HEALTH & DISEASES

This column is taken care of by the "Studygroup for Diseases and the Optimum Keeping and Breeding of Terrarium Animals" of the Belgian Society "Terra". If there is a question concerning health or diseases, feel free to contact the President of the Studygroup: Mr. Hugo Claessen, Arthur Sterckstraat 18, 2600 Berchem, Belgium. He will try to answer your question in this column to the benefit of all members.

ABOUT A PROGRESSIVE-PASSING INFECTION IN A REPTILE COLLECTION AND THE SUCCESSFUL TREATMENT OF A SERIOUS PNEUMONIA CAUSED BY *PSEUDOMONAS AERUGINOSA*.

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INTRODUCTION

'Reptielenland' in Brugge (Belgium) is a reptile exhibition that is accessible to the public; it accommodates about 180 reptiles, mainly snakes. The

reptiliary consists of an exhibition room, a quarantine department and a breeding centre. The two last mentioned rooms are not accessible to the public. In the beginning of January 1986 there developed in the reptile collection a general, infectious disease, that secured several victims.

THE FACTS

On 11 January 1986, we found an adult *Vipera lebetina schweizeri* dead in the terrarium. Her mouth was full of strong-smelling, bloody mucus. Nevertheless, the animal had looked perfectly healthy during the weeks before her death. The regular research for internal parasites in her faeces had always been negative.
One day later, two *Hemachatus haemachatus* were found dead in their terrarium and within a period of two months the following specimens died under the same circumstances, which was bloody mucus in the mouth and a swollen throat: *Naja mossambica, Cerastes cerastes, Echis carinatus sochureki, Lampropeltis triangulum, Hemachatus haemachatus* (4 specimens),*Naja nivea, Chrysopelea ornata* and *Agkistrodon contortrix.*
Next to the abundant production of mucus, all animals showed remarkable signs of a fast putre faction after the death.
The post-mortem report of the Vakgroep Pathologie, afdeling Bijzondere Dieren, gave the following results: in the *Vipera lebetina schweizeri* it appeared that the lung was strongly affected and there were lesions found. During the bacteriological research they had been able to isolate *Pseudomonas aeruginosa.* In the two specimens of *Hemachatus haemachatus* they found, next to a pneumonia, a purulent and bloody enteritis. In the lungs and the intestinal tube they also found plenty of *Aeromonas hydrophila.* They diagnosed pneumonia, caused

by *Pseudomonas aeruginosa* and/or *Aeromonas hydrophila*.

BACTERIOLOGICAL RESEARCH AND DETERMINATIONS

In the meanwhile cultures of all kinds of samples taken in the reptiliary and its immediate surroundings were set up. This was done in a Bacteriological Laboratory in Gent. There were cultures made from the water out of the drinktanks of the terraria, the supply-bottle, the tapwater, the bath-water of the dolphinarium,from various substrate samples of the terraria and from the purulent mouth mucus of different snakes.
Most samples had a flora consisting of bacteria that are normal for these environments. A single time they also found potential pathogens (disease-forming) like unpigmented *Pseudomonas*-spp (*acidovorans stutzeri, cepacia, putida*), *Achromobacter xylosoxidans, Acinetobacter calcoaceticus* var. *Iwoffi, Enterobacter agglomerans, Enterobacter cloacea, Serratia marcescens* and *Micrococcus* spp. Eighty percent of the examined water samples that were taken from the drinktanks of the terraria, from the supply-bottle and samples of the mouth mucus however had a dominant flora of *Pseudomonas aeruginosa*!
The infection source was obvious: the supply-bottle, in which in the course of the months a sediment of protein and calcium had deposited - also in the bottle and in the sprinkler-mechanism - formed an ideal milieu for *Pseudomonas aeruginosa*.
In the contaminated water in the drinktanks of the terraria a strong development of the bacteria occurred. Every time a snake drank water it got a large amount of *Pseudomonas*-bacilli in its stomach/intestinal tube, where they were abled to colonize in their host.
Pseudomonas aeruginosa is a, in the natural milieu,

