

Chlamydia in koalas

Fact sheet

Introductory statement

Chlamydia (“Chlamydiosis” “wet-bottom syndrome”) is the most common and well known disease of wild koalas. The infection occurs throughout their range, although some populations appear to be free of it. Originally classified as *Chlamydia psittaci* the causative agent has been reclassified as *Chlamydia pneumoniae* and *Chlamydia pecorum*, though arguments have been made for a return to the single genus *Chlamydia* (Stephens et al 2009).

Aetiology

The *Chlamydiaceae* are a family of Gram negative, coccoid, obligate intracytoplasmic bacteria. They have two forms: an infectious elementary body (0.30-0.35 µm) and a replicating reticulate body (0.5-1.3 µm). The family contains two genera. The *Chlamydia* genus contains three species including *Chlamydia trachomatis*, the causative agent of trachoma in humans. The genus *Chlamydia* contains six species including *Chlamydia pneumoniae* and *Chlamydia pecorum*, the causative agents of chlamydophilosis in koalas (Higgins 2012, Blanshard and Bodley 2008).

Natural hosts

As well as koalas, *C. pneumoniae* has been isolated from humans, reptiles, frogs and horses (Pospisil and Canderle 2004). However, the koala biovar appears to be monophyletic and is genetically distinct from the human and horse ones. *C. pecorum* only infects mammals and has been found in ruminants, swine and bandicoots as well as koalas. It can be divided into five distinct genotypes: A – E. Genotypes A and E appear to be koala specific, while the other three genotypes have similar genetic sequences to those isolated from cattle, sheep and swine (Blanshard and Bodley 2008, Warren et al 2005).

World distribution

The disease has been seen in captive koalas held outside Australia (Whittington 2001).

Occurrences in Australia

Chlamydia has been diagnosed in wild koalas in Victoria, NSW, Queensland and South Australia.

Epidemiology

Most cases of severe chlamydia appear to be caused by *C. pecorum* and it is considered to be the more pathogenic of the two. Both species can be isolated from ocular and urogenital sites but, despite *C. pecorum*'s apparent greater pathogenicity, infections commonly occur without evidence of clinical disease. One study found 73% of 28 koalas in a wild population south of Brisbane to be infected with *C. pecorum* but only 17% showed clinical signs. In the same population seven koalas were infected with *C. pneumoniae* but none had clinical evidence of disease. While *C. pneumoniae* has been isolated from cases of rhinitis and pneumonia a direct causal relationship has not been proven (Blanshard and Bodley 2008, Jackson et al 1999).

Spread is generally by direct contact or aerosol. This can include faecal-oral transmission during pap feeding by dependent young, direct transfer of infected discharges from the eyes and urogenital tract and venereal transmission via infected semen. Invertebrate vectors are also capable of carrying and transmitting organisms (Blanshard and Bodley 2008, Whittington 2001).

Chlamydia are quite resistant organisms. One study reported that the elementary bodies of both *C. pneumoniae* and *C. pecorum* could survive for four hours in solutions of pH 4–10. *C. pneumoniae* survived best at pH 7.2–7.5, while *C. pecorum* preferred pH 7.0–7.2. *C. pneumoniae* elementary bodies were inactivated after five minutes at 56°C but at temperatures between 18 and 23°C they remained viable for up to 28 days. They survived for two to four days after drying and maintained infectivity for cell culture after three days exposure on the leaves of *Eucalyptus tereticornis* (Rush and Timms 1996).

After experimental inoculation the incubation period was seven to 19 days for the ocular form of the disease and 25 to 27 days for the urinary tract form (Whittington 2001).

Clinical signs

Infection can be clinical or subclinical and causes keratoconjunctivitis, urinary tract infection, and/or reproductive tract infection.

Koalas acutely affected with ocular disease may have blepharospasm, and a serous discharge that progresses to become mucopurulent. The conjunctival tissues become hyperaemic and begin swelling within two weeks after the onset of clinical signs with the discharge becoming purulent. Over time the conjunctival tissues may proliferate and project beyond the lid margin completely obscuring the eye. A secondary keratitis may develop.

Koalas with urinary tract disease develop brownish staining and wet fur around the cloaca and rump due to constant wetting with urine. There may also be evidence of dysuria and tenesmus.

