



Review Article

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A Comprehensive Review of Diseases in Camels (*Camelus spp.*): Infectious, Parasitic, and Non-Infectious Disorders

Dr, Anjaliben Kantibhai Prajapati, Veterinary Officer, Veterinary Dispensary Kuvadva

Dr. Jainikkumar Hemantbhai Prajapati, Veterinary Officer, AIC Rajkot

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Abstract

Camels (*Camelus spp.*) are vital livestock in arid regions, providing milk, meat, fiber, leather, fuel, and transportation. As pseudo ruminants with three stomach compartments, they are uniquely adapted to desert environments through features such as humps for fat storage, long legs, and specialized ocular and nasal structures. Despite their resilience, camels are susceptible to a wide range of diseases affecting multiple organ systems, including digestive, respiratory, urinary, cardiovascular, nervous, musculoskeletal, dermatological, ophthalmic, and reproductive systems. Infectious diseases caused by bacteria, viruses, fungi, protozoa, and parasites, as well as non-infectious conditions like nutritional deficiencies, trauma, and plant poisoning, are commonly reported. Bacterial pneumonia, rabies, dermatophytosis, and ectoparasitic infestations such as scabies are particularly prevalent. Clinical signs, diagnosis, and treatment often parallel those in other large ruminants, though some conditions are camel-specific. Research on camel diseases, particularly in India, is limited, emphasizing the need for systematic studies to establish baseline data, guide therapeutic strategies, and improve health management for sustainable camel productivity.

Introduction

Camels, belonging to the order Artiodactyla and suborder Tylopoda, include Old World species—*Camelus dromedarius* (dromedary), *Camelus bactrianus* (Bactrian), and *Camelus bactrianus ferus* (wild Bactrian)—and New World camelids such as llamas, alpacas, guanacos, and vicuñas. Pseudoruminants with three stomach compartments, camels provide essential resources including milk, meat, fiber, leather, and fuel, and are used for transportation, riding, racing, and draft purposes. Their anatomical and physiological adaptations, such as fat-storing humps, long limbs, pendulous nostrils, and double-layered eyelashes, enable survival in harsh desert environments.

Camels are prone to diverse systemic disorders affecting the digestive, respiratory, urinary, cardiovascular, nervous, ophthalmic, dermatological, musculoskeletal, and reproductive systems. These include infectious diseases caused by bacteria (*Clostridium*, *Pasteurella*, *Mycobacterium*), viruses (rabies, poxviruses, FMD), fungi (dermatophytes), protozoa (*Trypanosoma*, *Theileria*, *Eimeria*), and ectoparasites (ticks, mites, lice), as well as non-infectious conditions such as trauma, nutritional deficiencies, plant poisoning, and behavioral disorders. Common conditions in camels include bacterial pneumonia, dermatophytosis, rabies, and scabies.

Given the economic and cultural importance of camels, particularly in Indian states like Rajasthan and Gujarat, there is a critical need for systematic research to generate baseline data, improve diagnostic and therapeutic strategies, and enhance overall camel health management.

Digestive System Diseases in Camels

Camels are susceptible to a wide range of digestive system disorders affecting the lips, oral cavity, pharynx, oesophagus, stomach, intestines, liver, and rectum. Common conditions include lip disorders, stomatitis, glossitis, palatitis, gingivitis, dental plaques, fractured jaws, pulpitis, alveolar periostitis, malocclusion, lampas, epulis, chick impaction, dulla, pharyngitis, pharyngeal paralysis or obstruction, choke, esophagitis, dysphagia, ectasia, diarrhoea, constipation, gastric ulcer, indigestion, enteritis, obstruction, peritonitis, tympany, neoplasia, rectal prolapse or lacerations, foreign body ingestion (FBI), hernia, hepatic lipidosis, and hepatic insufficiency.

Lip disorders in camels may range from mild inflammation to ulceration, particularly in infectious conditions such as camel pox, ecthyma, blue tongue, mucosal diseases, and foot-and-mouth disease (FMD). Lip sagging is commonly observed in older animals, and the lips may fold back under the chin when not involved in prehension. Additional causes include trauma from thorny vegetation, use of bits, fighting injuries, or repeated mineral licking. Hair loss around the lips is often associated with frequent mineral supplementation.

