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AN OUTBREAK OF CASEOUS LYMPHADENITIS (PSEUDOTUBERCULOSIS) IN DROMEDARY CAMELS AT QASSIM REGION, SAUDI ARABIA

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ABSTRACT

This study was carried out to investigate an outbreak of lymphadenitis in dromedary camels in private farm at Qassim region, Central of Saudi Arabia. Out of 220 camels included in this study, lymphadenitis was observed in 42 camels representing morbidity rate of 19.09%. The morbidity rate did not differ significantly among different age groups ($p \leq 0.4$ and Odds Ratio = 0.7) or between different sex ($p \leq 0.1$ and Odds Ratio = 0.5). Clinically, infected camels showed enlargement and abscessation of superficial lymph nodes, emaciation in some cases with normal body temperature. *Corynebacterium pseudotuberculosis biovar ovis* was the only microorganism isolated from the pus. Haematological examination revealed significant decrease in red blood cells and packed cell volume in addition to significant increase in the total white blood cells and neutrophils in lymphadenitis-infected camels compared to healthy ones. Penicillin therapy and surgical intervention in addition to some control measures as isolation of healthy camels away from infected herd and thorough disinfection of the contaminated environment were effective measures in the control of the outbreak.

Key words: Caseous lymphadeninitis, *Corynebacterium psuedotuberculosis*, dromedary camel, pseudotuberculosis

Caseous Lymphadenitis (CLA) is an infectious bacterial disease affecting sheep, goat, cattle, camelids and equids and in rare cases humans (Peel *et al*, 1997) caused by *Corynebacterium (C.) pseudotuberculosis* and clinically characterised by abscess formation mainly in one or more of the superficial lymph nodes (superficial form) and rarely in visceral lymph nodes (internal form) and organs (Paton *et al*, 1996; Wernery and Kinne, 2016).

Caseous Lymphadenitis is transmitted through inhalation, ingestion or directly through skin abrasion or insect biting as tick infestation (*Hyalomma dromedarii*) (Wernery and Kinne, 2016).

Based on the nitrate reduction test there are two biotypes (biovars) of *Corynebacterium pseudotuberculosis*; serotype 1 (*biovar ovis*) which infect sheep and goats is negative for nitrate and serotype 2 (*biovar equi*) which infect horse and cattle is positive for nitrate reduction (Sutherland *et al*, 1996). However, Oliveira *et al* (2016) concluded that *C. pseudotuberculosis biovar ovis* is being formed from *C. pseudotuberculosis biovar equi* through anagenesis.

Prevention is better than treatment to control CLA using bacterin-toxoid vaccines due to incurable nature of the disease and low economic capacity that will disable the country to apply identification and culling policy (Oreiby *et al*, 2014).

The aim of this study was to carry out some epidemiological, clinical and control measures associated with an outbreak of caseous lymphadenitis in camel herd at Qassim region, Saudi Arabia.

Materials and Methods

Animals

Camel herd consisted of 220 dromedary camels of different ages and sex belonging to private farm in Qassim Region, Central of Saudi Arabia were used in this study. These were subjected to clinical examination according to Higgins and Kock (1984). Epidemiological data was estimated according to Martin *et al* (1987).

Bacteriological examination

Pus samples were collected from the superficial lymph nodes from each animal in sterile container by aspiration from closed ripped abscesses. All samples were taken under complete aseptic conditions and used for both direct smear and isolation of

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the causative agent by culturing onto 10% sheep blood agar, nutrient agar and MacConkey's agar plates then incubated at 37°C for 48 hours aerobically as well as in CO_2 incubator for the first isolation according to the method described by Bailey and Scott (1990). Also the ability of microorganisms to grow on Hoyle's tellurite media were done by inoculating the microorganisms onto Hoyle's tellurite lysed blood agar plates and incubated at 37°C for 48 hours according to Hoyle (1941) and Jellard (1971). Colonial and other biochemical tests were used for identification (Cruickshank *et al,* 1975).

