Epidemiol. Infect. (1992), **108**, 203–210
Printed in Great Britain

A prolonged outbreak of ornithosis in duck processors

C. P. St. J. NEWMAN[1], S. R. PALMER[2], F. D. KIRBY[3] AND E. O. CAUL[4]

[1] *Communicable Disease Surveillance Centre, Public Health Laboratory Service, Colindale Avenue, London N.W.9*

[2] *Communicable Disease Surveillance Centre (Welsh Unit), Public Health Laboratory Service, Cardiff Royal Infirmary, Cardiff*

[3] *Welsh Office Agriculture Department, Veterinary Investigation Centre, Aberystwyth*

[4] *Regional Public Health Laboratory, Public Health Laboratory Service, Bristol*

(*Accepted 12 August 1991*)

SUMMARY

In 1985 an outbreak of ornithosis affected 13 of 80 (16%) workers in a duck-processing plant. New employees were three times more likely to become cases than established employees. The highest attack rate was in those on the production line. Following the outbreak, an occupational health scheme was set up to monitor the health of new recruits to the company. Serological evidence of recent infection was demonstrated in 18 of 37 (49%) new employees tested in the first 3 months of employment. Five (14%) also had clinical evidence of ornithosis. Veterinary investigation of the ducks demonstrated a high proportion with asymptomatic chlamydial infection. It is suggested that ornithosis may be more common in duck processors than is currently supposed. Strategies to reduce occupational risks are discussed.

INTRODUCTION

In the UK *Chlamydia psittaci* infection is a hazard to those working in the duck-processing industry. A national outbreak in duck-processing-plant workers occurred in 1979–80 [1] and was followed by an outbreak in veterinarians who had been exposed to infection whilst on a training course at another duck-processing plant [2]. Avian and ovine chlamydiosis (ornithosis, psittacosis) have now been added to the schedule of prescribed industrial diseases on the recommendation of the Industrial Injuries Advisory Council [3].

Following the outbreak in duck workers in 1979–80, veterinary investigations demonstrated *C. psittaci* infection persisting in duck flocks in the UK [4] and between 1981 and 1984 the Communicable Disease Surveillance Centre of the Public Health Laboratory Service received reports of 11 human cases in whom exposure to ducks had been mentioned. In 1985 an outbreak of ornithosis occurred in workers at one of the duck-processing plants which was implicated in the 1979–80 outbreak. We report the investigation and control measures which were

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

instituted at this plant together with follow-up studies designed to estimate the continuing risk to the workforce.

THE OUTBREAK

The duck-processing plant involved in the outbreak was situated on a family farm. In the months before the episode the company had established its own breeding flock, importing breeding stock from Denmark, France and the USA. Between January and August 1985 ducks from these newly established breeding flocks became the main source of supply for the processing plant, completely replacing outside suppliers. Eighty people worked at the plant. Staff turnover had always been high but the rate had markedly increased in the first half of 1985, when 36 members of staff left.

In August 1985 the local District Medical Officer received information that over the preceding 3 months three people had been admitted to separate hospitals in the area, each having a history of a respiratory illness and serological evidence suggestive of *Chlamydia psittaci* infection. Each individual had worked at the duck-processing plant.

Enquiries revealed that 12 people had been absent from work from June to the end of August 1985. They were interviewed and their clinical investigations reviewed. If blood had not been taken during the course of the illness, a sample was taken at the time of the interview. Eight of the 12 had serological evidence of ornithosis (Table 1).

Investigations were conducted in two parts; those concerned with human infection and those with the veterinary aspects.

Human Infection

Methods

In order to investigate the extent of the outbreak, questionnaires were distributed to the 66 people on the company payroll and 14 staff under contract to the company, including all the suspected cases. Information was requested on illness since January 1985, injury to hands, the wearing of glasses and the type of work undertaken. A blood sample was requested from each employee.

For analysis, employees were divided into five occupational groups: staff who worked with live birds (rearers); those who were involved in slaughtering, defeathering and evisceration on the production line (production); those weighing and packing cooled carcasses (packers); staff working in the kitchens (cooks); all other staff, which included managerial, clerical, maintenance and cleaning staff, were aggregated in a final group (other). The occupational group was determined by the occupation at the time the questionnaire was completed. Staff were also subdivided according to the duration of their employment. 'New' employees were those who had joined the company after 1 January 1985; those who joined before that date were designated 'Old' staff.

A case of ornithosis was defined as an individual who reported a febrile or respiratory illness during the period under enquiry and also had a complement-fixation (CF) titre of 64 or greater using a chlamydia CF antigen (Department of Microbiological Reagents and Quality Control, Public Health Laboratory Service).

