THEILERIOSIS

- Theileriosis is characterized by **fever and lymphoproliferative disorders** which may be associated with **leukopenia/ anaemia.**
- **Location: Lymphocytes and erythrocytes (sometimes in monocytes).**

	Cattle and Buffalo		
1	***T.annulata*** **(India) Highly pathogenic**	***Hyalomma marginatum*** Hyalomma anatolicum (Transtadial transmission)	Tropical Theileriosis, **Mediterranean coast fever,**Tropical Piroplasmosis, Egyptian Fever
2	***T. parva*** **Highly pathogenic**	***Rhiphicephalus appendiculatus*** Hyalomma anatolicum (Transtadial transmission)	Bovine Theileriosis, **East Coast fever,Turning Sickness**, African Coast Fever, **Corridor disease**, Rhodesian tick Fever,Rhodesian Red Water disease
3	***T. mutans*** **(India)** Non-fatal/Slightly pathogenic	***R.appendiculatus*** Haemophysalis bispinosa H. punctata (Transtadial transmission)	**Benign Bovine Theileriosis**, **Turning Sickness** **African Coast Fever**

TROPICAL THEILERIOSIS

Theileria annulata

- They have small, round, ovoid, irregular or bacilli form merozoites, as the parasites are pleomorphic and occur in lymphocytes, histocytes and erythrocytes of vertebrate host.
    - **Single or Multiple 4-7 parasites in single RBC** observed in severe cases.
    - **Binary fission** in RBC result in formation of 2-4 daughter individuals.
    - Micro and Macro **schizonts(Koch's Blue bodies)** can be seen in the lymphocytes of spleen and lymphnodes.
    - Schizonts can also be seen monocytes or in free state lymph node biopsy smears. Schizonts may also be seen in peripheral blood smears.
- Life cycle
    - **In vertebrarte host- Asexual reproduction - Schizogony**
    - ***Vectors*** **Ixodid ticks** are vectors in their life cycle
        - **Sexual reproduction- gamogony and sporogony**
        - **Transtadial transmission occurs in ticks. Infection from tick larvae to nymphs or nymphs to adults.**

Epidemiology :

Age

- **Both young calves (even 2-3 days old) and adults are affected**.

Breed

- Highly virulent in European breeds, especially in dairy animals and crossbred animals and less virulent in local zebu breeds; **Mortality in exotic cattle is up to 70%.**

- In endemic areas, all animals are virtually infected but the case- fatality is 10 -20% and is confined to calves.

Transmision:

- **Transtadial transmission (stage to stage) by ticks of *Hyalomma spp.***
- Infection from tick larvae to nymph or nymph to adult occurs.
    - Sporogony & gamogony takes place in salivary gland if the tick.
    - Schizogony takes place in the host – lymphocytes & RBCs- erythrocytic stages.
- Congenital transmission occasional in calves.

Carrier status

- **Indigenous cattle** without clinical signs, **Buffaloes, Recovered animals with long lasting immunity** act as carriers; Wild animals may also transmit the disease.

Immunity

- **No cross immunity occurs between *T. parva* and *T. mutans.***
- Immunity is developed by all 3 stages- sporozoites, schizonts and erythrocytic stages;

Season

- **In India, summer and rainy seasons (May - Oct) which is attributable to high incidence of tick vectors.;** Incidence due to stress of hot and humid weather.

Mixed infection

- **Mixed infection with *Anaplasma/ Babesia spp* is common.**

CLINICAL MANIFESTATION

- ***Incubation Period:* 15 days following tick transmission.**
- Mortality varies from 10- 90%.
    - ***Per acute form***
        - Common one lasting for 3 - 4 days or upto 20 days.
        - First sign is **fever(40.5 –41.5°C), continuous or intermittent persisting for 3- 20 days.**
        - Inappetence, cessation of rumination, rapid heart beat, **enlargement of superficial lymph nodes and odema of the eyelids**
        - **Marked anaemia, haemoglobinuria, bilirubinuria and bilirubinaemia, icterus of conjunctiva with petechial haemorrhage, jaundice, high colored urine, prostration and death.**
        - Laboured breathing, serous nasal discharge, coughing, restlessness and starry coat.
        - **Diarrhoea with blood and mucus in faeces**, greatly emaciated (RBCs < 1 million/ cmm); **Death after 15 days.**
    - ***Sub acute form***
        - Fever is irregularly intermittent for 15 days, then the animal recovers.
    - ***Chronic form***
        - Intermittent fever, in-appetence, marked emaciation , some degree of anaemia, icterus for 4 weeks or longer, In some cases, sudden death may occur within 1-2 days.
    - ***Mild form***
        - Little is seen, but mild fever, in appetence, listlessness, slight digestive disturbances, lachrymation for few days and moderate anaemia.
- **Cerebral theileriosis**

