Classical swine fever

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Economic impact of CSF

- Netherlands 1997
  - 11 million pigs killed
  - 2.3 billion US dollars (Meuwissen et al., 1999)

- Significant losses in endemic areas
  - Around 26% mortalities
  - Abortions, returns to service
  - Additional costs of control
  - Also losses to abattoirs, processors and retailers

- In extensive pig-holding systems in developing countries the animal and economic losses may be less obvious
  - Provide an important source of protein in communities that are very poor
  - Also "piggy bank" – up to 42% of family income

Pestiviruses - four genotypes:

- Classical swine fever virus
- Bovine viral diarrhoea virus type I (BVDV-I), BVDV-II, BVDV-III (atypical)
- Border disease virus (BDV)

Single strand positive sense RNA, 40-60nm, 12.5kB, one ORF/polyprotein
Family: Flaviviridae

Survival of CSF virus

- Can be regarded as moderately fragile
- May survive long periods under favourable conditions
  - Cool, moist, protein rich
  - Refrigerated meat - 3 months
  - Dry-cured meat - 6 months
  - Environment
    - Sheltered surfaces – 7-14 days
    - Manure - 15 days
    - Water - 6-24 days
- Disinfection – an enveloped virus
  - Sensitive to organic solvents
  - Also all commonly used disinfectants

Transmission of CSF

- Very contagious
  - Pig-to-pig contact
    - Oral and aerosol spread
    - Semen
    - Transplacental
  - Feeding of food scraps/swill
  - Infected pig pens, lorries, equipment, clothing
  - Transmission by needles/instruments
  - Vaccine contamination

Natural hosts of classical swine fever

Genus Sus
- Sus scrofa (wild boar)
- Sus scrofa domestica (domestic pig)
- Chinese breeds?
  - Some say variable...
- Other tribes of Suinae?
  - Pecary (Tayassu spp.), Warthog (Phacochoerus spp.)
  - Bushpig (Potamochoerus spp)
  - Pygmy hog (Sus salvanius)
  - All Yes
- Babyrousa - unknown
Epidemiology of CSF

• Virus endemic in wild pigs
• Also in village pigs in many countries
• Introduction into free countries by:
  – pigs
  – pig products, incl semen
  – Semen
  – Contamination of other biologicals
  – Inadequate containment within laboratories
• Spread by:
  – All of the above
  – Fomite transmission, incl. visitors clothing

Molecular epidemiology – Genotypes of CSF virus

• Compares nucleotide sequences of different regions of the viral genome
• Can distinguish groups and sub-groups
• Can assess the degree of inter-relatedness of isolates
• Can indicate the likely source of a virus in an outbreak
• Utilize complex computer algorithms

EPIDEMIOLOGY and PATHOGENESIS ARE LINKED

CSF - distribution

• Worldwide
  – Endemic in many countries, controlled by vaccination
  – Particularly prevalent in SE Asia
    • Husbandry systems are a challenge to control
    • Also reported in wild pigs in many countries in Asia
  □ South & Central America
    □ Much effort at eradication – some success
    □ Village pigs a problem
  □ Developed countries – mainly free
    □ But still occasionally appears in wild boar in Europe

Pathogenesis of classical swine fever

• Many factors can affect the clinical signs and pathology
  – Virulence of the virus
  – Health of the pigs
    • concurrent / 2° infections
    • Other stress factors eg environment, crowding
  – Age of the pigs
  – immune competence
  – nutritional condition

CSF virulence

• Field strains vary widely in virulence
• High virulence
  – acute disease, high mortality
  – Outcome independent of host factors
• Moderate/low virulence
  – subacute/chronic, low mortality
  • but may be high mortality in fetuses and newborns
  • Host factors can affect outcome of infection
**CSF infections - three forms**

1. Acute
   - postnatal, high virulence
2. Chronic
   - postnatal, moderate virulence
3. Late-onset - congenital infection
   - prenatal, low virulence

**Epidemiology of infection - high virulence strains**

- Highly contagious
  - large amounts of virus excretion
  - oronasal & lacrimal secretions, urine, faeces
- Fast spread
  - pig-to-pig
  - mechanical vectors
    - personnel, pets, birds, arthropods
- Pig density a significant factor

**Epidemiology of infection - low virulence strains**

- Infection often unnoticed
  - in utero transmission
- Short period of virus excretion during acute infection
  - lower levels of virus
- Large quantity of virus at farrowing
- Congenitally infected piglets a continuous source of spread

**CSF - early clinical signs**

- First appearance - only a few affected pigs
  - Drowsy, less active
  - arched backs / chilled
  - drooping head / straight tail
  - reduced appetite
  - marked anorexia
  - fever - to 42°C or more
- Drop in leukocyte count - 3 to 9 x 10^3 per mm^3
- Eyes - marked discharge/conjunctivitis
- Constipation, turning to grey diarrhoea
- Vomiting - bile

**CSF - the outbreak**

- More pigs show clinical signs
- Early-affected pigs:
  - gaunt, hollow-flanked
  - weaving, staggering gait - weak hindquarters
  - posterior paralytic
  - purplish discoloration over abdomen, ears, snout, medial sides of legs
  - High virulence - death 10 to 20 dpi
  - medium virulence - death within 30 days

**CSF: very sick sow IP9**

(UK infectious premise 2000)
Chronic CSF
(Mengeling & Packer, 1969)

