Trichomoniasis in the bull: a review
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Abstract
Trichomoniasis is a venereal disease of cattle of great economic impact on the cattle industry. The infected bull is the major vector for the causative organism *Tritrichomonas foetus*. An infected bull will be asymptomatic and may become infected for life after exposure. The organism is spread to the cow herd via coitus and the cow suffers the identifiable consequences of reproductive failure. There is currently no treatment for trichomoniasis in the United States. This paper will review trichomoniasis and the sexually active breeding bull including disease history, parasite morphology and life cycle, pathogenesis, prevalence, diagnostic techniques, and prevention and control strategies.

Keywords: Trichomoniasis, *Tritrichomonas foetus*, bovine, bull

Introduction
Trichomoniasis is a true venereal disease of cattle caused by the extracellular, flagellated protozoan *Tritrichomonas foetus*. Infected bulls efficiently transmit the organism to a female during coitus despite the fact they are asymptomatic carriers of *Tritrichomonas foetus*. Infected females may develop vaginitis, cervicitis, or endometritis and can exhibit infertility, embryonic death, abortion, fetal maceration or pyometra. Trichomoniasis seriously impairs the reproductive efficiency of natural service operations imposing a costly impact on the cattle industry. Preventive management is the focus of disease management because no legal form of treatment exists in the United States (U.S.).

The following review of the literature on trichomoniasis most specifically pertains to the breeding bull. This compilation will review disease history, parasite morphology and life cycle, pathogenesis, prevalence, diagnostic techniques, and prevention and control strategies.

History
The venereal protozoan *T. foetus* is thought to have been originally described in France in 1888. Unfortunately, the discovery of this organism coincided with the discovery of brucellosis in 1897. Little interest was given to *Tritrichomonas foetus* until the 1920’s when the Germans resumed research. In 1932, Emerson described the first case of trichomoniasis in the U. S. in the state of Pennsylvania. Since that time, trichomoniasis has been reported throughout the U. S. and around the world. Currently, the importance of this disease has initiated regulations for interstate, and often intrastate, movement of bulls for majority of the continental U. S.

Morphology and life cycle
*Tritrichomonas* means “three-haired single-celled protozoan”, which accurately depicts some of the morphological characteristics of the organism as described by Taylor et al. *Tritrichomonas foetus* is a pyriform-shaped protozoan with a rounded anterior end and a pointed posterior end. Its size can vary from 10 to 25 µm in length and 5 to 10 µm in width. *Tritrichomonas foetus* has a single nucleus and four flagella. Three of the flagella are located on the anterior end, while the fourth extends backwards as an extension of the undulating membrane. The undulating membrane is located on one side of the organism and has three to five waves, giving the organism a characteristic vibrating movement. This motile life stage is referred to as a trophozoite. Trophozoites undergo asexual reproduction by linear binary fission.

Trichomonads are described as having the ability to exhibit trophozoite, cyst, and pseudocyst stages across individual species. The term cyst describes an invagination of external organelles to form a compact, round, non-motile life stage with a change in the exterior integrity of the cell plasma membrane to act as a protective barrier. The pseudocyst stage exhibits invagination of external organelles but does not change the composition of the plasma membrane, thus the “pseudo” designation.
Invaginated forms are often considered to be a degenerative life form in response to a stressful environment. However, *Trichomonas foetus* exhibits pseudocyst formation and reversal to trophozoite formation when favorable conditions return.¹¹ *Trichomonas foetus* also has the ability to undergo reproduction by multiple binary fission, a budding or “shizongony-like” division, while in this pseudocystic stage.¹² A recent report indicates that this pseudocyst form actually appears more commonly than the trophozoite stage in preputial secretions from naturally infected bulls.¹³ The exact role of the pseudocyst form for *Trichomonas foetus* remains unclear at this time, but the fecundity of this life stage leads many to believe it may be a part of the normal life cycle.

