P- ISSN 1991-8941 E-ISSN 2706-6703 *Journal of University of Anbar for Pure Science (JUAPS)* Open Access
2018,12 (2) :08-17

A Seroprevalence of *Toxoplasma gondii* in human and chickens (*Gallus domesticus*) with histological effects on the internal chicken organs in AL-Door district, Salahdin province

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ARTICLE INFO

Received: 10 / 5 /2018
Accepted: 28 / 8 /2018
Available online: 3/1/2019
DOI: 10.37652/juaps.2022.171710

Keywords:
Toxoplasmosis.
Toxoplasma gondii prevalence.
Histological effects.

ABSTRACT

The present study included seroprevalence detection of *Toxoplasma gondii* in human and chickens (*Gallus domesticus*) in AL-Door district, Salahdin province, and the histological effects of *T. gondii* on some of internal organs (brain, kidneys, liver and muscles) from chickens. Positive seroprevalence result for human toxoplasmosis was recorded 22.3% with highest prevalence for positive IgG that reported 14.1%. Based on gender, significant increasing was recorded for toxoplasmosis in males 27.3% when compared with female 12.7%, while according to age, significant variances were reported among the age groups, the highest seroprevalence was 27.8% in age group 31-40 years. For seroprevalence of chicken toxoplasmosis, the percentage of positive results was 66.7%. Different histological effects were recorded in the current study such as congested blood vessels in the brain cortex tissue with vacuolation in the outer regions of brain, atrophied glomeruli in the renal cortex, masses of hepatocytes with presence of Kupffer cells, also cellular aggregation of fibroblast and WBCs in muscles.

Introduction

Toxoplasmosis is an important cosmopolitan zoonotic disease caused by coccidian parasite *Toxoplasma gondii* that belong phylum Apicomplexa (1). *T. gondii* is an obligate intracellular parasite that has a sexual cycle in the definitive host (cats and other felidae) and asexual cycle in all warm-blooded animals as intermediate hosts (2).

Human toxoplasmosis occurs via consuming tissue cysts from undercooked meat, eating or drinking contaminated food with infective stage that called oocysts and the accidental ingestion of oocysts from the environment.

Cats play the main role in the life cycle of *T. gondii* because these animals become infected by eating infected intermediate hosts, for example, birds and rodents. Also cats excrete environmentally resistant oocyst with the feces (3). Risk of toxoplasmosis occurs in the first 3 months of the pregnancy, the fetus will be at risk of abortion or congenital problems such as hydrocephalus, microcephalus and mental retardation (4).

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The present study aimed to detect seroprevalence of *T. gondii* in human and chickens (*Gallus domesticus*) in AL-Door district, Salahdin province, and the histological effects of *T. gondii* on some of internal organs from chickens.

Materials and Methods

Collection of Specimens

A total number 184 of serum specimens were collected from both male 121 and female 63 that aged between 10-40 years old who raise chickens in Al-Door district and a total number 264 of serum specimens were collected from their chickens. Collection of samples was performed during January to April of 2018. Serological and histological tests were carried out in laboratories of Veterinary College, Tikrit University.

Serological Study

According to manufacturer's instructions, seroprevalence of toxoplasmosis was detected by using *Toxoplasma gondii* IgG/IgM Rapid Test-Cassette (CTK Biotech, USA) for serum specimens of human and Toxo-Latex slide agglutination (Spinreact, Spain) for serum specimens of chickens.

Histological Study

The infected chickens were dissected and some of internal organs (brain, kidneys, liver and muscles) were recovered carefully. Then according to (5), histological sections were prepared.

Results and Discussion

Seroprevalence of Toxoplasmosis

In the present study, positive seroprevalence for human toxoplasmosis was recorded 22.3% and negative seroprevalence was 77.7%. IgM was detected in 4.9% of the total examined persons and IgG was reported in 14.1%, while both IgM and IgG were reported 3.3% (Table 1).

Table (1): Seroprevalence of human toxoplasmosis in Al-Door district.

