Glanders: A Treatable Disease?

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ABSTRACT

Equine glanders, often known as farcy, is an infectious zoonotic disease caused by Burkholderia mallei. The only known natural B. mallei reservoir is found in horses, donkeys, and mules. Even though glanders has been completely eradicated in the majority of countries, due to multiple recent outbreaks, the illness is once again considered to be reemerging. Pre-symptomatic or carrier animals are important in the propagation of the infectious agent and can be a source of infection for the healthy horse population. Ulcerating nodular lesions of the skin and mucous membranes are characteristic of glanders. Fever, lethargy, depression, coughing, anorexia and weight loss are examples of generalized symptoms. B. mallei can enter a host by way of the integument, gastrointestinal system, and mucous membranes. We still don't fully understand its pathophysiology and virulence processes. The frequency of false-positive and false-negative results, which cause difficulties in international equine trade and the spread of glanders to disease-free regions, is a significant issue when utilizing serological tests for the diagnosis of glanders. Furthermore, inadequate testing greatly contributes to inadequate disease control. These assays are not only unable to distinguish between antibodies against B. pseudomallei and B. mallei, but they are also unable to distinguish between animals that are naturally infected and those that are malleinized. The detection rate of glanders is increased by the combined use of molecular and serological diagnostic techniques. Early disease detection in susceptible animals, strict quarantine regulations, testing and safe carcass destruction, fair compensation to animal owners, disinfection of infected premises, and veterinary extension services that raise awareness of glanders and their potential zoonotic consequences are all examples of countermeasures against glanders. Also provided is a description of the clinical presentation and effective experimental treatment of spontaneous equine glanders.

Keywords: Glanders, farcy, Horses, Equines, Burkholderia mallei, zoonosis.

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1. INTRODUCTION

Glanders is a zoonotic disease that spreads through contagion and is triggered by the Burkholderia (B.) mallei infection. While glanders were initially believed to have acute or chronic manifestations exclusively, there is emerging evidence that B. mallei has the capacity to induce latent infections resembling those initiated by Burkholderia pseudomallei. (Kettle and Wernery 2016) This ailment has been denoted by a variety of alternate terms, such as cutaneous Droes, Farcy Pipes, Farcy, Malleus, Farcy Buds, and Equinia. (Jubb et al. 2012).

Glanders is an extremely infectious bacterial illness affecting horses, mules, and donkeys, identifiable by the development of nodular lesions in the respiratory, cutaneous, and lymphatic systems. This zoonotic ailment can be transmitted to individuals who are in close proximity to infected animals or those who handle the organism in laboratory settings. (Dvorak and Spickler 2008).

Human infection with this disease is relatively rare, even during outbreaks among horses. The recognition of this illness dates back to ancient times, with Hippocrates documenting clinical symptoms around 425 BC. Nearly a century later, Aristotle mentioned the disease within the broader context of epizootics and referred to it as 'melis'. (Al-Ani and Roberson 2007) (Whitlock et al. 2007) The causative agent, B. mallei, was officially documented in 1882 when researchers isolated it from the infected spleen and liver of a horse. (Schadewaldt 1975) It is believed that horses serve as the natural source of infection, with humans being accidental hosts. Human infection can happen through either the cutaneous or inhalational routes. (Kettle and Wernery 2016).

The formation of the present Burkholderia genus was determined by a combination of factors, including DNA-DNA homology values, phenotypic traits, cellular lipid and fatty acid composition, and 16S rRNA gene typing. This taxonomic revision occurred in 1992. (Yabuuchi et al. 1992) Within the Burkholderia genus, there are several notable species, among which Burkholderia pseudomallei stands out as the causative agent of melioidosis. Additionally, Burkholderia cepacia is recognized as a significant pathogen, particularly in patients suffering from cystic fibrosis. (Burns et al. 1996) Another member of this genus, Burkholderia thailandensis, is recognized as a bacterium with relatively lower virulence in comparison to certain other Burkholderia species. (Glass et al. 2006).

