Acute bilateral proptosis in a cross bred calf naturally infected with *Theileria annulata*

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Abstract Ever since 1970, Bovine tropical theileriosis has been recognized major constraint to livestock improvement programme in the semi- arid and enzootic areas of Rajasthan. In contrast to other apicomplexan protozoan infections of blood, pathophysiological impact of *Theileria annulata* has been incriminated to in situ intra-leucocytic development of the pathogen. In continuation with recent manifestations documented on trans-placental *T. annulata* in a 3 day old cross bred calf and cerebral form of bovine theileriosis “Turning Sickness” in an adult cow, herein an another interesting manifestation of the disease “exophthalmos” incriminated to congenitally acquired *T. annulata* infection in a cross bred calf, its pathogenesis and impact are being presented and discussed.

Keywords *Theileria annulata* · Proptosis · Exophthalmos · Crossbred calf

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Introduction

Bovine tropical theileriosis (BTT)—a tick borne protozoan disease, caused by *Theileria annulata*, has been a persistent constraint on the development of high yielding dairy animals including buffaloes (Levine 1973; Gill et al. 1978; Bhatia and Shah 2001; Urquhart et al. 2003; Soulsby 2005). In India alone, the disease accounts for an approximate annual loss of US\$384.3 million (Minjauw and McLeod 2003). In contrast to other apicomplexan protozoans, the pathological impact of *T. annulata* has been incriminated to intra leucocytic developing schizonts of the pathogen (Koch’s blue bodies) causing severe leucopenia. A leucocyte count below 1,000/mm³ is considered critical and fatal in a majority of the cases (Mehlhorn and Armstrong 2001). The clinical course of the disease vary from per acute to acute or sub acute to chronic. It mainly depends upon the damaging effect of the pathogen on lymphoid tissues and susceptibility of the host. Interestingly in recent past, transplacental BTT causing a fatal disease in a 3 day old neonate cross bred calf and cerebral form of the disease (turning sickness) in a cow were incriminated to *T. annulata* infection and documented elsewhere (Godara et al. 2009; Sudan Vikrant et al. 2012). Herein, details of yet another clinical manifestation of congenital BTT involving protrusion of eyeballs (bilateral exophthalmos) in a cross bred calf is being presented.

Materials and methods

A cross bred (Hostestein × Tharparkar) female calf, aged 30 days and weighing ~45 kg was presented on 5th January, 2011 before the clinicians at the Teaching Veterinary Clinical Complex, Apollo College of Veterinary Medicine,

Jaipur. The calf was reportedly suffering from protruded eyeballs (Fig. 1). The condition developed as conjunctivitis on Day-25 after birth. On the prescription from the local veterinarian, post boric acid washing, eye drops were instilled into the eyes twice a day for a period of 48 h. Animal did not show any improvement and on Day-27 the left eyeball started protruding out of its orbit. Synchronously, the right eye ball also got prolapsed. Ever since then, the animal was suffering from the bilateral exophthalmos for the past 72 h. Further enquiries revealed that the calf born full term with apparently normal size, vitality and physiological functions. The calf was fed colostrums and was housed on fresh hay bedding in a small temporary corridor adjacent to her dam. The mother, aged 4 years, was infested with *Hyalomma anatolicum anatolicum*, and during the gestation period reported to have recovered from an acute course of BTT. Evidently, she was in immune carrier state at the time of parturition. The cattle shed management including surroundings, hygiene, etc. were typical traditional type, suited to accommodate small animal holdings of 3–5 animals. The owner belonged to socio economically weaker section of Indian society in the semi arid part of Rajasthan state. The sanitation, housing and management etc. were of typical traditional type and were not in absolute conformity with the scientific standards.

The calf appeared emaciated and weak. Peripheral blood (5 ml aliquots in EDTA) was aseptically collected. Grossly visible surface acarine parasites from the infested sites of the soft skin were carefully detached using a weak solution of a beta cyfluthrin (“Responsar” Bayer (India) Limited) besides, copro samples in adequate quantity from the rectum were respectively collected in wide mouth specimen bottles and polybags, brought to the laboratory and

processed for identification of the pathogen and its vector using standard techniques and keys (Coles 1980; Bowman et al. 2003; Soulsby 2005; Hendrix and Robinson 2006). Ophthalmic examinations of the eyes in respect of symmetry, confirmation were carried out from 2 to 3 feet distance with the least restraint head. In absence of tonometric and ophthalmic equipmental facilities, ocular pressure was roughly assessed by application of gentle pressure on the orbits.

