

Clinical Q fever in Northern Ireland 1962–1989

J H Connolly, P V Coyle, A A J Adgey, H J O'Neill, D M Simpson

Accepted 5 July 1990.

SUMMARY

Q fever was diagnosed in 443 patients in Northern Ireland between 1962 and 1989. From 1986 onwards there was an increase, which peaked in 1989 with 107 cases of whom 47 were infected in Ballycastle, Co Antrim. There were three outbreaks and 21 clusters of patients with Q fever. Most cases were in April and May which correlated with the peak lambing and calving season. Q fever mainly affected males in the 40–49 year old age group. County Antrim had the highest prevalence rate of 40/100,000 population and also had the most sheep. The number of sheep in Northern Ireland has doubled in the past ten years.

Q fever was strongly associated with occupation and animal contact. Eighty-seven patients (19.6%) drank unpasteurised milk. The commonest presenting illnesses were pneumonia (62.8%), influenza-like illness (24.6%), involvement of the heart (9.0%) and hepatitis (1.6%). Thirty-two patients (7.2%) had endocarditis, 20 of whom had prosthetic valves and three of whom died. *Coxiella burnetii* was present on valves removed from seven patients.

INTRODUCTION

Unexplained fevers in Brisbane abattoir workers were investigated by Derrick in 1937.¹ An organism was isolated by guinea pig inoculation and serial passage, and later shown by Burnet to be a rickettsia. Derrick named the disease Q fever and the organism *Rickettsia burneti*.² It was subsequently renamed *Coxiella burnetii* because it had different properties from the rickettsia.³ Q fever is now known to have a worldwide distribution. Investigation of Belfast abattoir workers in 1957 had shown that they lacked antibody indicating that the animals they slaughtered up to that time were not infected,⁴ and the first patient known to have had Q fever in Northern Ireland was identified in 1962.⁵ This paper reports the Northern Ireland experience since that date.

Regional Virus Laboratory, Royal Victoria Hospital, Belfast BT12 6BN.

J H Connolly, MD, FRCPI, FRCPath, Consultant Virologist.

P V Coyle, MB, MRCP, Consultant Virologist.

H J O'Neill, BA, PhD, Principal Scientific Officer.

D M Simpson, FIMLS, Chief Medical Laboratory Scientific Officer.

Regional Medical Cardiology Centre, Royal Victoria Hospital, Belfast BT12 6BA.

A A J Adgey, MD, FRCP, FRCPI, FACC, Consultant Cardiologist.

Correspondence to Dr Connolly.

MATERIALS AND METHODS

Serological methods. Complement fixation tests were performed using the method of Bradstreet and Taylor⁶ and the Microtiter system. Q fever phase 2 antigen was used for diagnosing acute infections and in seroprevalence surveys. Phase 1 antigen was used for diagnosing chronic infections. Sera from chronic infections and inoculated guinea pigs were titrated to high titre to avoid prozone effects. All titres are expressed as reciprocals. A four-fold or greater rise of phase 2 antibody indicated recent infection. A titre of ≥ 160 indicated infection in the recent past provided there was supporting clinical or epidemiological evidence indicative of recent infection. In seroprevalence surveys a titre of 8 or 10 indicated infection in the past. The presence of phase 1 antibody at a titre of > 200 indicated chronic infection.⁷ Antigens and antisera were supplied by the Division of Microbiological Reagents and Quality Control, Public Health Laboratory Service, Central Public Health Laboratory, London NW9 5DF.

Isolation of *C. burnetii*. Natural heart valves were homogenised in 5 ml buffered saline. Prosthetic valves were rinsed in buffered saline and any material attached was homogenised. Groups of four guinea pigs were inoculated with each valve suspension using 1 ml intraperitoneally. The guinea pigs were bled before inoculation and again 24 days later.

A surveillance form was sent to the doctor caring for each clinical case asking for details of the age, sex, address, occupation, animal contact (especially if parturient), unpasteurised milk drinking, travel abroad in month before onset, chest X-ray and final clinical diagnosis.

