

13 Multisystemic Diseases

African Swine Fever

This highly contagious disease with a high mortality is caused by an iridovirus. It is a totally different virus from that causing CSF. Clinically it is impossible to differentiate the two diseases. It is found mainly in Africa but there have been outbreaks in Southern European countries. It occurs in Central Asia. It also occurs in the Caribbean and South America. It is a notifiable disease in the UK. It affects domestic pigs and wild boar. It does not cause clinical signs but occurs in bush pigs (*Potamochoerus porcus*) and wart-hogs (*Phacochoerus aethiopicus*). Both these species of pig are carriers and spread the disease to domestic pigs. The disease can be spread by pig lice and soft ticks. The virus will survive for long periods of time in meat products. The severity of the clinical signs is extremely variable but in the majority of outbreaks they are acute after an incubation period of 5–7 days. Affected pigs will have a high rectal temperature and be hyperaemic. They will be anorexic, depressed and recumbent. They often vomit and show respiratory distress. There may be epistaxis and bloody diarrhoea. Death will follow in 48 h. The severe disease may result in neurological signs. If the less severe signs occur there is a lower viraemia and pigs will recover. There may be some transient joint inflammation. The first manifestation

may be abortions. Diagnosis in live pigs is made by PCR and a variety of methods have been described. Virus isolation and diagnosis can also be carried out by replication of virus in primary macrophages and detection of infected cells by the characteristic haemadsorption of red blood cells around infected cells (Coggins, 1968). Diagnosis can be made by serum ELISA but this has a reduced sensitivity compared with PCR. At post-mortem the spleen, tonsils and gastro-hepatic lymph nodes should be submitted for virus isolation. This can be verified on PCR. There are petechiae in the kidneys, lymph nodes and heart.

Strict import controls on pigs, pig products and pig by-products should prevent the spread of this disease. However, illegal imports, accidentally or intentionally, continue to cause this disease to spread. The ban on swill feeding reduces the risk of exposure of pigs to illegally imported infected meat products. However, accidental exposure, particularly in farms with outdoor pigs and pet pigs, remains a risk. The infection of wild boar from exposure to infected meat is also possible, which could increase the risk of spread to domestic pigs if they come in contact with wild boar. Wild boar constitute a risk of trans-boundary spread in areas where wild boar are common.

There is no treatment or vaccine available. However the prospects for vaccine development are good.

Anthrax

This rapidly fatal disease in cattle is not nearly so acute in pigs, although of course it is still a zoonosis and is notifiable in the UK and throughout the world. It is extremely rare in the UK and most other temperate countries; however it is seen more often in tropical countries. The disease is caused by *Bacillus anthracis*. While the organism is in the pig it may multiply and is sensitive to penicillin. If the blood or other body fluids are allowed to leak out of the pig into the fresh air, the bacteria will form spores which are very resistant to boiling and most disinfectants. These spores can survive in the soil for decades. It is therefore vital that infected pigs are either burnt or buried in quicklime. Pigs can develop three forms: the enteric form, the septicaemic form and the skin form. Pigs can become infected with the enteric form in various ways: ingesting the spores in the soil when rooting, from biting flies and most importantly from eating contaminated foodstuffs. Pigs can develop the septicaemic form as a result of the enteric form. The organism normally gets into the circulation via the tonsils. Pigs can also become infected with the skin form through contamination of wounds. The septicaemic form is rare in pigs. The most common manifestation is swelling of the throat with difficulty in breathing. Pigs will have a raised rectal temperature and will be depressed and anorexic. Mortality is under 20%. However, recovery will be slow and often areas of skin become necrotic and slough off. Diagnosis can be carried out by seeing the organism with its tell-tale capsule in smears taken from subcutaneous oedema of the throat and stained with MacFaddean's stain. Smears should be taken on to blood slides and air-dried. These should then be fixed by heat from a naked flame. Old methylene blue should be applied to the slide when cool and left for 30 s. It should be washed off with running water. Once the slide is dry it can be examined under oil emersion. The rectangular bacteria in chains will take up the stain and the capsule will be clearly seen as a translucent covering.

It must be remembered that anthrax is a zoonotic disease and therefore the wisdom

of treating pigs with anthrax is in question. Certainly the meat from infected pigs should not be used for human consumption.

There is a vaccine available in certain countries but it is not licensed for use in the UK or elsewhere in the EU.