    - Nervous signs predominate and brain impression smears reveal Koch's Blue bodies.
- **Cutaneous form**
    - Some cases reveal urticarial type of skin lesions and haemoglobinuria.

Lesions

- Emaciated body of the carcass, pale mucous membrane, **enlargement of the superficial lymph nodes, spleen and liver; Distension of the gall bladder with thick bile**; Congestion and petechial haemorrhages on the kidney and lungs; In few cases, necrotic infarcts of brain.
- **Punched necrotic ulcers in the abomasum are pathognomonic; In young calves, abomasum is full of undigested clots of milk.**
- Haematological changes
    - Fall of haemoglobin (< 2 gm/ml) , reduced PCV, reduced RBC count (1.5-2 million/ Cmm), leukocytosis followed by leukopenia.

Diagnosis

- Based on clinical signs.
- Demonstration of erythrocytic forms **(piroplasms) in pheripheral blood smears**
- Demonstration of **Koch's blue bodies (schizonts) in lymphocytes from lymph nodes**.
- For latent cases, serological tests can be employed CFT, Capillary tube agglutination test, IFA.
    - Others: IHA, AGID, Dot-ELISA, LMI test, Conglutination Complement Absorption test (CCA), Gel agglutination test, immunoelctrophoresis
- By autopsy, examination for lesions
- **Differential diagnosis: Anaplasmosis, Babesiosis, Trypanosomosis, Ehrlichiosis.**

Treatment

- Different drugs respond differently with schizonts and erythrocytic stages of the parasite and none of the drugs are fully effective; but buparvaquone is fully effective in clinical cases.
- To combat the anaemic changes, haematinics as supportive therapy.
    - **Buparvaquone (Butalex) - Naphthaquinone drug and drug of choice.**
        - **@ 2.5 mg / kg, deep I/M against different stages of T. annulata, it is effective.**
        - **2nd dose at 48 hours intervals.**
    - Parvaquone - 10 mg/kg, deep I/M, effective against piroplasmic stage.
    - Berenil (Diminazene aceturate) – 2.5 to 5 mg /kg, deep I/ M; Doubtful against erythrocytic stage.
    - Oxytetracycline - 20 mg /kg for 7 days; I/M; effective against of schizogony.
    - Halofuginone (stenorol*) – Potent against schizont stage but toxic.
        - 1 to 2 mg/kg as 2 doses, as tablets.
    - Others

- Methohexate, 3% Tryphan blue solution, Sulpha drugs, Diethyl carbamazine citrate, Babesan, Chloramphenicol, Sulphadimidine+ chloroquine phosphate, Nivaquin and Famaquin.

- **PROPHYLAXIS AND CONTROL**
- **By Chemoprophylaxis + Immunoprophylaxis + Tick control.**
  - Wide spread and strict application of acaricides
  - Use of genetically resistant breeds.
  - Immunoprophylaxis
    - **Tissue culture vaccines (Rakshavac-T*)**
      - Attenuated Schizonts of *T. annulata* developed by in – vitro cultivation of bovine lymphocytes infected with *T. annulata* schizonts. A dose of 2 x 10^6infected cells suspended in serum free tissue culture remains viable at 4 ^{0}C for 1 week and used to vaccinate cattle.
      - Age: Cross–bred and exotic cattle of **2 months / above**.
      - **Dose: 3 ml , S/c, annually**.
  - Infection and Treatment method
    - A potentially lethal known dose of stabilate of ground up infected ticks together with a long acting formulation of OTC or Buparvaquone is developed. It suppresses the development of the parasite and allow the effective CMI response with minimal disease response.

EAST COAST FEVER

Life cycle: Similar to *T. parva.*

Pathogenesis

- Serious disease in cattle; High rate of mortality.