RESULTS

There were 443 patients with Q fever diagnosed between February 1962 and December 1989. There were 6 deaths (1.4%) including one suicide after the illness. The annual incidence of Q fever is shown in Fig 1.

There was a moderate peak in 1976 and a greater increase from 1986 onwards peaking in 1989 with 107 cases. The month of onset of illness is shown in Fig 2. There was a marked rise in April with a peak in May.

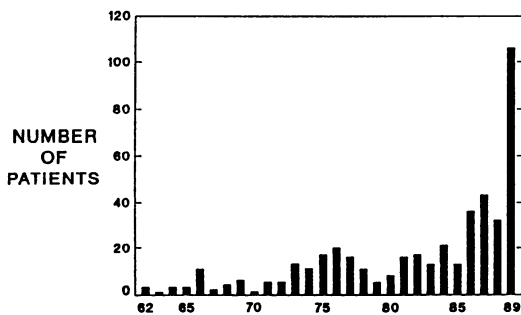


Fig 1. Annual incidence of Q fever.

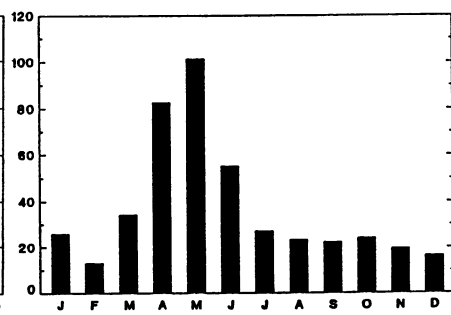


Fig 2. Monthly incidence of Q fever.

The age and sex of the patients is shown in the Table. There were 346 males and 97 females. Age ranged from 3 to 84 years and the peak incidence was in the 40–49 year old age group.

TABLE
Age and sex distribution of patients with Q fever

<i>Age (Yrs)</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
0-9	1	0	1
10-19	14	0	14
20-29	46	17	63
30-39	65	20	85
40-49	88	21	109
50-59	70	23	93
60-69	39	12	51
70-79	18	2	20
80-89	5	2	7
Total	346	97	443

Location

The number of patients in each county was:- Antrim 141, Down 93, Londonderry including the city 71, Armagh 51, Tyrone 33, and Fermanagh 4. There were 50 cases in Belfast city. The prevalence rate was 40 per 100,000 in Antrim, 39 per 100,000 in Londonderry including the city, 38 per 100,000 in Armagh, 30 per 100,000 in Down, 24 per 100,000 in Tyrone, 8 per 100,000 in Fermanagh, and 14 per 100,000 in Belfast city. Three patients were infected outside Northern Ireland, in Majorca, Cyprus and Sudan.

Outbreaks and clusters

The original outbreak on a farm on the eastern Ards peninsula in Co Down during 1965/66 has been described.⁵ The second outbreak was in a Belfast animal research laboratory during March 1986. Two animal laboratory technicians each had pneumonia and an influenza-like illness and three others were found to have Q fever antibody out of 11 tested. The source was not proven, although sheep and calves were in the unit. The third outbreak was in Ballycastle, Co Antrim during April — June 1989 when 47 people became ill. The origin of the outbreak was not found although sheep were known to be lambing in fields around the town. Clustering of patients in time and place was present in Limavady during April — June 1988 (8 cases), Londonderry during April — June 1989 (5 cases), Kilkeel during April and May 1989 (5 cases) and Rostrevor during March and April 1976 (4 cases). In addition 17 towns or villages had clusters of two or three patients each. Belfast was not included in the study of clusters.

Occupation

Occupations where farm animal contact occurred and the numbers affected were farmers (72), farmers' wives (17), farmers' daughters (2), farm labourers (10), abattoir workers (14), butchers (3), a veterinary surgeon and a veterinary assistant. Eleven other people had visited farms in the course of their work, including animal feed and other salesmen, Tourist Board inspectors and milk tanker drivers. Others who had animal contact outside farms included cattle dealers, graders, herders and livestock truck drivers (9), animal laboratory technicians (2),

a pig dealer, a sheep skin assessor, a sheep skin painter, a fur factory worker, a taxidermist, a dog handler and a horserider. Seven doctors, eight nurses, two dentists and a dental technician developed Q fever.

