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## Infectious diseases of reptiles: An overview



African spurred tortoise (*Centrochelys sulcata*) with rhinitis

Photo source: PD Dr. Rachel Marschang

In recent years, our understanding of infectious diseases in reptiles has grown immensely. It is also clear that the connection between infection and disease is often dependent on multiple factors, including pathogen specific factors (e.g. strain specific properties, virulence factors) and host specific factors (e.g. species, age, sex), as well as environmental conditions (e.g. temperature, hygiene, time of year) and coinfections with other agents. Infections in reptiles also often persist, making quarantine particularly important in this group of animals. The diagnosis of infectious agents in reptiles has also made great strides in recent years. The following pages contain an overview of select infectious agents found in tortoises and turtles, snakes, and lizards. The overview is mainly focused on microorganisms (viruses, bacteria, and fungi), although some parasites are also included. If you are unsure what tests or what types of samples are best in a specific case, we are happy to consult with you on cases.

### Select pathogens according to affected organ systems:

#### Tortoises and turtles

**Skin:** Herpes-, rana-, papillomaviruses, various bacteria, various fungi (USA: *Emydomyces testavorans*); **Respiratory tract:** Herpes-, picorna-, adeno-, rana-, paramyxoviruses (a.k.a. ferlaviruses), mycoplasma, chlamydia, other bacteria, fungi, intranuclear coccidia (TINC); **Gastrointestinal tract:** Herpes-, adeno-, rana-, reoviruses, various bacteria, fungi, intranuclear coccidia (TINC), cryptosporidia, various other parasites

#### Snakes

**Skin:** Arena-, papillomaviruses, various bacteria, *Ophidiomyces ophidiicola*, other fungi; **Respiratory tract:** Nido-, arena-, adeno-, reo-, paramyxoviruses (a.k.a. ferlaviruses), sunshinevirus, mycoplasma, chlamydia, other bacteria, fungi, parasites; **Gastrointestinal tract:** Adeno-, arena-, herpes-, rana-, reoviruses, various bacteria, fungi, cryptosporidia, other parasites; **CNS:** Arena-, paramyxoviruses (a.k.a. ferlaviruses), sunshinevirus, *Entamoeba invadens*

#### Lizards

**Skin:** Rana-, irido-, herpes-, reo, papilloma-, poxviruses, *Devriesea agamarum*, other bacteria, *Nannizziopsis* spp., other fungi; **Respiratory tract:** Paramyxoviruses (a.k.a. ferlaviruses), adeno-, reoviruses, chlamydia, other bacteria and fungi; **Gastrointestinal tract:** Adeno-, herpes-, irido-, reoviruses, various bacteria, fungi, cryptosporidia, other parasites; **CNS:** Adenoviruses

PD Dr. Rachel Marschang

**Table 1:** Select infectious agents found in tortoises and turtles and their laboratory diagnosis

| Infectious agent |                                | Affected species | Affected tissues and clinical signs                                                                 |  | Samples for diagnosis*                                                                                   | Methods                 |
|------------------|--------------------------------|------------------|-----------------------------------------------------------------------------------------------------|--|----------------------------------------------------------------------------------------------------------|-------------------------|
| Viruses          | Adenoviruses                   | Tort and turt    | From inapparent carriers to systemic disease and sudden death                                       |  | Cloacal swabs, intestine, liver, other affected tissues                                                  | PCR                     |
|                  | Herpesviruses                  | Various          | Mostly upper respiratory and GI tract, skin, in some cases inapparent infection                     |  | Oral swab, cloacal swab, skin, tissues (tongue, liver, brain, intestine, others)                         | PCR<br>Sero: VN in tort |
|                  | Paramyxoviruses (ferlaviruses) | Esp. tort        | Mostly pneumonia                                                                                    |  | Tracheal wash, oral and cloacal swabs, lung, other tissues                                               | PCR                     |
|                  | Picornavirus (virus „X“)       | Tort             | Softening of the carapace in juveniles, renal disease, rhinitis, in some cases inapparent infection |  | Oral swabs, cloacal swabs, various tissues                                                               | PCR, VI<br>Sero: VN     |
|                  | Ranaviruses                    | Tort and turt    | Upper respiratory and GI tract, liver, blood vessels                                                |  | Oral and cloacal swabs often not sensitive, blood can be tested, tissue samples best for virus detection | PCR, VI                 |
| Bacteria + fungi | Reoviruses                     | Esp. tort        | Respiratory tract, possibly also GIT                                                                |  | Oral and cloacal swabs, tissues                                                                          | PCR, VI                 |
|                  | Bacteria (aerob and anaerob)   | All              | Many facultative pathogens, can affect various tissues                                              |  | Samples from lesions. Interpretation in conjunction with clinical signs                                  | Culture                 |
|                  | Chlamydia                      | Esp. tort        | Granulomas, rhinitis, pneumonia, myocarditis, hepatitis                                             |  | Nasal washes, oral and cloacal swabs, affected tissues                                                   | PCR                     |
|                  | Mycobacteria                   | All              | Esp. granulomas                                                                                     |  | Material from lesions                                                                                    | Histo, ZN               |
|                  | Mycoplasma                     | Tort and turt    | URTD                                                                                                |  | Oral swabs, nasal washes                                                                                 | PCR                     |
| Parasites        | Fungi and yeasts               | All              | Many facultative pathogens, can affect various tissues                                              |  | Samples from lesions. Interpretation in conjunction with clinical signs                                  | Culture                 |
|                  | Cryptosporidia                 | Esp. tort        | Depending on the parasite species, the stomach or the intestine may be affected                     |  | Faeces, gastric or intestinal mucosa, possibly gastric lavage, cloacal swabs                             | PCR                     |
|                  | Intranuclear coccidia (TINC)   | Tort and turt    | From inapparent carriers to systemic disease and sudden death                                       |  | Cloacal swabs, oral swabs, faeces, tissues                                                               | PCR                     |
|                  | Parasites (others)             | All              | Esp. GIT, from inapparent carriers to severe infestations and death                                 |  | Esp. faeces                                                                                              | N, flot                 |