An overview of general condition of the animal and assessment of haematological parameters revealed grave prognosis of the case. The owner was suitably informed. The animal was synchronously administered specific and supportive therapy followed by surgical intervention involving careful incision of adequate length on lateral canthus and manual gentle pushing inward the protruded globes into the respective orbits under Peterson’s orbital nerve block using 5 ml xylocaine (2 % “lignocaine” Astra Zeneca) and there after eyelids and nictitating membrane were sutured following tarsorrhaphy technique using Nylon thread No. 1 (Fig. 2), in order to prevent reoccurrence (Kumar 2002). Specific therapy included single intramuscular injection of Buparvaquinone (“Zubion” Intas Pharmaceuticals) @2.5 mg/kg and 24 h there after she was deep intramuscularly inoculated with long acting oxytetracycline dihydrate, Pfizer India LTD. @ 20 mg/kg. The owner was advised to wash both the eyes with luke warm weak solution of boric acid and instilling four drops of ciprofloxacin and dexamethasone (“Ciplox- D” Cipla) morning and evening. However, the animal could not with stand the severity of the pathogen, got exhausted and unfortunately succumbed to the disease in the evening of 8th Jan, 2011. It could not be autopsied due to theological/religious limitations.

Fig. 1 Bilateral proptosis in a crossbred female calf

Fig. 2 Surgical intervention of the exophthalmos eyes

Results and discussion

A closer look to the calf revealed dull, dry and lustre less hair coat. Soft and thin skin areas were infested with a few developing instars of *H. anatolicum anatolicum* over dew lap, axilla and around peri anal region. The lymph nodes draining the probable infested sites were neither enlarged nor oedematous. This was suggestive of inherited infection during the gestation period by the calf. The calf was weak and emaciated. The conjunctival mucous membranes were profusely hyperemic, icteric with a few sub conjunctival petachial haemorrhages besides, ocular discharge from both the eyes. There was protrusion of both the eyeballs (Fig. 1). Ophthalmic examination of the eyes in respect of symmetry and confirmation, did not reveal any sort of deformity and abnormal vision but for forward displacement of eyeballs. There were no signs of physical trauma and/or insect bite around the eyes. However, sub conjunctival ophthalmic oedema of the eyelids and around the orbits with muco purulent discharges from both the eyes were evident. The eyelids did not show any signs of retraction. The eyeballs were devoid of intra ocular lesions suggestive of trauma, insect bite and/or inherited genetic defects. Muzzle was dry, normal pulse (50/min) and respiration (12/min) and rectal temperature was 102.5 °F. Auscultation sounds of the lungs were normal. Microscopic examination of the Giemsa stained thin smear evidenced characteristic intra erythrocytic piroplasms identified as *T. annulata* (Fig. 3). Laboratory investigation of the peripheral blood revealed suppressed heamatological indices (haemoglobin-9.0 g/dl, PCV-30 %, TLC- $11.1 \times 10^3/\text{mm}^3$) and altered differential cell counts (neutrophils 58 %, lymphocytes 37 %, monocytes 1 %, eosinophils 4 % and basophils 0 %) and confirmed that the animal suffered from milder form of anaemia. Copro samples could not demonstrate parasitic ova and/or cysts.

Fig. 3 The pathogen in circulation

In normal course, transstadially *T. annulata* infected ruminant require an incubation period of 7–21 days after the sporozoites of the pathogen got access into host circulation through the lymph node (s) draining the site of tick bite (Radostits et al. 1994; Urquhart et al. 2003; Soulsby 2005; Taylor et al. 2007; Lefevre et al. 2010). The clinical signs, course of the disease and pathogenesis considerably vary and mainly depend upon the quantum of pathogen inoculated as primary single dose and/or low dose of multiple inoculations vis-à-vis genetic makeup and immune status of the host. Neonate cross bred calves exposed to the infection during gestation period seems exceptions. The disease in such cases have a shorter incubation period, devoid of enlarged superficial lymph nodes and the affected calf develop clinical signs of the disease much before the normal incubation period, depending upon the patho physiological involvement of vital organs including CNS and the site of multiplication of the pathogen, consequential extent of damage caused, etc. The signs of the disease appear much before the calf could acquire passive immunity through colostrum from her immune carrier dam.

