Open Government Status
Fully Open

ADVISORY COMMITTEE ON DANGEROUS PATHOGENS

Occupational Exposure to *Coxiella burnetii* (Q fever) in the Agriculture and Food Sector

Issue

1. Consideration of the risk of occupational exposure to *Coxiella burnetii* (Q fever) in the agriculture and food sector.

Microbiology

2. *Coxiella burnetii* is the causative agent of Q fever (Annex 1). *C. burnetii* are obligate intracellular gram-negative bacteria, which replicate as large-cell variants in the phagolysosome of infected mammalian cells. The bacteria also exist as small-cell variants and small dense cells (SDC), the latter of which have a greater physical stability (related to heat, pressure and chemical agents) and are believed to be the persistant forms in the host and environment. The SDC variants are believed to survive extracellularly as infectious particles for ~150 days. *C. burnetii* has two antigenic states, which differ in the structure of their lipopolysaccharide (*i.e.* infectious phase I bacteria (complete LPS) and avirulent phase II bacteria (truncated LPS)).

3. *Coxiella burnetii* is found in most parts of the world and infects a wide range of wild and domesticated animals including sheep, cows, goats, dogs and cats. *C. burnetii* infections in animals are generally asymptomatic, however, in mammals infection can result in late stage abortion, stillbirths or delivery of weak offspring. Q fever however, is not considered to cause economically significant animal disease and consequently, there appears to be little effort to control this infection in animals. Although *C. burnetii* is endemic in the UK, the prevalence in UK sheep and cattle herds is not accurately known but has been estimated in England, to range from ~20% in dairy herds and between 1.6%-6.3% in sheep.

4. Infected mammals shed *C. burnetii* in birth products but also milk, urine and faeces. Following infection, the duration of bacteria shedding is variable but can be up to 13 months in the milk of cows. Transmission to humans is most often associated with: inhalation of infectious aerosols or contaminated dust from parturient or slaughtered animals; direct contact with infected animals, their products (*e.g.* wool) or contaminated materials (*e.g.* straw); and ingestion of contaminated unpasteurised milk. Only small numbers of organisms are reportedly required to establish an infection (1-10 organisms by inhalation route), and can be influenced by environmental factors (*e.g.* windborne spread 0.5 to 2 kilometres). The incubation period is variable and appears inversely proportionate to the level of exposure, however, is typically 2-3 weeks though has been reported up to 40 days.

Human Infections

5. There are typically 70 reported cases of Q fever each year in the UK. This is thought to be an under estimate of the true incidence as diagnosis may be missed due to ~60% of cases being asymptomatic seroconversions and of the remaining 40% symptomatic cases, the symptoms vary and are non-specific. Acute human infection is characterised by an influenza-like illness with varying degrees of pneumonia and hepatitis. In about 1-11% of cases, chronic infection may develop, which appears to be dependent on host rather than bacterial factors (i.e. immunocompromised/suppressed, those with underlying heart condition or pregnancy). The chronic infection can lead to fatal endocarditis, chronic fatigue syndrome and repeated miscarriage. In pregnant women, infection is often asymptomatic but can result in placentitis (leading to abortion), neonatal death, premature birth and low birth weight. Diagnosis is based on serological testing whereby a high titre of IgM antibodies to phase II antigens is indicative of acute disease and a high titre IgG antibodies to phase I and phase II antigens is indicative of chronic disease.

6. A study demonstrated that seroprevalence of antibodies to *C. burnetii* in the UK as ~27% in farmers and ~10% in the general population. Infection is strongly associated with certain occupations (*e.g.* farmers, veterinarians, abattoir and meat processing workers). In addition those handling contaminated straw, hides or fleeces are at risk of exposure. There have also been several documented cases of infection in laundry workers handling contaminated clothing. Person to person transmission of Q fever is theoretically possible (*e.g.* presence of bacteria in sputum), however is a rare event.

Outbreak

7. In June/July 2006, there was an outbreak of Q fever in Scotland, at one of the largest and most modern meat processing plants in Europe (Annex 2), where 46 employees presented influenza-like symptoms, serologically confirmed as Q fever. In addition, 47 employees were asymptomatic seroconverters and 86 employees tested negative for antibodies to *C. burnetii*. Of those who tested negative, 3 individuals had received the Q fever vaccine in Australia. To date, 2 employees are still off work as a result of the disease. The affected individuals are subject to a health care monitoring programme for the next two years by NHS Scotland.

