

Family: Adenoviridae

Adenoviruses

These are naked icosahedral viruses (75 nm in diameter) with double-stranded linear DNA. They cause pharyngitis, upper and lower respiratory tract disease, gastrointestinal, urinary tracts and eye infections. Many adenovirus infections are **subclinical***, and virus may persist in the host for months. There are at least 40 antigenic types, some of which cause sarcomas in animals but no tumors in humans.

***Subclinical infection:** an infection that has no symptoms or noticeable signs.

Important Properties of Adenoviruses

Virion: Icosahedral, 70–90 nm in diameter, 252 capsomeres; fiber projects from each vertex (Adenoviruses are unique among icosahedral viruses in that they have a structure called a **fiber**).

Genome: Double-stranded, linear DNA.

Envelope: None.

Outstanding characteristics: Excellent models for molecular studies of eukaryotic cell processes and **adenoviruses, the most strongly oncogenic types.**

Classification of Adenoviruses

All of the human adenoviruses are classified in the Mastadenovirus genus. Human adenoviruses are divided into six groups (A–F) on the basis of their genetic, physical, chemical, and biologic properties.

Pathogenesis

Adenoviruses infect and replicate in epithelial cells of the respiratory tract, eye, gastrointestinal tract, and urinary tract. They usually do not spread beyond the regional lymph nodes. Group C viruses persist as latent infections for years in adenoids and tonsils and are shed in the feces for many months after the initial infection. In fact, the name “adenovirus” reflects the recovery of the initial isolate from explants of human adenoids. Most human adenoviruses replicate in intestinal epithelium after ingestion but usually produce subclinical infections rather than overt symptoms.

Clinical Findings

About one-third of the known human serotypes are commonly associated with human illness. It should be noted that a single serotype may cause different clinical diseases and, conversely, that more than one type may cause the same clinical illness. Adenoviruses are responsible for about 5% of acute respiratory disease in young children, but they account for much less in adults. Most infections are mild and self-limited. The viruses occasionally cause disease in other organs, particularly the eye and the gastrointestinal tract.

A. Respiratory Diseases

Typical symptoms include cough, nasal congestion, fever, and sore throat. This syndrome is most commonly manifested in infants and children and usually involves group C viruses, especially types 1, 2, and 5. Infections with types 3, 4, and 7 occur more often in adolescents and adults. These cases are difficult to distinguish from other mild viral respiratory infections that may exhibit similar symptoms. Adenoviruses—particularly types 3, 7, and 21—are thought to be responsible for about 10–20% of pneumonias in childhood. Adenoviral pneumonia has been reported to have a mortality rate up to 10% in the very young.

Adenoviruses are the cause of an acute respiratory disease syndrome among military recruits. This syndrome is characterized by fever, sore throat, nasal congestion, cough, and malaise, sometimes leading to pneumonia. It occurs in epidemic form among young military recruits under conditions of fatigue, stress, and crowding soon after induction.

Eye Infections

Mild ocular involvement may be part of the respiratory–pharyngeal syndromes caused by adenoviruses. Pharyngoconjunctival fever tends to occur in outbreaks, such as at children’s summer camps (“swimming pool conjunctivitis”), and is associated with types 3 and 7. The duration of conjunctivitis is 1–2 weeks, and complete recovery with no lasting sequelae is the common outcome. A more serious disease is epidemic keratoconjunctivitis. It is caused by types 8, 19, and 37. This disease occurs mainly in adults and is highly contagious. **Adenoviruses can remain viable for several weeks on sinks and hand towels, and these**

may be sources of transmission. The disease is characterized by acute conjunctivitis followed by keratitis that usually resolves in 2 weeks but may leave sub epithelial opacities in the cornea for up to 2 years.

C. Gastrointestinal Disease

Many adenoviruses replicate in intestinal cells and are present in stools, but the presence of most serotypes is not associated with gastrointestinal disease. However, two serotypes (types 40 and 41) have been etiologically associated with infantile gastroenteritis and may account for 5–15% of cases of viral gastroenteritis in young children.

D. Other Diseases

Immunocompromised patients may suffer from a variety of casual and severe adenovirus infections. The most common problem caused by adenovirus infection in transplant patients is respiratory disease that may progress to severe pneumonia and may be fatal (usually types 1–7). Children receiving liver transplants may develop adenovirus hepatitis in the allograft. In addition, children with heart transplants who develop myocardial adenovirus infections are at increased risk of graft loss. Pediatric recipients of hematopoietic stem cell transplants may develop infections with a wide variety of adenovirus types. Patients with acquired immunodeficiency syndrome (AIDS) may experience adenovirus infections, especially in the gastrointestinal tract. Types 11 and 21 may cause acute hemorrhagic cystitis in children, especially boys. Virus commonly occurs in the urine of such patients.

Transmission

Adenoviruses are spread by direct contact, by the fecal–oral route, by respiratory droplets, or by contaminated fomites. Most adenovirus-related diseases are not clinically pathognomonic, and many infections are subclinical.

Laboratory Diagnosis

Detection, isolation, and identification of Virus

Samples should be collected from affected sites early in the illness to optimize virus isolation. Depending on the clinical disease, virus may be recovered from stool or urine or from a throat, conjunctival, or rectal swab.

Virus isolation in a **1. cell culture** requires human cells. Primary human embryonic kidney cells are most susceptible but usually unavailable.

2. Serological tests: Hemagglutination-inhibition and neutralization tests measure type-specific antigens and can be used to identify specific serotypes.

3. Polymerase chain reaction (PCR) assays are routinely used for diagnosis of adenovirus infections in tissue samples or body fluids.

Treatment

There is no specific treatment for adenovirus infections.

Prevention and Control

- Careful hand washing is the easiest way to prevent infections.
- Environmental surfaces can be disinfected with sodium hypochlorite.
- In group settings, paper towels may be advisable because dirty towels can be a source of infection.
- Conjunctivitis can be minimized by chlorination of swimming pools and waste water.
- Strict asepsis during eye examinations, coupled with adequate sterilization of equipment, is essential for the control of epidemic keratoconjunctivitis.

Gene Therapy: Adenoviruses are being used as gene delivery vehicles for cancer therapy, gene therapy, and genetic immunization studies.

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