

The American Association for Thoracic Surgery (AATS) 2026 Expert Consensus Document: Guidelines for donor/recipient size-matching in lung transplantation

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ABSTRACT

Background: Donor to recipient size matching is an essential part of lung transplantation, with significant mismatch leading to worse patient outcomes. The current practice is based on limited data along with broadly accepted themes that have not been articulated in the form of objective and definitive guidelines. The objective of the American Association for Thoracic Surgery Clinical Practice Standards Committee expert panel was to develop evidence- and expert-based recommendations for optimal donor to recipient lung allograft size matching based on review of the existing literature.

Methods: The American Association for Thoracic Surgery Clinical Practice Standards Committee assembled an expert panel of 18 lung transplant surgeons from 15 centers who developed a consensus document of recommendations. The panel was divided into subgroups covering size-matching in (1) bilateral-lung transplantation, (2) single-lung transplantation, (3) lobar transplantation, (4) unique situations, and (5) management of complications after severe size mismatch. After a focused literature review, each subgroup formulated recommendation statements for each subtopic, which were reviewed and further refined using a Delphi process until consensus was achieved on each final statement by the voting group.

Results: The expert panel achieved consensus on 20 recommendations for current best practices in donor and recipient size matching. These recommendations include the use of a ratio of donor-to-recipient predicted total lung capacity between 0.8 and 1.2, with special considerations based on recipient pathology, single-lung or lobar transplantation, and anatomic variations such as chest wall abnormalities or significant mediastinal shift. Furthermore, oversized allografts can be reduced in size via nonanatomic or anatomic resection in select cases when required.

Conclusions: Consistent practice guidelines regarding donor to recipient size matching will be helpful and important to achieve optimal outcomes in lung transplantation. The recommendations described here provide guidance for professionals involved in the care of patients with end-stage lung disease considered for transplantation. (J Thorac Cardiovasc Surg 2026; ■:1-16)

	General Sizing	Obstructive Disease	Restrictive Disease
 Bilateral Lung	pTLC 0.8-1.2	AVOID < 0.8	AVOID > 1.2
 Single Lung	AVOID undersizing	Aim for aTLC	AVOID < 0.8
 Lobar Transplant	Same as above, but calculate TLC with # of segments transplanted		

Summary of recommendations for donor/recipient size matching.

CENTRAL MESSAGE

Size matching is important aspect of donor selection for lung transplantation. It uses predicted donor and recipient total lung capacity, adjusting for individual recipient anatomy and disease.

PERSPECTIVE

Appropriate donor-to-recipient size matching is critical for successful lung transplantation. Significantly over- and undersizing can lead to early complications and late morbidity. Given limited available data regarding size matching in lung transplantation, an expert panel was formed to provide recommendations on preferred clinical strategies.

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See Discussion on page XXX.

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Abbreviations and Acronyms

AATS	= American Association for Thoracic Surgery
AI	= artificial intelligence
aTLC	= actual total lung capacity
BLT	= bilateral-lung transplantation
CPSC	= Clinical Practice Standards Committee
CT	= computed tomography
CXR	= radiograph of the chest
DCC	= delayed chest closure
ECMO	= extracorporeal membrane oxygenation
FVC	= forced vital capacity
IPAH	= idiopathic pulmonary artery hypertension
PE	= pectus excavatum
PGD	= primary graft dysfunction
PHM	= predicted donor heart mass
pTLC	= predicted total lung capacity
TLC	= total lung capacity



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Organ selection for lung transplantation requires a comprehensive evaluation of donor and recipient characteristics. Beyond lung allograft quality, assessment of donor-to-recipient size matching is an important consideration in donor selection. Determining appropriate size matching seems intuitive but is often imprecise and varies among practitioners as the result of limited data to inform evidence-based clinical practice. There are also factors to consider beyond chest size alone, including individual recipient anatomy, recipient restrictive or obstructive pathology, concomitant diaphragm dysfunction, and the planned procedure: single, bilateral, lobar, or combined heart-lung transplantation.

In practice, optimal size matching may be undervalued in the context of a persistent shortage of quality donor lungs. The permissible degree of tolerance is unknown, and donor allograft size does not need to be a perfect match; however, transplanting significantly size-mismatched lungs is associated with increased early and late morbidity.^{1,2} Oversized lungs may pose technical challenges during surgical implantation and/or chest closure and may hinder recovery as a result of thoracic tamponade, persistent atelectasis, or ventilation-perfusion mismatch. Alternatively, undersized lungs may lead to worse primary graft dysfunction (PGD), provide insufficient respiratory function, increase the risk of pleural space complications, and increase the risk of developing chronic lung allograft dysfunction.²

The traditional donor-to-recipient comparisons of height or the thoracic cranial-caudal dimension and transverse width on imaging of the chest are easily obtainable but remain suboptimal methods for size matching. The ratio of donor-to-recipient predicted total lung capacity (pTLC) is currently the most accurate strategy to correctly size match. Although a donor-to-recipient pTLC range of 75% to 125% for bilateral-lung transplantation (BLT) has served as a pragmatic benchmark recommended by consensus experts in 2003 by the International Society for Heart and Lung Transplantation, recent data support a more restricted ratio of 0.8 to 1.2, particularly for recipients with interstitial lung disease.^{3,4} Despite pTLC being a broadly applicable and reproducible method, it is recognized that pTLC does not fully account for the anatomic heterogeneity of diseased lungs and that calculations are derived from specific population data that may not be applicable for all individual patients and patients of all races.

The objective of this expert consensus document from the American Association for Thoracic Surgery (AATS) Clinical Practice Standards Committee (CPSC) is to systematically review the available literature regarding donor-to-recipient size matching and provide evidence- and expert-based recommendations for consideration in donor assessment and selection in lung transplantation. This document presents 20 recommendations organized by clinical scenario, including, bilateral, single, and lobar transplantation, unique anatomic considerations, innovations in size-matching, and complications related to size

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mismatch. These statements are supported by the available evidence; however, because of limited data, many recommendations are determined on the basis of expert consensus opinions. The class of recommendation and the level of evidence are reported according to the recommended terminology adopted by the AATS and other associations and societies.

METHODS

The AATS CPSC and Assembly of Expert Group

The CPSC of the AATS decided to formulate a consensus statement on donor/recipient size-matching in lung transplantation. A writing group was formed including 16 experts in lung transplantation. Five primary topics were identified: (1) size matching in BLT, (2) size matching in single-lung transplantation, (3) size matching in lobar transplantation, (4) unique situations, and (5) management of complications after severe mismatch. Writing group members were assigned topics on the basis of their expertise and individual interests (subgroups). The writing group members and the topics were approved by the AATS. All members completed their conflict-of-interest disclosures.

Development of an Expert Consensus Document

A systematic literature review was conducted on published evidence on donor/recipient size-matching using the following search strategy: lung transplantation AND [size-matching OR size mismatch OR size] AND [total lung capacity OR height OR weight OR chest radiography OR gender OR lobar lung transplantation OR volumetry OR artificial intelligence OR chest wall deformities OR pectus OR complications]. Results were screened by S.C. and K.H., and a complete list of literature was provided to the writing group. Next, 3 to 5 recommendation statements were developed for each topic by the subgroups and presented to all members of the writing group for evaluation using a Delphi methodology.