8. Approximately 2000 sheep and 200 cattle are processed at the plant per day. This includes housing of the animals in separate sheep and cattle lairages for up to 24 hours, then slaughter, skin removal, butchery processes and packaging of the raw meat for distribution to other companies and supermarkets. Whilst the source of the infection has not been conclusively identified, it is likely that *C. burnetii* was brought on to the site via infected sheep (*i.e.* an abortion in the lairage was recorded in the weeks preceding the outbreak), became aerosolised in the lairage and disseminated into an area frequented by workers. Dispersal of the bacteria appeared to be facilitated by an outward flow of air from the lairage, which was produced by supply fans creating a positive pressure within the building thus forcing potentially polluted air to escape via an open fire door and other orifices adjacent to employee's entrance and welfare facilities.

Investigation

9. The investigation of the outbreak identified that whilst, meat hygiene procedures and practices were at the forefront of the minds of employers and employees, the awareness of the risk from zoonoses appeared to be minimal. It is likely that other UK abattoirs have a similar lack of knowledge of zoonoses and little or limited occupational health provision. In 2007/8, it is HSE's intention to conduct a number of visits to other abattoirs to evaluate where an inspection programme is necessary to address this topic, in the 2008/9 work plan.

10. In addition to ensuring appropriate risk assessments were implemented and awareness of the zoonotic risk raised, a number of measures were recommended including: restricted and authorised access to specific areas; implementation of good hygiene practices (*e.g.* segregation of clean and dirty processes and practices; regular cleaning and disinfection of the lairages); and alterations to the lairage ventilation system to address containment requirements, balanced with animal welfare requirements (*e.g.* ammonia concentration in lairage). The control measures are aimed at adequate control rather than elimination of all risk.

11. In terms of occupational health provision, the outbreak identified the potential role of screening for those at risk because of pre-existing medical conditions, as well as screening for immunity as part of pre-employment assessments. Consideration is being given to vaccination of those without existing immunity at pre-employment assessment, or, otherwise, the use of serial serology as a means of detecting those with chronic but asymptomatic disease so that they can be given appropriate medical advice. There is also a need to to consider whether any special instructions should be given to at risk employees advising them of what to do if they have symptoms consistent with Q fever, and the need to consider whether any special advice should be given to those who are, or think they may be pregnant when there is a risk of exposure.

Control Measures

11. Sector specific control measures will be discussed with industry-wide trade organisations (*e.g.* British Meat Packers Association), which include abattoir workers, livestock handlers, meat hygiene officers and veterinarians. It is proposed to raise awareness of groups at higher risk of chronic disease and the need for the following measures, to minimise the potential for exposure:

- Provision of information and training for staff on the sources of zoonoses, routes of transmission and the most appropriate control measures necessary to adequately control exposure (*e.g.* task-specific risk assessments);
- Provision of pre-employment screening, health surveillance or reallocation of work for high risk groups (*e.g.* pregnant workers, immunocompromised individuals and those with heart valve conditions);
- Regular cleaning and disinfection of lairage areas to minimise accumulation of contaminated material resulting from bacterial shedding by animals;
- Specific measures for the timely disposal of placenta, birth products, foetal membranes, and aborted foetuses where present;
- Emphasis on the need for good occupational hygiene measures (*e.g.* hand washing, covering cuts/grazes, adequate segregation of welfare & work areas, wearing PPE) and restricted access to lairage to authorised staff;

- Where mechanical ventilation systems are used, measures should be in place to prevent the positive pressurisation of the lairage and airflow from the lairages being discharged into communal areas (*e.g.* location and operation of fans, ducting and deflectors);
- Location of the lairage areas away from communal areas (*e.g.* canteen) to minimise contact between the animals and workers.

Vaccination

12. In Australia, occupational vaccination against Q fever is mandatory for workers in this sector, however the vaccine is not commercially available or licensed for use in the UK. There are several vaccine types including an Australian licensed whole-cell vaccine (Q-Vax), and acellular vaccines from Czechoslovakia (Chemovaccine) and the USA (CMR vaccine) (Annex 3). Pre-vaccination screening is necessary and includes history, skin test and serology. The vaccine is only given if there is no history of Q fever disease or vaccination and the blood/skin tests are negative, since individuals previously exposed to the bacteria may experience severe reactions in the area of the injection site.

