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Dr. S Kalavathi

Assistant Director, VBRI,
Vijayawada, Andhra Pradesh,
India

Dr. G Sireesha

Assistant Director, VBRI,
Vijayawada, Andhra Pradesh,
India

Dr. G Deepika Kumari

Associate Professor, College of
Veterinary Science, Garividi,
Andhra Pradesh, India

Dr. B Chandramouli Naik

Joint Director, VBRI,
Vijayawada, Andhra Pradesh,
India

Dr. T Damodar Naidu

Director of Animal Husbandry
Department, Vijayawada,
Andhra Pradesh, India

Corresponding Author:

Dr. S Kalavathi

Assistant Director, VBRI,
Vijayawada, Andhra Pradesh,
India

Vaccination for brucellosis control: Strengthening livestock health and veterinarians' safety

**Dr. S Kalavathi, Dr. G Sireesha, Dr. G Deepika Kumari, Dr. B
Chandramouli Naik and Dr. T Damodar Naidu**

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Abstract

Brucellosis is a contagious bacterial disease that affects livestock such as cattle, sheep, and goats and can also spread to humans. It causes reproductive problems in animals, including abortion, infertility, and reduced milk production, leading to major economic losses for farmers. Vaccination is one of the most effective methods to control brucellosis in livestock and reduce its spread. Vaccines such as S19, RB51, and Rev.1 help protect animals from infection and decrease the risk of transmission to humans. Veterinarians and livestock workers are at higher risk of exposure because they frequently handle infected animals and biological materials. Therefore, proper vaccination programs along with safety measures are important to protect both animal health and veterinary professionals. Strengthening vaccination strategies and awareness among farmers and veterinarians can play a key role in controlling brucellosis and improving public health.

Keywords: Brucellosis, bacterial disease, livestock disease

Introduction

Brucella species are important zoonotic pathogens infecting a wide range of animals (Shome *et al.*, 2020). Those affecting domestic livestock are *Brucella abortus* in bovines, camels, and yaks, *Brucella melitensis* in caprines and ovines, *Brucella ovis* in rams, *Brucella suis* in swine and reindeer. All these species except *B. ovis* are known to infect humans^[1]. The disease leads to reproductive disorders such as abortion, infertility, reduced milk production, and weak offspring, resulting in major economic losses to the livestock sector. Furthermore, brucellosis is transmissible to humans, making it a serious occupational hazard for veterinarians, farmers, and animal handlers^[2].

Brucellosis is one of the most important zoonotic diseases affecting livestock and humans worldwide. The disease is caused by bacteria of the genus *Brucella*, which are facultative intracellular pathogens capable of persisting within host cells and establishing chronic infections. Because of this ability, the disease is difficult to eliminate once it becomes established in animal populations. Brucellosis remains a major concern in many developing countries where livestock farming forms an essential component of rural livelihoods and food security.

Given the persistent nature of the organism and its ability to spread silently within animal populations, control of brucellosis requires coordinated and sustained intervention strategies. Among the various control measures available, vaccination has emerged as one of the most practical and effective approaches for reducing disease prevalence in endemic regions. Vaccination not only protects susceptible animals but also helps in lowering bacterial circulation within herds, thereby reducing the risk of transmission to other animals and humans. Consequently, strengthening vaccination programs plays a crucial role in long-term brucellosis control and in safeguarding both animal productivity and public health.

Epidemiology of Brucellosis

Brucellosis occurs worldwide but is more common in developing countries where livestock

vaccination and disease control programs are limited. The most important species affecting livestock are *Brucella abortus* in cattle, *Brucella melitensis* in sheep and goats, and *Brucella suis* in pigs. Among these, *B. melitensis* is considered the most pathogenic for humans. The disease spreads through contact with infected animals, aborted fetuses, placentas, and reproductive discharges^[3].

Impact on Livestock Health

Brucellosis primarily affects the reproductive organs of animals. In infected female animals, the disease often causes abortion during the last trimester of pregnancy. Other symptoms include retained placenta, birth of weak offspring, and decreased fertility. In males, the infection may cause orchitis and infertility. The disease also reduces milk production and overall productivity of animals. These reproductive failures result in substantial economic losses due to reduced productivity, increased veterinary costs, and decreased herd fertility. Because treatment in animals is difficult and costly, prevention is the most practical method of control^[4].

