BACTERIAL INFECTIONS AND TREATMENT WITH ANTIBIOTICS IN SNAKES, A RECENT VISION. PART 2.

By: R. Jooris, Gemoedsveld 3, 9200 Wetteren, Belgium.

Contents: Bacteria as pathogenic agents in snakes - Conclusions.

BACTERIA AS PATHOGENIC AGENTS IN SNAKES

1) Salmonella spp as causative agent of gastro-enteritis and systemic disease.

Because of the high frequence of occurrence of Salmonella spp in clinically healthy snakes, these species were classified as common, non-pathogenic bacteria of cold blooded animals (Cooper, 1981). However, when Salmonella positive and negative samples in animals showing clinical signs of disease are compared there is a significant (p0.01) correlation between gastro-intestinal disorders and the presence of Salmonellae. Furthermore, during the course of the investigations we were able to establish clinical signs of illness in which Salmonella spp are highly considered as primary causative agents.

Patient 1: *Crotalus cerastes.*

Post mortem examination was carried out on a female snake, who died shortly after the hibernation period. Shortly before dying, she suffered from diarrhoea and digestion disorder. From faecal samples Salmonella bacteria were cultured and there was a clear inflammation (leucocytes +++); protozoa

and helminths were not seen. The post mortem culture from a liver extract and an abdominal cyst showed a dominant growth of Salmonella subgroup III (S. arizonae).

Patient 2: *Vipera ammodytes transcaucasiana.*

A female snake was transported during hibernation without ensuring the maintenance of the optimal (low?) temperature. Shortly after hibernation the animal showed respiratory problems, purulent exudate was expelled from the glottis. Bacteriological examination revealed a pure culture of Salmonella subgroup III. The snake died shortly afterwards.

Patient 3: *Crotalus ruber.*

This animal had digestive problems, vomited and developed slimy diarrhoea. Microscopic examination of the faeces was negative on protozoa and helminths, bacteriological examination however showed a pure culture of Salmonella subgroup III.

Patient 4: *Crotalus durissus.*

A male snake suffered from heavy pneumonia (purulent oral mucus) followed by a gastro-intestinal disorder. Bacteriological examinations carried out on samples of the purulent oral mucus revealed growth of predominantly Salmonella subgroup I, together with other enterobacteriaceae like Escherichia coli and Klebsiella pneumoniae. The animal died shortly afterwards.

From the results of the investigations it seems that on the one hand clinically healthy animals can be carriers of Salmonella spp; on the other hand, statistical analysis between the fore

mentioned clinical disease and the presence of Salmonella spp, indicates that the Salmonella may be considered the primary causative agent of several infections in snakes. Resistance of snakes (and other reptiles) against Salmonella when compared to other animals (birds, mammals) may be high, therefore a normal, healthy and properly feeding animal might be able to live in equilibrium with these organisms. The inocculation of snakes with Salmonella spp (Chiodini, 1983), without evoking changes in health indicate this as well. It is a pity that the inocculation was not carried out in weakened or badly housed snakes.
Furthermore, it is remarkable that in two out of the four mentioned cases in which Salmonellae were isolated, the animals had been subjected to a period of less favourable circumstances; hibernation and transport. Therefore, our impression is that Salmonellae may be potential pathogenic agents in case of increased susceptibility, caused by the suppression of the immune system, evoked by the incorrect housing of animals, virus infections, etc. thus causing gastro-enteritis.
The way the enteritis developed was not clear from the investigation, however indications are that from enteritis (caused by bacteria?) a systemic infection developed. The isolation of Salmonella spp from several organs (Ippen and Schroeder, 1985) reinforce these suspicions. This might be the reason for the low succes rate in treatment of these infections with antibiotics such as neomycine, which are not resorbed in the gastro-intestinal tract.

2) Pseudomonas-Aeromonas spp as causative agents of several bacterial disorders.