- *Acute form*
  - More common; fever (41. 7 ^{0}C) , enlargement of superficial lymph nodes, swelling of eyelids and ears, diarrhoea with blood and mucus, marked emaciation.
  - Edema of lungs causes death immediately.
- *Sub acute*
  - Frequent in calves; less pronounced symptoms.
- ***Turning Sickness***
  - **In east and Central Africa. signs are circling movements and abduction of limbs; immunity is solid and specific**.

Diagnosis

- Demonstration of Schizonts in lymph node biopsy.
- Demonstration of erythrocytic forms are difficult.
- Differentiation from the *Theileria spp* is difficult.
- Serological tests: IHA, IFA, Capillary agglutination test

Treatment

- Oxytetracycline and Chlortetracycline, Buparvaquone.

THEILERIOSIS IN SHEEP AND GOAT

1	***T. hirci* (India) Highly pathogenic**	**Rhiphicephalus bursa,** Hyalomma anatolicum anatolicum, (Transtadial transmission)	**Malignant Theileriosis**
2	***T. ovis* *Non pathogenic***	**Rhiphicephalus bursa,**Haemophysalis spp (Transtadial transmission)	**Benign Theileriosis**

Life cycle: Similar to cattle.

- **Pathogenesis**
  - Similar to Bovine Tropical theileriosis
  - Acute: High fever, listlessness, nasal discharge, anaemia, jaundice, atony of rumen, weakness, transitory haemoglobinuria, petechial haemorrhage on abomasal mucosa, edematous lungs, enlargement of lymph nodes,
  - **No cross immunity between T. hirci and T. ovis.**
- **Diagnosis:** Examination of stained blood, lymph nodes or spleen.

	Theileria	**Vectors**	**Disease and pathogenisity**
1	***T.annulata* (India) Highly pathogenic**	**Hyalomma marginatum** Hyalomma anatolicum (Transtadial transmission)	Tropical Theileriosis, **Mediterranean coast fever,** Tropical Piroplasmosis, Egyptian Fever
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3	***T. mutans* (India)** Non-fatal/ Slightly pathogenic	**Rhiphicephalus appendiculatus** Haemophysalis bispinosa H. punctata (Transtadial transmission)	**Benign Bovine Theileriosis**, **Turning Sickness** **African Coast Fever**
	Sheep and Goat		
1	***T. hirci* (India) Highly pathogenic**	**Rhiphicephalus bursa** Hyalomma anatolicum anatolicum (Transtadial transmission)	**Malignant Theileriosis**
2	***T. ovis* *Non pathogenic***	**Rhiphicephalus bursa** Haemophysalis spp (Transtadial transmission)	**Benign Theileriosis**

PROPHYLAXIS AND CONTROL

- **By Chemoprophylaxis + Immunoprophylaxis + Tick control.**
  - Wide spread and strict application of acaricides
  - Use of genetically resistant breeds.
  - Immunoprophylaxis

- **Tissue culture vaccines (Rakshavac-T*)**
  - Attenuated Schizonts of *T. annulata* developed by in – vitro cultivation of bovine lymphocytes infected with *T. annulata* schizonts. A dose of 2 x 10^6infected cells suspended in serum free tissue culture remains viable at 4 ^{0}C for 1 week and used to vaccinate cattle.
  - Age: Cross–bred and exotic cattle of 2 months / above.
  - Dose: 3 ml , S/c, annually.
- Infection and Treatment method
  - A potentially lethal known dose of stabilate of ground up infected ticks together with a long acting formulation of OTC or Buparvaquone is developed. It suppresses the development of the parasite and allow the effective CMI response with minimal disease response.
- Subunit vaccines:
  - Antigen to be included are sporozoites and Schizonts that induce CD^4 + T cells and antigen stimulating specific response like cytotoxic cells.
- Recombinant antigens
  - Immunization with recombinant sporozoites / merozoites surface antigen partially protect against sporozoite which are poorly immunogenic. For *T. annulata*, it induces the innate immune response.

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BABESIOSIS

INTRODUCTION

- *Family:* Babesidae
- First vector borne disease caused by *Babesia spp* in cattle, sheep, pigs, horses and dogs and is characterized by fever, intravascular haemolysis causing a syndrome of anaemia, haemoglobinuria, and haemoglobinaemia and are transmitted by ticks.
- *Morphology*
  - In RBC- seen singly as ovoid, round, elongate or amoeboid trophozoites ; as pyriform merozoites (pairs)/ cruziform (tetrads) merozoites; Characteristically they are pear shaped; large forms lie with their narrow ends at an acute angle and small forms at obtuse angle.