Glanders is believed to have been one of the earliest instances of a biological weapon in the 20th century. Germany initiated a program of biological sabotage against multiple countries during World War I. These countries also include the United States. Covert operatives were provided with cultures of B. mallei and anthrax, which they employed in efforts to infect livestock intended for Allied nations. The objectives were twofold: to disrupt livestock and to facilitate the transmission of the extremely contagious, deadly agent from animals to humans. Presently, there are concerns about attempts to create an aerosolized, antibiotic-resistant form of B. mallei, which has the potential to become a bioweapon of significant potency, similar to anthrax. (Srinivasan et al. 2001).

2. CAUSATIVE AGENT

Burkholderia mallei is a Gram-negative bacterium that lacks motility, does not form spores, and is an obligate intracellular pathogen in mammals (Whitlock et al. 2007). Its dimensions span 0.3-0.8 µm in width and 2-5 µm in length, and its staining affinity with basic dyes is weak because of the presence of lipoid granules, resulting in irregular staining patterns. (Worley Jr and Young 1945) Rod-shaped forms of *B. mallei* both inside and outside macrophages in the spleen, liver, and lungs are observed. (Ferster and VIa 1982) Although the existence of a capsule in *B. mallei* was first reported by Miller et al. (1948), it wasn't confirmed until almost forty years later, emphasizing its critical function as a virulence component. Subsequent studies indicated that 19% and 33% of the tested strains developed a capsule after about 1

and 3 hours of incubation period, respectively. (Khan et al. 2013) When grown on appropriate culture media for a period of 1 to 2 days, *B. mallei* typically forms small, circular, shapeless, and translucent colonies. This distinctive colony morphology plays a significant role in the laboratory identification of the bacterium. (Wetmore and Gochenour Jr 1956).

3. TRANSMISSION

Glanders transmission takes place through diverse means. The number of documented instances of glanders in humans has been quite limited. Typically, these cases are linked to individuals who have had close contact with infected animals, with a particular focus on veterinarians and those involved in caring for animals afflicted with glanders. (Gangulee et al. 1966) (Howe and Miller 1947). Typically, transmission involves contact between infectious substances from contaminated animals and mucous membranes or open skin. Moreover, the organism can be inhaled through contaminated aerosols or dust particles. Infections in laboratory settings have occurred due to both skin contact and inhalation. (CDC, 2000). Human-to-human transmission is uncommon, with only a few documented cases, which include potential instances of sexual transmission and infections in family members who provided care to individuals with glanders. In rare situations, humans can acquire the infection by consuming meat that is contaminated.
In animals, the disease spreads by ingesting food and water contaminated by the nasal discharge of carrier animals. Carnivores are also vulnerable to infection if they consume meat that is contaminated with the pathogen. (Pal et al. 2016)
In addition, glanders can spread by direct skin-to-skin contact, inhalation that results in deep lung deposits, and bacterial invasion of the mucous membranes of the mouth, nose, and conjunctiva. Exposure to the skin during work is common, especially on the neck, face, hands, and arms. Normally, *B. mallei* cannot penetrate intact skin, although many cases lack evidence of wounds or penetrations during exposure. Interestingly, most laboratory-acquired infections occur without any injury or a clear recollection of injury. In the eighth case mentioned, there was no recollection of a skin break or a specific exposure-related incident, such as a needle stick or broken glassware. However, the patient did mention taking a finger-stick sample of their own blood for diabetic monitoring before entering the lab. Since gloves were not worn, the finger-stick site might have served as a bacterial entrance point. The presence of unilateral axillary lymphadenopathy in this patient aligns with a percutaneous infection (Van Zandt et al. 2013).