Impact on Human health

Brucellosis also poses a significant public health concern, as humans can become infected through occupational exposure or through consumption of contaminated animal products. Among the occupational groups exposed to this infection, veterinarians represent one of the highest-risk categories due to their close and frequent contact with infected animals and biological materials.

Occupational Risk for Veterinarians

Soto *et al.*, 2024 stated that *Brucella* vaccine strains causes occupational infections sub clinically^[5]. Veterinarians are a high-risk occupational group for brucellosis due to frequent contact with infected animals during handling and treatment of animals. Exposure can occur through direct contact with infected animals or reproductive materials (placenta, fetuses, uterine discharges), handling contaminated milk, blood, or semen, Inhalation of aerosols during animal handling or laboratory work, Brucellosis symptoms in humans are often non-specific. Usually intermittent or undulating fever, fatigue and weakness, headache, muscle and joint pain (especially back and large joints), night sweats, loss of appetite and weight loss are seen. In women, brucellosis may also be associated with menstrual irregularities, pelvic pain, complications during pregnancy (such as miscarriage, though this is less common). If untreated, the disease may become chronic and affect multiple organs^[6] leading to prolonged illness and complications.

Control of Brucellosis

Given the persistent nature of the organism and its ability to spread silently within animal populations, control of brucellosis requires coordinated and sustained intervention strategies. It requires a combination of management, surveillance, and biosecurity measures aimed at reducing transmission within livestock populations. Important control measures include regular surveillance and testing of animals, removing positive animals, proper disposal of aborted foetuses, placentas, and contaminated materials, maintaining good farm hygiene, and preventing contact between infected and healthy animals. Movement control of livestock, quarantine of newly introduced animals, and awareness among farmers, veterinarians, and animal handlers about safe

handling of animals and animal products are also essential for limiting the spread of the disease. Consumption of pasteurized milk and dairy products further reduces the risk of transmission to humans.

In many developing countries, including India, the test-and-slaughter policy is often not economically or socially feasible due to the large livestock population and associated compensation challenges. Therefore, vaccination of susceptible animals becomes the most practical and effective strategy for controlling the disease.

Importance of Vaccination

Vaccination is one of the most effective strategies for controlling brucellosis in livestock populations. It helps reduce the number of infected animals and prevents the spread of the disease within herds. Vaccination also plays a key role in protecting human health by reducing the risk of zoonotic transmission. In many countries, large-scale vaccination programs have significantly decreased the prevalence of brucellosis in livestock^[4].

Types of Vaccines Used for Brucellosis

S19 Vaccine

The S19 vaccine is a live attenuated vaccine used mainly for the prevention of *Brucella abortus* infection in cattle. It is usually administered to female calves between 4 and 8 months of age. The vaccine has been widely used for many years and provides good immunity against the disease.

RB51 Vaccine

RB51 is another live attenuated vaccine used in cattle. It is considered safer than the S19 vaccine because it does not interfere with some diagnostic tests used for brucellosis surveillance.

Rev.1 Vaccine

Rev.1 vaccine is primarily used for the prevention of *Brucella melitensis* infection in sheep and goats. It is highly effective in reducing abortion rates and controlling the disease in small ruminants.

Brucella vaccines may pose an occupational risk of infection to humans during their production, handling, and administration to livestock. The risk of exposure is generally higher during the production and laboratory handling of vaccine strains than during field administration to animals. Although such infections are relatively rare and morbidity is generally low, with no deaths reported, appropriate precautions should still be taken to prevent accidental exposure. Therefore, it is important to recognize the potential risk posed by occupational exposure to vaccine strains and to implement suitable preventive measures to minimize this risk. In view of these risks, veterinarians and animal health workers should follow appropriate biosafety precautions while handling and administering brucellosis vaccines.

Accidental Exposure Risks During Brucellosis Vaccination

During vaccination procedures, veterinarians and animal health workers may face accidental exposure to vaccine strains if proper precautions are not followed. Such exposure can occur during routine steps such as expelling air bubbles from the syringe or due to accidental needle-stick injuries while administering the vaccine. Brucellosis vaccines contain viable organisms, and therefore accidental exposure, though rare, may pose an occupational risk.

