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Present status of camel *Trypnosomiasis* in Pakistan, a review of literature

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Abstract
Camel is one of the important multipurpose animals, found in arid and semi-arid regions of the world. It is primarily used for draught purpose along with meat and milk production. In Pakistan, majority of camel population is found in Balochistan province. The disease called *Surra* is of great concern for the camel beneficiaries. It is caused by *Trypanosoma evansi*, a well known protozoan. Treatment of *Surra* with different kind of drugs is leading to multi drug resistance development; more susceptibility to camel as compare to other species. Lack of availability of vaccines is big hurdle in the treatment and prevention. Here, in this article, we will discuss prevalence, pathogenesis, clinical signs, diagnosis, treatment and prevention of *Surra* in camel.
Key words: Camel, Surra, *Trypanosomiasis*, *T. evansi*.

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Introduction

Camel (*Camelus dromedarius*) is an important multipurpose animal in arid areas as well as in semi-arid regions of the world. There are about twenty million camels reported in the world [1] reared for a variety of purposes e.g. transportation, racing and as source of human food [2].

There are about 1.2 million heads of dromedary camels in Pakistan, placing it at the third position in camel rearing countries [3] with yearly increase of 1.62% [4]. Out of this, majority of them are found in Balochistan (41%), followed by Sindh (30%), Punjab (22%) and Khyber Pakhtunkhwa (7%) [5]. Mainly, camels are being raised for draught purposes, while in a few cases they are serving human beings by providing milk and meat [6]. They mainly exist in two types, namely riverine and mountainous. First type is meant for work in deserts and plains, while the latter adapted to work in mountain regions due to their physically powerful and hard feet.

Trypanosomiasis is a vector-borne disease caused by flagellated protozoa *T. evansi* which is unicellular organism belongs to the genus *Trypanosoma* [7]. *T. evansi* infection commonly called 'Surra' is perhaps the most serious protozoan disease of camel and is prevalent throughout camel rearing areas of the world [8]. *T. evansi* can also cause disease in other species e.g. cattle, buffaloes, sheep, goats and horses. *T. evansi* perhaps was evolved from *T. brucei*, when camels entered the tsetse fly belt. Later, the disease was manifested via mechanical transmission by biting flies, notably *Tabanus*, *Haematopota* and *Pangonia* species and spread to the Middle East, India and the Far East Asian countries [9].

Characteristics of *Trypanosoma evansi*

It has been proved that *T. evansi and T. equiperdum* are actually strains of *T. brucei*, may emerge time after time from *T. brucei* [10]. The difference in species depends on size and shape of the body, position of nucleus, degree of development of the undulating membrane and flagellum [11]. Size of trypanosomes is ranged from 15.30 µm in length and 1.5 to 3 µm in width [9, 11, 12].

Epidemiology

In Pakistan, previous studies on the prevalence of Surra have been carried out in Khyber Pakhtunkhwa and different areas of Punjab [13]. Husain et al. [14] recorded 13.2% occurrence of *T. evansi* in camels. There is low incidence of *T. evansi* infection in the region of province Punjab. Hassan et al. [13] reported that 3.3% camels were positive for parasites.

Transmission

Source

Tabanid flies particularly the genus *Tabanus*, are considered the chief vectors of Surra [15]. At least twenty seven species of *Tabanus* have been experimentally discovered responsible for the transmission of *T.* evansi [15]. The mode of transmission of Surra by biting flies is through direct phenomenon, *i.e.*, occurring when flies take blood from infected animal. The parasites in the peripheral blood, and immediately after that feed on a hale and hearty animal. When dislodged from a host they seek the nearby accessible host to continue

feeding, a behavior which renders them proficient mechanical vectors of diseases. One *Tabanus* fly can infect three animals successively [16].

Age, gender and breed susceptibility

Bhutto et al. [17] reported that a higher percentage of infected camels were found in females (15.79%) as compared to males (9.84%). Husain et al. [14] reported similar data (15.68% for females and 11.76% for males) with a slight difference with earlier study. The difference may be due to stress during gestation and milk production rendering them more susceptible to *T. evansi* infection [12]. Bhutto et al. [17] also observed the highest (14.96%) infection rate in age group of more than 7 years. This was followed by 8.57% in age group of 3-7 years and the lowest 4.65% in less than age of 3 years. Higher infection is noted in males above four years of age compared with animals less than three to four years of age [12]. Similar results were also recorded for female camels. However, Pathak and Khanna [18] reported that all camels are equally prone to trypanosome infection regardless of breed and age.

As for the breed vulnerability is concerned the highest infection rate is observed in Sakrai breed followed by Kharai, Sindhi and Dhati breed has the least [17]. With increase in herd size infection chances increased as in one study it ranged from least to highest percentage in herds possessing one to five, six to ten, eleven to twenty and more than twenty animals [17].

Pathogenesis

The disease cause significant economic losses in areas where camel is reared causing morbidity up to thirty percent and mortality of around three percent [19]. This disease unfavorably affects the growth, reproduction as well as draught ability of the camel [20]. *Trypanosomiasis* in camel is typically chronic but can be acute with ninety percent mortality, if not treated [21]. There are some histological changes including primarily lymphocyte and some macrophage penetration in the connective tissue of all examined organs [22].

