BRUCELLOSIS IN THE HORSE

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Summary

Brucellosis is a major disease of domesticated and wild animals worldwide, and is also an important zoonosis. Of the domesticated species, cattle, sheep, pigs and goats are most commonly affected, and reproductive failure is the most common clinical manifestation. Infection in horses is uncommon, but is usually associated with infectious bursitis, arthritis or tenosynovitis. Less commonly, cases of vertebral osteomyelitis, abortion and infertility in stallions have been recorded. Fistulous withers and poll evil are the commonest clinical manifestations in the horse, and infection most frequently involves *Brucella abortus*. Serological surveys indicate that many horses may be exposed to *B. abortus* without developing clinical signs of disease.

Aetiology and epidemiology

Bacteria of the genus *Brucella* are nonmotile, aerobic, intracellular Gram-negative cocci, cocco-bacilli or short rods. *Brucella* spp. are transmissible to a wide range of species, and among the domesticated animals, cattle, sheep, goats and pigs are most commonly affected (**Table 1**) (Godfroid *et al.* 2004). Wild animal species are also occasionally infected (Godfroid 2002). The most important clinical manifestations are reproductive failure (including mid- to late-term abortions and infertility in cows, and orchitis and inflammation of the accessory sex glands in bulls). Chronic infections can result in arthritis. In cattle, the primary sources of infection include fetal membranes and fluids, vaginal discharges, milk and semen. Placental samples from brucellosis-induced abortions in cattle have yielded 10^{10} organisms/g (Alexander *et al.* 1981). Six major *Brucella* species have been classically characterised: *B. abortus*, *B. melitensis*, *B. suis*, *B. canis*, *B. ovis* and *B. neotamae*. Recently, 2 new species, *B. ceti* and *B. pinnipedialis*, have been isolated from marine species (Foster *et al.* 2007). Most *Brucella* spp. have a strong host preference, which is evident in their ability to establish chronic infection in individuals and maintain transmission and infection in populations of specific animal species (Glynn and Lynn 2008).

Brucellosis in cattle is usually caused by biovars of *B. abortus*, although in southern Europe and the Middle East, *B. melitensis* may cause abortion in cattle kept close to infected sheep and goats (Godfroid *et al.* 2004). Brucellosis is an important zoonotic disease; in man, brucellosis (undulant fever) is seen primarily in veterinarians, stock inspectors, abattoir worker, etc. (Anon 1986). Human brucellosis is dependent on the presence of *Brucella* spp. among other animals with which people have direct or indirect contact (Glynn and Lynn 2008). In many areas of the world, animal disease control programmes and occupational safety practices have diminished the impact of brucellosis over the last half century.

None of the *Brucella* spp. are adapted to the horse. Equine infections usually involve the cattle pathogen *B. abortus*, although infection with *B. suis* has been reported (Nicoletti 2007). There are no

TABLE 1: *Brucella* spp. infections among domesticated animals

Brucella species	Disease	Species affected
B. abortus	Brucellosis (contagious abortion)	Sheep
B. ovis	Epididymitis/orchitis	Sheep
B. melitensis	Abortion and orchitis	Sheep and goats
B. suis	Abortion, stillbirth, sterility in sows and orchitis in males	Pigs

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reports of natural infection of horses with *B. canis* (Hagler *et al.* 1982).

B. abortus infections in domestic animals have been reported worldwide, but have been effectively eradicated from several European countries, Japan and Israel (Nicoletti 2007). There is no apparent age, gender or breed predisposition to infection in horses, although most cases have been reported in horses aged >3 years (Nicoletti 2007).

Brucella spp. are fairly hardy; organisms have been recovered from fetal and manure samples that remained in a cool environment for >2 months. However, exposure to sunlight kills the organisms within a few hours, and the organisms are susceptible to many common disinfectants (Glynn and Lynn 2008).

Pathogenesis and clinical signs

Brucella spp. are facultative intracellular pathogens and establish infection by invading macrophages and evading macrophage-induced host defence mechanisms (Gorvel and Moreno 2002). These characteristics contribute to the clinical signs and therapeutic considerations, including the difficulty in both diagnosis and treatment (Glynn and Lynn 2008). Following ingestion of the organism, the bacteria travel through the oral mucosa to the regional lymph nodes. Infection leads to bacteraemia, which is usually transient; the organisms ultimately settle in the reproductive tissues or musculoskeletal system.

