**CARDIOVASCULAR DISEASE**

- The incidence of CVD is high after kidney transplantation.
- The presence of traditional risk factors in the general population, including smoking, diabetes, hypertension and dyslipidemia, are risk factors for CVD.
### Acute Rejection and Chronic Allograft Injury (caI)

**Acute Cellular Rejection**
- Occurs within the first month after transplantation.
- Commonly associated with symptoms of fever, nausea, and vomiting.
- Management involves corticosteroids and/or calcineurin inhibitors (CNIs).
- Suggested strategies include:
  - Using prednisone to treat acute rejection.
  - Converting from CNI to another CNI.
  - Using anti-thymocyte globulin (ATG) or basiliximab.

**Chronic Allograft Injury**
- Results from chronic inflammation and injury to the transplanted organ.
- Management involves immunosuppressive therapy.
- Treatment options include:
  - Dosing of CNI.
  - Adding or restoring prednisone.
  - Using corticosteroids for subclinical and borderline acute rejection.

### Screening and Graft Monitoring

**Screening for Recurrent Diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Screening (in addition to standard screening)</th>
<th>Minimum Screening Frequency</th>
<th>Diagnostics Tests (in addition to kidney biopsy)</th>
<th>Potential Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV</td>
<td>PTAT NAT (seronegative)</td>
<td>3 months then annually</td>
<td>HBV NAT (seronegative)</td>
<td>Antiviral therapy</td>
</tr>
<tr>
<td>HCV</td>
<td>PTAT NAT (seronegative)</td>
<td>3 months then annually</td>
<td>HCV NAT (seronegative)</td>
<td>Antiviral therapy</td>
</tr>
<tr>
<td>BKV</td>
<td>EBV NAT (seronegative)</td>
<td>3 months then annually</td>
<td>EBV NAT (seronegative)</td>
<td>Antiviral therapy</td>
</tr>
<tr>
<td>EBV</td>
<td>PTAT NAT (seronegative)</td>
<td>3 months then annually</td>
<td>EBV NAT (seronegative)</td>
<td>Antiviral therapy</td>
</tr>
</tbody>
</table>

**Screening for other Transplant Disease**

- Surveillance for Epstein-Barr virus (EBV) infection.
- Screening for malignancies.
- Screening for viral infections.
- Screening for infectious diseases.

**Screening for Recurrent Disease**

- Infectious disease screening.
- Monitoring for graft dysfunction.
- Monitoring for graft rejection.

**Screening and Graft Monitoring**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Screening Intervals by Time after Transplantation</th>
<th>Outcome and Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV</td>
<td>Post-transplant screening within 1 year then annually</td>
<td>Diagnosis and treatment of hepatitis B virus (HBV) infection</td>
</tr>
<tr>
<td>HCV</td>
<td>Post-transplant screening within 1 year then annually</td>
<td>Diagnosis and treatment of hepatitis C virus (HCV) infection</td>
</tr>
<tr>
<td>BKV</td>
<td>Post-transplant screening within 1 year then annually</td>
<td>Diagnosis and treatment of BK polyoma virus (BKV) infection</td>
</tr>
<tr>
<td>EBV</td>
<td>Post-transplant screening within 1 year then annually</td>
<td>Diagnosis and treatment of Epstein-Barr virus (EBV) infection</td>
</tr>
</tbody>
</table>

**Screening for Recurrent Disease**

- Surveillance for recurrent disease.
- Monitoring for graft dysfunction.
- Monitoring for graft rejection.

**Potential Treatment**

- Antiviral therapy.
- Antibiotic therapy.
- Immunosuppressive therapy.
- Surgical intervention.
- Supportive care.

**Screening for Recurrent Disease**

- Surveillance for recurrent disease.
- Monitoring for graft dysfunction.
- Monitoring for graft rejection.

**Screening and Graft Monitoring**

- Surveillance for recurrent disease.
- Monitoring for graft dysfunction.
- Monitoring for graft rejection.
**Therapy for Chronic Rejection**

- **Prevention:**
  - Avoidance of cold ischemia time greater than 24 hours.
  - Use of lymphocyte-depleting antibody.
  - Use of corticosteroids for 1 week after transplantation.
  - Use of calcineurin inhibitors (CNIs).

