Research Article

Hemato-Biochemical and Mineral Status in Dogs with Intermittent Diarrhea and Unthriftiness

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Abstract | Poor growth rate and intermittent diarrhea in pets are common problem faced on daily practice. *T. canis* is one of the most common cause to these problem and has a major health impact to both veterinarian and pet owner. This study aims to scrutinize hemato-biochemical and mineral status in dogs suffering from intermittent diarrhea and unthriftness due to *T. canis*. Thirty dogs were involved in this investigation, hematologic, serum and stool samples were taken and examined. Significant decrease in RBCs, HB, and PCV (P≤0.01, P≤0.001) along with significant increase *(*P≤0.05) in WBCs and eosinphils (P≤0.01) were the most consistent hematologic alterations recorded. Significant decrease (P≤0.01, P≤0.05) in TP, albumin accompanied by significant increase (P≤0.05) in ALT, AST and cholesterol values were found. Mineral profile showed significant decrease (P≤0.05) in zinc, copper and iron levels in the examined dogs. In conclusion, *Toxocara canis* infection appeared to have direct effect on mineral status, in dogs suffered from diarrhea due to *T. canis*, the cholesterol levels change; anemia is furthermore major health concern associated with the parasite and affects the growth of these dogs.

Keywords | Diarrhea, *Toxocara canis,* Mineral profile, Hematology, Biochemical alterations

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INTRODUCTION

In canine practice, one of the most recognizable problem faced on daily basis is intermittent diarrhea, which known to cause a major annoyance to pets' owners. Poor growth and diarrhea causes are varied, one of them is *Toxocara canis* (*T. canis*).

Toxocara canis is one of the most common and significant parasite-affecting dog cosmopolitan (Chattha et al., 2009; Traversa, 2012). *Toxocara canis* is a nematode belongs to Ascaridae family that inhabit dog's small intestine (Lawrence and Schantz, 1981; Yarsan et al., 2003).

Toxocara canis infection is directly correlated with GIT disturbance, diarrhea, vomiting, potbelly and poor growth are the most common clinical signs in puppies (Carter and Payne, 2005; Bowman, 2014).

The most common hematologic alteration associated with helminthes invasion of the body is eosinophilia (Löscher and Saothoff, 2008). Researches on minerals are complicated by the reality they have multi-function (Seyreck et al., 2009). Zinc plays an integral part in T-cell mediated reactions for host protection in opposition to parasite invasion (Shi et al., 1998). Copper is fundamental constituent of ceruoplasmin, which aid load iron into transferrin (Evans and Haliwell, 2001). Zinc and copper are essential component of SOD, an enzyme of major participation in oxidative process (Brodzki et al., 2015).

Research papers offered haemato-biochemical alterations and mineral profile status in dogs infected with *Toxocara canis* are scarce. Therefore, the present study aims to investigate hemato-biochemical alterations and mineral profile in dogs suffering from diarrhea and unthriftiness due to *Toxocara canis.*

MATERIAL AND METHODS

Thirty dogs of different ages, sexes, and breeds were involved in this study; the dogs were referred to small animal medicine-teaching hospital, faculty of veterinary medicine, Cairo University. Dogs showed poor growth rate and intermittent diarrhea were considered eligible for parasitologic investigation.

The stool samples of suspected dogs were examined by direct smear method, sedimentation method and salt floatation technique (Urquhart et al., 1996) under light microscopy. Identification of parasites was performed based on the morphological features (Soulsby, 1982).

Blood samples for hematologic evaluation were taken. Sera of infected dogs were analyzed for total protein, albumin, total bilirubin, cholesterol, triglycerides, ALT, AST, BUN, creatinine, potassium and sodium and mineral profile (Zinc, copper and iron) with respective test kits (Stanbio® Inc. USA, Spectrum-Diagnostics).

Student t-test (STATISTICA for Windows, version 5.1., StatSoft, Inc.) was used, P ≤ 0.05 significant.

RESULTS

Toxocara canis egg in the fecal samples of affected dogs (Figure 1) were found; egg was subspherical brown to light brown in colour. Pups below 3 months old were the most commonly affected.

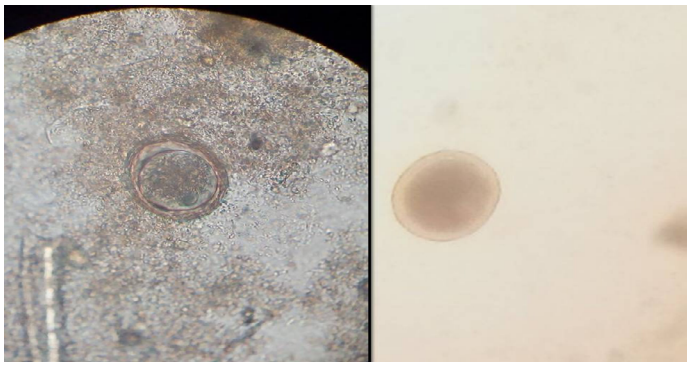

Figure 1: Stool sample examination under light microscopy reveals Toxocara canis egg

The hematologic alterations are shown in Table 1. Significant decrease in RBCs (4.886±0.2002), Hemoglobin content (10.840 ± 0.453) and PCV percentage (32.306 ± 1.18) (P≤0.01, P≤0.001 respectively) along with significant increase in WBCs (P≤0.05) and eosinophils counts (P≤0.01) (16.4200±1.09; 12.501±1.61 respectively) were observed compared to control data.

The serum biochemical and mineral profile alterations are shown in Table 2. Significant decreases (P≤0.01, P≤0.05 respectively) in total protein (5.534± 0.111), Albumin (2.710±0.29) along with significant increase (P≤0.5) in cholesterol, AST, ALT (244.427±22.4; 82.147±5.94; 67.416±12.25 respectively) were recorded.