Horses usually become infected by the ingestion of *B. abortus*-contaminated feed, and most reported cases indicate a history of contact with cattle (Duff 1937; McCaughey and Kerr 1967; Denny 1973; O'Sullivan 1981; Ocholi *et al.* 2004). There is no evidence to suggest that horses are a reservoir of brucellosis in endemic areas or that they are an important source of infection for other animals (Acosta-Gonzalez *et al.* 2006).

Serological surveys in endemic areas indicate that many horses can be exposed and infected by *B. abortus* without any clinical signs of disease (Denny 1973; Dawson and Durrant 1975; Dawson 1977; Nicoletti *et al.* 1982; MacMillan and Cockrem 1986). Following experimental infection by instillation of *B. abortus* into the conjunctival sac of horses, an intermittent bacteraemia was detected for up to 2 months, and serum antibodies (measured by serum agglutination, complement fixation, Coombs antiglobulin, 2-mercaptoethanol, Rose Bengal plate and agar gel immunodiffusion tests) became detectable between 7 and 12 days after infection (MacMillan *et al.* 1982). No clinical signs were detected in these horses apart from mild pyrexia. Five of these 7 experimentally infected horses were mares that were subsequently put in foal; they all bred normally, and no organisms were recovered from the horses or from in-contact cattle (MacMillan and Cockrem 1986).

In horses that develop clinical signs of infection the organism usually localises in bursae (causing septic bursitis), tendon sheaths (causing septic tenosynovitis) and joints (causing septic arthritis) (Denny 1972, 1973; Carrigan *et al.* 1987; Ocholi *et al.* 2004). Less commonly, cases of vertebral osteomyelitis (Collins *et al.* 1971), abortion and infertility in stallions have been recorded (Denny 1973). The commonest clinical diseases associated with *Brucella* spp. infection in horses are septic supraspinatous bursitis (fistulous withers) (**Figs 1** and **2**) and septic supra-atlantal bursitis (poll evil) (**Fig 3**). Duff (1937) reported 85 cases of fistulous withers or poll evil, and identified *B. abortus* infection in 80%. Chronic draining sinuses occur in both conditions (Crawford *et al.* 1990). *B. suis* has also been isolated from horses with septic bursitis (Portugal *et al.* 1971; Cook and Kingston 1988), aborted equine fetuses (McNutt and Murray 1924), and the internal organs of a mare with no external signs of disease (Cvetnic *et al.* 2005).

Fistulous withers and poll evil

Fistulous withers is a chronic inflammatory disease of the supraspinatus bursa and associated tissues (Gaughan *et al.* 1988; Rashmir-Raven *et al.* 1990; Cohen *et al.* 1992). Although infection by *B. abortus* has been associated with the condition (Duff 1937; O'Sullivan 1981), other infectious organisms and trauma can also cause the disease. Indeed in geographical areas with a low prevalence of brucellosis in cattle, *B. abortus* is rarely isolated from fistulous withers cases (Gaughan *et al.* 1988; Cohen *et al.* 1992). Infection by multiple bacteria is often present. Other than *B. abortus*, organisms commonly isolated from clinical cases include *Streptococcus zooepidemicus*, *Streptococcus equi*, *Staphylococcus*

FIGURE 1: Fistulous withers with multiple draining tracts discharging purulent material (courtesy of Ceri Sherlock).

aureus, *Staphylococcus epidermidis*, *Proteus mirablis*, *Actinomyces bovis*, *Bacteroides fragilis*, *Escherichia coli*, *Pasteurella* spp. and *Corynebacterium* spp. (Guard 1932; Gaughan *et al.* 1988; Cohen *et al.* 1992; Hawkins and Fessler 2000). Infection by *Onchocerca cervicalis* has also been incriminated in some cases (Lyons *et al.* 1988; Rashmir-Raven *et al.* 1990; Hawkins and Fessler 2000).

The supraspinous bursa is located between the funicular portion of the nuchal ligament and the dorsal spinous processes of the second to fifth thoracic vertebrae (Hawkins and Fessler 2000). The bursa is approximately 5 cm wide and ranges in length from 5–11 cm, and has a capacity in the normal horse of 30–90 ml. Clinical signs of supraspinous bursitis (fistulous withers) include singular or multiple draining tracts (**Fig 1**) or diffuse swelling of the withers without drainage (**Fig 2**). The onset of clinical signs may be abrupt or insidious. Early signs include localised heat, pain and swelling of the bursa. There may be lethargy and general stiffness. In most cases the bursa ruptures and purulent exudate is discharged from one or more fistulae. These fistulae may heal over, but may subsequently reform. Extensive fibrosis may occur. Horses with fistulous withers that are seropositive to *B. abortus* are significantly more likely than seronegative horses with fistulous withers to have radiographic evidence of osteomyelitis of the underlying dorsal spinous processes (Cohen *et al.* 1992).

