Epidemiology and control of Aujeszky’s disease in Great Britain

W.A. WATSON*

Summary: The Aujeszky’s disease control programme was introduced in 1983 with the support of the owners of 75 per cent of the pigs in the country. It commenced at a time when infection was spreading rapidly, particularly in the areas of high pig density.

The exercise has illustrated the importance of having available the best possible information on all aspects of the disease if the correct control strategy is to be selected; it has also shown that where the long-term financial benefits outweigh the costs it is difficult in the early stages to finance such a programme and to maintain support if funded by the industry.

Despite the cost and some criticism of the programme it is interesting to reflect on the problems still being experienced by all the major pig producing countries which had no option but to permit the use of vaccines with or without the selective slaughter of heavily infected herds.

KEYWORDS: Aujeszky virus - Diagnostic procedures - Disease control - Economics - Epidemiology - Immune response - Swine diseases - United Kingdom - Virulence.

INTRODUCTION

Aujeszky’s disease (AD), first recognised in North America as early as 1813 and differentiated from true rabies by Aujeszky in Hungary in 1902, now has a worldwide distribution. It occurs in North and South America, Asia, New Zealand and North Africa. In Europe, only Norway, Finland, Luxemburg, Austria and now Switzerland, following eradication, appear to be free. There has been a rapid increase in incidence in many countries over the past two decades, particularly in the Netherlands, France, Belgium, West Germany and the USA [Figures 1 and 2 after Basinger (3)]. The factors responsible for this upsurge are not clear but it is likely to be associated with more intensive management, a greater concentration of pigs and possibly the occurrence of strains of increased virulence. As a result, most countries in which the incidence has escalated have moved to a vaccination policy complemented in some by a slaughter programme.

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FIG. 1
Recorded incidence of AD in Denmark, Belgium and France

Denmark (pig pop. 8.5 million)
Belgium (pig pop. 5 million)
France (pig pop. 11 million)
FIG. 2
Recorded incidence of AD in Holland, USA and USSR

Holland  (pig pop. 8 million)
USA      (pig pop. 72 million)
USSR     (pig pop. 63 million)
In Great Britain, AD was first recognised in pigs in the South West in 1953. In the earlier years sporadic outbreaks were reported with clinical signs in cattle and sheep, but little or no disease in pigs. By the 1970's, outbreaks of severe disease were occurring in pigs and, in 1977, infection appeared to be concentrated in three main areas — Avon, Humberside and East Anglia.

During 1977-80 infection spread mainly in East Anglia but, in the 18 months to May 1982, new foci appeared in North Humberside, North Yorkshire and Lancashire. No cases have ever been confirmed in Scotland.

The spread of infection was by the movement of pigs. For instance in 1982, 13 outbreaks were traced to weaner movements to fattening herds from a single breeding herd in Lincolnshire. However local spread occurred from these with no evidence of pig movement or personal contact. Detailed enquiries and the study of meteorological data suggested that airborne transmission could have accounted for seven of these outbreaks.

If a successful control or eradication programme is to be adopted, it is essential to have as much information as possible on the agent and the epidemiology of the disease.
FIG. 4
Aujeszky's disease
known infected premises to 31.7.79
• Infection last recorded prior to 1977
▲ Infection recorded from 1977 to 31st July 1979
FIG. 5
Aujeszky's disease (infected premises: 1/8/79 to 13/3/83)
TABLE I
Aspects of the pathogenesis and epidemiology of AD which influence decisions on control/eradication strategies

<table>
<thead>
<tr>
<th>Strains of virus in the pig population and their virulence.</th>
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<td>Host range.</td>
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<td>Wildlife reservoirs.</td>
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<td>Immune responses.</td>
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<td>Latent infection.</td>
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<td>Sensitivity and specificity of diagnostic tests.</td>
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<td>Routes of excretion.</td>
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<td>Means of transmission.</td>
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<td>Survival in pig carcasses and products and in the environment.</td>
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**STRAINS OF VIRUS AND THEIR VIRULENCE**

Although all isolates of AD virus behave as a single serotype in neutralisation tests, different biotypes have been recognised which vary in virulence. Four of the strains in Northern Ireland, for example, range from NIA 4, derived from cattle and non-pathogenic in pigs, to NIA 3 which will kill up to 20 per cent of older fattening pigs. Recently a fifth strain of low pathogenicity has been isolated.

