

# BACTERIAL ZONOSSES AMONG DOMESTIC REPTILES

## ZOONOSI BATTERICHE TRASMESSE DA RETTILI DOMESTICI

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### SUMMARY

In the last years an ever-increasing importation of exotic animals destined to live under domestic conditions has been observed. Chelonians, terrestrial and aquatic turtles, are the most commonly present in domestic environment, even if saurians (lizards) and ophidians (snakes) are frequently kept in houses. Reptiles, that can be considered new pet animals, even if clinically healthy, often harbor opportunistic pathogens, which can become cause of serious infections under stress condition. Viral, protozoal, fungal and parasitic agents can infect the cold-blooded animals, but bacteria are the most common pathogens recovered from these animals and in most cases they can be transmitted to humans. Domestic reptiles represent an emerging problem for the public health. New reptile owners should be educated about a proper animal care in order to assure the pet health, to protect themselves from venomous or aggressive species, and to avoid the risk of infection.

The main bacterial infections, transmitted from reptiles to humans, are reported, with particular attention to salmonellosis, mycobacteriosis, chlamyphilosis and *Aeromonas* and *Pseudomonas* infections.

Key words: reptiles; bacteria; zoonoses; public health.

### RIASSUNTO

Negli ultimi anni si è assistito ad una notevole crescita del numero degli animali esotici destinati a vivere in ambiente domestico. I cheloni, tartarughe di terra e di acqua dolce, sono i più numerosi, ma i sauri e i serpenti sono tenuti come animali domestici con sempre maggiore frequenza. I rettili, anche se clinicamente sani, spesso albergano microrganismi patogeni opportunisti che possono divenire causa di serie patologie durante periodi di stress. Gli animali a sangue freddo sono colpiti da virus, protozoi, funghi, parassiti, ma sono i batteri i microrganismi più frequentemente isolati da soggetti con o senza patologie clinicamente manifeste. Molti di questi batteri sono in grado di causare infezione anche nell'uomo e per questo motivo i rettili domestici devono essere considerati un problema emergente per la sanità pubblica. I nuovi proprietari dovrebbero quindi essere opportunamente educati sui rischi che corrono tenendo i rettili nelle loro case, legati non solo a graffi e morsi talora velenosi, ma anche alle infezioni.

Di seguito vengono trattate le principali zoonosi ad eziologia batterica trasmissibili dai

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rettili all'uomo, con particolare attenzione alle infezioni sostenute da salmonelle, micobatteri, clamidie, *Aeromonas* e *Pseudomonas*.

Parole chiave: rettili; batteri; zoonosi; sanità pubblica.

## INTRODUCTION

In the last years, the number of reptiles housed as pet animals is increased; chelonians, turtles and tortoises, are the most commonly present in domestic environment, even if saurians (lizards) and ophidians (snakes) are often bred in houses.

Reptiles are able to carry a wide variety of pathogens that can determine infections in humans. Herpetologists, zoo personnel and veterinarians are at high risk through frequent exposure to cold-blooded animals. However, the owners of pet reptiles have several occasions of infection, because often they are not educate on the importance of proper hygiene and reptile care.

Even if all humans may contract infections by household reptiles, immunocompromised individuals are particularly at risk: children, elderly, pregnant women, persons with chronic diseases or AIDS, patients on immunosuppressive therapy.

Bacteria are cause of infectious pathologies in reptiles, but often represent the normal bacterial flora of these animals.

Bacterial organisms are the main pathogens responsible of zoonoses, even if viral, fungal, protozoal and parasitic agents can be transmitted from reptiles to humans.

The main zoonoses of cold-blooded animals caused by bacterial etiologic agents are successively described, with attention to the simptomatology in reptiles and the route of transmission to humans.

## SALMONELLOSIS

Reptiles may become infected with salmonellae mainly through direct contact with other infected reptiles, but also heating contaminated food, particularly live food such as mouse or chick. Salmonellae are able to readily penetrate turtle eggs with contamination of the internal contents within 1 hour of exposure (Feeley & Treger, 1969). Infection is also possible through transovarial transmission (Austin & Wilkin, 1998). Reptiles usually do not show clinical signs of salmonellosis. However, *Salmonella enterica* may cause septicemia, pneumonia, coelomitis, abscess, granuloma, hypovolemic shock and death (Onderka & Finlayson, 1985; Frye, 1991). In all cases, salmonellae, if they are saprophytic or pathogens, are carried in the gastrointestinal tract and are shed intermittently under stress conditions (Chiodini & Sundberg, 1981; Bradley et al., 2001).

Human salmonellosis associated with cold-blooded animals is a rapidly emerging public health problem. It results in diarrhea, abdominal cramp, vomiting and

fever, but severe illness is possible because of spreading to blood-stream, bone marrow and nervous system (Aleksic et al., 1996; Woodward et al., 1997; Austin & Wilkins, 1998; Nowinski & Albert, 2000; Jafari et al., 2002).