Total No. of examined persons	Positive results n (%)	Negative results n (%)	IgM n (%)	IgG n (%)	IgM and IgG n (%)
184	41 (22.3)	143 (77.7)	9 (4.9)	26 (14.1)	6 (3.3)

This study agreed with study of (6) in Baiji district, Salahdin province, while disagreed with another studies in AL-Hawija, district, Kirkuk province (6), Al-Najaf province (7) and Wasit province(8).

Prevalence of human toxoplasmosis has different rates in the world according to many factors such as nutritional habits, lifestyle, socio-economic conditions and geographic area (9,10).

According to the current study, presence of toxoplasmosis in Al-Door district may due to most of families still raise different animals such as chickens, sheep and cattle, which are intermediate hosts and increasing in the number of stray cats. Also lacking the knowledge of the parasite and its transmission methods. In addition, AL-Door district lacks chlorinated drinking water and most of families in that area depend on chickens as a fresh source for meat.

In our study, prevalence of human toxoplasmosis IgM was higher than studies of (11) and (12) who that mentioned IgM 5%. While for human toxoplasmosis IgG, the present study was recorded lower percentage when compared with IgG 36% and IgG 46.75% by (11) and (12), respectively. Also the percentage for prevalence of IgM and IgG was lower than (11) and (12) which reported 13.45% and 47.40%, respectively.

Based on some of risk factors (gender and age), significant increasing was recorded for

toxoplasmosis in males 27.3% when compared with female 12.7% with non-significant differences between males and females for presence of immunoglobulins (Table 2).

Table (2): Seroprevalence and presence of immunoglobulins of human toxoplasmosis according to gender in Al-Door district.

Gender	Positive results n (%)	Negative results n (%)	Total n (%)	Presence of immunoglobulins			Total n (%)
				IgM n (%)	IgG n (%)	IgM & IgG n (%)	
Males	33 (27.3)	88 (72.7)	121 (65.7)	8 (24.2)	21 (63.7)	4 (12.1)	33 (80.5)
Females	8 (12.7)	55 (87.3)	63 (34.3)	1 (12.5)	5 (62.5)	2 (25.0)	8 (19.5)
Total	41 (22.3)	143 (77.7)	184 (100)	9 (21.9)	26 (63.5)	6 (14.6)	41 (100)
X^2 (P-value)	5.082 (0.024) *			2.248 (0.134) ns	3.029 (0.082) ns	0.002 (0.962) ns	

ns: no-significant differences and * significant differences.

Some of previous reports had shown higher seroprevalence rates of toxoplasmosis in females as compared to males whereas, other reports were recorded a higher prevalence rate in males as compared to females and the last reports agreed with the present study(13). The differences in the hormonal profiles of males and females may play an important role in determining the susceptibility to parasitic infections (14). It is widely accepted that certain hormones including the sex-associated hormones directly influence the immune system (15). It has been reported that estrogen enhances antibody production and androgen suppress both T- and B- cell immune responses, but immunity in females can be broken down due to various factors including nutrition, age, reproductive and certain environmental factors (16, 17).

While according to age, significant variances were reported among the age groups, the highest seroprevalence was 27.8% in age group 31-40 years followed by 23.7% and 10.9% in the age groups 21-30 and 10-20, respectively. In addition, highly significant differences were recorded among the age groups for IgG presence with non-significant variances among these groups for IgM also for IgM and IgG (Table 3).

Table (3): Seroprevalence and presence of immunoglobulins of human toxoplasmosis based on age in Al-Door district.

Age groups	Positive results n (%)	Negative results n (%)	Total n (%)	Presence of immunoglobulins			Total n (%)
				IgM n (%)	IgG n (%)	IgM & IgG n (%)	
10-20	5 (10.9)	41 (89.1)	46 (25.0)	3 (33.4)	1 (3.8)	1 (16.7)	5 (12.2)
21-30	14 (23.7)	45 (76.3)	59 (32.1)	4 (44.4)	8 (30.8)	2 (33.3)	14 (34.1)
31-40	22 (27.8)	57 (72.2)	79 (42.9)	2 (22.2)	17 (65.4)	3 (50.0)	22 (53.7)
Total	41 (22.3)	143 (77.7)	184 (100)	9 (21.9)	26 (63.5)	6 (14.6)	41 (100)
X^2 (P-value)	4.944 (0.044) *			3.704 (0.157) ns	20.544 (0.0006) **	1.500 (0.472) ns	

ns: non-significant differences, *significant differences and ** highly significant differences.

