

## The significance of Torque teno virus (TTV) on porcine circovirus diseases

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## Once upon a time...

Journal of Virology, 2002, 76(12):2912-2917  
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### A Novel DNA Virus (TTV) Associated with Elevated Transaminase Levels in Posttransfusion Hepatitis of Unknown Etiology

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TT were the initials of the affected patient

## TTV taxonomy

Genus: *Anellovirus*

**Anello** from Latin "Anello", the ring, related to the circular nature of the DNA genome



Nowadays, the name **Torque teno virus (TTV)** has taken from Latin: "Torques", the necklace; and "Tenuis", thin.

## TTVs have been described in a number of species

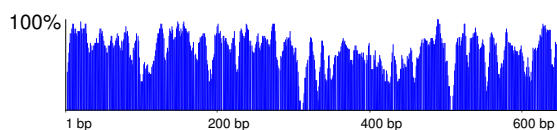


But, they are considered, apparently, non-pathogenic for all species they are infecting

## Two swine TTV genogroups have been so far identified in pigs and wild boars... more than 20 in humans!

Swine genogroups are genetically distinct:

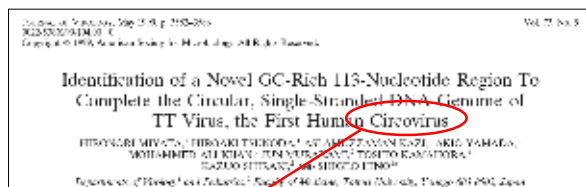
- Intra-genogroup nucleotide sequence variation <9%
- Inter-genogroup nucleotide sequence variation up to 51%



Identity between TTV1 and TTV2

## What prompted us to study such virus in swine?

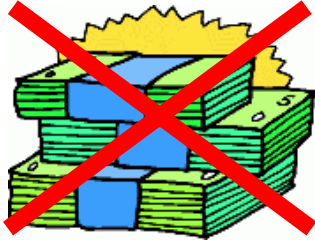
In 1999 we were at the beginning of PMWS studies...



Similarities in genome with pathogenic members of the *Circoviridae* family

## Reality at that time (1999)...

Since it was a new “circovirus”, we had scientific curiosity... but...



## Subsequently...

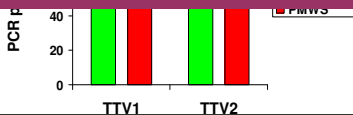
A potential concern regarding porcine TTV is the risk of human infection during xenotransplantation with pig organs and cells. Although porcine TTV is

**Could TTV be the potential “agent X” in PMWS?**

showed that pigs co-infected with PCV2 and porcine parvovirus developed more severe clinical diseases (Krawowka et al., 2000).

Short Communication Prevalence of swine Torque teno virus in post-weaning multi-systemic wasting syndrome

**This study represented the starting point on our swine TTV research**



## Since then, three main focuses on swine TTVs...

- Development of laboratorial techniques
- Epidemiology
- Involvement in disease occurrence

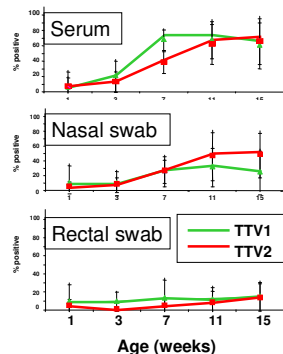
## Swine TTVs infection dynamics (healthy pigs)

✓ So far all tested farms in Spain (n=12) positive for TTV

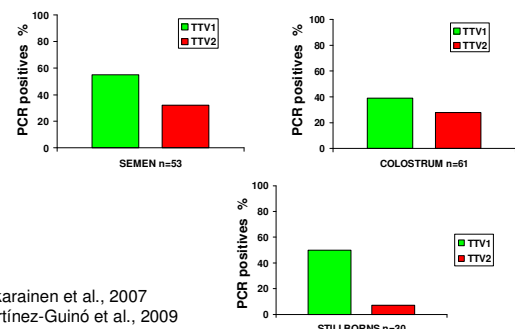
✓ Percentage of infected piglets (n / timepoint = 55) increases with the age of the animals

