Tickborne Diseases

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www.cdc.gov

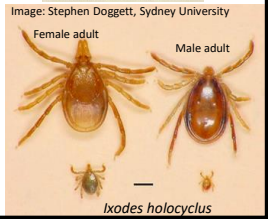
Ticks
Class Arachnida

Soft Tick
www.cdc.gov

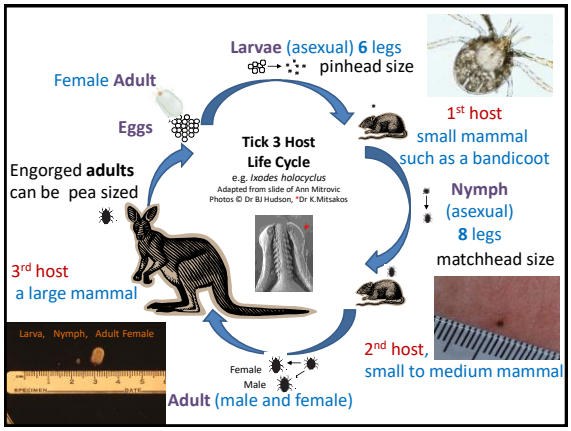
www.cdc.gov

BROWN DOG TICK
Rhipicephalus sanguineus

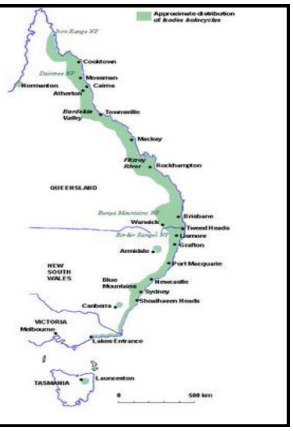
Image: Stephen Doggett, Sydney University



Ixodes holocyclus



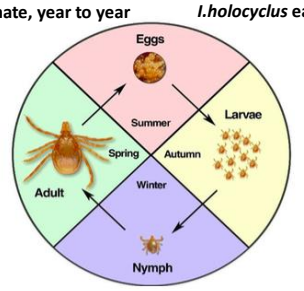
Ixodes holocyclus (paralysis tick) Distribution



Map adapted from Roberts FHS (1970) Australian Ticks. Yeerongpilly, QLD, Australia by TAGS Inc., Bill Conroy & Norbert Fischer.

Ticks – "Seasons"

Varies with climate, year to year ***I.holocyclus* eastern seaboard**



All 4 stages may be present at any time throughout the year

Image: Stephen Doggett, Sydney University

Narrative review
doi: 10.5694/mja17.00090

Tick-borne infectious diseases in Australia

Stephen R Graves, John Stenos

The incidence of tick-related medical problems in Australia is largely unknown. Appropriate diagnostic tests are not always available and, of all tick-related diseases, only Q fever is notifiable.[1] Anecdotally, however, many patients present to their doctor after a tick bite. This narrative review focuses on tick-borne infections but also touches briefly on other medical problems caused by tick bites.

Summary

- Tick bites in Australia can lead to a variety of illnesses in patients. These include infection, allergies, paralysis, autoimmune disease, post-infection fatigue and Australian multisystem disorder.
- Rickettsial (*Rickettsia* spp.) infections (Queensland tick typhus, Flinders Island spotted fever and Australian spotted fever) and Q fever (*Coxiella burnetii*) are the only systemic bacterial infections that are known to be transmitted by tick bites in Australia.

Australian ticks

Tick species	Common name	Known human pathogen	Disease	Possible human pathogen
Ixodes holocyclus	Paralysis tick (scrub tick in Queensland)	*Rickettsia australis*	Queensland tick typhus	*Candidatus* Neoehrlichia spp.
		Coxiella burnetii	Q fever	*Bartonella henselae*; *Ehrlichia* spp.
Ixodes tasmani	Common marsupial tick	*R. australis*	Queensland tick typhus	*Candidatus* R. tasmanensis
		R. honei subsp. *marmionii*	Australian spotted fever	*Bartonella* spp.
Ixodes cornuatus	Southern paralysis tick	*R. australis*	Queensland tick typhus	
Amblyomma triguttatum	Ornate kangaroo tick	*C. burnetii*	Q fever	*R. gravesii*; *Anaplasma* sp.; *Ehrlichia* sp.
Bothriocroton hydrosauri	Southern reptile tick	*R. honei*	Flinders Island spotted fever	
Haemaphysalis novaeguinae	No common name	*R. honei* subsp. *marmionii*	Australian spotted fever	
Haemaphysalis longicornis	Bush tick (introduced, not native to Australia)			*Babesia* sp.
Ornithodoros capensis	Seabird soft tick			Virus

