Rickettsial Family

Prof. Md. Akram Hossain
Howard Taylor Ricketts (1871-1910) was an American pathologist after whom the Rickettsiaceae family and the Rickettsiales are named.

In the earlier part of his career, Ricketts undertook research at Northwestern University on blastomycosis and later at the University of Chicago on Rocky Mountain spotted fever.

In 1909, Ricketts became interested in typhus due to an outbreak in Mexico City and the apparent similarity of the disease to spotted fever. Somewhat ironically, days after isolating the organism that he believed caused typhus, he himself died of the disease.
Charles Jules Henry Nicolle (September 21, 1866 Rouen - February 28, 1936) was a French bacteriologist who received the Nobel Prize in Medicine for his identification of lice as the transmitter of epidemic typhus in 1903.
Henrique da Rocha Lima (1879–1956) was a Brazilian physician, pathologist and infectologist.

Working in Germany, he discovered *Rickettsia prowazekii*, the pathogen of epidemic typhus.

He named it *Rickettsia prowazekii*, after Howard Taylor Ricketts (1871)-1910 and German zoologist Prowazek, who both died of this disease.

In 2007, a new strain of Gram-negative bacteria was named after Rocha Lima, *Bartonella rochalimae*.
Frank Macfarlane Burnet, Australian biologist.

He was a pioneer in the application of ecological principles to viral diseases.

He proposed two concepts in immunology – **acquired immunological tolerance** and the **clonal selection theory of antibody production**

In the later stages of his life he lectured and wrote extensively about problems of human biology and human affairs, ageing and cancer. He was a Foundation Fellow and, from 1965 to 1969, President of the Australian Academy of Science.

*Coxiella burnetii* is named after him.
3 genera - obligate intracellular parasites:
- *Rickettsia*
- *Coxiella*
- *Ehrlichia*

Not an intracellular parasite
- *Rochalimaea* (transferred to *Bartonella*)
General Characteristics

- Resemble bacteria/grow only in living cells (NOT viruses)
- Parasites of arthropods = lice, fleas, ticks, mites - infect humans via bite
- Similar in size and shape - nonmotile coccobacillary forms
Pathogenesis: *Rickettsia*

- Arthropod bite
- Invade endothelial cells/vascular
- Destroy endothelial cells
- Inflammatory cells accumulate/blood leakage: rash
- Released organisms reinfect
Signs of Infection

- Fever, chills
- Severe headache
- 4th-6th day later = skin rash = lasts throughout course of disease
- EXCEPTION: Q-fever = no rash
Rash
Important Clinical Diseases

- Typhus Group
  - *Rickettsia prowazekii* = Epidemic typhus
    - body louse = bite/feces
    - fever/severe headache
    - skin rash = trunk to extremities
Important Clinical Diseases

- Spotted Fever Group
  - *Rickettsia rickettsii* = Rocky Mountain spotted fever
    - tick bite
    - fever/severe headache
    - skin rash = wrists and ankles to trunk/palms of hands, soles of feet
Figure 5. Gimenez stain of tick hemolymph cells infected with *R. rickettsii*
Compliments of the CDC

Figure 7. Approximate distribution of the American dog tick

American dog tick (*Dermacentor variabilis*)

**Rocky Mountain wood tick** (*Dermacentor andersoni*) is found in the Rocky Mountain states and in southwestern Canada. The life cycle of this tick may require up to 2 to 3 years for completion. Adult ticks feed primarily on large mammals. Larvae and nymphs feed on small rodents.
Figure 8. Approximate distribution of the Rocky Mountain wood tick

Yellow indicates approximate distribution area

Rocky Mountain wood tick
(Dermacentor andersoni)

Other Tick Species

Other tick species have been shown to be naturally infected with *R. rickettsii* or serve as experimental vectors in the laboratory. However, these species are likely to play only a minor role in the ecology of *R. rickettsii*. 
Important Clinical Diseases

● Scrub Typhus Group
  ■ Rickettsia tsutsugamushi =
    Scrub typhus
    – mite bite
    – fever/severe headache
    – skin rash = covers body/eschar
Important Clinical Diseases

- Q-Fever Group
  - *Coxiella burnetii* - Q fever
    - inhale contaminated aerosol; resist dessication = up to 3 years outside host
    - intermittent fever/pneumonia
    - NO skin rash
Important Clinical Diseases

- Scrub Typhus Group
  - *Rickettsia tsutsugamushi* = Scrub typhus
    - mite bite
    - fever/severe headache
    - skin rash = covers body/eschar
Important Clinical Diseases

- **Q-Fever Group**
  - *Coxiella burnetii* - Q fever
    - Inhale contaminated aerosol; resist dessication = up to 3 years outside host
    - Intermittent fever/pneumonia
    - No skin rash
Important Clinical Diseases

- Trench Fever Group - transferred to *Bartonella*
  
  *Rochalimaea quintana* - Trench fever
  
  - body louse bite/feces
  - fever/headache/mild symptoms
  - skin rash - global
Diagnosis of Rickettsial Diseases

- Rise in serum antibody/often do not develop in early stages
Treatment, Prevention, and Control

- tetracycline/chloramphenicol
- vaccines under study/one=
- Q fever
- control =
- insecticides/cleanliness
Pathogenesis: *Ehrlichia*

- Tick bite (deer or dog)
- Invasion of white cells: lymphocytes, neutrophils, monocytes
- 20% of patients show rash
- Lymph nodes up, high fever, headache, malaise, myalgia
- Treat with doxycycline