Hepatitis C Virus and *Helicobacter Pylori* Infections in Pediatric non-Hodgkin's Lymphoma

**Amal H. Atta, Nehad A. Karam**, Ehab Abd El-Hamid and Manal El-Nemer
Microbiology & Immunology, Pediatric and Pathology Departments,
Faculty of Medicine, Zagazig University

It has been recently hypothesized that Hepatitis C virus (HCV) and *Helicobacter pylori* (*H. pylori*) might be involved in the pathogenesis of non-Hodgkin's lymphoma (NHL). However, most of the studies were done on adult patients. So the objective of this study was to determine the prevalence of these infections in pediatric NHL patients and if there is any possible clinical or histopathologic picture linked to the presence of these infectious agents. The study was carried out on 40 pediatric NHL patients, either as new cases or with relapsing disease, presenting to the Hematology Unit of Pediatric Department. In addition, 20 apparently healthy children were studied as control group. Each child was investigated for the presence of *H. pylori* and HCV IgG antibodies using enzyme immuno-assay (EIA) and for the presence of HCV-RNA by the reverse transcriptase polymerase chain reaction (RT-PCR). *H. pylori* IgG antibodies were detected in 19/40 of pediatric NHL patients (47.5%) and in none of the control group (*P* < 0.001); whereas HCV antibodies were found in 8/40 of the patient group (20%) and in 1/20 of controls (5%) (*P* > 0.05). HCV-RNA was detected by RT-PCR in 7/40 (17.5%) of the patients and in none of the controls. No specific histological subtype, extra-nodal presentation nor stage of disease was related to *H. pylori* or HCV positivity. Older age group was related to *H. pylori* positive NHL patients. Also a positive relation between the presence of *H. pylori* antibodies and the complaint of vomiting and diarrhea was observed in the patient group (*P* < 0.001). In conclusion, a high prevalence of HCV and *H. Pylori* infections was reported in pediatric NHL patients. As regard the hypothesis of their pathogenetic role in lymphomagenesis it is still unclear, whether these agents have a direct role in malignant transformation in pediatric lymphoma since a typical NHL clinico-histological feature associated with HCV and *H. pylori* is deficient.

**INTRODUCTION**

Non-Hodgkin's lymphoma (NHL) is a common condition whose incidence has increased by 75% over the last 15 years. The HIV epidemic is among the factors that contributed to this increase. Patients with AIDS have 1% annual risk of developing NHL, and the increase in survival of AIDS patients has led to an increase in the frequency of AIDS-associated lymphoma (1).

The etiology of non-Hodgkin's lymphoma remains a controversial matter, but in the last few years considerable evidence suggests that inherited or acquired immune-deficiencies are associated with an increased incidence of lymphoma. The role of toxic chemicals, especially those used in farming, is receiving increasing attention. Also a number of infectious diseases promote the occurrence of lymphoma (1). Several viruses other HIV viruses have been identified as possible etiologic agents for NHL; one of the best studied is the Epstein-Barr virus, which was detected in patients with Burkitt's lymphoma. In addition, the human T-cell lymphotropic virus type-I (HTLV-I) was also recognized as a possible cause for several lymphoma such as cutaneous T-cell lymphoma and T-cell leukemia-lymphoma syndrome and HTLV-II was associated with T-cell hairy cell leukemia (2).

Recently, hepatitis C virus has also been recognized as a possible etiologic agent of several hematological malignancies such as low grade malignant lymphoma, mixed cryoglobulinemia and Waldenstrom's disease (3). Thus, it is evident that many infections may play a pathogenetic role in the occurrence of lymphoma. Owing to its heterogeneity in site and different cell types, several infectious agents may contribute to this nature of lymphoma (4).

