

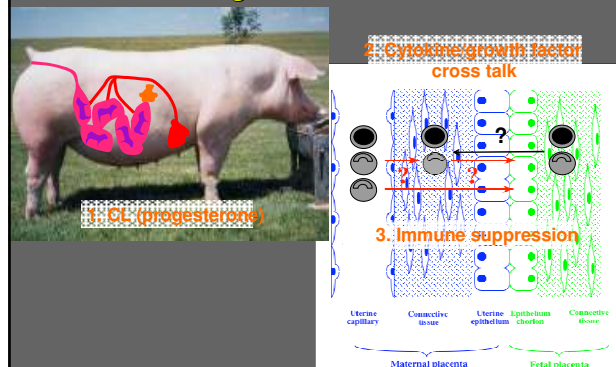


Virus infections causing reproductive problems Pathogenesis, clinical symptoms and diagnosis

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Normal gestation in the sow



How do viruses cause reproductive problems?

1. General disease (fever) ~ pro-inflammatory cytokines causing distortion of cytokine balance
-> swine influenzavirus, ...
2. Replication of pathogens in reproductive tract/embryo/fetus
-> DNA viruses: Aujeszky's disease virus, parvovirus, porcine circovirus 2
-> RNA viruses: porcine reproductive and respiratory syndrome virus, porcine enteroviruses, encephalomyocarditis virus, classical swine fever virus

How do viruses reach embryos/fetuses?

1. Contaminated sperm



How do viruses reach embryos/fetuses?



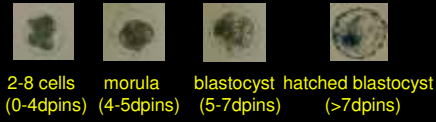
1. Via contaminated sperm



Virus excretion in sperm
~ viremia

Viruses	Embryo	Repeat breeding
DNA-viruses	Virus rep & ↑	} repeat breeding
ADV (<14 dPI)	Virus rep & ↑	
PPV (<14 dPI)	Virus rep & ↑	
PCV2 (<50 dPI)	Virus rep & ↑	} repeat breeding
RNA-viruses	No virus rep (only infection sow)	
PRRSV (<50 dPI)	Virus rep & ↑	
PEV (<14 dPI)	Virus rep & ↑	
CSFV (<14 dPI)	Virus rep & ↑	

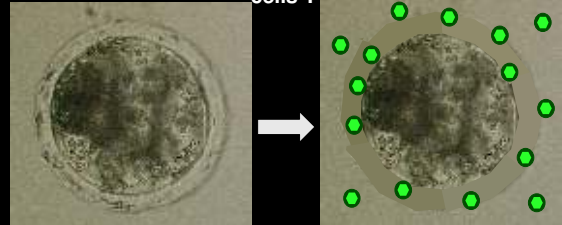
At what stages can embryos be infected ? ZP intact embryos



	2-8 cells (0-4dpins)	morula (4-5dpins)	blastocyst (5-7dpins)	hatched blastocyst (>7dpins)
ADV	-	-	-	+
PPV	-	-	-	+
PCV2	-	-	-	+
PRRSV	-	-	-	-
PEV	?	?	?	+
CSFV	?	?	?	+

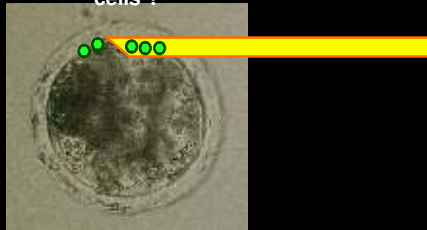


Resistance of ZP+ embryos
-> due to the presence of the ZP ?
-> due to the resistance of embryonic cells ?



a. removal of ZP by enzymes/mechanical forces
+ virus incubation

Resistance of ZP+ embryos
-> due to the presence of the ZP ?
-> due to the resistance of embryonic cells ?



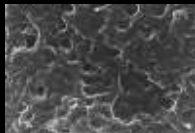
b. subzonal microinjection of viruses

At what stages can embryos be infected ? ZP-

	2-8 cells (0-4dpins)	morula (4-5dpins)	blastocyst (5-7dpins)	hatched blastocyst (>7dpins)
ZP+ ADV	+	+	+	+
ZP+ PPV	+	+	+	+
ZP+ PCV2	+	+	+	+
ZP- ADV	-	-	-	-
ZP- PPV	?	?	?	+
ZP- PCV2	?	?	?	+
ZP- CSFV	?	?	?	+

No receptor

Zona pellucida is an ideal barrier



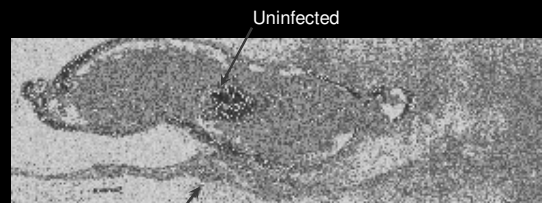
1° Physical barrier

Channels in ZP : ± 30 nm (inner ϕ)
Viruses > 30nm (ADV, PRRSV, CSFV)

2° Chemical barrier

Viruses < 30nm (PPV, PCV2, PEV)


