# *Mycobacterium avium* **subspecies** *paratuberculosis* **in Camels; Clinical Aspects and Control Suggestions**

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## ABSTRACT

Camel paratuberculosis which is caused by *Mycobacterium avium* subspecies *paratuberculosis*, is a chronic granulomatous enteric disease. Several domestic and wild ruminants species may be affected by this organism which complicates the epidemiology of the disease. The clinical manifestation and control measurements of the disease in the camel is not well characterized. The aim of this article is to explore the clinical manifestations and the possible strategies to control the disease in camels.

**Key words:** Camels, *Mycobacterium paratuberculosis*, clinical, control.

## INTRODUCTION

Camel Paratuberculosis is a chronic wasting granulomatous enteric disease that is characterized by irreversible clinical signs including loss of body weight, diarrhea, dehydration and ultimately death of affected animal. Affected animal is unresponsive to treatment (Yayo *et al.* 2001). The disease is caused by *Mycobacterium avium* subspecies *paratuberculosis* (Collins, 2003, González,et al 2005). The disease also affects several domestic and wild ruminant species. (Chiodini RJ, 1984, Chiodini RJ, 1983). In addition, the organism is highly capable of surviving in the environment (Manning EJ, 2001, Pickup RW, 2006). In Saudi Arabia, paratuberculosis (which is also called Silag) was documented in many ruminants species mainly cattle, sheep, goat, and camel (Ahmed and Towfik, 1999, Gameel *et al.,* 1994; Alluwaimi *et al.,* 1999; Al Hajri and Alluwaimi, 2007, Alluwaimi, 2008, Alharbi, *et al,* 2012, Zaghawa *et al.,* 2011).

## Camel Management

Camels are raised for several purposes including showing, breeding, milk and meat production as well as racing and pleasure riding. The growing interest in raising camels has lead to significant increase in the value of these animals. Since camel population is rapidly growing in the country exceeding 200,000 according to the statistics of the ministry of agriculture where they are considered valuable animals with significant social and economical impact (Ministry of Agriculture, Annual Report 2011, p164). Camels are raised in an open system with variable herd sizes ranging on average between 30 to 200 animals. Most of the herds are allowed to graze freely in the wild especially during the raining season (October through March, in the central and eastern regions and August through January in the Southwestern region). In the Central and Eastern regions, animals start the trip following the rain from the south toward the north in early fall and head back to the south late spring. Hygiene and sanitation procedures are difficult to implicate in such open housing system. In addition, having a good system of record keeping and adequate training of herd managers is another obstacle. On the other hand there are a limited numbers of herds that are held in confined farms in an intensive system. Their feeding program includes

supplements with concentrates, hay and forages. Herds are maintained in fairly enough hygienic farms with continuous cleaning and manure disposal.

**Epidemiology**

In the last few years, it was observed that paratuberculosis is becoming an increasing health problem in many camel herds. Though, the general circumstantial evidences, are increased clinical cases, samples from abattoirs, owner's observations and the veterinarians examination, there is no available data on the actual incidence of the disease in Saudi Arabia. Also its exact impact on camel industry is not well known. This increase in clinical cases number was hindered by efficient diagnostic tests, although PCR –ELISA tests were attempted (Al hebabi and Alluwaimi, 2010, Alharbi, *et al.,* 2012).

Zoonatic potential of *M. paratuberculosis* has been examined in dairy cattle. Studies on raw milk and even on occasion commercially pasteurized milk showed detectable level of *M. paratuberculosis* (Grant IR, 2003). Knowing the fact that drinking fresh unpasteurized camel milk is a social tradition in Saudi Arabia. The association between *M. paratuberculosis* and Crohn's disease has been suggested, though there is no data on consumption of camel milk and this disease (Alluwaimi AM, 2007).

**Clinical Manifestation**

Clinical manifestation of *M. paratuberculosis* are not specific however it may include depression, general weakness, emaciation, diarrhea, alopecia, wry neck and pale mucous membranes and anemia (Alharbi, *et al,* 2012). The diarrhea starts with soft feces then progress to watery form leading to dehydration (Almujalli and AlGhamdi, 2012). Fluctuation in the body temperature is probably a signs of the hydration status of the body and the perfusion of the peripheral circulation.

Clinically affected camels may have elevated granulocytes and leukocytes. Moreover, a decrease in the haemoglobin, RBCs and packed cell volume has been reported. The biochemical changes includes significant increase in creatinine, magnesium, AST and ALT as well as blood urea nitrogen (BUN). On the other hand both the total protein and albumin are significantly reduced.

