

Semen characteristics of goats with subacute, acute and chronic besnoitiosis

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ABSTRACT

A study on the semen obtained from breeding goats suffering from mild to severe chronic besnoitiosis revealed marked changes in semen volume, colour, density, concentration, mass and individual motility and percentage live. There were also many neutrophils and spermatozoa with primary and secondary defects, including missing tails and deformed heads and tails. The observed changes were considered to be severe enough to account for the infertility observed in the flock. Sections of testes obtained for histopathology were characterised by massive blockage of the pampiniform plexus, degeneration of the germinal epithelium, tubular necrosis with an inflammatory infiltrate and, in some cases, accumulation of haemosiderin-like material in the tunica vaginalis.

Key words: besnoitiosis, caprine, orchitis, semen quality.

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INTRODUCTION

Caprine besnoitiosis, which mainly affects the integumentary and reproductive systems, is an economically important disease in Iran¹ and Kenya^{2,3,4}. The infertility associated with besnoitiosis is due to blockage of the veins and arteries in the pampiniform plexus by *Besnoitia* cysts, leading to degeneration of the germinal epithelium, and aspermia^{1–4}. All these reports were based on *post mortem* findings. The present report documents a study of breeding bucks in a flock of goats on a state-owned sheep and goat breeding and distribution station with a history of infertility, abortions and neonatal death.

HISTORY

The Kiburine and Marimanti Sheep and Goat Breeding Stations, situated 250 km north of Nairobi, were established to oversee the production and distribution of high-quality breeding Galla bucks and

does to livestock producers in the arid and semiarid areas of Kenya through the Embu, Meru and Isiolo (EMI) Development Programme. An increase in infertility, abortions and neonatal deaths was first noticed on the stations in 1989. By 1993 the return-to-service rates were between 50 and 70 %, while abortions and pre-weaning mortality ranged from 20 to 30 %. From available records, cattle held at the Kiburine breeding station were not affected. Members of the veterinary Faculty of the University of Nairobi were invited to the stations to establish the possible causes of the poor reproductive efficiency in the goat flocks.

MATERIALS AND METHODS

The goat flocks were examined clinically on-station. Bucks with evidence of orchitis were palpated and body temperatures recorded. Semen from 11 bucks with obvious signs of varying degrees of orchitis was collected in graduated insulated glass tubes by electroejaculation using an ITT-cannon and Pulsator 11 (Lane Manufacturing, Denver, Colorado). The method described by Smith⁵ and Roberts⁶ was adopted for semen evaluation for volume, consistency, colour, estimated density, concentration, wave motion or swirl, individual percentage motility, percentage live, pH, defects and

presence of other cells.

Ten bucks, 9 with chronic and 1 with acute orchitis, were donated to the Large Animal Clinic of the Clinical Studies Department, University of Nairobi, for further investigations. After a thorough clinical examination, semen was collected by electroejaculation.

Three bucks, 2 with chronic and 1 with acute orchitis, were sacrificed and necropsies were performed. Samples taken from the testes and scrotal skin were routinely prepared for histopathological examination.

RESULTS

Clinical findings

Bucks with acute orchitis, characterised by swollen testes, would not allow palpation, were reluctant to move and had a temperature of 41.8 °C. Bucks afflicted with subacute and chronic orchitis had atrophied testes that were firm on palpation, and normal body temperature.

Chronically affected does and bucks showed classical signs of chronic besnoitiosis, including body condition that varied from poor to very good, alopecia and hyperkeratosis of especially the face and the carpal, metacarpal, tarsal and metatarsal joints, and cysts in the conjunctiva.

Based on the clinical findings, a tentative diagnosis of caprine *Besnoitia* orchitis was made.

Semen examination

There was marked variation in individual and mass motility of semen obtained from bucks with acute orchitis, while the concentration and percentage live spermatozoa were comparable to those in semen from bucks with subacute orchitis (Table 1). Primary and secondary defects were higher (20–30 %) in semen from bucks with subacute orchitis than bucks with acute involvement (10–20 %). Semen obtained from bucks with chronic orchitis had low sperm concentration ($<3 \times 10^3/\text{mm}^3$) and less than 50 % live and individual motility. The mass motility was

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Table 1: **Quality of semen collected on-farm from bucks suffering from subacute, acute and chronic naturally-occurring besnoitiosis at the Marimanti and Kiburine Sheep and Goat Breeding Stations, Meru.**

Parameter	Acute ^a	Subacute ^b	Chronic ^c	Normal
Volume	2.2 ± 0.38	2 ± 0.50	1.4 ± 1.0	0.7–3.0
Colour	Milky-yellowish	Milky	Milky	Thick-creamy
Density	Creamy	Milky	Milky	Thick-creamy
Sperm concentration/mm ³	8.2 × 10 ⁵ ± 1.8 × 10 ⁴	5 × 10 ⁵ ± 5 × 10 ⁵	2.8 × 10 ³ ± 2 × 10 ³	1–3 × 10 ⁶
Wave motion or swirl	0	0	0	± ^d
Percent motile (individual)	74 ± 40	65 ± 15	30 ± 17.8	100
Mass motility	4–5	2–3	0–2	6.0
Percent live	65 ± 11.4	62.5 ± 17.0	46.25 ± 15.50	>80.0
pH	6.68 ± 0.04	6.7 ± 0.10	6.8	6.8
Other cells	Epithelial	None	Epithelial	None
Defects: primary	20 %	30 %	2 %	<20.0 ^e
secondary	10 %	20 %	4 %	—

^aAcute orchitis (n = 5),

^bSubacute orchitis (n = 2),

^cChronic orchitis (n = 4).

