Evaluation and Management of the Potential Lung Donor

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KEYWORDS

• EVLP • Brain death • Ex vivo perfusion • Lung transplant • Organ donor • Donor lung management

KEY POINTS

- Donor evaluation is best conceptualized as weighing a constellation of specific patient-related and organ-related risk factors and their impact on post-transplantation allograft function.
- There is sufficient evidence that, for any 1 factor that makes a donor acceptable rather than ideal, there is not a significant negative impact on recipient prognosis.
- After brain death, donor management should focus on protocol-driven optimization of pulmonary and extrapulmonary physiologic parameters.
- Ex vivo lung perfusion is a viable intervention to recondition lungs that would otherwise fall below acceptable criteria for transplant.

INTRODUCTION

The number of lung transplants in the United States grew by 250% over the past 20 years, from 932 in 1996 to 2327 in 2016.[1] This dramatic increase, which was mirrored worldwide, was related to advancements in surgical techniques and improvements in immunosuppression and post-transplantation management, making lung transplantation an increasingly attractive treatment option for end-stage lung disease. The proliferation of lung transplantation programs, however, would not have been possible without a corresponding expansion of the donor lung pool. This has involved an evidence-driven redefinition of acceptable donors coupled with improved management of potential lung donors and preservation of lung quality after procurement. This review focuses on the current state of donor and donor lung assessment strategies and contemporary techniques for lung preservation prior to transplantation.

DONOR EVALUATION

Historic approaches to evaluating potential lung transplant donors focused on identifying perceived absolute contraindications to donation, leaving a small pool of young donors with no significant medical history, minimal smoking history, and robust pulmonary function (**Table 1**). As data have emerged on the impact of transplantation from nonideal—or extended criteria—donors, current donor evaluation is better conceptualized as weighing a constellation of specific risk factors and their impact on post-transplantation allograft function. These variables can be broadly divided into patient-specific and organ-specific considerations.

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Table 1
Ideal versus acceptable donor criteria

Ideal	Acceptable	Additional Data Needed
Donor characteristics		
Age <55	• Age >65	• Age >70
<20 pack year smoking history	• <40 pack years and no active smoking • <20 pack years and actively smoking	• >40 pack years
No significant medical history	• Hepatitis B, if access to prophylactic lamuvidine • Donor diabetes for planned bilateral-lung transplant • Low transmission risk malignancy (early-stage basal cell, cervical carcinoma in situ, localized low-grade (Gleason score $\leq$6) prostate cancer)	• Hepatitis C, if access to direct-acting antiviral drugs • Donor diabetes for planned single-lung transplant • Early-stage melanoma, breast, ovarian, and colonic cancer with a significant cancer-free period after curative surgery
Organ characteristics		
No evidence of active pulmonary infection or organisms on sputum gram stain	• No active infection with a multidrug-resistant organism for which appropriate post-transplant antibiotics or antifungals cannot be implemented	• Transplantation from donors with CRE or ESBL organisms; recent influenza or other viral infections
Pao_2 >300 mm Hg on 100% Fio_2 and PEEP 5	• Pao_2 >200 mm Hg on 100% Fio_2 and PEEP 5	• Pao_2 <200 mm Hg on 100% Fio_2 and PEEP 5
Appropriate size matching	• pTLC at least >0.8 and ideally between 0.90 and 1.3, particularly for bilateral transplants	• Optimal pTLC for recipients with emphysema • Use of graft volume reduction and/or delayed chest closure for significantly oversized (pTLC >1.6) patients

Abbreviations: CRE, carbapenem-resistant enterobacteriaceae; ESBL, extended-spectrum beta-lactamases.

Acceptable Donors

Smoking

Although nonsmokers are ideal and a donor history of cigarette smoking has been associated with primary graft dysfunction (PGD), a large prospective cohort study in the United Kingdom demonstrated significantly decreased mortality for recipients who received transplants from donors with a smoking history than patients who remained on the waiting list.[2,3] The UK study did not specifically assess post-transplant risk by donor pack years but a subsequent study in the Untied States showed no increased mortality in single-lung or bilateral-lung transplants using donors with greater than 20 pack years.[4,5] Patients who received lungs from actively smoking donors with a greater than 20–pack year history had higher adjusted mortality, however, and smaller cohort studies have suggested higher short-term and long-term morality rates with transplantation from donors with greater than 40 pack years of smoking.[6]

Although smoking cannibals may be a risk factor for donor-acquired fungal infections after transplant, single-center cohort studies have not shown an adverse impact of donor inhalational marijuana use.[7]

Age

Large retrospective cohort studies have consistently shown little impact on survival and freedom from bronchiolitis obliterans syndrome (BOS) when using donors 55 years to 65 years of age.[8] A single-center study has suggested similar 1-year mortality with donors greater than 70 years old, although larger cohort studies have found increased mortality with donors older than 65 years, suggesting that utilization of very old donors carries