

HEALTHY HEART

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Lung Transplantation in India: Progress, Challenges, and Future Directions

Introduction

Lung transplantation is a life-saving procedure for individuals suffering from end-stage lung diseases, offering hope for extended life and improved quality of life. In India, the landscape of lung transplantation has evolved significantly over the years, driven by advancements in medical technology, improvements in surgical techniques, and growing expertise among healthcare professionals. With improving survival rates, the number of lung transplant recipients with preexisting and posttransplant comorbidities that require attention continues to increase. A partnership between transplant and nontransplant care providers is necessary to deliver comprehensive and optimal care for transplant candidates and recipients. The goals of this partnership include timely referral and assistance with transplant evaluation, optimization of comorbidities and preparation for

transplantation, management of common posttransplant medical comorbidities, immunization, screening for malignancy, and counselling for a healthy lifestyle to maximize the likelihood of a good outcome.

Historical Perspective

The history of lung transplantation in India dates back to the late 1990s when the first successful lung transplant was performed. Since then, the field has witnessed steady growth, with several medical institutions across the country establishing dedicated lung transplant programs. Initially, lung transplantation in India was limited by factors such as lack of infrastructure, expertise, and awareness about organ donation. However, with time, concerted efforts by healthcare organizations and advocacy groups have helped overcome many of these barriers, paving the way for a more robust

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lung transplant ecosystem in the country.

Current Scenario

Presently, lung transplantation in India is performed for a range of indications (Image 1), including chronic obstructive pulmonary disease (COPD), interstitial lung diseases (ILDs), cystic fibrosis (CF), non-CF bronchiectasis, and pulmonary hypertension. The procedure involves various surgical techniques, including single lung transplant, double lung transplant, and heart-lung transplant, depending on the patient's condition and specific needs. Major transplant centers in cities like Mumbai, Gujarat, Delhi, Chennai, and Bengaluru have emerged as hubs for lung transplantation, equipped with state-of-the-art facilities and experienced multidisciplinary teams. Image 2 outlines various factors that could hinder a patient's eligibility for lung transplantation. These include medical conditions, patient characteristics, and potential risk factors. These contraindications help healthcare providers assess which patients are suitable candidates for the procedure, ensuring optimal outcomes while minimizing risks.

Challenges

Despite the progress made, lung transplantation in India still faces several challenges. One of the most significant barriers is the shortage of donor organs. The number of potential donors remains inadequate to meet the growing demand for lung transplantation, resulting in long waiting times for patients. Additionally, logistical issues related to organ procurement, transportation, and allocation pose significant challenges, further complicating the process. Moreover, the high cost of transplantation, limited insurance coverage, and lack of financial support for patients exacerbate the accessibility issues faced by many individuals in need of lung transplants.

Experiences of Transplant Centers

Transplant centers in India have accumulated valuable experiences over the years, contributing to the refinement of surgical techniques, post-operative care protocols, and patient management strategies. These experiences have been instrumental in improving transplant outcomes and enhancing the overall quality of care provided to transplant recipients. Moreover, transplant centers have actively participated in research initiatives, clinical trials, and collaborative studies aimed at advancing the field of lung transplantation and addressing specific challenges unique

INDICATIONS FOR LUNG TRANSPLANTATION

Primary pulmonary hypertension
Idiopathic pulmonary fibrosis
Chronic emphysema
Bronchiectasis
Sarcoidosis
Lymphangioleiomyomatosis
Eisenmenger's syndrome
Other type of interstitial pneumonia*
Bronchiolitis obliterans
Pneumoconiosis
Pulmonary eosinophilic granuloma
Diffuse panbronchiolitis
Chronic thromboembolic pulmonary hypertension
Multiple pulmonary arteriovenous fistula
 α_1 -Antitrypsin deficiency emphysema
Cystic fibrosis

*Interstitial pneumonia except for idiopathic pulmonary fibrosis.

to the Indian context.

Impact of COVID-19 Pandemic

The COVID-19 pandemic has significantly impacted lung transplantation in India, leading to disruptions in organ donation and transplantation activities. The lockdowns, travel restrictions, and overwhelmed healthcare systems have posed unprecedented challenges for transplant centers, affecting patient care and transplant outcomes. However, healthcare professionals have adapted quickly, implementing stringent safety measures, telemedicine services, and innovative approaches to ensure continuity of care for transplant recipients while mitigating the risk of COVID-19 transmission.

Post transplantation care

After lung transplantation, post-operative care is intricate and demands a high level of patient compliance. Given the limited number of comprehensive transplant centers nationwide, patients often need to remain in close proximity to monitor their progress, detect any possible complications, and intervene proactively.

The immunosuppressive regimen post-lung transplantation typically involves a triple combination of medications: a calcineurin inhibitor (such as cyclosporine or tacrolimus), a purine synthesis antagonist (like azathioprine or mycophenolate mofetil), and prednisolone. The dosage of calcineurin inhibitors is carefully adjusted based on blood levels. During the initial year, higher target levels of these inhibitors are necessary to prevent acute rejection, albeit with an increased risk of



toxicity. Since calcineurin inhibitors are metabolized by the hepatic cytochrome P450 system, interactions with other medications can significantly impact their blood levels, underscoring the importance of close coordination with the transplant center.