^dWave motion or swirl may/may not be observed.

^eBoth primary and secondary defects should not exceed 20 %.

Table 2. **Characteristics of semen collected from 1 (Goat no. 1) and 9 (Goat nos 2–10) bucks with acute and chronic besnoitiosis respectively.**

Semen parameters	Buck No.										
	1	2	3	4	5	6	7	8	9	10	NV ^a
Volume	3	1.5	1.5	1.8	3	3	1.5	3	2.5	2.7–3	
Colour ^b	C	Y	M	M	W	M	Y	M	M	Y	TC
Estimated density	0	2	1	2	0	3	3	2	3	3	5
Sperm concentration/mm ³	0	5	10	8	0	10	10	10	12	15	25
% Individual motility	0	50	50	70	0	80	80	60	80	75	100
Mass motility	0	2	2	4	0	5	4	3	4	4	4–6
Percent live	0	45	50	85	0	80	80	70	55	75	>80
pH	6.8	6.8	6.8	6.6	6.8	6.7	6.6	6.7	6.8	6.6	6.8
Defects ^c	—	+	+	+	—	+	+	+	+	+	<20

^aExpected semen parameters: NV = normal value^{5,6}.

^bY = yellow, C = clear, M = milky, W = watery, TC = thick and creamy.

^c+ = >20 % primary and secondary defects, — = no sperm were observed (aspermia).

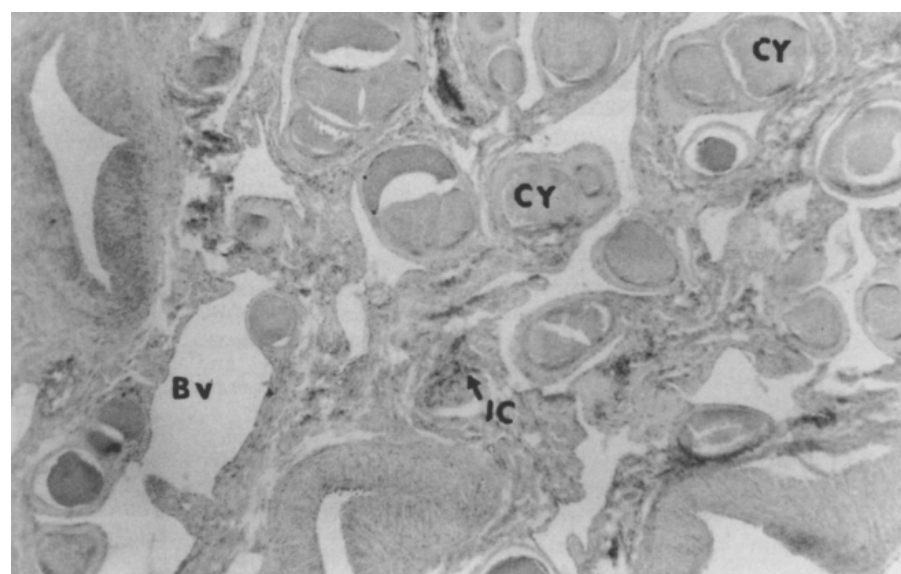


Fig. 1: **A tangential section of the pampiniform plexus showing numerous cysts (CY) within lumens and lining of blood vessels (BV). A mild inflammatory reaction is evident (IC). HE, ×200.**

between 0 and 2. None of the samples examined had swirl of motion (Table 1).

The results of semen examination of the 10 donated animals are given in Table 2.

Gross and histopathology

The testes from the bucks with chronic orchitis were macroscopically atrophied, yellowish on cut surface, with a rubbery consistency. In 1 buck, dark brown pigment was found scattered in the tunica vaginalis but not in other tissues. The scrotal skin was alopecic and hyperkeratotic. Numerous cysts were present in the subcutis of the scrotal skin, tunica vaginalis, tunica albuginea, vas deferens, epididymis and in the endothelium of the vessels of the pampiniform plexuses, from which the cysts extended for a short distance along the abdominal part of the testicular artery. Only a few cysts were evident in the testicular parenchyma, urethra and penis. No cysts were observed in the accessory glands.

The testes from the buck with acute orchitis were swollen and hyperaemic and the usual cream colour on cut surface.

