TABLE 169-4 COMMON INFECTIONS AFTER SOLID ORGAN TRANSPLANTATION, BY SITE OF INFECTION

	Period after Transplantation		
Infected Site	**Early (<1 Month)**	**Middle (1–4 Months)**	**Late (>6 Months)**
Donor organ	Bacterial and fungal infections of the graft, anastomotic site, and surgical wound	CMV infection	EBV infection (may present in allograft organ)
Systemic	Bacteremia and candidemia (often resulting from central venous catheter colonization)	CMV infection (fever, bone marrow suppression)	CMV infection, especially in patients given early posttransplantation prophylaxis; EBV proliferative syndromes (may occur in donor organs)
Lung	Bacterial aspiration pneumonia with prevalent nosocomial organisms associated with intubation and sedation (highest risk in lung transplantation)	*Pneumocystis* infection; CMV pneumonia (highest risk in lung transplantation); *Aspergillus* infection (highest risk in lung transplantation)	*Pneumocystis* infection; granulomatous lung diseases (nocardial and reactivated fungal and mycobacterial diseases)
Kidney	Bacterial and fungal (*Candida*) infections (cystitis, pyelonephritis) associated with urinary tract catheters (highest risk in kidney transplantation)	Kidney transplantation: BK virus infection (associated with nephropathy); JC virus infection	Kidney transplantation: bacterial infections (late urinary tract infections, usually not associated with bacteremia); BK virus infection (nephropathy, graft failure, generalized vasculopathy)
Liver and biliary tract	Cholangitis	CMV hepatitis	CMV hepatitis
Heart		*Toxoplasma gondii* infection (highest risk in heart transplantation); endocarditis (*Aspergillus* and gram-negative organisms more common than in general population)	*T. gondii* (highest risk in heart transplantation)
Gastrointestinal tract	Peritonitis, especially after liver transplantation	Colitis secondary to *Clostridium difficile* infection (risk can persist)	Colitis secondary to *C. difficile* infection (risk can persist)
Central nervous system		*Listeria* infection (meningitis); *T. gondii* infection; CMV infection	Listerial meningitis; cryptococcal meningitis; nocardial abscess; JC virus–associated PML

Abbreviations: CMV, cytomegalovirus; EBV, Epstein-Barr virus; PML, progressive multifocal leukoencephalopathy.

replication and enhanced graft rejection is well established: elevated immunosuppression leads to increased CMV replication, which is associated with graft rejection. For this reason, considerable attention has been focused on the diagnosis, prophylaxis, and treatment of CMV infection in SOT recipients. Early transmission of WNV to transplant recipients from a donated organ or transfused blood has been reported; however, the risk of WNV acquisition has been reduced by implementation of screening procedures. In rare instances, rabies virus and lymphocytic choriomeningitis virus also have been acutely transmitted in this setting; although accompanied by distinct clinical syndromes, both viral infections have resulted in fatal encephalitis. As screening for unusual viruses is not routine, only vigilant assessment of the prospective donor is likely to prevent the use of an infected organ.

Beyond 6 months after transplantation, infections characteristic of patients with defects in cell-mediated immunity—e.g., infections with *Listeria*, *Nocardia*, *Rhodococcus*, mycobacteria, various fungi, and other intracellular pathogens—may be a problem. International patients and global travelers may experience reactivation of dormant infections with trypanosomes, *Leishmania*, *Plasmodium*, *Strongyloides*, and other parasites. Reactivation of latent *M. tuberculosis* infection, while rare in Western nations, is far more common among persons from developing countries. The recipient is typically the source, although reactivation and spread from the donor organ can occur. While pulmonary disease remains most common, atypical sites can be involved and mortality rates can be high (up to 30%). Vigilance, prophylaxis/preemptive therapy (when indicated), and rapid diagnosis and treatment of infections can be lifesaving in SOT recipients, who, unlike most HSC transplant recipients, continue to be immunosuppressed.

SOT recipients are susceptible to EBV-LPD from as early as 2 months to many years after transplantation. The prevalence of this complication is increased by potent and prolonged use of T cell–suppressive drugs. Decreasing the degree of immunosuppression may in some cases reverse the condition. Among SOT patients, those with heart and lung transplants—who receive the most intensive immunosuppressive regimens—are most likely to develop EBV-LPD, particularly in the lungs. Although the disease usually originates in recipient B cells, several cases of donor origin, particularly in the transplanted organ, have been noted. High organ-specific content of B lymphoid tissues (e.g., bronchus-associated lymphoid tissue in the lung), anatomic factors (e.g., lack of access of host T cells to the transplanted organ because of disturbed lymphatics), and differences in major histocompatibility loci between the host T cells and the organ (e.g., lack of cell migration or lack of effective T cell/macrophage/dendritic cell cooperation) may result in defective elimination of EBV-infected B cells. SOT recipients are also highly susceptible to the development of Kaposi's sarcoma and, less frequently, to the B cell–proliferative disorders associated with KSHV, such as primary effusion lymphoma and multicentric Castleman's disease. Kaposi's sarcoma is 550–1000 times more common among SOT recipients than in the general population, can develop very rapidly after transplantation, and can also occur in the allograft. However, because the seroprevalence of KSHV is very low in Western countries, Kaposi's sarcoma is not common. Recipients (or donors) from Iceland, the Middle East, Mediterranean countries, and Africa are at highest risk of disease. Data suggest that a switch of immunosuppressive agents—from calcineurin inhibitors (cyclosporine, tacrolimus) to mTor pathway–active agents (sirolimus, everolimus)—after adequate wound healing may significantly reduce the likelihood of development of Kaposi's sarcoma and perhaps of EBV-LPD and certain other posttransplantation malignancies.

KIDNEY TRANSPLANTATION

See Table 169-4.

Early Infections Bacteria often cause infections that develop in the period immediately after kidney transplantation. There is a role for perioperative antibiotic prophylaxis, and many centers give cephalosporins to decrease the risk of postoperative complications. Urinary tract infections developing soon after transplantation are usually related to anatomic alterations resulting from surgery. Such early infections may require prolonged treatment (e.g., 6 weeks of antibiotic administration for pyelonephritis). Urinary tract infections that occur >6 months after transplantation may be treated for shorter periods because they do not seem to be associated with the high rate of pyelonephritis or relapse seen with infections that occur during the first 3 months.