**Pathogenesis**

*Trichomonas foetus* is an obligate, extracellular parasite of the bovine reproductive tract and prefers a microaerophilic to anaerobic environment. The preputial cavity of the bull provides an ideal environment where it localizes in the smegma or secretions of the epithelial lining of a bull’s penis and prepuce, and may invade the external urethral orifice.¹⁴ The organism does not invade the epithelium¹⁵ nor typically invoke an effective immune response in the bull.¹⁵,¹⁶ *Trichomonas foetus* causes no penile or preputial pathology and does not affect semen quality or libido.¹⁵,¹⁷ Therefore, an infected bull acts only as an asymptomatic carrier. Disease transmission occurs when an infected bull breeds a non-infected cow, or a non-infected bull breeds an infected female.

The period for which a bull remains infected is a subject of much debate. Transient infections and a chronic carrier state are two popular theories regarding length of infection. The carrier state is apparently related to the depth of the preputial and penile epithelial crypts. Traditional thought is that older bulls have deeper epithelial crypts which provide the appropriate microaerophilic environment required for establishment of chronic infections.¹⁵,¹⁸-²⁰ However, a recent study of the histology of the penile and preputial epidermal surface of the bull argues against the existence of preputial crypts and suggests no difference in the depth of preputial skin folds between young and mature bulls.²¹ The chronic carrier state associated with many *Trichomonas foetus* infections in bulls rarely clears regardless of time. Details regarding the complete pathology of chronic infection within the mature bull remain unknown.

*Trichomonas foetus* infections in bulls less than three to four years of age are more likely to be transient. Younger bulls may only transmit disease if sexual contact with a non-infected cow occurs within minutes to days following breeding of an infected cow.¹⁵ Some studies indicate that clearance in a young bull is possible within minutes after breeding an infected cow.²²,²³ Therefore, transmission of *T. foetus* by a young bull is more a passive, mechanical transmission, as compared to transmission associated with a chronically infected older bull. However, any bull exposed to *T. foetus* in a natural breeding situation is capable of becoming chronically infected, regardless of age.

**Prevalence**

The prevalence of trichomoniasis has been estimated for different areas of North America and other regions of the world. In 1964 a 7.5 % prevalence was reported in western range bulls.²⁴ More recent studies from Florida,²⁵ Oklahoma,²⁶ and California²⁷ found prevalence rates of 7.3, 7.8 and 4.1 %, respectively. An epidemiological survey in Florida between 1997 and 1999 found a 6% prevalence of *T. foetus* infected bulls.²⁸ A 6 % prevalence rate was reported for bulls in Saskatchewan, Canada.²⁹ In the North Western Cape Province, Western Transvaal, and the Orange Free State in South Africa a prevalence of 7% was determined.³⁰ All reports are considered to be estimates because some surveys sampled bulls from sale barns or abattoirs and others sampled bulls from randomly selected natural service beef herds.
Diagnostic technique

Sampling technique

Sampling a bull for trichomoniasis involves attempting to recover organisms from the preputial cavity and transporting the sample to a laboratory for positive identification of organisms. Sampling techniques utilized for obtaining diagnostic specimens in the bull include: 1) a swab technique; 2) a dry pipette technique; 3) a wet pipette technique; and 4) the douche technique. The dry pipette technique is one of the most common sampling methods in the U.S., while the douche method is the preferred technique in Europe. Regardless of technique used, it is generally recommended that bulls be sexually rested one to two weeks before testing. Because breeding mechanically removes many of the organisms from a bull’s penis and prepuce, sexual rest may allow for organismal replication and allow for a greater chance of recovery during sampling. Samples can be submitted for microscopic evaluation or molecular-based evaluation.

Sample analysis

Direct microscopic examination of specimens for *Tritrichomonas foetus* can be diagnostic, but a far more sensitive method for the detection of *T. foetus* is *in vitro* culture of preputial smegma in a selective nutrient medium for up to one week. *In vitro* culture allows the proliferation of *T. foetus* to more readily detectable levels. All cultures containing organisms resembling *T. foetus* should be confirmed with appropriate molecular-based assays to avoid false-positive results due to fecal trichomonad contamination of culture media. *In vitro* cultivation using either Diamond’s medium or the InPouch™ TF is currently the most common method used to diagnose *T. foetus* in the U.S.