BABESIOSIS IN CATTLE

Disease

- Cattle tick fever
- Red water disease or Piroplasmosis or Texas Fever.

Morphology

- A large piroplasm, round, pyriform, oval or irregular form or characteristically pear shaped and lie in pairs forming an acute angle in RBCs.

Life cycle

- The spherical forms in the ovary of *B. microplus* occur with parasitophorous vacuole formed by host cells where they are transformed into folded kinetes.
- The sporozoites in tick salivay gland is pyriform.

Epidemiology

- *Virulence of parasite*
  - *B. divergens* and *B. canis* – relatively pathogenic; *B.major* and *B.ovis* – mildly pathogenic producing transient anaemia.
- *Age of the host*
  - Inverse age resistance; Greatest infection rate in animals in the age 6-12 months age group and infection is uncommon in animals over 5 years of age.
  - *B. bigemina* : Under 1 year age are susceptible and *B. bovis* - Over 2 years of age are susceptible.
- *Breed*
  - *B. bigemina*- All races of cattle are equally susceptible; *B. bovis*- Zebu and Africander cattle are more resistant than British and European breeds and Santa Getrudis- intermediate position.
- *Transmission*
  - Transovarian transmission-one host tick & Transtadial transmission- two or three host tick. Transmission by several generations of ticks is possible.
  - Intra uterine transmission- B. bigemina and *B.ovis*.
  - Physical-By contaminated needles and surgical instruments. eg. *B. bigemina* and *B. equi*. also *B. bovis*.
- *Carrier status*
  - Infected adult animals like sheep act as carriers for over 2 years; if the are constantly infected , they act as carriers for life.
- *Reservoir status:* White tailed deer and African buffaloes.
- *Premunity*
  - Cattle are immuned to reinfection due to exposure to continuing low grade infection.
  - Eg: Premunity occurs for more than 1 year. Immunity is species specific. In endemic areas, calves acquire colostral immunity.
- *Risk factors*
  - Endemic areas-Outbreak is associated with stress due to parturition, tick borne fever/ starvation.
  - Break down of immunity occurs if there is superimposed infection with *A.marginale*/ FMDV in cattle and canine distemper in dog.
- *Season:* Greatest incidence occurs soon after the peak of tick population which varies with temperature, humidity and rainfall.
- *Enzootic instability:* It occurs when there is sudden increase in the tick population due to favourable climatic conditions, the incidence of the clinical cases may increase sharply.

- **PATHOGENESIS**
- Highly pathogenic and death rate is higher in adults.
- Intra vascular haemolysis is the principal pathogenic effect due to the multiplication of *B. bigemina* and *B.bovis* in peripheral and visceral blood vessels respectively thus resulting in profound anemia, (hypochromic normocytic), jaundice and haemoglobinuria.
- Death is due to destruction of RBCs by auto-antibody mechanism, failure to recoup blood loss, cerebral anoxia and accumulation of toxic by-products.

- *B. bovis*
    - Production of vaso active substances, kinin and kallikrein results in vasodilatation accompanied by increased vascular permeability leading to circular stasis and shock.
    - Disseminated intravascular coagulation (DIC) due to break down products resulting in fatal pulmonary thrombosis in calves.
- Ischaemic changes in skeletal and cardiac muscles in survivors.
- *Haematology:* TEC - less than 2 million/ cmm and neutrophilia.
- *Biochemical changes:* Reduced calcium, phosphorous, total serum protein; Increase in blood glucose, total serum bilirubin and SGOT in liver damage
- *Necropsy findings:* Urinary bladder containing reddish, pink or coffee colored urine; Enlargement and congestion of lymph nodes.

Clinical findings

- Incubation period: 2-3 weeks; Sub clinical infection infection in young cattle.
- Fever, anorexia, brick red conjunctiva which becomes anaemic, depression, weakness, cessation of rumination, salivation, dryness of muzzle, lachrymation, dropped milk yield.
- Profound diarrhoea followed by constipation.
- Advanced stages: Severe anaemia, haemoglobinuria, jaundice, dark red to brown urine with a very stable froth and death after 24 hours.
- In survivors - course is 3 weeks. Abortion in pregnant animals.
- Cerebral form (*B.bigemina*): In coordination, posterior paralysis, mania, convulsions, coma, fever, death within 12-36 hours after clinical signs.
- Chronic cases: extend for several weeks with intermittent temperature.
- *B.divergens*: similar to above. Also spasm of anal sphincter muscles causing the passage of Pipe-stem liver.