Classical Swine Fever

The disease is also called hog cholera in the USA. It is caused by a pestivirus. It is a highly contagious disease and cannot clinically be differentiated from ASF. It is found worldwide but the UK, Australia, New Zealand and the USA are free of the disease. On the whole, Europe is free but there are sporadic outbreaks. It is a notifiable disease in the UK. It affects domestic pigs and wild boar may harbour the virus, but the main transmission is from pig to pig. Like ASF the virus may be spread by feeding pig products to pigs. The CSF virus is more fragile than the ASF virus and is readily killed by heat. Historically this resulted in the boiling of swill, but now swill feeding is banned in most countries. The normal manifestation of the disease is the severe acute form. However, the chronic form is also seen. Pigs die eventually within a couple of months. The normal incubation period is 3–7 days with death in 10 days. Affected pigs will have a high fever and constipation which is then followed by diarrhoea. There are haemorrhages and cyanotic areas on the skin, particularly on the legs. There are often neurological signs which are not just from the high fever. There may be abortions. The disease can be suspected on clinical grounds. Whole blood in ethylene diamine tetra-acetic acid (EDTA) (normally a purple-topped tube) can be taken for virus isolation. Clotted samples (normally a red-topped tube) are useful for serology. On post-mortem there are widespread haemorrhages and ecchymoses found in the lymph nodes, spleen, bladder and larynx. The pathognomic sign is the ecchymotic kidneys, the so-called 'turkey egg' kidneys. There is a non-suppurative encephalitis. Antigen detection can be carried out using direct immunofluorescence on frozen sections of the tonsil. RT-PCR can be used to differentiate CSF virus

from other pestiviruses. There is no treatment and most countries adopt a slaughter policy. In countries where the disease is endemic there is a vaccine which may be used. If wild boar are involved there is a live vaccine, which can be put in bait to attempt to control the disease.

***Clostridium novyi* Infection**

This bacterium used to be called *Clostridium oedematiens*. It is type B *Clostridium novyi* which normally affects pigs. It is possible that type A will also cause a similar condition. It occurs worldwide. It causes sudden death in adult pigs and large fat pigs because it produces a powerful toxin. It replicates only in an anaerobic situation. This occurs in the liver of a pig affected with chronic pneumonia or severe enteritis. On post-mortem the liver is full of gas and looks like foam rubber. Diagnosis can be confirmed on FAT or PCR on the liver tissue. Post-mortem changes occur extremely rapidly, so trying to confirm the diagnosis by seeing the organism on smears is unreliable.

There is no treatment as the animals will be found dead. However, controlling the predisposing conditions such as the pneumonia or enteritis with antibiotics might be helpful. There is no licensed vaccine for pigs in the UK. Sheep vaccine can be used on the cascade system and seems to be effective.

Foot and Mouth Disease

FMD is a highly contagious disease which occurs as an acute disease in pigs. It is caused by an aphthovirus. It is notifiable throughout the world. It is not found in the UK and mainland Europe except occasionally there may be incursions from the East. It is not found in the USA, Australia or New Zealand. It is found in Asia, Africa and South America.

There are seven different serotypes. 'A', 'O' and 'C' are classically described as European serotypes. They are the only serotypes which have been found in Europe. They are also found in Asia and Africa. The Asia serotype is restricted to Asia. The three South African

serotypes, 'SAT 1', 'SAT 2' and 'SAT 3', are found in Africa and on occasions have been found in Asia.

The virus is extremely contagious and can infect pigs by inhalation, ingestion and by skin wounds. The most important for an initial infection is when pigs eat an infected piece of meat. However, when an outbreak has become established then the respiratory route becomes extremely important. There is a massive outpouring of virus in exhaled air. With housed pigs kept in modern pig houses with good ventilation, there is a 'plume' effect. This can spread the virus over wide areas.

Clinical signs are seen in all ages of pig. They are very marked and unlikely to be missed by observant practitioners. There will be a sudden onset of severe lameness in the whole herd. Piglets and growing pigs will actually squeal if made to move. All ages will have hunched backs and be reluctant to move. They should have their feet washed with water, ideally from a hose, to clean off any debris and then the small raised areas will be seen. These rapidly turn into vesicles approximately 1 cm in diameter. Vesicles will be seen on the tongue and the snout, which make the pig produce excessive saliva. Disinfectants should not be used to clean the feet as they will lessen the chances of virus isolation.

Leptospirosis

This can be considered to be a multisystemic disease as it can cause meningitis, jaundice and fever in young pigs. However its main manifestation occurs in the reproductive system of sows which leads to abortions and stillbirths.

Malignant Catarrhal Fever

Malignant catarrhal fever (MCF), a cattle disease which is caused by ovine herpes virus type 2 (Ov-HV2), has been recorded in pigs. The main clinical signs are: corneal opacity, ocular discharge and respiratory distress. Diagnosis is made by PCR. The disease is contracted from sheep.