The mineral profile showed significant reduction (P≤0.05) of zinc level, meanwhile copper and iron showed decrease (P≤0.05) in the levels in comparison to normal data and the decrease considered to be statistically significant.

DISCUSSION

In veterinary practice, diarrhea causes major annoyance to pet's owners, diarrhea of parasitologic etiology is known to decrease nutrient absorption from intestinal tract and hence causes unthriftiness.

Table 1: Hematologic alterations (Mean ± SEM) in *Toxocara* affected dogs compared to control data

Parameter	Patient data	Control Data
RBCs count	4.886 ± 0.2002**	6.033± 0.149
HB content	10.840 ± 0.453**	14.15 ± 0.44
PCV percentage	32.306 ± 1.18***	41.08 ± 1.16
WBCs count	16.4200 ± 1.09*	12.383± 0.990
MCV	61.126 ± 5.87	68.95 ± 2.05
MCHC	35.109 ± 0.909	33.742± 0.439
Neutrophil	57.538 ± 2.74	56.066± 3.02
Lymphocyte	28.103 ± 2.85	36 ± 2.29
Monocyte	6.27 ± 0.56	6.58± 0.59
Eosinophil	12.501 ± 1.61**	3.714 ± 0.56
Platelet	270.00 ± 5.08	273 ± 3.10

*p≤0.05; ** p≤0.01; ***p≤0.001

Table 2: Serum biochemical alterations (Mean ± SEM) in *Toxocara* affected dogs compared to control data

Parameter	Patient data	Control Data
Total protein	5.534± 0.111**	7.221 ± 0.64
Albumin	2.710 ±0.29*	3.742 ±0.245
Cholesterol	244.427 ± 22.4*	170.862 ± 18.9
Triglyceride	47.00 ±4.55	37.063 ± 4.706
Total Bilirubin	0.41 ± 0.13	0.35 ± 0.03
AST	82.147 ± 5.94*	49.75 ±9.87
ALT	67.416 ± 12.25*	36.131 ± 4.706
BUN	15.832 ±1.30	13.710 ± 0.740
Creatinine	1.455 ± 0.218	1.168 ± 0.124
Sodium	142.985 ± 0.776	146.5 ± 1.721
Potassium	4.151 ± 0.166	4.360 ± 0.449
Copper	97.483±19.19*	156.142±13.67
Zinc	64.047±8.381*	93.490±7.9
Iron	113.37±5.7*	156.660±13.336

*p≤0.05; ** p≤0.01; ***p≤0.001

In this study, puppies below 3 months old were the most common affected, the prevalence of *T. canis* tends to be higher in puppies, however, the adult dogs can be also infected (O'Lorcain, 1994; Ridley et al., 1994; Overgaauw, 1997). Dogs of all ages can acquire *Toxocara* infection (Bowman, 2009; Epe, 2009; Lee et al., 2010) nevertheless; the clinical picture tends to be more predominant in young puppies (Carter and Payne, 2005).

Significant reduction in erythrogram in parasitized dogs compared to control dogs suggesting anemia, correlation between *Toxocara* infection and anemia in puppies has been recorded (Deger et al., 1997; Ogunkoya et al., 2006; Chattha et al., 2009; Qadir et al., 2011; Kumar et al., 2014) but the exact cause of the anemia was not fully explained. However, in one research paper dealt with *Toxocara vitulorum* in buffalo calves, Sarma et al. (2012) postulated the anemia might be a result of oxidative stress and lipid peroxidation mechanism of tissue damage.

Eosinophilia was the predominant feature of *Toxocara canis* infected dogs leukogram, it is widely accepted that the eosinophils number is increased as a part of host protection in parasitic infection (Kwon et al., 2006). Eosinophils play a fundamental part in host defense mechanism against parasitic infection by lowering number of infectious agents (McEwen, 1992).

Significant reduction in total protein especially albumin level was observed in this study, the parasite can cause intestinal mucosa damage which may interfere with the mucosal absorption and digestion mechanism ability (Dargie and Allonby, 1975).

Significant increase in Cholesterol, AST and ALT levels were recorded. The epinephrine and corticosteroids that elevated due to stress might lead to consequent rise in cholesterol level (Atasoy et al., 2015). The elevated activities of liver enzymes might be correlated to increase hepatic cells permeability of those enzymes to blood stream due to the parasitic effect (Kumar et al., 2014).

Significant decrease in zinc level was found in this study, similar result was found in Arabian foal with *Parascaris equorum* (Salem et al., 2015). The impairment of absorption caused by the parasite physical damage to intestinal epithelial lining might be implicated (Ertan et al., 2002); however, Sarma et al. (2012) attributed the drop of zinc level to excessive consumption of zinc to counterbalance reactive oxygen species overproduction. The nematodes are believed to have outstandingly high content of zinc-dependent superoxide dismutase (Shi et al., 1998). Zinc deficiency weakens host response to parasite invasion and expanded parasite life span in host (Scott and Koski, 2000). Inverse correlation between copper and cholesterol levels has been recorded; animal with decreased copper level tends to have elevated cholesterol value (Rucker et al., 2008). Iron absorption and metabolism are impaired due to copper reduction (O'Dell and Sunde, 1997).

In conclusion, *Toxocara canis* infection appeared to have direct effect on mineral and cholesterol levels in dogs; anemia is furthermore major health concern associated with the parasite and affects the growth of these dogs.

CONFLICT OF INTEREST

The authors whose names are listed on this manuscript certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest in the subject matter or materials discussed in this manuscript.

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AUTHORS CONTRIBUTION

All authors were equally involved in preparation and making of this manuscript.

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