Although sub orbital ophthalmic oedema, conjunctival chemosis, oedema of eyelids of varying degree, consequential to *Theileria parva* infection in bovine have been documented in the literature more often than none (Soulsby 2005; Taylor et al. 2007), interestingly clinical manifestations of bilateral protrusion of eyeballs (exophthalmos) as reported here in seems to be an important documentation of ocular form of congenital BTT caused by *T. annulata* in a neonate cross bred calf. In the earlier reports of exophthalmos caused by *T. annulata*, there was no evidence of congenital transmission as in most of the cases the condition aroused in older calves and not as congenitally transmitted natured infection and it terminated fatally (Mallick et al. 1986, Mallick 1993; Sudhan et al. 1987; Randhawa et al. 1983; Sengupta et al. 1993). The cross bred calf in the present case, apparently born healthy with normal physiological functions and vision at the time of birth, in semi arid enzootic region of a South Asian country and developed exophthalmos after 25 days after birth. The findings have been in continuation with recent reports on vertical and/or transplacental transmission of *T. annulata* infection from an immune carrier dam to the foetus published elsewhere (Godara et al. 2009). The characteristic clinical signs are in conformity with congenital form of BTT coupled with physical demonstration of the pathogen in the host circulation confirmed that the neonate calf suffered from ocular theileriosis incriminated to *T. annulata*.

Aetiology of eyeball protrusion has been multifactoral. In exotic cattle breeds (Holstein, Jersey), the condition is presumably a heritable trait, characterized by an antero-medial rotation of the orbit around its axis “crossed eyes”.

The ocular defect become evident by the time a calf attains an age of 6 months. The affected animal has defective vision and display difficulty in walking in unfamiliar surroundings (Smith 1990). Proptosis could be a consequence of slow developing ophthalmic neoplasm (lymphosarcoma) characterized by reduced ocular mobility, corneal ulcerations and exposure keratitis. It has also been reported as an outcome of retrobulbar abscesses or post orbital cysts/granuloma and sweet clover poisoning, etc. (Aiello and Mays 1998) characterized by loss of vision, intraocular bleeding and corneal oedema. Above all, in the above stated clinical conditions, the protrusion of the orbit is often unilateral, develop slowly and do not affect the neonates. Possibilities of bilateral exophthalmos in the neonate calf as reported here in as a sequel of above stated aetiological factors were thus ruled out on the grounds of susceptible age and altogether absence of characteristic signs.

Obviously, bilateral proptosis with normal vision in the instant case appears to be an ophthalmic manifestation of an inherited *T. annulata* utero-infection, adversely affecting vascular supply to the orbits. In the instant case, it is strongly believed that *T. annulata* in the foetal circulation might have got access into cerebral circulation and caused increased vascular permeability. This might have resulted in an abnormally increased intra-orbital pressure so much so that the eye balls could not with stand and started protruding out from Day-27 of birth onwards and complete development of bilateral exophthalmos occurred when the affected calf attained an age of 30 days. It is believed that the endothelial cells of the fine ocular blood vessels of the orbit were the probable site of multiplication of the pathogen congenitally acquired from the dam during gestation and consequential oedema of the orbits and eyelids. Thus, an increased pressure in the orbits was incriminated to protruded eyeballs. Further, non involvement of lymphoid tissues (spleen and lymph nodes) outside CNS confirmed that the calf acquired congenital infection.

Therefore in conclusion, the neonate calf acquired *T. annulata* infection from her immune carrier mother during gestation, analogous to *Theileria equi* infection in horses, resulting in either still birth and/or full term birth of live foal with normal physiological functions and unenlarged non oedematous superficial lymph glands (Allsopp et al. 2007). The *Theileria sergenti* and *T. annulata* affected bovine develop clinical disease either soon after the birth or during the neonatal life (Baek et al. 2003; Godara et al. 2009). Nevertheless, considering the transplacental/congenital BTT, a fast emerging problem in cross bred cattle population in the enzootic semi arid regions of the South Asian Countries, it would be interesting and most appropriate to precisely investigate the epizootiological determinants, pathophysiology and immunopathogenesis of

congenital BTT in the affected dams and her off springs while using selective and reliable methodology. This would precisely define financial losses in terms of money, magnitude of the problem and its financial impact on the cattle owners in the rural India.

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