- **Treatment:**
  - Initial therapy: Avoid calcineurin inhibitors.
  - Use of corticosteroids.
  - Use of lymphocyte-depleting antibody.
  - Use of anti-interleukin 2 receptor.

**Monitoring of Chronic Rejection**

- **Corticosteroids:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Creatinine:**
  - Baseline 1 week, then annually.

- **Complete blood count:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Lipid profile:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Urine protein:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Diabetes:**
  - Baseline 1 week.
  - Every 3 months thereafter.

**Screening for Risk Factors**

- **Diabetes:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Hypertension:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Anemia and leukopenia:**
  - Baseline 1 week.
  - Every 3 months thereafter.

**TODAY’S RECOMMENDATIONS FOR PRACTICE**

- **Screening:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Diagnostics:**
  - Baseline 1 week.
  - Every 3 months thereafter.

**Drug Therapy for Chronic Rejection**

- **Corticosteroids:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Calcineurin inhibitors:**
  - Baseline 1 week.
  - Every 3 months thereafter.

- **Cytotoxic agents:**
  - Baseline 1 week.
  - Every 3 months thereafter.

**Screening Program**

- **Baseline 1 week:**
  - Complete blood count.
  - Creatinine.
  - Lipid profile.
  - Urine protein.
  - Blood glucose.
  - Antihypertensives.
  - Prophylactic antibiotics.

- **Every 3 months thereafter:**
  - Complete blood count.
  - Creatinine.
  - Lipid profile.
  - Urine protein.
  - Blood glucose.
  - Antihypertensives.
  - Prophylactic antibiotics.

**Acute Rejection**

- **Diagnosis:**
  - Presence of a new or worsening creatinine.
  - Presence of a new or worsening blood pressure.
  - Delayed onset of graft function.
  - Cold rejections >24 hours.

- **Treatment:**
  - Immediate reduction of immune suppression.
  - Use of corticosteroids (IV and/or PO).
  - Use of lymphocyte-depleting antibody.

**Chronic Allograft Rejection**

- **Diagnosis:**
  - Presence of a new or worsening creatinine.
  - Presence of a new or worsening blood pressure.
  - Presence of a new or worsening proteinuria.
  - Presence of a new or worsening hypertension.

- **Treatment:**
  - Immediate reduction of immune suppression.
  - Use of corticosteroids (IV and/or PO).
  - Use of lymphocyte-depleting antibody.

**Acute Cellular Rejection**

- **Diagnosis:**
  - Presence of a new or worsening creatinine.
  - Presence of a new or worsening blood pressure.
  - Presence of a new or worsening proteinuria.
  - Presence of a new or worsening hypertension.

- **Treatment:**
  - Immediate reduction of immune suppression.
  - Use of corticosteroids (IV and/or PO).
  - Use of lymphocyte-depleting antibody.
INITIAL IMMUNOSUPPRESSION

**Recommended starting combination immunosuppression therapy in kidney transplant recipients:**

- Cell-sensitized: daily tacrolimus, mycophenolate, and corticosteroids.
- Non-cell-sensitized: daily tacrolimus, mycophenolate, and steroids.

**Induction Therapy:**

- Recommended a biologic agent and corticosteroids (3-5 mg/kg of prednisone) for patients with an alloantibody-mediated injury.
- Limited to the efficacy of immunosuppressive therapy.

- Avoiding induction of new components of the regimen, such as calcineurin inhibitors (CNIs) or corticosteroids.

**MAINTENANCE IMMUNOSUPPRESSION**

**First-line induction therapy: recombinant human interleukin-2 receptor blocking agents (IL-2Rb) or tumor necrosis factor alpha-converting enzyme inhibitors (TACE).**

**Induction therapy for high immunogenicity renal allograft:**

- After transplantation between identical twins.