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

Table 1. *Details of cases: 1985 outbreak*

Case no.	Age	Sex	No. days ill	Period between recruitment and onset (months)	Occupation	CFT
1*	40	M	34	> 12	Arable worker '79. Moved to duck rearing Jan '85	64
2	41	F	5	< 1	Duck rearing. Eviscerator in '84	64
3*	43	F	28	1	Eviscerator	96
4*	23	M	56	2	Packer. Eviscerator in March '85	256
5*	50	M	28	2	Management	64
6*	43	M	32	3	Cleaner	64
7	32	M	?		Carpenter	192
8*	33	M	21	< 1	Plucker	512
9	39	M	7	> 12	Management	192
10*	33	M	27	1	Plucker and slaughterer	96
11*	20	M	9	1	Plucker	384
12	35	F	4	1	Eviscerator. Lived with case 7	512
13	41	M	14	> 12	Hatchery worker	384

* Original 'possible case' identified by DMO.

Table 2. *Cases of ornithosis in 'New' and 'Old' staff*

	Staff member	
	New	Old
Cases	9	4
Non-cases*	17	40

Fisher exact test: $P < 0{\cdot}02$.
* Start date unavailable on one employee.

Individuals who returned the questionnaire but in whom the CF titre was less than 64 were designated as non-cases.

Results

Seventy-six (95%) of 80 questionnaires were completed. Fifty-eight men and 18 women responded, the mean age of whom was 34 years of age (range 16–65 years). Blood samples were obtained from 71 of the 76 responders. In addition to the 8 index cases, 4 others also met the case-definition (Table 1). The most frequent symptoms were fever (100%), muscular aches and pains (83%) and shortness of breath (75%). The illness lasted between 4 and 56 days with a median duration of 27 days.

Staff who had recently joined the company were more likely to develop clinical ornithosis (relative risk = 3·0; 95% C.I. = 1·3–11·1) (Table 2). Most cases occurred in staff working on the production line (Table 3).

All but one of the cases in the 'other' category of staff cases frequently visited all parts of the processing plant. An arable worker was also included in this category; he had been involved in the rearing of ducks in January and February 1985 and was regarded as an 'Old' employee.

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

Table 3. *Occupation and ornithosis in 'New' and 'Old' staff*

	New (ill/total)	Old (ill/total)
Rearers	0/6	2/8
Production	5/11	0/9
Packing	1/4	0/7
Cooking	0/1	0/7
Other*	3/4	2/13

* Start data unavailable on one employee.

Twenty-six people, including 8 cases, had cut their hands once a week or more and were 2·2 (95% C.I. = 0·7 – 6·0) times more likely to be infected, but this was not statistically significant. Such lacerations occurred in 13 (65%) of those who worked on the production line (relative risk = 2·6; 95% C.I. = 1·4–4·5). Those who wore gloves (23) had the same risk of illness as those who did not (relative risk = 1·3; 95% C.I. = 0·5 – 3·6). The proportion of those wearing glasses was not significantly different when cases and non-cases were compared.

Veterinary investigation

Processing

Ducks were reared in pens adjacent to the processing plant, which had been in continuous use for 20 years, and day-old ducklings had been provided to the plant by a UK commercial supplier. During the first 3 months of 1985 the company developed its own breeding stock and hatchery, which enabled a transition from outside suppliers to in-house production. The breeding, hatching and rearing were undertaken by local contractors. The day-old ducklings were transferred from the hatchery to rearers, initially being raised under gas-brooders and then transferred through a series of pens as they increased in size. Ducklings were fed pellets incorporating chlortetracycline from the 7th to 18th day of life. The contractors kept the birds housed, but towards the end of the rearing period, when they were transferred to the main farm, they were put in open pens. Cleaning of the pens between batches of birds was not undertaken on a regular basis.

Findings

At the time of the investigation in 1985, clinical examination of the flocks showed no evidence of overt disease. Reported mortality was variable, usually 3–5%, but was dependent upon stock density and remained unchanged following the investigation. Twelve birds dying during the rearing process were examined; post-mortem examination showed changes consistent with chlamydial infection, including pulmonary lesions, hepatomegaly and splenomegaly in 4 birds, and *C. psittaci* was isolated from viscera samples from 7 ducks.

Samples of blood were taken at random from 49 clinically well ducks. ELISA tests [4] showed that 36 ducks had antibody titres of 200 or greater against psittacosis, which is considered by the Animal Trust as indicative of infection (personal communication); 26 of these ducks were at the main farm at the time of sampling and 10 were birds from an outlying farm.