Long term results

Annually, transplant centers worldwide publish their outcomes, including lung transplantation statistics accessible through the NOTTO website in India. While lung transplantation serves as a therapy rather than a cure, it doesn't match the life expectancy of the general population. Nonetheless, 51% of lung transplant recipients globally survive beyond five years, with European centers boasting over 60% survival at this milestone.

In the most recent era (2009–2016), the overall median survival stands at 6.7 years, a notable improvement from 6.5 years (2002–2009) and 4.7 years (1992–2001). Median survival rates vary significantly based on the underlying pulmonary disease, with cystic fibrosis patients experiencing superior survival (median 9.9 years) compared to other groups.

To enhance patient care, there are comprehensive Quality of Life assessment, utilizing General Health Questionnaires and World Health Organization Quality of Life assessment models for all transplant recipients.

ABSOLUTE CONTRAINDICATIONS:

- Candidates with these conditions are considered too high risk to achieve successful outcomes post lung transplantation.
 - Factor or condition that significantly increases the risk of an adverse outcome post-transplant and/or would make transplant most likely harmful for a recipient.
 - Most lung transplant programs should not transplant patients with these risk factors except under very exceptional or extenuating circumstances.
1. Lack of patient willingness or acceptance of transplant
 2. Malignancy with high risk of recurrence or death related to cancer
 3. Glomerular filtration rate < 40 ml/min/1.73m² unless being considered for multi-organ transplant
 4. Acute coronary syndrome or myocardial infarction within 30 days (excluding demand ischemia)
 5. Stroke within 30 days
 6. Liver cirrhosis with portal hypertension or synthetic dysfunction unless being considered for multi-organ transplant
 7. Acute liver failure
 8. Acute renal failure with rising creatinine or on dialysis and low likelihood of recovery
 9. Septic shock
 10. Active extrapulmonary or disseminated infection
 11. Active tuberculosis infection
 12. HIV infection with detectable viral load
 13. Limited functional status (e.g. non-ambulatory) with poor potential for post-transplant rehabilitation
 14. Progressive cognitive impairment
 15. Repeated episodes of non-adherence without evidence of improvement (Note: For pediatric patients this is not an absolute contraindication and ongoing assessment of non-adherence should occur as they progress through different developmental stages.)
 16. Active substance use or dependence including current tobacco use, vaping, marijuana smoking, or IV drug use
 17. Other severe uncontrolled medical condition expected to limit survival after transplant

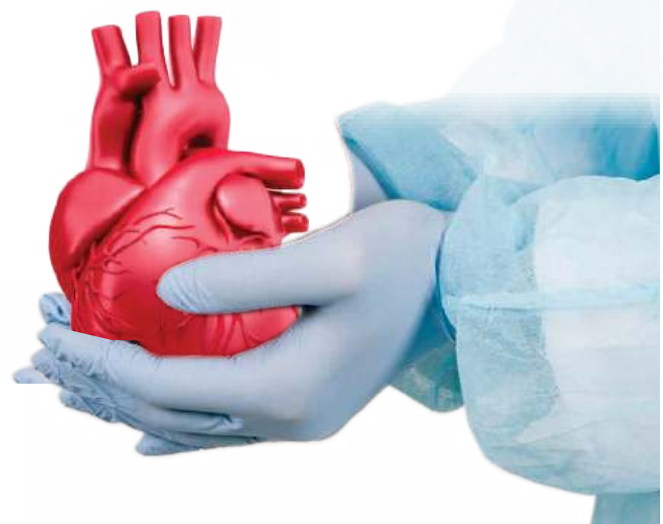
Future Prospects

Looking ahead, the future of lung transplantation in India holds promise, driven by ongoing advancements in medical technology, increasing public awareness about organ donation, and collaborative efforts between healthcare stakeholders. Strategies to expand the donor pool, streamline organ allocation processes, and enhance post-transplant care will be critical in addressing the existing challenges and improving patient outcomes. Furthermore, the integration of emerging technologies such as ex vivo lung perfusion (EVLP) and organ care systems (OCS) could revolutionize lung transplantation practices, making the procedure more accessible and sustainable in the long run.

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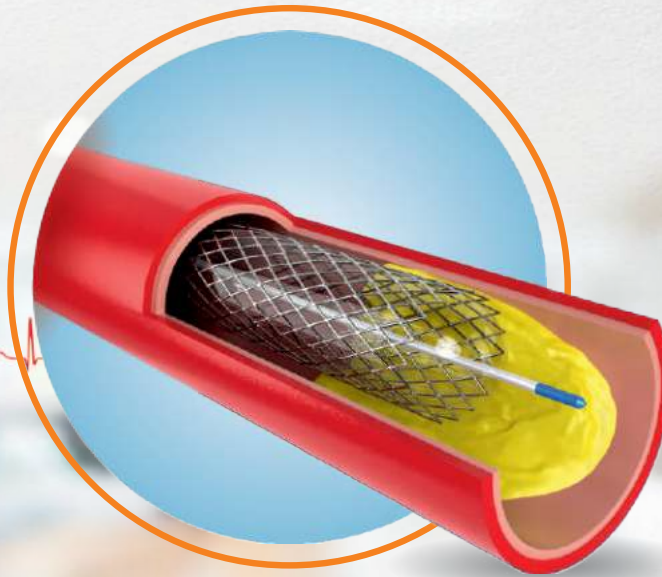
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