**TERATOLOGY PROFILES OF IMMUNOSUPPRESSIVE AGENTS**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Teratogenicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZA</td>
<td>1A</td>
</tr>
<tr>
<td>CNI</td>
<td>1A</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>1C</td>
</tr>
<tr>
<td>MTX</td>
<td>1D</td>
</tr>
<tr>
<td>Tacrolimus</td>
<td>1D</td>
</tr>
<tr>
<td>MMF</td>
<td>1D</td>
</tr>
<tr>
<td>PD</td>
<td>1D</td>
</tr>
<tr>
<td>Prednisone</td>
<td>1D</td>
</tr>
<tr>
<td>Stavudine</td>
<td>1D</td>
</tr>
</tbody>
</table>

**Acute rejection and chronic allograft injury**

**Acute Cellular Rejection**

- **Risk Factors for Acute Rejection**
  - Anemia and leucopenia
  - Diarrhea, nausea/vomiting
  - Decreased glomerular filtration rate (GFR)
  - Use of mycophenolate mofetil (MMF) as induction therapy
  - Use of antithymocyte globulin (ATG) as induction therapy

  **Avoiding a mild-moderate adverse effect on the complication.**

**Acute cellular rejection**

- Increased risk of acute rejection

**Corticosteroids**

- **Suggested using corticosteroids as an initial IS medication**
  - First-line induction therapy: recommend
  - Prednisone to a target dose of 0.5-1 mg/kg/day

- Decrease to a minimum effective dose within 1 week after transplantation.

**Antibiotic-Mediated Acute Rejection**

- **Risk Factors for Antibiotic-Mediated Acute Rejection**
  - Acute cellular rejection
  - Use of antimicrobial agents
  - Use of antiviral agents

**TREATMENT OF ACUTE REJECTION**

- **Treatment of Acute Rejection**
  - Recommended treatment of acute rejection, unless the complication will substantially affect graft function or survival.
  - Use of corticosteroids
  - Use of antithymocyte globulin (ATG)

**SCREENING AND GRAFT MONITORING**

**Routine Screening After Kidney Transplantation**

<table>
<thead>
<tr>
<th>Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete blood count</td>
<td>Daily 2–3 per week</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>Weekly or as needed</td>
</tr>
<tr>
<td>Urea nitrogen</td>
<td>Monthly</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>Annually</td>
</tr>
<tr>
<td>Blood pressure, pulse, weight, height, body mass index</td>
<td>Annually</td>
</tr>
</tbody>
</table>

**Screening for Infections**

- **Screening for tuberculosis**
  - Tuberculosis can be a serious complication of immunosuppressive therapy.

**Screening for recurrent diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Screening (in addition to screen cancers)</th>
<th>Minimum Screening Frequency</th>
<th>Diagnostics Tests (in addition to kidney biopsy)</th>
<th>Potential Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>Measurement of HbA1c</td>
<td>Every 3 months</td>
<td>Glycosylated hemoglobin, plasma glucose, fasting glucose, 2-hour postprandial glucose</td>
<td>Oral hypoglycemic agents, insulin, intensive lifestyle modification</td>
</tr>
<tr>
<td>Lipid profile</td>
<td>Measurement of total cholesterol, HDL cholesterol, triglycerides</td>
<td>Every 3 months</td>
<td>Lipid profile, Lipid profile, Lipid profile</td>
<td>Lipid-lowering medications, lifestyle modification, medication</td>
</tr>
<tr>
<td>EBV NAT (seronegative)</td>
<td>Once at 1 year post transplantation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Acute Cellular Rejection**

- **Definition**: Sudden increase in serum creatinine (≥0.5 mg/dL in 2 days), new onset of proteinuria, or decrease in graft function.
- **Risk Factors**: Recent steroid withdrawal, cold ischemia time, panel-reactive antibody (PRA) ≥30%, presence of certain antibodies.
- **Diagnosis**: Biopsy is needed.
- **Treatment**: Corticosteroids alone or in combination with other immunosuppressants.

**Antibody-Mediated Acute Rejection**

- **Definition**: Presence of circulating donor-specific antibodies associated with a decrease in graft function.
- **Diagnosis**: Biopsy is needed.
- **Treatment**: Immunosuppressive agents, plasmapheresis, and other interventions.

**Chronic Allograft Injury**

- **Definition**: Persistence of mild-moderate acute rejection despite treatment, leading to progressive graft loss.
- **Risk Factors**: Chronic rejection is characterized by a combination of chronic rejection, chronic allograft nephropathy, and ischemia-reperfusion injury.
- **Diagnosis**: Biopsy is needed.
- **Treatment**: Immunosuppressive agents, plasmapheresis, and other interventions.