Outcome of PPV-infection



Uninfected


PPV-infected

Outcome of embryonic PCV2-infection




HB 6 dpins
PCV2/mock

Surgical ET



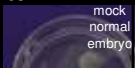
Euthanasia D14 post ET

Inspection of ovaries & Collection & analysis of embryos




Outcome of embryonic PCV2-infection

Sow n°	Embryos at transfer n°	Embryos at euthanasia n°	Embryos normal	Embryos degenerated	Ovaries
A	statu	19	19	0	CL
B	s	17	15	2	CL
C	26 mock	13	7	6	CL
D	26 mock	3	0	3	CL
E	20	0	0	0	follicles
F	PCV	0	0	0	follicles
G	2	0	0	0	follicles
	23				
	PCV				
	2				
	20				
	PCV				
	2				



mock normal embryo



PCV2 degenerated embryo

Outcome of embryonic PCV2-infection

Sow n°	Embryos at transfer n°	Embryos at euthanasia n°	Embryos normal	Embryos degenerated	Ovaries
A	statu	19	19	0	CL
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E	20	0	0	0	follicles
F	PCV	0	0	0	follicles
G	2	0	0	0	follicles
	23				
	PCV				
	2				
	20				
	PCV				
	2				

IHC-PCV2

Outcome of embryonic PCV2-infection

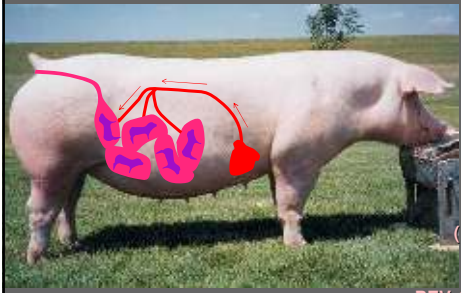
Sow n°	Embryos at transfer n°	Embryos at euthanasia n°	Embryos normal	Embryos degenerated	Ovaries
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F	PCV	0	0	0	follicles
G	2	0	0	0	follicles
	23				
	PCV				
	2				
	20				
	PCV				
	2				

IHC-PCV2

PCV2 infection of embryos leads to

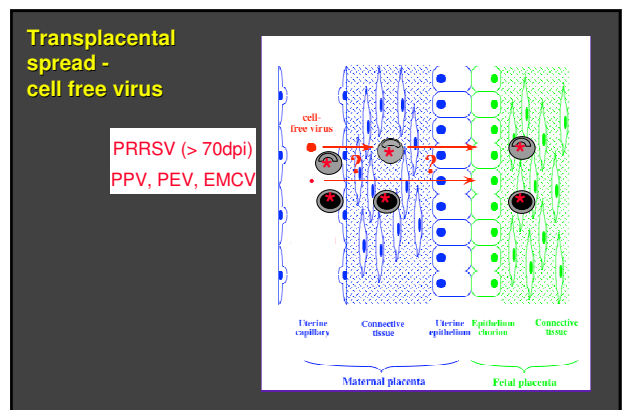
- embryonic death
- return to oestrus of sow

Viremia + transplacental spread



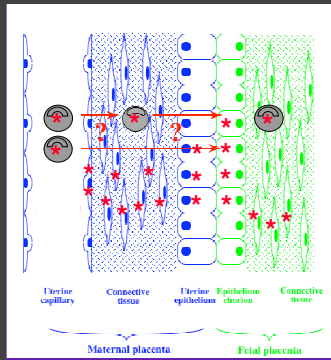
DNA-viruses (PPV, PCV2, ADV)
RNA-viruses (PRRSV, CSFV, PEV 1, 3, 6 & 8, EMCV)

- Cell-free: PPV, PEV, PRRSV, EMCV
- Cell-associated: ADV, PCV2, CSFV



Transplacental spread - cell-associated virus

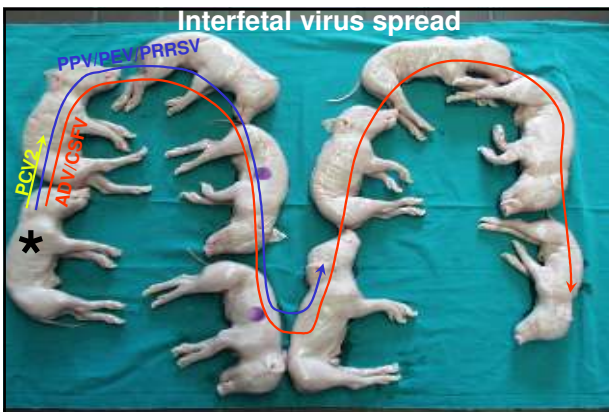
PCV2, ADV, CSFV



Cell-associated transplacental spread of ADV



Interfetal virus spread



Clinical outcome - fetus

	Infection time (days of gestation)			
	0-30	30-60	60-90	90-113
ADV	†	†	†	†
PPV	†	†	†/IR	IR
PCV2	†	†	†/IR	IR
PRRSV	-	(†)	†	†/IR
PEV	†	†	†/IR	IR
CSFV	†	†/IT terato	†/IR	†/IR

