Effect of chronic toxoplasmosis on levels of some neurotransmitters (Dopamine, Adrenaline, and Noradrenaline) in human serum

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Abstract
Latent *Toxoplasma gondii* infection has been considered asymptomatic for many years, but results of recent studies have associated it with various neuropsychiatric problems, including Alzheimer’s, Schizophrenia, Parkinson, Depression, Epilepsy. These chronic disease occur as a result of changes in the levels of hormones and neurotransmitters caused by parasitic infection in the host brain. A total of 45 blood samples of donors (33 men and 12 women) from AL-Najaf province, Iraq were tested for IgG anti-Toxoplasma antibodies by Elisa method and the results as follows 17 seropositive(12 male and 5 female) and 28 seronegative (21 male and 7 female). All samples were subjected to Elisa test to determine levels of three of neurotransmitters (Dopamine, Adrenaline, and Noradrenaline) in serum. The result show significantly (t test) higher serum levels of Adrenaline in patients with latent toxoplasmosis compared to controls (p<0.05). Both Dopamine and Noradrenaline hormones serum levels in patients showed a slight increase compared with control group, but statistically insignificant (p>0.05). Our findings suggest that chronic infection by *T. gondii* causes a change in some neurotransmitters and may be explained by the occurrence of certain neurological diseases in the incidence of latent toxoplasmosis.

Keywords: Latent toxoplasmosis, Neurotransmitters , Dopamine.

INTRODUCTION
*Toxoplasma gondii* is a protozoan parasite that is main or final host is cat but intermediate host is mammals and birds. It is estimated that 30–50% of the world suffers from toxoplasmosis, the incidence of toxoplasma infection in younger peoples has decreased from 20 – 25% to 10% in the United states of American and several countries in Europa during the past fifteen years, at same time, the incidence increased from about 5% – more than 10% in some Asian countries. In Iraq the seroprevalence of toxoplasmosis vary according to age, gender and region, they were ranging from 19-45% . *T. gondii* infection causes various neurological disease in host and alters neurological signaling pathways. *Toxoplasma gondii* as chronic infection producing distinctive neuropsychiatric diseases and alterations in its intermediate hosts, (humans and rodents). Miscellaneous human diseases that correlated with chronic *T. gondii* infection, including Alzheimer’s, schizophrenia, Parkinson, depression, epilepsy. Its induce behavioral changes in human and rodents, also a significant association between *T. gondii* infection and suicide attempts was reported. Many studies correlated these symptoms with alterations in hormones concentrations in host, that include sex hormones and neurotransmitters hormones. One factor that pay to the vague changes and neurological disorder in human and animal is modulate of neurotransmitters levels during chronic toxoplasmosis such as dopamine. In this paper we attempt to emphasis role of chronic toxoplasmosis in changes of three neurotransmitters levels in human serum.

MATERIALS AND METHODS
Forty-five samples (33 men and 12 women) of AL-Najaf province, Iraq aged 52.2±16.5 years were taken to investigate chronic toxoplasmosis using the Elisa method(IgG anti-Toxoplasma antibodies)(Calbiotech Inc.,). Five ml of blood were withdrawn from each person. The serum was isolated in eppendorf's tubes and kept at -80°C until use. Serum concentrations of Three neurotransmitters (Dopamine, Adrenaline, and Noradrenaline) were measured using Elisa method (Elabscience biotechnology Co., Ltd) and the results were expressed at mean ± standard deviation for both the total experiment and the control group. Statistical analysis was used with a single-tailed t-test and a 5% probability level using Microsoft Excel 2010.

RESULTS
Table 1 shows the population characteristics of the samples under study. The levels of neurotransmitters (Dopamine, Adrenaline, and Noradrenaline) were monitored. The levels of hormones in case or patients group (seropositive IgG *Toxoplasma* antibodies persons) and in control group (seronegative IgG *Toxoplasma* antibodies persons) in human serum were presented in table (2). The result show significantly higher serum levels of Adrenaline in patients with latent toxoplasmosis compared to controls (p<0.05). Both Dopamine and Noradrenaline hormones serum levels in patients showed a slight increase compared with control group, but statistically insignificant (p>0.05).