Dental abnormalities frequently observed include dental plaque formation, pigmentation changes, alveolar periostitis, pulpitis, fractures of incisors or canines, mandibular fractures, sharp enamel points due to malocclusion, excessive tooth wear, elongated teeth, dental fistulae, and other developmental defects. These conditions may lead to difficulty in prehension, mastication, and overall feed intake.

Dulla trauma is another notable condition, often caused by self-injury, fighting, thorny vegetation, or wire wounds. Clinical signs may include oedema, hematoma, perforation, sepsis, maggot infestation, necrosis, or gangrene depending on the severity and causal agent. In severe cases, retraction of an inflamed or degenerated dulla into the oral cavity can obstruct respiration. Food impaction in the dulla is also common, and chronic abscess formation may progress to fibroma development.

Proper diagnosis, timely intervention, and management of these digestive disorders are critical for maintaining camel health, welfare, and productivity.



Inflamed dulla

Gastrointestinal Disorders in Camels

Camels are prone to several gastrointestinal (GIT) disorders that can significantly impact their health, productivity, and survival. Common GIT conditions include choke, acid indigestion, simple indigestion, ruminal tympany, intestinal obstruction, diarrhoea, constipation, ingestion of foreign bodies, bloat, and hernia.

Choke occurs due to obstruction of the oesophagus by foreign bodies, coarse feed, or improperly chewed material, resulting in dysphagia, salivation, retching, and discomfort. Chronic cases may lead to esophagitis, aspiration pneumonia, or weight loss.

Indigestion and acid indigestion are frequently caused by sudden dietary changes, consumption of excessive concentrates, or low-quality feed. Clinical signs include inappetence, bloat, mild diarrhea, colic, and decreased milk production. Chronic acid indigestion may lead to ulcer formation and secondary metabolic disturbances.

Ruminal tympany (bloat) is characterized by excessive accumulation of gas in the forestomach. It may occur due to dietary changes, ingestion of fermentable feeds, or obstruction of eructation. Clinical signs include abdominal distension, respiratory distress, and in severe cases, death.

Intestinal obstruction may arise from foreign bodies, impaction, or volvulus, leading to colic, abdominal distension, constipation, and anorexia. Early diagnosis and intervention are essential to prevent necrosis or perforation.

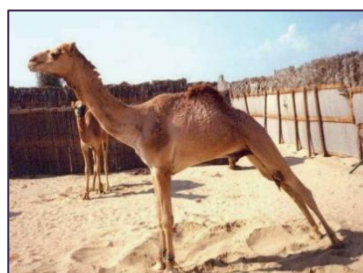
Diarrhea in camels can result from various infectious, parasitic, and nutritional causes. Etiologies include haemorrhagic enteritis, haemorrhagic septicaemia, trypanosomiasis, neonatal calf diarrhea, colibacillosis, salmonellosis, internal parasitism, and plant poisoning. Clinical signs include watery or hemorrhagic feces, dehydration, weakness, anorexia, and weight loss. Diarrhea in calves is particularly severe and can result in high morbidity and mortality.

Constipation and fecal impaction may occur due to low-fiber diets, dehydration, or mechanical obstruction. Clinical manifestations include straining, abdominal discomfort, reduced fecal output, and potential rectal prolapse.

Bloat and hernia are additional GIT conditions observed in camels. Herniation, often involving the abdominal wall or umbilical region, can lead to incarceration or strangulation of intestinal loops, requiring surgical intervention.



Colic Rolling on ground)



Colic (Stretching of limbs)

Effective management of GIT disorders in camels relies on prompt diagnosis, dietary management, supportive therapy, and, when necessary, surgical intervention. Preventive measures, including proper feeding practices, deworming, and avoidance of ingesting foreign objects, are critical to reduce the incidence of these conditions.

Systemic Disorders in Camels

Camels are susceptible to a wide range of systemic disorders affecting the respiratory, urinary, nervous, cardiovascular, ophthalmic, aural, and dermatological systems. These conditions can result from infectious, parasitic, congenital, traumatic, or metabolic causes.

Respiratory Tract Disorders

Respiratory diseases in camels involve both upper and lower airways and may be acute or chronic. Common conditions include rhinitis, laryngitis, tracheitis, bronchitis, pneumonia, aspiration pneumonia, pulmonary abscess, pleurisy, pulmonary congestion and edema, pulmonary hemorrhage, and narrowing of nasal passages. Etiologies include infectious agents, parasitic infestations, congenital defects, trauma, and environmental factors such as drowning. Clinical signs typically include nasal discharge, coughing, dyspnea, exercise intolerance, and fever, depending on the underlying cause.

