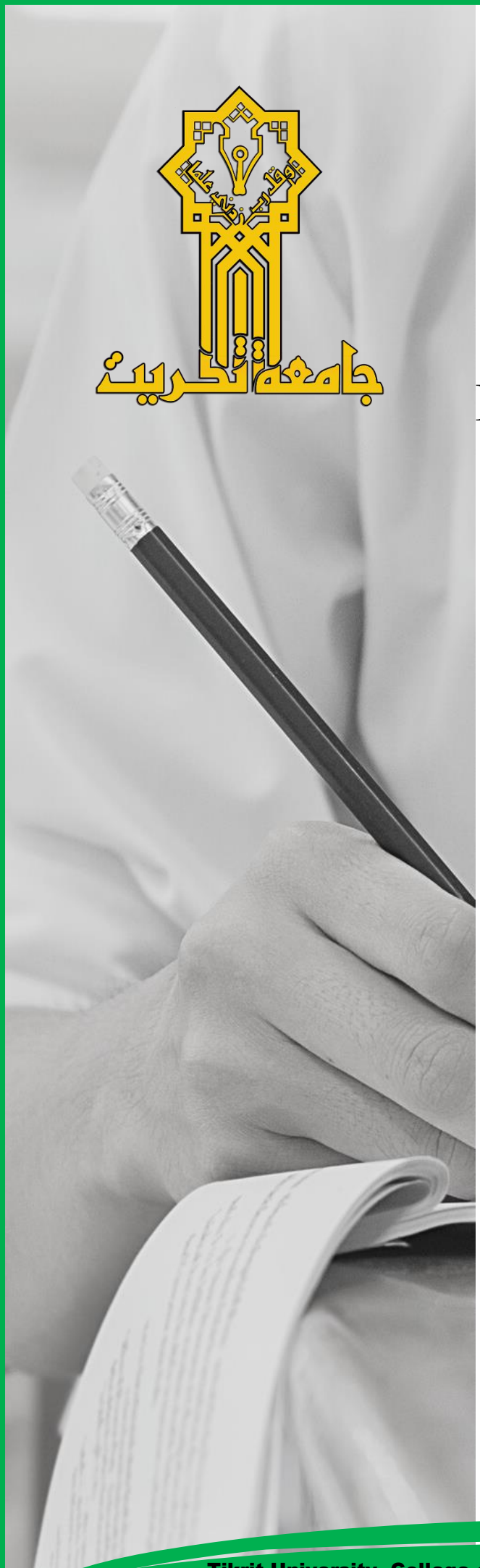

Tikrit University
College of Veterinary Medicine

Lect. 5-Virology

Subject name : Host Specificity and Tissue Tropism
Subject year:2024-2023
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Host Specificity and Tissue Tropism

The capacity of a virus to selectively infect cells in particular organs is referred to as *tropism.* Viral tropism depends on viral and host factors. There must be an interaction between viral attachment proteins and matching cellular receptors.

Mechanisms of Infection and Viral Spread through the Body

Like microorganisms, viruses must gain entry into their host's body, replicate, and spread, either locally or systemically, and in generalized infections they must localize in appropriate target organs. Further, to survive in nature, viruses must be transmitted, i.e., they must be shed with secretions or excretions into the environment, be taken up by a host or a vector, or be passed congenitally from mother to offspring.

Routes of Entry

To infect its host, a virus must first attach to and infect cells of one of the body surfaces, unless the body surfaces are bypassed by parenteral inoculation via a wound, needle, or the bite of an arthropod or vertebrate.

Entry via the Respiratory Tract

The mucosal surfaces of the respiratory tract have living cells at their surfaces; these cells can support the replication of many viruses so safeguards are necessary to minimize the risk of infection. The respiratory tract is ordinarily protected by two effective cleansing systems:

(1)a blanket of mucus produced by goblet cells that is kept in continuous flow by

(2) the coordinated beating of ciliated epithelial cells lining the upper and much of the lower respiratory tract.