Some occupations listed in our survey had no obvious animal contact yet this may have occurred indirectly such as house builders, customs officers, a docker's wife, a dustman's wife, an evangelist in a tent mission, forestry workers, housewives who visited farm shops, truck drivers, policemen, soldiers, postmen, telephone engineers, a tyre fitter, a farm vehicle mechanic and those who holidayed in caravans or farms.

In 1976, 90 workers in an Omagh Co Tyrone abattoir, and 73 workers in a Belfast abattoir were bled. Fifteen (17%) of the Omagh workers and 23 (31.5%) of the Belfast workers had Q fever antibody in their sera. In 1986, 406 farmers from all over Northern Ireland were tested and 114 (28%) had Q fever antibody in their sera.

Animal contact and milk consumption

The animal contact and number of patients in contact were as follows: – cattle (137), dogs (127), sheep (101), cats (25), horses (17), pigs (16), goats (9) and fowl (5). Eighteen patients had unspecified farm animal contact. One hundred and eleven patients (25%) had no animal contact recorded although 11 of these drank unpasteurised milk.

Pasteurised milk was consumed by 331 patients and unpasteurised milk by 87 patients, three of whom drank goat's milk. Among the unpasteurised milk drinkers were farmers, farmers' wives or farm labourers (42), abattoir workers (2), a cattle grader and a farm salesman. Unpasteurised milk was consumed from February 1962 through to November 1989. No information was available from 25 patients.

Clinical illness

The presenting illness with the number and percentage of patients affected were: – pneumonia 278, (62.8%); influenza-like illness/pyrexia of unknown origin 109, (24.6%); endocarditis 32, (7.2%); hepatitis 7, (1.6%); myocarditis 4, (0.9%); pericarditis 4, (0.9%); meningitis 2, (0.5%); others 7 (1.6%).

Additional complications of the presenting illness included hepatitis (23); chest pain (4); myocarditis (2) including one death; pericarditis (2); auricular fibrillation (3); arthritis (3); and one patient each with meningism, popliteal nerve palsy, parotid swelling, lymphadenitis, purpura, spontaneous rupture of the spleen, and unsuspected pneumonia.

Endocarditis

Thirty-two patients had endocarditis between 1974 and 1989. One patient had high phase 1 antibody only and the rest had high phase 1 and phase 2 Q fever antibody titres. One patient had high phase 1 and 2 Q fever antibody twelve weeks before developing symptoms and signs of endocarditis.⁸ Eighteen were males and 14 were females. Their ages ranged from 23 to 74 years, but half the cases were in the 50 – 69 year old age group. The incidence of endocarditis in Q fever infected patients fell from a peak of 37.5% in 1981 to 1.9% in 1989. The valves infected were aortic (18), mitral (9) and both of these (5). Twenty of these valves were prosthetic, one was a homograft and eleven were natural. Two

female patients had immunological or neoplastic abnormalities: one a serum paraprotein band, the other a non-Hodgkins lymphoma and had progressed from an acute Q fever pneumonia to chronic endocarditis in seven months. No other patient had a previous history of acute Q fever. There were three deaths (9.4%) in this sub-group of patients aged 48, 67 and 71 years. Nineteen of the endocarditis patients had contact with cattle or sheep and four of these also drank unpasteurised milk. Three additional patients drank unpasteurised milk who had no animal contact. Valves removed at surgery from seven patients were available for isolation of *C. burnetii* and all were positive. Three of these valves were prosthetic, one was a homograft and three were natural.

DISCUSSION

The patients investigated in this study were sufficiently ill to consult their general practitioners or be admitted to hospital. Many other patients with minor illnesses or no illness must also have been infected with Q fever. This disease is now endemic in Northern Ireland, which has become second only to the south-western region of England in the number of cases reported in the United Kingdom.⁹ The increasing yearly incidence of Q fever may be related to the number of farm animals. In 1990 there were 1,439,231 cattle and 2,073,111 sheep in Northern Ireland and the human population was 1.56 million. The number of sheep has doubled in the last ten years. Sixty-one per cent of all calving occurs between January and April with a peak in March, and 80% of all lambing takes place in March and April. Calving and lambing probably both contribute to the peak incidence of Q fever in April and May.