Urinary Tract Disorders

Urinary diseases in camels encompass urinary ischemia, glomerulonephritis, pyelonephritis, nephrosis, embolic nephritis, cystitis, urolithiasis, urinary retention, and urethritis. These disorders often manifest as dysuria, hematuria, polyuria, oliguria, anorexia, and systemic illness. Early diagnosis and appropriate therapeutic intervention are critical to prevent irreversible renal damage.

Nervous System Disorders

Neurological diseases in camels include cerebral anoxia, hydrocephalus, cerebral edema, encephalitis, encephalomalacia, traumatic brain injury, brain abscess, coenurosis (GID), meningitis, toxicities, metabolic disorders, and nerve paralysis. Clinical signs may involve altered consciousness, ataxia, seizures, paresis, paralysis, and behavioral changes. These conditions often require thorough neurological examination, imaging, and laboratory diagnostics for accurate diagnosis.

Cardiovascular Disorders

Cardiac disorders reported in camels include heart failure (acute and chronic), peripheral circulatory failure, cardiomyopathy, pericarditis/traumatic pericarditis, atherosclerosis, hemorrhagic disease, edema, anemia, and lymphoblastic leukemia. Specific camel conditions include Kapali, an inflammation of the facial vein, and Khanid, which encompasses lymph node enlargement and hemorrhagic manifestations in the skin, mucous membranes, and other organs. Clinical presentations include lethargy, exercise intolerance, edema, jugular distension, and sudden death in severe cases.

Ophthalmic Disorders

Eye diseases in camels are diverse and include conjunctivitis, keratitis, keratoconjunctivitis, panophthalmitis, eye worm infestation, hyphema, and entropion. Clinical signs involve ocular discharge, redness, corneal opacity, photophobia, and impaired vision. Prompt intervention is essential to prevent permanent visual impairment.

Aural Disorders

Diseases of the ear include otitis externa, otitis interna, acral gangrene, and lacerations. Clinical signs may include head shaking, ear discharge, pain, hearing loss, and, in severe cases, necrosis of ear tissue.

Dermatological Disorders

Dermatological conditions in camels are common and include lymphadenitis, granulomatous lesions, friction injuries, contagious skin necrosis, skin abscesses, pityriasis (dandruff), parakeratosis/hyperkeratosis, skin tumors, urticaria/erythema, eczema, dermatitis, anasarca/subcutaneous edema, and mange. Clinical manifestations range from alopecia, scaling, and pruritus to severe necrosis and systemic illness. Causes are multifactorial, including infectious agents, parasites, nutritional deficiencies, and environmental stressors.



Lesion of Sarcopic mange in a camel

Reproductive System Disorders in Camels

Camels are susceptible to a variety of reproductive disorders affecting both males and females, which can significantly impact fertility, productivity, and overall herd performance.

Male Reproductive Disorders

Disorders of the male reproductive system include inflammation of the prepuce, paraphimosis, phimosis, hydrocele, pyocele, testicular hematoma, testicular tumors, funiculitis, orchitis, cryptorchidism, epididymal cysts, testicular hypoplasia, and testicular degeneration. Clinical signs commonly include swelling, pain, abnormal penile extrusion, reduced libido, infertility, and, in severe cases, systemic illness. Etiologies are multifactorial, including trauma, infections, congenital defects, and neoplastic conditions. Timely diagnosis and intervention are critical for preserving reproductive function.

Female Reproductive Disorders

Disorders of the female reproductive system in camels include cystic ovaries, ovarian hypoplasia, ovariobursitis, ovarian tumors, oophoritis, congenital anomalies, metritis, vaginitis, embryonic death, abortion, retention of placenta, prolapse of the vagina or uterus, dystocia, and uterine torsion. Clinical presentations include infertility, abnormal estrus cycles, vaginal discharge, systemic illness, and parturition difficulties. Causes are diverse, ranging from hormonal imbalances, infections, nutritional deficiencies, congenital defects, and traumatic events. Early identification and management are essential for maintaining reproductive efficiency and reducing economic losses in camel herds.