✓ Secretion by nasal and fecal routes

Sibila et al., 2009



## Swine TTVs seem to be transmitted vertically by several routes



Kekarainen et al., 2007  
Martinez-Guinó et al., 2009

## Swine TTVs have been present in Spain at least since 1985

- Genome evolution study across years indicated no relationship between the date of virus detection and phylogenetic clusters
- Earliest evidence of TTV infection in any species

TTV is an "old" virus in pigs, equivalent to others such as PCV2 or HEV

Segalés et al., 2009

## Even... swine TTV DNAs have been found in pig vaccines and human medicines

### Evaluation of *Mycoplasma hyopneumoniae* bacterins for porcine torque teno virus DNAs

Svetlan Kraljickova, DVM, PhD; Susan S. Ringler, MS; P. Josee A. Domingos, BS; John M. K. Lee, PhD; Kathy McIntosh, PhD; Catherine Durrumay, BS; Alison M. Hamling, DVM; Michael Rings, DVM; Mike Godwin-Allen, PhD; Lisa A. Ellis, DVM, PhD

Swine torque teno virus detection in pig commercial vaccines, enzymes for laboratory use and human drugs containing components of porcine origin. Kekarainen T, Martinez-Guinó L, Segalés J. J Gen Virol. 2009 Mar;90(Pt 3):648-53.

## TTVs and pathology? (1)

### Effect of coinfection with genogroup 1 porcine torque teno virus on porcine circovirus type 2-associated disease in piglets

Is TTV a potential PMWS trigger in PCV2 infected pigs?

Conclude  
no that  
is not a

Int J Vet Res. 2009;2(1):103-104.

## TTVs and pathology? (2)

### Evaluation of the effects of porcine genogroup 1 torque teno virus in antibiotic swine

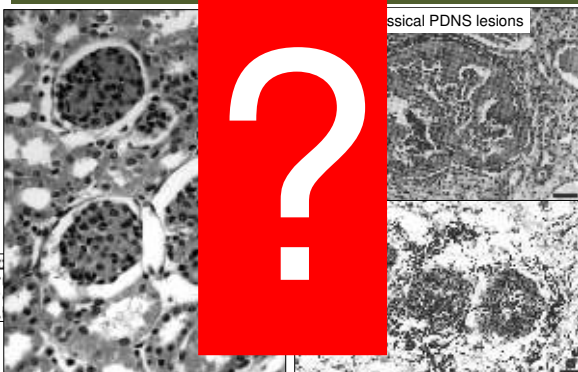
Such lesions are of subclinical nature

Results—All  
pigs, that  
were in the  
antibiotic  
group, had  
TTV DNA in  
their tissues.

Conclusion—The  
antibiotic swine  
study revealed  
that TTV DNA  
was present in  
the tissues of  
antibiotic swine.

Antibiotic swine study revealed that TTV DNA was present in the tissues of antibiotic swine. This indicated a clinical as well as a subclinical nature of TTV infection in antibiotic swine. The results of this study indicate that TTV DNA is present in the tissues of antibiotic swine. This indicated a clinical as well as a subclinical nature of TTV infection in antibiotic swine. The results of this study indicate that TTV DNA is present in the tissues of antibiotic swine.

## TTVs and pathology? (3)



## Further interest in elucidating the potential involvement of swine TTVs in pathology – development of new laboratorial techniques

- Development of monoclonal antibodies – potential use in immunohistochemistry (on-going task)
- Development of an *in situ* hybridization method (on-going task – but first results were not successful – cross-reactivity with PCV2)

## Final conclusions

- Swine TTVs may represent pathogens able to interact with others in order to potentiate disease
- However, a definitive prove of such relationship is still lacking, for both PCVDs and non-PCVDs
- Further research in this area is needed



**THANK YOU VERY MUCH  
FOR YOUR ATTENTION !!!**