Poll evil (septic supra-atlantal bursitis) causes similar clinical signs to fistulous withers in the poll region. There is frequently pain and neck stiffness (**Fig 3**). Swelling of the region occurs which may be followed by discharge of purulent material.

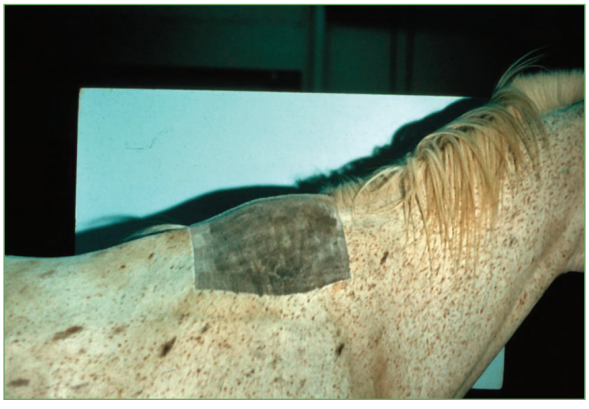

FIGURE 2: Fistulous withers in a 9-year-old mare. There is diffuse swelling of the supraspinous bursa (without drainage in this case).

Abortion

Mid- to late-term abortion in mares has been reported, but this appears to be rare (McNutt and Murray 1924; McCaughey and Kerr 1967; Shortridge 1967; Robertson *et al.* 1973; Hinton *et al.* 1977). *B. abortus* may be isolated from the fetus and fetal membranes, and the affected mares show a

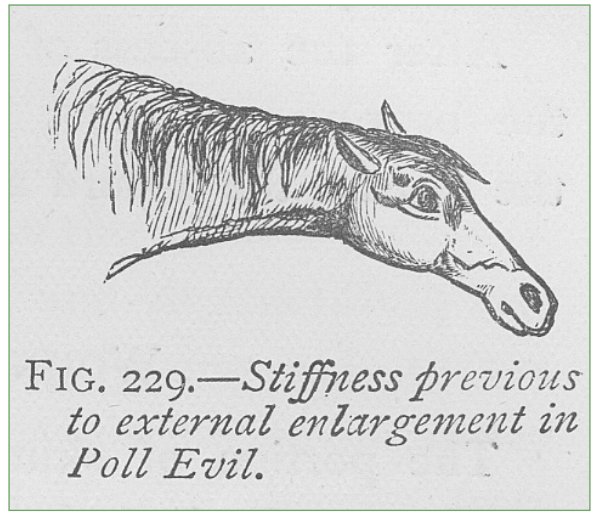

FIGURE 3: Neck pain and stiffness associated with poll evil (Armitage 1892).

serological response to infection. Unlike infected cows, excretion of the organism in vaginal discharges appears to be short-lived. In most instances, mares have become infected by co-grazing pastures with infected cattle.

Diagnosis

Brucella spp. require complex media for growth in culture, and many strains require complementary carbon dioxide for optimum growth. Although attempts should always be made to culture *B. abortus* from exudates in cases of fistulous withers and poll evil, overgrowth by other bacteria commonly makes the organism difficult to isolate (Nicoletti 2007).

Serological testing is recommended in suspected cases. The card test that is widely used for screening of *B. abortus* in cattle has poor specificity (Nicoletti 2007). The plate agglutination test is considered to be more sensitive and specific; a titre ≥1:50 is considered positive (Dohoo *et al.* 1986; Nicoletti 2007). Occasionally, false positive results will be obtained, and there are reports or *B. abortus* isolation from seronegative horses (Denny 1973). Other serological tests can be used, including tube agglutination, complement fixation, Coomb's antiglobulin, mercaptoethanol and agar gel diffusion tests. Although a rising titre will establish an acute infection, this might not be seen in long-standing cases; in these circumstances, a high titre in combination with appropriate clinical signs should be considered diagnostic (Nicoletti 2007).

Radiography can be useful in fistulous withers and poll evil cases to assess the extent of bursal distension and associated osseous damage.