Table 1: Demographic data in current study.

<table>
<thead>
<tr>
<th>Categories</th>
<th>+ve IgG Toxoplasma</th>
<th>-ve IgG Toxoplasma</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples</td>
<td>17(37.8%)</td>
<td>28(62.2)</td>
<td>45</td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>21</td>
<td>33</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Age (year mean ±sd)</td>
<td>52.3±17.5</td>
<td>52.2±16.2</td>
<td>52.2±16.5</td>
</tr>
</tbody>
</table>
several studies have shown that an increase in the concentration of dopamine in the brain of rodents, such as stages limited in neurons during brain infection. There are synthesis of dopamine. Numerous studies have manipulate more than thousand genes in a body of infected host. T. gondii and the amount of dopamine released. The mechanism by which nervous system diseases are linked to pathological condition of the rats. In Toxoplasma- infection of toxoplasmosis in rats, and this change in norepinephrine was found to be lower in the chronic infection toxoplasmosis become not afraid of predators, cats, but rather become attracted to it. Toxoplasma gondii also induce behavioral changes in man and animals. The one of important mechanism that confirmed by study of Prandovszky et al. which provide interpretation for psychobehavioral changes in toxoplasmosis-infected humans is direct correlation between the number of infected dopaminergic cells in brain with T. gondii and the amount of dopamine released. The current study showed that there was no significant difference in the concentrations of dopamine and adrenaline between the group of chronic toxoplasma parasites and the control group, although there was a slight increase in concentration in the infected group from control parasites and the control group, although there was a slight change these factors are the strain of parasite, the severity of the infection and the specific variations of the host. In conclusion, changes in catecholamine levels in the incidence of toxoplasmosis gave an explanation of the mechanism by which nervous system diseases are linked to infection.

Table 2: Dopamine, Adrenaline, and Noradrenaline hormones levels in seropositive IgG Toxoplasma antibodies and control group.

<table>
<thead>
<tr>
<th>Hormones</th>
<th>+ve IgG (test) Mean ± SD</th>
<th>-ve IgG (control) Mean ± SD</th>
<th>P value (t test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dopamine (pg/ml)</td>
<td>1567.709 ± 273.340</td>
<td>1462.116 ± 204.858</td>
<td>0.0736</td>
</tr>
<tr>
<td>Adrenaline (pg/ml)</td>
<td>265.814 ± 189.790</td>
<td>169.203 ± 101.314</td>
<td>0.0329</td>
</tr>
<tr>
<td>Noradrenaline (ng/ml)</td>
<td>3.878 ± 2.065</td>
<td>3.451 ± 1.956</td>
<td>0.282</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Many may be unaware of the importance of toxoplasmosis and many consider it a secondary and transient disease, but recent studies have indicated that most psychiatric and neurological diseases affecting people are caused by the parasitic infection. The toxoplasma parasite is one of the most important parasites that manipulate its host, which contributes to the successful completion of its life cycle. Studies have shown that mice infected with toxoplasmosis become not afraid of predators, cats, but rather become attracted to it. Toxoplasma parasites manipulate more than thousand genes in a body of infected host. T. gondii and the amount of dopamine released. The mechanism by which nervous system diseases are linked to pathological condition of the rats. In Toxoplasma- infection of toxoplasmosis in rats, and this change in norepinephrine was found to be lower in the chronic infection toxoplasmosis become not afraid of predators, cats, but rather become attracted to it. Toxoplasma gondii also induce behavioral changes in man and animals. The one of important mechanism that confirmed by study of Prandovszky et al. which provide interpretation for psychobehavioral changes in toxoplasmosis-infected humans is direct correlation between the number of infected dopaminergic cells in brain with T. gondii and the amount of dopamine released. The current study showed that there was no significant difference in the concentrations of dopamine and adrenaline between the group of chronic toxoplasma parasites and the control group, although there was a slight increase in concentration in the infected group from control parasites and the control group, although there was a slight change these factors are the strain of parasite, the severity of the infection and the specific variations of the host. In conclusion, changes in catecholamine levels in the incidence of toxoplasmosis gave an explanation of the mechanism by which nervous system diseases are linked to infection.

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