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Research Article

Pathological changes in female rat kidney tissue infected by *Toxoplasma Gondii*

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bstract: This study aimed to investigate the effect of *Toxoplasma gondii* infection in female t kidney tissue. The results showed that infection of rates to *T. gondii* alters some blood arameters such as urea, uric acid, and creatinine concentrations. In addition, the parasite fection affects the kidney tissue causing severe necrosis of the renal cells with bloody ngestion, bleeding, the occurrence of tissue cysts, anaphylaxis, bowman space, and renal bule expansion.

Keywords: *Toxoplasma gondii*, Fetal abnormality, Kidney, Rat.
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Introduction

Toxoplasma gondii is an intracellular parasite with worldwide distribution of pathological importance (Dubey 2009). The parasite reproduces sexually in the cat intestine as a primary host (Tenter et al. 2000). Inside the intermediate host such as human or rodent, parasitic infiltration through the central nervous system could occur leading to the slow formation of growing cysts inside neurons which could affect the host's life (Hutchison 1965). When a secondary host such as a rodent gets infected and eaten by a cat, the life cycle of the *T. gondii* would be accomplished (Lamberton et al. 2008).

The warm-blooded animals could be infected with *T. gondii* in the early three months of pregnancy leading to congenital diseases or abortion (Da Silva et al. 2006). *Toxoplasma gondii* may infect carnivores by eating bradyzoite occurring in meat tissue cysts while herbivores could be infected by ingesting oocysts from soil contaminated with cat faeces and also humans could be infected with both stages (Frankel 1999). Lymphadenitis is the most common clinical type of human infection with *T. gondii* but the congenital infection of the fetus is its major clinical problem that resulted during pregnancy from primary infection, also immunocompromised patients could be infected by ocular toxoplasmosis (Ghazaei 2006). This work aimed to study the effect of *T. gondii* infection on female rat kidney tissue.

Material and Methods

Infection procedures: In this study, 15 pregnant female Balb/c rats were infected with *T. gondii* by adding cat excretion in the water dish, and every five rats were placed in one cage. The control group included 5 rats placed in a separate area. 5 of the 15 rats were killed two months post-infection, their brains were collected, smears stained with Giemsa, and examined microscopically immediately for the cyst of *Toxoplasma*. For this purpose, 5 g of their brain were mixed with normal saline, 1000IU of penicillin, and 100 IU of Streptomycin. A solution of 10% was made, and 1ml of this solution was injected into 10 rats intraperitoneally (Beverley 1960). The injected rats were isolated in cages and their peritoneal fluid was examined. On the tenth day, the peritoneal was

Table 1. The effect of the parasite on the proportions of abnormalities embryos.

Groups	Eye abnormalities (%)	Limb abnormalities (%)	Fetal abnormalities (%)	Tail abnormalities (%)
1st. group (Control)	_	_	_	-
2nd. Group (infected with parasite)	20%	30%	60%	10%

washed with Phosphate Buffer Saline solution to examine the parasite by examining it under a light microscope using Gimsa stain (Dubey et al. 1998). The infected animals were killed after anesthesia and the living fetus was fixed directly into 10% formalin, then they were used for the histological studies by comparing those infected with those of the control group.

Hematological examinations: The blood samples were collected immediately after killing the rats from the heart in 5ml plastic containers with 10% EDTA as an anticoagulant. About, 1ml of blood per rat was collected on 2ml microtubes and used for Hb (g/100ml), RBCs count (cell/mm^3), WBCs count (cell/mm3) and PCV (%) tests (Schalam et al. 1975; Coles 1980; Sood 1987).

Biochemical tests: For the biochemical experiment, rat blood samples were kept in microtubes free of EDTA at room temperature and then centrifuged (1200g for 10min) to collect the plasma. All the biochemical examinations were done using a special kit for each test such as urea, uric acid, creatinine, ferritin, and iron (MacKey 1927; Itano 1978; Tietz 1999).

