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Recent Advances in Diagnostics and Therapeutics for Cytomegalovirus Management

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Cytomegalovirus (CMV) continues to be a major opportunistic pathogen, particularly among immunocompromised individuals such as recipients of solid organ and hematopoietic stem cell transplants. CMV infection in these populations is associated with significant morbidity and can result in graft rejection, prolonged hospitalization, and, in severe cases, mortality. As a result, the timely diagnosis and effective management of CMV infection are critical components of post-transplant care. Recent advances in diagnostics have enabled earlier and more precise identification of CMV reactivation. Quantitative polymerase chain reaction (qPCR) assays for monitoring CMV DNAemia have become the standard tool for surveillance, offering high sensitivity and allowing for preemptive therapeutic intervention. In parallel, the incorporation of CMV-specific cell-mediated immunity (CMI) assays into routine practice has improved the ability to stratify patients based on their immunologic risk and tailor prophylactic or therapeutic approaches accordingly. Furthermore, next-generation sequencing (NGS) has significantly advanced the field of resistance profiling by allowing detection of low-frequency resistance mutations in the viral genome, thereby supporting personalized antiviral regimens and preventing treatment failure. Therapeutically, the emergence of newer agents such as letermovir and maribavir has expanded the available options for both prophylaxis and treatment. Letermovir, with its favorable toxicity profile, is now widely used for primary prophylaxis in stem cell transplant recipients. Maribavir has shown efficacy in managing resistant or refractory CMV infections, especially when first-line antivirals fail due to toxicity or resistance. In addition, CMV-specific adoptive T-cell immunotherapy is currently under investigation and holds promise for high-risk patients with limited treatment options. Collectively, these innovations reflect a shift toward precision medicine in CMV management. Continued research into viral-host interactions, immunologic monitoring, and optimized combination therapies will be essential to improving outcomes and reducing the disease

burden in susceptible patient populations.

Keywords: Kidney transplantation, Cytomegalovirus, Diagnostics, Therapeutics, Immunosuppressant