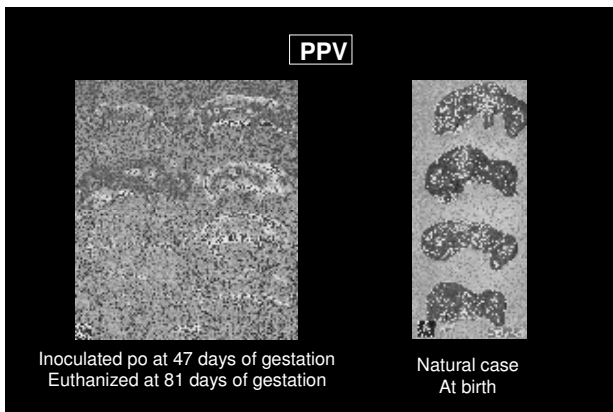
IR immune response
IT immune tolerance

Clinical outcome - sow

	Infection time (days of gestation)			
	0-30	30-60	60-90	90-113
ADV	repeat br.	abortion	abortion	abortion/msw
PPV	repeat br.	msw	msw	normal
PCV2	repeat br.	msw	msw	normal
PRRSV	-	-	late abortion/msw	late abortion/msw
PEV	repeat br.	msw	msw	normal
CSFV	repeat br.	abortion/msw	abortion/msw	abortion/msw




msw: mummies, stillborn and weakborn piglets at birth



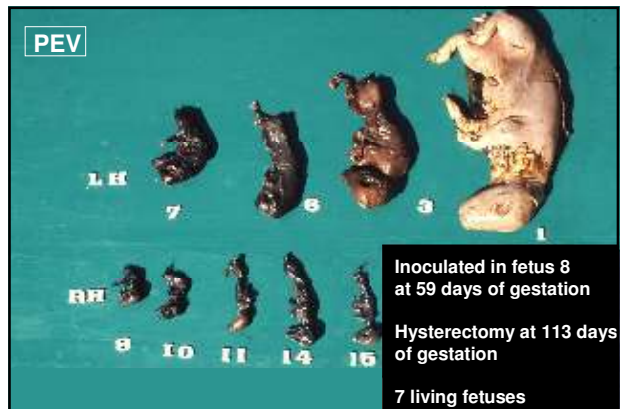
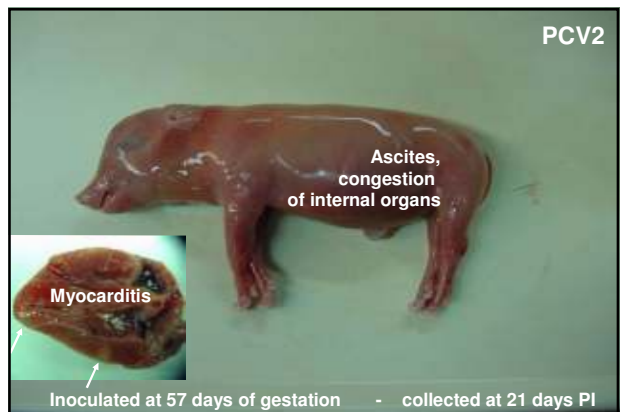


PCV2

Inoculated (days of gestation)	Aspect at birth	Virus	Abs	Intra-uterine spread	Interruption of gestation
57	mummified	+	-	+	-
75	stillborn autolytic	+	+	-	-
92	normal	+	+	-	-

mummified
autolytic
normal



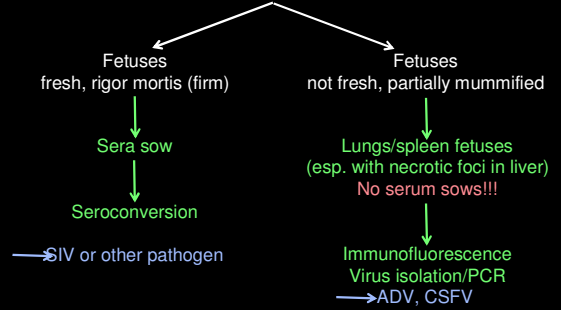
CSFV



Inoculation of CSFV (low virulence) po at 43 days of gestation
Collection at parturition

Reproductive failure - Diagnosis?

Main complaint: abortion ≠ stages of gestation



Reproductive failure - Diagnosis?

Main complaint: SMEDI

Fetuses/piglets at birth
Mummies (≠ stages), stillborn and normal piglets

- 1) Heart/spleen/lungs fetuses (<70 dpins; <17cm)
 - 2) Body fluid/serum fetuses (>70dpins; >17cm)
- No serum sows!!!

- 1) Virus isolation/PCR
- 2) Antibody detection (NOT FOR PCV2!!!)

→PPV, PCV2, PEV, EMCV

Reproductive failure - Diagnosis?

Main complaint: Late abortion/early farrowing

Fetuses at late abortion/early farrowing
Early stages of mummification (brown), stillborn and normal piglets

Placenta/lungs/spleen fetuses
Serum stillborn/piglets before colostrum uptake

No serum sows!!!

Virus isolation/PCR

→PRRSV

Virus-embryo/fetus work

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