Tickbite - Sequelae

- Local reaction
  - With or without local lymph gland enlargement
- Allergic reactions
  - Generalised, Local, Red Meat Allergy
- Tickbite paralysis
  - Generalised, Local
- Agreed
  - Spotted Fever (Rickettsia), Q fever, Cellulitis
- Not agreed
  - Babesiosis, Borreliosis (incl. Lyme Disease), Ehrlichiosis
- NOTHING ……. ? Other/Undetected

First report of human babesiosis in Australia

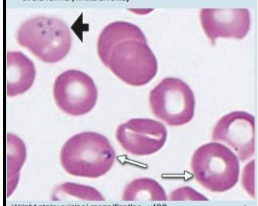
Sanjaya N Senanayake
MB BS, FRACP, MApplStat, Associate Professor of Medicine, and Infectious

MJA 2012; 196: 350–352
doi: 10.5694/mja11.11378

We report the first human case of babesiosis in Australia, thought to be locally acquired

Death post MVA and multi-organ failure
- Pancytopenia, hemolysis,up to 5% parasitemia
- From South Coast NSW, no BT, no IVDU

1 Blood film from a 56-year-old man infected with *Babesia microti*, showing a tetrad form (black arrow) and single ovoid forms (white arrows)



Wright stain; original magnification, ×100.

2 Diagnosing human babesiosis in Australia

When to suspect babesiosis

Clinicians should suspect babesiosis in patients in Australia who have haemolytic anaemia, thrombocytopenia, fever, an influenza-like illness and a history of at least one of the following:
- tick bites
- outdoor activities putting one at risk of tick bites
- transfusion of blood products
- overseas travel to a region where babesiosis is endemic.

How to proceed with the diagnosis

Thick and thin blood films should be examined for intraerythrocytic parasites (three sets of films should be taken, 8–12 hours apart). If the results of blood films are negative but the diagnosis is still suspected, antibody testing of serum and molecular testing of blood (by polymerase chain reaction) can be done.

Australian Spotted Fever (ASF)

Australian Spotted Fever

- All along the eastern seaboard
  - very **distinctive** clinical presentation
- Main species is ***Rickettsia australis***
  - **rickettsia are obligate intracellular bacteria**
- Emerging species
  - *Rickettsia honei*
  - Others – *R.marmionii* (??CFS)
  - Strains or species?
- Clinical Manifestations (infected endothelial cells > **vasculitis**)
  - Similar to most spotted fever group (**SFG**) rickettsioses
  - Rash often **vesicular** with *R.australis*
  - Rash may be absent but **eschar is common**
  - Hospitalisation usually = lack of recognition
  - Few recorded deaths (~3)

Australian Spotted Fever

- 1946 **Andrew** (MJA) North Queensland
  - cluster of 12 cases (military)
    - first isolate of *Rickettsia australis*
    - QTT – **Queensland Tick Typhus**
- 1991 **Stewart** (MJA) Flinders Island in Bass Strait
  - febrile illness on the island related to tickbite
    - Eventual first isolate of *Rickettsia honei* (description Stenos et al 1998)
    - FISF – **Flinders Island Spotted Fever**
- 1991 Sexton (CID) - reviewed all ASF
  - FISF, QTT (*R.australis*)
- CMR update articles
  - 1997 Raoult
  - 2005 & 2013 Parola

CID – Clinical Infectious Diseases; **CMR** – Clinical Microbiology Reviews; **MJA** – Medical Journal of Australia

Table 6. Diagnostic criteria for Mediterranean spotted fever caused by *Rickettsia conorii* **Adaptable for ASF**

Criteria	Score[a]
Epidemiological criteria	
Stay in endemic area	2
Occurrence in May–October	2
Contact (certain or possible) with ticks	2
Clinical criteria	
Fever > 39°C	5
Eschar	5
Maculopapular or purpuric rash	5
Two of the above criteria	3
All three of the above criteria	5
Non-specific laboratory findings	
Platelets < 150 G/L	1
SGOT or SGPT > 50 U/L	1
Bacteriological criteria	
Blood culture positive for *Rickettsia conorii*	25
Detection of *Rickettsia conorii* in a skin biopsy	25
Serological criteria	
Single serum and IgG > 1/128	5
Single serum and IgG > 1/128 and IgM > 1/64	10
Four-fold increase in two sera obtained within a 2-week interval	20

SGOT, serum glutamate–oxaloacetate transaminase; SGPT, serum glutamate–pyruvate transaminase.
[a]A positive diagnosis is made when the overall score is ≥ 25.