Control measures

Control of the outbreak was done through several steps including isolation of healthy camels away from the infected ones. Treatment of infected animals using penicillin-streptomycin (Pen & Strep/NorBrook company) administered by deep intramuscular once daily for 7 consecutive days at doses of 8 mg procaine penicillin and 10 mg dihydro-streptomycin sulphate per kg bodyweight (1ml/ 25 Kg B.W). Surgical intervention was done for the ripened abscesses and irrigation using iodine in separate place away from the farm in addition to hygienic disposal of pus. Disinfection of the farm and equipments were done in adjunct with animal treatment.

Statistical analysis

The obtained data was analysed by Chi-Square and t test using the SPSS for Windows (Version 15.0, USA) statistical software program and probability (*P*-values) of less than 0.05 was considered significant.

Results

Out of the examined 220 camels of different ages and sex, 42 camels were infected with CLA representing an infection rate of 19.09%.

Concerning age predisposition, 10 camels out of 64 examined camels under three years and 32 out of 156 camels older than three years were infected representing an infection rate of 15.62 and 20.09%, respectively (Table 1).

Table 1. Prevalence of lymphadenitis in relation to camels' age.

Age	Camels examined	Infected camels	Prevalence (%)
< 3 years	64	10	15.62
> 3 years	156	32	20.51
Total	220	42	19.09

Concerning sex predisposition, 33 camels out of 189 examined female camels and 9 out of 31 male camels were infected representing infection rate of 17.46 and 29.03%, respectively (Table 2).

Table 2. Prevalence of lymphadenitis in relation to camels' sex.

Sex	Camels examined	Infected camels	Prevalence (%)
Females	189	33	17.46
Males	31	9	29.03
Total	220	42	19.09

Clinical signs observed in infected camels were in the form of enlargement of superficial lymph nodes especially submandibular and superficial cervical lymph nodes (Fig 1). Emaciation was observed in 11.9% of the affected animals. Body temperature and appetite were not affected (Table 3).

Table 3. Clinical signs in lymphadenitis infected camels.

Signs / %	No.	Per cent
Temperature	0/42	0
Off food	0/42	0
Emaciation	5/42	11.90
Cervical LNs	37/42	88.09
Sub-mandibular LNs	35/42	83.33
Pre-femoral LNs	2/42	4.76
Pre-scapular LNs	1/42	2.38
Pre-femoral LNs	1/42	2.38
Parotid LNs	1/42	2.38

Blood examination for infected animals revealed decrease in the red blood counts and PCV in addition to increase in the white blood counts as a result of increase in the number of neutrophils and eosinophils (Table 4).

Table 4. Haemogram in healthy and lymphadenitis infected camels (mean ± SD).

Variable	Healthy camels (n=10)	Infected camels (n=10)
RBCs (10^6/µl)	11.13 ± 0.81	9.61 ± 1.80*
Hb g/dl	13.12 ± 1.00	13.78 ± 2.28
PCV %	24.10 ± 1.56	20.76 ± 2.42**
WBCs (10^3/µl)	16.84 ± 2.60	28.10 ± 15.22*
Neutrophils (10^3/µl)	8.37 ± 1.85	22.15 ± 15.73*
Lymphocytes (10^3/µl)	2.33 ± 0.45	3.64 ± 1.47
Monocytes (10^3/µl)	0.15 ± 0.17	0.15 ± 0.09
Eosinophils (10^3/µl)	1.79 ± 0.90	5.02 ± 3.33**

RBC, red blood cells; WBC, white blood cells; Hb, haemoglobin concentration; PCV, packed cell volume.
* P < 0.01 ** P < 0.006

Management of the outbreak by isolation of healthy camels away from the infected ones and