**Proteinuria**

- **Definition**: Protein excretion in urine, which can be a sign of kidney disease.
- **Risk Factors**: Hypertension, diabetes, obesity, family history of kidney disease.
- **Diagnosis**: Measurement of urine protein-to-creatinine ratio.
- **Treatment**: Lifestyle modifications, medications, or other interventions.

**Screening for Reckless Diseases**

- **Disease**: Kidney disease, hypertension, diabetes, obesity, family history of kidney disease.
- **Screening**: Baseline urinalysis, serum creatinine, urine protein-to-creatinine ratio, blood pressure, fasting blood glucose, lipid profile.
- **Diagnosis**: Baseline urinalysis, serum creatinine, urine protein-to-creatinine ratio, blood pressure, fasting blood glucose, lipid profile.
- **Treatment**: Medications, lifestyle modifications, or other interventions.
Important factors for consideration in reducing IS medications for KTRs with cancer include:

- Developing an individualized screening plan that includes past medical and family history.
- KTRs are at greater risk of developing cancer compared to the general population.
- Reduce risk for: New-onset diabetes, obesity, hypertension and dyslipidemias.

Therapies available for the cancer overview of risk factors and treatment goals for CVD include:

Offer a weight-reduction program to all obese KTRs.

- Assess at each visit. [R 16.4.1 (not graded)]
- Adults: 18 years of age [R 16.1.2 (2C)]
  - Calculate body mass index (BMI) at each visit.
  - Measure height and weight at each visit, in adults and children.
- Suggest avoiding NSAIDs and COX-2 inhibitors whenever possible. [R 23.1.3 (2D)]
- Recommend avoiding allopurinol in patients receiving azathioprine. [R 23.1.2 (1B)]
- Recommend using ACE-Is or ARBs for initial treatment of erythrocytosis. [R 22.4 (1C)]

Assess and treat anemia by removing underlying causes and using standard measures applicable to CKD.

- Suggest minimizing or avoiding corticosteroid use in children who still have growth potential. [R 24.3 (2C)]
- Suggest interferon treatment should generally be avoided in HBV-infected KTRs. [R 13.6.2 (2C)]
- Suggest monitoring high-risk (donor EBV seropositive/recipient seronegative) KTRs using NAT.
- Suggest prophylaxis for at least 6 weeks during and after treatment for acute rejection.
- To determine antiretroviral therapy, refer HIV-infected KTRs to an HIV specialist, who should pay attention to the risk of acquiring human immunodeficiency virus type 1, 2
- Suggest reduction or cessation of IS medication in patients who have EBV disease, including
- Suggest reduction or cessation of IS medication in patients who are EBV-seronegative with an associated illness, including

Additional recommendations include:

- Recommend measuring growth and development in children [R 24.1 (1C)]
  - At least every 3 months if <3 years old (including head circumference) [not graded]
- Measles (except during an outbreak) [R 14.2.2 (2C)]
- Meningococcus: administer if recipient is at high risk [R 14.3.2 (1C)]
- Inactivated polio [R 14.2.2 (2C)]
- Live Japanese B encephalitis vaccine [R 14.2.2 (2C)]
- Oral polio [R 14.2.2 (2C)]
- Rubella [R 14.2.2 (2C)]

For more information on immunizations, see the American College of Physicians’ recommendations for immunizations contained within the Am J Transplant. 2009. It is designed to provide information and recommendations for research contained within a standard of care, and should not be construed as an exclusive course of management.
The incidence of CVD is high after kidney transplantation.

- Blood pressure and mortality risk factors in the general population, including cigarette smoking, diabetes, hypertension and dyslipidemia, are also risk factors for CVD and can be managed accordingly.

- Suggest using aspirin (81-100mg/day) in all KTRs with atherosclerotic CVD, unless there are contraindications.