4. CLINICAL SIGNS AND SYMPTOMS

Glanders manifests clinically in horses, mules, and asses and is likely transmitted to humans from affected animals. Interestingly, cattle seem to be immune to the disease. In animals, glanders can manifest as either an acute or chronic condition, with the chronic form being more prevalent. During acute glanders, there is significant constitutional and functional disturbance, marked by a high fever reaching 105 or 106 degrees and lasting several days. Rapid weight loss, frequent chills, and unexplained lameness may occur, along with swelling in the limbs. Diagnosis during this stage is challenging. Subsequently, the fever subsides, and local lesions develop. Glanders nodules develop on the nasal septum, progressively softening and giving rise to discharge, which results in the formation of deep, irregular-edged ulcers. The disease rapidly spreads to the lungs and lymphatic glands, causing severe inflammation in the joints' synovial membranes. Fever reappears, extensive cheesy deposits form in the lungs, and death occurs within one to two weeks. Four distinct types of equine glanders can be identified as cutaneous, nasal, pulmonary, and asymptomatic carriers. (Falah et al. 1987) Cutaneous glanders can occur as a result of skin trauma or may manifest as a secondary condition stemming from the respiratory form of the disease. This variety of glanders is marked

by the existence of nodules, pustules, and ulcers, which may manifest on various parts of the horse's body, even though they can be most frequently seen on legs. (Mohammad 1989) Infections induced by *B. mallei* are recognized to result in profound anemia, which is probably attributable to the inhibition of erythropoietic activity within the bone marrow. (Al-Kafawi et al. 1977) One of the most prevalent clinical presentations of horse glanders is its pulmonary manifestation. It is recognized by the development of solid, encapsulated, spherical, grayish nodules that are dispersed throughout the lung tissue. (Al-Ani and Zubaidy 1978) The upper respiratory tract is where the glandes that cause nasal manifestations appear as nodules or ulcers. These ulcers are usually located on the cartilaginous nasal septum and lower portions of the turbinate. (Jubb et al. 2012)

Chronic glanders typically begins with a mild acute attack, often unrecognized and mistaken for a minor cold or lymphangitis. The acute variant of the chronic glanders usually exhibits an incubation period that spans from 1 to 14 days (Al-Ani et al. 1998), whereas the incubation time for the chronic form might last up to 12 weeks.

Localized infection usually appears 1-5 days after exposure and is marked by swelling of the affected region and the onset of a discharge. After a period of 10 to 14 days of incubation, signs of acute lung infections may manifest. Septicemia may appear right after exposure or take up to 14 days to manifest. If left untreated, pneumonic illness almost always results in death within 10 to 30 days and frequently has a quick start. Notably, a significant observation in the eight cases since 1943 is that at least half of the patients experienced temporary improvement in both their overall condition and clinical signs after the initial symptoms, before a second wave of symptoms emerged. This transient improvement might be mistakenly perceived as the disease being eliminated by both the patient and the physician. However, it is crucial to understand that this temporary improvement should not discourage physicians from recommending necessary treatments. (Van Zandt et al. 2013).

Pre-symptomatic or carrier animals can provide a risk of infection to healthy horses and are essential to the spread of the infectious agent. Ulcerating nodular lesions on the skin and mucous membranes are the hallmark of glaucoma. Fever, lethargy, depression, coughing, appetite loss, and weight loss are typical symptoms. *Burkholderia mallei* can enter a host by way of the gastrointestinal system, the integument, or mucous membranes. Despite ongoing research, the virulence mechanisms and pathogenesis of the bacteria remain incompletely understood. A notable challenge in diagnosing glanders stems from the reliance on serological tests, which frequently produce false-positive and false-negative results. These inaccuracies not only complicate international trade involving equids but also contribute to the spread of glanders to disease-free regions. (Khan et al. 2013).

5. DIAGNOSIS OF GLANDERS

5.1. CLINICAL EVALUATION

The clinical manifestations of glanders in equids can often resemble those of other respiratory diseases, highlighting the significance of veterinarians in distinguishing them from conditions such as ulcerative lymphangitis (*Corynebacterium pseudotuberculosis*), strangles (*Streptococcus equi* spp. *equi*), pseudotuberculosis (*Yersinia pseudotuberculosis*), epizootic lymphangitis (*Histoplasma farciminosum*) and sporotrichosis (*Sporotrichum* spp.) (Kettle and Wernery 2016).