Histological study: The weight of the rats was measured before and after the experiment. Some parts of their kidney tissue were taken and fixed into 10% formalin. Then, the histological slides were prepared based on Drury *et al.* (1967)

Statistical analysis: Statistical analysis was done using SPSS (Version 2008) to compare means and standard deviations. $P \leq 0.05$ was considered statistically significant (Duncan 1955).

Results and Discussion

Phenotypic abnormalities: The results indicated that the incidence of abortion in the second group was 50% compared to the control group and infection with the parasite leads to miscarriages and congenital abnormalities in many births i.e. the mother's infection may be transmitted to the fetus and cause birth malformed and fetal death (Anne et al. 1971; Al-Ghezy et al. 2016). In addition, the small size of the placenta plays an important role in cases of miscarriages, and its cohesion with the uterus is weak causing uterine infections and repeated abortions (Babillstray & Anne 1997; Alhamdani & Mahdi 1997). The rate of fetal distortion was 60%, of which the limb distortion was 30%, followed by 20% of eye distortion and tail distortion at 10% (Table 1). The distortion was due to the secretion of antigenic substances that lead to hypersensitivity and breaking down the cysts, which had led to inflammation of the retinal tissues. The incidence of deformities in the extremities is represented by the shortening of the limbs (Walter et al. 2004) as a result of hemorrhagic necrosis of the limb tissues. Also, the tail deformation of the hooked end appeared as a result of necrosis at the bend site (Stahi et al. 2004). Significant decreases in rat weight, hemoglobin concentration, blood cell volume, red blood cells count, ferritin, and iron concentration were found compared to the control group (Table 2). Also, significant increases were observed in white blood cells count, uric acid, urea, and creatinine concentration compared to the control group due to the effect of the parasite on the kidney tissue causing a defect in the kidney functions (Alan et al. 1984; Reza et al. 2014).

Table 2. Parameters values in studied groups.

Measurements (Mean±SE)	1st group (control)	2nd group (infected with parasite)
Rat weight (g)	233.76±0.95744[a]	193.7±11.5299[b]
Haemoglobin concentration (g/100ml)	13.96±0.3874[a]	9.82±0.39[b]
Blood cell volume (%)	45.5±1.29[a]	34.5±1.73[b]
Red blood cells count (cell/mm3)	8.34±0.138[a]	6.226±0.18[b]
White blood cells count (cell/100ml)	8757±84.988[a]	9450±129.09[b]
Uric acid (mg/dl)	2.85±0.075[a]	3.52±0.05[b]
Urea (mg/dl)	24.83±0.781[a]	36.15±0.002[b]
Ferritin concentration (ng/dl)	127±54.03[a]	37.20 ±22.16[b]
Iron concentration (µg/dl)	105.0±2.160[a]	55.25±1.707[b]
Creatinine concentration (mg/100ml)	0.6825±0.069[a]	1.945±0.170[b]