Fever + eschar + rash + tick bite or likely tick exposure = likely ASF
Some areas notorious – residents often know more than the new doctor!!

Other Clinical Features in ASF (NSW, Qld)

FEATURE	FREQUENCY	N
Headache	88 %	58
Myalgias	82 %	62
Local nodes	79 %	53
Arthralgias	61 %	59
Neck stiffness	54 %	56
Anorexia	43 %	44
Photophobia	29 %	51
Gen.nodes	28 %	46
Sore throat	26 %	47
Nausea/ vomit	27 %	44
Confusion	22 %	55
Cough	19 %	48
Conjunctivitis	14 %	44
Splenomegaly	14 %	35*
Diarrhea	7 %	44
Jaundice	2 %	43

Often diagnosed with "?viral illness", including meningitis, CSF normal

CMR

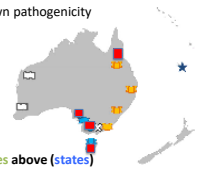
Update on Tick-Borne Rickettsioses around the World: a Geographic Approach

Philippe Parola,[a] Christopher D. Paddock,[b] Cristina Socolovschi,[a] Marcelo B. Labruna,[c] Oleg Mediannikov,[a] Tahar Kernif,[a] Mohammad Yazid Abdad,[a,e] John Stenos,[d] Idir Bitam,[f] Pierre-Edouard Fournier,[a] Didier Raoult[a]

Clinical Microbiology Reviews p. 657–702 October 2013 Volume 26 Number 4

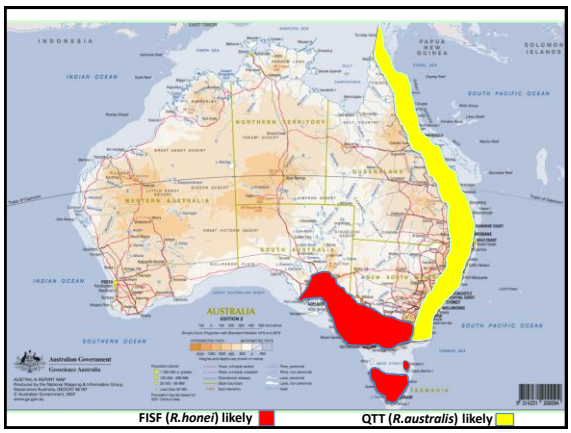
Coloured = pathogenic rickettsiae
White = potential or unknown pathogenicity

Species
1.*R.gravesii*
2.*R.honei marmioni*
3.*R.honei*
4.*R.australis*
5.*R.argasii*
6.*R.africae*



Tick vectors for numbered species above (states)

1. *Amblyomma triguttatum* (all)
2. *Haemaphysalis novaeguineae* (Qld,SA,Tas,Vic)
3. *Bothriocroton hydrosauri* (NSW,Tas,Vic) (Thailand, Nepal: *Ixodes, Rhipicephalus*)
4. *Ixodes holocyclus, tasmani, cornuatus* (NSW, Qld, Vic)
5. *Argas dewae* (soft tick, microbats) (Vic)
6. *Ambylomma loculosum* (Indian Ocean, South Pacific) (New Caledonia)



FISF (*R.honei*) likely QTT (*R.australis*) likely

Spotted Fever

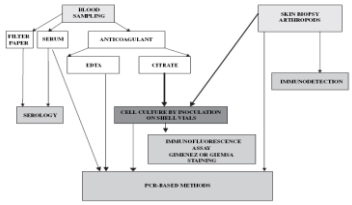
Diagnosis

Blood - Rickettsemia

Short –lived
Low titre
Antibiotic affected
Storage affected

Serology

Can take 28 days to be (+)
Cut-off 64 or 128
IgM & IgG
Rarely get a 2nd specimen



PCR of eschar (viral) swab is best

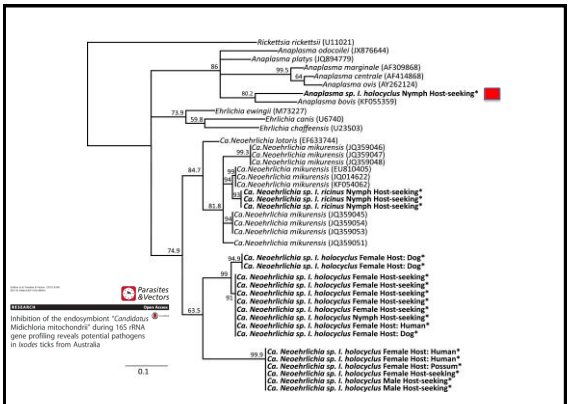
Eschar is where the bugs are:

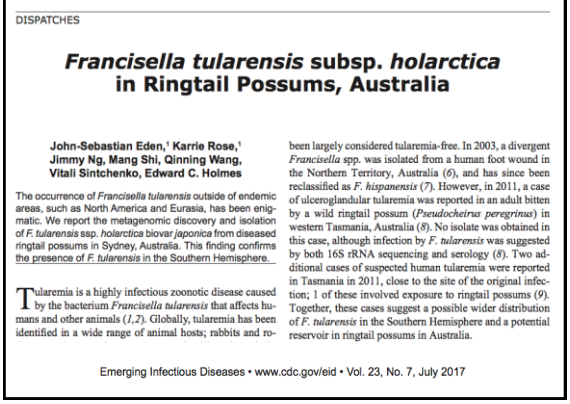
- Rickettsiae persist in eschar
- For weeks at high titre
- Not affected (?much) by antibiotics
- Original advice to biopsy or remove eschar unpractical and unacceptable

Other Rickettsial Illnesses

- Cross-reactive serology – with SFG and each other
  - **Murine typhus - *R.typhi* (flea-borne)*^**
  - Rickettsialpox - *R.akari* (mouse mite-borne) – rash vesicular^
  - **Cat-flea typhus - *R.felis* (flea-borne)*^**
  - Epidemic typhus - *R.prowazekii* (louse-borne)*^
  - Unclassified rickettsia?
- Usually **not** cross-reactive serology
  - ***Orientia tsutsugamushi* (mite-borne)*^**
  - *Orientia chuto* (mite-borne)*^

*Rash absent or if present not vesicular
^Eschar may be less obvious or absent
Bolded species occur in Australia





DISPATCHES

Francisella tularensis subsp. *holarctica* in Ringtail Possums, Australia

John-Sebastian Eden,[1] Karrie Rose,[1] Jimmy Ng, Mang Shi, Qinning Wang, Vitali Sintchenko, Edward C. Holmes

The occurrence of *Francisella tularensis* outside of endemic areas, such as North America and Eurasia, has been enigmatic. We report the metagenomic discovery and isolation of *F. tularensis* ssp. *holarctica* biovar *japonica* from diseased ringtail possums in Sydney, Australia. This finding confirms the presence of *F. tularensis* in the Southern Hemisphere.

Tularemia is a highly infectious zoonotic disease caused by the bacterium *Francisella tularensis* that affects humans and other animals (*1*,*2*). Globally, tularemia has been identified in a wide range of animal hosts; rabbits and rodents have been largely considered tularemia-free. In 2003, a divergent *Francisella* spp. was isolated from a human foot wound in the Northern Territory, Australia (*6*), and has since been reclassified as *F. hispanensis* (*7*). However, in 2011, a case of ulceroglandular tularemia was reported in an adult bitten by a wild ringtail possum (*Pseudocheirus peregrinus*) in western Tasmania, Australia (*8*). No isolate was obtained in this case, although infection by *F. tularensis* was suggested by both 16S rRNA sequencing and serology (*8*). Two additional cases of suspected human tularemia were reported in Tasmania in 2011, close to the site of the original infection; 1 of these involved exposure to ringtail possums (*9*). Together, these cases suggest a possible wider distribution of *F. tularensis* in the Southern Hemisphere and a potential reservoir in ringtail possums in Australia.

Tularemia

Gram negative coccobacillus transmitted by:

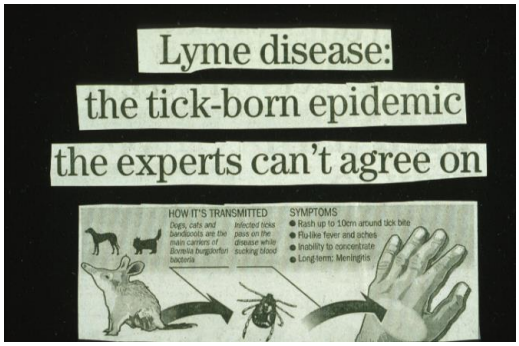
- Contact – rabbits/hares, **possums (Tasmania possum bites)**
- Tick bite
- Biting flies