For the evaluation process, the expert consensus panel used a 5-point Likert scale, graded as 1, strongly disagree; 2, disagree; 3, neither agree nor disagree; 4, agree; or 5, strongly agree. A predetermined 80% response rate was mandated for the vote to be considered complete. To establish a consensus, a predefined threshold of at least 75% agreement (“agree” or “strongly agree”) was required for acceptance of the consensus statement.⁵ If the 75% threshold was not achieved, the statement underwent revision by the subgroup on the basis of a discussion involving the whole writing group and was resubmitted for repeat voting. This iterative process continued until consensus was achieved on all recommendation statements. Agreement was reached after a median of 2 rounds of voting (min 1 to max 4). The language for each statement was chosen to be consistent with that recommended in the

harmonizing guidelines consensus document by the AATS, European Association for Cardio-Thoracic Surgery, European Society of Thoracic Surgeons, and Society of Thoracic Surgeons (Figure 1).⁶ A consolidated table summarizing all 20 recommendations is provided in Table 1.

RESULTS

Section 1: Size Matching in BLT

Statement 1.1. Appropriate donor and recipient size matching is critical for successful lung transplantation. Although size-matching strategies have traditionally included height-based measurements, lung and chest-wall measurements from radiographic imaging, and the ratio between donor and recipient pTLC, we recommend pTLC as the most accurate strategy to correctly size match and adjust for key variables. (**Class I, Level B-NR**)

Donor-to-recipient lung size matching has repeatedly been demonstrated to affect short- and long-term outcomes after BLT.⁷⁻⁹ Multiple studies have demonstrated an association between donor-to-recipient size mismatch and poor survival after lung transplantation with size mismatching being associated with PGD,^{7,8} hemodynamic compromise³ and impaired survival.¹⁰ Eberlein and colleagues¹¹ reported that size mismatch is also an independent predictor of death after lung transplantation.

Historically, multiple sizing strategies have been used, including height-based measurements or lung and chest-wall measurements from radiographic images. Although height is an important predictor of lung size, height-based sizing strategies fail to account for important lung size differences associated with sex, age, and race. Mason and colleagues¹² and Eberlein and colleagues^{13,14} demonstrated that sex affects lung size independent of height, with the male lung being approximately 20% larger than the female lung.¹⁵ In a height-based sizing system, significant size mismatch can occur with donor and recipient sex mismatch, resulting in poorer outcomes and worse survival.

Imaging-based sizing strategies that use lung height and chest-wall measurements are subject to variability in measurement technique, imprecise measuring, as well as patient positioning and ventilatory conditions. Although a recipient's radiograph of the chest (CXR) is performed in the standing position without positive pressure ventilation, the donor's CXR is performed in the supine position under positive pressure ventilation, making an accurate comparison between both images difficult. Furthermore, the measurement of recipient lung size on the basis of CXR is more reflective of the recipient's underlying diagnosis and body mass index, rather than an appropriate measurement of a more normal size after lung transplant, increasing the risk of size mismatch.¹⁶ Because the chest cavity generally trends toward its normal size after lung transplantation, the recipient's pTLC is the most accurate parameter to

Class of Recommendation

Suggested phrases for writing recommendations	
I Strong recommendation Benefit >>> risk	• Is recommended • Is indicated
IIa Moderate recommendation Benefit >> risk	• Should be considered • Is reasonable • Can be useful/effective/beneficial
IIb Weak recommendation Benefit ≥ risk	• May/might be reasonable • May/might be considered
III Moderate recommendation No benefit: risk = benefit Strong recommendation Harm: risk > benefit	• Is not recommended • Is contraindicated • Should not be performed/administrated

Level of Evidence

A	High-quality evidence from more than one RCT with no concern for high risk of bias, or meta-analyses of high-quality RCTs with no concerns for significant bias.	
B	Randomized (B-R): Non-Randomized (B-NR):	Moderate-quality evidence from 1 or more RCT or meta-analysis of RCTs. Moderate-quality evidence from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies or meta-analyses of such studies.
C	Limited data (C-LD): Expert opinion (C-EO):	Studies with limitations of design or execution, meta-analyses of such studies, case series, or physiological or mechanistic studies in human subjects. Consensus of expert opinion based on clinical experience.

FIGURE 1. Framework for class of recommendation and level of evidence. Adapted from American Association for Thoracic Surgery, European Association for Cardio-Thoracic Surgery, European Society of Thoracic Surgeons, and Society of Thoracic Surgeons guidelines. (reprinted with permission).⁶

guide donor-to-recipient size matching and can most accurately reflect the sizing goal to restore physiology towards normal after transplant.⁸

In pediatric donors, age also should be considered during matching, because lung growth usually lags behind body length growth. Therefore, these donors may still have

TABLE 1. Recommendations

	COR	LOR
Size-matching in bilateral-lung transplantation		
Statement 1.1. Appropriate donor and recipient size matching is critical for successful lung transplantation. Although size-matching strategies have traditionally included height-based measurements, lung and chest wall measurements from radiographic imaging, and the ratio between donor and recipient pTLC, we recommend pTLC as the most accurate strategy to correctly size match and adjust for key variables.	I	B-NR
Statement 1.2. Formulas for calculating pTLC are derived from population-based analyses and vary by region. For bilateral-lung transplantation, the preponderance of data recommends targeting a donor-to-recipient pTLC ratio of 0.8 to 1.2.	I	B-NR
Statement 1.3. Undersizing with a donor-to-recipient pTLC ratio of <0.8 should be avoided in general, particularly in recipients with primary pulmonary arterial hypertension and obstructive lung disease. Oversizing with a donor-to-recipient pTLC ratio of >1.2 should generally be avoided in recipients with restrictive lung disease.	III	B-NR
Statement 1.4. Sizing decisions should be made in the context of recipient-specific considerations including the patient's underlying disease, actual total lung capacity, and chest anatomy.	IIa	C-EO
Statement 1.5. In certain candidates, such as individuals with high immune sensitization or other barriers to donor organ access, taking oversized lungs and doing anatomic or non-anatomic downsizing may be reasonable.	IIb	C-LD
Size-matching in single-lung transplantation		
Statement 2.1. In the setting of single-lung transplantation, it is recommended to look beyond pTLC ratios and to also assess possible pleural cavity asymmetry from native lung disease or previous surgeries.	I	C-EO
Statement 2.2. Candidates with restrictive lung disease undergoing single lung transplant should be considered for a larger donor allograft, provided it is not oversized for the chest cavity, because undersizing may lead to worse outcomes. Data would suggest that long-term outcomes may be compromised when the D:R ratio is less than 0.8.	IIa	C-LD
Statement 2.3. In candidates with obstructive lung disease undergoing a single-lung transplant, it is recommended to match a lung closer to the actual TLC to prevent undersizing.	I	C-EO
Size-matching in lobar transplantation		
Statement 3.1. Lobar-lung transplantation can be a viable option when donor-recipient size matching is appropriately assessed, and the surgical procedure is technically well-executed.	IIa	B-NR
Statement 3.2. Compared with whole-lung transplantation, the risk of primary graft dysfunction in lobar lung transplantation may be greater (IIb, B-NR); however, satisfactory functional recovery and long-term survival can be achieved (IIa, B-NR).	IIb	B-NR
Statement 3.3. Size matching in lobar lung transplantation should follow the same principles as whole lung transplantation, primarily based on pTLC.	IIa IIa	B-NR B-NR
Statement 3.4. In lobar-lung transplantation, graft size should be calculated on the basis of the number of lobar segments to be transplanted.	IIa	C-LD
Statement 3.5. Because of the particular technical aspects and challenges in size-matching, lobar-lung transplantation should be performed in experienced centers.	IIa	C-EO
Unique considerations		
Statement 4.1. In patients with severe asymmetric chest wall abnormality and/or significant mediastinal shift (such as scoliosis, PE, previous lung resection, bronchiectasis), bilateral-lung transplant is recommended with appropriate downsizing of the graft if required to accommodate for the smaller pleural space to avoid oversizing.	I	C-LD

(Continued)