\*The ideal sample depends on the stage of infection, type of pathogen, and host species and should be chosen based on the clinical question. Flot = flotation; GIT = gastrointestinal tract; Histo = histology; N = native; Sero = serology (antibody detection); tort = tortoise; turt = turtle; URTD = upper respiratory tract disease; VI = virus isolation in cell culture; VN = virus neutralisation test; ZN = Ziehl-Neelsen stain

**Table 2:** Select infectious agents found in snakes and their laboratory diagnosis

| Infectious agent |                                | Affected species                | Affected tissues and clinical signs                                               |  | Samples for diagnosis*                                                          | Methods          |
|------------------|--------------------------------|---------------------------------|-----------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------|------------------|
| Viruses          | Adenoviruses                   | All                             | Esp. GIT and liver                                                                |  | Cloacal swabs, faeces, intestine, liver                                         | PCR, VI          |
|                  | Arenaviruses                   | Boas and pythons                | Inclusion body disease (IBD)                                                      |  | Oesophageal swabs, blood, tissues (esp. brain, liver, kidney, lymph., pancreas) | PCR, cyto, histo |
|                  | Herpesviruses                  | Various                         | Liver, kidney, oral mucosa, venom glands                                          |  | Oral swabs, tissues                                                             | PCR              |
|                  | Nidoviruses                    | Esp. pythons                    | Lung, upper respiratory tract, other systems, in some cases inapparent infection  |  | Oral swabs, cloacal swabs, tissues (lung)                                       | PCR              |
|                  | Paramyxoviruses (ferlaviruses) | Various, esp. vipers, colubrids | Esp. respiratory tract                                                            |  | Tracheal wash, oral and cloacal swabs, lung                                     | PCR<br>Sero: HI  |
|                  | Ranaviruses                    | Various                         | Esp. liver, oral cavity                                                           |  | Oral and cloacal swabs often not sensitive, tissue samples best for testing     | PCR, VI          |
|                  | Reoviruses                     | Various                         | Respiratory tract, GIT, CNS                                                       |  | Oral and cloacal swabs, tissues                                                 | PCR, VI          |
|                  | Sunshinevirus                  | Pythons                         | CNS, respiratory tract                                                            |  | Oral and cloacal swabs, tissues (esp. brain)                                    | PCR              |
|                  | Bacteria (aerob and anaerob)   | All                             | Many facultative pathogens, can affect various tissues                            |  | Samples from lesions. Interpretation in conjunction with clinical signs         | Culture          |
|                  | Chlamydia                      | Various                         | Granulomas, pneumonia, myocarditis, hepatitis, other tissues can also be affected |  | Oral and cloacal swabs, affected tissues                                        | PCR              |
| Bacteria         | Mycobacteria                   | All                             | Esp. granulomas                                                                   |  | Material from lesions                                                           | Histo, ZN        |
|                  | Mycoplasma                     | Esp. pythons                    | Upper respiratory tract                                                           |  | Oral swabs                                                                      | PCR              |
|                  | <i>Ophidiomyces ophidicola</i> | Various                         | Skin                                                                              |  | Skin (swabs, biopsies, sheds)                                                   | PCR              |
| Fungi            | Fungi and yeasts               | All                             | Many facultative pathogens, can affect various tissues                            |  | Samples from lesions. Interpretation in conjunction with clinical signs         | Culture          |
|                  | Cryptosporidia                 | Various                         | Stomach most often affected                                                       |  | Gastric lavage, regurgitated material, gastric mucosa                           | PCR, ZN, IFAT    |
| Parasites        | Parasites (others)             | All                             | Esp. GIT, inapparent carriers to severe infestations and death                    |  | Esp. faeces                                                                     | N, flot          |