Reproductive tract infections are often asymptomatic, the only indication of their presence being reduced fertility (Blanshard and Bodley 2008, Higgins 2012, Ladds 2009).

Diagnosis

Diagnosis is based on clinical signs presenting in conjunction with laboratory test results. Palpation and ultrasonography can be used to detect ovarian bursal cysts, bladder wall thickening, pyometron, hydronephrosis and renal fibrosis.

Pathology

Ocular chlamydia presents histologically as a conjunctival accumulation of plasma cells and neutrophils along with villous hypertrophy and hyperplasia of the conjunctival epithelium.

Urinary tract disease involves the bladder and kidneys. Cystitis is characterised by mucosal hyperplasia and degeneration of the epithelium with mixed inflammatory cells and fibrosis of the lamina propria and submucosa, depending on the chronicity of the disease. In severely affected bladders hyperplasia and hypertrophy may result in a polypoid appearance. Renal changes include tubular dilatation and degeneration, protein cast formation, hydronephrosis, chronic interstitial nephritis, pyelonephritis and fibrosis.

Koalas with prostatitis may have degeneration of the glandular epithelium with large accumulations of necrotic debris and inflammatory cells in the ducts and gland parenchyma. Fibrosis and mononuclear infiltration of the lamina propria and submucosa of the prostatic urethra may also occur.

Female koalas may have evidence of vaginitis, cervicitis, metritis, salpingitis and ovarian diverticulitis. These are characterised by a mixed inflammatory infiltrate and, in more chronic cases, squamous metaplasia of the uteri and cystic dilation of the uterine glands along with submucosal fibrosis causing the walls of the genitalia to be thickened and distorted. Endometrial glands may be destroyed. There may be fibrous adhesions between the ovaries and bursal walls and cyst formation in the ovarian bursae (Higgins 2012, Ladds 2009).

Differential diagnosis

Differential diagnoses include other agents that can cause conjunctival, urinary or reproductive tract disease in koalas. *Streptococci*, *Staphylococci*, *Corynebacterium* spp., *E. coli*, *Bacillus* spp., *Pasteurella* spp., *Aspergillus* spp. and *Klebsiella oxytoca* have all been isolated from koala reproductive tracts (Higgins 2012).

Laboratory diagnostic specimens

A complete necropsy should be performed on all dead koalas. Collect a range of tissues including any obvious lesions, and submit them in formalin for histopathology.

For live koalas swab the conjunctiva and urogenital sinus or penile urethra. Viable organisms are more reliably obtained on a second swab. The first swab removes exudate and surface debris while the second swab is more likely to remove viable epithelial cells. If not destined for immediate analysis swabs for Clearview testing may be refrigerated and stored for up to five days (Blanshard and Bodley 2008, Higgins 2012).

Laboratory procedures

An immunohistochemistry test is available that can be used on formalin fixed material.

The Clearview test kit or PCR can be used to test swabs. The Clearview kit can detect as few as 130 elementary bodies per ml and, in one study, had a sensitivity of 91% and specificity of 100%, but false positives can occur with faecal contamination. This compares with a cell culture sensitivity of only 36% (Wood and Timms 1992).

There is currently no commercially available serological test (Higgins 2012).

Treatment

Treatment generally involves the administration of antibiotics such as enrofloxacin 10 mg/kg SID PO or SC, or chloramphenicol 60 mg/kg SID SC. Topical antimicrobials, usually combined with topical corticosteroids, are used to treat ocular disease. For badly affected eyes showing severe conjunctival proliferation conjunctival ablation is the treatment of choice.

Analgesia is provided using meloxicam 0.2 mg/kg PO on the first day followed by a maintenance dose of 0.1 mg/kg every 24 hours PO thereafter, buprenorphine 0.01 mg/kg BID SC or IM and carprofen 4 mg/kg SID SC.

Because antibiotics may affect the koala's gastrointestinal microflora supplementary feeding with a soya based formula or a low lactose milk powder such as Di-Vetalact, Infasoy, Karicare, PediaSure, Portagen or Prosobee is usually required to prevent weight loss and death. The powder is mixed with water to form a semi-liquid paste that is administered orally by syringe. The provision of 60 ml of paste daily, divided into two or three doses, generally maintains body weight (Blanshard and Bodley 2008, Osawa and Carrick 1990).