Q fever predominantly affects males with a peak incidence in the 40–49 year old age group. It is unexplained why younger age groups have a lower incidence. Geographically the highest prevalence rates for Q fever were in counties Antrim and Londonderry (including the city). County Antrim has 565,590 sheep which is the highest number in any county, while County Londonderry was second highest with 476,604 sheep.

Several outbreaks have been described on farms, including one in Northern Ireland.⁵ The danger of infection with *Coxiella burnetii* in laboratory workers despite the use of safety precautions is well known¹⁰ and includes personnel who worked with sheep.¹¹ The Ballycastle outbreak may have originated from surrounding fields where lambing was taking place. *Coxiella burnetii* is excreted in milk, urine, faeces and birth fluids of infected animals. The animal placenta may contain 10^9 infectious doses per gram of tissue. Humans are at greatest risk of exposure at parturition of livestock because primary aerosols containing large numbers of *Coxiella burnetii* are shed at that time.¹² *Coxiella burnetii* has been recovered from soil and surface water of fields used by parturient sheep and viable organisms were continuously present in soil for periods up to 150 days.¹³ The concentration in the soil was such as to suggest that secondary dust aerosols may lead to infection of man and livestock in the absence of active shedding of the organisms by infected animal hosts. In guinea pigs, and probably also in humans a single inhaled organism is sufficient to initiate infection.¹⁴

The extreme resistance of the organism to drying and to physical and chemical agents means that it can survive for long periods in the environment.¹⁵ All of these factors contribute to the successful transmission of Q fever infection. Since Northern Ireland has large rural areas the clustering of cases in towns and villages could be explained in the same way. Q fever has also been described in an urban

area where there was no direct contact with farm animals but farm vehicles had probably disseminated contaminated straw, manure or dust in the area.¹⁶ A large outbreak of 136 cases in Birmingham occurred in 1989 although there was no obvious animal contact.¹⁷ Occupation was strongly associated with Q fever: those who worked, lived on or visited farms or worked with farm animals were affected while indirect contact with farm animals probably played an important part in other occupations. Farm animal contact was predominantly with cattle and sheep while pigs, horses, goats and fowl were less often associated with Q fever. Dogs (domestic⁵ or stray¹⁸) may carry *Coxiella burnetii* into the house. Parturient cats¹⁹ and wild rabbits²⁰ have also been associated with Q fever infections. One quarter of all patients had no recorded animal contact. Unpasteurised milk was consumed by 87 patients up until 1989. Forty-two of these patients were farmers, farmers' wives or farm workers who presumably drank milk from their own cows or goats. There are now only four licensed farm producers of unpasteurised milk in Northern Ireland. Outbreaks of Q fever associated with drinking raw milk have been described.²¹

The seroprevalence studies in Co Tyrone abattoir workers showed an increase from 5.9% in 1966⁵ to 17% in 1976. This may indicate a greater spread of Q fever in farm animals in that county. There was a fall in the number of Belfast abattoir workers with Q fever antibody from 71.7% in 1966⁵ to 31.5% in 1976, but 33 of these workers in 1966 were aged 40–63 years and in 1976 only ten men were over the age of 30 years. The seroprevalence of farmers throughout Northern Ireland has increased slightly from 23.1% in 1965–67⁵ to 28% in 1986 although past infection is now more widespread geographically.

