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RESEARCH ARTICLE

EFFECTS OF HUMAN CYTOMEGALOVIRUS ON SOME HEMATOLOGICAL PARAMETERS AND LIVER FUNCTION IN PREGNANT WOMEN, YEMEN

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Abstract

Human Cytomegalovirus (HCMV) infection is a common congenital infection that affects approximately 0.7%–1% of all live births worldwide. Approximately 11% of newborns who are infected show symptoms at birth, and of these, between 30% and 40% are at a risk of experiencing long-term neurological complications. This study aimed to evaluate the effect of HCMV on hematological parameters and liver function in pregnant women in Hajjah governorate, Yemen. This study is a cross-section study that conducted in the Hajjah governorate of Yemen during a period of March to June 2023. A total of 108 blood specimens were collected from participants; 78 from patients group and 30 health group. Hematological parameters, such as total red blood cell count (RBC), hemoglobin (HB), platelet count (PLT), and white blood cells (WBC), as well as liver function tests, such as total protein, albumin, alkaline phosphatase (ALP), serum glutamic oxaloacetic transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), total bilirubin, and direct bilirubin, were measured. Majority of participant patients aged between 16–21 years 27 (34.7%), studied at secondary schools (46.2%), in their second trimester 51 (65.4%), those with multigravida 54 (69.2%), and those with no history of congenital diseases 60 (76.9%). Compared with the control group, the mean WBC levels were significantly lower in HCMV patients ($P < 0.05$), whereas PLT levels were higher among HCMV patients ($P < 0.05$). Additionally, the mean levels of total bilirubin, direct bilirubin, SGOT, ALP, and albumin were significantly lower in patients with HCMV than in HC ($P < 0.05$). Furthermore, there were no significant differences between the patient and healthy groups in terms of HB, RBC counts, SGPT, and total protein ($P > 0.05$). It can be concluded that HCMV infection had a statistically significant effect on WBC, PLT, total bilirubin, direct bilirubin, SGOT, ALP, and albumin levels in pregnant women. Consequently, further studies are needed to define the role of HCMV in liver disorders.

Keywords: Human Cytomegalovirus, HCMV, Hematological Parameters, Liver Function, Pregnant Women, Yemen.

Introduction

Human Cytomegalovirus (HCMV) is known as the herpes virus and is very common in adults and children, particularly in developing nations [1]. The transmission of CMV infection occurs through contact with contaminated bodily secretions, such as breast milk, urine, saliva, or genital secretions. It can cause serious harm to immunocompromised people, including foetuses, but typically has minimal symptoms in immunocompetent people [2, 3].

Globally, the prevalence of HCMV is 83% in the general population, 86% in productive women, and 86% in blood or organ donors [4]. Approximately 30–40% of these newborns are infected at birth, suggesting that primary HCMV infection during pregnancy is the greatest risk factor for congenital infection. However, only 1–3% of newborns from mothers with non-primary infections are affected [5, 6].

According to research conducted on primary maternal infections, transmission to the foetus varies with the trimester of pregnancy, with rates ranging from 20–30% in the first trimester to 72% in the third trimester [5–8]. As a result of HCMV infection or immune-mediated destruction, a foetus can suffer direct or indirect damage, including miscarriage, preterm birth, or fetal growth restriction [8]. According to reports, the prevalence of HCMV in pregnant women in Yemen was recorded at 100% in Sana'a [9], 98.7% in Hodeidah [10], 68% in Ibb [11], 75.79% in Yarim [12], 99% in Taiz [13], and 93.8% in Ad-Dhale'e [14].

Several studies have suggested that HCMV infection impairs the immune system's ability to respond to future antigenic challenges and increases the likelihood of developing liver dysfunction [15, 16]. In addition, a study by Farag *et al*. [17] revealed a strong and statistically significant correlation between HCMV seropositivity and elevated levels of some liver functional tests, which are indicators of liver dysfunction that can potentially culminate in liver cirrhosis.

The people living in Yemen's Hajjah Governorate face several challenges, including limited access to healthcare, widespread poverty, food insecurity, and unsafe drinking water. Each of these elements raises the possibility of being vulnerable to infectious diseases [18–22]. There is no data on the HCMV epidemiology in the governorate of Hajjah. Thus, the purpose of this study was to evaluate the HCMV effect on the hematological parameters and liver functional test among pregnant women in the Hajjah governorate, Yemen. These findings may provide a new foundation for comprehensive prospective studies of pregnant women with haematological diseases and liver functional status.