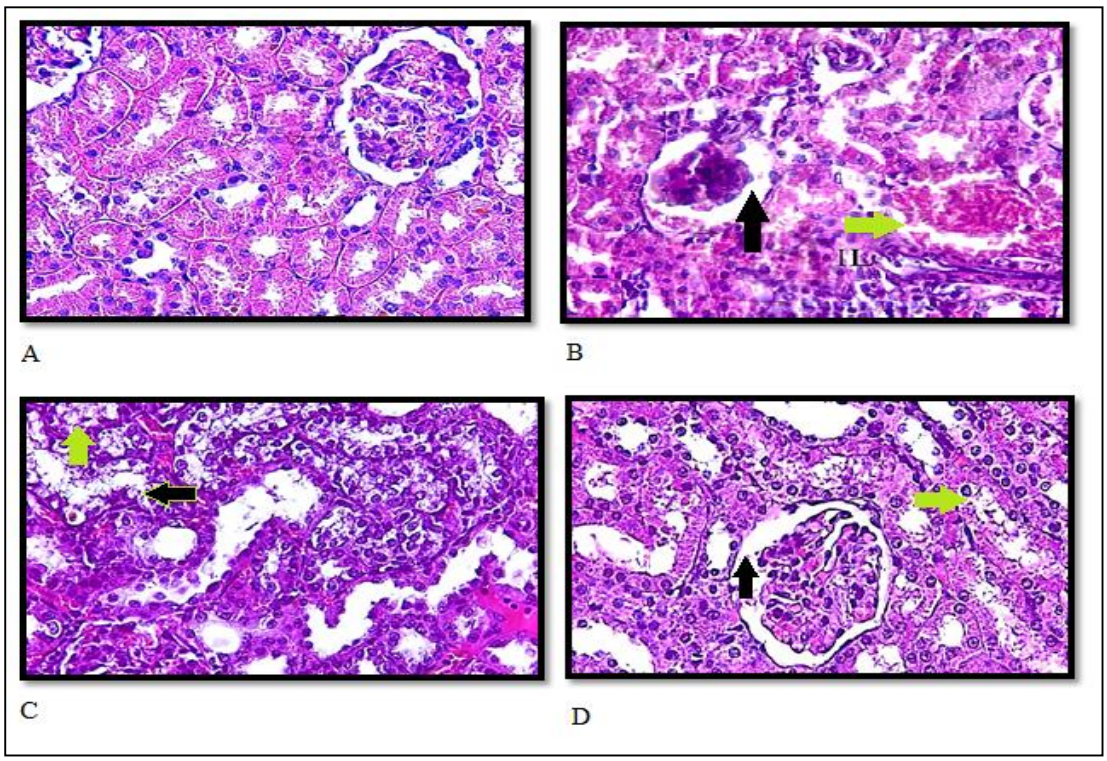

Fig.1. Cross section kidney (A): control group, (B): cross-section showing expansion of Bowman's space (black arrow) and hemmorage (green arrow), (C): cross-section showing necrosis and degeneration of cells (black arrow) and expansion of the lumen of the tubules (ىreen arrow) and (D) cross section showing the appearance (black arrow), the occurrence of explosions and hemorrhage (green arrow) (H&E, 400X).

Histopathological abnormalities in the kidney: The histological alternations of the kidneys in the group infected with the parasite are shown in Figure 1B, C, and D. The presence of representative pathological changes was observed with severe necrosis, degeneration of cells in the urinary tubules, and severe bleeding hemorrhage in kidney tissue comparing with the control group (Fig. 1A). The histological section, expansion of bowman's space and expansion of the lumen of the tubules renal and insult due to the parasites access to the kidneys, which led to the occurrence of many of

the pathological changes which caused damage to the glomeruli, severe bleeding, necrosis of the cells of the renal tubules, and the state of dystrophy.

As well as the occurrence of hemolysis and the emergence of dark areas in the tubules and glomeruli as a result of cell damage and these results are in agreement with the results or pathological changes in other studies (Toporovski et al. 2012; Shailendra 2012; Reza et al. 2014; Pereira et al. 2020). Also, the cause of cell necrosis is the result of the death of tubular cells due to lack of access to oxygen, and any damage to blood vessels, such as narrowing of the renal artery, may lead to poor blood flow and thus a lack of oxygen supply to cells, and cause of tissue damage occurs as a result of the release of the free phases of the parasite, which are directed to sites where antibodies are lacking and this leads to necrosis and destruction of tissue cells (Dubey et al. 2007).

Conclusion

Cats are inhabitants close to people in rural and urban areas of the world and are an important source of transmitting zoonotic parasites such as *Toxoplasma*. The current study showed the effect of the parasite on the physiological, biochemical, and histological features, especially the kidney tissue rate, causing cellular necrosis and degeneration in the cells of the renal tubules.

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