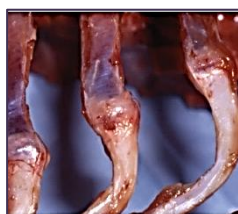


Uterine prolapsed in a female camel

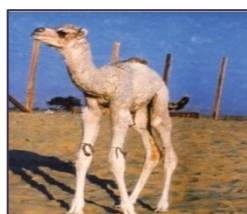


Fetal dystokia

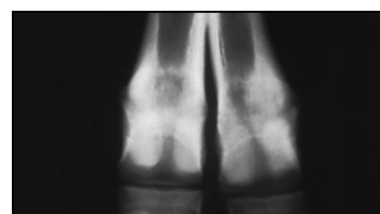
Camels are prone to a range of musculoskeletal disorders that affect locomotion, productivity, and overall health. Common conditions include punctured soles, worn or cracked toenails, foot gangrene, worn footpads, herniation of the digital cushion, elephant foot, rickets, osteomalacia, osteodystrophic fibrosa, osteomyelitis, fractures, myopathy, myositis, arthritis, dorsal fixation of the patella, patellar luxation, scoliosis, tail disorders, tumors, and sternal trauma.



Rachitic rosary in camel



Camel calf with clinical rickets



Rdiograph of legs of calf with rickets

Infectious diseases include a wide range of common bacterial diseases that affect animals and cause significant health and economic losses. Among these, clostridial diseases are caused by different species of *Clostridium* and are often characterized by sudden onset and high mortality. Botulism caused by *C. botulinum* leads to flaccid muscle paralysis, while tetanus due to *C. tetani* produces severe tetanic muscle spasms. Blackleg, caused by *C. chauvoei*, presents with fever, hemorrhagic swelling, and gas formation in muscles, whereas malignant edema due to *C. septicum* is marked by edematous swelling around wounds without gas formation and sudden death. Black disease (*C. novyi* type B) and bacillary hemoglobinuria (*C. haemolyticum*) are associated with sudden death, dyspnea, ataxia, anemia, and hemoglobinuria. Enterotoxaemia caused by *C. perfringens* varies by type, with type A causing

sudden death and colic without diarrhea, type C resulting in severe diarrhea, abdominal distension, and paddling, and type D leading to neurological signs such as convulsions, circling, posterior paralysis, and diarrhea. Other important bacterial diseases include tuberculosis caused by *Mycobacterium bovis*, *M. tuberculosis*, and *M. avium*; Johne's disease due to *Mycobacterium paratuberculosis*; anthrax caused by *Bacillus anthracis*; and brucellosis caused by *Brucella abortus* and *B. melitensis*. Necrobacillosis (*Sphaerophorus necrophorus*), actinomycosis (*Actinomyces* spp. and *Fusobacterium* spp.), hemorrhagic septicemia caused by *Pasteurella multocida*, abscesses due to *Arcanobacterium pyogenes* and *Corynebacterium pseudotuberculosis*, and mastitis caused by organisms such as *E. coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus* spp., and others are also commonly encountered. Additionally, streptococcal and staphylococcal skin diseases, colibacillosis, melioidosis, listeriosis, leptospirosis, and mycoplasmosis further contribute to the burden of bacterial infectious diseases in animals.



Encephalomalacia - Cl.