Histopathology confirmed the presence of cysts (Figs 1, 2, 3). Some of the cysts appeared to have elicited a severe inflammatory reaction and others very little or

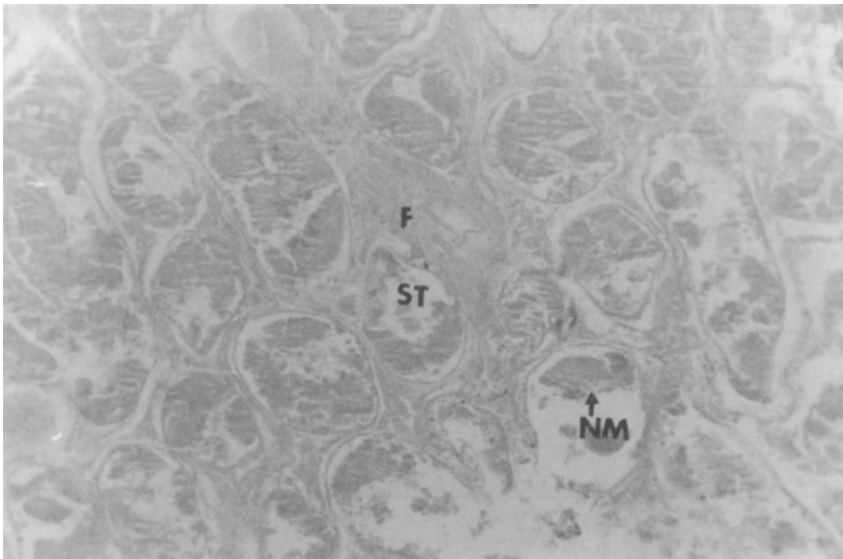


Fig. 2: A tangential section of the testicular parenchyma showing absence of germinal epithelium, necrotic material (NM) in the seminiferous tubules (ST), and interstitial fibrosis (F). HE, $\times 200$.

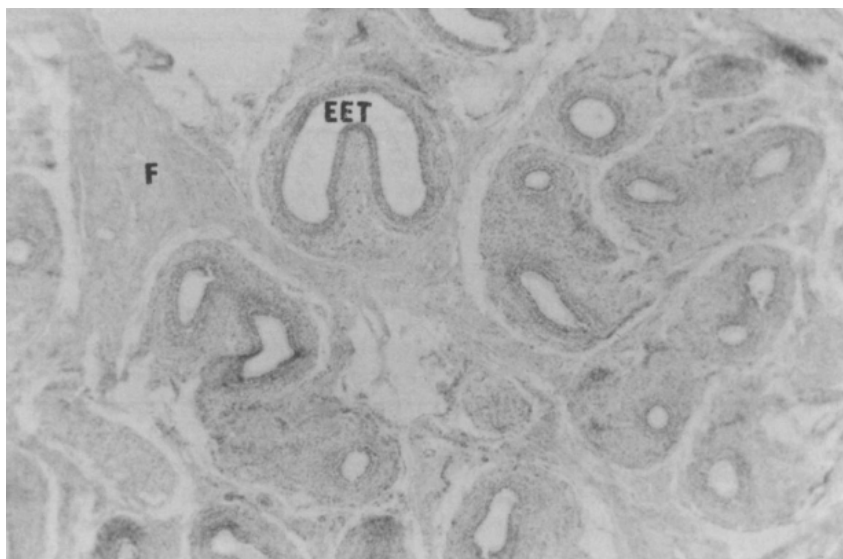


Fig. 3: A cross-section of the caudal epididymis in a buck with chronic besnoitiosis, with tubules (EET) devoid of sperm, and prominent interstitial fibrosis (F). HE, $\times 200$.

none. A mild, chronic, cellular inflammatory reaction was noted in the interstitium of the pampiniform plexus (Fig. 1). Moderate to severe interstitial fibrosis was present in the testis and epididymis (Figs 2, 3). The lumens of both the epididymal and seminiferous tubules were aspermatic (Figs 2, 3). Necrotic debris was present in the seminiferous tubules and no viable germinal epithelium was evident (Fig. 2).

DISCUSSION

The present study indicated that acute, subacute and chronic caprine besnoitiosis causes severe changes in semen parameters. These changes were considered severe enough to at least partly account for the infertility observed on the Marimanti and Kiburine sheep and goat breeding stations in Meru, Kenya²⁻⁴. It is

possible that poor body condition may have delayed the onset of puberty in doe kids and suppressed the expression of oestrus in mature does. Breeding of underweight pubertal doe kids and does in poor body condition may have accounted for the increased abortions, parturient and pre-weaning mortality. The latter may also have been due in part to the birth of underweight kids.

The findings of the present study suggest that the presence of a large number of cysts in the pampiniform plexus, epididymis and vas deferens led to severe fibrosis of those tissues, with degeneration of the germinal epithelium and consequently poor semen quality. This agrees with the histopathological findings of Bwangamoi^{2,3} and Cheema and Toofania¹.

The results of this study confirm the assertion by other researchers that

Besnoitia organisms exhibit genitotropism, leading to sterility in males in a variety of ruminants, including cattle⁷⁻¹⁰, Kudus¹¹, reindeer and caribou^{12,13}. The reason(s) for this genitotropism requires further investigation, especially since large numbers of cysts occur at other skin sites. Veterinarians and livestock producers should be aware of this potentially economically important disease to prevent spread.

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