Psittacosis associated with pet bird ownership: a concern for public health

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Introduction: Psittacosis is a zoonotic infectious disease caused by *Chlamydia psittaci* and most cases involve avian contact history. In humans, psittacosis induces symptoms ranging from mild 'flu-like' symptoms to serious atypical pneumonia. Unless specifically thought of, the diagnosis of psittacosis can be missed and the disease is usually treated as atypical pneumonia. Here, we detail cases of psittacosis related to pet birds.

Case presentation: A 16-year-old male was admitted with fever and persistent cough. The patient reported previous treatment with broad-spectrum antibiotics that led to limited improvement of his condition, and owning pet birds; thus, psittacosis was suspected. Serum samples from the patient were obtained and tested using a microimmunofluorescence assay, revealing an IgG titre of 64. An epidemiological investigation was conducted in five family members related to the patient; two possessed anti-*C. psittaci* antibodies (IgG titre=64 and IgM titre=20; IgG titre=128 and IgA titre =20). Additionally, *C. psittaci* DNA was detected by PCR carried out on the family's pet birds.

Conclusion: Psittacosis probably occurs more often than reported. Individuals with milder cases may not seek medical attention, and physicians may not inquire about bird exposure. There is a need for awareness campaigns directed at health workers and birds owners.

Keywords: Atypical pneumonia; *Chlamydia psittaci*; chlamydiosis; psittacine; zoonosis.

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Introduction

Psittacosis is a zoonotic disease caused by the obligate intracellular bacterium *Chlamydia psittaci*. Clinical psittacosis in humans varies in severity from mild 'flu-like' symptoms with fever, headache, sore throat and photophobia to a more serious atypical pneumonia with a dry cough and painful breathing (NASPHV, 2010). Infections occur primarily in bird owners, pet shop employees, breeders, and poultry and wildlife workers who inhale aerosols from the faeces and secretions of infected birds. Humans typically become infected with *C. psittaci* after exposure to psittacine birds, although transmission has also been documented from poultry and free-ranging birds (Vanrompay *et al.* 1995; Kirchner, 1997; NASPHV, 2010). Rare cases of person-to-person transmission have also been reported (Wallensten *et al.*, 2014). In humans, psittacosis is typically diagnosed using a combination of clinical signs and serological tests. The most common test to con-

firm psittacosis is a microimmunofluorescence (MIF) test to determine if there has been an increase in anti-*C. psittaci* antibody titre (NASPHV, 2010).

In birds, the disease resulting from *C. psittaci* infection is called chlamydiosis. Avian chlamydiosis signs are usually non-specific and include ruffled feathers, anorexia, discharge and diarrhoea. Infected birds usually remain asymptomatic and may intermittently shed the agent in respiratory secretions and faeces, which is the source of infection for other avian species and humans (Vanrompay *et al.*, 1995).

Although notification is mandatory in most countries, the impact of psittacosis on human health is difficult to determine. This disease probably occurs more often than reported because individuals with mild cases may not seek medical attention and physicians may not inquire about bird exposure when evaluating patients. Additionally, antimicrobials employed empirically for the therapy of community-acquired pneumonia may prevent an accurate diagnosis (CDC, 1992). This disease is becoming a more significant public health concern because of the popularity of pet birds and the placement of birds in

Abbreviations: CDC, Centers for Disease Control and Prevention; MIF, microimmunofluorescence.

childcare facilities, garden centres and rest homes (Matsui *et al.*, 2008; Harkinezhad *et al.*, 2009). In this report, we present mild and severe cases of psittacosis in members of a family who owned pet birds.