Also numerous studies confirmed the crucial role of *H. pylori* in the pathogenesis of
gastritis, peptic ulcer and gastric cancer (1,2). Moreover, *H. pylori* infection has been linked to extra-gastric mucosa-associated lymphoid tissue (MALT) lymphoma, based on the observation that early eradication of this infection in low-grade tumors leads to complete remission (5).

Many studies done on adult NHL patients confirmed a pathogenetic role of HCV for a subset of B-cell NHL and *H.pylori* with MALT lymphoma (8,9). Therefore, we aimed to study if there any increased frequency of HCV and *H.pylori* infections in pediatric lymphoma patients when compared to healthy children. In addition, we sought to find out any clinical or histological distinctive features in those who are HCV and *H.pylori* positive to find out if they have a possible role in lymphomagenesis.

SUBJECTS, MATERIALS & METHODS

The present study was carried out in the Microbiology & Immunology, Pediatric and pathology Departments, Faculty of Medicine, Zagazig University in the period from September 2004 to September 2005. The studied subjects consisted of 40 pediatric lymphoma patients, diagnosed at the Hematology Unit, Pediatric Department, Zagazig University Hospitals. They were 23 males (57.5%) and 17 females (42.5%) and their age ranged from 1 to 15 years with mean of 7.4 ± 4.2 years. They were either new cases or cases in active disease (during relapse). The diagnosis was based on clinical, hematological and pathologic examination as well as imaging. Twenty apparently normal children [12 males (60%) and 8 females (40%)], not suffering from any malignancy, abdominal or hematological conditions, with matched age, sex and socioeconomic condition were studied as a control group. Their ages ranged from 1 to 15 years with mean of 6.8± 4.3 years. They were either new cases or cases in active disease (during relapse). The diagnosis was based on clinical, hematological and pathologic examination as well as imaging. Twenty apparently normal children [12 males (60%) and 8 females (40%)], not suffering from any malignancy, abdominal or hematological conditions, with matched age, sex and socioeconomic condition were studied as a control group.

Blood sample (3 ml) was withdrawn from each subject; 2 ml were collected in a disposable plastic tube for separation of serum used in the serological studies (HCV and *H.pylori* IgG antibodies). The remaining 1ml was collected in 1.5 ml autoclaved microcentrifuge tube; the separated serum from it was stored at - 70°C in another 1.5 ml autoclaved microcentrifuge tube to be tested by RT-PCR for HCV-RNA.

I- Detection of serum anti- *H.pylori* IgG:
Serological detection of IgG antibodies to *H.pylori* by ELISA sandwich technique was done using kit supplied by Biotest-Germany according to manufacturer's instructions. The density of the developed color which was read at 450 nm, was proportional to the concentration of IgG present in the serum sample. The interpretation of the results was qualitatively determined as positive if samples showed an absorbance ≥ the cut-off value (0.9). Then, the concentration of antibodies was quantitatively measured in arbitrary unit (Au/ml) by a semilog calculation for the calibrators (11).

II – Detection of serum anti-HCV IgG:
The presence of anti-HCV antibodies (IgG) in serum was determined using Murex anti-HCV version-4.0 kit (Murex Diagnostics Limited-UK) according to manufacturer's instructions. Shortly, the diluted samples were incubated in microwells which coated with highly purified antigens, which contain sequences from the putative core (C, structural), protease/helicase (NS3, non structural), NS4 and replicase (NS5, non-structural) regions of the virus. During the first incubation any anti-HCV antibodies in the sample will bind to the immobilized antigens. Following washing to remove unbound material, the captured anti-HCV antibodies were incubated (second incubation) with horseradish peroxidase conjugated monoclonal anti-human IgG. After removal of excess conjugate, bound enzyme was detected by the addition of a solution containing 3, 3 ‗, 5, 5 ‗ tetramethylbenzidine (TMB) and hydrogen peroxide. A purple color developed in the wells contained anti-HCV positive samples. The enzyme reaction was terminated with sulphuric acid to give an orange color, which was read photometrically at 450 nm. The amount of conjugate bound, and hence the color in the wells, was directly related to the concentration of the antibody in the sample. Positive samples were those give an absorbance equal to or greater than the cut-off
value (0.6 more than the mean absorbance of the replicates of the negative control) \(^{(12)}\).

