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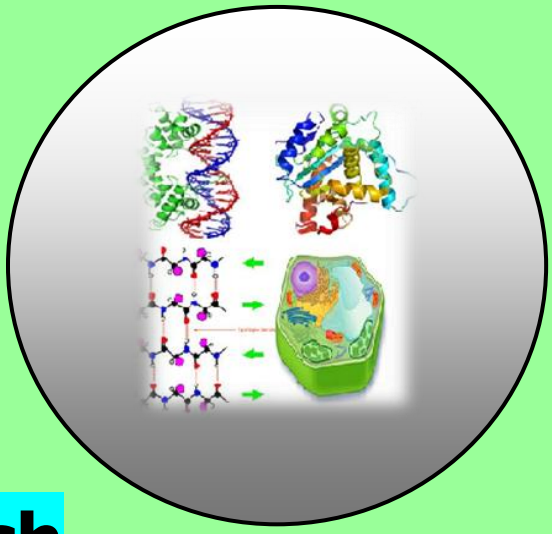

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REVIEW ARTICLE

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An Overview on Retrovirus

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ABSTRACT

Retroviridae is a family of enveloped viruses that replicate in a host cell through the process of reverse transcription. The life cycle of retroviruses is arbitrarily divided into two distinct phases: the early phase refers to the steps of infection from cell binding to the integration of the viral cDNA into the cell genome, whereas the late phase begins with the expression of viral genes and continues through to the release and maturation of progeny virions. During the long journey from the cell surface to the nucleus, retroviruses will face multiple obstacles, since in addition to finding a path through the cytoplasm to the nucleus they have to cross two main barriers, the plasma and nuclear membranes, whilst at the same time avoiding or counteracting cellular defenses that can interfere with many of these steps (Amar and Littman, 2003).

Key words: cDNA, Retrovirus, Reverse Transcription and Virions.

INTRODUCTION

A retrovirus is a single-stranded positive-sense RNA virus with a DNA intermediate and, as an obligate parasite, targets a host cell. Once inside the host cell cytoplasm, the virus uses its own reverse transcriptase enzyme to produce DNA from its RNA genom. The reverse of the usual pattern, thus *retro* (backwards). This new DNA is then incorporated into the host cell genome by an integrase enzyme, at which point the retroviral DNA is referred to as a provirus. The host cell then treats the viral DNA as part of its own genome, translating and transcribing the viral genes along with the cell's own genes, producing the proteins required

to assemble new copies of the virus. It is difficult to detect the virus until it has infected the host. At that point, the infection will persist indefinitely (Perez and Nolan, 2001).

Replication of retrovirus

Retroviruses are enveloped animal ribonucleic acid (RNA) viruses that replicate via a deoxyribonucleic acid (DNA) intermediate, which is integrated into the host genome as a provirus. Interaction of the viral envelope protein with a target cell receptor triggers entry of the viral nucleoprotein core by fusion of viral and cellular membranes. After entry, the viral enzymes reverse transcriptase and integrase mediate reverse transcription of viral RNA and integration of the resulting double-stranded DNA copy of the viral genome, respectively. Expression of viral RNA and proteins from proviral DNA utilizes the transcription and translation machinery of the host. Retrovirus particles are assembled through protein–protein and protein–lipid interactions, released from the cell by budding, and subsequently matured by a viral protease. A provirus can be transmitted through the germ line from parents to offspring as an endogenous retrovirus. Host cell restriction factors target multiple steps of retroviral replication in a complex interplay of virus–host interactions. Reverse transcription and integration into the host genome are hallmarks of retroviral replication. The viral RNA genome contains a packaging signal for selective encapsidation into viral particles and a binding site for a tRNA primer for initiation of reverse transcription. The integrated virus contains long-terminal repeats harboring signals for transcriptional initiation and polyadenylation, which define the retroviral transcription unit. Open reading frames for Gag, Pol and Env are found in all retroviruses, but some retroviruses encode additional proteins such as Tat and Rev of HIV-1. A stop-codon between gag and pol can be bypassed by read-through or frame-shifting during translation of retroviral mRNA to make the Gag–Pol polyprotein. Retroviruses have specialized strategies for export of unspliced genomic-length viral RNA from the nucleus. The metastable retroviral envelope protein drives the fusion of viral and cellular membranes by a type I fusion mechanism to allow retroviral entry in a receptor-dependent manner. The retroviral protease is required for maturation of viral particles after their release from producer cells by budding. A retrovirus can integrate into the genome of germ cells and become part of the genetic material transmitted from parents to offspring. A provirus can be maintained through species diversification as an endogenous retrovirus that may serve as a marker of phylogenetic relationship and evolutionary distance.