Materials and Methods

Study design and area

This study is a cross-section study that conducted in the Hajjah Governorate of Yemen during a period of March to June 2023. The Hajjah Governorate is situated in the northwestern region of Yemen, approximately 123 kilometers away from the capital city, Sana'a. The region is bordered by the Sa'ada governorate and the Kingdom of Saudi Arabia to the north, the Amran governorate to the east, the Al Mahwit and Al Hudaydah governorates to the south, and the Red Sea and a portion of the Al Hudaydah governorate to the west. The governorate has an approximate area of 10,141 square kilometers (3,915 square miles) and a population of 2,782,000 people. The mountainous areas of Hajjah Governorate experience a moderate temperature during the summer and cold weather during the winter, whereas the coastal plains are characterized by a hot and humid tropical environment in the summer and moderate winters. Hajjah Governorate is comprised of 31 districts, each of which is further divided into sub-districts and further subdivided into villages.

Study population and sample size

A total of one hundred and eight (108) blood specimens were collected from participants in this study, which were divided into two groups. This first group (patients group) is a pregnant woman suspected of being infected with cytomegalovirus infection and collected 78 samples. The second group, known as the control group, consisted of healthy women, from whom we collected 30 specimens. The patients were attended to the hospitals and centers in the city of Hajjah. The experimental work was performed at the medical laboratory at AL-Gumhorri hospital, the National Center for Central Public Health Laboratories-Hajj ah branch, and the Al-Tayseer laboratory that is located in Hajjah city.

Data collection

All participants received a brief explanation of the study's purpose and aims prior to specimen collection. A structured questionnaire that includes data about the socio-demographic (age, education level, and district name) and health characteristics (gestational trimester, gravidity, abortion status, and congenital malformation) were collected by face-to-face interviews using a structured questionnaire. We constructed the questionnaire in Arabic and translated it into English.

Inclusion and exclusion criteria

The pregnant women who were residents of Hajjah, suspected of having a HCMV infection, signed the informed consent, and delivered specimens were included. Conversely, pregnant women who are not living in the Governorate of Hajjah, are not suspected of HCMV infection, and refuse to sign the informed consent or sample collection were excluded from the study.

Samples collection and analysis

Blood collection:

Approximately 10 mL of venous blood was collected in sterile tubes from each study participant under aseptic conditions. Approximately 5 mL of specimen was transferred into a tube containing EDTA for hematological analysis, while the last 5 mL of specimen was transferred into a tube without anticoagulant for liver function analysis and cytomegalovirus detection.

Blood hemoglobin assessment:

Hematological parameters, such as total red blood cell count (RBC), hemoglobin (HBC) concentration, blood platelet count (PLT), and differential white blood cells (WBC), were measured using a fully automated hematology analyzer ADVIA® 360 (Siemens Healthineers, US).

Biochemical parameters:

The liver function tests including total protein, albumin, alkaline phosphatase (ALP), serum glutamic oxaloacetic transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), total bilirubin and direct bilirubin were measured by using spectrophotometers (Rogo-Sampaic Co., France).

Detection of Human Cytomegalovirus (HCMV) antibodies:

Anti-HCMV antibodies (IgM and IgG) in the serum of specimens were detected serologically using an Enzyme-linked Immunosorbent Assay (ELISA) Mindray MR-96A (Shenzhen Mindray Bio-Medical Electronics Co., China) according to the manufacturer's instructions.

Ethics approval:

The Ethical Review Board of Hajjah University's Department of Medical Microbiology, Faculty of Applied Sciences, Hajjah University, conducted and approved this study. Further, participation was voluntary, and participants completed a consent.

Statistical analysis:

The obtained outcomes were subjected to statistical analysis using the SPSS program, version 26 (SPSS Inc., Chicago, IL, USA). For descriptive analysis, the variables were presented in tables and figures as frequencies and proportions. In addition, the One-Way ANOVA test was used to evaluate the effect of HCMV on hematological parameters and liver functions. A *P*-value was set at < 0.05 to consider it statistically significant.

