

## ***Salmonella (S. enterica, salmonellosis)***

### **Prevalence**

- Very rare in modern laboratory animal colonies, varying prevalence in pets, and common in wild animals
- All laboratory rodents are susceptible; some serotypes are found in cold-blooded animals and the free environment globally

### **Significance**

- Potentially zoonotic – may cause serious illness in workers or even be fatal
- Infected clinically ill rodents are not suited for research
- Infections in apparently healthy carriers may resurge when undergoing handling stress and infect other animals and caretakers
- Histological lesions associated with salmonellosis in carriers may disconcert results

### **Disease**

- Gram- negative, rod-shaped, aerobic bacteria
- *Salmonella enterica* encompasses six subspecies and more than 2,500 serovars - *S. enterica* subspecies *enterica* strains share a common core but differ in their pathogenicity islands, transposons, and prophages, which influence their pathogenicity (strains may carry plasmids that contribute to virulence)
- Commonly subclinical and may manifest only as acute death– need to colonise distal small intestine or colon to initiate disease (disruption of normal intestinal flora increase host susceptibility)
- Clinical signs:
  - Diarrhoea
  - Anorexia
  - Ruffled coat and hunched posture
  - Weight loss
  - Conjunctivitis
  - Variable morbidity and mortality
  - Rats – porphyrin staining at external nares

### **Transmission**

- Faecal-oral route
- Fomites
- Possibly vertical
- Infection via mucous membranes of conjunctiva or upper respiratory tract suspected

### **Isolation and Diagnosis**

- Preferred – Bacterial culture of faeces, intestinal contents, or mesenteric lymph nodes (may be positive if faeces are negative), spleen and liver culture in acute cases
- PCR – can distinguish serotypes

## Strains

- Successful identification of several *Salmonella* resistance genes (lty, lps, xid, etc.) in laboratory mice
- Susceptibility of inbred mice to infection with virulent *S. enterica* serovar Typhimurium is genetically controlled and varies from strain to strain:
  - 129S6/SvEvTac mice are very resistant
  - A/J mice present an intermediate susceptibility and show increased survival time with decreasing infectious dose but cannot survive the infection
  - C57BL/6J, BALB/cJ and C3H/HeJ are highly susceptible - all succumb within the first week independent of the inoculum size

## Screening

- Routine intestinal culture should be a normal part of health monitoring for a rodent colony

## Duration

- Oral infection of susceptible mouse strains with *Salmonella* leads to a systemic infection without efficient colonization of the intestine and mice succumb within 5–6 days
- Transgenic B6 mice develop a strong inflammatory response following oral infection and survive for several weeks
- Strain dependent, it is possible to study both acute and chronic *Salmonella* Typhimurium infections - during systemic chronic infections of mice with the wild type allele of the Slc11a1 gene, *Salmonella* Typhimurium reside in macrophages of the spleen, liver, and MLNs for up to 1 year with sporadic excretion of *Salmonella* Typhimurium bacteria in the faeces
- The disease can become endemic, with periodic cycling of overt disease symptoms such as acute deaths, chronic low fertility, foetal reabsorption, or abortion

## Durability

- *Salmonella* forms biofilms that adhere to surfaces and can survive for months in dust and other debris
- Can survive for more than 9 months in moist soil, water, faecal particles, and animal feeds

## Prevention and Control

- Incoming animals should be quarantined
- Routine intestinal culture as part of health monitoring
- Wild rodents should be excluded from facility as part of pest control program (program should include invertebrates and vertebrates - cockroaches previously linked to *Salmonella* outbreak)
- Staff working in animal house should not have rodents as pets
- If diagnosed, all animals in the colony must be euthanized - treatment only recommended as temporary measure to relieve clinical signs while rederivation is in process

## Reading

- Russell DA, Bowman CA, Hatfull GF. Genome Sequence of *Salmonella enterica* subsp. *enterica* Strain Durban. *Genome Announcements*, 2014, 2(3)
- Roy MF and Malo D. Genetic regulation of host responses to *Salmonella* infection in mice. *Genes and Immunity*, 2002, 3:381–393
- Nilsson OR, Kari L, Steele-Mortimer O. Foodborne infection of mice with *Salmonella* Typhimurium. *Public Library of Science*, 2019, 14(8)
- Nilsson OR, Kari L, Steele-Mortimer O. Highly reproducible murine model of oral *Salmonella* infection via inoculated food. *bioRxiv* (2019): n. pag.