TABLE 1. Continued

	COR	LOR
Statement 4.2. In patients with severe PE, repair of the pectus deformity should be considered at the time of transplant.	IIa	C-EO
Statement 4.3. When sizing for heart-lung blocks, using recipient's pTLC and predicted donor heart mass is recommended.	I	C-LD
Complications after severe size-mismatching and how to overcome		
Statement 5.1. Nonanatomic lung resizing, ie wedge resection(s), is recommended in lung transplant recipients of oversized allografts on the basis of intraoperative postimplant observation.	I	B-NR
Statement 5.2. Anatomic lung resizing with lobectomy is a reasonable strategy in lung transplant recipients of oversized allografts based on preoperative planning using donor-recipient pTLC ratio-based sizing.	IIa	B-NR
Statement 5.3. Delayed chest closure may be considered in exceptional cases of lung transplant recipients of oversized allografts with reversible lung edema.	IIb	C-LD
Statement 5.4. Diaphragm plication of a functional diaphragm for the purpose of accommodating oversized allografts is not recommended, because this impairs ventilatory mechanics and may result in more prolonged recovery and poorer lung function.	III	B-NR

COR, Class of recommendation; LOR, level of recommendation/evidence; pTLC, predicted total lung capacity; PE, pectus excavatum.

relatively small lungs despite having reached adult height. They often also have smaller airways, which must be considered when performing airway anastomosis.

The pTLC provides an estimate of organ size using regression equations to calculate lung size on the basis of height, sex and age.¹⁷ A size-matching strategy on the basis of donor-to-recipient pTLC could optimize outcomes after lung transplantation and provides a more accurate approach to lung sizing.

Statement 1.2. Formulas for calculating pTLC are derived from population-based analyses and vary by region. For BLT, the preponderance of data recommends targeting a donor-to-recipient pTLC ratio of 0.8 to 1.2. (**Class I, Level B-NR**)

The most widely used formulae for pTLC in the context of lung transplantation are the European-derived ERS 1995 equations,¹⁸ which adjust for sex and height. More recently, the Global Lung Initiative has produced more complex formulas that incorporate age as a nonlinear term¹⁹ and are race-neutral.²⁰ However, the additional complexity requires the use of an online calculator (www.lungfunction.org), and the specific formulas used for pTLC calculation vary across centers and regions.²¹

Transplantation with oversized allografts, defined by donor-to-recipient pTLC ratios >1, has been shown to be associated with improved survival and reduced incidence of severe PGD⁷ and chronic lung allograft dysfunction.² In a large analysis using the United Network for Organ Sharing dataset, oversizing of the pulmonary allograft in

BLT was found to be independently associated with improved survival. A nonlinear association between the pTLC ratio and lung transplant survival was identified, with improved survival correlating to a greater pTLC ratio between values of 0.5 to approximately 1.3. At a pTLC-ratio of 1.3, an inflection occurs such that worse survival is clearly apparent when the pTLC-ratio exceeds 1.5.¹¹

Additional studies by Moneke and colleagues²² demonstrated that oversizing donor organs by 10% to 20% leads to a decreased incidence of severe PGD grades 2 and 3, whereas a pTLC ratio of >1.2 was associated with significantly reduced survival in female recipients of lung transplant. It has been hypothesized that these patients have a greater incidence of atelectasis²³ and are therefore more prone to infection.²⁴ Riddell and colleagues⁴ demonstrate improved short-term and long-term outcomes for bilateral transplant procedures when the donor pTLC is within 20% of the recipient. With these studies in mind, targeting a donor-to-recipient pTLC ratio of 0.8 to 1.2 allows for the benefits associated with slight oversizing donor organs while avoiding the detrimental effects of severe size mismatch.

Statement 1.3. Undersizing with a donor-to-recipient pTLC ratio of <0.8 should be avoided in general, particularly in recipients with primary pulmonary arterial hypertension and obstructive lung disease. Oversizing with a donor-to-recipient pTLC ratio of >1.2 should generally be avoided in recipients with restrictive lung disease. (**Class III, Level B-NR**)

The use of undersized allografts has been shown to be associated with an increased risk for PGD, anastomotic airway complications, and greater resource use.^{7,14} Although undersizing is generally avoided, the impact of using an undersized lung allograft in patients with idiopathic pulmonary artery hypertension (IPAH) can be more significant. Because IPAH does not affect the chest-wall size, it is important to avoid undersizing because of the physiological disadvantage of a smaller vascular bed. In a study examining lung size mismatch and survival after BLT for IPAH, slightly oversized allografts were associated with a substantially lower risk of death compared with undersized allografts.²⁵ Different indications for transplant can substantially impact a recipient's chest cavity size, requiring additional considerations in the size matching process. Candidates with severe emphysema and severe restrictive lung disease have the most profound differences between actual total lung capacity (aTLC) and pTLC.¹²

In recipients with severe obstructive lung disease and a significantly enlarged chest cavity, the recipient's pTLC should be considered in the context of aTLC. The decision to implant a significantly larger lung allograft may not allow for normalization of respiratory mechanics and may negatively impact physical endurance and survival after transplant. Mason and colleagues¹² reported that the use of an extremely large donor's pTLC greater than a recipient's aTLC in patients with emphysema results in inferior survival after bilateral-lung transplant. An increased risk of mortality at the extremes of aTLC ratio mismatch has been identified (aTLC-ratio <0.65 and >1.1) in severe emphysema. In the case of a substantial size mismatch between a large recipient's chest cavity and undersized allograft, the lung may not be able to completely fill the thoracic cavity, resulting in pleural space complications.

Patients with pulmonary fibrosis are characterized by a particularly small thoracic cavity, which may make it more challenging to find an appropriately sized lung allograft. For recipients with restrictive lung disease, pTLC and aTLC should be considered. Unless severe restriction is demonstrated on aTLC or imaging studies, the recipient's pTLC is an evidence-based sizing goal, with a pTLC ratio of 0.8 to 1.2 being associated with improved outcomes.⁴ However, Franz and colleagues²⁶ recently demonstrated that patients with pulmonary fibrosis who receive a lung allograft with a donor-to-recipient pTLC ratio of <1 have a better long-term survival compared with patients who receive a lung with a donor-to-recipient's pTLC ratio of >1 to <1.1, and >1.1. In addition, the authors demonstrated that oversizing lung allografts more than 10% was associated with greater PGD, postoperative bleeding, acute rejection incidences, and decreased long-term survival in patients with pulmonary fibrosis. Thus, it may be appropriate to avoid a donor-to-recipient's pTLC ratio >1 in cases of

severe restrictive physiology demonstrated by the recipient's aTLC.

Statement 1.4. Sizing decisions should be made in the context of recipient-specific considerations including the patient's underlying disease, aTLC, and chest anatomy. (Class IIa, Level C-EO)

The pTLC of the donor is likely reflective of the allograft size; however, the pTLC of the recipient might not accurately reflect the chest cavity size of a patient with end-stage lung disease. In patients with idiopathic pulmonary fibrosis or chronic obstructive pulmonary disease, aTLC as measured by pulmonary function testing is significantly different from the predicted or expected measurements and does not reflect the true lung parenchyma volume needed after transplant.

Thoracic cavity volume can vary according to a patient's underlying lung disease pattern, with the ratio of aTLC to pTLC being larger in emphysema, smaller in fibrotic disease, and often similar in bronchiectasis, cystic fibrosis, and pulmonary arterial hypertension. In such cases, a comparison of the aTLC and pTLC provides a quantitative estimate of chest cavity distortion secondary to the underlying lung disease. When selecting an allograft for a patient with emphysema, the lung size should be smaller than the aTLC to improve respiratory mechanics, because transplanting a large lung that approximates the hyperinflated diseased lung contributes to diminished long-term survival.²⁷

Previous studies have demonstrated that the pathologic changes in the ventilatory pattern in advanced lung disease can be reversed after transplant, suggesting that the main contributing factor is the lung itself rather than systemic effects of the disease.²⁸ Ideally, an appropriate size-matched lung should be able to restore the respiratory mechanics back to normal. Depending on the type of end-stage lung disease, the patient's chest wall can undergo adaptive changes with disease-specific chest-wall remodeling.