Most inhaled virions are trapped in mucus, carried by ciliary action from the nasal cavity and airways to the pharynx, and then swallowed or coughed out. Particles that are 10 μm or more in diameter are usually trapped on the nasal mucosa. Particles 5-10 μm in diameter may be carried to the trachea and bronchioles, where they are usually trapped in the mucus blanket. Particles 5 μm or less in diameter are often inhaled directly into the lungs and some may reach the alveoli where they may be ingested by alveolar macrophages. At each of these levels, virus may infect epithelial cells. Despite its protective systems, the respiratory tract is the most common portal of viral entry into the body. All viruses that infect the host via the respiratory tract probably do so by attaching to specific receptors on epithelial cells. Following respiratory invasion, many viruses remain localized (e.g., rhinoviruses, adenoviruses, and influenza viruses of mammals) whereas others become systemic (e.g., foot-and-mouth disease viruses, canine distemper virus, rinderpest virus, and Newcastle disease virus).

Entry via the Oropharynx and Intestinal Tract

Many viruses are acquired by ingestion. They may either be swallowed and reach the stomach and intestine directly or they may first infect cells in the oropharynx, their progeny being eventually carried into the intestinal tract. The esophagus is rarely infected, probably because of its tough stratified squamous epithelium and the rapid passage of swallowed material over its surface. The intestinal tract is protected by mucus, which may contain specific secretory antibodies (IgA), but the directional peristaltic movement of gut contents provides many opportunities for virions to contact susceptible epithelial cells. Virions may also be taken up by M cells that overlie Peyer's patches in the ileum, from where they may be passed to adjacent mononuclear cells where they may replicate. Other protective mechanisms may inactivate viruses in the intestinal tract: acid in the stomach

and bile and proteolytic enzymes in the small intestine. In general, viruses that cause intestinal infection, such as rotaviruses, caliciviruses, and enteroviruses are acid and bile resistant. However, there are acid- and bile-labile viruses that cause important intestinal infections; for example, bovine, porcine, and murine coronaviruses are protected during passage through the stomach of young animals by the buffering action of milk. Some enteric viruses not only resist inactivation by proteolytic enzymes in the stomach and intestine, their infectivity may actually be increased by such exposure. Thus, cleavage of an outer capsid protein by intestinal proteases enhances the infectivity of rotaviruses and some coronaviruses.

Entry via the Skin

The skin is the largest organ of the body, and because its outer layer consists of keratinized cells, it provides a tough and usually impermeable barrier to the entry of viruses. Breaches in skin integrity such as cuts, punctures, abrasions, or wounds expose deep epidermal layers that contain few blood vessels and lymphatics and therefore are rather remote from host inflammatory defenses. Viruses that enter these layers, such as the papillomaviruses, typically induce local pathology.

Deeper trauma may introduce viruses into the dermis, with its rich supply of vessels, lymphatics, and nerves, or even into the underlying subcutaneous tissue and muscle. Generalized infections of the skin with exanthema, such as in lumpy skin disease, sheep pox, and swine vesicular disease, are due to viral spread via viremia. One of the most efficient ways by which viruses are introduced through the skin is via the bite of arthropods, such as mosquitoes, ticks, *Culicoides* spp., or sand flies.

Insects, especially flies, may act as simple mechanical vectors ("flying needles"); for example, equine infectious anemia virus is spread among horses, rabbit hemorrhagic disease virus and myxoma virus are spread

among rabbits, and fowlpox virus among chickens in this way. However, most viruses that are spread by arthropods replicate in their vector. Viruses that are transmitted by and replicate in arthropod vectors are called *arboviruses* (from *arthropod-borne).* Infection can also be acquired through the bite of an animal, as in rabies. Finally, introduction of a virus by skin penetration may be *iatrogenic,* i.e., the result of veterinary care or related husbandry practices. For example, equine infectious anemic virus has been transmitted via contaminated needles, twitches, ropes, and harnesses and orf virus and papillomaviruses have been transmitted via ear tagging or tattooing.

Entry via Other Routes

The urogenital tract is the route of entry of several important pathogens (e.g., bovine herpesvirus 1, equine herpesvirus 3, and porcine papillomavirus). Small abrasions in the penile mucosa and the epithelial lining of the vagina may occur during sexual activity and permit the entry of virus. The conjunctiva, although much less resistant to viral invasion than the skin, is constantly cleansed by the flow of secretion (tears) and is wiped by the eyelids; some adenoviruses and enteroviruses gain entry in this way.