English isolates from 1974 to 1982 have shown little difference in virulence when inoculated into pigs, other than for one less virulent strain isolated in 1974 which probably originated from Northern Ireland. Strains recently isolated at the Central Veterinary Laboratory, Weybridge, by stressing single seropositive sows removed from herds by steroid injections, were all virulent and caused typical AD when inoculated into 3 to 4-week-old piglets.

Syncytium formation in cell culture has been correlated with virulence in mice and there are indications that the mouse virulence marker can be correlated with virulence for the pig (4, 16). Harkness and Sands (12) observed that two of eight British isolates tested formed few syncytia and these were avirulent for mice.

The occurrence of strains of low virulence and their prevalence has important implications for the control strategy adopted. In Northern Ireland, for example, where strains of varying virulence occur and where a high proportion of the larger breeding herds are infected, national eradication by herd slaughter is not believed to be a practical proposition at the present time.

**HOST RANGE**

AD is a terminal disease in ruminants, carnivores and rodents with an incubation period of four to eleven days. Death supervenes about 48 hours after the onset of symptoms. Other domestic species and wildlife are of little importance in the maintenance of infection in pig populations.
**IMMUNE RESPONSE**

Seropositive pigs are potential excretors of virus for life and it is now well recognised that reactivation of latent infection may follow stress. This may be responsible for periodic acute phases of disease in an infected herd. Therefore, with any control policy based on the detection and removal of infected pigs, all seropositive animals must be slaughtered.

Attenuated and inactivated vaccines are used in many countries and recently sub-unit vaccines have been developed (14, 17). Sero-conversion following the application of vaccines complicates diagnosis and their use has never been allowed in Great Britain and it is restricted in certain other countries.

Although vaccinated pigs do not excrete vaccinal virus, they are still susceptible to challenge with field strains and excrete these, although the amount of virus is markedly reduced and excretion takes place for a shorter period (7). Until recently, it was widely accepted that such pigs were capable of acting as a focus of infection but some workers now believe that they are of little or no risk to susceptible in-contact animals.

A pilot control scheme in Northern Ireland has been based on the vaccination of breeding herds with an attenuated Bartha 61 strain (Duvaxyn) and NIA 4 with the removal of seropositive pigs from closed herds as soon as possible. This is seen as a means of establishing clean herds at minimal expense (McCracken, personal communication). Nevertheless, some countries, such as West Germany, only license inactivated vaccines and it is considered that spread of virus by vaccinated pigs is not completely prevented (18).

One problem associated with the use of vaccines is the lack of resistance in vaccinated colostrally immune piglets, when these are introduced into fattening units.

### Table II

**Aujeszky's disease vaccination**

<table>
<thead>
<tr>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Does not prevent infection with field strains.</td>
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<tr>
<td>Interferes with serological diagnosis.</td>
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<td>Immunity wanes — revaccination recommended at 6 monthly intervals.</td>
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<td>Programmes must be maintained indefinitely to maintain herd immunity.</td>
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<td>Passive immunity can interfere with active protection.</td>
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<td>Clinical disease may shift from the breeding to the fattening herd.</td>
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<td>Contaminated vaccine could introduce disease.</td>
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<td>The serological response may interfere with export certification.</td>
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<td>Vaccine virus may spread when given by the nasal or oral route should this be required to overcome passive immunity.</td>
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<td>No suitable vaccines are available for other species; these would be at a greater risk as AD spreads more widely.</td>
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</table>
Table III

Aujeszky's disease vaccination

Advantages

- Reduces clinical signs in an outbreak within 2-10 days.
- Some vaccines reduce shedding of virulent virus.
- Challenged vaccinated pigs may take only a few days longer to fatten — non-vaccinated pigs may take two weeks longer to fatten.
- Vaccines and culling may be used to establish clean herds.