Results

Socio-demographic characteristics

Table 1 shows that the majority of participant patients who with the age group of 16–21 years (34.7%), who studied at secondary schools (46.2%), and who lived in Hajjah City (50%). Additionally, most specimens were collected from healthy individuals with the age group of 27–32 years (40.0%), who studied at preparatory schools (50.0%), and who lived in Hajjah city (50%).

Table 1. Sociodemographic characterization of patient cases and healthy control

Variables	Category	Patients group		Health group	
		No.	%	No.	%
Age group	16–21	27	34.7	9	30.0
	22–26	21	26.9	9	30.0
	27–32	15	19.2	12	40.0
	33–40	15	19.2	0	0
Educational	Illiterate	21	26.9	3	10.0
	Preparatory	15	19.2	15	50.0
	Secondary	36	46.2	9	30.0
	Graduate	6	7.7	3	10.0
Resident area	Rural	39	50.0	15	50
	Urban	39	50.0	15	50
District name	Hajjah City	39	50.0	15	50.0
	Hajjah	6	7.7	0	0
	Mabyan	3	3.8	3	10.0
	Sharas	3	3.8	0	0
	Ash Shaghadirah	6	7.7	3	10.0
	Al Miftah	6	7.7	3	10.0
	Al Mahabishah	3	3.8	3	10.0
	Aflah Al Yaman	3	3.8	0	0
	Abs	9	11.5	3	10.0

Most specimens were collected from pregnant women in their second trimester (51; 65.4%), those with multigravida (54; 69.2%), those with and without a history of abortion (39; 50%), and those with no history of congenital diseases (60; 76.9%), as listed in Table (2).

Table 2. Health characteristics according to pregnancy statement

Variables	Category	No.	%	98% CI	*P* value
Gestational trimester	1st trimester	3	3.8	2.21-2.40	0.000
	2nd trimester	51	65.4		
	3rd trimester	24	30.8		
Gravidity	Primigravida	24	30.8	2.36-3.03	0.000
	Multigravida	54	69.2		
History of abortion	Yes	39	50.0	1.55-1.73	0.000
	No	39	50.0		
Malformed Children	Yes	18	23.1	1.76-1.90	0.000
	No	60	76.9		

SD = Standard Deviation; ***P*** value: < **0.05** (significant)

Association between HCMV infection and some hematological parameters

Table 3 reveals that the mean concentrations of WBC and PLT were significantly lower in specimens collected from HCMV patients than in HC, with a statistically

significant difference (P < 0.05). The mean PLT concentration was higher among HCMV patients than HC (P < 0.05), and there was no statistically significant difference between HCMV patients and HC in the mean concentrations of HB and RBC (P > 0.05).

Table 3. Hematological parameters among infected patients compared with health individuals

Liver function	Cases type	No.	Mean ± S.D.	F	P value
WBC	Control	30	6.23 ±0.78	21.64	0.000
	Patients	78	5.08 ± 1.28		
HB	Control	30	14.10 ± 0.77	0.001	0.440
	Patients	78	14.09 ± 1.54		
RBC	Control	30	4.897 ±0.54	2.66	0.106
	Patients	78	5.12 ± 0.69		
PLT	Control	30	257.30 ± 58.87	75.36	0.000
	Patients	78	391.54 ± 77.34		

SD = Standard Deviation; ***P*** value: **< 0.05 (**significant)

Association between HCMV infection and liver function test

Table 4 shows that the mean concentrations of total bilirubin, direct bilirubin, SGOT, ALP, and albumin were significantly lower in specimens collected from HCMV patients than those in HC, with a significant statistical difference (P < 0.05). In contrast, there was no statistically significant difference between HCMV patients and HC in the mean concentrations of SGPT and total protein (P > 0.05).