Diagnosis

- Based on clinical signs.
- Detection of piroplasms in peripheral blood smears which is not always possible. Both thick and thin blood smears may be used for demonstration of organisms in RBCs.
- Presence of heavy infestation with ticks.
- FAT- Acridine orange fixed with blood smear appeared red with yellow nucleus; DNA probes.
- Necropsy: Splenomegaly, jaundice, haemoglobinuria, myocardial ecchymoses –highly suggestive.
- Immunodiagnosis in sub clinical infections
    - IHA- 80% effective in field infections
    - IFA, CFT, IHA and Capillary agglutination tests (specific and no cross reaction).
    - Others: Latex agglutination tests, Card agglutination test, ELISA, Microplate enzyme immuno assay. IFA differentiates antibodies due to vaccination and natural infection.
- **DIFFERENTIAL DIAGNOSIS**
- Epierythrozoonoses -anemia
- Theileriosis-haemoglobinuria
- Leptospirosis- severe in young ones
- Anaplasmosis

- Trypanosomosis
- Bacillary haemoglobinuria
- Rabies
- Copper toxicity.

Treatment

- Aromatic diamidines:
    - Imidocarb dipropionate (Imizol)
    - @ 1 mg/kg, S/C; 2 mg/kg, Most effective against B. bigemina; therapeutic and prophylactic; completely eliminates the parasites with some residual activity.
    - Merit:
        - Non- infected cattle develops one month resistance;
        - To protect cattle during pregnancy where vaccination is contraindicated.
- Quinuronium derivatives (Acaprin, Babesan, piroplasmin. Piruvan)
    - Effective against B. bigemina and other larger spp; 1 ml/ 50 kg but with a maximum dose of 6 ml, S/C.
- Other Aromatic diamidines
    - Diamprone -@ 10 mg. kg, deep I/M.
    - Phenamidine-@ 12 mg/kg, S/C in 40 % aqueous solution.
    - Pentamidine- Chemo immunizing agent against B. bigemina in cattle.
- Others
    - Tryphan blue solution (1-2 %) - 100 ml , I/V.
    - Acriflavin (5%)- 20 ml.
- Amicarbalide - effective in cattle and horses; @ 5-10 mg/kg, but I/M at 24 hrs interval.
- Primaquine - 0.5 mg/ kg; I/M.

Control

- Control of ticks- acaricides, repellants;dipping of animals at regular intervals
- Segregation and treatment of animals harbouring infection.
- Chemoprophylaxis- Imidocarb for 2 months which allows animals infected gradually.
- Killed vaccine- with incomplete Freund's adjuvant and irradiated Babesia spp.
- Chemoimmunization- vaccination with virulent organisms and simultaneous subsequent challenge with Babesia spp.
- Live attenuated vaccine- less virulent and attenuated babesia are suspended in a cell free plasma are used after passing through spleenectamized calves.
- Vaccine contains 10^3 B. bovis organisms / dose are the minimum infective dose.
- Live attenuated tissue culture vaccines are also effective.
- Vaccination with non-living antigens, antigenic proteins produced in blood stream or culture medium as a part of the growth process of Babesia spp.
- Sub unit vaccine from monoclonal technology
- Blood transfusion- Oldest; immunization by inoculation of infected blood followed by babesidal drugs but transmission of bovine leucosis and other diseases.
- Diminazene aceturate-@ 3-8 mg/ kg, but deep I/M; safe and effective to treat all spp.

BABESIOSIS IN HORSES

Life cycle: Similar to *B. bigemina*

- *B. equi*
    - Incubation Period: 10-21 days

    - Severe in young and new born foal
    - Course-8-10 days
    - Chronic cases survive for months and carries persists for 4years.
    - Mixed infections with *B. cabbali* can occur
    - Fever, reluctance to move, edema of fetlock, head and ventral abdomen, frequent colic, jaundice, anaemia.
- *B. caballi*
    - Nervousness
    - Walking in circle
    - Incoordination and paralysis of hind quarters
    - Haemoglobinuria - rare.

