The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Q	Flow rate
P	Pressure
r	Radius
η	Fluid viscosity
l	Length of tubing

$$Q = \frac{\pi Pr^4}{8\eta l}$$

REPLY FROM AUTHORS: PULMONARY ALLOGRAFT ARTERY SIZE MATTERS: NOT JUST THE LENGTH, BUT THE WIDTH TOO!

To the Editor:

We enjoyed reading the reply from Saddoughi and colleagues[1] and appreciate the opportunity to have this critical dialogue. They raise an important point by differentiating pulmonary artery (PA) main segment length versus caliber mismatch as distinct etiologies of PA obstruction in lung transplantation. Our group's review[2] on the topic found that PA kinking because of excessive donor or recipient main PA length is the second most common cause of PA blood flow obstruction and the most common reason immediately after chest closure. On the other hand, a stricture or narrowing of the PA secondary to donor–recipient PA caliber mismatch is much less common, as stated by Yokoyama and colleagues,[3] likely due to surgeons' direct visualization and the use of surgical techniques such as the ones described in their article. Although we wholly agree that donor length is critical to the anastomosis to prevent kinking and torsion, ensuring proper blood flow to the newly transplanted lung, we maintain that vessel diameter also plays a crucial role.

Reviewing the physics of flow dynamics, we recall that the Hagen-Poiseuille equation demonstrates that incremental changes in the diameter of a tube more significantly affect the overall flow through the tube than an equal change in length (Figure 1). The flow rate is proportional to the radius of the pipe to the fourth power. Conversely, the equation also asserts that the flow rate is inversely proportional to the length, meaning that the longer the tube, the slower the rate of flow. This theoretically supports the notion that the diameter of the PA anastomosis may play a more significant role in allograft perfusion.

Q	Flow rate
P	Pressure
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l	Length of tubing

$$Q = \frac{\pi Pr^4}{8\eta l}$$

FIGURE 1. Hagen-Poiseuille equation.

Regardless of the etiology of PA flow obstruction, PA diameter and length, and vessel geometry can be evaluated by transesophageal echocardiography (TEE). Saddoughi and colleagues[1] are correct about the inherent limitations of TEE, which hinder its ability to visualize the left PA. However, we would advise extreme caution before advancing a PA catheter through a fresh anastomosis to obtain pressure gradients. Additionally, a PA catheter offers minimal utility compared with TEE, which can provide a real-time morphological assessment of the right ventricle in the setting of severe pulmonary hypertension.[4] TEE can uniquely diagnose PA anastomosis complications and guide real-time surgical correction, which would otherwise be delayed until symptoms of graft failure begin to manifest postoperatively.

In closing, TEE should be a standard of care in lung transplantation because it can aid surgeons and improve patient outcomes.[5] Although certain things can be seen by the naked eye, once the chest is closed, even surgeons are blind whether or not they are wearing loupes.

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https://doi.org/10.1016/j.xjtc.2021.09.016