Statement 1.5. In certain candidates, such as individuals with high immune sensitization or other barriers to donor organ access, taking oversized lungs and performing anatomic or nonanatomic downsizing may be reasonable. (Class IIb, Level C-LD)

Patient-specific factors such as short stature or human leukocyte antigen antibody levels may affect access to suitable organs.²⁹ In an analysis from the United States Organ Procurement and Transplantation Network, there were strong associations between short stature and poor waitlist outcomes, suggesting that a shorter height range leads to a smaller pool of available donors.³⁰ Multiple previous publications have demonstrated that height remains an independent predictor for waitlist mortality, due to shorter lung donors being less common.^{15,31} In addition, patients with high immune sensitization also have a decreased donor pool, often necessitating acceptance of lungs from an

oversized donor with downsizing to create an appropriate size match.

In certain occasions and given the urgency of the recipient's condition, it may be necessary to accept organs that are larger than required. In these situations, oversized lungs may be considered outside of the traditionally acceptable size range, with the plan for anatomical or nonanatomical size reduction if required (see Section 5).

Because a severely oversized graft may lead to a greater incidence of ventilatory dysfunction, perpetual atelectasis, and hemodynamic instability in recipients of lung transplant with end-stage restrictive lung disease, a plan for volume reduction allows for the downsizing of larger implanted lungs and the opportunity to fit smaller chest cavities. Downsizing strategies are most commonly accomplished via peripheral nonanatomic wedge resections and/or anatomical lobectomy. Santos and colleagues³² reported their experience with downsizing and found no significant differences between patients who received downsized lungs and patients who underwent standard lung transplantation in surgical and postoperative complications, functional outcome, and survival. Shigemura and colleagues³³ reported their use of allograft volume reduction via nonanatomic wedge resection at the time of transplantation in the management of oversized allografts in recipients with restrictive lung disease. They reported that the disadvantage of using oversized grafts in recipients with restrictive pulmonary diseases can be overcome by performing a reduction of the lung allograft.

Section 2: Size Matching in Single-Lung Transplantation

Statement 2.1. In the setting of single-lung transplantation, it is recommended to look beyond pTLC ratios and to also assess possible pleural cavity asymmetry from native lung disease or previous surgeries. (**Class I, Level C-EO**)

There is a paucity of literature specifically addressing size matching for single-lung transplantation. Therefore, the consensus is to follow guidelines presented for size matching in the context of BLT. Although determining the donor-to-recipient pTLC ratio remains the preferred method,⁴ the retained contralateral native lung can vary in function among recipients. In sizing donor lungs for single transplantation, emphasis is placed on avoiding undersizing. In addition, pleural cavity asymmetry resulting from native lung disease or previous surgeries must be factored into size matching for single-lung transplant. In particular, previous cardiac surgeries can render the mediastinum fixed and may not allow mediastinal shift after an oversized single-lung transplant. In these scenarios, the addition of direct unilateral measurement techniques of the recipient (such as apex-to-diaphragm height, anteroposterior diaphragmatic width and hilum-to-chest wall distance) or computed tomography (CT) scan volumetry can complement the pTLC ratio assessment.

Statement 2.2. Candidates with restrictive lung disease undergoing single-lung transplant should be considered for a larger donor allograft, provided it is not oversized for the chest cavity, because undersizing may lead to worse outcomes. Data would suggest that long-term outcomes may be compromised when the donor-to-recipient ratio is below 0.8. (**Class IIa, Level C-LD**)

In addition, the retained contralateral native lung disease should also prompt nuanced sizing of the allograft. Indeed, in patients with restrictive lung disease, smaller allografts may limit recipient's functional outcome as peak oxygen consumption correlates with vital capacity posttransplant.³⁴

Statement 2.3. In candidates with obstructive lung disease undergoing a single-lung transplant, it is recommended to match a lung closer to the actual total lung capacity (TLC) to prevent undersizing. (**Class I, Level C-EO**)

In candidates with obstructive lung disease, larger allografts may yield better outcomes in minimizing the mechanical consequences of contralateral native lung hyperinflation while also enhancing physiologic performance. Therefore, it is believed that a larger donor allograft that more closely matches the available chest cavity volume may be optimal.

Section 3: Size Matching in Lobar Transplantation

Statement 3.1. Lobar-lung transplantation can be a viable option when donor-recipient size matching is appropriately assessed and the surgical procedure is technically well-executed. (**Class IIa, Level B-NR**)

Statement 3.2. Compared with whole-lung transplantation, the risk of PBD in lobar-lung transplantation may be greater (**Class IIb – Level B-NR**); however, satisfactory functional recovery and long-term survival can be achieved. (**Class IIa, Level B-NR**)

Lobar-lung transplantation has been applied in selected circumstances, most commonly in 3 situations: (1) small recipients, particularly of short stature, who have limited access to appropriately sized whole lungs; (2) when part of the donor lung is unusable because of localized pathology such as severe congestion; and (3) a combination of these scenarios.

Although no prospective clinical trials have been reported, multiple case series collectively suggest that lobar-lung transplantation provides satisfactory long-term outcomes and represents a viable alternative when whole-lung transplantation is not feasible.³⁵⁻³⁹ Nevertheless, the incidence of PGD and early mortality may be greater than with whole-lung transplantation.^{36,38-40}

The reasons underlying the increased risk of PGD and mortality remain uncertain. A leading hypothesis is suboptimal size matching, particularly when the transplanted lobes are relatively small in relation to the recipient's thoracic cavity and vascular bed. Loizzi and colleagues⁴¹ demonstrated that the ratio of donor-to-recipient pTLC is

more informative for size matching than the ratio of donor pTLC-to-recipient aTLC. On the basis of expert consensus, the use of pTLC is recommended for donor-recipient size matching, with a target donor-to-recipient ratio of 0.8 to 1.2. As discussed later, this principle should also guide the selection of which lobes to transplant. An additional ethical consideration must be acknowledged, particularly in small recipients. If a whole lung is otherwise usable, prioritizing a small-statured patient for lobar transplantation over another candidate who could accept the intact graft raises ethical questions of organ utility versus distributive justice. This dilemma depends heavily on the allocation system and the overall availability of donor organs. To address the problem of organ use, innovative surgical strategies have been explored. For example, bilateral lobar-lung transplantation can be performed using a single unilateral donor lung, thereby reducing graft waste.⁴² Although technically challenging and associated with unresolved allocation issues, such approaches illustrate how lobar transplantation may contribute to alleviating donor organ shortages and optimizing the effective use of available lungs.

Statement 3.3. Size matching in lobar-lung transplantation should follow the same principles as whole-lung transplantation, primarily based on pTLC. (Class IIa, Level B-NR)

Statement 3.4. In lobar-lung transplantation, graft size should be calculated on the basis of the number of lobar segments to be transplanted. (Class IIa, Level C-LD)

As discussed in other sections of this consensus document, size matching in lung transplantation is generally performed using pTLC. Although no direct evidence exists for lobar-lung transplantation, it is reasonable to apply the same principles used for whole-lung transplantation, targeting a donor-to-recipient's pTLC ratio of 0.8 to 1.2.