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

Table 4. *Clinical symptoms and serological tests*

Clinical history	Paired serology			
	Rise	No change	No data	Total
Illness	5	6	4	15
No illness	7	5	12	24
No clinical data	6	8	12	26
Total	18	19	28	65

Table 5. *Occupational health review: cases of ornithosis*

Case no.	Age	Sex	Period between recruitment and onset (months)	Occupation
34	47	F	3	Cook until Feb. '87. Packer from Feb. '87
35	—	M	2	—
44	32	M	1	Poultry-meat inspector
56	—	F	1	—
63	41	M	< 1	Eviscerator

OCCUPATIONAL HEALTH SCHEME

Following the outbreak of ornithosis new recruits underwent a pre-employment medical assessment during which a blood sample was taken for serological examination.

After 3 months a postal questionnaire was sent to these employees and those who continued in employment were invited to provide a second blood sample. In addition, information was supplied, on a confidential basis, by a local general practitioner.

Cases of ornithosis were defined as a history of illness characterized by fever and respiratory symptoms together with a fourfold or greater elevation of CF antibody or fluorescent antibody between the first and second blood samples.

During the first 18 months of the scheme 65 people joined the company. Eighteen of 37 (49%) with paired sera showed a fourfold or greater rise in titre (Table 4), of whom 12 had been free from symptoms. Five people met the case definition, all reporting a febrile illness with respiratory symptoms.

On recruitment, 6 employees had CF or fluorescent antibody titres of 64 or greater; of these, 3 had previous exposure at the plant (Table 5).

DISCUSSION

In humans, infection by *C. psittaci* is associated with a range of clinical manifestations from asymptomatic infection to severe atypical pneumonia and septicaemia [5]. Diagnosis is usually based upon a fourfold or greater rise in CF titre between paired sera. Retrospective diagnosis of ornithosis is problematic. The case-definition used was based on the presence of an influenza-like or respiratory illness associated with a single CF antibody titre of 64 or greater. This definition would exclude those who had previously had a raised CF antibody titre

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

which had returned to normal at the time of testing, but would include individuals who had had febrile illness from some other cause but also had raised circulating antibodies as a result of previous infection [6]. Nevertheless, independent clinical diagnoses of ornithosis based on the results of a wider range of investigations were made on four of the cases. Furthermore, the occurrence of ornithosis was confirmed by the occupational health scheme, in which fourfold rises in antibody titre by both CF antibody and fluorescent antibody tests were observed. The poor correlation between clinical and serological results demonstrates the occurrence of asymptomatic infection.

Within the UK many species of both wild and domestic birds have been shown to be infected by *C. psittaci* [7]. *C. psittaci* infection may be acquired early in the life of the bird and is commonly asymptomatic; during this latent stage the organism may be present in the body tissues and excreted in the faeces of these apparently healthy birds [8]. Reports indicated that in early 1985 clinical disease associated with *C. psittaci* infection in ducks [4] and wild birds had been identified elsewhere in the UK. At that time, there was no overt evidence of *C. psittaci* infection in the flocks of ducks reared for processing at this particular plant. However, there was both serological and microbiological evidence indicating infection in ducks and ducklings alike.

The route of infection of duck processors is believed to be by inhalation of aerosols generated by evisceration and from dried excretions and discharges. These aerosols, together with dust, may drift through the plant and account for the lower attack rates away from the evisceration lines that have been observed in some studies [1, 9]. Such variation in attack rates has not been observed in all outbreaks [10]. Illness in turkey processors has arisen where they have handled previously eviscerated and cooled carcasses [10]. From the data obtained in the 1985 outbreak, those at greatest risk were new employees at the plant rather than those in a particular occupation; the occurrence of the highest attack rates in new employees of duck-processing plants has been reported previously [11]. The conclusion that previous exposure to *C. psittaci* provides protection is supported by evidence from the veterinarian outbreak, where disease occurred in visitors to the plant but none was reported in the workers [2]. However, serologically confirmed symptomatic reinfection has been reported [12], suggesting that such protection may be specific to a particular serotype.

