ASSOCIATION BETWEEN VIRAL INFECTION AND CANCERS

BY

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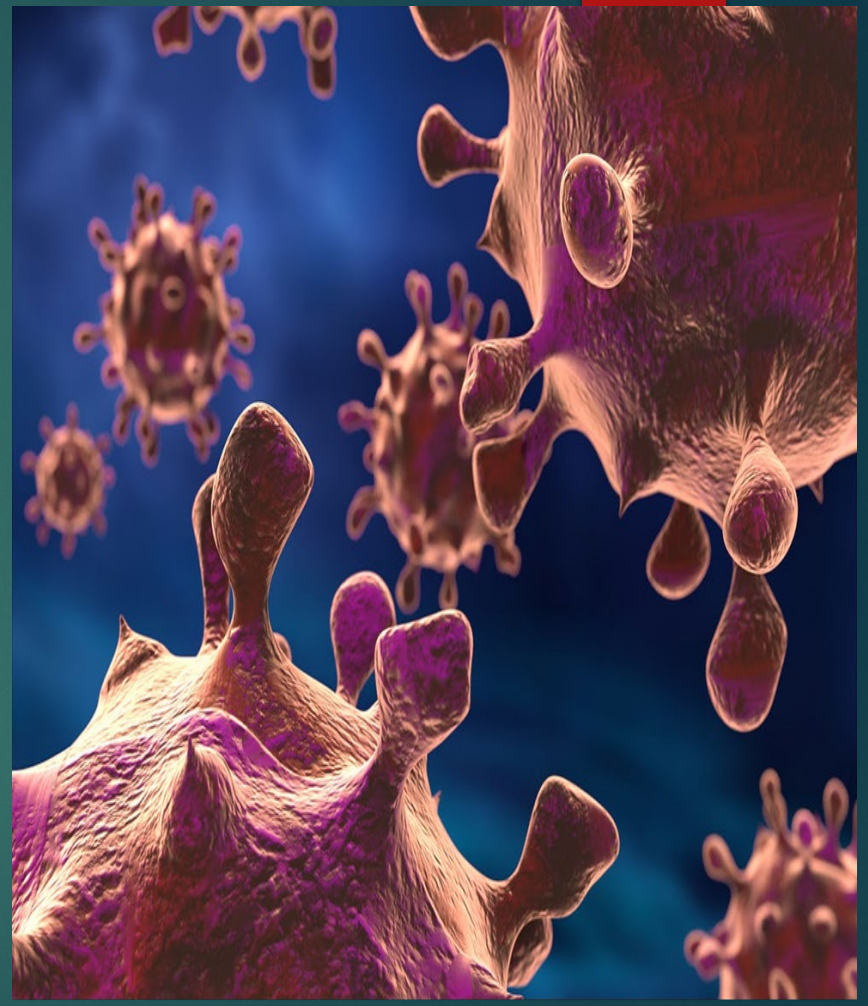


- It is now estimated that approximately 10 % of worldwide cancers are attributable to viral infection, with the vast majority (85 %) occurring in the developing world.
- Oncogenic viruses include various classes of DNA and RNA viruses which induce cancer by various mechanisms.
- cancer develops in a minority of infected individuals and only after chronic infection of many years duration.

The viruses associated with the greatest number of cancer cases are:

It was recently estimated that almost 13 million yearly cases of human cancer worldwide are caused by one of

the following human viruses:

Human papillomaviruses (HPV) which cause cervical cancer and several other epithelial malignancies

Hepatitis B virus (HBV), hepatitis C virus (HCV) which are responsible for the majority of hepatocellular cancer. , Epstein–Barr virus (EBV), Kaposi's sarcoma associated herpes virus (KSHV) (also called Human Herpes Virus 8), human T-cell leukemia virus (HTLV-1), and Merkel cell polyomavirus (MCPyV)

- Multiple factors have been associated
- with the oncogenic process such as environment, lifestyle,
- host factors, infectious agents and inheritance

Mechanism Of The Virus inside human body

- Once a viral infection has been established, innate and adaptive
- immunity are activated in response, aimed to eliminate the infection.

- Chronic inflammation may result from unresolved acute inflammation due to failure in eradicating the pathogenic agent. Therefore, chronic inflammation may favor the persistence of the pathogen in the tissue for a prolonged period of time

Viruses can cause cancer by:

- Insertional mutagenesis: Viral DNA integrates into host genome, disrupting tumor suppressor genes or activating oncogenes.
- Viral oncoproteins: Viral proteins interfere with cell cycle regulation, apoptosis, and DNA repair.
- Chronic inflammation: Persistent viral infections lead to inflammation, promoting cancer development.
- Example: HPV E6 and E7 proteins inactivate p53 and Rb tumor suppressor proteins.

- A variety of inflammatory cells are activated during this process, releasing cytokines, chemokines and nitric oxide (NO), particularly, an inducible isoform of nitric oxide synthase (iNOS), and NO-derived reactive nitrogen species (RNS), which may be able to cause DNA damage and have a direct effect upon cell proliferation and neoangiogenesis.

- Factors such as :
- host immunity and chronic inflammation play an important role in promoting the conditions for neoplastic cells to proliferate.
- In fact, chronic inflammation is supposed to be beneficial for the host by trying to clear the antigenic insult,
- but it has also been recognized as a factor that can promote carcinogenesis.

