplies, a pulmonary and a separate bronchial circulation (**Fig. 1**). Bronchial circulation is not re-established in standard lung transplantation and provides the blood supply to the major airways and supporting structures of the lungs. Previous anatomic studies have defined fairly consistent origins of the bronchial arteries. These vessels arise either as branches of the aorta or as intercostal arteries and travel through the hila, where small arterials enter into the muscular layer of the airway and eventually terminate in a plexus within the bronchial mucosa. This submucosal plexus gives rise to a collateral circulation between the pulmonary and bronchial vessels. Each proximal mainstem bronchus receives its primary blood supply through the bronchial circulation, although the pulmonary circulation can contribute via retrograde collaterals. Although the pulmonary circulation is re-established during the transplantation procedure, bronchial vessels are not. This feature places bronchial viability and anastomotic healing completely dependent on retrograde blood flow from the pulmonary to bronchial circulation. As one can imagine, this has the potential for perioperative ischemia jeopardizing the anastomosis and distal airways. The main carina and both proximal mainstem bronchi are supplied via the coronary collateral system arising from atrial branches at the left and right coronary arteries, possibly explaining why the proximal airways seem to suffer less ischemic injury (see **Fig. 1**).

INCIDENCE AND PREVALENCE

There is a wide range in the reported incidence of anastomotic complications in the lung transplant population. Reports of complication rates range

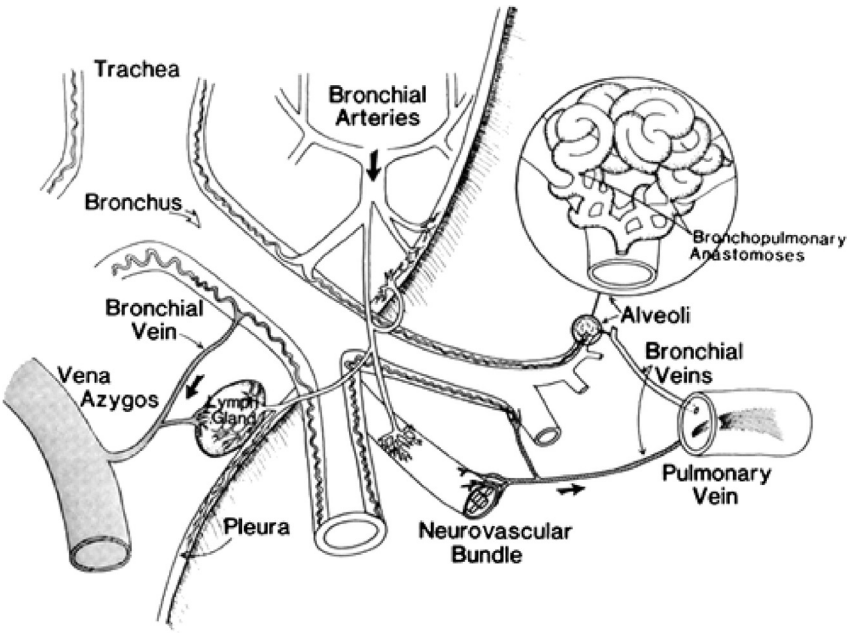

Fig. 1. Bronchial circulation. Schematic of the systemic blood supply to the lung. (*From* Deffebach ME, Charau NB, Lakshminarayan S, et al. State of the art: the bronchial circulation—small but vital attribute of the lung. Am Rev Respir Dis 1987;135:467; with permission.)