\*The ideal sample depends on the stage of infection, type of pathogen, and host species and should be chosen based on the clinical question. CNS = central nervous system; cyto = cytology; flot = flotation; GIT = gastrointestinal tract; HI = haemagglutination inhibition; histo = histology; IFAT = immunofluorescence antibody test; lymph. = lymphatic tissue; N = native; sero = serology (antibody detection); VI = virus isolation in cell culture; ZN = Ziehl-Neelsen stain

**Table 3:** Select infectious agents found in lizards and their laboratory diagnosis

| Infectious agent |                                | Affected species                                                       | Affected tissues and clinical signs                            | Samples for diagnosis*                                                  | Methods         |
|------------------|--------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------|-----------------|
| Viruses          | Adenoviruses                   | All, esp. bearded dragons                                              | Liver and GIT, in some cases CNS signs                         | CS, tissues (liver and intestine)                                       | PCR             |
|                  | Herpesviruses                  | Various                                                                | Liver, skin, oral mucosa                                       | OS, CS, tissues                                                         | PCR             |
|                  | Iridoviruses                   | Esp. bearded dragons, chameleons, others, also feed insects (crickets) | Skin, GIT                                                      | Tissues (not CS since virus can originate from feed insects)            | PCR, VI         |
|                  | Nidoviruses                    | Shinglebacks, others                                                   | Upper respiratory tract                                        | OS, tissues                                                             | PCR             |
|                  | Paramyxoviruses (ferlaviruses) | Various                                                                | Esp. respiratory tract                                         | Tracheal wash, OS, CS, tissues                                          | PCR<br>Sero: HI |
|                  | Ranaviruses                    | Various                                                                | Skin, liver, other tissues                                     | Tissues samples; OS and CS not sensitive                                | PCR, VI         |
| Bacteria         | Reoviruses                     | Various                                                                | Respiratory tract, GIT                                         | OS, CS, tissues                                                         | PCR, VI         |
|                  | Bacteria (aerob and anaerob)   | All                                                                    | Many facultative pathogens, can affect various tissues         | Samples from lesions. Interpretation in conjunction with clinical signs | Culture         |
|                  | Chlamydia                      | Various                                                                | Granulomas, pneumonia, myocarditis, hepatitis, others          | OS, CS, affected tissues                                                | PCR             |
|                  | <i>Devriesea agamarum</i>      | Esp. <i>Uromastyx</i> spp., others                                     | Skin (cheilitis)                                               | Skin                                                                    | Culture         |
|                  | Mycobacteria                   | All                                                                    | Esp. granulomas                                                | Material from lesions                                                   | Histo, ZN       |
|                  | <i>Encephalitozoon poguei</i>  | Bearded dragons, other microsporidia described in other species        | Liver, granulomas, others                                      | Faeces, CS, tissues                                                     | PCR             |
| Fungi            | <i>Nannizziopsis</i> spp.      | Various, esp. agamids                                                  | Skin, in some cases systemic disease                           | Skin                                                                    | Culture, histo  |
|                  | Fungi and yeasts (others)      | All                                                                    | Many facultative pathogens, can affect various tissues         | Samples from lesions. Interpretation in conjunction with clinical signs | Culture         |
|                  | Cryptosporidia                 | Various, common in leopard geckos                                      | Esp. intestine                                                 | Faeces, CS                                                              | PCR, ZN, IFAT   |
| Parasites        | Parasites (others)             | All                                                                    | Esp. GIT, inapparent carriers to severe infestations and death | Esp. faeces                                                             | N, flot         |

\*The ideal sample depends on the stage of infection, type of pathogen, and host species and should be chosen based on the clinical question. CNS = central nervous system; CS = cloacal swab; flot = flotation; GIT = gastrointestinal tract; HI = haemagglutination inhibition; histo = histology; IFAT = immunofluorescence antibody test; N = native; OS = oral swab; Sero = serology (antibody detection); VI = virus isolation in cell culture; ZN = Ziehl-Neelsen stain