13. When considered by the Joint Committee for Vaccination and Immunisation, questions were raised over the efficacy of the vaccine and the incidence of Q fever in the UK (Annex 4).

Action

14. Members are asked to consider:

- The adequacy, proportionality and practicality of the proposed control measures, in respect of this occupational setting;
- Sources of further information on the incidence of Q fever in livestock in the UK;
- Whether vaccination of workers in this sector or particular groups (*e.g.* female veterinarians) is appropriate and should be recommended?
- The proportionality, and practicability, of pre-employment screening for at risk groups and pre-existing immunity, and in the absence of vaccination, the serological follow-up of those at risk and other ongoing surveillance/advice measures mentioned above.

Secretariat **January 2007**

References

- Arricau-Bouvery, N & Rodolakis, A (2005), *Is Q Fever an emerging or re-emerging zoonosis*, Veterinary Research, 36, 327-349
- Cutler *et al* (2006), *Q fever – a rarely reported zoonosis*, The Biomedical Scientist, November, 973-978;
- Maurin, M & Raoult D, (1999), *Q Fever*, Clinical Microbiology Reviews, 12(4), 518-553
- Parker *et al*, (2006), *Q Fever*, The Lancet, 367, 679-688;
- Tissot-Dupont *et al* (2007), *Role of sex, age, previous valve lesion and pregnancy in the clinical expression and outcome of Q fever after a large outbreak*, Clinical Infectious Diseases, 44, 232-237
- Van Woerden *et al* (2004), *Q fever Outbreak in Industrial Setting*, Emerging Infectious Diseases, 10(7), 1282-1289
- Woldehiwet, Z (2004), *Q fever (coxiellosis): epidemiology and pathogenesis*, Research in Veterinary Science, 77, 93-100;
- Zhang, G & Samuel, J E (2004), *Vaccines against Coxiella infection*, Future Drugs, 3(5), 577-584

Annexes

Annex 1 – Arricau-Bouvery, N & Rodolakis, A (2005), *Is Q Fever an emerging or re-emerging zoonosis*, Veterinary Research, 36, 327-349; Parker et al, (2006), *Q Fever*, The Lancet, 367, 679-688;

Annex 2 - Donaghy *et al* (2006), *Outbreak of Q fever in workers at a meat processing plant in Scotland July 2006*, Eurosurveillance, 11(8), 060824; van Woerden et al (2004), *Q fever Outbreak in Industrial Setting*, Emerging Infectious Diseases, 10(7), 1282-1289

Annex 3 - Zhang, G & Samuel, J E (2004), *Vaccines against Coxiella infection*, Future Drugs, 3(5), 577-584

Annex 4 - Joint Committee on Vaccination and Immunisation, Minutes of the meeting held on 6 February 2004, Para 17 ‘Q Fever’.

Annex 2 – Outbreak of Q Fever in UK

Outbreak of Q fever in workers at a meat processing plant in Scotland, July 2006; Eurosurveillance, 11(8), 060824;

M Donaghy[1], H Prempeh[2], N Macdonald[1] (Norman.MacDonald@hps.scot.nhs.uk)
[1]Health Protection Scotland, Glasgow; [2]Forth Valley NHS Board, Stirling.

On 9 July 2006, local public health authorities became aware of an increase of influenza-like illness in people who worked at a meat processing plant where cattle and sheep were slaughtered and meat packaged, in the town of Bridge of Allan in central Scotland [1]. An investigation was initiated and, by 14 of July, 49 members of the staff, out of a workforce of 228, had been identified as having fallen ill predominantly with two or more of the following symptoms: fever, headache, myalgia, dry cough and joint pain. All those with symptoms were screened for a range of pathogens and results from blood samples tested at the West of Scotland Specialist Virology Centre confirmed the illness as Q fever. Since then an epidemiological investigation has been undertaken including screening of all staff working at the plant. Nine patients had been admitted to hospital by 18 July. By 4 August, 51 cases for which the initial IgM result was greater or equal to 256 had been identified.The investigation continues.

There is a risk of contracting Q fever by airborne spread especially within a half-mile radius of a source. The plant is not situated near to residential buildings, but is close to a road with much vehicular traffic. Enhanced surveillance was begun to identify cases in the surrounding communities. All public health authorities in the country were alerted. So far no cases have been identified in individuals who do not work at the plant. Control measures including shutting down of the putative source and cleaning and disinfection have been put in place.