A direct correlation of seroprevalence of *T. gondii* antibody with age of the animals might be related to the fact that as animal became older, its cumulative likelihood for exposure increased or older animals had more opportunities to get infection than the younger ones (18).

For seroprevalence of chicken toxoplasmosis, the percentage of positive results was 66.7% and the percentage of negative results was 33.3% (Table 4).

Table (4): Seroprevalence of chicken toxoplasmosis in Al-Door district.

Total No. of examined chickens	Positive results		Negative results	
	Number	%	Number	%
264	176	66.7	88	33.3

The current study agreed with study of (19) that recorded 65% for prevalence of toxoplasmosis in domestic chickens in Diwaniyah city, also agreed with study by (20) that mentioned 76.6% for seroprevalence of toxoplasmosis in the turkey in some areas of Mosul province, while disagreed with (21) which reported 9% of toxoplasmosis in domestic chickens in AL-Hamdania district, Mosul province.

Chicken is one of the important intermediate host because it feeds from contaminated soil with the oocytes (22). In addition, chickens are considered as one of the most important hosts in the epidemiology of *T. gondii* because they are an efficient source of infection for cats that excrete the environmentally resistant oocysts and because humans may become infected with *T. gondii* after eating undercooked infected chicken meat (23), (24). The present study suggests that the main reason for prevalence chicken toxoplasmosis due to share chickens and cats in their feeding on the kitchen waste and presence stray cats, as well as that region lacks control over stray cats especially in the last years.

Only asymptomatic of chicken toxoplasmosis infections were recorded in the present study and this agreed with (24) that mentioned birds can be intermediate hosts for *T. gondii* with asymptomatic infections.

Histological study

According to the histological sections for the brain of infected chicken with *T. gondii* (Figure 1), the results showed following: (A) the brain tissue at the cortex (grey matter) demonstrated the presence of congested blood vessels that surrounded by white zone non-neuronal tissue, the outer region also had vacuolations around the pyramidal cells and some of the microglial cells.

(B) The cavities around the neurons were well demonstrated with presence of degenerated cells (neurons) in these cavities and appeared as a cellular debris.

(C) The brain tissue also included great masses of neural degeneration, which are difficult to recognize from the neural structures of neurons and the other microglial cells appeared as dense bodies. However.

(D) the cytoplasm of certain neurons included spherical bodies, which are following a parasite. Otherwise, the other neurons are partially degenerated and surrounded by peripheral cavitation.

(E) Control specimen for brain tissue with normal pyramidal cells and blood capillaries.