The fact that Pseudomonas aeruginosa and Aeromonas hydrophila can cause stomatitis ulcerosa (mouth

rot) is well known (Cooper, 1981; Ippen et al., 1985; Ross & Marzec, 1984; Isenbgel & Frank, 1985). During this investigation as well, a case of stomatitis caused by Aeromonas hydrophila was established. Whether Pseudomonas and Aeromonas can cause enteritis as mentioned by others (Ippen & Schroeder, 1985) could not be proved in this study. The numbers of faecal examinations were to small to be statistically tested. Bacteriological examination of the faeces of a *Cerastes cerastes*, which died during hibernation and suffered from haemorrhages in the intestinal wall, revealed A. hydrophila. Additionally, the animal was infested by cestodes.
When comparing bacteriological examinations from samples from the oral cavity of clinically sick (pneumonia, apathetic animals with petechia in the mucosa of the mouth, considered to be suffering from a bacteriological infection) and clinically healthy animals, it was noticed that P. aeruginosa, P. malthophilia, Salmonella spp and A. hydrophila almost exclusively occurred in the first mentioned group. Statistical analysis between samples negative and positive for one or more of the above mentioned bacteria, from healthy and sick animals was undertaken. When pneumonia had been clinically established and one ore more of these bacteria were isolated, we consider them as causative agents for the pneumonia or sepsis. Some examples follow.

Patient 5: A *Crotalus durissus terrificus* suffered from severe pneumonia (petechia in the oral mucosa). From the purulent mucus of the mouth a pure culture of P. aeruginosa was isolated. Due to the treatment with an anti-pseudomonas penicillin (Piperacilline) and the addition of aminoacids, the animal recovered rather quickly. This was not a solitary case of infection but

part of an epidemic in a reptile collection, caused by the infection of the drinking-water with P. aeruginosa (Jooris & Tubex, 1988).

Patient 6: An *Epicrates cenchria cenchria* lay stretched out in a vivarium and did not respond to any external stimuli. Bacteriological examination of the oropharyngeal mucus revealed dominant growth of P. maltophilia. The animal died two days later.

Patient 7: A *Crotalus cerastes* lay apethetically in the vivarium. From the oral mucus a pure culture of P. maltophilia was isolated. The animal died the same day.

Patient 8: A sample taken from the oral mucus of a *Boiga dendrophila* with signs of pneumonia revealed A. hydrophila and other bacteria like E. coli and Staphylococcus spp The animal was not treated, the pneumonia aggravated and the animal died within two weeks.

Patient 9: A *Trimeresurus flavoviridis* suffered from a sever pneumonia. In the purulent mucus from the mouth A. hydrophila was isolated.

3) Other potential pathogenic organisms in snake.

In table 7 different infections of bacteriological or mycotic origin in the examined population are summarized: pneumonia and enteritis are most the frequently encountered problems. Only two cases of stomatitis ulcerosa (mouth rot) occurred, a remarkably low number, since this disorder is frequently seen in snakes. Mouth rot is usually easily recognised by the snakes' owner, therefore bacteriological samples are seldom sent to a laboratory;

treatment is thus often done "blindfold".
As mentioned before mouth roth in a *Liasis childreni* was caused by A. hydrophila. In an other patient, a *Boa constrictor*, a combination of Serratia marcescens, Flavobacterium indologenes and Morganella morganii were isolated from the cheese-like exudate.
A mixed flora was also isolated from samples from exudate from mouth and throat from a *Bitis arietans* (P. aeruginosa, M.morganii, Proteus vulgaris and Salmonella spp), a *Boa constrictor* (M. morganii and Providencia rettgeri) and a *Naja naja naja* (P. aeruginosa and S. marcescens). These three animals showed clear signs of rhinitis. Gram negative aerobic and anaerobic bacteria were also isolated in case of necrotic dermatitis. From samples from the foul smelling, skin exudate of a *Python molurus bivittatus*, housed on damp soil, a mixed flora of P. aeruginosa, Fusobaterium spp, Bacteroides fragilis and Trichoderma spp (contamination through the soil?) was isolated. The dermatitis was far advanced, the animal died 8 days after the sample was taken, probably due to a bacterial systemic infection.
From a sample of a dry, scaleless part of the skin in a *Lacerta lepida* a Trychophyton spp was isolated. Rhodotorula rubra was the causative agent of a dermatitis in the neck area of a *Crotalus durissus terrificus*. The infection was probably brought about by repeated manipulation of the animal in the treatment of a severe pneumonia (Jooris & Tuubex, 1988).
An *Epicrates cenchria cenchria* had burned its nose on an "Elstein" lamp. The burn was neglected, became necrotic and infected by P. aeruginosa. The snake was offered for treatment in very bad condition and died some days later, probably due to systemic disease and weakening.
From cloacal abcesses from a *Trimeresurus okina-*