Q fever is an uncommon zoonotic infection caused by an organism called *Coxiella burnetii.* In the United Kingdom (UK), the organism is most commonly found in infected farm animals, especially sheep, cattle and goats, it may also be found in cats and wild animal species such as birds, rodents or bats; in some countries it is also carried by ticks. Transmission of *C. burnetii* to humans occurs primarily through inhalation of aerosols or dust contaminated with faeces or urine, or from direct contact with infected animals or their products of conception, or at slaughter. It may also be acquired from drinking unpasteurised milk. It is extremely rare for the infection to be passed from person to person and does not typically occur. The infective dose can be as low as one organism, and so large outbreaks can be caused by a small source. *C. burnetii* can survive for many years as a spore-like form before being inhaled and causing infection.

Human infection is divided into acute and chronic Q fever, although several distinct syndromes have been described. Usually symptoms occur two or three weeks after exposure (range 9-40 days) and illness is typically self limiting and influenza-like. Symptoms include:

- Fever (high temperature)
- Headache

- Muscle pains
- Fatigue
- Dry cough
- Pneumonia

Q fever is diagnosed by a blood test but a positive result is obtained two to four weeks after onset of the illness.

Full recovery usually occurs, even without treatment, but in some cases symptoms can be serious or prolonged, especially with pneumonia or pre-existing valvular disease, and may require hospital admission. Acute Q fever is treatable with antibiotics. The chronic Q fever form, particularly endocarditis, is a more serious complication and occurs in about 10% of cases. It may not appear until several years after the primary episode.

In the UK, most Q fever cases are sporadic or associated with exposure to farm animals or occur in areas (such as slaughterhouses) where animals are handled. Retrospective serological studies have shown evidence of extensive infection in high risk populations, which suggests that many cases are often not identified at the time of illness [2]. Q fever is not uncommon and seroprevalence studies indicate that approximately 27% of farmers and 10% of the general population in the UK have been exposed to *C. burnetii* at some time. Being present at calving and handling cattle products of parturition may pose significant risks, as high concentrations of the organism are found in the placenta and birth fluids.

Animal infection is most commonly reported in ruminants and studies in England and Wales have suggested that infection may be as high as 20% [3]. Although heavy infections in sheep have also been associated with abortions, it is not generally considered to be pathogenic in animals. Q fever is rarely recorded as a cause of bovine abortion and disease although 1.6% – 6.3% of ewes in England are seropositive, with over 30% of ewes positive in some flocks [4].

Outbreaks are frequently reported worldwide, but sources of infection in sporadic cases are often difficult to elucidate. There were two laboratory confirmed cases of Q fever reported in Scotland in 2005.

This article is adapted by the authors from reference 1.

References:

1. Q fever in Forth Valley meat processing plant. HPS Weekly Report 2006; 40(29): 149. (http://www.documents.hps.scot.nhs.uk/ewr/pdf2006/0629.pdf)
2. Thomas D R, Treweek L, Salmon R L et al. The risk of acquiring Q fever on farms: a seroepidemiological study. *Occup Environ Med* 1995; **52**:644-647
3. *Zoonoses Report, United Kingdom 2001*. London: Department for Environment, Food and Rural Affairs; 2003.
4. Martin W B, Aitken I D . *Diseases of sheep*. 3rd ed. Oxford: Blackwell Science; 2000.

Annex 4 – Excerpt from Joint Committee on Vaccination and Immunisation, Minutes of the meeting held on 6th February 2004

Joint Committee on Vaccination and Immunisation

Minutes of the meeting held on 6 February 2004

17. Q FEVER

The Committee was asked to consider if occupational vaccination against Q fever should be recommended.

The vaccination is currently recommended for occupational use in Australia and has been reported to be 100% effective. However, this report is questionable as other evidence suggests that 12 immunised individuals acquired the disease. The disease is occupationally acquired but the burden of the disease is difficult to assess. The vaccine contains thiomersal.

There were several unknowns, such as who was at risk of Q fever in the UK, the efficacy of the vaccine; and the data concerning the risk of vaccinating individuals previously exposed to Q fever.

The Committee asked for more information particularly about the burden of disease in the UK.