In lobar transplantation, estimation of graft size can be performed by calculating the proportion of donor lobar segments to be transplanted relative to the total 18 segments of the lungs. This approach has been developed primarily from the Japanese experience with living-donor lobar-lung transplantation, where forced vital capacity (FVC) rather than TLC is often used.^{43,44} For example, if a donor pTLC is 3.5 L and the graft consists of the left whole lung plus the right lower lobe, the estimated graft volume would be $3.5 \text{ L} \times [(18 - 3 \text{ segments of the right upper lobe} - 2 \text{ segments of the right middle lobe})/18] = 2.53 \text{ L}$.

Particular caution is necessary to prevent undersizing the graft. Reliance on visual assessment, either from CXRs or intraoperative inspection, may underestimate the recipient's thoracic cavity, potentially resulting in inadequate graft size relative to the vascular bed and an increased risk of severe PGD.

If available, CT volumetry can be used as a supplementary tool, as is practiced in living-donor lobar-lung

transplantation.⁴⁴ However, interpretation must be cautious in the setting of deceased donors, where ventilatory conditions such as high positive end-expiratory pressure can cause overinflation of the lungs and overestimation of graft size.

For these reasons, this consensus document recommends the use of pTLC as the primary reference for donor-recipient size matching in lobar-lung transplantation, complemented by segmental adjustment when lobes rather than whole lungs are used. This method provides a more systematic and reproducible framework for graft size estimation and reduces the risk of underestimation inherent in visual methods. Ultimately, careful application of these principles is expected to improve safety and optimize outcomes in lobar-lung transplantation.

Notably, it should be recognized that segmental volumes are not uniform across the lung and may vary among individuals. Therefore, segment counting provides only an approximate estimate of graft volume. When available, CT volumetry may provide more precise information regarding lobar volume and its proportion relative to the whole lung. Donor-specific conditions such as edema, atelectasis, or localized disease should also be taken into account.

Statement 3.5. Because of the particular technical aspects and challenges in size-matching, lobar-lung transplantation should be performed in experienced centers. (Class IIa, Level C-EO)

In addition to challenges in size matching, lobar-lung transplantation involves several technical and physiological considerations that differ from whole-lung transplantation. Because the vascular bed of a lobar graft is inherently limited, careful control of pulmonary blood flow—often supported by venoarterial extracorporeal membrane oxygenation (ECMO)—may be necessary to reduce the risk of pulmonary edema and PGD, which has been reported to occur more frequently after lobar transplantation.^{36,38-40} In addition, precise bronchial, arterial, and venous anastomoses are required to avoid complications that may have disproportionate consequences in a graft with limited reserve.

These considerations highlight the complexity of lobar-lung transplantation and underscore why such procedures should be preferably performed in high-volume, experienced centers (Figure 2).

Section 4: Unique Considerations

Statement 4.1. In patients with severe asymmetric chest-wall abnormality and/or significant mediastinal shift (such as scoliosis, pectus excavatum (PE), previous lung resection, bronchiectasis), bilateral lung transplant is recommended with appropriate downsizing of the graft if required to accommodate for the smaller pleural space to avoid oversizing. (Class I, Level C-LD)

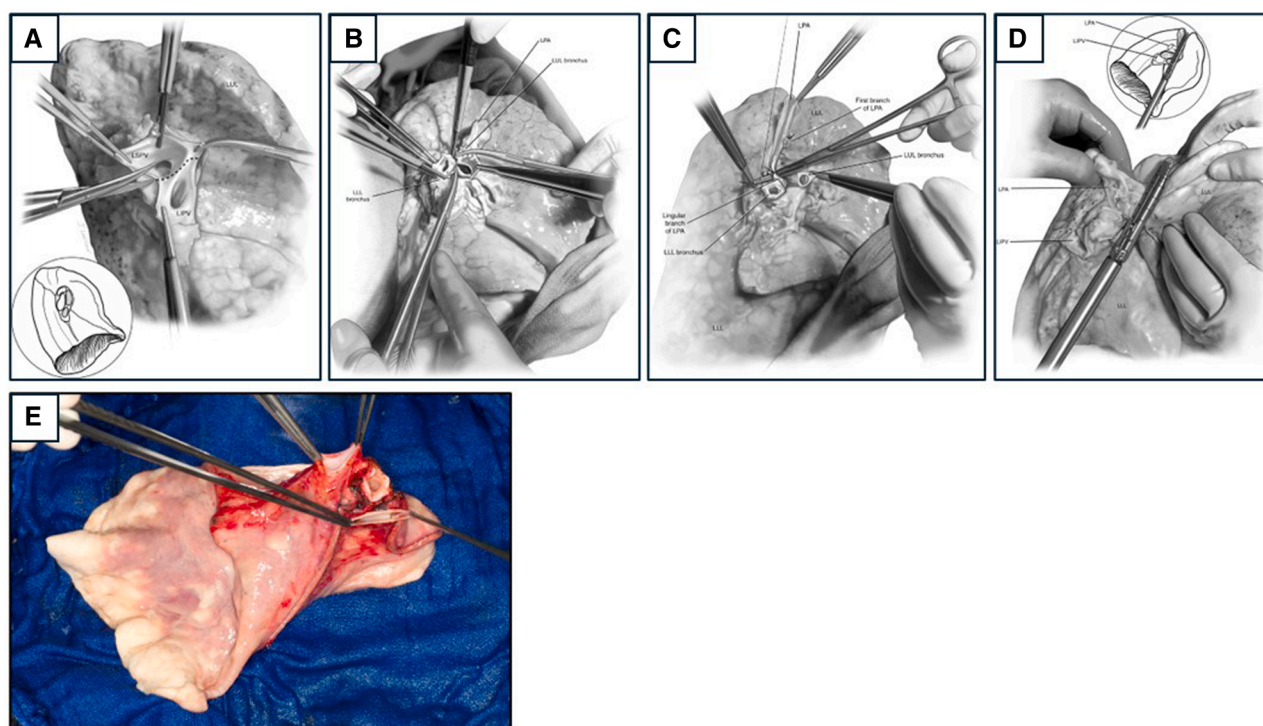


FIGURE 2. Illustrations of a back-table preparation of a left lower lobe graft; division of pulmonary veins (A), division of bronchus at the secondary carina, taking care to ensure that adequate cuff is left on the lobe to be implanted (B), ligation of lingula PA branches to elongate the PA for later anastomosis (C), and division of the fissure (D). Adapted from Laura L. Donahoe, Marcelo Cypel, Lobar Lung Transplantation, *Operative Techniques in Thoracic and Cardiovascular Surgery*, Volume 26, Issue 4, 658-668. Left lower-lobe graft before implantation (E). PA, Pulmonary artery.

BLT can be performed in patients with asymmetric chest-wall deformities. In cases of lung volume loss from previous lung resections or lung collapse, the mediastinum is often mobile and can be recentered with the new bilateral lung transplant. Significant size reduction of donor lungs is not typically needed in these cases. In cases with a fixed chest-wall defect such as PE or scoliosis, the lung size must be estimated based on the pleural cavity size. For severe scoliosis, for example, a significant lung volume reduction or a lobar transplant may be necessary for the smaller affected cavity.⁴⁵ Despite this potential need for smaller lungs, long-term outcomes have been satisfactory in a relatively large series of cases from Japan.⁴⁶ Notably, single-lung transplantation is also a valid option for patients with severely asymmetric chests, unless they are precluded from this option for other reasons (eg bronchiectasis or colonization). In such cases, single-lung transplantation should be performed on the larger side of the chest.