While expelling air bubbles from the syringe before vaccination, a small quantity of vaccine may be released along with the air. These tiny droplets can fall on exposed areas of the face or skin, particularly the eyes, nose, or mouth, if the syringe is directed towards the body. To prevent such exposure, the syringe should always be pointed away from the face and body while removing air bubbles, and this step should preferably be performed at arm's length while directing the needle downward. - Wearing personal protective equipment such as gloves, masks, and protective goggles can further reduce the risk of accidental contact.

Another important hazard is accidental needle-stick injury during vaccination. Such injuries may occur while handling restless animals, during injection, or while recapping or disposing of needles. In case of self-inoculation, the vaccine strain may be introduced directly into the body, creating a potential risk of infection. - Ensuring proper restraint of animals, avoiding recapping of needles after use, and disposing of used syringes along with needles immediately in puncture-proof sharps containers are important preventive measures.

In the event of accidental exposure or needle-stick injury, the affected area should be washed immediately and medical advice should be sought. Although infections from vaccine strains are uncommon, adherence to these precautionary measures is essential to minimize occupational risks during brucellosis vaccination programs.

Challenges in Brucellosis Vaccination Programs

Although vaccination is effective, several challenges limit its success:

1. Limited awareness among farmers and veterinarians
2. Incomplete vaccination coverage in endemic regions
3. Diagnostic interference with some vaccines- Live attenuated vaccines such as *Brucella abortus* S19 vaccine can induce antibodies that are similar to those produced during natural infection. As a result, commonly used serological tests may not easily differentiate between vaccinated and infected animals, which can complicate disease surveillance and control programs.
4. Perception of vaccine strain infection in humans also contributes to hesitancy in vaccine use. Although infections in humans from vaccine strains are rare, concerns about accidental exposure during vaccine handling or administration may discourage some veterinarians and animal handlers from recommending or implementing vaccination.

Weak surveillance and reporting systems

Studies in India show that only a few veterinarians actively recommend vaccination, indicating a need for better awareness and training.^[7]

Addressing these challenges through better awareness, improved veterinary training, strengthened surveillance systems, and expanded vaccination coverage is essential for the effective control of brucellosis and reduction of its impact on livestock productivity and public health.

Strategies to Strengthen Vaccination Programs

To enhance the effectiveness of brucellosis control programs, the following strategies are recommended:

- Strict mass vaccination campaigns for livestock- This helps build herd immunity and reduce the spread of the *Brucella* infection.
- Increase awareness among farmers and veterinary

professionals - Educating farmers and vets about it's the transmission, symptoms, and zoonotic risks are essential. Awareness encourages early reporting of suspected cases, regular testing, and active participation in vaccination programs.

- Training programs promote good farm practices, such as proper hygiene, safe handling of animals, and appropriate disposal of infected materials
- Strengthen surveillance and diagnostic facilities
- Promote biosecurity and hygiene practices on farms- Biosecurity measures help prevent the introduction and spread of infections. These include controlling animal movement, isolating sick or new animals, maintaining clean housing and equipment, ensuring safe water supply, and properly disposing of animal waste and infected materials
- Ensuring deworming before vaccination for better immunity
- Maintain Cold Chain and proper logistics- Proper storage and transportation conditions are necessary to maintain vaccine potency and ensure effective immunization
- Integrate One Health approaches linking animal and human health sectors- Collaboration among veterinarians, medical professionals, public health authorities, and environmental experts is important. Data sharing and joint surveillance systems can facilitate early detection of outbreaks in both animals and humans, thereby improving disease control.

Conclusion

Brucellosis remains a major zoonotic disease affecting livestock productivity and human health. Vaccination plays a crucial role in controlling the disease by reducing infection rates in animals and preventing transmission to humans. Effective vaccination programs not only safeguard livestock health but also protect veterinarians and other professionals from occupational exposure. Strengthening vaccination coverage, improving awareness, and implementing integrated control strategies are essential for the long-term management and eventual eradication of brucellosis.

Conflict of Interest

Not available.

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