Summary

- Infection by bacteria: *Streptobacillus moniliformis* or *Spirillum minus*
- Rate bite fever is named sodoku in Asia, caused by *S. minus*
- Haverhill fever is rat bite fever caused by *Streptobacillus moniliformis* after ingestion of food or water contaminated with rat faeces
- Rat bite wound followed by fever, lymphadenopathy, migrating arthralgia, skin rash and muscle pain
- If transmitted via infected drink: episodic fever, throat pain, rash, muscle and joint pain
- Systemic complications possible: myocarditis, pneumonia, abscesses, meningitis
- Treatment with penicillin

General

Rat bites may give rise to infection with various bacteria but two deserve special attention. *Spirillum minus* is a systemic zoonosis occuring mainly in Asia. Rat bite fever caused by *Streptobacillus moniliformis* has a more cosmopolitan distribution and is mainly recognised in Europe and North America. A third species causing rat bite fever – *Streptobacillus notomytis* – has only been reported rarely. Infection in third world countries will probably be discovered as soon as better diagnostic facilities are available. Rat bite fever may trigger intermittent fever which may make it similar to other infections.

Clinical aspects

Spirillum minus is a small spiral-shaped bacterium and is usually classified as a spirochaete and is unable to be cultured. The bacterium has flagellae and moves quickly unlike *Streptobacillus moniliformis*.

Streptobacillus moniliformis is a difficult to culture pleomorphic non-motile Gram-negative rod-shaped bacterium. Its name refers to the necklace like morphology exhibited by the bacteria that form thin branched filaments.

The disease caused by *S. minus* is known as sodoku in Asia (a Japanese name: *so*: rat, *doku*: poison). Infection may follow a rat bite or the consumption of water or milk contaminated by

rat urine or faeces.

Streptobacillus moniliformis infection occurs after ingestion of food or water contaminated with infected rat faeces. The disease is known as **Haverhill Fever**. The name Haverhill refers to a small town in Massachusetts where an epidemic broke out in 1926 following the consumption of contaminated unpasteurized milk. The bacteria occur naturally in the nasopharynx of rats and are found in 50 to 100% of rats living in the wild. The risk of rat bite fever due to *S. moniliformis* after a rat bite is estimated to be 10%. Not only rats, but also other rodents such as mice, gerbils, squirrels or carnivores or omnivores which eat rodents (cats, dogs, pigs, weasels, ferrets) can transmit the bacteria. People who work with animals (laboratory staff, some biologists) are at increased risk.

The incubation time is 1 to 30 days, usually approximately 1 week. If infection (*S. minus and S. moniliformus*) is transmitted orally, there are no skin wounds. A bite wound of*S. minus* causes local inflammation and even tissue necrosis with enlarged regional lymph nodes and its initial wound may reappear at the onset of systemic illness. *Streptobacillus moniliformis* bite wounds heal spontaneously.

After the wound has healed, intermittent chills, extreme fatigue, vomiting, diffuse muscle and joint pain and headache follow. Arthritis is not common in *S. minus* infection. *S. moniliformis* infection may give rise to an asymmetrical non-purulent poly-arthritis in up to 50% of patients. Generally the large joints are affected, such as the knees, ankles, elbows, wrists, shoulders and hips. Purulent arthritis is rare. If a patient is bitten on a finger, a neighbouring interphalangeal joint may exhibit impaired function.
Approximately two to four days after the beginning of the fever a skin rash occurs. This may have a morbilliform, pustular or petechial character. The rash is most pronounced on the hands and feet. Desquamation may occur. Somewhat later the patient develops painful pharyngitis. After an average of five days spontaneous improvement is seen. The fever disappears and the other lesions improve over the course of a few weeks.

After an irregular period of time there might be a relapse which resembles a picture of fever of unknown origin. This recurrence may persist for two years.
Complications include ulcerative endocarditis, subacute myocarditis, pericarditis, meningitis, pneumonia, amnionitis and anaemia. Abscesses may occur in any organ. In epidemics the

name erythema arthriticum epidemicum is used.

Differential diagnosis:

Differential diagnosis includes coxsackievirus (hand-foot-mouth syndrom) or an aspecific viral exanthema, meningococcal septicaemia, leptospirosis, erythema multiforme, secondary syphilis, rickettsiosis (RMSF [Rocky Mountain spotted fever]), tularaemia, *Bartonella henselae* (cat scratch disease) and infections which typically occur after bites, such as *Capnocytophaga canimorsus*, *Eikenella corrodens* or *Pasteurella multocida* infections. If joint problems are prominent, Lyme disease, acute rheumatic fever, brucellosis, gonococcal infection, septic arthritis, infectious endocarditis and auto-immune disorders may have to be excluded.

Diagnosis

A diagnosis may be reached clinically: unexplained (relapsing) fever or sepsis, maculopapular rash and/or polyarthritis in patient with rat exposure. But even if there has been a rat bite, this will not always be reported when taking the history. Nevertheless this detail will be an important guiding factor. Some patients have a normal blood count, while others have significant leukocytosis (to 30,000) with left shift. Confirming a diagnosis microbiologically is extremely difficult: *Spirillum minus* can be demonstrated using dark-field microscopy of a little fluid from the site of the bite but cannot be cultured yet in vitro. *Streptobacillus moniliformis* can be cultured on specially enriched anaerobic media.

Serology (ELISA) may be carried out in specialised laboratories.

Treatment

Empirical therapy should be started instantly if rat bite fever is suspected since mortality may reach 13% in untreated patients and laboratory confirmation is strenuous and time consuming. The treatment is based on penicillin (or a tetracycline in patients allergic to penicillin) preferably given for 14 days. There may be a Jarisch-Herxheimer-like reaction at the beginning of treatment. Ceftriaxone is also effective.