Table 4. Liver function tests among infected patients compared with health individuals

Liver function	Cases type	No.	Mean ± S.D.	F	*P* value
Total Bilirubin	Control	30	0.67 ± 0.13	17.74	0.000
	Patients	78	0.49 ± 0.23		
Direct Bilirubin	Control	30	1.913 ± 1.01	22.88	0.000
	Patients	78	1.03 ± 0.80		
SGOT	Control	30	30.20 ± 3.74	5.62	0.020
	Patients	78	26.92 ± 7.29		
SGPT	Control	30	33.50 ± 5.05	1.63	0.205
	Patients	78	31.77 ± 6.82		
ALP	Control	30	196.40 ± 73.14	4.93	0.029
	Patients	78	165.92 ± 60.87		
Total protein	Control	30	7.630 ± 0.56	0.53	0.471
	Patients	78	7.54 ± 0.57		
Albumin	Control	30	4.50 ± 0.43	5.32	0.023
	Patients	78	4.27 ± 0.49		

SD = Standard Deviation; ***P*** value: **< 0.05 (**significant)

Discussion

Pregnant women in Yemen face many challenges, including medical challenges represented by the lack of appropriate health care during pregnancy and childbirth and the lack of awareness programs that increase women's awareness of the necessary precautions during the stages of pregnancy. Many studies have focused on the spread of viral and bacterial diseases in pregnant women in Yemen [23–25]. According to our knowledge, this study is the first report that evaluated the effect of HCMV on some hematological parameters and liver function in pregnant women in the governorate of Hajjah, Yemen.

The present outcomes revealed that the majority of infected pregnant women were in the age group of 16–21 years (34.7%). In a similar study, the high rate of HCMV infection was among pregnant women in the age group of 15–25 years [10] and 14–30 years [13]. This study is inconsistent because it documented that the high rate of HCMV infection was among pregnant women in the age group of 25–34 years (97.3%) [14] and 31–40 years [12]. In general, the frequency of HCMV is higher among women, people in older age brackets, people with lower socioeconomic status, and people in developing countries. The global prevalence of HCMV in women of reproductive age varies from 45% to 100% [26].

The difference in the results may be attributed to a variety of factors, such as geographical location, survey duration, study subject characteristics, differences in inclusion criteria, diagnostic approach, sample size, application of preventative and control measures, and socioeconomic status. However, other factors, such as hygienic practices, awareness, and the studied community, could also contribute to these discrepancies.

According to the current results, those who studied in secondary schools (46.2%) had the highest rate of HCMV prevalence. Different studies found a high proportion of HCMV infections in pregnant women with basic levels of education [10, 14]. In terms of gestational stage, pregnant women experienced the highest rate of HCMV infection in their second trimester (65.4%). Previously, HCMV had a high seroprevalence rate among pregnant women in the third and first trimesters [13], the first trimester [10], and the third trimester (95.9%) [14].

Pregnancy does not seem to increase the severity of maternal HCMV disease; however, among pregnant women, cervical shedding may be more common as pregnancy progresses. The incidence of occurrence is 5% during the first trimester, 6%–10% during the second trimester, and 11%–28% during the third trimester [27]. In this study, pregnant women with multigravida had a higher rate of HCMV infection (69.2%) compared with primigravida (30.8%). In earlier reports, it was

documented that a high rate of HCMV was found in women with a parity of more than one child [10, 13 –14].

This finding showed that approximately 50% of infected pregnant women had a history of abortion, and this result is in agreement with other research studies [13]. Gubran [28] conducted a study in Aden City, Yemen, and found that 83.3% of aborted women tested positive for HCMV-IgM antibodies. Therefore, additional investigations are necessary to identify HCMV and other factors that cause abortion in different regions of Yemen.

Furthermore, approximately 23.1% of pregnant women infected with HCMV have a history of congenital disease. This study is consistent with a previous report [10]. The prevalence of congenital HCMV is approximately 0.2-2.0% among all pregnancies. Each year in the United States, an estimated 20,000 to 40,000 newborns are born with congenital HCMV infection, as reported by Hughes *et al*. [29]. Screening for HCMV during pregnancy is not regarded as the most effective approach for preventing congenital infection. The lack of an effective antiviral treatment significantly contributes to the transmission of the virus from mother to fetus, resulting in either abortion or congenital abnormalities. Therefore, it is required to periodically screen women of childbearing age for HCMV infection in order to reduce the adverse outcomes of pregnancy caused by HCMV infection.

HCMV has a consistent impact on regulating the balance of blood T cells and a more extensive influence on other populations of lymphoid and myeloid cells [30]. This result showed that the mean WBC counts were significantly lower in patients with HCMV than in HC ($P < 0.05$). In contrast, the mean PLT concentration was higher in the HCMV group than in the HC group ($P < 0.05$). In contrast, there was no statistically significant difference between HCMV patients and HC in the mean concentrations of HB and RBC ($P > 0.05$).