Case report

A 16-year-old male patient was attended to at the Institute of Infectology, Emilio Ribas, São Paulo, Brazil, with chest pain and a cough that had persisted for 3 weeks. When he first sought medical assistance, he received treatment with azithromycin (500 mg once a day for 3 days) and prednisone (20 mg, once a day for 4 days), followed by treatment with levofloxacin (500 mg once a day for 7 days). His symptoms, including a fever (38.4 °C), returned after the antibiotic therapy was completed. A chest X-ray was performed, which revealed increased hilar bronchovascular markings, mild hyperlucency at the lung bases and subtle perihilar linear opacities in the middle lung fields, more conspicuous on the right side. The laboratory tests are summarized in Table 1.

The patient lived with his family (a mother, two brothers and one sister) in an urban area, and he reported no recent travel. He did not smoke or use illicit drugs, and he had not been exposed to individuals with a contagious illness. He did report having close contact with several psittacine birds every other weekend at his father's residence, which was a small apartment located in downtown São Paulo. The epidemiological profile associated with the patient's clinical symptoms led to a hypothesized diagnosis of psittacosis. To confirm the diagnosis, paired serum samples were collected with a 4-week interval in between samples and evaluated for anti-*C. psittaci* antibodies (IgG, IgM and IgA) using immunofluorescence (Chlamydia MIF Serology; Focus Diagnosis). The results revealed an IgG anti-*C. psittaci* titre of 32 in the first serological sample evaluated and a titre of 64 in the second sample. In both samples, IgM and IgA titres were not detected. The patient recovered completely following anti-

biotic therapy with doxycycline (100 mg twice a day for 14 days).

Because of the zoonotic nature of this disease, four family members who had had contact with the pet birds as well as the patient's mother, who had had no contact with the birds, were clinically evaluated. Serum samples were also collected from the family members for *C. psittaci* serological testing by MIF. Two family members possessed anti-*C. psittaci* antibodies. The patient's father, who was 51, had an IgG titre of 64 and an IgM titre of 20; the patient's brother, who was 14, had an IgG titre of 128 and an IgA titre of 20 (Table 2). Informed consent was obtained from all individuals who participated in this study.

The patient's father revealed that a few months earlier he had developed a persistent non-productive cough that lasted for several weeks. He did not seek medical assistance because he attributed his condition to his smoking habits. The other relatives of the patient did not report previous illnesses.

Because the pet birds were the potential source of *C. psittaci* infection, a veterinarian went to the family's home to evaluate the birds. At the time, the family kept 35 birds, none of which had been recently acquired. Nonetheless, the owners reported that about 2 years earlier, they had bought a family of seven lovebirds (*Agapornis personata*), six of which had died just after being purchased. Despite the fact that, since then, some of the other birds had become sick, the patient's father had not asked for veterinarian assistance before. Cloacal swabs samples were collected from all of the birds, including 12 lovebirds (11 *A. personata* and one *Agapornis roseicollis*), 21 cockatiels (*Nymphicus hollandicus*) and two yellow-chevrons parakeets (*Brotogeris chiriri*). To determine if the birds were carrying *C. psittaci*, genomic DNA was extracted from the cloacal swab samples with a Nucleic Acid and Protein Purification kit (Macherey-Nagel) according to the manufacturer's protocol. Our standard laboratory strain of *C. psittaci* from monk parakeets (*Myiopsitta monachus*) (strain Cpsi/Mm/BR01, GenBank accession no. JQ926183.1) and ultrapure water were used as positive and negative controls, respectively. The PCR primers targeted a conserved region of the *pmp* gene sequence that has been reported previously (Laroucau *et al.*, 2001). *C. psittaci* DNA was detected in the samples from one lovebird (*A. personata*) and two cockatiels (*N. hollandicus*). No birds presented clinical signs of disease at the time of sample collection.

