UNDERSTANDING BOVINE ROTAVIRUS GENOTYPES

Background

There is limited information available for NZ vets regarding rotavirus structure and serotypes, specifically rotaviruses that are infectious to cattle. A better understanding of bovine rotavirus will likely assist in understanding the relevance of rotavirus subtypes in cattle vaccines available in New Zealand. Vaccines containing rotavirus antigens administered to cows and heifers boost antibodies in serum, and subsequently increase rotavirus antibody levels in colostrum and milk when administered prior to calving. This results in provision of passive immunity to newborn and young calves that drink this 'hyper-immune' (antibody enriched) colostrum and milk. This Technical Bulletin is a summary of information published on bovine rotavirus, with a focus on rotavirus structures, genotypes, and serotypes.

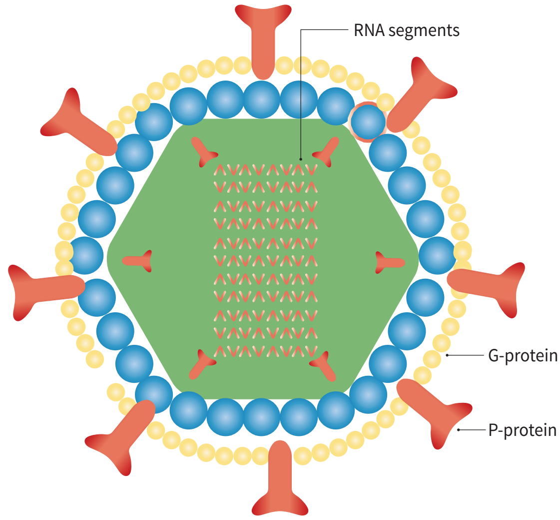

Figure 2: Schematic representation of rotavirus viron

Rotavirus structure and genetic diversity

Rotavirus is widespread and is found endemically worldwide. The virus is maintained in a population in carrier animals and is shed during times of stress such as the periparturient period. It is a well-known causative agent of acute diarrhoea in mammalian species.

Rotavirus is a genomically diverse virus. It is a hardy, non-enveloped RNA virus in the family reoviridae. The double-stranded RNA genome is surrounded by three protein shells, the core, the inner capsid and the outer capsid.

Two structural proteins, a glycoprotein (G-protein) and a protease-cleaved protein (P-protein) form the outer shell and the classification system for rotaviruses. Each rotavirus viron consists of a P-protein and a G-protein type, which is denoted by a number for each. Strains are reported by describing the P and G types together (e.g. P5G6). The genes that code for the G-protein and the P-protein can segregate separately, resulting in the large genetic diversity seen in rotaviruses.

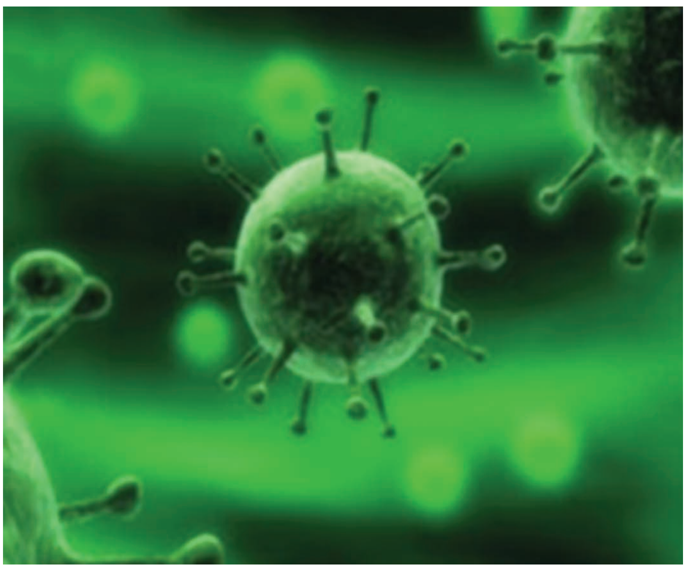

Figure 1: Electron microscope image of rotavirus particle

Like most RNA viruses, mutation is very fast and can occur spontaneously and accumulate over time to result in the many different lineages within types. Regardless, reassortment of genes coding for P and G proteins is considered the most important and significant factor in the generation of strain diversity.

At least 5 different G-proteins and 6 different P-proteins have been identified as rotaviruses causing disease in bovines. Some serotypes are able to infect humans and hence cause a zoonosis. G-protein type G6 is the most common bovine serotype but is not commonly seen in humans, so is the ideal vaccine candidate. By far the most common strain of rotavirus reported in cattle internationally, including New Zealand is P5G6.

Rotavirus vaccines

Rotavirus vaccines are administered to cows within the last trimester of gestation. Typically these vaccines are trivalent, with rotavirus antigens included alongside bovine coronavirus and *E. coli* antigens. Administration of the vaccine in late pregnancy amplifies the antibodies in colostrum and milk resulting in provision of passive immunity to newborn calves.

The most commonly administered vaccines for cattle in New Zealand contain a single serotype of bovine rotavirus. This serotype, P5G6, is also the most commonly occurring strain in New Zealand and internationally.

A small study in New Zealand identifying G-protein genotypes in faecal samples collected from young calves with diarrhoea showed that rotavirus identified as G10 occurred rarely (3 out of 41 antigen positive faecal samples). This has led to claims that both types of G-protein antigen (G6 and G10) are required in cattle vaccines in New Zealand. This is not the case however.

Studies have shown that vaccination of cattle with a single (monovalent) strain of rotavirus results in both homotypic and heterotypic increases in serum antibody titres. This induction of heterotypic antibody production occurs due to pre-exisiting heterologous immunity (memory cells to all rotavirus serotypes that the individual animal has been exposed to during their life-time, from both natural virus exposure in the environment, and from vaccination).

When a monovalent serotype vaccine is administered, an immune response to all rotavirus strains to which the animal has ever been naturally or artificially exposed is stimulated, resulting in an antibody response of multiple serotypes.

Discussion

The induction of a heterotypic antibody response following a single serotype vaccination in cows is widely documented.

Vaccinating dams with the most commonly occurring rotavirus strain and feeding the hyper-immune (antibody enriched) colostrum from these cows is an accepted strategy for protection of young calves from infection with rotavirus in the first month of life. The dam responds to the vaccination by raising serum antibody titres (and subsequently having higher colostrum and milk antibody titres) against all rotavirus serotypes to which it has ever been exposed. At a herd level this provides passive immunity to calves consisting of antibodies to protect against the rotavirus serotypes which are present within the surrounding cattle population and therefore the calves' environment.

Conclusion

Calves that consume colostrum and milk from vaccinated cows can be protected during their first weeks of life from all the rotavirus serotypes that their dams may have encountered.

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