In a study by Saleh *et al*. [31], the concentration of Hb and neutrophil count in patients with HCMV were 13.0233 and 75.2300, respectively, compared to the control group's values of 12.8733 and 74.2800, respectively, ($P > 0.05$). In addition, Hama and Abdurahman [32] observed similar results, indicating that HCMV seropositivity does not have a substantial impact on some blood parameters such as Hb concentration. However, Alebady *et al*. [33] showed a significant drop in haemoglobin (Hb) and neutrophil count in HCMV patients. HCMV is an intracellular virus found inside leukocytes that is particularly abundant in the neutrophil component of the buffy coat [34]. Laboratory tests showed normal results for the metabolic panel, renal function, and total blood count, except for a slight increase in the white blood cell count [35].

People with thalassemia (95.1%) and blood cancers (75.5%) were more likely to have a HCMV infection, according to a study of people with these conditions [36, 37]. In Bahia, Brazil, individuals with various haematological illnesses had a high frequency of HCMV infection (89.4%) [38]. Prior studies have established a correlation between microbial infection and the occurrence of haematological diseases [39–42].

Another report recorded that the median white cell count in the HCMV-positive group was considerably greater than that in the HCMV-negative group (10.1×10^9 cells/L versus 6.0×10^9 cells/L, P =0.001). In addition, there were no notable differences in other laboratory tests, such as transaminases, coagulation function, hemoglobin, platelets, erythrocyte sedimentation rate (ESR), C-reactive protein, procalcitonin, ferritin, and lactic acid levels between patients who experienced HCMV reactivation and those who did not [43].

Despite congenital HCMV infection carries significant consequences and is highly prevalent in terms of absolute numbers, pregnant women typically possess limited awareness of this condition, and healthcare professionals responsible for their care do not typically provide guidance on primary prevention. Pregnant women and those planning to conceive should be educated about this illness and methods to enhance cleanliness in order to prevent transmission [44, 45].

This study revealed a significant decrease in the mean levels of total bilirubin and direct bilirubin in patients with HCMV compared to those in healthy controls ($P < 0.05$). According to Vig *et al*. [46], the study HCMV-positive group had substantially higher mean total and direct bilirubin readings than the HCMV-negative group ($P < 0.05$). HCMV infection during pregnancy markedly elevated bile duct damage-associated markers, including total bile acid, direct bilirubin, and γ-glutamyl transpeptidase (γ-GT) [47]. Therefore, prognosis prediction and risk classification depend on the identification of HCMV positive. To determine if adjuvant antiviral medication can reverse this damage and enhance the prognosis for patients with HCMV-positive biliary atresia overall, more research is necessary.

In the current study, the mean SGOT and ALP levels were lower among HCMV patients than among HC ($P < 0.05$). This finding disagrees with the report by Zahid *et al*. [35], who showed an increase in ALP levels to 254 u/L. Recent measurements of mean ALP levels in the study and control groups revealed a significant difference [46]. In addition, Farag *et al*. [17] demonstrated an association between HCMV positivity and ALT, AST, ALP, and GGT levels. There was a significant difference in the positive correlations between the two antibodies. Furthermore, the four determined liver enzymes and two antibodies had independent correlations that allowed for

the determination of simultaneous liver damage linked to HCMV infection.

Furthermore, primary biliary cirrhosis and autoimmune hepatitis are frequently inducing by HCMV infection. This explains the highly significant positive association between HCMV antibodies and AST, ALT, and ALP that shown in the three age groups that were tested [48–49].

The present results showed that the albumin level was significantly lower in specimens collected from patients with HCMV than in those collected from HC ($P < 0.05$). The serum albumin level in the HCMV-positive group was significantly lower than that in the HCMV-negative group ($P = 0.039$) [43]. In contrast, there was no statistically significant difference between HCMV patients and HC in the mean concentrations of SGPT and total protein ($P > 0.05$). This finding is inconsistent with the results of a study by Zahid *et al*. [35].