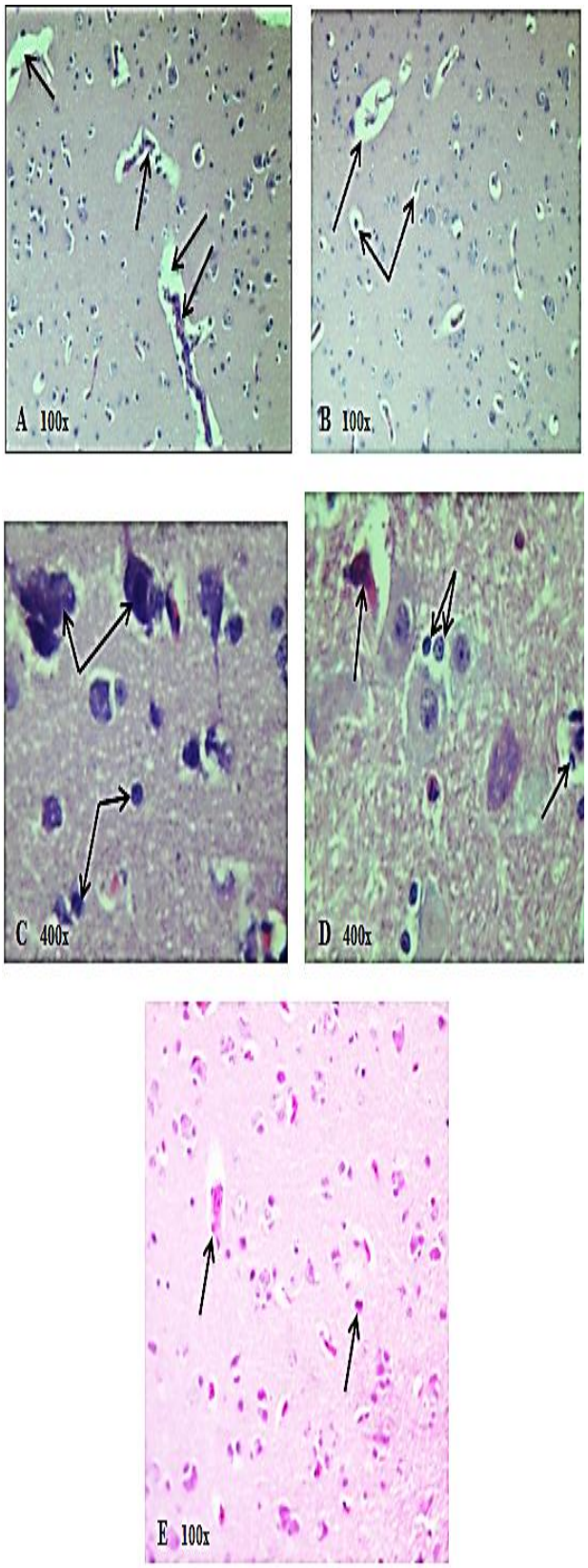

Figure 1: Histological sections for the brain of infected chicken with *T. gondii*.

The present study agreed with the study of (25) that reported congested blood vessels, degeneration and vasculitis in the brain of infected mice with *T. gondii*. Also, the current study agreed with (26) that mentioned a high rate of degenerating neurons associated with presence of *T. gondii* in the brain. This neurodegeneration may due to cell-mediated immunity that confers protection against *T. gondii* through the production of inflammatory molecules such as nitric oxide (NO) and neurons are highly susceptible to NO.

For kidneys of infected chicken with *T. gondii*, the histological sections (Figure 2) showed as following: (A) the renal cortex was including the presence of atrophied glomeruli with a great aggregation of lymphocytes and other WBCs on it's surface. Also, the mass of parasite could be recognized in-among WBCs. (B) The lymphocytic mass on the surface of glomerulus of kidney was well demonstrated which also extended along the periphery of glomerulus. (C) The proximal and distal convoluted tubules of the renal cortex were infiltrated by lymphocytes. (D) Medulla of kidney, reveal that the renal tubules were surrounded by lymphocytes and other WBCs infiltration. In addition, the lumen of these tubules was containing renal filtration. (E) The interstitial connective tissue of the renal medulla was thickened (hyperplasia) with collagenous fibers, which had many fibroblasts and lymphocytes. The renal tubules commonly shrunken from the basement membrane and a space was noted between the epithelial cells lining and the basement membrane with a few cellular debris in the lumen of these tubules. (F) Renal cortex with normal glomerulus.