Table 1. Laboratorial tests for the 16-year-old male patient with psittacosis

Test	%	Results	Reference values
Leukocytes (cells mm ⁻³)		13.7 × 10 ³	4 × 10 ³ –11 × 10 ³
Neutrophils	73.7	10.1 × 10 ³	1.6 × 10 ³ –7 × 10 ³
Eosinophils	2.5	0.3 × 10 ³	0.05 × 10 ³ –0.5 × 10 ³
Basophils	0.6	0.1 × 10 ³	0–0.2 × 10 ³
Lymphocytes	15.1	2.1 × 10 ³	0.9 × 10 ³ –3.4 × 10 ³
Monocytes	8.1	1.1 × 10 ³	0.2 × 10 ³ –0.9 × 10 ³
C-reactive protein (mg l ⁻¹)		18.2	<5

Discussion

Psittacosis in humans is considered to be a rare but potentially severe disease. Acute psittacosis cases, some with fatal outcomes, have been described in the literature (Verweij *et al.*, 1995; Petrovay & Balla, 2008; Fraeyman *et al.*, 2010; Raso *et al.*, 2014). However, these cases are most likely the tip of the iceberg. What goes undetected are

Table 2. Clinical features and serology results for the six individuals connected to the index case of psittacosis

Individual*	Gender	Age (years)	Clinical features	Contact with <i>C. psittaci</i> -infected birds	Antibody titres (MIF test)					
					First sample			Second sample		
					IgG	IgM	IgA	IgG	IgM	IgA
1	M	16	Chest pain, cough, fever	Yes	32	<10	<16	64	<10	<16
2	M	14	None	Yes	128	<10	20	–	–	–
3	M	51	Persistent cough	Yes	64	20	<16	–	–	–
4	M	12	None	Yes	<16	<10	<16	–	–	–
5	F	39	None	No	<16	<10	<16	–	–	–
6	F	10	None	Yes	<16	<10	<16	–	–	–

* 1, Index patient; 2, 4 and 6, index patient's siblings; 3, index patient's father; 5, index patient's mother.

–, Serum sample not collected.

less severe infections, which are either asymptomatic or misdiagnosed because the symptoms triggered by the infection are similar to those of other respiratory pathogens (Harkinezhad *et al.*, 2007). In the current study, milder cases of psittacosis were diagnosed only after an index patient with more severe symptoms sought medical assistance. Additionally, the third medical team that cared for this patient was the first team to raise the possibility of psittacosis and conduct a more thorough inquiry into the patient's history of bird exposure.

Concerning laboratory tests for psittacosis, the Centers for Disease Control and Prevention (CDC) has established case definitions for psittacosis. A patient has a confirmed case of psittacosis if the clinical illness is compatible with symptoms of the disease and there is a fourfold or greater increase in antibodies against *C. psittaci* between paired acute- and convalescent-phase serum samples. A case of psittacosis can also be confirmed if there are IgM antibodies against *C. psittaci* with a reciprocal titre of ≥ 16 detected by MIF testing (CDC, 1997; NASPHV, 2010). According to this classification, the patient's father, who presented with a milder case of psittacosis, was considered to be a confirmed case (Table 2). A fourfold increase in antibodies against *C. psittaci* between paired serum samples was not observed in the index case. Nevertheless, a delay in gathering the serum samples after the onset of symptoms may have affected the serological tests. Furthermore, treatment with antibiotics 2 weeks prior to testing may have inhibited the patient's antibody response, which has been reported previously in the literature (Fraeyman *et al.*, 2010). The other case, the patient's brother probably had an asymptomatic infection because the brother reported no illness even though he had anti-*C. psittaci* IgG and IgA titres as well as close contact with the infected pet birds.

Note that the CDC case definitions were established primarily for epidemiological purposes; these definitions should not be used as the sole criteria for establishing a clinical diagnosis (NASPHV, 2010). As observed in this study, psittacosis diseases can be highly variable with the

severity of the disease ranging from asymptomatic infection or a mild non-specific illness to a more severe pneumonia (NASPHV, 2010; Cheng *et al.*, 2013). This variability makes it challenging to confirm a psittacosis diagnosis. A history of bird contact is a valuable piece of information that should be collected during diagnosis because exposure to birds has been reported in 85 % of psittacosis cases (Yung & Grayson, 1988). The epidemiological investigation conducted in this study was especially important for confirming the diagnosis because the source of the infection was determined through molecular detection of *C. psittaci* in the infected pet birds.