Conclusions

It can be concluded that HCMV infection had a statistically significant effect on WBC, PLT, total bilirubin, direct bilirubin, SGOT, ALP, and albumin levels in pregnant women when compared with the control groups. Conversely, there was no statistically significant effect of HCMV on HB, RBC counts, SGPT, or total protein levels in the study and control groups. A proper hygienic environment, good diagnosis, and educational health promotion could be helpful in controlling HCMV and related abnormalities in pregnant women and their neonates. The development of newer, less toxic, antiviral agents with activity against HCMV may offer opportunities to study their role in prenatally decreasing HCMV shedding and preventing congenital infection. Further studies are required to determine the epidemiology of HCMV in pregnant women in the study area and other geographic zones of Yemen.

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Conflicts of Interest

The author declares no conflicts of interest.

Data Availability Statement

The datasets used and analyzed during the current study available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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مقالة بحثية

تأثير الفيروس المضخم للخلايا البشرية HCMV على بعض خصائص الدم ووظائف الكبد لدى النساء الحوامل، اليمن

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المُلخّص

الاصابة بفيروس المضخم للخلايا البشرية (HCMV) هي عدوى خلقية شائعة تؤثر على حوالي 0.7% الى 1% من جميع المواليد الأحياء في جميع أنحاء العالم. حوالي 11% من الأطفال حديثي الولادة المصابين بهذا الفيروس تظهر عليهم أعراض عند الولادة، ومن بين هؤلاء، يتعرض ما بين 30% و40% لخطر الإصابة بمضاعفات عصبية طويلة الأمد. هدفت هذه الدراسة إلى تقييم تأثير فيروس HCMV على بعض خصائص الدم ووظائف الكبد لدى النساء الحوامل في محافظة حجة، اليمن. هذه الدراسة عبارة عن دراسة مقطعية أجريت في محافظة حجة، اليمن، خلال الفترة من شهر مارس إلى يونيو للعام 2023م. وتم جمع عدد (108) عينة دم من النساء الحوامل؛ منها 78 عينه من المرضى و30 عينة من الأصحاء (مجموعة ضابطه). تم أجراء قياس تراكيز خصائص الدم مثل عدد خلايا الدم الحمراء (RBC)، والهيموجلوبين (HB)، وعدد الصفائح الدموية (PLT)، وعدد خلايا الدم البيضاء (WBC). بالإضافة إلى اختبارات وظائف الكبد، مثل البروتين الكلي، ألبومين، *الفوسفاتيز القلوي* (ALP)، الجلوتاميك-أوكسالوسيتيك ترانساميناس (SGOT)، إنزيم ناقلة الأمين الجلوتاميك-بيروفيك (SGPT)، والبيليروبين الكلي، والبيليروبين المباشر. أظهرت النتائج بأن 27 (34.7%) من المرضى تتراوح أعمارهن ما بين 16-21 سنة، يدرسن في المدارس الثانوية (46.2%)، يحملن في الثلث الثاني 51 (65.4%)، لديهن حمل متعدد 54 (69.2%)، وليس لديهن تاريخ من الأمراض الخلقية 60 (76.9%). بالمقارنة مع مجموعة الضابطة، كان متوسط تركيز WBC أقل بكثير في المصابات بفيروس HCMV وذات دلالة احصائية ($P < 0.05$)، في حين أن مستويات الـ PLT كانت أعلى بين المرضي بفيروس HCMV ($P < 0.05$). وبالإضافة إلى ذلك، فإن متوسط مستويات البيليروبين الكلي، والبيليروبين المباشر، وSGOT، وALP، والألبومين كانت أقل بكثير في المرضى المصابات بـ HCMV عن ما هو في المجموعة الضابطة ($P < 0.05$). وعلاوة على ذلك، لا توجد فورق معنوية ($P > 0.05$) بين مجموعات المرضى والمجموعات الضابطة فيما يتعلق بتراكيز HB، RBC، SGOT، والبروتين الكلي. يمكن الاستنتاج أن الإصابة بفيروس HCMV كان لها تأثير ذو دلالة إحصائية على تراكيز WBC، PLT، البيليروبين الكلي والمباشر، SGOT، ALP، والألبومين لدى النساء الحوامل. وبالتالي، هناك حاجة إلى مزيد من الدراسات لتحديد دور فيروس HCMV في اضطرابات الكبد.

الكلمات المفتاحية: الفيروس المضخم للخلايا البشرية، HCMV، خصائص الدم، وظائف الكبد، النساء الحوامل، اليمن.

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