The disease:

The mechanism of PRRSV recombination

Enric Mateu
Senior lecturer at the Department of Animal Health and Anatomy at the Faculty of Veterinary Medicine/Science (Autonomous University of Barcelona) Researcher at CReSA-IRTA

Cinta Prieto
Senior lecturer at the Department of Animal Health at the Faculty of Veterinay Medicines/ Science (Complutense University of Madrid)

Highlights

Recombination is natural mechanism of evolution of most RNA viruses. For recombination to occur is necessary that the animal is co-infected by two different PRRS viruses simultaneously.

The persistence of a recombinant viral variant in the population will depend on its fitness to replicate and transmit in a given environment (immunity, etc.).

The result of a recombination event can be an inviable virus, a neutral recombinant with no biological advantage over parental viruses or a virus that is better fit to replicate and transmit within the population.

Attenuated viruses may recombine but since they replicate to lower levels than wild-type viruses, the likelihood of recombination is probably lower, particularly if vaccination of already infected animals is avoided.

Recombination is a natural mechanism of evolution of RNA viruses. To understand how this phenomenon occurs it is necessary to explain the replication mechanism of PRRSV genome. PRRSV genome encodes for a RNA-dependent RNA-polymerase; namely, an enzyme that produces new RNA strands using RNA as a template. When a cell is infected by two different strains, the cytoplasm of the cell contains copies of both genomes. The RNA-polymerase may jump from one template to the other, creating thus copies of the viral genome that contain a part of the genome of one strain and a part of the other. These recombinations may produce inviable viruses, viruses with no biological gain or, less commonly but extremely relevant for viral evolution, viruses that gained some biological advantage over the parental viruses. Moreover, recombination may produce deletions or insertions in the genome.

The generation of a recombinant isolate depends thus firstly on the fact that the animal must be infected simultaneously by the two isolates. Secondly on the replicative efficiency of each isolate; in other words, the more one virus replicates, the more copies of the genome have to be done and the more the likelihood of generating a recombinant if another isolate is replicating at the same time.

Once a recombinant variant is generated, its predominance or survival in the whole viral population

will depend on its fitness. A recombinant isolate that is "neutral"; namely, has no biological advantage in comparison with the parental viruses, will probably spread randomly or even may disappear. In contrast, a recombinant isolate that gained a biological advantage will spread and persist in the population. Those biological advantages most often imply the ability to replicate more in a given environment or the ability to escape the immune system.

PRRSV is no exception to what happens with other RNA viruses. Several studies have shown that recombination is common in field isolates of PRRSV1 and PPRSV2. This recombination is more likely to happen between isolates of the same species and same subtype. At present, it cannot be said what proportion of the isolates circulating in the field are recombinant. Some studies suggested that this proportion could be at least in the range of 1/100 or even more.

Can modified live vaccines (MLV) recombine with wild-type viruses? Yes, but this must be examined in context. By definition, MLV are attenuated. This means that they replicate less than wild-type viruses. Secondly, a rational use of vaccines should avoid vaccinating already infected animals. These two factors will contribute to decreased likelihood of a vaccine strain recombining with a wild type virus. And what can the result of such a recombination be? This cannot be forecasted but, as of today, none of the known highly virulent isolates of PRRSV1 or PRRSV2 have been confirmed to recombine with an attenuated vaccine. The most rational action is to monitor the farm by sequencing the PRRSV isolates circulating.