widely distributed bacterium. In human medical science it is known as an 'opportunist pathogen', and most infections occur in patients that are, for a long time, treated with medicines that are detrimental to their defence-system. By these medicines one should for example think at corticosteroids, antimetabolic antibiotics, but also, for example, radiation.
The opportunist character of this bacterium also finds expression in reptiles, and specially in snakes. However, *Pseudomonas aeruginosa* rather often gets isolated from the mouth mucus and the intestine-flora of clinically healthy snakes (personal research, not published data). This bacterium also contains the procreator of infections of the intestine mucous membrane that lets tissue die (Gray et al, 1960), of stomatitis (Cooper, 1973), of bloodpoisoning (Cooper & Leaky, 1976) and infection of the respiratory organs (Levy, 1974; personal research, not published data). Such infections mostly appear in animals that are not kept under the right circumstances, for example, when the surrounding temperatures are not optimal, when the accommodation is insanitary, when the animals suffer from stress etc. Such factors should cause a suppression of the immune-defence-system in reptiles, so the bacteria get the opportunity to settle in their host (Evans, 1963). So perhaps it is not strange that the *Pseudomonas*-infection rose in the middle of the winterperiod, when possibly for some animals the right surrounding temperatures were not available.

TREATMENT OF A *PSEUDOMONAS*-INFECTION IN A *CROTALUS DURISSUS TERRIFICUS*

Notwithstanding the great loss of animals, mortalities which were all explained by the isolent progress of the infection - all animals died one to

two days after the first illness-symptoms - we still were able to treat one animal with success which was suffering from a very serious pneumonia. The treatment of this snake, a *Crotalus durissus terrificus*, therefore will be discussed in detail. Possibly it can act as a guide for analogous infections.

SYMPTOMALOGY

In the beginning of February 1986 the male *Crotalus durissus terrificus* (13th calenderyear, 130 cm length, weight 4000 g) showed the first symptoms of a general infection: the snake laid not normally coiled, but with the front third part of the body stretched. The reaction (tail- and head-reflex) to external stimulus was rather weak. Three days later the rattlesnake got the first signs of respiratory problems (breathing with open mouth). Therefore he was transferred to a quarantine terrarium with a temperature of 28-30^{0}C. Towards the evening we diagnosed a marked deterioration of the physical condition: the mouth was full with purulent mucus and the respiration was laborious. We also saw clear signs of decay, something that is a frequent symptom for a *Pseudomonas*-infection (Griner, 1983). The inside of the mouth showed many small lesions, which is typical for a blood-poisoning and we also saw infections that are coupled with the sprouting of infection cells. The cloaca was red and swollen by dropsy. The faeces that were produced thanks to the stress of handling of the snake were slimy, yellow-green coloured and spread a putrefacted smell. On the purulent mouth mucus we performed microscopic- and bacteriological research and sensitivity tests. In advance of the result of tests, we administered the animal intramuscular Cotrimoxazole (80 mg Trimethoprim/400 mg Sulfamethoxazole per ampoule) 50

mg/kg bodyweight. This gave no visible improvement of the clinical condition and perhaps further treatment with this antibiotic would have led to the death of the animal.

DIAGNOSIS

The direct microscopic research after Gram-colouring showed large numbers of 'neutrofied' white blood-corpuscles and clearly showed the presence of the gram-negative bacterium. The bacteriological culture gave a pure culture of *Pseudomonas aeruginosa*. In view of the pure culture, the result of the above mentioned research and the clinical image, it was practically certain that the rattlesnake was going through a general infection with *Pseudomonas* with bloodpoisoning and pneumonia.
The *Pseudomonas*-stock was in the culture-media sensitive for Piperacilline and three of the four tested aminoglycosides: Tobramycine, Gentamycine and Amikacine. There appeared to exist a moderate sensitivity to Colimycine, while the bacterium was 'resistant' to Cotrimoxazole, Chloramphenicol, Cefotaxime and the aminoglycoside Dibokacine.

TREATMENT

Because of the known harmful effect to the aminoglycosides on the kidneys (Falco et al, 1969; Luft et al, 1978) we chose the treatment with Piperacilline (Pipcil, Ledere); this is a semi synthetic, wide-spectrum Penicillin that exclusively can be adminstered in another way than via the stomach/intestinal tube.
Piperacilline has a strong bacteriumkilling effect and is active against a wide scale of gram-negative and gram-positive micro-organisms. In human medical science this antibiotic is often used

