Pulmonary Infections of the Transplanted Patient
Veronica A. Arteaga, MD

Introduction

- Infection is one of the most significant contributors to morbidity and mortality following lung transplantation
- Focused review of the common infections in this group of patients and helpful diagnostic considerations
- No disclosures.

Background

- According to the Registry of the International Society of Heart and Lung Transplantation 2013 report, adults who underwent lung transplant from January 1994-June 2011 had a median survival of 5.6 years
- Complications include:
  - Reperfusion edema
  - Airway related factors: dehiscence, stenosis
  - Acute rejection, Chronic rejection- bronchiolitis obliterans syndrome
  - Malignancy: Post transplant lymphoproliferative disorder (PTLD), Lung cancer
  - Pre-transplant disease recurrence

Scientific Registry of Transplant Recipients

Lung transplant

The pulmonary allograft is the most common site of infection—Why?

- Denervation of the allograft, impaired cough
- Mucociliary clearance, lymphatic drainage impairment
- Complications at the site of anastomosis
- Direct contact with inhaled microbes
- Donor lung infection transmission
- Immunosuppression

Simplified Timeline of Infections

- 1st month: Immunosuppression effect not yet evident—Donor/recipient derived or nosocomial etiologies
- 1st-6th months: Residual or relapsed perioperative or opportunistic infections
- After 6 months: Risk of infection declines after 6 months due to tapered and stabilized immunosuppressive therapy—However ongoing increased risk infection, including community acquired infection
**Timeline Summary**

<table>
<thead>
<tr>
<th>1st month</th>
<th>~1st-6th months</th>
<th>&gt;6th months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial infection</td>
<td>Viral</td>
<td>Fungal</td>
</tr>
<tr>
<td>Aspiration</td>
<td>Fungal</td>
<td>Nocardia</td>
</tr>
<tr>
<td>Line/wound infection</td>
<td>Mycobacterial</td>
<td>Rhodococcus</td>
</tr>
<tr>
<td>Fungal</td>
<td>Pneumocystis</td>
<td>Mucormycosis</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>Nocardia</td>
<td>Comm. Acquired</td>
</tr>
<tr>
<td></td>
<td>Toxoplasma</td>
<td></td>
</tr>
</tbody>
</table>

**Post op Day 10**

Findings:
- Diffuse airspace disease
- Peribronchial/Perivascular thickening
- Small effusions

Considerations:
- Residual Reperfusion edema
- Acute rejection
- Infection

**Bacterial Infection**

- Most common type of infection during the 1st month and will remain a concern
- Broad range, some organisms to consider:
  - Klebsiella, Enterobacter
  - Staphylococcus aureus
  - Pseudomonas aeruginosa
  - Mycobacterial infection- uncommon but can occur later in post transplant course, consider > 4 months

**Imaging Findings**

- Lobar/segmental or multilobar consolidation
- Groundglass opacity
- Nodules
- +/- Cavitation

**1 week post-op: Two Patients-Comparison of findings**

Asymmetric left lower lobe hazy and nodular opacities

Pattern suggests bacterial infection: Pseudomonas suspected--gram negative and positive coverage

**~2 month postop: Cavitary consolidation—left upper lobe**

Staphylococcus Aureus
1-2 months post op: Bilateral ill-defined consolidation with LUL cavitary nodule

Suspected Staph infection

Viral Infection

- Cytomegalovirus
- Herpes simplex virus
- Epstein-Barr virus, also associated with post transplant lymphoproliferative disease (PTLD)
- Influenza, Adenovirus, respiratory syncytial virus

Imaging features

- CXR may be normal
- Hazy opacities
- Groundglass
- Reticular
- Nodules
- Small effusions

Left Unilung transplant ~3 mon post op

Patches opacities in the right lung appear heterogeneous

Left upper and lower lobe-consolidation, groundglass and nodules

Respiratory syncytial virus

Cytomegalovirus

- CMV – most common opportunistic infection. Can occur 1-12 months post transplant with peak incidence in 1-4 months.
- Seronegative recipients transplanted with a positive donor are at highest risk.
- CMV may provoke immune system alterations: pose an increased risk for other infections or bronchiolitis obliterans syndrome.
> 4 month post op: groundglass opacities, dense airspace filling with subtle nodules

Diffuse groundglass, small pleural effusions

Several months post-op: Bilateral lower lobe consolidation and pleural effusions

Fungal Infection
- Occurs in 15-35%, ~10 – 60 days post op
- Aspergillus
- Candida
- Invasive fungal infections—e.g. *Mucormycosis*

Imaging Features
- Consolidation
- Nodules/Masses—peripheral ground glass
- Cavitation
- Airway involvement: Bronchiectasis, bronchial wall thickening, bronchocentric nodules, endobronchial lesions
- Adenopathy

Left apical cavitary mass
> 1 year post op: Acute Lung Rejection

Aspergillus

> 2 years post op: Mucormycosis

Other opportunistic pathogens of interest

- **Pneumocystis Jiroveci**-not as common due to prophylaxis
- **Nocardia**-infection developed by ~ 1.9-3.5%
  - Trimethoprim-sulfamethoxazole prophylaxis also helps prevent this infection
- **Breakthrough infections can occur**

Nocardiia

- **Gram positive bacteria**
- **Imaging features:**
  - Airspace consolidation—may be heterogeneous
  - Nodules, solitary or multiple
  - +/- cavitation
  - Pleural involvement

Nocardia Examples

History of Heart and Lung transplant

Nocardia - ? Early cavitation

Mimicker of malignancy
Nocardia

RLL nodule, bilateral pleural effusions

Mass-like LLL consolidation with multilobar nodules

Summary

Lung transplant recipients are at increased risk for infection which significantly impacts outcomes and may occur throughout patient’s life.

Imaging findings can be nonspecific.

Correlation with time interval and presentation helpful to make relevant interpretations.

Collaboration with Pulmonary Medicine colleagues is essential.

Thank you

References/Acknowledgements


