Measure twice, cut once: Increasing the precision of size matching in lung transplantation

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Lung transplantation is a lifesaving therapy for those with end-stage lung disease. Despite many advances in the medical and surgical care of the patient after lung transplantation, 5-year survival remains suboptimal at 50% to 60%. Survival is influenced by many factors that have been incompletely understood. Recently, donor-to-recipient size matching has been one such variable that has been increasingly recognized as an important component to the evaluation and outcomes that follow. This area of imprecision could clearly benefit from a more refined approach.

The standard evaluation of lung donors involves analysis of evaluation not only of their quality but also of their suitability for a particular recipient. Traditionally, the most weight in this size assessment has been placed on donor height. Height alone is not the answer. As I can recently attest to while on call, a 14-year-old male patient who is 5 foot 4 inches, 115 lbs will have a vastly different lung size than the 54-year-old female patient who is 5 foot 4 inches, 180 lbs. In reality, experienced surgeons consider several of these characteristics, including age, height, gender, and disease process. They also execute this using the “art” of clinical medicine based on experience. For years, we have been searching for precision beyond the rather crude metrics we use today. Many centers have used measuring of donors to recipients using the available information at the time of evaluation. These commonly include cranial-caudal thorax measurement, transthoracic measurement, and thoracic depth (when available). Even considering those, the process is still not that simple because every donor and recipient have additional variables that contribute to a potential size discrepancy. One such critical variable is the relative reliability of the imaging studies. Poor-quality imaging leads to assessment that is not meaningful and imprecise.

In the article by Konheim and colleagues,¹ the group used 3-dimensional computed tomography (3D-CT) volumetry

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Central Message

Ongoing important work in size matching for lung transplantation is moving toward increased precision between donor and recipient.

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as a potentially new size-matching strategy. The authors aimed to use 3D-CT volumetry measurements from a normal patient population to generate predictive equations for total, right, and left lung volume for size matching. The authors evaluated 400 normal adults in their training group that was used to create the fitted model. This resulted in the construction of predictive equations that were based on height, gender, race, and age (variables identified by the Lasso regression as predictors of total, right, and left lung volume). The predictive equations correlated strongly with measured volumes. The authors acknowledged several limitations of the study, including the need for full inspiration on 3D-CT evaluation, several outlier cases in the study, and no insight into the degree of variance between predicted total lung volume and recipient total lung volume. However, the study does provide meaningful data that set the stage for a future prospective study assessing the applicability of 3D-CT as a strategy to improve donor:recipient selection and outcomes.

Why is donor:recipient sizing important? For starters, the technical aspects of the lung transplant have to be able to be completed and the chest closed. Although effective strategies for dealing with the open chest as a temporary

step have been described, eventually the patient does need his/her chest closed formally to recover and leave the hospital.^{2,3} The potential morbidity of an oversized graft can be quite dramatic.⁴ The current International Society for Heart and Lung Transplantation report suggests that no clinical or adverse event is encountered when donor-predicted total lung capacity is between 75% and 125% of the recipient.⁵ Generally, it is preferred to have larger donor lungs for those with obstructive pathologies and smaller donors for restrictive pathologies leading to end-stage lung disease. Indeed, there are some data that would suggest that oversized allografts are associated with a decreased risk of higher-grade primary graft dysfunction.⁶ One explanation for this finding is that an oversized allograft may receive a more protective ventilatory strategy (inherent to the smaller tidal volume ratio) and operate at lower pulmonary vascular resistance relative to the amount of blood flow for that lung. Although some progress is being made, we have surprisingly limited published data on this topic to guide surgeons in the decision-making for size matching of donors and recipients. Data are limited on decisions that are made every day in our operating rooms and hospitals.

The study by Konheim and colleagues¹ is a timely communication in the lung transplant setting when one considers how novel approaches are transforming the surgical practice. Currently, we are beginning to explore in more detail the important relationship of donor and recipient size matching. Lobar transplantation is now a

viable option for smaller chests. The open chest can keep patients off extracorporeal support in the postoperative setting. Trimming of donors is relatively routine for facilitating chest closure when an oversized graft is used. As we seek to apply the study reviewed here in the future, it is reasonable to postulate that formulas, novel imaging strategies, and technology will play a larger role. There is no reason in 2016 and beyond that formulas and technology can't guide us to a more precise size-matching algorithm. I am confident that the future of donor:recipient evaluation will be applied in a more thoughtful way such that improved precision can lead to better outcomes for these critically ill patients.

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