Chicken Anemia Virus

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Abstract  Chicken anemia virus (CAV), the only member of the genus *Gyrovirus* of the Circoviridae, is a ubiquitous pathogen of chickens and has a worldwide distribution. CAV shares some similarities with Torque teno virus (TTV) and Torque teno mini virus (TTMV) such as coding for a protein inducing apoptosis and a protein with a dual-specificity phosphatase. In contrast to TTV, the genome of CAV is highly conserved. Another important difference is that CAV can be isolated in cell culture. CAV produces a single polycistronic messenger RNA (mRNA), which is translated into three proteins. The promoter-enhancer region has four direct repeats resembling estrogen response
elements. Transcription is enhanced by estrogen and repressed by at least two other transcription factors, one of which is COUP-TF1. A remarkable feature of CAV is that the virus can remain latent in gonadal tissues in the presence or absence of virus-neutralizing antibodies. In contrast to TTV, CAV can cause clinical disease and subclinical immunosuppression especially affecting CD8+ T lymphocytes. Clinical disease is associated with infection in newly hatched chicks lacking maternal antibodies or older chickens with a compromised humoral immune response.

**Abbreviations**  
ALV: Avian leukosis virus; CAV: Chicken (infectious) anemia virus; COUP-TF1: Chicken ovalbumin upstream promoter transcription factor 1; CTL: Cytotoxic T lymphocytes; DR: Direct repeat(s); ds: Double-stranded; EGFP: Enhanced green fluorescent protein; ERE: Estrogen response element; HRE: Hormone response elements; HVT: Herpesvirus of turkeys; IBD(V): Infectious bursal disease (virus); IB(V): Infectious bronchitis (virus); MAb: Monoclonal antibodies; MDCC: Marek’s disease chicken cell line; MDV: Marek’s disease virus; MHC: Major histocompatibility complex; NK: Natural killer; nt: Nucleotides; p: Passage; pi: Post infection; PCR: Polymerase chain reaction; PCV: Porcine circovirus; q(RT-)PCR: Quantitative (reverse transcription) PCR; RF: Replicative form; REV: Reticuloendotheliosis virus; SPF: Specific-pathogen-free; TCR: T cell receptor; TTV: Torque teno virus; TTMV: Torque teno mini virus; VN: Virus-neutralizing; VP: Viral protein

**Introduction**

In 1979 Yuasa and coworkers (Yuasa et al. 1979) reported the presence of a new chicken pathogen causing anemia in specific-pathogen-free (SPF) chickens inoculated with herpesvirus of turkeys (HVT) to protect against Marek’s disease (MD), a herpesvirus-induced T cell lymphoma. This new pathogen was first named chicken anemia agent (CAA) and is now known as chicken infectious anemia virus (CAV or CIAV). CAV is thus far the only member of the genus *Gyrovirus*, which belongs to the family of Circoviridae together with viruses of the *Circovirus* genus (ICTV 2008). In addition to these two genera, the Anelloviruses, which include the human torque teno virus (TTV) and torque teno mini virus (TTMV), are often included in the Circoviridae (Hino and Miyata 2007). As with TTV and TTMV in humans, infection with CAV is ubiquitous in its target species (chickens) and can be found in most if not all commercial poultry operations in all continents with a poultry industry (Schat and Van Santen 2008). However, unlike TTV and TTMV, CAV has been linked to specific clinical diseases and subclinical immunosuppression, although the degree of disease and immunosuppression depends on a number of factors, which will be discussed in Pathogenesis. This review will focus on the aspects that are relevant to the understanding of the pathogenesis and highlights