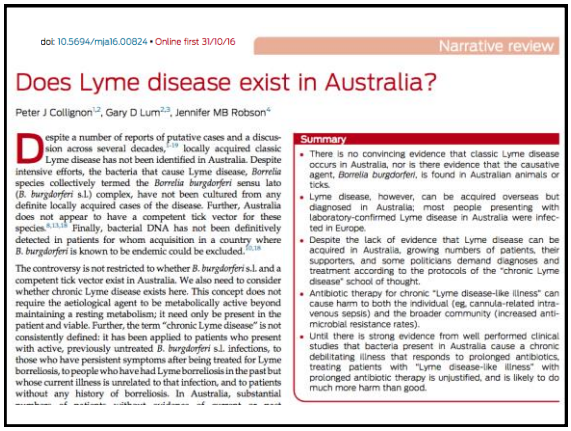
Febrile illness, inoculation lesion, "plague", bioterrorism

- ***Gentamicin, streptomycin, ciprofloxacin***

Francisella tularensis sub-species

- *Francisella tularensis* – most virulent
- *Francisella holarctica* – intermediate virulence
- *Francisella novicida* – low virulence
- *F.hispaniensis*
- *F.philomiragia*





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Narrative review

Does Lyme disease exist in Australia?

Peter J Collignon[1,2], Gary D Lum[2,3], Jennifer MB Robson[4]

Despite a number of reports of putative cases and a discussion across several decades,[1-10] locally acquired classic Lyme disease has not been identified in Australia. Despite intensive efforts, the bacteria that cause Lyme disease, *Borrelia* species collectively termed the *Borrelia burgdorferi* sensu lato (*B. burgdorferi* s.l.) complex, have not been cultured from any definite locally acquired cases of the disease. Further, Australia does not appear to have a competent tick vector for these species.[8,13,18] Finally, bacterial DNA has not been definitively detected in patients for whom acquisition in a country where *B. burgdorferi* is known to be endemic could be excluded.[10,18]

The controversy is not restricted to whether *B. burgdorferi* s.l. and a competent tick vector exist in Australia. We also need to consider whether chronic Lyme disease exists here. This concept does not require the aetiological agent to be metabolically active beyond maintaining a resting metabolism; it need only be present in the patient and viable. Further, the term "chronic Lyme disease" is not consistently defined: it has been applied to patients who present with active, previously untreated *B. burgdorferi* s.l. infections, to those who have persistent symptoms after being treated for Lyme borreliosis, to people who have had Lyme borreliosis in the past but whose current illness is unrelated to that infection, and to patients without any history of borreliosis. In Australia, substantial

Summary

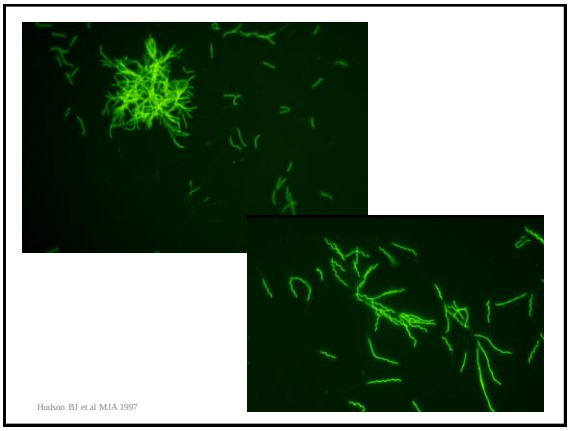
- There is no convincing evidence that classic Lyme disease occurs in Australia, nor is there evidence that the causative agent, *Borrelia burgdorferi*, is found in Australian animals or ticks.
- Lyme disease, however, can be acquired overseas but diagnosed in Australia; most people presenting with laboratory-confirmed Lyme disease in Australia were infected in Europe.
- Despite the lack of evidence that Lyme disease can be acquired in Australia, growing numbers of patients, their supporters, and some politicians demand diagnoses and treatment according to the protocols of the "chronic Lyme disease" school of thought.
- Antibiotic therapy for chronic "Lyme disease-like illness" can cause harm to both the individual (eg, cannula-related intravenous sepsis) and the broader community (increased antimicrobial resistance rates).
- Until there is strong evidence from well performed clinical studies that bacteria present in Australia cause a chronic debilitating illness that responds to prolonged antibiotics, treating patients with "Lyme disease-like illness" with prolonged antibiotic therapy is unjustified, and is likely to do much more harm than good.