Treatment

Treatment of brucellosis in horses generally involves a combination of systemic antimicrobials and local surgical drainage/debridement of infected tissue (see fistulous withers above). Although *Brucella* spp. are generally sensitive to tetracyclines, chloramphenicol, streptomycin and some sulphonamides, there may be insufficient penetration into infected tissues to achieve resolution of the infection (Nicoletti 2007). In addition, polymicrobial infections are common. The successful treatment of 3 horses using clofazimine has been reported (Knottenbelt *et al.* 1989).

Administration of the *Brucella* strain 19 vaccine has been reported in the treatments of horses with brucellosis (Denny 1973; Gardner *et al.* 1983; Cohen *et al.* 1992). In a survey of veterinarians in Florida concerning the treatment of fistulous withers, treatment with antibiotics and strain 19 vaccine was reported to be effective in 37 of 46 horses (80.4%) (Gardner *et al.* 1983). Treatment regimes have varied from a single dose of vaccine to 3 doses at 10 day intervals (Denny 1973; Nicoletti 2007). Local and systemic reactions have been recorded with the use of the vaccine, including death in some horses that received the vaccine intravenously (Cosgrove 1961; Millar 1961; Denny 1973; Cohen *et al.* 1992).

Treatment of fistulous withers and poll evil can be difficult. Medical treatment is directed towards controlling infection and inflammation. Broad-spectrum antibiotics are recommended, pending serological and microbiological findings, and when culture results are unavailable or considered unreliable due to contamination. Lavage of draining

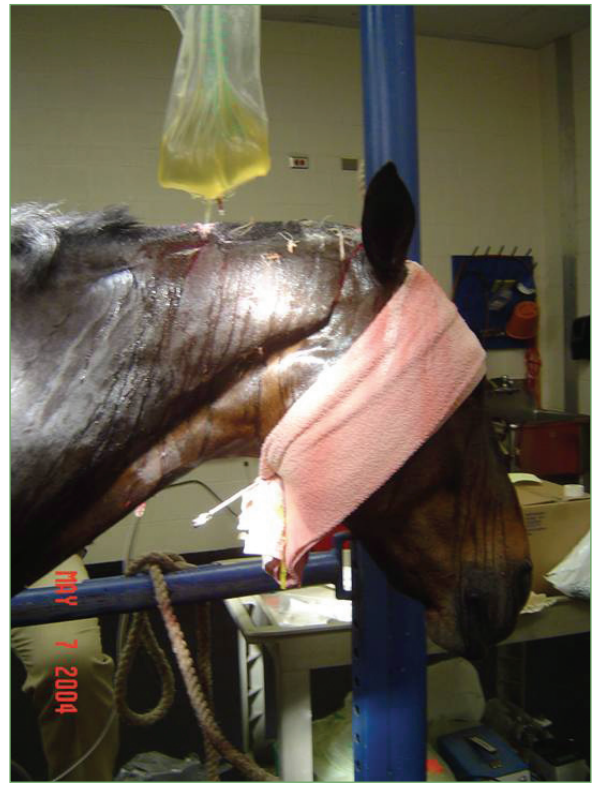

FIGURE 4: Lavage of the supra-atlantal bursa of a horse affected by poll evil.

tracts with antiseptic solutions and dimethyl sulphoxide may be helpful (Cohen *et al.* 1992) (**Fig 4**). Radical surgical debridement of infected bursal tissue, with or without curettage of the dorsal spinous processes in the case of fistulous withers may be necessary in some animals (Gaughan *et al.* 1988; Hawkins and Fessler 2000); the surgery may be performed in the standing horse or under general anaesthesia.

Prevention and public health risk

Since horses usually acquire *B. abortus* infection from cattle (Denny 1973; Cramlet and Bernhanu 1979), they should not be housed or pastured with seropositive cattle. Since trauma is considered to be a predisposing factor for the development of fistulous withers, properly-fitting saddles and tack should always be used. Parasite control measures to reduce the incidence of *Onchocerca* spp. should also be used.

Horses infected by *B. abortus* may represent a source of infection to man (Anon 1986; Acha and Szyfres 1987), although documented cases of this route of infection are rare (Jalil 2008). The organism can enter the body through abraded skin and enter across intact mucous membranes, including the conjunctiva and respiratory mucosa. The number of human cases of brucellosis has declined dramatically over the past 30 years as a result of effective control measures to control the disease in domestic animals (Salata 2000).

B. abortus infection is a reportable disease in many countries, and seropositive horses may require to be quarantined or subjected to euthanasia.

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