

candidiasis. The uterine cervix is covered by squamous mucosa that is also resistant to infection. However, minor trauma may expose immature proliferating epithelial cells that are susceptible to infection by human papilloma viruses, an important sexually transmitted pathogen that is the cause of most cases of cervical carcinoma (Chapters 7 and 22).

Vertical Transmission

Vertical transmission of infectious agents from mother to fetus or newborn child is a common mode of transmission of certain pathogens, and may occur through several different routes.

- **Placental-fetal transmission.** This is most likely to occur when the mother is infected with a pathogen during pregnancy. Some of the resulting infections interfere with fetal development, and understandably the degree and type of damage depend on the age of the fetus at the time of infection. For example, rubella infection during the first trimester can lead to heart malformations, mental retardation, cataracts, or deafness, while rubella infection during the third trimester has little effect.
- **Transmission during birth.** This mode of transmission is caused by contact with infectious agents during passage through the birth canal. Examples include gonococcal and chlamydial conjunctivitis.
- **Postnatal transmission in maternal milk.** Agents transmitted in this fashion include cytomegalovirus (CMV), human immunodeficiency virus (HIV), and hepatitis B virus (HBV).

Spread and Dissemination of Microbes Within the Body

While some disease-causing microorganisms remain localized to the initial site of infection, others have the capacity to invade tissues and spread to distant sites via the lymphatics, the blood, or the nerves (Fig. 8-1). Pathogens can spread within the body in several ways. Some extracellular pathogens secrete enzymes that break down tissues, allowing the organisms to advance virtually unimpeded. For example, *S. aureus* secretes hyaluronidase, which degrades the extracellular matrix between host cells, allowing the microbes to follow tissue planes of least resistance. Eventually the organisms may travel through the lymphatics to regional lymph nodes and the blood, potentially leading to bacteremia and spread to distant organs, such as heart and bone. Certain viruses, such as rabies, poliovirus, and *Varicella*, spread to the central nervous system by infecting peripheral nerves and then traveling intracellularly along axons. However, the most common and efficient mode of microbial dissemination is through the bloodstream. Some blood-borne pathogens, such as certain viruses (e.g., poliovirus, hepatitis B virus), most bacteria and fungi, some protozoa (e.g., African trypanosomes), and helminths are transported free in plasma, while others are carried within leukocytes (e.g., herpesviruses, HIV, mycobacteria, and certain fungi and protozoa) or red cells (e.g., malarial parasites).

The consequences of blood-borne spread of pathogens vary widely depending on the virulence of the organism, the magnitude of the infection, the pattern of seeding, and host factors such as immune status. Sporadic

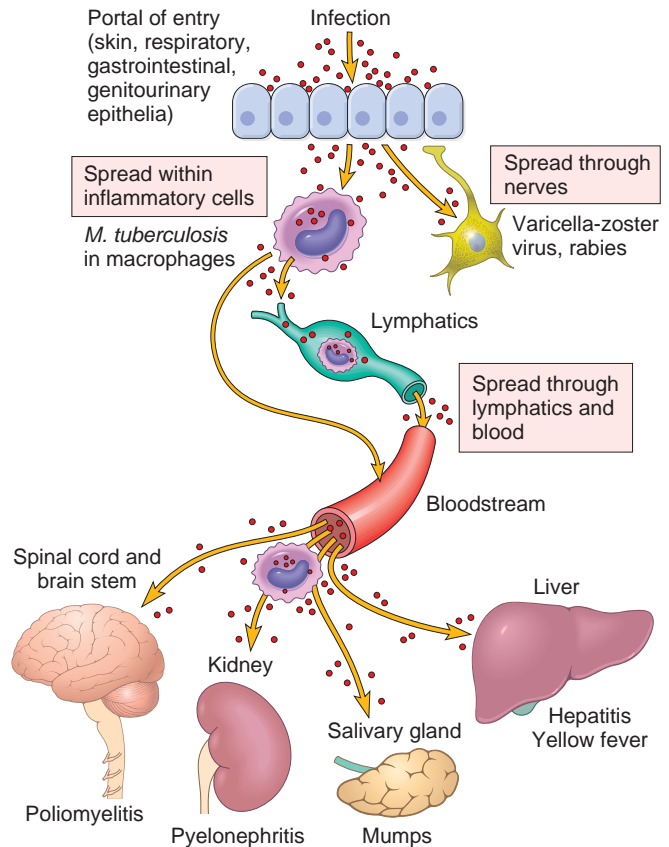


Figure 8-1 Routes of entry and dissemination of microbes. To enter the body, microbes penetrate the epithelial or mucosal barriers. Infection may remain localized at the site of entry or spread to other sites in the body. Most common microbes (selected examples are shown) spread through the lymphatics or bloodstream (either freely or within inflammatory cells). However, certain viruses and bacterial toxins may also travel through nerves. (Adapted from Mims CA: *The Pathogenesis of Infectious Disease*, 4th ed. San Diego, Academic Press, 1996.)

bloodstream invasion by low-virulence or nonvirulent microbes (e.g., during brushing of teeth) is common but is quickly controlled by normal host defenses. By contrast, disseminated viremia, bacteremia, fungemia, or parasitemia by virulent pathogens often produces severe illness and is a serious threat to life. As discussed in Chapter 4, such infections may produce a systemic inflammatory response syndrome that manifests as fever, low blood pressure, and coagulopathies that may progress to organ failure and death if unchecked, even in previously healthy individuals. In other instances, the major signs of spread of the infection are related to tissue seeding. These may take the form of a single large infectious nidus (an abscess or tuberculoma), multiple small sites of infection (e.g., miliary tuberculosis or *Candida* microabscesses), or infection of the heart and vessels (infectious endocarditis and mycotic aneurysm).

Other microbes cause characteristic patterns of disease because of tropism for specific tissues. These include already mentioned neurotropic viruses (rabies, poliovirus, varicella) and certain parasites. For example, after penetrating the skin, *Schistosoma mansoni* parasites localize to blood vessels of the portal system and mesentery, leading