Overall the heart was involved in 47 patients (10.6%) and there were four deaths in this group. In patients with endocarditis who have repeatedly negative blood cultures it is important to test for Q fever phase 1 and 2 antibody since the antibiotic treatment of Q fever endocarditis differs from other bacterial causes.²² The incidence of endocarditis in Q fever infected patients has fallen in England, Wales and Ireland from 13% in 1976–78 to 4% in 1985–87.⁹ Our endocarditis patients were on average at least 10 years older than the peak incidence of acute Q fever, and data from England and Wales also suggest that there is a 5–10 year delay between acute infection and the diagnosis of chronic Q fever endocarditis.²³ Only one of our patients had a previous history of acute Q fever but she also had a non-Hodgkins lymphoma. Only eleven endocarditis patients (34%) had natural valves. Two-thirds of the endocarditis patients had contact with cattle or sheep or drank unpasteurised milk, which are high risk factors for patients with prosthetic valves.²⁴ The presence of *Coxiella burnetii* on valves from seven patients confirms its causative role in their endocarditis, as chronic Q fever infection of the liver may also produce high phase 1 and phase 2 antibody titres.²⁵ Pericarditis²⁶ and myocarditis²⁷ associated with Q fever have been previously described.

Pneumonia was the commonest presenting illness, followed by an influenza-like illness or pyrexia of unknown origin. Hepatitis is a well known complication²⁸ and was present in 30 patients (6.8%). Meningitis, encephalitis, rashes, lymphadenitis,²⁹ and meningoencephalitis associated with nerve palsies³⁰ have been described. Spontaneous rupture of the spleen in a patient with Q fever pneumonia was first described in a patient in the Northern Ireland series.³¹

The control of Q fever presents difficult problems. The farm animals do not show any obvious signs of infection, so they cannot be segregated from people. Although *Coxiella burnetii* is present in milk, urine and faeces of an infected

animal the placenta is the most infectious product. The placenta should be disposed of properly and not left in the open air, which presents huge problems because of the large numbers involved. All milk for human consumption should be pasteurised. Ticks may transmit Q fever but there is no evidence that they do so in Northern Ireland. The commonest method of infection is by inhalation of infected aerosols or dust but dealing with this in the workplace is very difficult. There is at present no respiratory protective equipment approved specifically by the Health & Safety Executive for work involving microbiological risk.³² The only effective protection would be a "moonsuit" or a high efficiency full face ventilated visor or blouse with an independent positive pressure air supply. The cost of purchase and maintenance, and the inability to do heavy work while wearing such equipment makes it impracticable. In an abattoir, infected material may be accidentally swallowed or contaminate the eyes. *Coxiella burnetii* may be inoculated through cuts in the skin or by thorns entangled in the wool of sheep. Control of infection should be by good general working methods, facilities, hygiene and education. In particular the workers should be made aware of the possibilities of infection and the need to seek prompt medical attention. An abattoir should provide proper washing facilities, protective clothing and suitable ventilation to help disperse aerosols which are generated. Segregation of pregnant animals to a separate area should diminish the risk of infection to other workers in the rest of the abattoir. Training workers in health and safety should help to reduce the risk of infection in abattoirs and in farms as well. A Q fever vaccine has been used in Australian abattoir workers³³ but it is not licensed for use in the United Kingdom. Research work on farm animals, particularly sheep, should be confined to laboratories dedicated solely for that purpose and all isolation procedures for *Coxiella burnetii* must use a containment level 3 laboratory.³²

While it should be inappropriate to advise people to stay away from the countryside, it would be sensible to avoid farm animals at parturition, to stop drinking unpasteurised milk and to constrain household pets from running about in the fields. Pregnant women, immunosuppressed persons²⁸ and those with damaged or prosthetic heart valves²⁴ should take particular care to avoid at-risk work and leisure activities.

We thank Dr S N Donaldson, DHSS Northern Ireland, for helpful comments; Mr R N Martin, Chief Veterinary Officer, Department of Agriculture, Northern Ireland for data on cattle and sheep; and Dr D A Rutter, PHLS Centre for Applied Microbiology and Research Special Pathogens Reference Laboratory, Porton Down, Wiltshire for inoculating guinea pigs with heart valve tissue. We also thank Dr B Smyth, Consultant in Communicable Disease Control, Northern Health and Social Services Board who supplied information on the Ballycastle outbreak, and doctors throughout Northern Ireland who reported their Q fever patients. Our thanks are also due to Mr M Killen FIMLS, Department of Microbiology & Immunology for producing figures 1 & 2 and medical laboratory scientific officers in the Regional Virus Laboratory who carried out Q fever tests over the years of this study.

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