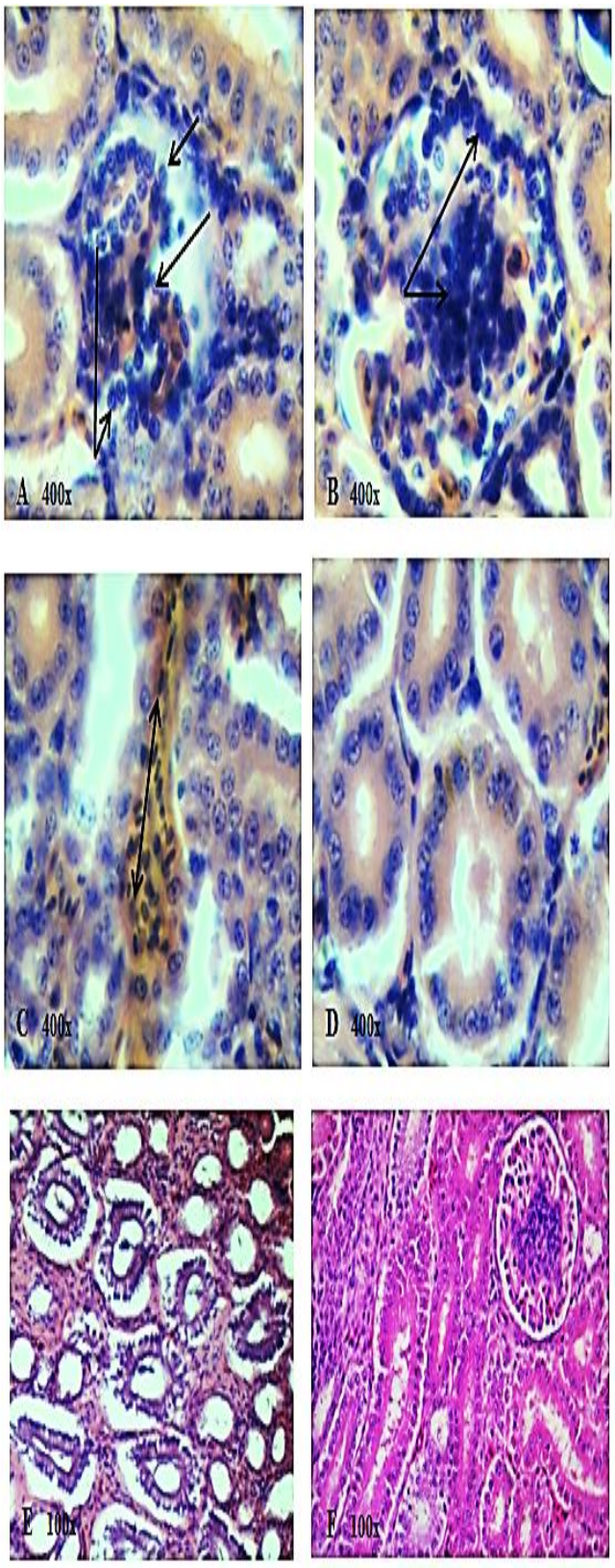

Figure 2: Histological sections for kidneys of infected chicken with *T. gondii*.

Result of the present study agreed with (13) that reported mild degree of congestion in renal parenchyma, clear urinary spaces in glomeruli and coagulative type of necrosis at some places that was indicative of severe inflammatory reaction. Also, at few places nuclei of tubular epithelial cells were condensed and pyknotic.

The liver tissue (Figure 3) was containing masses of hepatocytes (A), which are surrounded blood sinusoid with presence of Kupffer cells and parasite. (B) The hepatocytes were surrounded by lymphocytes in the form of diffusion and focal aggregation; also, the parasite could be recognized in the cells and blood sinusoids. (C) The hypertrophy of hepatocytes was demonstrated also with presence of cells debris in the sinusoids. (D) Control specimen with normal liver parenchyma.