vensis and a *Crotalus durissus*, a mixed flora of P. aeruginaosa and B. fragilis, and of S. marcescens and E. coli respectivily were isolated. From boils in the skin of a *Lacerta dugesii*, predominantly Acinetobacter calcoaceticus (biovar lwoffi) besides Staphylococci spp were isolated. This lizard was presented for examination after several animals, with the same clinical signs had died. The infection occurred after a break down of the automatic sprinkler system, causing the soil to be to damp. Acinetobacter spp are known to occur mostly in natural surroundings and only be the cause of disease (like sepsis after a local infection) in immune suppressed animals (Lenette et al., 1985). The rapid death of most of the lizards indicates systemic disease caused by these bacteria.

Furthermore, an akward case of oropharyngeal cellulitis (purulent inflammation of the subcutaneous connective tissue in the oropharyngeal cavity) occurred. According to Ross & Marzec (1984) this infection is caused by gram negative rods. Oropharyngeal cellulitis is especially expressed by severe oedema and inflammation of the tissues in oral cavity and pharynx, causing strong swelling of the head and neck. Without treatment the infection progresses and includes inflammation of the bone-marrow followed by death. Our patient was a *Vipera ammodytes transcaucasiana*. From the exudate of the oral mucus, which was covered with haemorrhages, no gram negative rods were isolated, however a pure culture of Corynebacterium spp was isolated. The snake reacted well to treatment with penicilline injections, which is normally not often applicable in reptiles, and recovered within 7 days.

Finally, a case of inflammation of an eye, which is not included in the tables because no bacteriological examination was done is presented. The reason for presenting this disease anyway is that

snake owners may be confronted with it, because it is far from rare in snake collections. In the first phase the inflammation of the eye is expressed as troubling of the eye, followed shortly by swelling and filling up with yellowish white exudate. The infection may be caused by migration of mostly gram negative bacteria from the oral cavity through the lacrimal gland and -canal to the space between the eye and the spectacle, causing inflammation and deposition of purulent and necrotic material. Treatment must be immediate (broad spectrum antibiotics) or else the eye might be lost.

CONCLUSIONS

The bacterial flora of Ophidia predominantly consists of gram negative bacteria. Only a few species may be primarily causative agents of disease. It is quite possible that only Aeromonas hydrophila is pathogenic in itself, because it was only isolated in well defined disease. Its role in the case of diarrhoea could not be demonstrated in our investigations, considering the single isolation from the intestinal tract.
However, it would be very interesting studying to what extent the occurrence of cytotoxin-producing Aeromonas spp (Atkinson, 1986) or even other Aeromonas spp (Hickmann-Brenner et al.,1987) are of importance as causative agents of enteritis in poikilothermic animals.
Most of the other bacteria causing disease in snakes may be considered opportunistic pathogenic agents, which in cases of increased susceptibility evoke local or systemic disease. Various factors can lead to an increased susceptibility. Best known are bad hygiene, non optimal climatic conditions and stress (many cases of disease occur after transportation). Virus infections also play

a role. Drinking of infected drinking water may be the cause of disease. Above mentioned may lead to a shift in bacterial flora (dysbacteriosis), leading to domination of certain more pathogenic species.
Many snakes are just symptomatic carriers of Salmonella spp In some animals however, the Salmonella may cause gastroenteritis end even systemic disease including pneumonia (diminished resistance?). Samples from the oro-pharyngeal cavity are not completely representative for the bacteriological diagnosis of pneumonia, however they may be indicative. Bacterial investigation of these samples predominantly reveal P. aeruginosa, P. maltophilia, Salmonella spp and A. hydrophila.

Table 7: Proportional ratios of the different infections caused by bacteria or fungi in the examined population

(N = 92).

Pneumonia, type I	8
Pneumonia, type II	6
Gastro-enteritis	13
Stomatitis ulcerosa (mouth rot)	2
Oro-pharyngitis	1
Rhinitis	2
Abcesses	2
Boils	1
Necrotic dermatitis	3
Fungal dermatitis	2
Infected burn	1
Systemic disease	2
Death without known cause	3

Translation: Marja Kik