While treatment improves the koala's clinical status and reduces shedding it appears unlikely that the organism is actually eliminated due to the chronic status of most of the infections encountered and the low blood concentrations achieved following administration of enrofloxacin and chloramphenicol (Govendir et al 2012, Griffith et al 2010).

Prevention and Control

To maintain a chlamydia free captive koala population all new koalas must be isolated and held in quarantine for a minimum of 45 days. They should be chemically restrained, examined and tested by either Clearview or PCR twice at least 21 days apart. See the Australian Government "Conditions For The Overseas Transfer Of Koalas" document (2009) which can be found at:

<https://www.environment.gov.au/system/files/resources/e54cd87f-22b5-46e9-8a21-5e16f7c645cb/files/koala-export-conditions.rtf>

Enclosures that have housed chlamydia positive koalas should be cleaned of organic matter, treated with a glutaraldehyde or chloramine based disinfectant for one to ten minutes and then rinsed (Whittington 2001).

Chlamydia infection status must be ascertained prior to embarking on any translocation programs. In one study fecundity of chlamydia free females dropped from 71% to 23% after they were moved into a chlamydia infected population. Rehabilitation centres should keep koalas from different areas separate and only release animals where they were found (Whittington 2001).

Surveillance and management

There is no targeted surveillance program or AUSVETPLAN for koala chlamydia. Wildlife disease surveillance in Australia is coordinated by the Wildlife Health Australia. The National Wildlife Health Information System (eWHIS) captures information from a variety of sources including Australian government agencies, zoo and wildlife parks, wildlife carers, universities and members of the public. Coordinators in each of Australia's States and Territories report monthly on significant wildlife cases identified in their jurisdictions.

Statistics

There are currently 37 reports of koala chlamydia from Victoria, NSW, Queensland and South Australia in the National Wildlife Health Surveillance Database (eWHIS) (www.wildlifehealthaustralia.com.au). NOTE: access to information contained within the National Wildlife Health Information System dataset is by application. Please contact admin@wildlifehealthaustralia.com.au.

Surveys of free-ranging koalas in several states have revealed highly variable infection rates ranging from 0% up to 86% (Ladds 2009). Infected koalas also show highly variable fertility rates ranging from 0% to 78% (Whittington 2001).

Research

Little is known of the impact of treating infected koalas and releasing them back into the wild, as likely carriers. A study undertaken at a koala rehabilitation facility in NSW found that 21 of 34 koalas presenting with conjunctivitis and 25 of 54 koalas presenting with urogenital disease were successfully treated and released back into the wild. Of the 21 conjunctivitis cases nine re-presented, while 14 of the 25 urogenital cases re-presented. This suggests either a failure to completely eliminate the pathogen resulting in recrudescence, or re-exposure to the pathogen (Griffith and Higgins 2012).

Prevalence of infection and disease vary among different koala populations. A wide range of host, pathogen and environmental factors, including genetic diversity, territorial stress, poor nutrition, exposure to toxins, infection by the koala retrovirus, strain virulence and multiple strain infection, can influence disease outcomes and need to be further investigated.

Chronic renal disease is a common cause of koala mortality. The reasons behind the high prevalence of this condition are not known but some recent work has suggested that chlamydia may play a role in at least some of these cases. This also needs to be investigated further.

Human health implications

To date, there has been no evidence of transmission of koala *C. pneumoniae* or koala *C. pecorum* to humans (Blanshard and Bodley 2008).

Conclusions

While an extremely common and important disease koala chlamydiosis by itself is unlikely to cause the extinction of koala populations. Populations that have existed with chlamydia for a significant period of time appear to achieve a balance with moderate to high infection rates but low rates of clinical disease. However, when combined with other pressures, there is potential for the organism to cause significant declines, particularly in naïve populations.

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This fact sheet was written by Peter Holz.

To provide feedback on this fact sheet

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Wildlife Health Australia would be very grateful for any feedback on this fact sheet. Please provide detailed comments or suggestions to admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and would like to produce a fact sheet (or sheets) for the network (or update current sheets). A small amount of funding is available to facilitate this.

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