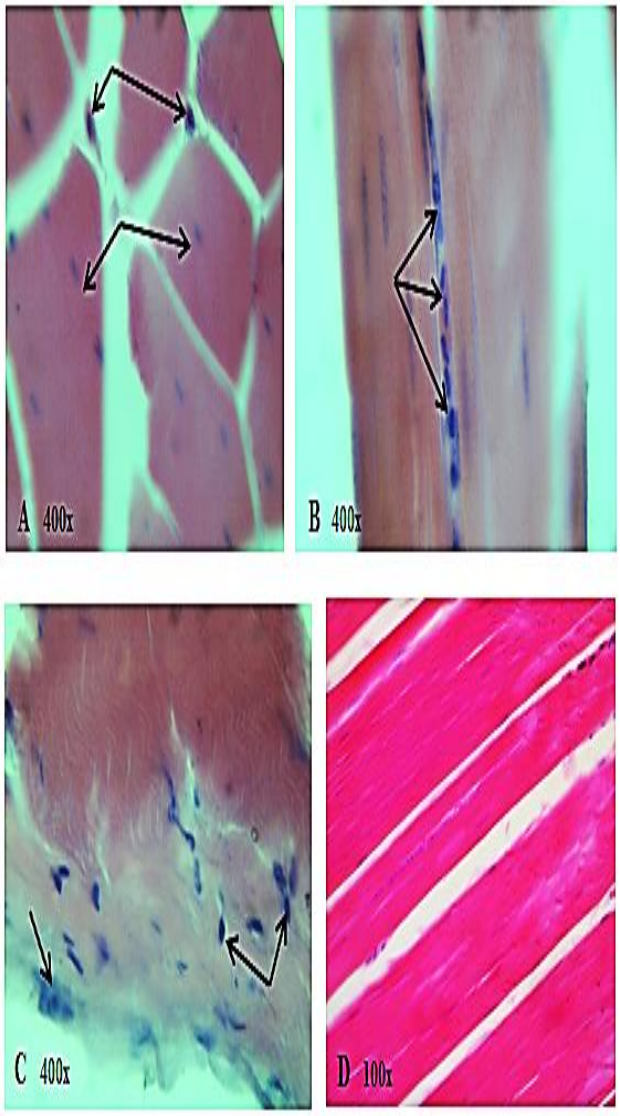

Figure 3: Histological sections for liver of infected chicken with *T. gondii*.

Results in the present study were closed to result of (13) that found vacuolar degeneration in liver. Sinusoidal places were dilated at few places. Cell swelling and individual cell necrosis of hepatocytes was also present. Plasma cells were observed at the site of inflammation. Bile duct hyperplasia was also recorded in the portal area. According to (27), the changes of individual cell might be due to the release of toxin(s) by the parasites, lymphokines by the inflammatory cells or small infarcts due to localized blood vessel occlusions at sites of parasite invasion.

Based on muscular tissue sections (Figure 4), the sarcoplasm of skeletal muscle fibers showed normal in cross and longitudinal sections and the perimysium was lodged with cellular aggregation of fibroblast, WBCs and possible parasite (A,B). The skeletal muscle fibers of other section demonstrated the presence of parasitic bodies, which are resting in the epimysium also (C). Control specimen of muscular tissue was normal (D).

