Lung “life support”: Enter the era of improving the function of transplanted lungs

Lung transplantation is a relatively new science, with the first successful transplant being performed in 1983 in Toronto, Canada. Almost all transplants performed in this country involve the removal of the lungs from a deceased donor, flushing the blood out of them with a preservative solution, putting them on ice in a cooler, and transporting them to the recipient’s location before finally surgically implanting them in their new “home.” This process of preservation and transportation is a time-sensitive one, as the organs deteriorate with time. Historically, we have aimed to have the new lungs working in the recipient within 6 hours of their removal from the donor.

The lungs are the first organ to suffer from infection (eg, pneumonia), aspiration, or postmortem swelling. Therefore, we are often unable to use the organs, even though they have been generously donated for transplant. For years, we in the transplant community have been frustrated by the inability to use all donated lungs because of this swelling, bruising, infection, or poor function. In fact, only about 15% of lungs received from organ donors are ultimately transplanted. Although we have learned that we can utilize donor organs that are less than perfect, many are still turned down. Furthermore, the incidence of primary graft dysfunction (PGD) in transplanted lungs remains a significant problem. PGD refers to the condition that occurs when the transplanted organs do not function optimally after implantation. It can result from a multitude of causes—problems with preservation or a reaction from the immune system, for example. Not only does PGD interfere with the rapid recovery of the patient after transplant, but it also translates to increased chronic rejection and poorer overall long-term survival.

How are we working to address these issues? Enter the world of ex vivo lung perfusion (EVLP). Organs can now be harvested and then placed on a circuit that constantly pumps fluid and blood to the lungs and ventilates the organ just as it would be ventilated in a living person. Essentially, this is a “life support system for the lung,” and it allows us to spend time improving the function of the lungs and assessing them at different time points to estimate how well they will work when implanted. It also allows us to treat the lungs for infection, swelling, and contamination from aspiration.

Furthermore, EVLP offers us for the first time the ability to try unique treatments to alter the recipient’s immune response after organ implantation. Different systems are being investigated, but the primary goals of this new technology are: 1) better preservation of the organ to improve its function once implanted, and 2) salvage organs for transplant that would otherwise be deemed unacceptable. Early reports have shown that both goals can be met. There remains much to be learned, however: for example, we are still searching for the best solution for perfusing the lungs on the circuit. We are also trying to decide on the best modality for ventilation of the lungs on the circuit. A number of centers are now aggressively investigating these and other matters. It is an extremely exciting time to be involved in lung transplantation, as this new science could not only

increase the pool of donors (resulting in more people on the waitlist receiving viable organs), but also may improve the short- and long-term function of these new lungs.

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