Most of the macroscopic changes are detected in the ileum and colon. The most prominent gross lesions are thickening of the intestinal wall and corrugation of the mucosa that becomes folded into transverse ridges. The ileocaecal and mesenteric lymph nodes are enlarged and oedematous. Granulomas may be detected in the liver, lymph nodes, and spleen. The microscopic findings in the ileum and the colon may include short, blunt and distorted villi. The villi may occasionally be fused to each other. The goblets cells of the villi and the crypts of lieberkuhn are hyperactive and contain mucin droplets. The lamina propria is heavily infiltrated with mononuclear cells mostly macrophages as well as a few number of eosinophils. The peyer's patches as well as lymphoid aggregation in the ileum and the colon respectively exhibited hyperplasia. Acid fast bacilli may be detected using Ziehl-Neelsen staining macrophages infiltrated organs (Alharbi, *et al.,* 2012).

In most cases the mesenteric and the ileocaecal lymph nodes appeared to be hyper-activated. There is also a marked lymphocytic hyperplasia in lymphoid follicles and medullary cords. The most prominent findings are medullary histocytosis.

**Diagnosis**

Several classic and molecular approaches are available for the diagnosis of *M. paratuberculosis* . The most important one are:

1) Bacterial culture is sensitive and specific method, however it is expensive, time consuming and laborious.

2) Allergic testing utilizing *M. paratuberculosis* intradermal injection however it has low specificity (Khon, FK 1983).

3) Serologic tests including complement fixiation test (CFT), agar gel imunodoffusion (AGID) and ELISA (Khon, FK 1983). ELISA is highly specific but with low sensitivity (Whitlock R *et al*. 2000). In addition, ELISA is the test of choice since it is simple, easy to perform fast and affordable (Alharbi, *et al.*, 2012). Variations between commercial kits and inter-laboratory differences were reported (Alinovi C *et al*. 2009, Garrido J *et al*. 2002; Bilbao, 2002, Dieguez, 2009).

4) In a recent study, clinical evaluation and hematologic and blood chemistry profiles were suggested to detect *M. paratuberculosis* affected camel (Almujalli and AlGhamdi , 2012). These procedures are simple, inexpensive and can be performed in the field.

**Control**

Adequate research on control of *M. paratuberculosis* in camels is extremely rare. Several suggestions have been made to control the disease in cattle with great focus on test and culling, management modification, and vaccination (Bastida1 F & Juste R A, 2011). In camels, laboratory tests may include faecal culture, ELISA and PCR. The use of ELISA and PCR has been documented in camel herds. (Alharbi, *et al.*, 2012). But further work is required to examine these tests under the field conditions. In addition, challenges such as record keeping, sample handling and processing, and training farm camel owners and farm mangers remain major obstacles.

Control of *M. paratuberculosis* has been focused on the appropriate sanitation procedures. In the open management system, such application is laborious since any undetected infected animal may spread the organism on wide area. On the other hand in intensive system suspected animals may be detected, isolated, tested and if confirmed may be slaughtered. In both management system, adequate hygiene policy are extremely important. These include using separate tools of feeding, drinking, cleaning and milking of suspected animals as well as handling suspected animals last. Appropriate disposal of manure is crucial.

Management changes to contain the disease in ruminants species have been described (Rossiter CA, 1996, Goodger WJ, 1996). Such approach may be adapted in camel herds. However, the need to train camel owners cannot be overstressed. The management changes are aimed at preventing or limiting contact between affected and susceptible young animals. This may be achieved by separating camel calves from dam immediately after birth, feeding calves coloustrum obtained from paratuberculosis known free source and milk replacement, raising replacement camel heifers in a separated locations, prevent cross contamination and improving farm hygiene.

In conclusion, control measurements may be initiated based on preliminary clinical findings. Such control approaches are simple and applicable in open and intensive housing system aiming at reducing the chances of the spread of the disease in camel herds.

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## ARABIC SUMMARY

**مايكوباكتيريم ايفيم باراتيبوركلوزيز في الجمال و الجوانب الاكلينيكية ومقترحات للتحكم به**

**غانم الغامدي**
**قسم الاحياء – كلية العلوم-جامعة الباحة- السعودية**

يعد مرض نظير السل في الجمال من الأمراض المعوية المزمنة الذي تسببه بكتيريا مايكوباكتيريم ايفيم باراتيبوركلوزيز. يصيب هذا المرض العديد من الحيوانات المجترة المستأنسة والمتوحشة وهذا الأمر يعقد وبائية المرض. لازالت المظاهر الاكلينيكية ووسائل التحكم في المرض غير معرفة جيدا في الجمال. الهدف من هذا البحث تسليط الضوء على مظاهر المرض الاكلينيكية والاستراتيجيات الممكنة للتحكم فيه في الجمال.