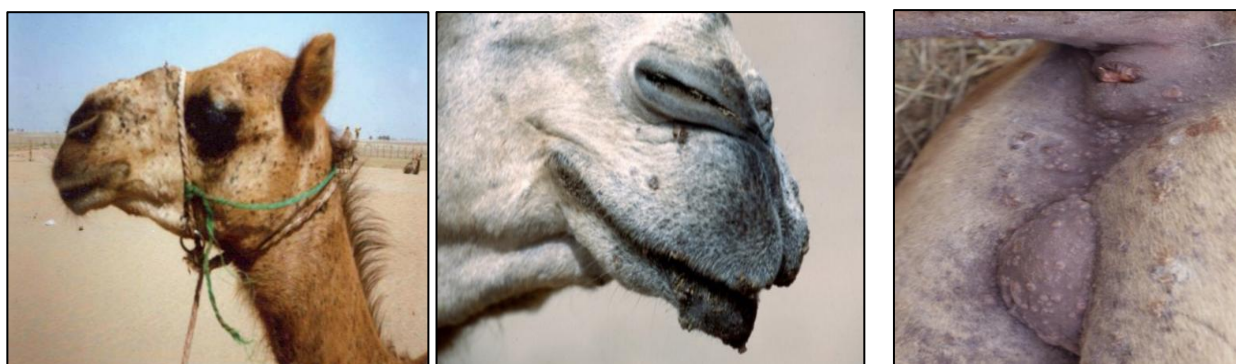


Abscess – Cor. pseudotuberculosis

Common viral diseases affect a wide range of animals and are caused by diverse groups of viruses with varying clinical significance. Rabies, caused by the Lyssa virus, is a fatal zoonotic disease characterized by nervous signs and aggressive behavior. Pox diseases, including camel pox, are caused by Orthopox viruses and lead to skin lesions and systemic illness, while contagious ecthyma caused by Parapox virus results in proliferative lesions around the mouth and lips. Foot and Mouth Disease (FMD), due to the Aphthous virus, is a highly contagious disease producing vesicular lesions on the mouth, feet, and teats, whereas rinderpest caused by the Morbilli virus is a severe systemic disease marked by high fever, diarrhea, and high mortality. Bluetongue, caused by an Orbivirus. Herpes virus diseases, such as those caused by Equine herpes virus-1, lead to respiratory, neurological, and reproductive disorders. Borna disease, caused by Borna virus, affects the central nervous system, while bovine viral diarrhea due to Pestivirus results in diarrhea, immunosuppression, and reproductive problems. Vesicular stomatitis, caused by a Rhabdovirus, produces vesicular lesions similar to FMD. Papillomatosis, caused by Papilloma virus, leads to benign wart-like growths. Viral encephalitis such as Eastern Equine Encephalitis caused by an Alphavirus and West Nile Encephalitis caused by a Flavivirus result in severe neurological signs. Influenza, caused by Influenza A virus, affects the respiratory system and can spread rapidly among susceptible animal populations.



Rabies in camel

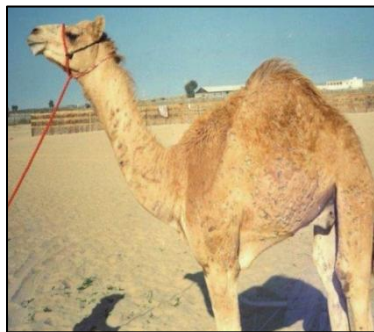


Camel pox

Common fungal diseases of camels are mainly represented by dermatophytosis, a contagious superficial fungal infection of the skin, hair, and keratinized tissues. Dermatophytosis is caused primarily by *Trichophyton* spp. and *Microsporum* spp. and is transmitted either directly through contact with infected animals or indirectly via contaminated equipment, housing, or grooming tools. Clinically, the disease is characterized by dry, hairless, circular patches covered with thick, scaly, grey-whitish crusts that are most commonly observed on the head, neck, shoulders, legs, and flanks. These lesions are typically non-pruritic, which helps differentiate dermatophytosis from other skin conditions. Treatment focuses on the use of antifungal agents, including topical antimycotics such as Mycostatin. Traditional topical applications like a mixture of 100 g sodium chloride with one liter of cooking oil or tincture of iodine mixed with glycerine in a 50:50 ratio are also effective. Additionally, enilconazole spray at a concentration of 0.2% applied two to three times at three-day intervals is commonly recommended. Systemic treatment with griseofulvin is generally not advised in camels due to the risk of adverse side effects, making topical therapy and proper hygiene the preferred approach for management and control.

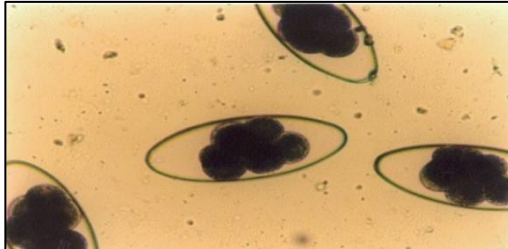
Parasitic diseases caused by helminths are common in camels and can significantly affect their health, productivity, and overall performance. Nematode infections are the most prevalent and include species such as *Haemonchus*, *Nematodirus*, *Camelostrongylus*, *Ostertagia*, *Marshallagia*, *Trichostrongylus*, *Cooperia*, *Nematodirella*, *Strongyloides*, *Trichuris*, *Oesophagostomum*, and *Bunostomum*. These gastrointestinal nematodes commonly cause anemia, weight loss, diarrhea, poor growth, reduced milk production, and general weakness, particularly in young or poorly managed camels. Cestode infections in