Domestic reptiles are a source of salmonellae also for dogs, cats and the other pets present in the houses, increasing the occasion of infections for the owners.

Several *S. enterica* serotypes can be isolated from reptiles. Studies carried out in Italy detected a relevant number of isolates belonging to serotypes traditionally present in this territory, but also to exotic serotypes that should be considered potential human pathogens (Ebani et al., 2005).

## MYCOBACTERIOSIS

Mycobacterial infections, caused by atypical mycobacteria, have been reported in ophidians, saurians and chelonians, that react mainly developing granulomas in different body districts (Soldati et al., 2004). *Mycobacterium chelonae* has been frequently isolated from turtles and tortoises with plastral ulcerations, cutaneous and oral mucosa lesions (Rhodin & Anver, 1977; Quesenberry et al., 1986; Greer et al., 2003). *Mycobacterium fortuitum*, *M. kansasii*, *M. haemophilum* and *M. marinum* are able to infect reptiles (Hernandez-Divers & Shearer, 2002; Oros et al., 2003). All the mycobacteria can spread through the hematogenous route with involvement of lung, liver, spleen, kidney, heart, bone, gonads, nervous system and joints (Frye, 1991; Greer et al., 2003).

Atypical mycobacteria are naturally present in water, soil and dust, thus cold-blooded animals have numerous occasions to contract these pathogens. However, reptiles possess a natural resistance to mycobacteria, because the cases of diseases are rarely reported in these animals. Pathologies occur when the animal is immunocompromised or a large number of organisms were introduced (Frye, 1991).

Atypical mycobacteria are potentially pathogen for humans which develop lesions similarly to reptiles. *Mycobacterium chelonae* and *M. fortuitum*, rapidly growing mycobacteria classified in the Runyon group IV, cause mainly lung disease, but also local cutaneous infections, osteomyelitis, joint infections, disseminated skin and soft tissue lesions. *Mycobacterium kansasii*, belonging to the Runyon group I, induces a chronic pulmonary disease similar to pulmonary tuberculosis; it may spread from the local side and causes lymphadenitis and disseminate disease. *Mycobacterium haemophilum*, of the Runyon group III, causes skin, joint, bone, and pulmonary infections in immunocompromised patients and lymphadenitis in children. *Mycobacterium marinum*, classified in Runyon group I, is found in salt and fresh water. *M. marinum* infection occurs following skin trauma in fresh or salt water and usually presents as a localized granuloma or lymphangitis. Infection may result in persistent ulceration, draining sinuses, septic arthritis and osteomyelitis

Cases of infections in reptiles due to the tubercular mycobacteria (*M. tuberculosis*, *M. bovis*, *M. avium-intracellulare* complex) are not reported in literature.

## AEROMONAS AND PSEUDOMONAS INFECTIONS

Bacteria of genera *Aeromonas* and *Pseudomonas*, as well as the species in the newly-created genera *Burkholderia* and *Ralstonia* (ex-*Pseudomonas*), are Gram negative microorganisms widely spread in the environment and considered opportunistic pathogens for animals and humans. These bacteria are involved in several pathologies of reptiles, even if they can be isolated from specimens of healthy animals. *Aeromonas* and *Pseudomonas* spp. are frequently cultured from clinical specimens collected from cold-blooded animals with dermatitis, often ulcerative, stomatitis, ear and respiratory infections, cloacitis, abscesses. All these infections often determine septicemia and consequently death.

Humans may come in contact with *Aeromonas* and *Pseudomonas* bacteria from the environment and directly from spreader animals. Human infections of different origin are sometimes complicated by *Aeromonas* and *Pseudomonas* bacteria. In some cases these microorganisms are the direct cause of pathologies, mainly in immunocompromised individuals. *Aeromonas* spp. are associated with enteric disease which produce symptoms ranging from a mild diarrhoea to a febrile dysentery-like illness. *Pseudomonas* spp. cause infections of urinary tract, respiratory system, skin, soft tissue, bone, joint and gastrointestinal tract. *Burkholderia cepacia* in patients with cystic fibrosis can cause the “cepacia syndrome” characterized by a progressive and fatal bacteremia (Manno et al., 2004).

*Ralstonia pickettii* causes infections mainly of the respiratory tract, in immunocompromised and cystic fibrosis patients.

## CHLAMYDOPHILOSIS

Chlamydiae are obligate intracellular microorganisms recently reorganized in the family *Chlamydiaceae* with *Chlamydia* and *Chlamydophila* genera. The pathogens belonging to *Chlamydophila* genus are widespread among domestic and wild animals and cause severe illness in humans. Sporadic cases of chlamydophilosis have been observed among cold-blooded animals; the prevalence of this infection is probably higher than reported in literature, because clinical signs are not detected and diagnosis is usually defined after the death of animals. The etiologic agent of the cases observed was *Chlamydophila psittaci*, thus a transmission from feral birds to reptiles was presumed.