against *Pseudomonas*-infections of the upper-bronchia; this on account of its ability to reach high concentrations in the lungtissue (Valenti et al, 1981). Also in serious general infections (Winston et al, 1980) and in bloodpoisoning (Limson et al, 1980) it appears to be successful.
The treatment with Piperacilline was started on 13 February 1986. This was the seventh day after the first illness-symptoms. As dose we used the children's dose of human medical science, namely 100-150 mg/kg bodyweight per day. On the grounds of the slower metabolism in view of the coldblooded nature of the animal, we did not give the injections every day, but only every 48 hours. In all we administered 9 injections in the belly (n.b. to smaller animals you are advised to give intramuscular injections, because the doses you have to inject are smaller).
Instead of dissolving the antibiotic in the usual amount of distilled water (4 ml), we only took 3 ml and diluted this up to 4 ml with 1 ml vitamin C solution (Roche, amp i.m. or i.v., 500 mg vitamin C per amp.). Vitamin C, it is true, is not a real vitamin for reptiles, but it possibly could act as a brake on the evolution of *Pseudomonas* in the blood, thanks to the temporarily lowering the acidity of the blood. Simultaneously with the injection, we cleaned the cavity of the mouth with Mucosept (Qualiphar) and disinfected the terrarium with a diluted Javel-solution and with an U.V.-radiation of 15 minutes (Philips Germicidal U.V. lamp, 15 Watt). The drinkwater was soured with 1 n HCl (6 ml per litre water).
On 19 February we noticed a first positive development in the consistence and the colour of the mucus; it became less purulent. Two days later there was a general improvement of the physical condition of the rattlesnake and on 25 February nearly all mucus was gone. The bacterial culture

of the mouth mucus of 25 February showed a growth of *Eschericha coli* and of *Acinetobacter calcoaceticus*. All the previously present *Pseudomonas* appeared to have disappeared!
To stimulate kidney-function and also to reduce the risk of possible damage to the kidneys (Bush, 1980), we administered, next to the antibiotic, also solutions of aminoacids and electrolytes intraperitoneally: on 21 and 25 February we gave 15 ml Aminofusin (Pfrimmer) and 20 ml Hartmann (Travernol). On 2 March we lessened the amounts respectively to 5 ml and 10 ml, for the administering of too much fluid could lead to lung oedema.
On 5 March the snake sloughed and all the apathy had disappeared. He reacted normally again to stimuli and ate a dead rat on 10 March, for the first time again.
Just behind the head a slight irritation had developed due to the repeatedly handling the animal. A yeast, *Rhodotorula rubra*, was also responsible for this. This dermatitis disappeared after a fortnight following treatment with a Pevaryl-spray (Cilag) twice a day.

PIPERACILLINE, A VALUABLE ANTIBIOTIC IN THE HERPETOLOGICAL MEDICATION?

Referring to the successful treatment of the Tropical rattlesnake (*Crotalus durissus terrificus*) was Piperacilline, on our advice, applied in analogous infections in various other snakes. Although the number of treated animals is still too small to judge this antibiotic against infection diseases of reptiles, we got, with one exception, very good results and destroyed the pathologic condition (pneumonia, enteritis) after a treatment of a few days.
On empirical grounds we may conclude, that the symptoms disappear faster by daily parental in-

jections than by injections every second day. The halving time of Piperacilline by excretion via the kidneys should be enough, so that reptiles can assimilate daily doses without noticeable co-symptoms.
Although Piperacilline has up to now appeared active against all tested *Pseudomonas aeruginosa*-stocks, we also have to point to the fact that this antibiotic cannot be used just like that for all infections. Isolation of the original germ and the making of an antibiogram (diagram of the sensitivity of a disease-breeding micro-organism for different antibiotics), are still of the greatest importance!
As with most Penicillines, Piperacilline is also de-activated by certain beta-lactamase-producing bacteria (e.g. *Staphilococcus* spp). Against beta-lactamase-producing *Enterobacteriaceae* it would indeed keep a remarkable activation. Also *Aeromonas hydrophilia*, another important reptile-pathogen and also a 'beta-lactamase-producer' could develop resistence, although all tested stocks were sensitive during research in the laboratory. The very resistant *Pseudomonas maltophilia* is also resistant against this antibiotic. A Piperacilline treated pneumonia of a *Vipera ammodytes transcaucasiana* deteriorated, with a dominant growth of this *Pseudomonas* species, so we had to change over to another medication.
Still we can have confidence in this antibiotic, certainly for the treatment of infections that are caused by *Pseudomonas aeruginosa*. It appears the antibiotic is tolerated well by reptiles and it is also one of the few possibilities for the aminoglycosides that are rather harmful for the kidneys. Very resistant *Pseudomonas aeruginosa*-stocks could, when Piperacilline alone gives not enough result, be controlled by a combination of Piperacilline with an aminoglycoside, for example

Netilmicine, Gentamycine or Tobramycine. The simultaneous use of a penicillin with an aminoglycoside gives a remarkable synergism (mutual strengthening) and is in human medical science frequently used against bloodpoisoning. By way of precaution and based on the serum halving time of Gentamycine for reptiles (Bush, 1980), you would have to administer the aminoglycoside only every third or fourth day, intramuscularly.

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