Clinical Signs

Signs of illness caused by *T. evansi* have been often reported which include: anemia, edema, paralysis of the rear legs and sterility among others [23]. *T. evansi* causes a wasting disease wherever the course is prolonged [24] associated with anemia and unsteadiness of hind limbs [25, 26]. Nervous signs have also been reported [27]. Frequent recurrent episodes of fever and parasitaemia occur at frequent intervals during the period of the disease. Oedema is also found at the lower parts of the body. Urticaria and petechial haemorrhages of the serousal membranes is sometimes seen [28].

Changes in Serum Bio Chemistry

In a study with infections concerning *T. evansi*, it has been reported that the action of enzymes was increased. Among them glucose-6-phosphate dehydrogenase and glutathione reductase and catalase are important in RBCs of the host [29]. These enzymes provide the first defence line against the attack of pro-oxidant agents [29]. Anemia [29], a lower mean total serum protein [31] as well as the lymphocyte numbers were decreased which developed in most infections due to powerful stimulation by antigens. This increases the demands for lymphocytes to be changed into plasma cells [32]. Neutrophilia were also observed in camels infected with *T. evansi* [32].

Diagnosis

Because the parasites may be hard to find in microscopic examination, recognition may be enhanced about tenfold by the haematocrit tube centrifugation technique or a modified miniature anion-exchange centrifugation technique [22]. Many tests especially serological tests include card agglutination test and enzyme-linked immunosorbent assay (Ab-ELISA) are important [33]. The polymerase chain reaction has been used to determine the occurrence of *T. evansi* in camels [19]. The PCR represents a reasonable tool for the studies of epidemiology which will be used to report the true incidence of the trypanosome infection and to allow the application of strategies to control the disease [34]. Application of PCR using *T. evansi* specific primers is the top method of *T. evansi* detection (90%) followed by the card agglutination test (60%), MI (50%), buffy-coat technique (18%) and wet blood film (30%) [34, 35].

Treatment

Drugs such as suramin, prothridium and isometamidium chloride (as a prophylactic) and

diminazene aceturate (curative) can be used although drug resistance has been reported. Higgins [36] suggested the use of anthrycide sulphate. Fazil [37] suggested that for an animal having body weight of 500 kg, two grams of anthrycide sulphate was practically sufficient as the dose rate of 4.4 mg per kilograms of body weight when injected by subcutaneous route. He argues against the administration of berenil because of its toxicity in camels. Balis and Richard [38] reported good efficiency of isometamidium chloride hydrochloride having the rate for dose of 0.5-1 mg per kilograms of body weight. They recommended its use only when more efficient drugs are not available. Dosages higher than 1 mg/kg are hardly tolerated by the camels [38]. Isometamidium is available under the brand name of Trypamidium Samorin in the form of injection by Marush and Saadat pharmaceuticals with good trypanocidal activity. Diminazine aceturate is available under the names of Dimenol, Fatrybanil, Diminazene DS and Dimenol. Combination therapy against Trypanosoma and other protozoa is available for diminazine and phenazone under the brand name of Diminol and Dimirine as well. For camels, melarsomine (cymelarsan) is very effective (curative) against *T. evansi*. This has been the most modern trypanocidal drug; cymelarsan has not been widely adopted but has excellent results [39]. In a study, it was reported that injection of melarsomine is excellent treatment at the dose rate of 0.25 mg/kg of body weight [40]. The protective efficacy of diminazene aceturate was as good as that of isometamidium chloride dictating that treatments against trypanosomosis are sufficient for combination with vector control. Pronil with a chemical composition of diminazine aceturate and antipyrine is available in Pakistan and has got results. This drug is being manufactured by a local company named as National Agencies Pakistan. Quinamine, Try-Ban and Biquin are also effective drugs with a chemical composition of quinapyarmine sulphate and chloride and more effective recent drugs for camel *Trypanosomiasis* are easily available in Pakistan. Two gram is sufficient as treatment dose for an adult over 350 kg body weight (personal experience). Tryponil is being sold with a chemical composition of diamenazine aceturate and phenazone in powder form to be injectable by making solution. Drug resistance of trypanosomes was studied by Witola et al. [41] for the first time that RNAi gene silencing in *T. evansi* was induced using plasmids. Gene responsible for adenosine transporter for drugs was knocked out. *TevAT1* knock-out had no effect on the activity of antrycide and suramin, but some resistance was conferred to samorin [41]. In 2009, a research was conducted and 3 diamidine compounds (DB 75, DB 867, and DB 1192) explored as lead compounds with the potential to act as preclinical candidates against the infection of *T. evansi*. They were more effective than the standard drugs quinapyramine, diminazene and suramin [42]. These studies demonstrate that resistance is becoming more common against which necessitate the importance of more reliable remedies. The vaccines may be one of them but they also accompanied with their own disadvantages. DNA vaccines can also be tried for control and prevention of trypnosomiasis as has been tried for other parasitic maladies [43-47].

Conclusions

For further studies, it is suggested to monitor drug resistance for areas where resistance of the drug may be encountered which will play vital role in future. Preservation of breeds with more trypano-tolerance but identification is the first and foremost arena in this subject matter of Trypanosomiasis. There should be efforts to stimulate skin reactions by injection of bloodstream forms of *T. evansi* intradermally to play a significant role in inducing immunity. It has been speculated that cattle with Trypanotolerance are indigenous to some areas.

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