



## Microbial diseases of the genital system of rams or bucks



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### ABSTRACT

Objective of the present paper is to review microbial diseases of the genital system of male small ruminants. The paper reviews the infections and the diseases by taking an organ approach within the genital system, whilst relevant health management actions are also discussed. Diseases of the genital organs of male small ruminants include orchitis, of bacterial or viral aetiology, epididymitis, primarily caused by *Brucella ovis*, by other bacteria as well (e.g., *Actinobacillus seminis*, *Haemophilus somni*), infections of the accessory glands, orf, other infections of the penis or prepuce and infections of the scrotum. The health management of rams/bucks include the appropriate diagnostic investigations, the relevant therapeutic approaches and, finally, the preventive measures.

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### 1. Introduction

Worldwide, there are fewer scientific publications about rams or bucks than about ewes or does. Hence, it could be assumed that male small ruminants have been scientifically 'neglected', although 50% of breeding success depends on their reproductive soundness. However, reproductive disorders of rams and bucks, many of which are caused by microbial agents, can have a tremendous impact in small ruminant farms, adversely affecting their financial performance, leading to potential transmission of infectious agents and decreasing animal welfare (Scott et al., 2007). Many pathogenic agents may affect the genital system of male small ruminants, with implications to their health and welfare. Objective of the present paper is to review microbial diseases of the genital system of male small ruminants. The paper presents the infections and the diseases by taking an organ approach within the genital system, whilst relevant health management actions are also discussed.

### 2. Methodology

The review includes references published in journals cited at the Web of Knowledge database ([wok.mimas.ac.uk](http://wok.mimas.ac.uk)); papers published in these journals have been refereed. Various search terms have been employed to identify relevant publications (e.g., 'sheep', 'goat\*', 'ram', 'buck', 'orchitis', 'epididymitis' 'semen', 'brucella', 'trueperella'). Subsequently, the full papers have been retrieved

through the websites of the respective journals. Moreover, reference to book chapters has been made occasionally.

### 3. Orchitis

Orchitis may range from a mild infection of the affected testis through to extensive suppuration or necrotic destruction of the organ and can be the result of an ascending infection, of haematogenous microbial spread or of direct microbial penetration into the organ. Often, it can develop in association with epididymitis or superimpose on pre-existing traumatic, viral or parasitic damage (Parkinson, 2009). Bacterial isolates from cases of ovine/caprine orchitis include *Brucella* spp. strains, specific pyogenic organisms (e.g., *Trueperella pyogenes* or *Corynebacterium pseudotuberculosis*) or various non-specific bacteria. Viruses have also been reported to affect the testes of rams/bucks.

#### 3.1. Orchitis associated with *Brucella* spp.

*Brucella ovis* is the most significant pathogen of the genital system of male small ruminants, with a worldwide distribution. It has a predilection for their genitalia and causes various problems (mainly epididymitis), which lead to reproductive failure. Carvalho Junior et al. (2012) have studied the effects of intra-preputial or intra-conjunctival challenge of rams with *B. ovis* and reported that testicular degeneration was consequent. Paolicchi et al. (2000) found that rams with genital lesions caused by *B. ovis* had developed a long-standing anti-sperm immune reaction, which might be responsible for the subfertility present in such animals.

Infection with *Brucella melitensis* is of particular importance in small ruminants, as it results in reproductive failure (Blasco and

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Molina-Flores, 2011). The pathogen has a predilection for the genital system of ewes/does, but can also infect rams/bucks as well. In male animals, infection can often be followed by orchitis, frequently present unilaterally (Radostits et al., 2007). Chand et al. (2002) have reported testicular enlargement, with thickened capsule and presence of adhesions with the *Tunica vaginalis* in the affected rams and evidence of necrotic material under the capsule. Histological examination can reveal diffuse infiltration of inflammatory cells into the tubular epithelium, thickening of the tubular walls, presence of purulent exudates in the lumen and fibrosis of the interstitial tissue (Chand et al., 2002).

### 3.2. Orchitis associated with *Trueperella pyogenes*

*T. pyogenes* (formerly *Arcanobacterium pyogenes*, formerly *Actinomyces pyogenes*) is a widely distributed organism, which colonises mucous membranes of domestic animals. It has been frequently associated with the genital tract (Tzora et al., 2002; Jost and Billington, 2004; Gouletsou et al., 2006). Infection can frequently occur following a precipitating injury or can superimpose on another infection. This bacterium is a commonly opportunistic pathogen in domestic ruminants and may cause severe, clinical orchitis/epididymitis. During the acute stage, enlargement, heat, pain and swelling of the affected testis and epididymis are evident, while in the long-standing stage reduced testicular size, mobility and induration of testicular tissue predominate. Inflammation of the affected testis can result in sub-normal fertility, with ejaculates containing leucocytes, immature germ cells and only a few normal sperms (Gouletsou et al., 2004). Histologically, diffuse neutrophilic infiltration and extravasation, interluminal presence of leucocytes, degeneration of seminiferous tubules and destruction of Leydig's cells can be observed. Similar findings have been described during naturally occurring (Gouletsou et al., 2006) or experimentally induced (Gouletsou et al., 2004) cases of the disease. Animals with unilateral disease maintain some degree of (substantially reduced) fertility. During the long-standing stages of the disorder, fertility can be restored to some extent (Gouletsou et al., 2004).

