

Oncogenic Viruses _ Human Tumor Viruses

An oncovirus or oncogenic virus is a virus that can cause cancer, it now refers to any virus with a DNA or RNA genome causing cancer and is synonymous with "tumor virus" or "cancer virus".

Tumor viruses induce tumors in animals and humans by transforming the infected host cells. These oncogenic viruses encode viral proteins, which deregulate the integrated framework of host cellular processes, while preventing cell death.

A **cancer** in a human or an animal is a malignant tumour, involves continuous proliferation of a clone of cells derived from one of the body's normal cells. The cell undergoes changes known as transformation as a result of events that include mutation, activation of oncogenes (tumour genes) and inactivation of tumour suppressor genes.

Some of the steps in the cells transformation can be triggered by environmental factors including some chemicals, some forms of irradiation and some viruses. In some types of tumour the virus DNA is integrated into a cell chromosome, while in other types it is present as multiple copies of covalently closed circular DNA.

Oncogenic viral mechanism:

Generally, tumor viruses cause little or no disease after infection in their hosts, or cause non-neoplastic diseases such as acute hepatitis for hepatitis B virus or mononucleosis for Epstein–Barr virus. A minority of persons will go on to develop cancers after infection.

A **direct** oncogenic viral mechanism: involves either insertion of additional viral oncogenic genes into the host cell or to enhance already existing oncogenic genes (proto-oncogenes) in the genome.

Indirect viral oncogenicity involves: chronic nonspecific inflammation occurring over decades of infection, as in the case for HCV-induced liver cancer.

Tumor viruses are sub-classified as either:

1. **DNA viruses, which include:**
 - a. Epstein–Barr virus (EBV)
 - b. Kaposi's sarcoma–associated herpesvirus (KSHV)
 - c. human papillomavirus (HPV)
 - d. hepatitis B virus (HBV)
 - e. Merkel cell polyomavirus (MCPyV).

2. **RNA viruses, which include:**
 - a. hepatitis C virus (HCV)
 - b. human T-cell lymphotropic virus (HTLV-1).

The important onco-viral types

1. Papillomavirus-linked cancers:

The papillomaviruses are small DNA viruses. They enter the body through small abrasions and infect keratin-making cells (keratinocytes) in skin or a mucous membrane causes cervical carcinoma in women.

Each HPV type infects a preferred sites, such as the hands or the genitals, and infection may result in a benign wart (papilloma) or a carcinoma. The papillomaviruses that infect the genitals are transmitted between individuals during sexual contact.

2. Polyomavirus-linked cancers:

Two human polyomaviruses are known: JC and BK viruses, named after the initials of the persons from whom they were first isolated. There is evidence that they have roles in some types of tumour in humans, especially brain tumours.

3. Epstein-Barr virus-linked cancers:

Burkitt's lymphoma (BL) is a B cell tumour that occurs with a high frequency in children in central Africa. Shortly after it was first described (by Denis Burkitt) Anthony Epstein established cell lines from the tumour of a patient. The cells were found to be persistently infected with a herpesvirus, which was named Epstein_Barr virus (EBV).

4. Kaposi's sarcoma:

Kaposi's sarcoma was first described as a rare skin cancer that affected elderly men. Since the arrival of AIDS this picture has changed. It is one of the most common cancers in people with AIDS, and in these patients the cancer disseminates throughout the body and is more aggressive. It is thought that the tumour cells are derived from endothelial cells.

5. Adult T cell leukaemia:

Adult T cell leukaemia is associated with human T_lymphotropic virus 1 (HTLV-1) infection. Regions of the world with a high prevalence of the virus, such as south-west Japan, have a high prevalence of these tumours.

6. Hepatocellular carcinoma (liver cancer):

A number of factors are implicated as causative agents, including consumption of mould toxins in food, and two viruses: hepatitis B virus (HBV) and hepatitis C virus (HCV). HBV is the most causative agent.

Prevention of virus-induced cancers

To prevent virus-induced cancers include attempting to prevent transmission of the viruses, so knowledge of the **modes of transmission** of the viruses is important. Knowledge of the modes of virus transmission allows the development of strategies aimed at reducing the risks of transmission. Most of the oncogenic human viruses can be transmitted sexually and in blood, so measures implemented to prevent transmission.

Vaccination provides another approach to reducing rates of virus transmission. Most transmission of HBV occurs from mother to baby around the time of birth, so several countries with high incidences of HBV infection have initiated programs to give babies HBV vaccine within 2 days of birth. There is evidence of a reduced incidence of liver cancer in children as a result of this program.

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