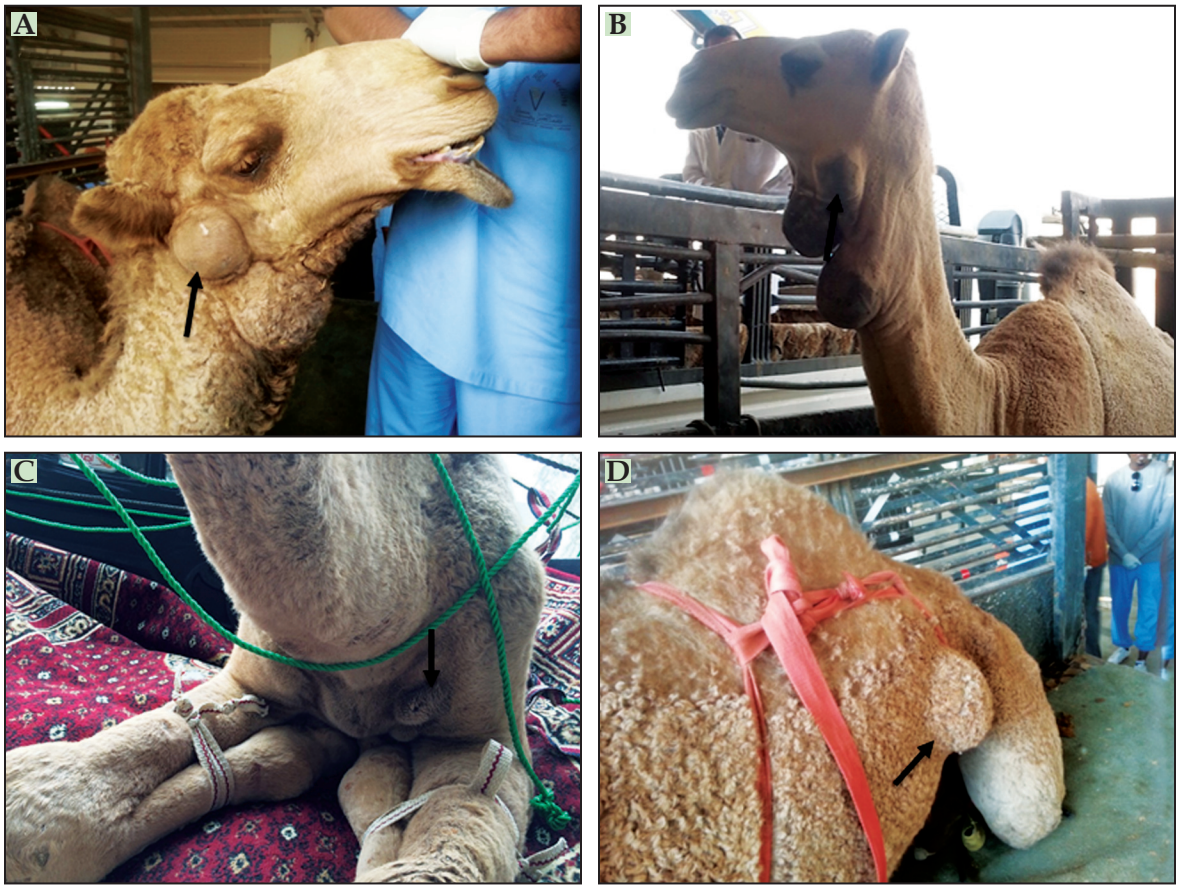

Fig 1. CLA infected camel showing enlargement and abscessation in the **(A)** parotid lymph node **(B)** submandibular lymph nodes **(C)** Prescapular lymph nodes **(D)** pre-femoral lymph node.

treatment of the infected camels using penicillin in addition to surgical intervention for the ripened abscesses and irrigation using iodine in separate place away from the farm was effective in control of the outbreak and treatment of infected camels in addition to prevent other transmission.

Discussion

The prevalence of caseous lymphadenitis in this study was 19.09%. Nearly similar prevalence was recorded previously by Radwan *et al* (1989) who reported a prevalence of 15% in an outbreak of CLA in two farms in Saudi Arabia and isolated *biovar ovis* from the lesions. Lower prevalence of CLA was recorded in Egypt by Abou-Zaid *et al* (1994) who recorded a prevalence of 10% and Borham *et al* (2017) who recorded a prevalence of 10.35%. Higher prevalence was recorded previously by Borham *et al* (2016) who detected CLA in camels based on clinical and postmortem examinations in 35.4% of camels compared to seropositivity percentages of 58.06% by exotoxin ELISA and 61.29% by SWC ELISA. The variations in the disease prevalence during each study may be attributed to the number of camels in each herd in addition to the hygienic measures applied in each farm.