**Recommended Risk Factors and Treatment Goals for CVD**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>&lt;130/80 mm Hg</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Control HbA1c (7.0-7.5%)</td>
</tr>
<tr>
<td>Lipids</td>
<td>LDL &lt;70 mg/dL, Non-HDL &lt;100 mg/dL</td>
</tr>
<tr>
<td>Smoking</td>
<td>No smoking</td>
</tr>
</tbody>
</table>

**Infection**

- **Infectious agents:**
  - Epstein-Barr virus, CMV, BK virus, and adenovirus
  - Cytomegalovirus (CMV)
  - Herpes simplex virus (HSV), varicella-zoster virus (VZV)
  - Hepatitis B virus (HBV), hepatitis C virus (HCV)
  - Pneumocystis jirovecii
  - Mycobacterium tuberculosis
  - Candida albicans
  - Bacillus Calmette-Guérin (BCG)
  - Varicella-zoster virus
  - Human parvovirus B19

**Recommended Vaccinations**

- **Infants and children:**
  - Mumps
  - Measles (except during an outbreak)
  - Influenza types A and B (administer annually)
  - Oral polio
  - Yellow fever

**Screening**

- **Routine screening:**
  - Suggest screening all KTRs with NAT for BK polyoma virus.
  - Suggest treating HCV-infected KTRs only when the benefits of treatment clearly outweigh the risks.
  - Suggest monitoring high-risk (donor EBV seropositive/recipient seronegative) KTRs using NAT.

**Recommendations for managing infection**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Management</th>
</tr>
</thead>
</table>
| Recipient infection |%
| Severe | Treat with empiric antibiotic therapy |
| Minor | Treat with specific antibiotic therapy |

**Other considerations:**

- **Ischemic heart disease:**
  - Consider starting patients on a weight-reduction program to all obese KTRs.
  - Suggest using aspirin (65–100mg/day) in all KTRs with atherosclerotic CVD, unless there are contraindications.
  - Suggest treating HCV-infected KTRs only when the benefits of treatment clearly outweigh the risks.

**Summary:**

- Cardiovascular disease is common in KTRs and can be managed through lifestyle modifications, medication, and screening.

**References:**

- KDOQI 2009 Clinical Practice Guidelines and Clinical Practice Recommendations for the Care of Kidney Transplant Recipients

**Disclaimer:**

- Recommendations are general and do not imply a recommendation for or against a specific course of management.

**Disclosure:**

- All members of the Work Group are required to submit an attestation form showing all such relationships that may arise as a result of an outside relationship or reasonably perceived conflicts of interest that might influence their work on this document.

**Clinical Practice Guidelines:**

- Published and updated annually, available at www.kidogo.org

**Recommendations:**

- Level 1: Consistent evidence of benefit and harm.
- Level 2: Evidence that is inconclusive or conflicting, or that is based on expert opinion.
- Level 3: Expert opinion or anecdotal evidence.

**Evidence grading:**

- Grade A: Strong evidence of benefit or harm.
- Grade B: Moderate evidence of benefit or harm.
- Grade C: Limited evidence of benefit or harm.

**Knowledge level:**

- Level 1: Evidence-based practice.
- Level 2: Expert opinion.

**Recommendation:**

- We suggest that guidelines are developed by KDIGO.
**Cardiovascular Disease**

- The incidence of CVD is high after kidney transplantation.
- Use of "high-risk factors" in the general population, including cigarette smoking, hypertension, diabetes, hyperlipidemia, and dyslipidemia, are risk factors for CVD and should be considered.
- Support using aspirin (325 mg/d) in all KTRs with atherosclerotic CVD, unless contraindicated. (R 23.1.2 (1B), KDIGO 2012)

**Overview of Risk Factors and Treatment Goals for CVD**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Treatment Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-HDL</td>
<td>&lt;160 mg/dL (R 16.2.2.3)</td>
</tr>
<tr>
<td>LDL</td>
<td>&lt;100 mg/dL (R 16.2.2.2)</td>
</tr>
<tr>
<td>HDL</td>
<td>&gt;40 mg/dL in males, &gt;50 mg/dL in females (R 16.1.2.1)</td>
</tr>
</tbody>
</table>

**Therapies available for the cancer**

If cancer is likely to be exacerbated by immunosuppression, consideration should be given to de-escalating immunosuppression or using alternative immunosuppressive agents. (R 23.2.1 (2D), KDIGO 2012)

**Central Nervous System**

- Adults: 18 years of age [R 16.1.2 (2C)]
- ≥3 years until final adult height. (not graded)

<table>
<thead>
<tr>
<th>Test</th>
<th>Frequency</th>
<th>Description</th>
</tr>
</thead>
</table>
| Blood calcium and phosphorus | At least every 3 months if <3 years old (including head circumference) | Monitor calcium and phosphorus levels. (not graded)
| Growth and development | At least every 3 months if <2 years old, At least monthly if <1 year old, and At least monthly if <1 year old (not graded) |
| Immune function | At least every 6 months after transplantation (1B) |