It should be emphasized that birds are among the most popular pets around the world. For example, in the USA, 8.3 million birds are kept as companion animals (American Veterinary Medical Association, 2012). Nevertheless, public awareness about the risks of contracting zoonotic diseases from pet birds is very limited. Psittacine birds (e.g. macaws, parrots, budgerigars, cockatiels) are among the most popular birds kept as pets. These birds are also the main *Chlamydia*-positive avian species (Kaleta & Taday, 2003; Evans, 2011) and, as observed in this study, may represent a major risk for humans in terms of contracting psittacosis. The risk of infection with further disease development was enhanced by the 35 birds living in the family's apartment balcony. The risk was also enhanced for their neighbours because they were probably unaware of this potential source of infection and the possibility of acquiring a zoonosis. Therefore, this family's living situation poses a public health risk to the individuals living in the neighbouring apartments.

Another concern is that only 12.3 % of bird-owning households currently seek veterinary advice for their animals (American Veterinary Medical Association, 2012). Birds infected with *C. psittaci* can be asymptomatic, and testing programmes conducted by veterinarians could help protect humans from acquiring this zoonosis. In this report, the birds presented no evident clinical signs of disease at the time of the swab sampling, and the owners had never

taken their pets to a veterinarian. It was not possible to determine when their pet birds become infected, but *C. psittaci* could have been introduced in their flock after the *A. personata* family acquisition 2 years earlier. Possibly, by that time the birds had had an episode of avian chlamydiosis, became asymptomatic carriers and started shedding the infectious agent after a stressful episode, such as crowding, chilling, or breeding. The owners could not provide additional information to clarify this issue. However, they reported this episode as the most remarkable concerning their pet's health and from then on gave empirical antibiotic therapy in the drinking water whenever their pets became apparently ill.

In general, successful infection prevention requires that individuals in contact with animals be aware of the disease risks. If the family had been informed earlier about the zoonotic nature of avian chlamydiosis, effective prophylactic measures could have been taken earlier. Many of the disease risks associated with pet contact can be reduced through simple measures, such as proper animal selection and changes in animal contact (Stull *et al.*, 2012). *C. psittaci* resists drying and may remain infectious for months, so the cages of infected birds must be disinfected thoroughly. Sick birds should be treated, and their handlers should wear protective clothing and a high-efficiency respirator (N95 rating) (Center for Food Security and Public Health, 2009; NASPHV, 2010).

Aviary and pet shop owners should also establish programmes of avian chlamydiosis control in their facilities. Such programmes encourage disease prevention, improving animal health (NASPHV, 2010). By the time infection is recognized in a pet owner due to close contact with a purchased bird, a critical period of pathogen dissemination might already have occurred. Thus, effective prophylactic measures taken in birds before being sold would enhance the prevention of further disease transmission among pet owners and other susceptible avian species.

Improved zoonotic disease education is needed for pet-owning households. Pet birds should be bought from reputable suppliers and examined by a veterinarian when they are first acquired. Birds and cages should be kept in a well-ventilated area to prevent the accumulation of infectious dust. Cages should be cleaned regularly to prevent the build-up of waste, and they should first be treated with a cleaning solution to reduce aerosolization (Center for Food Security and Public Health, 2009). Furthermore, increased communication between professions is needed to improve the overall knowledge of zoonotic diseases and develop optimal approaches for reducing pet-associated pathogen transmission (Stull *et al.* 2012). Therefore, additional effort from physicians and veterinarians is required.

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the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 and 2008. Informed consent was obtained from all patients included in the study. All institutional and national guidelines for the care of animals were followed. All named authors meet the ICMJE criteria for authorship for this manuscript and take responsibility for the integrity of the work as a whole. The authors declare no conflicts of interests.

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