camels include *Moniezia* spp., *Stilesia vittata*, *Stilesia hepatica*, and *Echinococcus granulosus*, the latter being of major zoonotic importance as camels act as intermediate hosts, contributing to hydatid disease. Although cestodes often cause mild clinical signs, heavy infections may result in digestive disturbances and poor body condition. Trematode infections such as *Fasciola* spp., *Schistosoma* spp., *Ornithobilharzia* spp., and *Eurytrema pancreaticum* affect the liver, blood vessels, and pancreas, leading to chronic wasting, anemia, edema, reduced productivity, and sometimes death. Effective control of these parasitic diseases in camels relies on strategic anthelmintic treatment, improved management practices, and proper grazing and water source control to reduce exposure.



Skin lesions in camels - Dermatophytosis

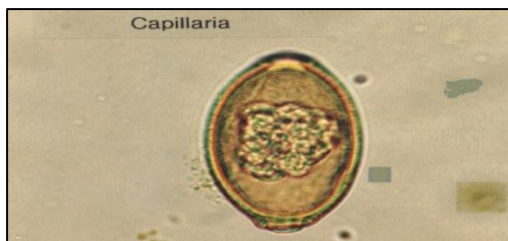
Endoparasites



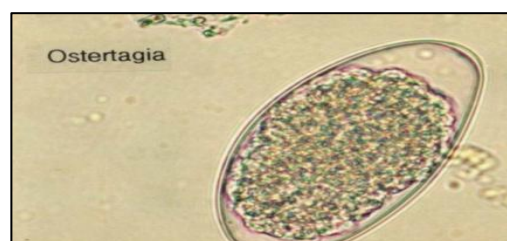
Nematodirus spp.



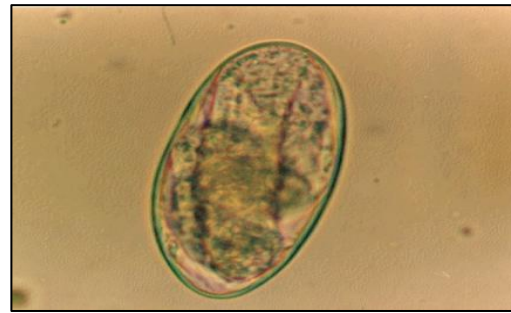
Trichuris spp.



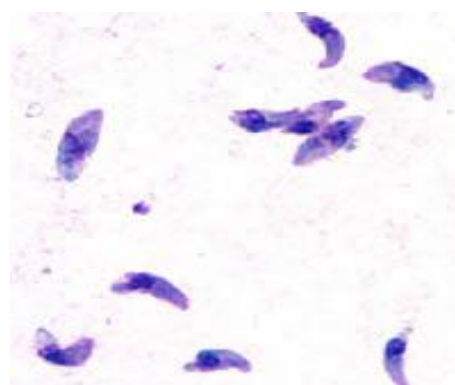
Capillaria spp.



Ostertagia spp.

*Monezia spp.**Strongyloides spp.*

Protozoal diseases are important infectious conditions affecting camels and can involve the blood or gastrointestinal tract, leading to significant health and productivity losses. Trypanosomiasis, also known as surra, is caused by *Trypanosoma evansi* and is a hemoprotozoan disease transmitted mainly by biting flies; it is characterized by intermittent fever, anemia, weight loss, edema, weakness, and reduced work performance. Theileriosis, caused by *Theileria* spp., is another hemoprotozoan infection transmitted by ticks and may result in fever, lymph node enlargement, anemia, and debilitation. Gastrointestinal protozoal diseases include balantidiasis caused by *Balantidium coli*, coccidiosis due to *Eimeria* spp., and cryptosporidiosis caused by *Cryptosporidium* spp., all of which commonly produce diarrhea, dehydration, poor growth, and weakness, particularly in young camels. Toxoplasmosis, caused by *Toxoplasma gondii*, primarily affects the gastrointestinal system and may also be associated with reproductive problems such as abortion. Control of protozoal diseases depends on vector control, good hygiene, proper management, and timely therapeutic intervention.

*Trypanosoma spp.**Toxoplasma spp.*



Eimeria spp.



Balantidium spp.