Statement 4.2. In patients with severe PE, repair of the pectus deformity should be considered at the time of transplant. (Class IIa, Level C-EO)

PE can occasionally impact cardiac and pulmonary function, limiting exercise capacity and posing space problems when planning lung transplantation. Furthermore, up to 20% of cases present with concomitant scoliosis, posing

another space problem.⁴⁷ Currently, the presence of significant PE is a relative contraindication for lung transplantation.⁴⁸ The question then arises as to whether repairing the PE simultaneously will improve results. PE can impact pulmonary function, mainly producing a restrictive pattern⁴⁸ with abnormal anterior chest-wall motion compensated with significantly increased abdominal excursion.⁴⁹ The clinical impact of PE not only depends on the severity of the deformity but also on the compliance of the chest wall, producing more difficulties as the patient grows older and the chest wall becomes stiffer.^{50,51} Results of surgical corrections extensively assessed after retrosternal bar repair (ie, Nuss procedure) confirm an improvement of vital capacity, FVC, TLC, and forced expiratory volume in the first 3 to 6 months after bar removal.⁵² Not surprisingly, cardiac compression is correlated with the maximum depth of the deformity, which is also responsible for the cardiac rotation angle and the position of pulmonary veins.⁵³ Right ventricular ejection fraction has been shown to be decreased and to return to normal as early as 2 weeks after pectus repair, and left ventricular stroke volume can improve despite being normal before surgery.⁵⁴ All these changes influence individual exercise capacity. This brief review of the effects of the PE and its repair supports correcting the PE simultaneously during transplantation to accommodate larger implants to ensure best outcomes. However, clinical

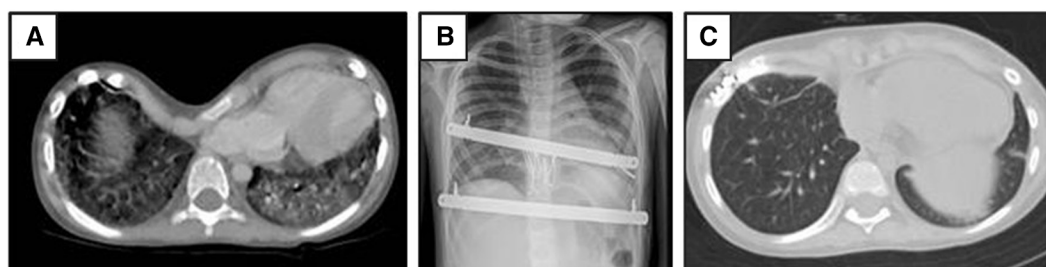


FIGURE 3. Pectus deformities can be addressed at the time of transplantation to provide space for the donor lungs, especially in young recipients. A, Pretransplant computed tomography scan. B and C, Posttransplant images.

experience is limited to several case reports that offer variable results.^{46,55-61}

Data from flat chest-wall deformity cases showed that the chest wall modifies its shape naturally after transplant, and despite demonstrating significant differences in FVC, exercise capacity is similar to normal controls.⁵⁵ Furthermore, it has been shown that downsizing to lobar transplantation results in similar FVC, exercise capacity, and 5-year survival compared with control patients with normal chest walls.⁵⁶ A published series including 18 patients with PE⁴⁶ reported more complex postoperative recovery, with a high rate of delayed chest closures (DCCs; 61.1% vs 18.9% in controls), prolonged mechanical ventilation and intensive care unit stay, and greater rates of grade 3 PGD (27.8% vs 12.2% in controls). Despite a more challenging postoperative recovery, long-term outcomes were similar to controls.

Several case reports illustrate the results after correcting the PE using Nuss bars alone or as support for a modified Ravitch procedure simultaneously with the transplant in young patients (Figure 3).⁵⁸⁻⁶¹ In all cases, the postoperative period was uneventful, with no reported complications arising from the PE correction.

In summary, currently available evidence on lung transplantation in patients with PE is not strong enough to make a definitive recommendation, but the largest series showed that nonrepaired patients with PE have a more difficult early postoperative periods but good long-term results. A concomitant PE repair is likely not suitable for all patients and should be limited to younger patients with more compliant chest walls. Minor defects need no correction.

Statement 4.3. When sizing for heart-lung blocks, using recipient's pTLC and predicted donor heart mass (PHM) is recommended. (Class I, level C-LD)

The conventions for donor-recipient size matching are relatively well defined for individual organ transplant (heart, single lung, bilateral lung). However, because of a significantly smaller number of combined heart-lung transplants performed worldwide, the sizing strategy for heart-lung blocks is not as well described. Current decision making is on the basis of data from individual organ sizing. Size matching for heart transplant has been described using

height, weight, and PHM matching.⁶²⁻⁶⁶ Among those 3 variables, donor-recipient weight correlates well with PHM, whereas height does not. Therefore, in contemporary practice, PHM is preferred over height, weight, or body surface area in choosing appropriate donor size.⁶⁷ The key decision point is to avoid undersizing the graft as it is associated with worse outcomes.

In case of the lung allograft, the benefits of using the pTLC ratio over other methods of size matching discussed previously in the context of lung transplantation would be expected to apply in heart-lung transplant. Importantly, undersized allografts are associated with worse graft function, and, in case of heart-lung transplant, worse survival.^{2,7,10} A review of 1532 adult heart-lung transplants performed between 1992 and 2018 showed that difference in weight appeared to correlate with survival at both 1 and 5 years; however, no such effect was seen with difference in height.⁶⁸ Although this association was no longer significant in multivariable analysis, it likely points to some role of weight as predictor of heart mass as described above. Therefore, to appropriately size both organs, it is recommended that both pTLC and PHM be incorporated for appropriate size matching for heart-lung transplant, with caution to avoid undersizing.

Section 5: Complications After Severe Size Mismatching and How to Overcome

Statement 5.1. Nonanatomic lung resizing, ie, wedge resection(s), is recommended in lung transplant recipients of oversized allografts on the basis of intraoperative postimplant observation. (Class I, Level B-NR)

Although ideal size matching in lung allocation is usually optimal, it is not always possible in critically ill, highly sensitized, short stature, and pediatric lung transplant candidates, where limited donor options can prolong wait times and result in higher mortality.^{30,69-71} In these settings, surgeons may need to use size mismatched lungs to facilitate equitable access to life-saving lung transplantation.

In some cases, this mismatch can also result in donor-to-recipient undersizing, a scenario which can be associated with lower peak lung function, an increased risk of PGD, and potentially poorer overall survival.^{2,7,11,14,72} There are no intraoperative surgical strategies to mitigate the risks

associated with donor-recipient undersizing, so avoiding undersizing can only be meaningfully accounted for in the allocation phase. These patients may benefit from ventilatory strategies that address donor size rather than the recipient⁷³ and may require prolonged chest tube drainage postoperatively, preferably on water seal rather than continuous suction given the latter can result in hyperinflation of undersized lungs.⁷⁴

In other cases, size mismatches will occur via donor-to-recipient oversizing, particularly in smaller recipients, to improve their access to transplantation. Although donor-recipient oversizing is generally considered beneficial compared with undersizing, oversizing can result in mechanical challenges of fitting a donor allograft into the recipient hemithorax. Depending on the degree of the size mismatch, oversizing has also been shown in some studies to have disease-specific and possibly center-specific negative effects, potentially increasing the risk of PGD and death in recipients with interstitial lung disease.²⁶ As such, intraoperative surgical mitigation strategies should be considered to accommodate oversized grafts, including lung resizing.

One approach to mitigate the mechanical challenges of donor-to-recipient oversizing is nonanatomic lung resizing, typically done via multiple wedge resections.^{32,33} These wedge resections are done peripherally using a mechanical stapler, typically in the upper lobes, the right middle lobe, or the lingula, and can facilitate a 10% to 20% reduction in graft volume (Figure 4). We believe wedge resections are best done after implantation, so that they can be performed to specifically accommodate the recipient's chest cavity. Because wedge resections require an incision to the visceral pleura, they carry a risk of prolonged air leak after transplant, particularly in patients on high dose corticosteroids who may have impaired healing. Wedge resection during post-implant observation may help to minimize the number that are required.

