



ONCOGENIC VIRUSES: A SHORT REVIEW

Dr. Karanam Badari Rao

MDS, Professor & HOD, Department of Oral Pathology, Vananchal Dental College & Hospital, Garhwa, Jharkhand – 822 114, India

ABSTRACT

Viruses that cause neoplasia are called oncogenic viruses. Identification of oncogenic viruses in humans is a complex process and has intrigued researchers over the years. Functional analysis of protein sequences expressed during viral infection continues to provide clues to its persistent nature, as well as reactivation and malignant transformation. Understanding the relationship between viruses and neoplasia and implication of viruses to specific cancers is important for the prevention and treatment of virally induced tumors and diseases.

KEYWORDS : Virus, Oncogenic, Neoplasia

INTRODUCTION

Viruses are obligate intracellular parasites that depend on the host cell for their survival and replication. They typically consist of a nucleic acid genome, either deoxyribose nucleic acid (DNA) or ribose nucleic acid (RNA) surrounded by a protein capsid and encased in a lipid membrane envelope (Fig. 1). The viral genome contains information necessary for programming the infected host cell to synthesize specific macromolecules required for their replication and can persist within the host cells for years, as non-replicating form only to be reactivated later.¹

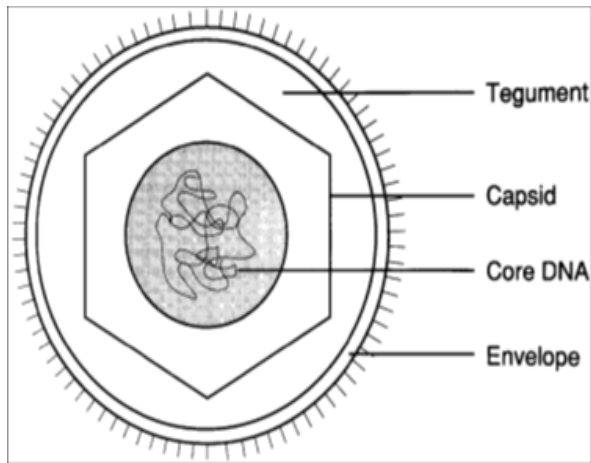


Fig. 1: Structure of a Typical Virus

Primary infection by viruses accounts for a wide variety of diseases in humans causing transient illnesses (e.g. influenza) or are not eliminated from the body, either continuing to multiply (e.g. chronic infection with hepatitis B virus) or surviving in non-replicating form (e.g. latent infection with herpes zoster virus). Some viruses can transform a host cell into a cancer cell (e.g. human papilloma viruses causing oral squamous cell carcinoma) and are frequently reactivated in immunocompromised patients to cause severe disease (e.g. Epstein-Barr virus causing lymphomas).² Primary infection and reactivated disease may involve different cell types and present different clinical pictures depending on the type of virus.^{2,3}

Viruses and Neoplasia

Viruses that cause neoplasia are called oncogenic viruses and approximately 15% of human cancers have been linked to viral etiology.³ The mechanism of virally associated tumor formation is variable and complex. The potential of certain viruses to become involved in the etiology of tumors is due to the ability to incorporate their genome into that of the host cell. Both the DNA and RNA viruses have been implicated in the etiology of human cancers (Table 1).⁴

Table 1: List of Viruses Linked to Human Cancers

Virus	Cancer
DNA viruses	
• Human papilloma virus	➤ Oral squamous cell carcinoma ➤ Oral verrucous carcinoma ➤ Cancer of the skin
• Epstein-Barr virus	➤ Anogenital cancer ➤ Burkitt's lymphoma ➤ Nasopharyngeal carcinoma ➤ Hodgkin's lymphoma ➤ Thymic lymphoepithelial carcinoma ➤ Immunosuppression-related lymphoma
• Human herpes virus 8	➤ Kaposi's Sarcoma
• Hepatitis B virus	➤ Hepatocellular carcinoma
• Hepatitis C virus	➤ B-cell non-Hodgkin's lymphoma
RNA viruses	
• Human T-lymphotropic virus 1	➤ Endemic T-cell leukemia / lymphoma

In vitro studies have demonstrated that viruses are able to establish persistent infections and thereby transform or immortalize cells. The immortalized cells are more likely than normal cells to accumulate mutations or chromosomal rearrangements and may be more susceptible to cofactors and tumor promoters. The characteristics of these transformed or immortalized cells include an increased cell growth rate with loss of cell growth inhibition, continued cell growth without senescence, and changes in cellular morphology and metabolism. Since the demonstration of direct viral oncogenesis in human tumors is not as clear as in vitro studies, it is necessary to develop criteria for establishing the viral etiology of human neoplasms which are:⁴

- The regular presence and persistence of the respective viral genome in tumor biopsies and cell lines derived from the same tumor type
- The demonstration of growth-promoting activity of specific viral genes or of virus-modified host cell genes in tissue culture systems or in suitable animal systems
- The demonstration that the malignant phenotype depends on the continuous expression of viral oncogenes or on the modification of host cell genes containing viral sequences
- Epidemiological evidence that the respective virus infection represents a major risk factor for cancer development.

Results of studies examining the effects of viruses in neoplastic pathogenesis include epidemiologic evidence and experimental results that suggest modes of interaction.^{5,6} The epidemiological pattern of some human tumors is consistent with an infectious etiology (e.g. human herpes virus 8 causing Kaposi's sarcoma).⁵

CONCLUSIONS

Despite the exponential growth in modern medicine, mankind still suffers from viral infections and its many diseases. The outcome of the disease is often severe and fatal especially in emerging viral infections such as the recent coronavirus disease 19 (COVID-19) caused by SARS CoV-2 coronavirus. Of great importance is the fact that the oral cavity continues to be a key source of transmission and asymptomatic shedding of viruses, the site of their active replication and persistent infection in the face of an eventual virally induced tumorigenesis.^{1,5} Establishing relationship between viruses and neoplasia and the pathogenic process by which viruses act as primary factors or cofactors is important in the prevention and treatment of neoplasms in humans.

REFERENCES

1. Miller CS. Pleotropic mechanisms of virus survival and persistence. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005; 100: 27-36.
2. McAdam AJ, Sharpe AH. Infectious diseases. In: Kumar V, Abbas AK, Fausto N, editors. *Pathologic basis of disease*. Pennsylvania: Saunders 2004; p. 343-414.
3. Brooks GF, Butel JS, Morse SA, editors. *Medical microbiology*. USA: McGraw-Hill 2001; p. 370-4.
4. Phelan JA. Viruses and neoplastic growth. *Dent Clin N Am* 2003; 47: 533-43.
5. Contreras A, Slots J. Herpesviruses in human periodontal disease. *J Periodont Res* 2000; 35: 3-16.
6. Stoopler ET, Greenberg MS. Update on herpesvirus infections. *Dent Clin N Am* 2003; 47: 517-32.