Lyme Disease

- LD is a tickborne infection that is caused by a spiral bacteria (spirochete)
- Spirochete that causes LD is a *Borrelia* species (**lyme borreliosis** – **LB**)
- The "hallmark" skin lesion of LD is called **erythema migrans**
  - Can appear at the tickbite site
  - Can appear elsewhere & be multiple
  - Tickbite (30-40%) or EM (10-25%) not always reported

Lyme - Clinical

- **Stage I** - Skin, <u>mild</u> constitutional
  - Erythema (chronicum) migrans (e.g. 2-30 days)
- **Stage II** - Skin, CNS, Cardiac
  - Multiple EM, aseptic meningitis, nerve roots & nerve pain, heart problems (e.g. wks to mths)
- **Stage III** - Joints, CNS/PNS, Skin
  - Arthritis (1/>1 jts) USA (80% if unRx) (days/wks)
  - Encephalomyelitis, Periph.neuropathy (mths/yrs)
  - Funny skin lesions (e.g. ACA years)



Borrelia burgdorferi sensu lato - Lyme

- **Eurasia associated**
  - ***B.afzelii*, *B.bavariensis*, *B.garinii*,** *B.japonica*, ***B.lusitaniae***, *B.sinica*, ***B.spielmanii***, *B.tanukii, B.turdi*, ***B.valaisiania***, *B.yangtze*
- **USA only (initially thought so)**
  - *B.americana, B.andersonii, B.californiensis, B.carolinensis,* ***B.kurtenbachii***, ***B.mayonii***
- **Both Old & New World**
  - ***B.burgdorferi sensu stricto***, ***B.bissettii***, *B.carolinensis*

Haemaphysalis sp. & Ixodes granulatus; all others Ixodid vector

Identification of a novel pathogenic Borrelia species causing Lyme borreliosis with unusually high spirochaetaemia: a descriptive study *Lancet Infect Dis 2016; 16: 556–64*

6 (5 blood & 1 synovial fluid) of **100,545** samples submitted to Mayo Clinic (Rochester MN) for **Lyme PCR** (over 11 years)

- *Borrelia mayonii*
- Illness is like **relapsing fever**
- **Early** negative serology
- **Late** positive serology **but** …
- Only 1 positive IgG western blot

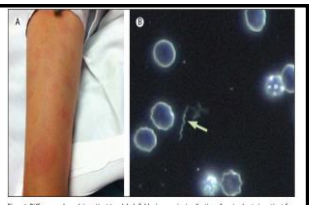


Figure 1: Diffuse macular rash in patient 1 and dark-field microscopic visualisation of a spirochaete in patient 6. (A) Diffuse macular rash seen 4 days after onset of symptoms in patient 1. Rash was reported by patient's caregiver to involve the palms and soles, but this was not documented in the medical record. (B) Dark-field microscopic visualisation (400× magnification) of a single spirochaete in diluted blood from patient 6.

	Days from onset of illness to collection of specimen	*B burgdorferi* EIA—whole cell	*B burgdorferi* EIA–C6	*B burgdorferi* IgM immunoblot (number of bands detected/number of possible bands); specific antigens detected	*B burgdorferi* IgG immunoblot (number of bands detected/number of possible bands); specific antigens detected
Patient 1	6	Not available	Positive	Positive (2/3); 23, 41	Negative (1/10); 41
Patient 3	2	Not available	Equivocal	Negative (0/3)	Negative (0/10)
Patient 3	29	Not available	Positive	Positive (3/3); 23, 39, 41	Negative (2/10); 23, 41
Patient 3	104	Positive	Positive	Negative (0/3)	Negative (4/10); 18, 23, 39, 41
Patient 4	266	Positive	Positive	Negative (1/3); 23	Positive (5/10); 23, 39, 41, 45, 58
Patient 5 (plasma)	3	Negative	Positive	Negative (0/3)	Negative (0/10)
Patient 5	32	Positive	Positive	Positive (2/3); 23, 39	Negative (2/10); 23, 41
Patient 6 (plasma)	1	Negative	Negative	Negative (0/3)	Negative (1/10); 41

Specimens from patient 2 were not available for testing. IgM immunoblot was deemed second tier positive for *B burgdorferi* if two or more of a possible three bands (23–25 kDa [OspC], 39 kDa [BmpA], and 41 kDa [FlaB]) are detected within 30 days of onset.[7] IgG immunoblot was deemed second tier positive for *B burgdorferi* if five or more of a possible ten bands (18 kDa, 23 kDa [OspC], 28 kDa, 30 kDa, 39 kDa [BmpA], 41 kDa [FlaB], 45 kDa, 58 kDa [not GroEL], 66 kDa, and 93 kDa) were detected.