**III- Detection of serum HCV- RNA by RT-PCR:**

**1-RNA Extraction:** Viral nucleic acid was extracted using the pure viral nucleic acid kit (Boehringer Mannheim, Germany) according to the manufacturer's instructions. Virus lysis was accomplished by incubation of the sample in a special lysis/binding buffer in the presence of protease K. Subsequently, nucleic acids bond specifically to the surface of glass fibers in the presence of a chaotropic salt. The bound nucleic acids were purified from salts, proteins and other impurities by a washing step and were eluted in low salt buffer elution buffer \(^{(13)}\).

**2- cDNA synthesis and amplification of double stranded DNA:** It was performed using Ready To-Go™ RT-PCR Beads (Amersham Pharmacia Biotech). 5 µl of the extracted RNA, 25 pmol (2 µl) of anti-sense primer for cDNA synthesis (5’-CGA-GAC-CTC-CCG-GGG-CAC-TCG-CAA-GCA-CCC-3’ ) and 25 pmol (2 µl) of each internal primers for amplification of 266 bp of the 5’-UTR, [ RB6A (5’-GTG-AGG-AAC-TAC-TGT-CTT-CAC-G-3’ ) and RB6B (5’-ACT-CGC-AAG-CAC-VVT-ATC-AGG-3’ ) (synthesized by Biosource, Europe)] were added to the bead. The volume was completed to a final volume of 50 µl with sterile distilled water. The reaction was overlaid with 50 µl of mineral oil to prevent evaporation of the sample. The tubes were incubated at 42 °C for 30 min, heated to 95°C for 5 min to inactivate the reverse transcriptase and to completely denature the template. Then the reaction was preceded for 40 cycles in thermal cycler (Perkin Elmer Cetus, USA), each one was programmed for 1 min at 94 °C for denaturation, 1 min at 55 °C for primers annealing and for 2 min at 72 °C for extension. After the cycling program, the samples were incubated for 10 min at 72 °C to confirm the formation of all double stranded DNA \(^{(14)}\).

**3- Detection of the amplification products:** The RT-PCR products were detected by agarose gel electrophoresis by using 2% agarose gel stained with ethidium bromide according to Sambrook et al. \(^{(15)}\). The DNA molecular weight marker (Roche, Germany) which gave bands ranging from 50-1000 bp as well as negative and positive control samples were run in parallel to the samples. The gel was run at 100 Volt for 30 min. Then the gel was viewed and photographed over an ultraviolet transilluminator. Florescent bands of products equivalent to the MW of approximately 266 bp were recorded as positive for HCV-RNA (Fig. 1).

**RESULTS**

**Clinical characteristics of the patient group:** The main presentation was found to be extra-nodal (E) lesion (42.5%) followed by mixed nodal and extra-nodal (N+E) (35%); whereas 22.5% of the patients presented with nodal (N) lesion. As regard the site of disease, 16 cases (40%) showed GIT mass, 9 cases (22.5%) showed mediastinal mass and 15 cases (37.5%) showed other clinical sites (e.g. eye, kidney and maxillary). Thirteen cases (32.5%) complained of vomiting and diarrhea.

**Staging and pathologic subtype of the lymphoma:** According to St. Jude staging system \(^{(16)}\), 17.5% of the cases presented at stage I, 20% of cases as stage II, 32.5% as stage III and 30% as stage IV. The pathologic subtypes were classified according to WHO \(^{(10)}\) into 40% Burkitt's lymphoma (BL), 37.5% lymphoblastic lymphoma (LBL) and 22.5% were large cell lymphoma (LCL).