Outcomes in patients treated with donor-to-recipient oversized donors accommodated with a non-anatomic resizing strategy have varied, with some studies showing similar outcomes to non-resized grafts,³² and some studies showing an increased risk of poor post-transplant lung function and poorer overall survival.⁷⁵ These risks likely vary

between centers and surgical experience and must be weighed against the risks of non-utilization of a donor for a population who have a high waitlist mortality risk.

Statement 5.2. Anatomic lung resizing with lobectomy is a reasonable strategy in lung transplant recipients of oversized allografts based on pre-operative planning using donor-recipient pTLC ratio-based sizing. (**Class IIa, Level B-NR**)

A separate strategy to accommodate oversized donor lungs is anatomic lung resizing through lobectomy and lobar transplantation. This procedure is most often done using pre-implant (back-table) lobectomy on the basis of the donor and recipient's pTLC, with plans for reductions on the basis of the proportional contributions of the lobes that will be used and removed. In most cases, the upper lobes are removed and, depending on the pTLC ratio considerations, the right middle lobes may be removed as well. The lower lobes are typically transplanted with or without the right middle lobe, but cases must be individualized on the basis of the donor lung assessment and the position of the right middle lobe bronchial take-off. Careful consideration must be given to the bronchial division and preparation to ensure that sufficient bronchus is available for an anastomosis to mitigate the risk of ischemic or stenotic bronchial complications. Lobar transplantation sometimes results in transplanting lungs with blind bronchial stumps, which can increase the risk of dehiscence or air leak in patients on immunosuppression and particularly high dose corticosteroids. Lobar-lung transplants may also be more susceptible to volume overload because of reduced vascular surface area compared with a comparable full-sized lung for a given recipient's total lung capacity, which could compound or worsen reperfusion edema and PGD. As such, lobar transplants should be approached with caution in patients, like those with pulmonary arterial hypertension, who are already high risk for PGD. We recommend performing most lobar-lung transplants on intraoperative cardiopulmonary support, preferably ECMO. In addition, for all the aforementioned reasons, we recommend anatomic lung resizing and lobar transplantation be performed only at experienced centers.

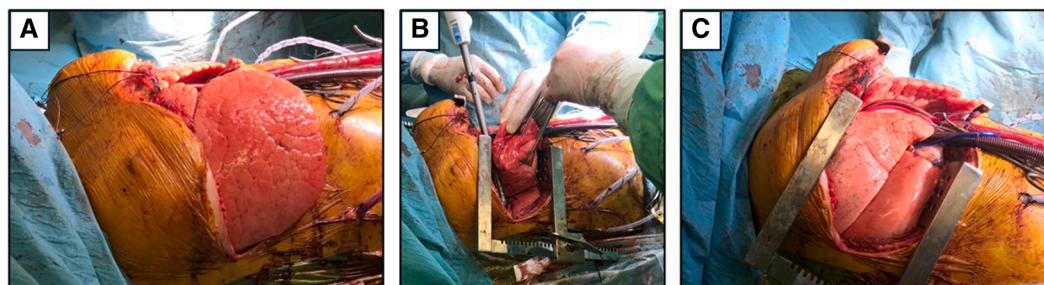


FIGURE 4. A 10% to 15% downsizing of grafts can be achieved by nonanatomical wedge resections (ie, middle lobe resection; see panels A-C).

Compared with conventional lung transplants, lobar transplants have been associated with an increased risk of PGD, lower peak lung function, and potentially an increased risk of short-term mortality.^{40,75} However, other studies have demonstrated lung function and survival similar to nonlobar transplant controls.^{32,76} These data can be challenging to interpret because they are often confounded by using lobar transplants in sicker recipients, in many cases for patients requiring invasive mechanical ventilation or ECMO bridging. These associations will also likely vary between centers and specifically may vary with a given center's outcomes in comparison with the nonlobar transplant group. As with nonanatomic lung resizing with wedge resection, these risks must be weighed against the risks of patients remaining on the wait list with a high mortality risk and low probability of a full-size donor offer.

Statement 5.3. DCC may be considered in exceptional cases of lung transplant recipients of oversized allografts with reversible lung edema. (**Class IIb, Level C-LD**)

Another option that may be considered in cases in which the allograft is either oversized or normally sized with significant tissue edema is to use DCC.⁷⁷⁻⁸⁰ With judicious use, DCC may allow for lung parenchymal edema to resolve over a short period—approximately 24 to 72 hours—to facilitate primary chest closure without the need for lung parenchymal resection. Alternatively, in an allograft with significant post-reperfusion edema resulting in poor tissue quality, but where one thinks downsizing may still be necessary, a DCC approach with subsequent parenchymal resection may facilitate surgical lung volume removal and minimize risk of staple line breakdown or air leak in overly edematous lungs.

When a DCC approach is implemented, it is critical to ensure adequate hemostasis and that the lung parenchyma be protected from the dressing and an airtight seal made, preferably with a negative-pressure wound dressing to optimize sterility and manage fluids. Prophylactic coverage with broad-spectrum antibiotics should strongly be considered to minimize the risk of infection and wound complications, particularly when using induction immunosuppression.

DCC may have its advantages in avoiding compressive atelectasis and the need for either high ventilatory support or ECMO with the chest open. The ability to allow for alveolar recruitment and ventilation by not closing the thoracic cage may reduce ventilator induced lung injury. In addition, lowering the risk of ECMO may avoid the associated risks of systemic anticoagulation, bleeding, and mechanical or infectious risks of the required intra-vascular cannulae.

Statement 5.4. Diaphragm plication of a functional diaphragm for the purpose of accommodating oversized allografts is not recommended, as this impairs ventilatory mechanics and may result in more prolonged recovery and poorer lung function. (**Class III, Level B-NR**)

There have been anecdotal reports of using diaphragm plication in functional diaphragms (ie, nonparalyzed) as an approach for expanding the pleural space to accommodate oversized allografts.⁸¹ We do not recommend this approach because it has a deleterious effect on diaphragmatic function and excursion, limiting optimal pulmonary mechanics. These complications may lead to hypoventilation and prolong posttransplant ventilatory support requirements and duration of mechanical ventilation. The impairment of pulmonary mechanics by combining a thoracosternotomy with intentional impairment of diaphragm function, particularly in patients who may have central adiposity, is a significant concern. There have been anecdotal descriptions of leaving diaphragmatic retraction sutures to accommodate oversized allografts, with the sutures being removed at the bedside days later. Again, there is no data to support this approach, so it should not constitute routine clinical practice as an approach to managing oversized allografts.

FUTURE DIRECTIONS

Recently, several advances have been made in image supported volumetry and artificial intelligence (AI)-driven tools, but they are not ubiquitously available in donor hospitals. These techniques may overcome some shortcomings of TLC matching, especially when it comes to anatomic heterogeneity of diseased lungs. Because the evidence is still limited, we decided not to provide Delphi statements but rather discuss their role separately.

Prabhu and colleagues⁸² demonstrated the accuracy of CT volumetry in restrictive lung disease, showing that volumetric donor-recipient ratios correlated with risk of graft oversizing, surgical reduction, and mortality, whereas traditional pTLC ratios were less predictive. Jung and colleagues^{83,84} and Konheim and colleagues^{83,84} extended these observations, deriving predictive CT equations for total and lobar-lung volumes based on demographic variables, demonstrating strong correlations with plethysmography and pulmonary function testing. Chen and colleagues⁸⁵ likewise compared CT volumetry with pulmonary function test-derived volumes in living donors, validating CT as a reliable technique. Collectively, these data establish CT volumetry (when available) as an adjunct to pTLC in the peritransplant evaluation.