Porcine Dermatitis and Nephropathy Syndrome

PDNS is normally a disease of large fattening pigs. It often occurs at the same time as PMWS. There is no direct link between the two diseases. Some authorities suggest that there is a link between PDNS and *Pasteurella multocida*. The syndrome is likely to be a hypersensitivity reaction to either a virus or a bacterium. Affected animals have confusing clinical signs. The pigs are normally pyrexemic. The most obvious other sign is the marked, purplish, widespread skin coloration. This is mainly on the hindquarters. There is no treatment and euthanasia is advised. On post-mortem there is general lymphadenopathy with the kidneys swollen and petichiated. There is also pneumonia.

Porcine Reproductive and Respiratory Syndrome

PRRS is a disease which affects all ages of pig when there is no immunity in the herd. This situation is now rare as not only is the virus widespread but also there are many good vaccines available. Sows will show respiratory distress but not marked pyrexia. Only a few animals will show the classical sign of blue ears. Abortions will occur and as time

goes on there will be a larger percentage of stillbirths and returns to service. There will be a sharp rise in the number of weak piglets born. These will have conjunctivitis. Many will not survive. The number of deaths in the weaner pens will rise. The pigs will have pneumonia. Post-mortems will not be very helpful as there will be a rise in the number of other conditions usually seen in the herd. Frozen tonsil samples will reveal the virus. Antibiotics will not be effective in controlling the disease. Vaccination is the key.

Post-weaning Multisystemic Wasting Syndrome

This disease is caused by PCV-2 and so PMWS is often called porcine circovirus. The infection is very widespread in the UK and throughout the world with the exception of Australia and New Zealand. It was first reported in Canada in 1996 (Fig. 13.1).

The virus spreads oro-nasally with an incubation period of 10–14 days. Piglets can also become infected in the womb. Passive immunity protects against clinical disease but not against infection. Presence of the virus predisposes to infections of PDNS. The presence of torque teno virus (TTV), which is a ubiquitous and species-specific virus that infects domestic pigs and wild boar, can serve as a 'trigger' or



Fig. 13.1. A pig with post-weaning multisystemic wasting syndrome (PMWS).

co-factor for PCV-2 in the pathogenesis of PMWS (Novosel *et al.*, 2012). Infection in a herd will increase pre-weaning mortality but signs are not seen until after weaning particularly in 7- to 9-week-old growing pigs. As the name suggests, there are several systems affected and therefore there are a large number of clinical signs, namely: wasting, pallor, pyrexia, rough coat, jaundice, lymphadenopathy, diarrhoea and death (Fig. 13.1). Mortality in totally naive herds may be two-thirds of the pigs. The non-affected pigs will appear to be totally normal. As there is no treatment and no chance of recovery after the development of clinical signs, affected animals should be destroyed as soon as possible. Fattening pigs and adults are not affected. Abortions and stillbirths will be seen but these signs are not common.

PME will reveal a pale, often jaundiced, generally wasted carcass with all of the lymph nodes swollen, firm and pale. The lungs fail to collapse. The liver will be small and will often have white foci. The kidneys may be normal but more commonly they are pale and also have white foci. There are ulcers in the stomach. The intestines are distended with watery contents. There may be a typhlitis. Histopathological samples of the foci in the liver and kidneys are helpful with diagnosis. Histopathological samples of enlarged lymph nodes and the tonsil will show basophilic inclusion bodies. Bacteriology is not helpful as there is often a wide range of secondary bacteria. Diagnosis can be made on these post-mortem signs together with PCR. The presence of antibodies in aborted fetal fluids is diagnostic.

Control is by attention to strict hygiene and movement restriction. The virus is spread around the farm by pig-to-pig contact. This can also be indirect by a needle, surgical instrument, muck or people. Stressed animals are far more likely to become diseased. Vaccination of growing pigs against PCV-2 has been shown to be highly effective in decreasing the prevalence and severity of porcine circovirus-associated disease (O'Neill *et al.*, 2012). Studies have shown that a substantial number of piglets are born viraemic and appear to be healthy. The consequences of early, subclinical PCV-2 infection of pigs are largely unknown but it seems logical to assume that reduction or elimination of vertical

PCV-2 transmission is beneficial. One way to reduce dam viraemia and infection of piglets may be through dam vaccination. This was shown to be effective (O'Neill *et al.*, 2012). Vaccination of piglets before weaning is definitely helpful.

Swine Erysipelas

Erysipelas in pigs is caused by the bacterium *Erysipelothrix rhusiopathiae* (formerly *Erysipelothrix insidiosa*) that is found widely in wild birds and rodents. The organism is capable of survival in a damp environment (including soil) for up to 6 months. Thus exposure of pigs to any of these sources has the potential to lead to disease if the animals are not immune. Many strains exist but two predominate in cases of pig disease.