**Helicobacter pylori IgG antibodies results:** 19 out of 40 cases (47.5%) were found to be positive to H.pylori IgG antibodies, while non of the controls was positive (0.0%) with a P-value < 0.001. As regard the clinical and pathological data there was a statistical significant relation between patients complaining of vomiting & diarrhea and the presence of H.pylori IgG antibodies (P < 0.001), while no significant difference was found between the different pathologic subtypes and stages of the disease in the positivity to H.pylori IgG antibodies (P > 0.05) (Table 1).

As regard H.pylori titer: among 19 positive cases, high titer (≥120 Au/ml) was found in 11 cases of them. Also there was a statistical significant relation between the antibody titer and patients presenting with vomiting and diarrhea, as higher titers were found in patients presented with these complains.

**Hepatitis C virus results:** HCV IgG antibodies was found in 8/40 of patients
(20%) and in 1/20 of controls (5%) with a P-value > 0.05. HCV positivity was equally distributed among clinical and pathological parameters (Table 2). HCV-RNA was detected in 7/40 (17.5%) of the patient group by RT-PCR (six cases were seropositive and one case was negative). However, the only seropositive case of the controls was found to be negative for HCV-RNA by RT-PCR (P > 0.05). Six out of the 8 cases of those positive for HCV IgG antibodies were also positive for *H. pylori* antibodies.

Fig. (1): A 2% agarose gel containing the RT-PCR products of some patients. Lane 1 and 15 had the MW marker and revealed 6 DNA bands of 1000, 750, 500, 300, 150 and 50 bp respectively. Lanes 3, 5, 7, 8, 11 and 14 show positive results (each has one DNA band of approximately 266 bp) and lanes 2, 4, 6, 9, 10, 12 and 13 are negative (No DNA band).
Table (1): The relation between *H.pylori* positivity (IgG-antibodies) and different clinical and pathological parameters in 40 lymphoma patients

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Positive N=19</th>
<th>Negative N=21</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>9.3 ± 4.2</td>
<td>7.3 ± 4.5</td>
<td>0.15</td>
</tr>
<tr>
<td>Sex</td>
<td>8 (47.1%)</td>
<td>9 (52.9%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Clinical data</td>
<td>8 (47.1%)</td>
<td>9 (52.9%)</td>
<td>0.96</td>
</tr>
<tr>
<td>Site of disease</td>
<td>9 (56.3%)</td>
<td>7 (43.7%)</td>
<td>0.36</td>
</tr>
<tr>
<td>Vomiting and diarrhea</td>
<td>11 (84.6%)</td>
<td>2 (15.4%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pathologic subtypes</td>
<td>7 (43.8%)</td>
<td>9 (56.2%)</td>
<td>0.69</td>
</tr>
<tr>
<td>Stage of Disease</td>
<td>6 (40%)</td>
<td>9 (60%)</td>
<td>0.46</td>
</tr>
</tbody>
</table>

* P-values > 0.05 are considered non-significant.
* P-values < 0.001 are considered highly significant.

Table (2): The relation between HCV positivity (IgG-antibodies & HCV-RNA) and different clinical and pathological parameters in 40 lymphoma patients.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Positive N=9</th>
<th>Negative N=31</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>7.6 ± 4.4</td>
<td>8.4 ± 4.3</td>
<td>0.62</td>
</tr>
<tr>
<td>Sex</td>
<td>3 (17.6%)</td>
<td>14 (82.4%)</td>
<td>0.71</td>
</tr>
<tr>
<td>Clinical data</td>
<td>4 (23.5%)</td>
<td>13 (76.5%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Site of disease</td>
<td>5 (31.3%)</td>
<td>11 (68.7%)</td>
<td>0.44</td>
</tr>
<tr>
<td>Vomiting and diarrhea</td>
<td>4 (30.8%)</td>
<td>9 (69.2%)</td>
<td>0.43</td>
</tr>
<tr>
<td>Pathologic subtypes</td>
<td>2 (12.5%)</td>
<td>14 (87.5%)</td>
<td>0.27</td>
</tr>
<tr>
<td>Stage of disease</td>
<td>3 (20%)</td>
<td>12 (80%)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* P-values > 0.05 are considered non-significant.
* P-values < 0.001 are considered highly significant.
DISCUSSION