Radiology can detect the existence of abscesses in various organs, including the lungs, liver, and spleen. It is significant to note that these abscesses may not be specific to glanders and can also be caused by other diseases. Therefore, specific diagnosis through the isolation and positive identification of the causative organism, *Burkholderia mallei*, is essential for confirming glanders (Van Zandt et al. 2013).

5.2. LAB TESTS

Glanders can be detected through several techniques, encompassing clinical indicators, the mallein test, serological examinations, and bacterial isolation. (Al-Ani and Roberson 2007)
Burkholderia mallei can be cultivated on various types of agar media, including nutritional agar, MacConkey agar, and blood agar, among others. When grown on these commonly used culture media, *B. mallei* typically forms colonies that are viscid, smooth, and creamy in appearance. These colonies can be observed after 48 hours of incubation at 37°C. Importantly, *B. mallei* exhibits the ability to thrive both as an aerobic organism and as a facultative anaerobe, and it can do so in the presence of nitrogen. (Pal and Gutama 2022) The low concentration of *B. mallei* in the tissues and biological fluids of infected equids (horses, donkeys, mules, etc.) makes pathogen isolation difficult. PCR (Polymerase Chain Reaction) and real-time PCR are two of the molecular techniques that have been developed to increase the detection of *B. mallei*. However, many of these tests encounter difficulty in differentiating between infections caused by *B. mallei* and those brought about by B. pseudomallei, a closely related bacterium responsible for melioidosis. (Kettle and Wernery 2016)
Currently, the diagnosis of glanders involves various methods, including the use of mallein (an allergic hypersensitivity test) and serological assays like the complement fixation test (CFT), counter immunoelectrophoresis test (CIET), indirect hemagglutination test (IHAT), enzyme-linked immunosorbent assays (ELISAs), and indirect fluorescent antibody test (IFAT). (Cravitz and Miller 1950).

6. ISOLATING AND IDENTIFYING THE RESPONSIBLE PATHOGEN

Cultivating *B. mallei* from an intact cutaneous nodule, pulmonary lesion, or lymph node is a valuable diagnostic approach. (Al-Ani et al. 1998) Culturing swabs from the pus-filled insides on glycerin agar usually produces diminutive, circular, shapeless, and translucent colonies. *B. mallei* can be identified by gram stain morphology, biochemical responses, and male guinea pig inoculation (Al-Ani et al. 1998). Several culture media were formulated to facilitate its cultivation, (Rogul et al. 1970) and 3% supplementation of glycerin in brain heart infusion agar is a frequently employed medium for extensive propagation.
The Straus reaction entails injection via intra-peritoneal route in male guinea pigs with suspected substances to facilitate the diagnosis. The manifestation of swelling and periorchitis within 3-7 days after immunization, offering additional confirmation of the existence of a *B. mallei* infection. (Al-Ani and Roberson 2007).

6.1. MALLEIN TEST

The test for delayed hypersensitivity is conducted through the intrapalpebral inoculation of mallein, which is a glycoprotein secreted by *B. mallei* and can be found in the culture supernatant. When hypersensitive horses infected with *B. mallei* are subjected to this test, they typically exhibit the development of purulent conjunctivitis within 24 hours, along with swelling of the eyelid. The mallein test is a valuable tool used in the field to diagnose glanders in equines. (Pal et al. 2016).
Serodiagnosis via the Complement Fixation Test (CFT) is recommended by (OIE), the World Organisation for Animal Health, for international trade purposes and is likewise endorsed for surveillance investigations. Although this test is acknowledged for its high sensitivity, it's important to note that it has a tendency to produce a significant number of false-positive results. These false-positive outcomes can cause unjustified limitations on the international trade of animals and related products, leading to economic losses for both proprietors and the equine industry. (Elschner et al. 2019).