Virus	Genome	Cancer
Epstein-Barr virus	DNA	Burkitt's lymphoma, nasopharyngeal cancer, B cell lymphoma
Hepatitis B	DNA	Hepatocellular carcinoma
Hepatitis C	RNA	Hepatocellular carcinoma
Human herpesvirus type I	DNA	Kaposi's sarcoma
Human papilloma viruses (certain types)	DNA	Cancer of the cervix
Human T-cell leukemia virus type 1	RNA	Adult T-cell leukemia

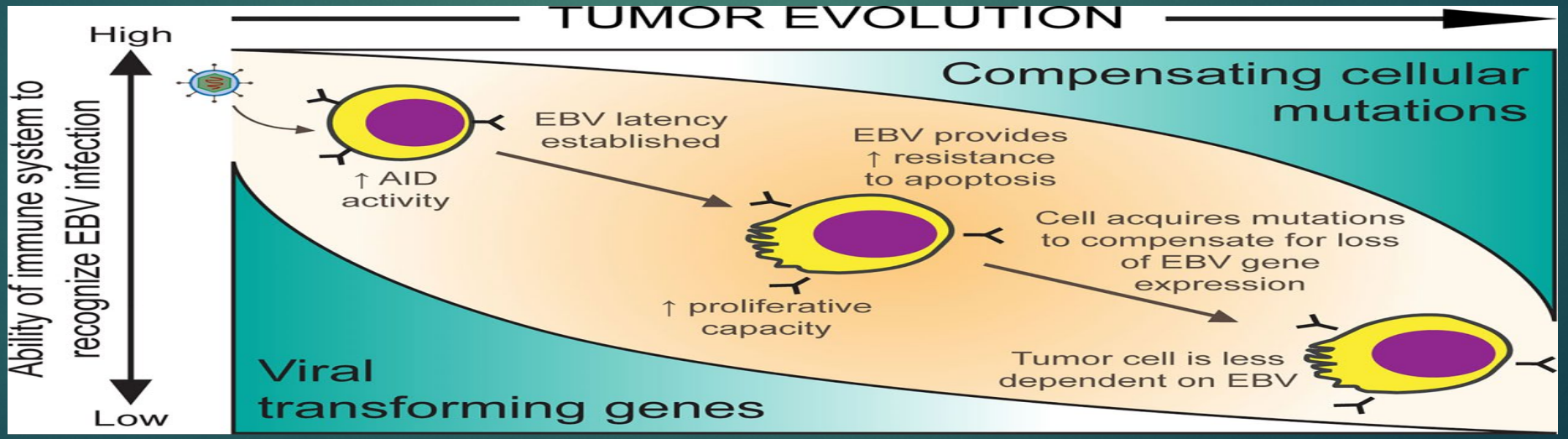
Note: It has been estimated that virus-linked human cancers are responsible for ~15% of total cancer incidence.

Hepatitis B and C

- It has been estimated that two billion people have had hepatitis B virus exposure and near 400 million have experienced chronic infection. After acute hepatitis, HBV infection persists in about 1–2% of immunocompetent hosts and higher percentage of immunosuppressed patients
- The chronic infection increases the risk of developing cirrhosis and hepatocellular carcinoma up to 40%

Epstein-Barr virus (EBV)

- Epstein-Barr virus (EBV) contributes to about 1.5% of all human cancer cases worldwide, and viral genes are expressed in malignant cells. EBV also very efficiently causes the proliferation of infected human B lymphocytes.



- White blood cell cancer (Burkitt lymphoma)
- Cancer of the nose and throat (nasopharyngeal cancer)
- Gastric cancer Cancer from EBV is the result of viral genes from the virus that change the growth cycle of infected cells and cause them to become cancerous. However, having EBV does not guarantee a person will get these cancers.

Kaposi’s sarcoma-associated herpesvirus

- Kaposi’s sarcoma (KS) is the most common cancer in HIV-infected untreated individuals. Kaposi’s sarcoma-associated herpesvirus (KSHV; also known as human herpesvirus 8 (HHV8)) is the infectious cause of this neoplasm
- KSHV is different from herpes type 1 and 2 in that it causes a blood vessel cancer called Kaposi’s sarcoma (KS), a lymphoma (a cancer of the lymphocyte) called body cavity-based lymphoma and some forms of severe lymph node enlargement, called Castleman’s disease.

Human T-lymphotropic virus type 1 (HTLV-1)

- is a retrovirus, similar to HIV, which causes a chronic lifelong infection in humans. Its transmission happens through breast feeding, sexual contact, needle sharing and unsafe blood transfusions. It causes a range of clinical manifestations including poor functioning immune system (immunosuppression), inflammation of the eye (uveitis) and skin (dermatitis), and pneumonia (pneumonitis). HTLV-1 may lead to cancer in some people (adult T-cell leukemia) and various neurological complications such as myelopathy (HTLV-1 associated myelopathy) and spastic paraparesis.

Merkel cell polyomavirus (MCPyV)

- Merkel cell polyomavirus (MCPyV), the sole member of Polyomavirus associated with oncogenesis in humans, is the major causative factor of Merkel cell carcinoma (MCC), a rare, neuroendocrine neoplasia of the skin was first described in January 2008 in Pittsburgh, Pennsylvania.

Interventions that may reduce the risk of Developing these tumors.

- In general, prevention remains the most effective approach against viral infection and towards cancer risk reduction.

Vaccine strategies seem to be the best approach for some of these viral infections, such as HBV and the recently released HPV vaccine. Nevertheless, additional information still needs to be gathered to understand the synergistic properties of cofactors and viral carcinogenic mechanisms.

Future Directions

- Research Areas:
- Development of vaccines for other oncogenic viruses (e.g., EBV, KSHV).
- Understanding viral-host interactions to identify new therapeutic targets.
- Improving early detection and screening methods.