Table 2: Serological test results from patients infected with the novel *B burgdorferi* sensu lato genospecies

Other Borrelia Infections

- **Relapsing Fever – Ixodid vector***
  - *B.miyamotoi* (Europe, USA & Asia)
- **Relapsing Fever – Soft (Argasid) ticks**
  - *B.crocidurae, B.dugesi, B.duttoni,* ***B.hermsii***, *B.hispanica, B.parkeri, B.persica, B.recurrentis* (louse), ***B.turicatae***
- **More acute illness - usually**
  - False (+) LB all tests: EIA, IFA
  - False (+) WB (even with CDC criteria for Lyme Dx)
  - ***Cannot be distinguished by serology from Lyme***

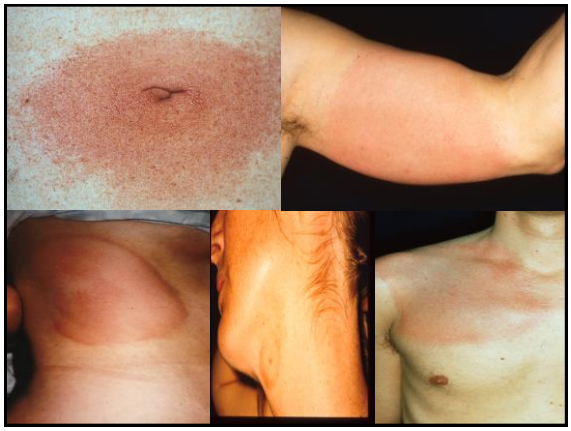
*TBRF & LB coinfection possible with same bite

Borreliosis

Australia?

Borrelia in Australia

- **Mackerras 1958**
  - Borrelia in bandicoots & kangaroos in Queensland
- **Carley & Pope 1962**
  - *Borrelia queenslandica* identified as cause of disease and death in a population of native rats in Queensland
- **Other borrelia**
  - *Borrelia anserina* (tick fever domestic birds)



Can you get LB in Australia ?

- **A body of clinical evidence**
  - But DDx EM from local reaction (?48 hr)
  - Not strong enough evidence by itself
- **Negative tick data**
  - Not necessarily mean absence
  - PCR with different primers & methods
- **Culture & PCR data**
  - Culture (+) case Pittwater v. Czech
  - Optimal methods & adequate specimens

Can you get LB in Australia ?

- **Can you find anyone who has never travelled to a Lyme endemic area ?**
  - Not on Sydney's Northern Beaches
  - The organism can persist for years
- **What if patient & tick are both (+) PCR &/or culture ?**
  - Is that good enough even with travel ?
- **Combined Clinical, Animal, Vector**
  - Use better tools - PCR, culture, other
  - **Updated next gen. sequencing finding multiple potential pathogens but no B.burgderfori s.l.**

What's It All Mean for Australia?

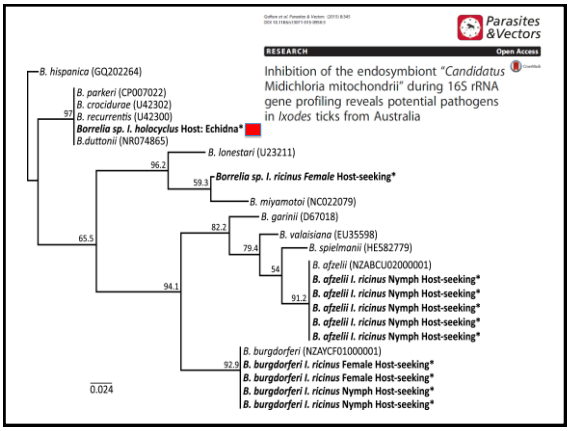
Bird migration - north-south spread of infected ticks - B.burgdorferi s.l. spirochetes (B.garinii) Olsen B 1995 JCM 33(12) 3270-4

Lyme borrelia (**B.burgdorferi sensu lato**)
- Are found in southern hemisphere
- Local enzootic focus may not occur -> sporadic cases only
- Local enzootic focus may occur

-> more than just sporadic cases?

Fig. 4.1. The geographical distributions of the primary vectors of Lyme borreliosis spirochaetes. (Designed by B. Kaye.)

Lyme borreliosis Gray J et al CABI Publishing 2002



Lyme or Lyme-like or …….?