Latent Infections

Latently infected carrier animals are an unwelcome complication if control by eradication is adopted, but they must be detected and dealt with.

Sensitivity and Specificity of Diagnostic Tests

The serum neutralisation test is sensitive and results are available in seven days, but it has now been superseded by the enzyme-linked immunosorbent assay (ELISA) with antibody detectable five to six days after infection and the advantage of more rapid confirmation and automation. This test has been used routinely throughout the present campaign and over 300,000 sera have been tested by Veterinary Investigation Centres and the Central Veterinary Laboratory, Weybridge. For surveillance purposes the Elisadisc technique is being introduced (2).

Transmission

Work by Donaldson et al. (6, 7) has confirmed and added to the knowledge on the excretion, transmission and persistence of virus.

They found that:
- after experimental infection of pigs most virus was excreted by the respiratory route;
- most virus recovered from aerosols was produced by infected pigs at three to four days post-inoculation;
- transmission of infection occurred by a 15 metre duct from accommodation housing experimentally inoculated pigs to other susceptible pigs in adjacent accommodation;
- virus could be recovered only from the tonsils of pigs killed 20 days after inoculation;
— pigs fed tissues from viraemic pigs showed no clinical signs of AD and did not develop a neutralising antibody response;
— pigs introduced into a loose box which had housed clinically affected pigs, without cleansing and disinfection, did not seroconvert.

Although other experimental observations suggest that the agent is relatively stable outside the host, in practice the cleansing and disinfection required for the present programme, and the requirements on restocking, have successfully prevented any recrudescence of disease.

The localisation and persistence of virus in tissues and carcasses is an important consideration if national eradication is attempted. These present little risk and the salvage of clinically normal pigs for human consumption is soundly based on the experimental findings.

It is believed that aerosol transmission of infection takes place both in Denmark (5) and in this country (9) and this is probably determined by the excretion of large amounts of virus, wind speed and consistency of direction and the topography of the area.

A feature of transmission, not appreciated until the present campaign was well advanced, is the risk from breeding movements. Although European observations (10, 15) on the presence of the virus in testes and semen were not confirmed by Hall et al. (11), they concluded that infection could be established via preputial inoculation. Some 65 outbreaks in 1983/84 were attributed to transmission of infection by breeding movements, mainly in small herds in the South West and Wales. Embryo transfer does not, however, appear to present a risk (13).

STRATEGY OPTIONS

In most countries with a high incidence of AD, vaccination has been adopted, supplemented in some by selective slaughter or herd slaughter. However, Switzerland, with only a few infected herds, introduced slaughter and compensation and the last seropositives were detected in 1983 (8). In Denmark the disease has been notifiable since 1980, and an eradication programme on an island by island basis has been introduced based on the testing of elite breeding herds with slaughter of reactors, restriction of all seropositive herds and sales limited to approved fattening units or direct for slaughter (1).

CONTROL IN GREAT BRITAIN

In July 1982 it was estimated that, if infection continued to spread at the same rate in Great Britain, there would be 50-100 new infected premises identified in 1985 and 100-300 each year to 1990. The actual number of infected premises was likely to be of the order of 1,000 by 1985 and up to 3,000 by 1990.
AD was made notifiable in 1979 but no action was taken following confirmation although advice was given to herd owners. In 1982 new legislation imposed restrictions on movement, but only if clinical signs were present in the herd. Pigs from these herds could only be sent for slaughter or to an approved fattening unit.

An analysis of the policy options for control in 1982 concluded that a national slaughter programme, with the salvage of marketable pigs not clinically affected for human consumption, would yield fairly substantial positive net benefits over a 21-year period on the assumptions used, over the policy adopted at that time or vaccination.