6.2. TESTS ASSESSING CELL-MEDIATED IMMUNITY

A frequently utilized in-vivo test to assess cell-mediated immunity for glanders diagnosis is the intradermopalpebral mallein test. (Verma et al. 1994) This test entails injection of 0.1 mL of mallein intradermally adjacent to the inferior eyelid. An optimistic reaction typically emerges in 48 to 72 hours and becomes prominent in pronounced eyelid swelling, accompanied by the blepharospasm and very severe purulent conjunctivitis. Mallein test demonstrates a positive prognostic value of 92% in acute as well as chronic cases and a negative prognostic value of 96% in progressive cases. (Wilson and Miles 1975) Nevertheless, it has been reported to exhibit sensitivity limitations, particularly in progressive clinical cases, (Jana 1982) and there have been documented cases of false positives linked to Streptococcus equi infections. (Falah et al. 1987) Additionally, the mallein test may at times trigger the production of antibodies against *B. mallei* in uninfected horses, potentially resulting in a positive complement fixation test (CFT) (Hagebock et al. 1993).

A cell-mediated immunity test conducted in vitro is the lymphocyte stimulation test. Combining this test with CFT and bacterial culture for glander diagnosis has been shown to offer high sensitivity and specificity rates, enhancing the accuracy of diagnosis.

The diagnostic utility of Rose Bengal plate agglutination test (RBT) has been tested for equine glanders (Naureen et al. 2007).

7. TREATMENT OF GLANDERS

Many disease-free nations ban treating animals exhibiting glanders infection symptoms, such as positive serological titers. Considerable research has been conducted regarding in vitro antibiotic susceptibility of *B. mallei*. Although medication sensitivity of the isolates studied thus far varied significantly, the organism is generally susceptible to sulfadiazine, sulphamethazine, sulphathiazole, sulphamdimidine, neomycin, tetracyclines, oleandomycin, erythromycin, polymyxin B, kanamycin, nystatin, and sigmamycin. It exhibits reduced sensitivity to chloramphenicol, furazolidone, and nitrofurazone, and varying degrees of resistance to streptomycin, para-aminosalicylic acid, penicillin, and isoniazid (Ipatenko 1972; Kovalev and Gnetnev 1975a,b; Lozovaia 1989; Al-Izzi and Al-Bassam 1989; Thibault FM et al. 2004a). Researchers from Pakistan found that thirteen *B. mallei* isolates demonstrated sensitivity to co-trimoxazole, chloramphenicol, danofloxacin, and norfloxacin (Muhammad et al. 1998), in contrast, cephalexin and penicillin exhibited the lowest in vitro effectiveness. It is reported that erythromycin, oxytetracycline, gentamicin, sulfamethoxazole/trimethoprim (TMP), ampicillin, and Baytril (enrofloxacin) all shaped significant zones of inhibition against *B. mallei* (Al-Ani et al. 1998).

Pakistani researchers conducted a study on the antibiotic vulnerability of 41 *B. mallei* isolates obtained from naturally occurring horse glanders epidemics in province of Punjab, Pakistan. As reported by, Naureen et al. (2010), every isolate exhibited resistance to ampicillin., whereas 94% of the isolates exhibited susceptibility to ofloxacin as well as enrofloxacin.

In 2009, Dr. Saqib employed antibiotic therapy to treat 23 horses affected by a glanders outbreak at Polo Club in Lahore city, Pakistan. The treatment regimen involved oral administration of doxycycline (doxycycline, Belgium; twice daily), followed by intravenous administration of enrofloxacin (Enrotil; Dae Sung Microbiological Labs, Korea; once daily), and trimethoprim (TMP) + sulphadiazine (Tribrissen®; GlaxoSmithKline, Pakistan; once daily). This treatment regimen was utilized to address the glanders infection in the affected horses. The following table provides the dose and dosage schedule. (Khan et al. 2013).