- **There are a lot of organisms in Australian ticks**
  - Including ticks that bite humans
  - Including a relapsing fever borrelia (RFB)
- **Consider *Borrelia miyamotoi* (RFB) 1st found in ticks**
  - Discovered Japan **1995** –but "not a human pathogen"
  - 2011: first cases Europe (meningitis, fevers, rash)
  - 2013: illness in LB(-) and LB(+) patients USA LB areas
  - 2017: common in LB ticks in LB endemic areas
  - 2017: LB-like illness agreed, best test ?PCR
- **History would indicate Oz RFB will be a pathogen**

Lyme or Lyme-like or …….?

- ***Borrelia miyamotoi* (RFB) illness**
  - Suspected in USA 2006 (Fish D et al)
  - Research funding calls ignored…
  - … until 2011 cases reported from Europe
- Australian RFB "could be a human pathogen"
  - **Research needed via GPs in tick areas**
  - **With laboratory support …..**
  - **…. to define illness, incidence, case management, preventive strategies**

Lyme Borreliosis

Diagnosis

Lyme "Classic" - Diagnosis

- **Still a clinical diagnosis**
  - Gardner P. JAMA. 2000; 283:658-9
  - Wang G et al. JCM. 1999; 12:633-53
- **Antibody tests – the usual test for diagnosis**
  - screening tests – EIA IgM and IgG
  - "confirmatory" Western Blot
  - False -ves & false +ves
  - C6 specific assays best (no WB needed)
  - **Uncertain how relevant overseas testing is to Australian tickborne illness**

Lyme "Classic" - Diagnosis

- **Culture (sensitivity)**
  - EM up to 80%
  - Blood (early) up to 40%
  - CSF and other specimens low yield
- **PCR (sensitivity)**
  - EM up to 60% (not homogeneously present)
  - CSF up to 25%
  - Joint fluid up to 85%
- **Histopathology**
  - Silver stain EM up to 40%

Lyme Borreliosis

Treatment

Lyme "Classic" - Treatment

- **Early treatment (?within 12 weeks)**
  - Most people recover fully
- **Oral antibiotics (mild or early disease)**
  - 14-28 days (doxy 200mg/d, amoxil 1.5g/d)
- **Intravenous antibiotics (neuroborreliosis, late disease)**
  - 14-28 days (ceftriaxone 2g/d) - then orals?
- **Antibiotics after tickbite**
  - **? No** - 200mg Doxycycline (USA - Ct) in 72hrs
- **Delayed treatment may prevent cure**
  - Controversial **but** true – cystic v. spirochetal forms

Tickbite Survey

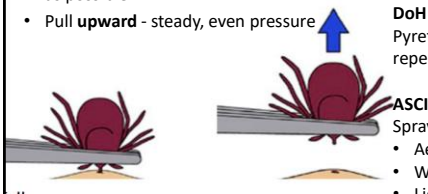
- How many attendees see **patients with tickbite**
- How many see **> 5 patients** with tickbite **annually**
- Participate in a GP surveillance network
  - Paid participation

Prevention

Removing a Tick

Avoid folklore remedies such as "painting" the tick with nail polish or petroleum jelly, or using heat to make the tick detach from the skin. Your goal is to remove the tick as quickly as possible–not waiting for it to detach.

- **Fine**-tipped tweezers - grasp tick as **close** to the skin's surface as possible
- Pull **upward** - steady, even pressure



DoH
Pyrethroid aerosol repellent **first** is OK

ASCIA
Spray **first** is best:
- Aerostart
- Wart spray (ether)
- Liquid N2 (Doctor)

Graphic & method: www.cdc.gov

Removing a Tick

- **Don't** twist or jerk the tick
  - can cause mouth-parts to break off & remain in the skin
  - if this happens, remove mouth-parts with tweezers
  - if unable to remove mouth-parts easily with clean tweezers, **leave it alone** & let the skin heal
- **After** removing the tick
  - thoroughly clean the bite area & your hands
  - use rubbing alcohol, iodine scrub, or soap & water
  - save tick (in pot with alcohol or a blade of grass)
  - dispose of in tape, tissue, flush down toilet
  - **never** crush it with your bare hands

Avoiding Tickbite

- Wear **light-coloured** long-sleeved shirts & long trousers
  - ticks seen more easily on light-coloured clothing
- **Tuck in**!
  - tuck shirt into trousers & trousers into long socks
- Wear a wide-brimmed **hat** &/or **overalls**
  - can be treated with **permethrin**
- **Brush** clothing before coming indoors
  - removes ticks
- Using an effective insect **repellent**
  - DEET, icaridin, extract of lemon eucalyptus (Mosiguard®)
- Carefully check for ticks in "favoured" sites
  - neck, scalp, groin, axillae in the shower/bath (**"tick check"**)