C. pseudotuberculosis was the only micro-organism isolated from infected animals of present study. The isolated biovar of *C. pseudotuberculosis* was negative for nitrate and this is an indication for *biovar ovis* which infect sheep and goats. This result is in agreement with the results of Hawari (2008) in Jordan and Radwan *et al* (1989) in Saudi Arabia who attributed this to the transmission of the infection from sheep and goats to camels where CLA is widespread among sheep and goats and they graze together on the same pasture (Saeed and Alharbi, 2014). Also, Borham *et al* (2017) detected serotype 1 from camel CAL. On contrary, Tejedor-Junco *et al* (2008) detected *C. pseudotuberculosis* biovar *equi* which is positive for nitrate from dromedary camels.

In agreement with our results, Braga *et al* (2006) isolated only *C pseudotuberculosis* in pure culture from closed abscesses and mixed with other pathogens as *Staphylococcus* species, *Streptococcus* species and yeasts from open abscesses from Alpacas.

Experimentally, isolates obtained from CLA infected sheep did not produce CLA in camels and produced only local abscess at the site of inoculation while isolates obtained from camels produced typical CLA in camels (Afzal *et al*, 1996).

Concerning age predisposition, no significant changes were recorded in infected camels compared to healthy ones. Similar result was observed previously by Braga *et al* (2006) who found the age has no effect on the prevalence of CLA in camels. On contrary Constable *et al* (2017) found that the prevalence of CLA increased by age and reached its maximum level in adults.

Concerning sex predisposition, no significant effect of the sex on the occurrence of CLA in camels where no differences among the disease prevalence were recorded in infected camels compared to healthy ones. On contrary, Braga *et al* (2006) recorded that the disease affected female more than male camels. Also, in a recent study in goats conducted by Yitagesu *et al* (2020) observed that the female goats were at higher risk to infection by CLA than male goats.

The main clinical signs observed in diseased camels were in the form of enlargement and abscessiation of superficial lymph nodes, emaciation in some cases with normal body temperature. Similar signs were observed previously by Radwan *et al* (1989); Tarazi and Al-Ani (2016) and Wernery and Kinne (2016). Emaciation which occurred in 11.90% of the cases of present study may be attributed to internal form of the disease. Similar observation was observed previously by Borham *et al* (2016 and 2017).

In this study all infected camels were heavily infested with ticks. This is an indication of the role of ticks in the disease occurrence. Similar observation was recorded previously in Saudi Arabia by Radwan *et al* (1989) who isolated *C. pseudotuberculosis* from ticks and mentioned the role of ticks in the disease transmission.

Blood examination revealed significant decrease in red blood counts ($P < 0.01$) and PCV ($P < 0.006$) in addition to significant increase in the number of white blood corpuscles ($P < 0.01$), neutrophil ($P < 0.01$) and eosinophil ($P < 0.006$) counts in the infected camels compared to healthy ones. Similar results were recorded previously by Tbaraka *et al* (2000) who recorded a significant decrease in the total erythrocyte counts and packed cell volume in CLA infected camels. Afzal *et al* (1996) observed no significant changes in the erythrocyte counts, haemoglobin concentration and haematocrit following experimental infection and increase in the white blood corpuscles due to neutrophilia.

Control of the outbreak by isolation of healthy camels away from the infected ones and treatment of the infected camels using penicillin in addition to surgical intervention for the ripened abscesses and irrigation using iodine in separate place away from the farm was effective in control of the outbreak. Similar results were observed by Wernery and Kaaden (2002) and Tejedor-Junco *et al* (2008) who found penicillin as effective drug in the treatment of CLA in camels.

In conclusion, *C. pseudotuberculosis* biovar *ovis* is the only biovar isolated from camels and the control of CLA outbreak can be done using several measures including isolation of healthy animals away from infected animals and pasture, treatment of infected animals, hygienic disposal of discharged pus in addition to disinfection of the environment. Moreover, tick control must be put in consideration.

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