### 3.3. Orchitis associated with other bacteria

*Actinobacillus seminis* has been isolated from cases of ovine/caprine orchitis (Watt et al., 1980; Heath et al., 1991; de la Puente-Redondo et al., 2000). Adhesions, atrophy and necrotic abscesses of the testis were the main findings. Histological examination revealed diffuse peri-orchitis, intra-testicular abscess formation, epithelial cell vacuolation, interstitial fibrosis, tubular atrophy, sperm stasis and spermatid granulomas in the affected testis. Garcia-Pastor et al. (2009) have identified cases of orchitis caused by *Mannheimia haemolytica*, *Bibersteinia trehalosi* or *Pasteurella multocida*. Salient findings included testicular atrophy, testis-tunica adhesions, intra-testicular abscesses and fibrosis, which, usually, occurred unilaterally. *C. pseudotuberculosis* can also possibly lead to formation of intra-testicular abscesses, testicular degeneration and marked fibrosis (Watt, 1978).

### 3.4. Orchitis associated with viruses

Viruses can also be causal agents of testicular disease. *Sheep Pox Virus* or *Goat Pox Virus* infection can lead to nodular orchitis, with presence of pale, discrete subcapsular foci evident on the surface of testes (Merza and Mushi, 1990). Small ruminant lentiviruses can cause long-standing interstitial orchitis (but not epididymitis) in rams; in the interstitium of the testes, infiltration by lymphocytes, histiocytes and plasma cells can be seen; the infiltration is mainly perivascular and of varying severity and accompanied by fibrosis;

the seminiferous tubules neighbouring the more severely affected parts are atrophic, hence, spermatogenetic alterations are evident in circumscribed areas of the affected organ (Foster and Ladds, 2007). Finally, *Bluetongue Virus* has been isolated from the semen of rams infected with the disease, although no specific lesions present in their testes have been described (Leemans et al., 2012). Burstel et al. (2009) reported that up to three months after infection with the virus, rams produced semen ejaculates of significantly reduced quality, which, nevertheless, later, after another three months, had been significantly improved.

## 4. Epididymitis

Epididymitis is of particular importance in rams/bucks as a serious cause of subfertility. The disease can develop as a separate clinical entity caused by organisms specifically affecting the epididymis; alternatively, lesions in the epididymis can be the sequelae of orchitis in the ipsilateral testis. Walker et al. (1986) has indicated that some organisms usually affected the organ in sexually-active adult rams/bucks, whilst different ones affected the organ in pre-pubertal animals, and suggested the existence of two different disease entities, depending on the reproductive age of the animals.

### 4.1. Epididymitis associated with *Brucella ovis*

The organism most often associated with epididymitis is *B. ovis*, which is prevalent worldwide (Songer and Post, 2005). It is a gram-negative, strictly aerobic, non-motile, coccobacillus, facultative intracellular parasite, not known to pursue an independent lifestyle. The organism can survive and multiply within phagocytic cells and reticuloendothelial tissue; persistence within host cells is significant for evolution of the granulomatous reaction (Olsen et al., 2004). No classical virulence factors, e.g., exotoxins, exoenzymes, cytolysins, fimbriae, flagella, capsules or apoptosis inducers, have been described for the organism. Hence, it appears that their true virulence is in their ability to invade, survive and multiply within the host's cells (Olsen et al., 2004).

The pathogen is usually introduced into a flock/herd by the purchase of infected male animals. Thereafter, other males in the farm become infected through direct contact with infected ones (e.g., homosexual behaviours of rams/bucks, sniffing or licking another male's urine or prepuce) or during the mating season, after mounting females that had previously been mated by infected animals (Bulgin, 1990; Ridler and West, 2011). It is noteworthy that rams as young as four- to six-month old have been found to be infected (Burgess, 1982; Bulgin, 1990), which should be taken into account during the implementation of control programs for the disease.

Following penetration of mucosal epithelium, the bacteria progress slowly, free or within phagocytic cells, to regional lymph nodes, which become enlarged due to lymphatic and reticuloendothelial hyperplasia and inflammation. Then, bacteraemia, which can last up to two months, occurs and is followed by localisation of the organism in various organs, including the genitalia. These changes may require several weeks to develop and may persist for many months with simultaneous long-standing shedding of the organism in semen (Ridler et al., 2006, 2014). Genital lesions can occur as early as two weeks after infection, but usually later than that. They involve more often the epididymal tail and have a varying severity: from mild enlargement of an epididymis to severe and extensive induration of both epididymides; detailed epididymal lesions include oedema, infiltration of peritubular tissue by lymphocytes and monocytes, neutrophilic infiltration, with epithelial hyperplasia, intraepithelial lumina, hydropic degeneration and progressive fibrosis in interstitial areas epithel

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