- Clinical improvement after acute phase
- Persistent leukopenia
- Second phase of illness
- Anorexia and depression
- Fever, death
- Survivors: growth retarded, skin lesions, arched backs. Can live for 100+ days
- Live for 100+ days
- "Textbook" lesions of CSF are seen
- Seropositive – lab levels may fluctuate
- Virus positive
- PCR or antigen ELISA
- Antibody may interfere with AgELISA
- "Textbook" lesions of CSF are seen

CSF (IP1)

Note skin lesion
Distribution - not typical

CSF - encrusted eyelids - conjunctivitis
CSF - skin lesions

CSF (IP6) - skin lesions on perineum

CSF - more extensive skin lesions (EURL Hannover)

Late onset disease - Congenital infection
(van Oirschot & Terpstra 1977)

- High amounts of virus excreted
- gradually aggravating depression and anorexia
- normal to slightly elevated temperatures
- conjunctivitis, dermatitis, locomotory dysfunction
- Death - 2 to 11 months
- Seronegative – MUST detect virus to identify them!
  • PCR or antigen ELISA
  • If one detected, cull whole litter

Gross pathology: lesions of acute CSF (1)

- Multiple haemorrhages - various sizes
  - haemorrhages of lymph nodes
    • peripheral or diffuse - marbled red to near-black
    • LN swollen, oedematous, haemorrhagic
    • virtually all LN may be affected
  - haemorrhages of kidney
    • petechiae to acchymotic
    • more frequently on cortex
    • Also seen in urinary bladder, larynx, epiglottis, heart, intestinal mucosa, serous and mucous membranes, skin (cyanotic)
Hepatogastric lymph nodes - enlarged & haemorrhagic

Gross pathology: lesions of acute CSF (2)

- Infarction of the spleen
  - almost pathognomonic
  - disrupted blood flow - occlusion of capillaries by thrombi
  - Raised, dark blebs of various sizes
    - singly, or as a series, coalescing along the edge of the spleen
    - Similar lesions in gall bladder and tonsil
- Septicemic complications
  - Suppurative tonsillitis
  - Fibrinous bronchopneumonia

Splenic infarcts

Kidney haemorrhages
Gross pathology: lesions of acute CSF (3)

• mummification, stillbirth, malformations
• in stillborns:
  • subcutaneous oedema
  • hydrops ascites
  • hydrothorax
  • deformities of head and limbs
  • hypoplasia
• in newborns:
  □ petechial haemorrhages of skin and internal organs

CSF: fetal death, mummification and size variation

Gross lesions of chronic CSF

• Infarction of the spleen
  – less pronounced than acute disease
• Ulceration of caecum and colon
  – often with necrosis - “button ulcers”
• Rib lesions
  – transverse line of semisolid bone across rib, proximal from costochondral junction
  □ growing pigs
  □ sudden calcification of cartilage cells
  □ maybe also on growth plates of long bones

CSF - caecal ‘button ulcers’

Gross lesions of late-onset CSF

• Relatively few overt lesions
• Thymic atrophy
  – most pronounced lesion
• Lymph node swelling

Sick pigs - some other causes

PMWS
PRRS
PDNS
Swine influenza
Prevention and control
Use of vaccination - the theory

• Does NOT prevent infection OR excretion

• Should result in:
  • A lower susceptibility of vaccinated pigs to infection
  • And if subsequently infected:
    – Reduced severity of disease
    – Decreased virus excretion
    – Prevention of in utero infection

Live vaccines - efficacy

• Depends on:
  – Strain and virus titre
    • minimum 100 PO25 per dose
  – Time between vaccination and challenge
    • European Pharmacopoeia - 14 days
  – Age of pigs
  • “C” & “CS” strains - 4 days post-vaccination
    – Benefits within 1 day (Dawulf et al 2003)
    – Protection > 1yr, even lifelong
    – Claimed to prevent congenital infection

Use of CSF vaccine in endemic areas

• Vaccines alone will NOT eliminate disease
  – Maintain sub-clinical infection
    • China, 95%+ coverage, but CSF still present
    • 0.4% mortality due to CSF (Li et al 2000)
  – To be free, MUST stop using vaccines at some stage
    • Cost savings and international trade
  – Vaccine failure CAN occur
    □ Poor transport, storage, coverage or administration
    □ New strains of CSF? NO
    □ NO evidence of C strain vaccine being ineffective against diverse field strains – in fact, quite the contrary

ALL RELY ON EFFECTIVE COLD-CHAIN
Implementation of a control scheme

- Main areas to consider:
  - Regional control is more successful than farm-level control
  - Good farm biosecurity is ESSENTIAL
  - Monitor production figures – piglet survival rates are a good indicator of any problems
  - Veterinary infrastructure
    - Structured surveillance – strategy & demonstrable successes
    - Field diagnosis and sample collection network
    - Secure, quick transport to laboratory
    - Education to farmers
  - Laboratory facilities
    - Prompt, accurate diagnosis
    - Biosecurity issues
  - Vaccine production/cold-chain

In summary

- It is possible to eliminate CSF from herds by vaccination
  - Acute and chronic disease generally eliminated
  - Piglets may be vulnerable at 3-5 weeks
  - In utero transmission may still occur – abortion and PI piglets
  - Piglets may harbour virus for long periods (up to 11 months)
- Live vaccines are safe and very effective
  - C strain – Immunity within 4 days
  - Probably lifelong
  - Work against all strains of CSFV
  - MUST be made by a competent company and transported by an effective cold chain
- Prompt investigation and laboratory diagnosis of suspect cases
  - Passive surveillance also of value
  - Wild pigs
- Good farm biosecurity is also essential
  - For CSF and other diseases
  - In high risk areas, vaccination of young stock and boosters for dry sows