8. DOSE AND DOSAGE REGIME

Total no. of animals: 23
Duration of treatment: 84 days
Total number of doses: Parenteral=42; Oral=126; Total=168

8.1. ANTIMICROBIAL THERAPY

Sr. #	Antibiotic	Dose	Duration	Time
1	Enrofloxacin	8 mg/kg	SID	1st week
		4 mg/kg	SID	2nd and 3rd week
2	Trimethoprim+Sulphadiazine	32 mg/kg	SID	1st week
3	Doxycyline	16 mg/kg	BID	2nd and 3rd week
		6 mg/kg	BID	4th to 12th week

SID = once in a day; BID = twice in a day
By the end of the 12-week therapeutic session, none of the horses had glanders returning. Aside from one horse that experienced delirium, which vanished entirely within three hours, no adverse effects associated with any antibiotics were seen. The clinical symptoms of the glanderous animals are shown in Fig. 1 and 2 before and after anti-biotic medication.
The treated horse was infection-free, according to the subsequent lines of evidence. (Khan et al. 2013).
1. After receiving high dosages of corticosteroids, the condition did not recur. Additionally, 6 of the 23 horses were put to sleep after receiving corticosteroid therapy. Lung tissue, submandibular lymph nodes, and mediastinal lymph nodes all diagnosed negative for *B. mallei* in culture tests. The suspension of the tissues after intraperitoneal inoculation in guinea pigs likewise tested negative for B. mallei. (Khan et al. 2013).
2. Throughout the one-year post-therapy monitoring period, 2 out of the 110 Sentinel horses that were introduced to the group of horses treated for glanders (totaling 17) continued to yield negative results for mallein, indicating their lack of infection.
3. At one month after birth, 3 foals (n = 2) of mares treated with glanders confirmed negative for mallein, and they remained negative throughout the observation period. (Khan et al. 2013).
The animal ethics committee at the Faculty of Veterinary Science, University of Agriculture Faisalabad, Pakistan, provided its approval to conduct an experimental treatment trial. (Khan et al. 2013).

8.2. PREVENTION AND CONTROL

For both humans and animals, there is currently no vaccination available to protect against glanders. In regions where glanders are prevalent among animals, human disease prevention primarily revolves around the identification and eradication of the infection within the animal population. (Pal and Gutama 2022) Occurrences of glanders in animals are required to be informed to the World Organization for Animal Health (OIE). The presence of this disease in a country can lead to international trade restrictions affecting horses and other animals that have been affected by glanders. Following notification, government veterinarians, who possess expertise in diagnosing exotic diseases, conduct thorough investigations to confirm the presence of glanders. When glanders is identified, a comprehensive set of control measures is put into place. These measures encompass:

8.2.1. STRINGENT QUARANTINE

All animals, both infected and those exposed to the disease, are placed under strict quarantine.