**TABLE IV**

*Aujeszky's disease: policy options for control*

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- All the slaughter control options considered yield fairly substantial positive net benefits over the 21-year period 1982-2002, on the assumptions used.
- Vaccination policies show net losses rather than benefits over the same period.
- Slaughtering with salvage for human consumption yields the highest net benefits — it is the economically most attractive of the policy options considered.
- There is little to choose in NPV terms between slaughtering with processing and slaughtering with burying or burning of all carcasses.
Difficulties thought likely to be experienced in implementing a stamping-out policy were:

— the need to phase the slaughter of pigs on some farms with removal of others for slaughter elsewhere to avoid welfare problems;
— the acceptability of pigs from known infected herds by transporters and abattoirs;
— ensuring satisfactory standards of cleansing and disinfection when this was left to owners;
— the extent of tracing and the timing and intensity of testing in suspect herds;
— the effects that such a policy could have on salvage values.

New legislation was introduced in the Aujeszky's Disease Order, 1983 and the slaughter of known infected herds commenced on 14 March 1983.

After the completion of the first phase of the programme, it was decided to limit the slaughter to seropositive pigs in those herds with no clinical disease where only one or two seropositives were detected and where there was no evidence of spread of infection on repeated serological testing. At the same time, a surveillance programme was introduced testing sera from slaughtered sows. To the end of September 1985, 500 outbreaks had been confirmed and selective slaughter carried out in 71 herds.
FIG. 8
Distribution of confirmed outbreaks of Aujeszky's disease
(14/3/83 - 30/8/85)
FIG. 9
Aujeszky's disease:
selective slaughter cases to 30.8.85
EPIDÉMIOLOGIE ET PROPHYLAXIE DE LA MALADIE D'AUJESZKY EN GRANDE-BRETAGNE. — W.A. Watson.

Résumé : En Grande-Bretagne, le programme de lutte contre la maladie d'Aujeszky a été lancé en 1983 avec le soutien des éleveurs qui possédaient 75% du cheptel porcin national. Il a débuté à un moment où l'infection était en train de se propager rapidement, en particulier dans les zones à forte densité porcine.

La mise en œuvre de ce programme a montré à quel point il est important d'avoir à sa disposition un maximum d'informations sur tous les aspects de la maladie pour choisir la stratégie de lutte adéquate. Il a également montré que, lorsque les bénéfices financiers à long terme l'emportent sur les coûts, il est difficile de financer un tel programme à son stade initial et de conserver le soutien des éleveurs s'il est subventionné par les organisations professionnelles.

Malgré le coût du programme et certaines critiques qui en ont été faites, il est intéressant de comparer l'expérience britannique avec les problèmes auxquels doivent encore faire face tous les autres pays producteurs de porcs ayant choisi d'autoriser l'emploi de vaccins, avec ou sans abattage sélectif des troupeaux fortement infectés.


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EPIDEMIOLOGÍA Y CONTROL DE LA ENFERMEDAD DE AUJESZKY EN GRAN BRETAÑA. — W.A. Watson.

Resumen : En Gran Bretaña, en 1983 se promovió el programa de lucha contra la enfermedad de Aujeszky con el apoyo de los ganaderos que poseían el 75% de la cabáña porcina nacional. Se inició en un momento en que la infección estaba progresando con rapidez, especialmente en las áreas de alta densidad porcina.

La aplicación de este programa demostró hasta qué punto resulta importante tener a disposición la máxima información sobre todos los aspectos de la enfermedad para elegir la adecuada estrategia de lucha. También se demostró que, cuando los beneficios financieros a largo plazo logran ventajas sobre los costos, resulta difícil financiar este programa en su fase inicial y conservar el apoyo de los ganaderos si está subvencionado por las organizaciones profesionales.

Pese al costo del programa y algunas críticas que se hicieron, es interesante comparar la experiencia británica con los problemas a los que todavía tienen que enfrentarse los demás países productores de cerdos que optaron por autorizar el uso de vacunas con o sin sacrificio selectivo de los rebaños altamente infectados.

PALABRAS CLAVE : Control - Economía - Enfermedades de cerdos - Epidemiología - Métodos de diagnóstico - Reino Unido - Respuesta inmunitaria - Virulencia - Virus de Aujeszky.

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REFERENCES