Many common cancers develop as a consequence of years of chronic inflammation. Increasing evidence indicates that the inflammation may result from persistent mucosal or epithelial cell colonization by microorganisms; including hepatitis B and hepatitis C viruses, which can cause hepatocellular cancer; human papilloma virus subtypes, which cause cervical cancer and the bacterium Helicobacter pylori, which can cause gastric cancer. Persistent inflammation leads to increased cellular turnover, especially in the epithelium, and provides selection pressure that result in the emergence of cells that are at high risk for malignant transformation. Cytokines, chemokines, free radicals and growth factors modulate microbial populations that colonize the host. Thus, therapeutic opportunities exist to target the causative microbe, the consequent inflammatory mediators, or epithelial cell responses. Such measures could be of value to reduce cancer risk in inflammation-associated malignancies (17).

Several recent studies have reported a high rate of previous hepatitis C viral infection in patients with non-Hodgkin's lymphoma. However, it appears that there are marked geographical difference in the prevalence of HCV among NHL patients. There is further controversy concerning a possible pathogenetic link between HCV and certain histologic lymphoma subtypes, in particular MALT lymphomas, and it has recently been speculated that HCV might be involved in multistep process of gastric lymphomagenesis, in addition to the well established role of chronic H.pylori infection (9).

In the present study, a high prevalence of H.pylori infection (47.5%) and hepatitis C virus (20% seropositive and 17.5% positive for HCV-RNA) was detected in pediatric NHL patients when compared to the control group (0.0% and 5% for H.pylori and HCV IgG antibodies, respectively). Similarly, a high prevalence of HCV and H.pylori infections was previously reported in 180 newly diagnosed HIV-negative B-cell NHL patients, consecutively seen at an oncology center in Southern Switzerland between 1990 and 1995 when prospectively studied. Infection with HCV was detected in 17/180 patients (9.4%); whereas, anti-Helicobacter antibodies were detected in 81/180 patients (45%) (9). Also, Tursi et al. (18) detected the presence of H.pylori in 18/25 patients (72%) and HCV-RNA by in situ hybridization in 7/25 patients with gastric MALT lymphoma (28%).

In addition, El-Mahallawy et al. (19) found a high prevalence of H.pylori (43.2%) and HCV (17.6%) infections in pediatric NHL patients, diagnosed at the National Cancer Institute (NCI), Cairo University when compared to the control group, 51/119 vs. 0/30 and 21/119 vs. 1/30; respectively. While Timuraglu et al. (20) found that anti-HCV antibodies were negative in both NHL and control groups, but HCV-RNA was positive in the serum of 3/48 patients (6.6%), who were diagnosed with diffuse cell lymphoma but negative in the control group.

The relation between HCV and non-Hodgkin's lymphoma was previously reported in several studies and was found to be linked to geographical areas with high HCV prevalence among the general population. In adult Egyptian NHL patients, 32% were found to be positive for HCV-antibodies and 28% for HCV-RNA (22). These results were in agreement with another study from Italy in which HCV prevalence was 17.5% among 400 lymphoma patients and 5.6% among 396 controls (21). On the other hand, other studies done in areas where HCV is rare, failed to find an association between HCV and NHL (23).

Thus, it is clear that the apparent difference between the various epidemiological studies performed so far could be explained by the geographical differences in infection patterns within the general population (8). The increased prevalence of HCV in our pediatric NHL patients might reflect the increased incidence of HCV in certain areas of Egyptian population, as Abdel-Wahab et al. (24) reported an incidence of 12% in children living in rural areas. Also, children with NHL pass through a series of investigations, where they could have been exposed to infection.