AI now builds upon these advances by automating segmentation and volumetric calculation, reducing observer dependence, and enabling application at scale. Rui and colleagues⁸⁶ developed an AI-based 3-dimensional reconstruction system that accurately estimated lung volumes across a spectrum of parenchymal diseases, outperforming manual workflows in speed and consistency. Ismail and colleagues⁸⁷ demonstrated that deep learning algorithms

can derive lung volumes directly from CXRs with strong concordance to CT-based measurements, possibly extending volumetric assessment into settings where CT is unavailable. Machine learning models that incorporate demographic and clinical characteristics further expand this capability. Pu and colleagues⁸⁸ reported accurate predictions of left and right lung volumes, thoracic cavity volume, and heart volume using age, sex, height, weight, and race, achieving mean absolute percentage errors of less than 15%. These approaches suggest that in the future donor lung size could be estimated algorithmically from readily available data, improving allocation efficiency. However, AI-derived CT volumes tend to slightly underestimate plethysmography measurements, which themselves may be somewhat lower than pTLC, suggesting that prospective validation is essential before adopting these techniques in clinical practice.

DISCUSSION

Lung transplantation remains one of the most challenging cardiothoracic operations, and matching an appropriately sized donor graft to the recipient's chest is pivotal for success. Significant size mismatching can lead to PGD, pleural space complications, atelectasis, vascular congestion, recurrent infections, and premature graft loss.

A variety of different techniques for size matching is currently used, including matching by height, CXR measurements, body surface area, spirometric measurements, and others. We therefore formed a group of experts to systematically review the available literature on size matching in lung transplantation and provide evidence- and expert-based consensus statements on this topic.

Notably, there was a strong agreement among this group that donor and recipient pTLC should be the standard technique used to determine donor and recipient size matching, because it represents the most physiologically accurate strategy and provides a practical and broadly applicable reference. In addition, the ratio of a recipient's aTLC to a recipient's pTLC should be considered to account for over-inflated chests (as in emphysema patients) versus contracted chests (as in interstitial lung disease patients).

CONCLUSIONS

Significant variability in lung size-matching strategies exists among lung transplant programs and regions. This expert panel has aimed to develop clear, practical, and standardized recommendations to help reduce complications related to size mismatching and thus improve posttransplantation outcomes. We recommend comparison of the donor's and recipient's pTLC as the most broadly applicable strategy for size matching in lung transplantation, with additional consideration for specific

recipient characteristics that influence the ideal donor-to-recipient pTLC ratio.

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Conflict of Interest Statement

See Table E1. U.A. reported honoraria MSD AstraZeneca. P.C. reported honoraria/payment for expert testimonial from Bolton Medical (Terumo Aortic) and Lewis Brisbois LLP. L.C. reported Medtronic: constancy and research grant, paid to institution; and Paragonix: research grant and honorarium for lecture, paid to institution. S.C. reported support for meetings from XVIVO and honoraria from AtriCure, Intuitive, and AstraZeneca (payment to self). M.C. reported consulting fees and stock from Lung Bioengineering Traferox Technologies. K.H. reported a grant from the Alberta Lung Association and advisory board for Sanofi. M.H. reported grants, consulting fees, and honoraria from Intuitive Surgical, Lung Bioengineering, Transmedics, Paragonix, CSL Behring, CF Foundation, NHLBI, and BioMedInnovations. K.H. reported speaker fees from Traferox. N.N. reported a grant from the University of Canada, project preservation at 10°, payment performed to the institution; Medtronic payment (to self) for expert testimony; and advisory board, J&J (to self) for advisory board collaboration. V.P. reported consulting fees from the NCI, NHLBI, AstraZeneca, and PrecisCa. B.W. reported board member, Transmedics. All other authors reported no conflicts of interest.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT in order to review grammar and reduce the number of words in statement 4.2. After using this tool/service,

the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Key Words: lung transplantation, size-matching, lobar, nonanatomical size reduction, total lung capacity

APPENDIX E1

TABLE E1. Conflict of interest statement

Writing group member	Primary affiliation	Location	Grants or contracts	Royalties or licenses	Consulting fees	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	Payment for expert testimony	Support for attending meetings and/or travel	Participation on a data safety monitoring board or advisory board	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	Stock or stock options	Receipt of equipment, materials, drugs, medical writing, gifts or other services	All entities with whom the author may have the indicated relationships, and if payments were made to the author or institution.
Usman Ahmad, MD	Department of Thoracic Surgery, Heart, Vascular and Thoracic Institute, Cleveland Clinic	Cleveland, Ohio				x							MSD AstraZeneca
Pedro Catarino, MD	Cedars-Sinai Medical Center	Los Angeles, Calif				x	x						Bolton Medical (Terumo Aortic), Lewis Brisbois LLP
Laurens J. Ceulemans, MD, PhD	University Hospitals Leuven, KU Leuven, Belgium	Leuven, Belgium	x		x	x							Medtronic: consultancy and research grant, paid to institution Paragonix: research grant and honorarium for lecture, paid to institution
Stephanie H. Chang, MD	New York University Langone Health	New York, NY				x		x					Support for meetings - XVIVO Honoraria - AtriCure, intuitive, AstraZeneca (payment to self)
Marcelo Cypel, MD, MSc	University Health Network	Toronto, Ontario, Canada		x	x						x		Lung Bioengineering Traferox Technologies
Travis C. Geraci, MD	New York University Langone Health	New York, NY											
Kieran Halloran, MD	Department of Medicine, University of Alberta	Edmonton, Alberta, Canada	x		x								Grant from the Alberta Lung Association Advisory board for Sanofi
John C. Haney, MD	Mayo Clinic Florida	Jacksonville, Fla											
Matthew G. Hartwig, MD	Duke University	Durham, NC	x		x	x							Intuitive Surgical, Lung Bioengineering, Transmedics, Paragonix, CSL Behring, CF Foundation, National Heart, Lung, and Blood Institute, BioMedInnovations

(Continued)

TABLE E1. Continued

Writing group member	Primary affiliation	Location	Grants or contracts	Royalties or licenses	Consulting fees	Payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events	Payment for expert testimony	Support for attending meetings and/or travel	Participation on a data safety monitoring board or advisory board	Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid	Stock or stock options	Receipt of equipment, materials, drugs, medical writing, gifts or other services	All entities with whom the author may have the indicated relationships, and if payments were made to the author or institution.
Konrad Hoetzenecker, MD, PhD	Vanderbilt University Medical Center	Nashville, Tenn						x					Traferox - speaker fee
Shaf Keshavjee, MD	Toronto Lung Transplant Program, University of Toronto	Toronto, Ontario, Canada											
Philippe H. Lemaitre, MD, PhD	Columbia University Irving Medical Center	New York, NY											
Nuria M. Novoa, MD, PhD, FEBTS	Puerta de Hierro-Majadahonda University Hospital	Madrid, Spain	x				x	x	x				Grant from the University of Canada. Project preservation at 10°. Payment done to the institution. Medtronic payment made to self for expert testimony and advisory board - J&J payment made to self for advisory board collaboration
Varun Puri, MD, MSCI	Washington University School of Medicine	Saint Louis, Mo	x		x								National Cancer Institute, National Heart, Lung, and Blood Institute, AstraZeneca, PrecisCa
Masaaki Sato, MD, PhD	The University of Tokyo Hospital	Tokyo, Japan											
Lara Schaheen, MD	Norton Thoracic Institute, St Joseph's Hospital and Medical Center	Phoenix, Ariz											
John W. Stokes, MD	Vanderbilt University Medical Center	Nashville, Tenn											
Bryan A. Whitson, MD, PhD	The Ohio State University	Columbus, Ohio							x				Transmedics