The Incidence, Cost, and Outcome Effects of Infections Two Years Before and After Kidney Transplantation

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Background

- Pediatric patients: post-transplant infections lead to more hospitalizations than acute rejections.

- Sepsis and pneumonia: most commonly diagnosed infections in dialysis patients and kidney transplant recipients.

- Negative impact of infections on patient and graft survival.
Aim

- Estimate the incidence, financial costs, and graft survival consequences of infections in the two years before and after renal transplantation.
Data

- United States Renal Data System (USRDS)

- Inclusion criteria:
  - First kidney transplants,
  - January 1, 1995 to December 31, 2001,
  - Medicare as the primary payer,
  - Complete information,
  - 44,916 observations.

- Start of follow-up: first physician/supplier or institutional claim.

- End of follow-up: last claim, last follow-up, death, or December 31, 2001.
Methods: Incidence

• Incidences of diagnoses calculated daily among followed individuals.
• Reported as the number of individuals with sepsis/pneumonia claims per 100 patient years.
• Claims: USRDS institutional and physician/supplier files with ICD-9-CM diagnoses.
  ➢ Sepsis: 038
  ➢ Pneumonia: 480-487
Methods: Cohort Analysis (Costs and Graft Survival)

- Infection “onset”: date of first inpatient and/or second outpatient claim with a relevant ICD-9-CM code.
- 5 cohorts:
  - 1) Infection onset 2nd year pre-transplant,
  - 2) Infection onset 1st year pre-transplant,
  - 3) Infection onset 1st year post-transplant,
  - 4) Infection onset 2nd year post-transplant,
  - 5) Patients with no infection claim in the 2 years pre- or post-transplant.
Methods: Costs

• Average Accumulated Medicare Payments (AAMPs): Medicare payments for treating an average patient in our 5 cohorts accumulated over 2 years before and after transplantation.

\[ \text{AAMP}(t) = \text{AAMP}(t-1) + \frac{\text{total Medicare payments (t)}}{\text{number of individuals followed (t)}} \]

• Confirmatory analyses:
  1. **Bootstrap techniques** used to identify significant differences.
  2. **Multiple regression analyses** of Medicare payments at one year post transplant (for individuals followed at least one year post transplant) controlling for significant recipient, donor, and transplant characteristics (age, gender, race/ethnicity, CMV status, HLA mismatches, warm ischemia time, cold ischemia time, immunosuppression regimen).
Methods: Graft Survival

- Graft survival rates calculated over 2 years post transplantation separately for our 5 patient cohorts.
- Kaplan-Meier graft survival curves.
- Pairwise log-rank statistics used to test the equality of graft survival across patient cohorts.
Results: Incidence

**Sepsis:**
- Pre-transplant: **52** episodes/100 patient years.
- 1<sup>st</sup> month post-transplant: **133** episodes/100 patient years.
- Post-transplant steady state: **46** episodes/100 patient years (p < 0.001).

**Pneumonia:**
- Pre-transplant: **37** episodes/100 patient years.
- 1<sup>st</sup> month post-transplant: **216** episodes/100 patient years.
- Post-transplant steady state: **60** episodes/100 patient years (p < 0.001).
**Results: Costs**

**Sepsis:**
- No sepsis claims:
  - Pre-tx: $27,400 annually,
  - 1\textsuperscript{st} year post-tx: $50,000,
  - 2\textsuperscript{nd} year post-tx: $13,000.
- Sepsis pre-transplant:
  - $27,400 extra during the year of sepsis onset.
- Sepsis post-transplant:
  - $48,400 extra during the year of sepsis onset.

**Pneumonia:**
- No pneumonia claims:
  - Pre-tx: $28,400 annually,
  - 1\textsuperscript{st} year post-tx: $51,100,
  - 2\textsuperscript{nd} year post-tx: $13,500.
- Pneumonia pre-transplant:
  - $22,800 extra during the year of pneumonia onset.
- Pneumonia post-transplant:
  - $38,400 extra during the year of pneumonia onset.

Size and significance of cost differences confirmed by bootstrapping and by multivariate regression techniques.
Results: Graft Survival

**Sepsis:**
- No sepsis claims:
  - 1-year graft survival: 91%.
- Sepsis pre-transplant:
  - 1-year graft survival: 86% (P<0.01).
- Sepsis 1st year post-transplant:
  - 1-year graft survival: 65% (P<0.01).

**Pneumonia:**
- No pneumonia claims:
  - 1-year graft survival: 90%.
- Pneumonia pre-transplant:
  - 1-year graft survival: 84% (P<0.01).
- Pneumonia 1st year post-transplant:
  - 1-year graft survival: 71% (P<0.01).
Conclusions

• Substantial, but temporary, increases in the incidences of sepsis and pneumonia immediately following kidney transplantation.

• Incidence of sepsis in the 2\textsuperscript{nd} year post-transplant slightly lower than in the 2 years before transplantation BUT incidence of pneumonia significantly above the pre-transplant value.

• Onsets of sepsis and pneumonia a strong and immediate impact on Medicare payments.

• Sepsis and pneumonia a significant detrimental effect on graft survival.

→ Strategies to reduce the incidences of sepsis and pneumonia infections needed to improve the graft outcomes and the cost-effectiveness of renal transplantation.