In this study, no specific characteristics as a certain clinical feature, histological subtype or stage of disease, were encountered in the group of HCV positive NHL patients. Similarly, neither histological subtype nor specific extra-nodal presentations of NHL
were associated with a high prevalence of HCV was encountered in some studies \(^9,25\). However, other studies reported a high prevalence of HCV in certain types of NHL as with low grade B-cell NHL \(^26\), or with aggressive NHL \(^21\). The failure of attribution of a certain subtype of NHL in the present study with HCV positivity could be explained by the limited histopathological subtypes of NHL in the pediatric patients and which usually falls in the high-grade category. In fact, hemato-oncologists from different geographic regions recommended that the terms like low, intermediate and high grade should no longer be used \(^27\).

Not only increased positivity of \(H. pylori\) IgG antibodies was observed in our pediatric NHL patients, but also high titers of antibodies. The seroprevalence of \(H. pylori\) was previously found to vary among different geographical areas, related to poor socioeconomic condition and to increase with age \(^28\). In the present study, \(H. pylori\) positivity was significantly increased with a complaint of vomiting and diarrhea and with older age patients. For better understanding of the significance of \(H. pylori\) in this study, the site of disease was considered. Although \(H. pylori\) was found more positivity in patients presenting with a gastrointestinal localization of disease, but the relation did not reach a significant level. Similarly, Moschovi and her coworkers \(^29\) recorded a 2% incidence of primary gastric lymphoma in childhood and suggested a causal link with \(H. pylori\) infection.

Several infectious agents have been identified as possible etiologic agents for NHL; in most cases the presence of a particular agent increases the risk of developing cancer or speeds its progression. For example, HIV and other viruses that affect the immune system make the infected individuals prone to a variety of cancers by weakening the body’s natural defenses. But in other cases, there is now compelling evidence that certain agents may also play a critical role in causing cancer. HCV and \(H. pylori\) are postulated to be involved in the pathogenesis of B-cell NHL. Yet both agents have not been linked to a known translocation nor endowed with oncogenesis. The exact mechanism of neoplastic transformation of both agents is still unknown \(^9\). Since the oncogenesis is a multistep process, possibly the persistence of these agents in the immune system with the consequent stimulation of clonal expansion of lymphocytes together with the combination of genetic and environmental factors may lead to transformation resulting in B-cell neoplasia \(^30\).

Whether the increased prevalence of HCV and \(H. pylori\) indicates an active role in lymphomagenesis or it just represent a failure of eradication of infection as a result of weak immune system is difficult to decide on the basis of our results. Primarily, the young age of patients gives no enough time for the evolution of established malignant disorder on top of an infectious disease especially for HCV infection \(^9\). Moreover, failure to define a certain extra-nodal presentation or specific histologic subtype of NHL in our pediatric patients further denies a possible pathogenetic role of these agents in pediatric NHL. Actually the possibility exists that these infectious agents occurred as independent events on a previously disturbed immune system that is susceptible to both chronic infections and lymphomagenesis, or that these infections were a previous event that led to immune suppression making the patient more amenable for lymphoma to occur. In fact, the presence of both infections in a good number of patients in this study necessitates a careful search for the effects of infections in pediatric patients.

Thus, our study reported a high prevalence of HCV and \(H. pylori\) infections in pediatric NHL patients. Neither specific histologic subtype nor certain extra-nodal presentation could be linked to both infections. Older age group and gastrointestinal manifestations were significantly related to \(H. pylori\) infections. A causal relationship could not be postulated on the ground of the results of the present study. So we recommended further studies to investigate other infections to clarify whether there is a defective immune system responsible for both chronic infections and lymphoma or that there is an actual relationship between these agents and pediatric lymphomas.