**Recommended Vaccinations after Transplantation**

- *Hepatitis A*:
- *Hepatitis B*:
- *Influenza*
- *Inactivated polio*
- *Live oral typhoid Ty21a*
- *Bacillus Calmette-Guérin (BCG)*
- *Smallpox*

**Other Complications**

- *Acute Rejection and Chronic Allograft Injury*
- *Infection*
- *Other Complications*

**KDIGO Disclaimer**

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- www.kdigo.org

**KDIGO Clinical Practice Guideline for the Care of Kidney Transplant Recipients**

**Section I: Use of the Clinical Practice Guideline**

1. **Objectives**
2. **Principles**
3. **Rationale**
4. **Methodology**
5. **Summary of Evidence**
6. **Recommendations**
7. **Section II: Disclosure**
8. **Appendix A: Managing Adverse Effects**
9. **Appendix B: Disease-Specific Chapters**
10. **Appendix C: Clinical Practice Guideline Appendices and Appendices for Other Use of Transplant Recipients**

**Section II: Disclosure**

- **Conflict of Interest**
- **Financial Support**
- **Other**

**Appendix A: Managing Adverse Effects**

- **Gastrointestinal**
- **Hematologic**
- **Infectious**
- **Neurologic**
- **Respiratory**

**Appendix B: Disease-Specific Chapters**

- **HIV**
- **Hepatitis**
- **Cancer**
- **Infection**
- **Other Complications**

**A Clinical Guide for Nephrology and Transplant Professionals on:**

- **Induction Therapy**
- **Maintenance Immunosuppression**
- **Managing Adverse Effects**
- **Disease-Specific Chapters**
- **Screening and Graft Monitoring**
- **Cancer**
- **Infection**
- **Other Complications**

The full text of the KDIGO Clinical Practice Guideline for the Care of Kidney Transplant Recipients is available at www.kdigo.org.
Important factors for consideration in reducing IS medications for KTRs with cancer include:

- KTRs are at greater risk of developing cancer compared to the general population.
- The incidence of CVD is high after kidney transplantation.

**Recommended Vaccine for Managing Infection**

**Recommended Vaccinations after Transplantation**

- AHS: 1 dose of series at 1.0 to 1.3 years of age
- Mumps: 2 doses at 0.5 to 1.3 years of age
- Rubella: 1 dose at 1.0 to 1.3 years of age
- Hepatitis A*: 2 doses at 0.5 to 1.3 years of age
- Haemophilus influenza B: 2 doses at 0.5 to 1.3 years of age
- Pneumovax: 1 dose at 0.5 to 1.3 years of age
- Bacillus Calmette-Guérin (BCG): 1 dose at birth

**Recommended Treatment for Infection**

- **If the patient develops an infection**:
  - Identify and treat the underlying cause.
  - Consider antimicrobial prophylaxis in patients with an increased risk of infection.

**Recommended Treatment for Vascular Complications**

- **Antihypertensive medications** should be used to control BP.
- **LDL cholesterol** should be lower than 100 mg/dL for all KTRs.
- **HbA1c** should be lower than 6.0%.

**Recommended Treatment for Osteoporosis**

- **Bone disease** should be treated with a bisphosphonate or calcitriol.

**Recommended Treatment for Anemia**

- **Erythropoietin-stimulating agent** should be used to maintain a hemoglobin level of 10.0 to 11.0 g/dL.

**Recommended Treatment for Neutropenia and Thrombocytopenia**

- **Erythropoietin-stimulating agent** should be used to maintain a hemoglobin level of 10.0 to 11.0 g/dL.
- **Granulocyte colony-stimulating factor** should be used to maintain a granulocyte count of 1000 to 1500 cells/µL.

**Recommended Treatment for Hypercalcemia**

- **Calcium** should be maintained at 8.8 to 9.8 mg/dL.
- **Vitamin D** should be used to maintain a 25(OH)D level of 25 to 50 ng/mL.

**Recommended Treatment for Hyperphosphatemia**

- **Phosphate binders** should be used to maintain a serum phosphorus level of 3.5 to 5.5 mg/dL.