Erysipelas is a true multisystemic disease. It can affect the circulatory system in two ways. It can be a peracute disease with a septicaemia. This may be so peracute that the pig is found dead with blue discoloration of the skin and the extremities, together with petechiae throughout the carcass. It can also cause endocarditis in adults. This may also result in sudden death. If endocarditis is suspected the pig should be given prolonged high doses of penicillin and this against expectations may resolve the condition.

The most common form of erysipelas is the acute form which is mainly seen in growing pigs rather than in adults. Pigs will be lethargic and off their food. Rectal temperatures will rise to over 42°C. The classic diamond-shaped, raised red lesions will appear. The red colour will not be seen in black pigs but the lesions will still be felt on the skin. As the disease is very sensitive to treatment with penicillin the mortality is very low, but without treatment it can be up to 20%. In most cases the skin lesions will regress as the rectal temperature falls and the appetite of the pig returns. In some cases the skin lesions, because of secondary infections with *Staphylococcus* spp., will become necrotic and there will be a sloughing of the skin. In these cases the pig will take weeks to regain health and start putting on weight.

The high fever experienced by gilts suffering from this acute form of erysipelas will lead to abortions if they are in the later stages of pregnancy. This is just because of the pyrexia. With treatment not only should the animals receive penicillin but also NSAIDs to reduce the fever. Practitioners should warn pig keepers of this possible sequel to the disease. However, erysipelas will cause abortions per se. The organism can readily be cultured from aborted fetuses and afterbirths. Ten days after the abortion, serum from affected pigs will show high titres against erysipelas. This is an even more significant finding if the titre is low on the day of the abortion. If sows and gilts suffer from erysipelas early in pregnancy there will be high levels of returns to service. If they are infected at 2–3 months of pregnancy they will go to term but produce mummified piglets.

Erysipelas will also cause arthritis in growing pigs and replacement gilts. This is thought to be immune mediated and often is seen in pigs which have not shown the clinical signs, although normally their pen mates have experienced the disease. In the author's experience the condition is incurable, even with aggressive antibiotic and NSAID treatment, and therefore euthanasia must be recommended.

Vaccination is inexpensive and should be recommended for all classes of pig, both commercial and on smallholdings. It should be recommended for both growing pigs and adults. The vaccine is normally an inactivated vaccine in an aqueous adjuvant, which should be injected im. Pigs need to be a minimum of 6 weeks of age before the first injection. The second injection should be given approximately 4 weeks after the first injection. Then the cover needs to be kept up by 6-monthly boosters. Sows and gilts can be injected during pregnancy but if possible this should not be in the two final weeks. Immune sows will give passive immunity to their piglets for up to 9 weeks, so vaccination between 6 and 9 weeks will give continuous protection.

Other methods of control include removing sources of contamination. This is difficult in outside pigs but is worthwhile as the control measures are useful for other diseases. As wild birds are a source of contamination they should be kept away from pigs and particularly away from pig feed. Poultry, particularly

turkeys, are a source of contamination and should be kept separate. Rodent control is important. Faecal hygiene should be improved with empty and clean scrape-through systems. The equivalent measure in outdoor pigs is moving to fresh ground. This will be helpful in controlling erysipelas. Some authors consider sheep to be a risk to pigs. However, in the author's experience it is the pig which is a danger to the sheep. When ewes are lambing down in the same accommodation as pigs there is an increase in the number of cases of joint ill in lambs. *E. rhusiopathiae* can be isolated from inflamed joints.

In acute outbreaks of erysipelas in growing pigs the recommended preventive treatment is amoxicillin in the water. This should only be used as an emergency treatment while vaccination is being carried out.

Swine Vesicular Disease

The importance of this disease, which is caused by an enterovirus, is that it is indistinguishable clinically from FMD. It was first observed in Italy in 1966 but was not seen in the UK until 1972. It occurred sporadically in the UK until the early 1980s. It was last seen in Europe in Italy in 2005. It has been seen in the Far East but not in Africa, the New World, Australia or New Zealand.

The virus can penetrate intact skin particularly on the coronary band. It can also gain entry via the gut. It tracts through the lymph system and rapidly causes a viraemia. It will cause mild pyrexia within 2 days. Lameness through pain in the feet is the most prominent sign. Animals are reluctant to move. Unlike FMD, it does not occur in ruminants. Vesicles may be seen on the tongue and snout but foot lesions are the most noticeable. The incubation period is 2 days but can be as long as a week. It is spread mainly by pig-to-pig contact. The virus can survive in faeces for several months. Swill feeding, which is now banned in the UK, is often the cause of an outbreak.

Diagnosis can be made with RT-PCR which will distinguish the virus from FMD. At the present time there would be a slaughter policy if the virus was located in the UK.