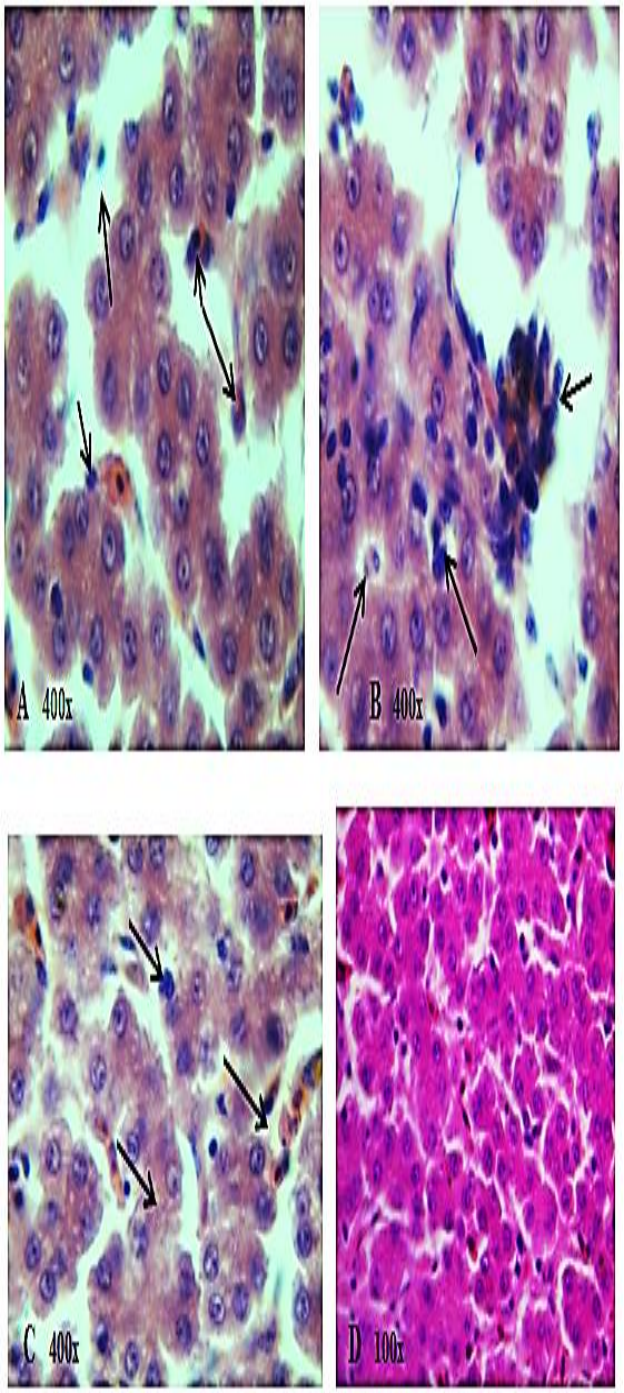

Figure 4: Muscular tissue sections of infected chicken with *T. gondii*.

Based on (24) that mentioned muscular toxoplasmosis with clear lesions and mononuclear cells infiltration can be happen, there are ample data from chickens indicating that *T. gondii* encysts in muscle more efficiently than in the brain.

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P- ISSN 1991-8941 E-ISSN 2706-6703 *Journal of University of Anbar for Pure Science (JUAPS)* Open Access
2018,12 (2) :08-17

الانتشار المصلي للمقوسة الكونديه في البشر والدجاج مع تأثيرات النسيجية على أعضاء الدجاج الداخلية في منطقة الدور ، محافظة صلاح الدين

سيناء ناجي محسن الدوري [1]، الشيماء محمد جاسم [2]، علي محمد عبد[2] وساريا ناجي محسن [2]

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الخلاصة:

هدفت الدراسة الحالية الى الكشف عن طفيلي المقوسة الكوندية في البشر والدجاج في منطقة الدور، محافظة صلاح الدين، والتأثيرات النسيجية للمقوسة الكوندية في بعض الأعضاء الداخلية (الدماغ والكليتين والكبد والعضلات) في الدجاج. تم تسجيل نتائج إيجابية لمعدل الانتشار المصلي لداء المقوسات الكوندية في البشر بنسبة 22.3% مع أعلى معدل لانتشار IgG والذي سجل 14.1%. بالاعتماد على الجنس، تم تسجيل ارتفاع معنوي لداء المقوسات في الذكور 27.3% مقارنة بالإناث 12.7%، بينما تبعاً للعمر فقد تم تسجيل فروقات معنوية بين الفئات العمرية، حيث أن اعلى نسبة انتشار مصلي كانت 27.8% في الفئة العمرية 31–40 سنة. أما الانتشار المصلي لداء المقوسات الكوندية في الدجاج فقد كان بنسبة مئوية 66.7%. كما تم تسجيل تأثيرات نسيجية مختلفة في الدراسة الحالية مثل انسداد الأوعية الدماغية في نسيج القشرة الدماغية مع تشكّل فجوات في المناطق الخارجية من الدماغ، ضمور كبيبات الكلى في القشرة الكلوية، وجود كتل من خلايا الكبد مع وجود خلايا Kupffer وكذلك تجمع خلوي للأرومات الليفية وكريات الدم البيضاء في العضلات.