Treatment: Imidocarb-@ 4mg/ Kg on 4 occasions at 72 hrs intervals.

BABESIOSIS IN DOGS

- Disease: Biliary fever/ Malignant jaundice.
- Pathogenesis
    - *B. canis*
        - Incubation period: 10-20 days; fever, anaemia, icterus, inappetence, marked thirst, weakness, prostration and frequent death.
        - Peracute cases: Haemoglobinuria, bilirubinuria.
        - Acute cases: Acute respiratory failure, extensor spasms and death within 4-5 days.
        - Atypical signs : Catarrhal bronchitis, pneumonia, subcutaneous edema, ascites, purpura, red urine or blood clots in faeces.
        - CNS signs: Locomotor disturbances, paresis and epileptic fits.
        - Lesions: Petechial hemorrhages in various organs and mucous membrane; icterus; edema in pleural and peritoneal cavities.
    - *B.gibsoni*
        - Chronic type of disease with relapses of fever, progressive anaemia, haemoglobinuria, jaundice - less common, staggering gait and death.
- Treatment: Berenil

Treatment

- Trypan blue single I/V injection 4.5 ml of 1-2 % solution.
- Phenamidine- 10 mg of 5% per kg s/c repeat 24 hrs later.
- Pyrivon 0.5 % at 0.5 %at 0.05 ml/kg s/c repeated 24 hrs.
- Berenil-3.5 mg/kg,
- Imidocarb: 1 mg/kg.
- Atovaquone (13.3 mg/kg every 12 h) plus azithromycin (10 mg/kg per day) was found to be as effective in clearing parasitemia and resolving symptoms as the combination of clindamycin (600 mg every 8 h) and quinine (650 mg every 8 h). Both drug combinations were given orally for 7 days.
- Doxy 5mg/kg, metronidazole 15mg/kg, clindamiicine 25 mg/kg bid for month

S.N.	Babesia sp	Vectors	Transmission	Disease
Cattle, Buffalo and Zebu				
	B. bigemina (India)	*Boophilus annulatus, B. microplus R. appendiculatus, R. bursa Haemophysalis punctata*	Transovarian and Transtadial, also Intra uterine	Cattle Tick Fever Red Water Disease Bovine Piroplasmosis Texas Fever,Triteza
2	*B. bovis* (India)	*B. microplus,B. calcaratus R. bursa ,Ixodes ricinus I. persulcatus*	Transovarian and Transtadial, also Intra uterine	Bovine Babesiosis Piroplasmosis Red Water Disease
3	*B. major*	*Ixodes ricinus*	Transovarian and Transtadial	Less severe than B. bigemina
4	*B. divergens*	*B. calcaratus Haemophysalis punctata*	Transovarian	Less severe than B. bovis
	Sheep and Goats			
1	*B. motasi*	*Dermacenter silvarian, Haemophysalis punctata R. bursa*	Transovarian and Transtadial	Pathogenic
2	*B. ovis*	*R. bursa*	TOT,TST, Transplacental	Less severe than B. motasi
	Sheep			
1	*B. foliata* (India)	Not known	Not known	Not known
	Goat			

1	*B. taylori* (India)	Not known	Not known	Benign type disease
	Dogs			
1	*B. canis*	*R. sanguineus*	Transtadial	Biliary Fever, Malignant jaundice,CaninePiroplasmosis Canine babesiosis
2	B. gibsoni (India)	*R. sanguineus, Haemophysalis bispinosa*	Transtadial and Transovarian	Slightly Pathogenic
	cats			
1	*B. felis* (India)	Not known	Not known	Less pathogenic than dog
2	*B. cati* (India)	Not known	Not known	Less pathogenic than dog
	Equines			
1	*B. equi* (India)	*Dermacenter spp, R. sanguineus R. bursa ,Hyalomma anatolicum*	Transovarian and Transtadial, also Intra uterine	More pathogenic
2	*B. cabbali*	*Dermacenter spp,R. sanguineus R. bursa ,Hyalomma anatolicum*	Transovarian and Transtadial, also Intra uterine	Less pathogenic
	Pigs			
1	*B.trautamanni*	*Boophilus spp ,R. sanguineus Dermacenter* spp	Transovarian	Mild/ Fatal
2	*B. peroncittoi*	Not known	Not known	Mild/ Fatal

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