**REFERENCES**


الملخص العربي

العذوي بالفيروس الكبدي سي والهليلوكبتكير بيلورى في مرضى الأطفال المصابين بالورم الليفماوي من النوع اللاهوذجكين

أمل حسن عطا، نهاد أحمد كرم، أبواب عبد الحميد، منال النمر

أقسام الميكروبيولوجي والمناعة، الأطفال والباثولوجي

أثبتت العديد من الدراسات أن العذوي بكل من ميكروب الهميلوكبتكير بيلورى والفيروس الكبدي سي قد يكون سبباً في حدوث الورم الليفماوي من النوع اللاهوذجكين، ولكن معظم هذه الدراسات قد أجريت على المرضى الكبير في السن.

ولذلك هدف هذا البحث هو تحديد نسبة العذوى بكل من الهميلوكبتكير بيلورى والفيروس الكبدي سي في مرضى الأطفال المصابين بالورم الليفماوي من النوع اللاهوذجكين وكذلك أبحاث إذا كان هناك أي صوره أتيلينكية أو هستوباثولوجية مرتبطة بوجود العذوى.

تتم أجراء هذه الدراسة في قسم الميكروبيولوجي والمناعة، قسم الأطفال والباثولوجي بكلية الطب جامعة الزقازيق واشتملت على 50 طفلاً من الأطفال الذين يعانون من أمراض الورم الليفماوي من النوع اللاهوذجكين والمصابين بإحداث وحدة الدم في قسم الأطفال بمستشفى جامعة الزقازيق وذلك بالإضافة إلى 20 طفلًا من الأطفال الأصحاء كمجموعة ضابطة.

وقد تم البحث عن وجود الأجسام المضادة لكل من الهميلوكبتكير بيلورى والفيروس الكبدي سي وذلك بواسطة التفاعل الأنزيمي المناعي (الإلينزا). كذلك تم الكشف عن وجود الحمض النووي للفيروس الكبدي سي في مصل الدم باستخدام طريقة التسمح العكسي (RT-PCR).

واظهرت نتائج هذا البحث الآتي:

- وجود الأجسام المضادة للهميلوكبتكير بيلورى في مصل 19 طفلًا (50.72%) من الأطفال المصابين بالورم الليفماوي من النوع اللاهوذجكين وذلك مقارنة بعدم وجودة في أي من المجموعة الضابطة.
- وجدت الأجسام المضادة للفيروس الكبدي سي في مصل 8 أطفال لمجموعة المرضي (20%) وفي حالة واحدة فقط من المجموعة الضابطة (3%).
- وجدت الأجسام المضادة للفيروس الكبدي سي في مصل 8 أطفال لمجموعة الضابطة (20%)، وفي حالة واحدة فقط من المجموعة الضابطة (3%).
- وجدت الأجسام المضادة للفيروس الكبدي سي في مصل 8 أطفال لمجموعة الضابطة (20%)، وفي حالة واحدة فقط من المجموعة الضابطة (3%).
- يوجد نسبة عالية من الأجسام المضادة للهميلوكبتكير بيلورى في الأطفال الأكبر سنًا والذين يعانون من أعراض القص وآلم في الجهاز الهضمي.
- وجدت طريقة انتقال الصفي من الأجسام المضادة للهميلوكبتكير بيلورى في الأطفال الأكبر سنًا والذين يعانون من أعراض القص وآلم في الجهاز الهضمي.

ومن هذا نستخلص وجود العذؤي بميكروب الهميلوكبتكير بيلورى والفيروس الكبدي سي بنسبة عالية في الأطفال المصابين بالورم الليفماوي من النوع اللاهوذجكين. وبالنسبة لحالات عدم وجود دوز يناسب في حدوث الورم الليفماوي غير واضح حتى الآن وهو دور مباشر في حدوث الأورام الخبيثة. لذلك نوصي بعمل دراسات أخرى لتفتيح علاقة أنواع العذؤي المزمنة المختلفة وظهور الأورام الليفماوية.