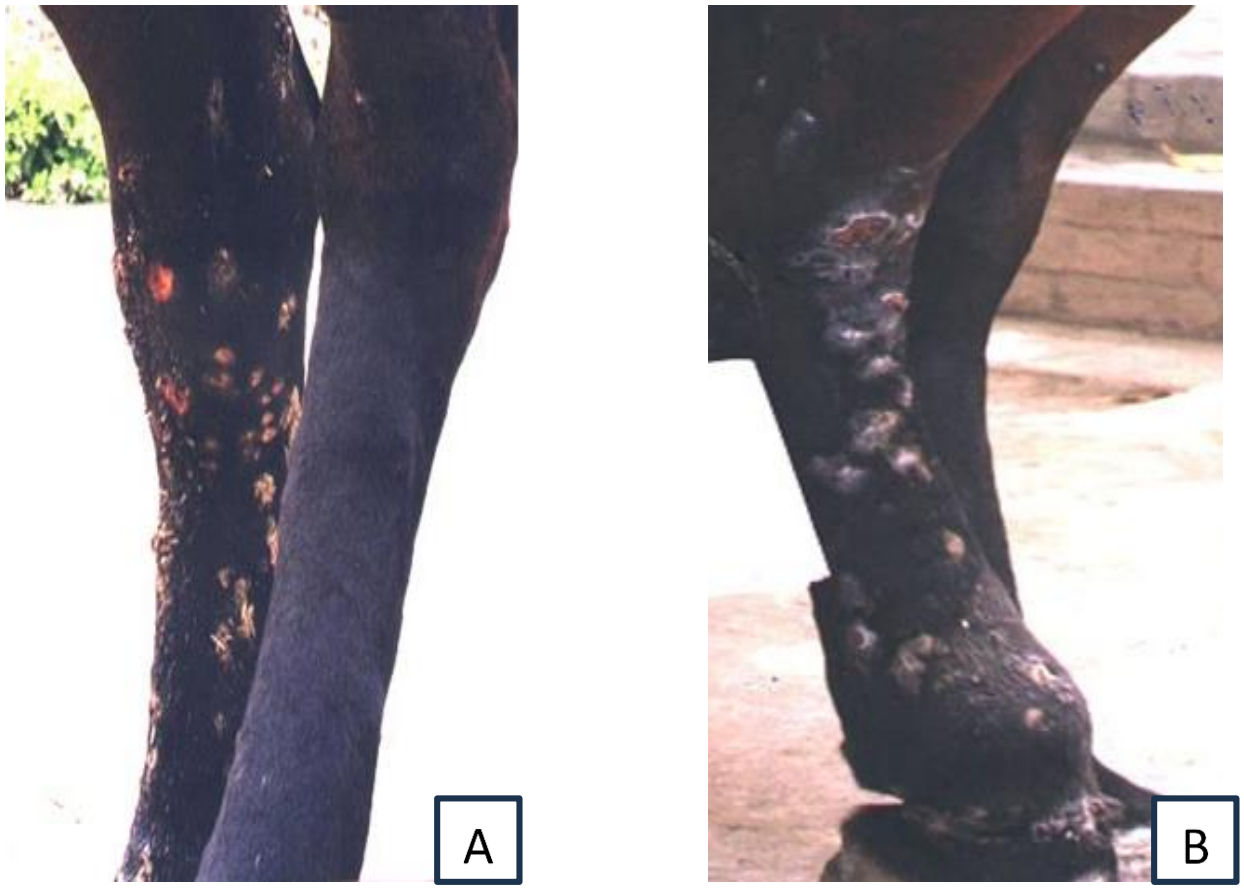

Fig. 1: The images illustrate the impact of an intravenous course of experimental therapy on a horse affected by glanders. In Figure (A), you can see the right hind leg with ulcers prior to treatment, and in Figure (B), the same leg shows signs of improvement with curative ulcers and scarring after completion of the second week of intravenous medication. This demonstrates the positive response to the treatment in addressing the ulcers caused by the glanders infection.