Alternatively, samples may be submitted directly for molecular-based evaluation. At present, polymerase chain reaction (PCR) is the test of choice for molecular based testing. Improved methods have allowed PCR to become an important diagnostic tool for trichomoniasis. In contrast to *in vitro* culture, PCR can be performed in a matter of hours offering a more rapid test result.

A single sample evaluated with either technique may yield inconclusive results, as false negatives are common. Sensitivity and specificity of both culture and PCR are maximized with sequential testing, sampling the bull at weekly intervals and repeating the same test. Positive bulls are more accurately identified when samples are tested in parallel, performing cultures and confirming with PCR on a single sample. To maximize sampling technique, personal recommendation is to submit three samples at one week intervals for parallel testing. A bull should not be considered negative until three negative test results have been achieved.

Prevention and control strategies

Historically, the most successful treatment for bulls with trichomoniasis utilized systemic treatment with nitromidazole derivatives. However, the use of nitromidazole derivatives is now illegal in food-producing animals in the U.S. because of their mutagenic and carcinogenic properties, and no alternative treatments exist. Therefore, bovine trichomoniasis must be prevented or controlled.

Prevention

Recommendations to avoid introducing trichomoniasis into a herd include:

1. Avoid grazing cattle on public lands to reduce exposure through coitus with other *T. foetus* infected animals.
2. Utilize artificial insemination when possible.
3. Use a 60-90 day breeding season. Cull all cows and heifers that are not pregnant after the breeding season. A long breeding season not only allows propagation of *T. foetus*, but may also hide production losses due to reduced weaning weights because of delayed conception.
4. Control animal movement into a herd by maintaining good fences.
5. Purchase virgin bulls and heifers as replacements. Buying older bulls and cows as replacements greatly increases the chance of purchasing a *Tritrichomonas foetus*-infected animal.
6. Test all bulls for *T. foetus* at least once before introducing them into a new herd.\(^{15}\) The test should be performed after two weeks of sexual rest. Ideally, a bull should have three negative tests at weekly intervals.

7. Maintain as young a bull battery as possible. Older bulls are much more likely to be chronically infected with *T. foetus*.\(^{14,46}\)

8. Breed purchased cows and heifers in a separate herd. Cull all the cows and heifers that are not pregnant after the breeding season. Ideally, continue to keep the pregnant animals segregated from the rest of the herd through the next breeding season.\(^{33}\)

**Control**

Recommendations for control of trichomoniasis in an infected herd include:

1. Test and cull all infected bulls. Infected bulls should be sold for slaughter only.

2. Decrease the number of bulls per breeding unit. Single-sire herds offer the lowest exposure potential. However, single-sire units may not always be practical.

3. Reduce the average age of the bull herd.

4. Only purchase bulls from herds known to be free of *T. foetus*. All purchased bulls must pass a breeding soundness evaluation and have at least one negative *T. foetus* culture before being allowed into the herd. The test should be performed after two weeks of sexual rest. Ideally, three negative test results at weekly intervals would be obtained.

5. Utilize artificial insemination when possible.\(^{15}\)

6. Reduce the breeding season to 90-120 days. Pregnancy exams should be performed 45-60 days after the breeding season. Open cows and heifers should be culled. If there are too many open cows for culling to be economically feasible, then these animals should at least be separated into a high-risk herd.

7. Culture all pyometras diagnosed in cows or heifers during pregnancy examinations.

8. Submit all aborted fetuses and placental tissue to a diagnostic laboratory.

9. Vaccinate all breeding age females against trichomoniasis. Vaccination does not offer complete protection, but it does reduce the duration of infection therefore mitigating the reproductive wastage caused by *T. foetus*.\(^{47-50}\)

**References**