Ectoparasites

Ectoparasites are common external parasites affecting camels and include ticks, mites, lice, fleas, and flies. Tick infestations involve both hard ticks of the family Ixodidae, such as *Hyalomma spp.*, *Amblyomma spp.*, *Dermacentor spp.*, and *Rhipicephalus spp.*, as well as soft ticks of the family Argasidae, mainly *Ornithodoros spp.* Mite infestations are caused by *Sarcoptes scabiei* var. *cameli*, *Psoroptes spp.*, and *Chorioptes spp.* Lice affecting camels include the biting louse *Damalinia breviceps* and the sucking louse *Microthoracius minor*. Flea infestation is mainly due to *Vermipsylla spp.*, while fly infestations include *Cephalopina titillator* (nasal bot flies) and *Simulid spp.* (black flies or buffalo gnats).



Microthoracius cameli



Damalinia breviceps



Psoroptes spp.



Chorioptes spp.



Sarcoptes spp.

*Hyalomma spp.**Ornithodoros spp.*

Skin lesions in camels – Scabies (Sarcoptic mange)

Non-infectious and miscellaneous conditions in camels include a wide range of common disorders affecting health and welfare. These conditions comprise deficiencies, hypo- or hyperthermia, allergy, downer syndrome, dry coat, vices, plant poisoning, drowning, edema, bee or wasp stings, snake bites, wounds and burns, abscesses, saddle sores, dermoids, torn nostrils, pedestal issues such as callosity, trauma and ulceration, wry neck, goitre, and tail gangrene. Camels include several management- and behavior-related disorders. Mada refers to traumatic wounds and bite injuries, often associated with aggression or fighting. Satyriasis is characterized by chronic rut, love sickness, or excessive sexual desire. Allotriophagia, also known as pica, involves a perverted appetite and is associated with phosphorus deficiency. Shimbri or shimriki describes the bent neck or wry neck syndrome, while Gudanki is a condition in which the head is raised erect and the neck becomes stiff.

Nutritional deficiencies in camels manifest in various systemic and clinical disorders, including normocytic normochromic anemia, sway disease, microcytic hypochromic anemia, normocytic normochromic anemia associated with goiter, white muscle disease, dermatological issues, milk fever (not common but reported), skeletal abnormalities, allotriophagia or pica with macrocytic hypochromic anemia, intracellular acidosis, vision abnormalities, growth-related issues, and abnormal calcium utilization leading to skeletal problems.



Pedestal callosity

Plant poisoning in camels can result from ingestion of various toxic plants, leading to a range of clinical signs. *Datura alba* or *Stramonium* causes extreme lethargy and bloat. *Capparis tomentosa* leads to wry neck, staggering gait, convulsions, and weight loss. *Cassia occidentalis* induces diarrhea and can be fatal if consumed in large quantities. *Euphorbia tirucalli*, *Daphne oleiodes*, and *Buxus sempervirens* cause cough, swollen belly, straining to defecate, and foul-smelling diarrhea. *Nerium oleander* poisoning results in diarrhea, vomiting, convulsions, and death within a day. *Sarcostemma andongense* causes paralysis and wry neck, while *Sorghum bicolor* leads to bloat, severe abdominal pain, difficulty in breathing, and death.

Conclusions

Camel finds a noticeable position in the list of livestock animals having economic significance in Indian states, especially Rajasthan and Gujarat. This also happens to be the reason behind sparse availability of published report on camel research. Camels suffer from various systemic infectious and non-infectious conditions most of which are having similarities to other livestock animals such as cattle and buffalos. Only a few conditions are reported or defined especially for camels such as Mala and Khanid. Out of all infectious diseases, the most common diseases caused by bacteria, virus and fungus in camel are bacterial pneumonia, rabies and dermatophytosis, respectively. The etiological factors, clinical signs, diagnosis and treatment are similar to other ruminants. Camels suffer from various ectoparasitic diseases out of which, scabies is the most common and most prevalent. The symptoms, progression, diagnosis and therapeutic regimen also have similarities to that of cattle and buffalo. Reports on exact dose and dosage of all drugs under different categories are not available at length. Therefore, common practice involves use and administration of common drugs at the same dose rate which are established for large ruminants.

Future prospects

Strategically planned research should be encouraged to establish certain baseline parameters and to assess existing status of diseases of camels in different geographic regions by research institutions, either individually or in collaboration with NRCC, Bikaner.

The database generated through such research should be used as teaching material for UG and PG veterinary students and as extension/training material for camel owners/keepers.

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