*Chlamydophila pneumoniae* has been recently detected in granulomatous lesions of household snakes and chelonians (Soldati et al., 2004). The typical host of *C. pneumoniae* is human, in which it causes pneumonia. Infected persons should be considered the reservoir of infection, but the potential of zoonotic transmission from reptiles to humans has to be considered too.

## OTHER BACTERIAL INFECTIONS

Clinically asymptomatic and diseased reptiles may carry a wide variety of bacteria. The enteric bacteria are the most frequently recovered. *Escherichia coli*, *Proteus* spp., *Klebsiella* spp., *Serratia* spp., *Enterobacter* spp., *Citrobacter* spp. (mainly *C. freundii*) are involved in stomatitis, cloacitis, ear infections, subcutaneous and visceral abscesses, upper respiratory infections and pneumonia.

*Citrobacter freundii* is also the cause of a serious pathology of turtles, called "septicemic cutaneous ulcerative disease (SCUD)" characterized by anorexia, lethargy, liver necrosis, and petechial hemorrhages on the shell and the skin; the scutes may slough with an underlying purulent discharge.

*Campylobacter* spp. and *Yersinia enterocolitica*, cause of human gastroenteritis, have been sporadically isolated from faecal specimens of clinically healthy reptiles, but reports of direct infection from reptiles to persons have not been segnalated.

*Erysipelothrix rhusiopathiae* has been rarely isolated from wild reptiles (alligator and crocodile). Humans, in which erysipeloid is primarily a cutaneous infection, could be infect through wounds or skin abrasion handling infected animals. However, domestic reptiles do not appear to be at risk of infection and consequently a source of this bacterium for people.

*Clostridium* spp. are often cause of death, consequent to septicemia. *Pasteurella* spp., *Staphylococcus* spp. and *Streptococcus* spp. have been cultured from reptiles exhibiting mainly respiratory diseases, but they can be isolated also from animals with different pathologies.

Sensitivity of ophidians to *Leptospira interrogans* has been supposed. An experimental infection of snakes with the serovar *pomona* was carried out by Abdulla & Karstad in 1962; spirochetes were demonstrable in kidneys 6 months after inoculation and one snake was found to have an interstitial nephritis. *Leptospira interrogans* serovar *ballum* has been isolated from a hog-nosed snake (Ferris et al., 1961) and serological positivities have been detected among reptiles, particularly ophidians and chelonians (Glosser et al., 1974; Stanchi et al., 1986). There are not data about reptiles as source of *Leptospira* infection for humans, which eventually contract the spirochetes directly from the environment where the cold-blooded animals live.

Snakes, lizards and turtles have been found to have antibodies to *Coxiella burnetii* (Yadav & Sethi, 1979), the etiologic agent of the "Q Fever" of warm-blooded animals including humans, but it is difficult to consider reptiles as reservoir hosts for this pathogen.

## DISCUSSION

Reptiles housed as pet animals may be a serious source of infection for humans. The new owners should to know the risk due to venomous and aggressive species, but also the importance of hygiene to protect themselves from zoonotic infections.

Owners must pay attention to the good care of their animals in order to reduce stress, which represent the main cause of excretion of pathogens. In fact, most infections of reptiles are due to opportunistic pathogen bacteria that infect immunosuppressed animals.

It is important to keep reptiles away from kitchen and areas where food is prepared or eaten; to wear gloves while cleaning the reptile cages or changing the water pool; to wash the hands after handling the reptiles and particularly the wounds due to bites or scratch by nonvenomous reptiles. In this last case, an antimicrobial therapy could be necessary.

Immunocompromised persons, children, elderly and pregnant women are at serious risk of infection and for this reason they should not handle the reptiles and their accessories.

The other household pets, such as dogs, cats and birds, should not have contact with reptiles and their water pool, cages, faeces and feed to reduce the occasions of transmission of bacteria.

In 2002, it was estimated that about 60,000 reptiles owners are present in Italy, for a total of 1,400,000 domestic reptiles. These exotic animals, household as pets, represent an emerging problem for the public health. In fact, the importation of animals from exotic countries to Italy can determine the introduction of new bacterial strains. Reptiles, even if appear healthy, often carry pathogens able to infect humans, which in numerous cases are not properly educated about the animal care and the potential zoonotic risk.

Moreover, the insufficient knowledge about infectious diseases of reptiles causes inappropriate antimicrobial therapies. The isolation and typing of the etiologic agent and the antimicrobial sensitivity test are of great importance to know the potential zoonotic risk and use a proper therapy. In fact, wrong treatments may induce the develop of bacterial strains with antimicrobial resistance, cause of therapeutic failure in veterinary and human diseases.

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