Diseases caused by retrovirus

Human

The human immunodeficiency virus (HIV) is a lentivirus (a subgroup of retrovirus) that causes HIV infection and acquired immunodeficiency syndrome (AIDS) (Douek *et al.,* 2009). AIDS is a condition in humans in which progressive failure of the immune system allows life-threatening opportunistic infections and cancers to thrive. Without treatment, average survival time after infection with HIV is estimated to be 9 to 11 years, depending on the HIV subtype (Cunningham *et al.,* 2010). Infection with HIV occurs by the transfer of blood, semen, vaginal fluid, pre-ejaculate, or breast milk. Within these bodily fluids, HIV is present as both free virus particles and virus within infected immune cells.

Horses

Swamp Fever

Equine Infectious Anaemia (EIA), also known as swamp fever is a horse disease caused by a retrovirus and transmitted by blood sucking insects.

Equine Encephalomyelits

Equine encephalomyelitis is an inflammation of the brain and spinal cord that affects horses but is also deadly for humans (Radostitis *et al*., 2007).

Bovines

Bovine immunodeficiency virus (BIV) is a retrovirus belonging to the Lentivirus genus. It is similar to the human immunodeficiency virus (HIV) and infects cattle. The cells primarily infected are lymphocytes and monocytes/macrophages (Louis *et al.,* 2004).

Like other retroviruses, BIV is spread through exchange of bodily fluids (Zhang *et al.,* 1997). When an animal tests positive, many of the animals within the herd are also positive. Some of the spread is attributed to reuse of contaminated needles used in vaccinations, communal sharing of colostrum by calves, and failure to completely sterilize instruments after invasive treatments (Gonda, 1992).

Birds

Avian leukosis complex

This is the infectiou cancerous condition of the mature birds involving the haemopoetic and lymphoid tissues like liver, bursa, spleen, gonads, kidneys, bones etc.

Implications

Since lentiviruses (retrovirus) can infect non-dividing cells, they have the potential to be utilized in gene therapy. Thus far, the lentiviruses used have been primate viruses that may possess the potential to cause disease in humans. As a non-primate virus, BIV does not have this potential and so may represent a safer candidate for gene therapy. Thus far, BIV has been found to transduce a variety of cells from a variety of organisms (Berkowitz *et al.,* 2001).

Endogenous retroviruses

Endogenous retroviruses (ERVs) are endogenous viral elements in the genome that closely resemble and can be derived from retroviruses. They are abundant in the genomes of jawed vertebrates, and they comprise up to 5–8% of the human genome (Belshaw *et al.,* 2004). The replication cycle of a retrovirus entails the insertion ("integration") of a DNA copy of the viral genome into the nuclear genome of the host cell. Most retroviruses infect somatic cells, but occasional infection of germ line cells (cells that produce eggs and sperm) can also occur. Rarely, retroviral integration may occur in a germ line cell that goes on to develop into a viable organism. This organism will carry the inserted retroviral genome as an integral part of its own genome—an "endogenous" retrovirus (ERV) that may be inherited by its offspring as a novel allele.

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