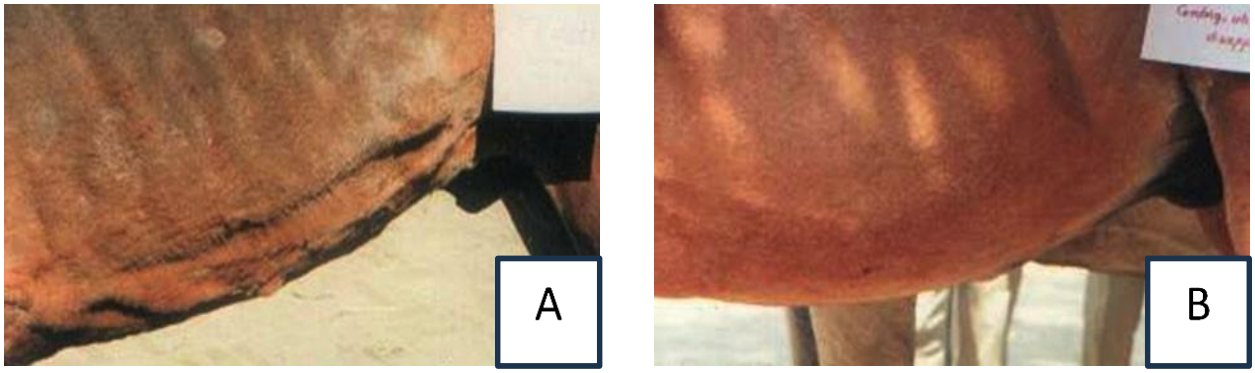

Fig. 2: Shows the results of a glander therapy experiment after six months. Note the horse's (A) deteriorated or shabby body coat and the presence of lymphangitis on the flanks and the medial part of the abdomen. The complete eradication of lesions (lymphangitis) and noticeably better physical condition are seen by the absence of rib demarcation (B).

8.2.2. DIAGNOSTIC TESTING

Animals displaying clinical signs suggestive of glanders undergo diagnostic tests to confirm the presence of the disease.

8.2.3. ASSESSMENT OF APPARENTLY HEALTHY EQUIDS

Equids that appear to be healthy but have been exposed to *Burkholderia mallei* undergo screening tests. Those that test positive in these screenings are removed.

8.2.4. EUTHANASIA

Sick animals and those with positive results in mallein test are compassionately euthanized.

8.2.5. ISOLATION AND RETESTING

Equids that have been exposed to *B. mallei* and initially tested negative in mallein tests are isolated and retested after a waiting period of 2 to 3 weeks.

8.2.6. PROPER DISPOSAL

Carcasses of euthanized animals, as well as any contaminated bedding or feed, should be disposed of in accordance with state regulations, typically through burning or burial.
These measures are critical for containing the spread of glanders and ensuring the protection of both animal and human health (Dvorak and Spickler 2008). *B. mallei* is notably vulnerable to conventional disinfectants, including benzalkonium chloride, iodine, mercuric chloride in alcohol, potassium permanganate, 1% sodium hypochlorite (chlorine bleach), 70% ethanol, and 2% glutaraldehyde. However, phenolic disinfectants are less effective against it. *B. mallei* can also be eradicated by heating it to 55°C for 10 minutes or by exposure to UV light. To ensure containment and prevent further dissemination, strict adherence to isolation, hygiene, and sanitation protocols is crucial. When cleaning contaminated materials, a solution comprising one-part household bleach (0.5 percent sodium hypochlorite) and nine parts water should be used. These measures are essential for controlling the spread of *B. mallei* and maintaining a safe environment (Pal and Gutama 2022).

9. QUARANTINE AND ISOLATION PROCEDURES

The spread of *B. mallei*, especially by asymptomatic carriers during animal importation or exportation, represents a significant transmission route. Therefore, it is imperative to implement infection control measures, ensure accurate screening before importing animals, prevent contact between infected and healthy animals, and advance rapid diagnostic techniques along with appropriate therapeutic interventions. These steps are crucial in managing and mitigating the dissemination of *B. mallei*. (Kianfar et al. 2019).

10. CONCLUSION

In conclusion, this chapter has shed light on the intricate aspects of glanders, an infectious disease caused by *Burkholderia mallei*, affects horses and poses a zoonotic threat to humans. We explored the historical

context of glanders, their transmission, clinical signs and symptoms, diagnosis, treatment, and prevention. Notably, while it was once used as a biological weapon, there is hope in modern medicine, as recent research suggests that antibiotic therapy can successfully treat equine glanders. Nevertheless, the disease remains a significant concern, both for animal and human health, with the need for stringent prevention measures, diagnostic accuracy and effective treatments. The history and current understanding of glanders serve as a reminder of the ongoing importance of vigilant surveillance and international cooperation in managing infectious diseases, whether natural outbreaks or potential bioterrorism threats.

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