Traditionally, occupational control measures have been based on the maintenance of apparently healthy flocks, together with some attempt to reduce environmental contamination by infected material. Preventive strategies have included the use of masks and improving ventilation. Measures to reduce infection in the flocks and contamination of the working environment were reinforced at the plant following the 1985 outbreak. Despite this, the actual risk appears to have remained substantially unchanged. In the 1985 outbreak 41% of new employees developed ornithosis soon after joining. In the 18 months between June 1986 and November 1987, 49% of new employees tested seroconverted within 3 months, 22% developing a clinical illness and meeting the case definition. Thus it seems that even in the absence of clinical disease amongst the ducks, the workers remained at risk of infection. Indeed, the evidence would suggest that the outbreak in 1985 may have been a function of increased susceptibility in the

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

workforce as a result of changes in staff rather than an increase in environmental contamination arising from increased rates of infection in the flocks.

In the USA the control of an extensive outbreak of psittacosis in turkey workers involved treating flocks of birds with tetracycline for a period of 3 weeks [9]. Flocks treated in this way were not associated with human disease during processing. However, in a subsequent outbreak in the same state, tetracycline was used to treat a flock of ill turkeys for 3 days before they were sold for processing; chlamydiosis was not suspected by food-safety inspectors but illness consistent with chlamydial infection occurred in the processors [13]. It would appear that tetracycline could be used to obscure chlamydial infection in poultry and potentially increase the risk to workers in the processing industry. In this study the company fed chlortetracycline to the ducks from the 7th to 18th day of a 50-day lifetime, and there was no evidence of undue mortality or morbidity in the flocks. This suggests that clinical infection in the birds was suppressed whilst transmission of infection continued. Since large doses of tetracyclines may suppress but not eradicate infection in poultry flocks, early detection of chlamydial infection has been recommended, together with the slaughtering of those birds found to be infected [14]. In the company studied, evidence obtained from examination of the breeding and rearing flocks suggested that up to 70% of birds were infected. While adoption of this strategy might protect the workers, it would have a major financial impact on the business. Nevertheless, the development of chlamydia-free flocks with stringent monitoring of the breeding and rearing process is, currently, the only satisfactory way of protecting those who work in the industry.

ACKNOWLEDGEMENTS

We would like to thank Dr J. W. Parsons, Swindon H.A., and colleagues of the Department of Environmental Health, Kennet D.C., for assistance in these studies, and staff of the Bath Public Health Laboratory for assistance with serological tests. We are grateful to Mr B. J. Bevan, Central Veterinary Laboratory, and Dr W. S. K. Chalmers of the Animal Health Trust for veterinary tests.

REFERENCES

1. Andrews BE, Major R, Palmer SR. Ornithosis in poultry workers. Lancet 1981; i: 632–4.
2. Palmer SR, Andrews BE, Major R. A common-source outbreak of ornithosis in veterinary surgeons. Lancet 1981; ii: 798–800.
3. Department of Social Security. Social Security Act 1975: Chlamydiosis and Q fever. Cm. 742. London: HMSO 1988.
4. Chalmers WSK, Farmer H, Woolcock PR. Duck hepatitis virus and *Chlamydia psittaci* outbreak. Vet Rec 1985; **116**: 223.
5. Christie AB. Infectious diseases: epidemiology and clinical practice, 3rd ed. Edinburgh: Churchill Livingstone, 1980: 813–23.
6. Nagington J. Psittacosis/ornithosis in Cambridgeshire. J Hyg 1984; **92**: 9–19.
7. Bracewell CD, Bevan BJ. Chlamydiosis in birds in Great Britain. J Hyg 1986; **96**: 447–51.
8. Jawetz E, Melnick JL, Adelberg EA, Borrks GF, Butel JS, Ornston LN. Medical microbiology, 18th ed. London: Prentice Hall International (UK) Ltd., 1989, 286–93.
9. Hedberg K, White KE, Forfang JC, et al. An outbreak of psittacosis in Minnesota turkey industry workers: implications for modes of transmission and control. Am J Epidemiol 1989; **130**: 569–77.

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press

10. Anderson DC, Stoesz PA, Kaufamann AF. Psittacosis in employees of a turkey-processing plant. Am J Epidemiol 1978; **107**: 140–8.
11. Palmer SR. Psittacosis in man – recent developments in the UK: A review. J Roy Soc Med 1982; **75**: 262–7.
12. Cartwright KAV, Caul EO, Lamb RW. Symptomatic *Chlamydia psittaci* reinfection. Lancet 1988; i: 1004.
13. Newman JA. *Chlamydia* spp. infection in turkey flocks in Minnesota. J Am Vet Med Assoc 1989; **195**: 1528–30.
14. Benenson AS. Control of communicable diseases in man, 15th ed. Washington, DC: American Public Health Association, 1990: 347–9.

https://doi.org/10.1017/S0950268800049657 Published online by Cambridge University Press