Original Article

Post-COVID-19 Complications and their Laboratory Findings: A Cohort Study

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Abstract

Type 2 severe acute respiratory syndrome caused by coronavirus infection has become the most well-known pandemic infectious viral disease in the present century. This study aims to find out the post-COVID-19 infection complications via a well-designed observational study. A total of 986 recovered cases (only the period ranged between 2 to 3 months after recovery) were obtained from public and private hospitals in Kirkuk and Erbil governorates\Iraq. The admitted patients were asked to answer a questionnaire through interviews; the laboratory findings were obtained from the patients. The results suggested that approximately half of post-COVID-19 patients (%45.606) were suffering from chest pain, while (%32.357) of the cases suffered headache and chest pain. Liver enzymes (ALT, AST, and ALP) showed abnormal percent values of 38.6,24.07, and 26.09, respectively. Renal function enzymes, mainly urea, were found to be abnormal in 45.37% of recovered individuals. Furthermore, abnormal LDH levels were found in (77.9%) of post-COVID-19 patients. This finding revealed that chest pain was an inflammatory condition and liver and renal enzyme disturbances, while elevation in LDH was the predominant long-term complication in post-COVID-19 patients.

Keywords: Coronavirus, Post COVID-19 Complication, LDH, Chest pain

1. Introduction

Humanity was affected by COVID-19 in almost all aspects, including health, economy, education, and other fields. Clinical evidence and research focus on long-term effects and the sub-acuteof COVID-19, which can affect many human organ systems (1, 2). Post-COVID syndrome was described in the spring of 2020 after the earliest COVID-19 cases were reported; observations declared that COVID-19 patients had symptoms that remained for several weeks or months after infection (3).

The long-term complications of COVID are well known as post covid syndrome. Common long-term symptoms include persistent cough, low-grade fever, breathlessness, fatigue, pain, chest pain, palpitations, myalgia, arthralgia, headaches (4), earache, tinnitus, sore throat, loss of taste/smell, tremors, skin rashes, gastrointestinal symptoms, sleep disturbances (5), and mental health conditions like anxiety and depression (6).

Only a few studies were focused on performing cohort studies on laboratory findings on post-COVID-19 patients; the main aim of this study is to find out the relation between COVID-19 infection and the abnormalities regarding the clinical and Laboratory findings in individuals who had COVID-19 infection not less than one months ago.

2. Materials and Methods

2.1. Subjects and Patients

Prospective data of 986 cases were obtained from public, and private hospitals belonging to Kirkuk and Erbil governates-Iraq from patients admitted to there for assessing their health condition after recovery from SARS COVID2 infection according to doctor's prescription and ethical approval in the research. The range period (2-3 months) after recovery was included. The data was collected from November 2020–June 2021. A questionnaire form was prepared for data collection. The questions focused on general demographic characteristics and lifestyle besides their clinical conditions, including the symptoms they were still suffering from, such as chest pain, headache, back pain, knee pain, and hair loss.

2.2. Laboratory Measurements

After obtaining a sufficient amount of 5 ml venous blood samples from the recovered patients, complete blood counts were performed, and sera were separated for other laboratory measurements. Liver function tests, renal function tests, serum ferritin, D-dimer, WBCs count, Platelets count, ESR, Lipid profile, blood sugar, and LDH were measured to assess the COVID19 complications, were assessed using an automated biochemistry analyzer.

2.3. Data Analysis

The data was then added excel program to be ready for statistical analysis by Graph pad prism. All data were presented as percent all figures were presented as bar charts. SPSS software version 18 has been used for statistical analysis of the obtained data, and values less than 0.05 were considered significant.

3. Results

The results of the present study revealed that approximately half of post-COVID-19 patients (%45.606) suffer from chest pain, and the second prominent clinical symptom was a headache, with a percent value reached (%32.357). The other symptoms which we obtained from post-COVID-19 patients were not abundant, including back pain with (%19.944),

Knee pain with (%18.270), and hair loss with (%15.202) (Figure 1).
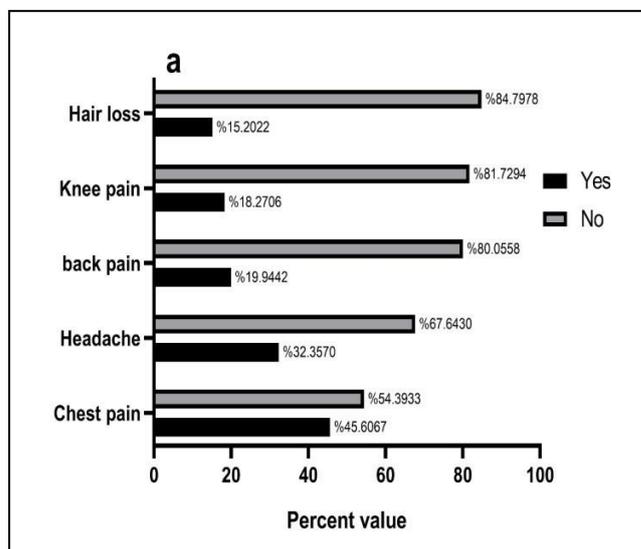
**Figure 1.** The presence of typical symptoms in post-COVID-19 patients

The laboratory findings in post-COVID-19 patients recorded alterations in serum ferritin, creatinine level, and blood urea nitrogen (BUN) and were found to be abnormal in %45.21, %33.23, and %45.37, respectively, in studied individuals (Figure 2a, 2b and 2c).

Liver function was among the studied measures in post-COVID-19 patients and was altered in numerous individuals. ALT, AST, and ALP showed abnormality in (%38.8, %24.07, and %26.08) among the cases (Figure 3).
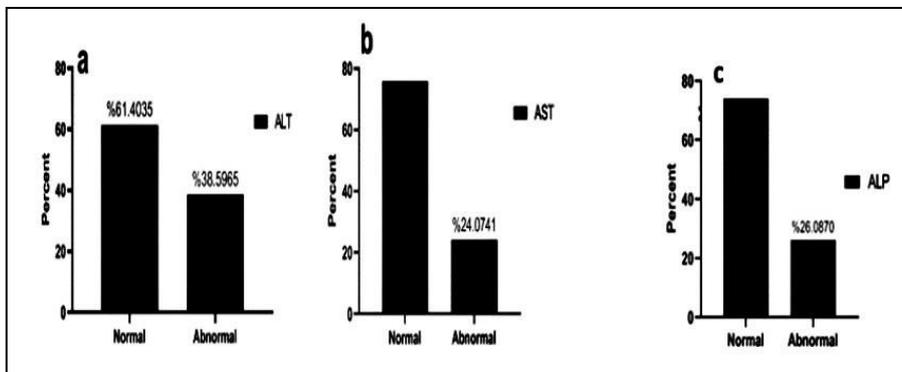
The percent value of abnormal WBC, Platelets and D-dimer levels in post-COVID-19 patients was (%14, %11, and %6.8), respectively (Figure 4).

The abnormal level of Erythrocyte sedimentation rate (ESR), RBCs count, Blood sugar, and LDH were (%30.7, %17.8, %30.2, and %77.9) among the obtained cases (Figure 5).

Lipid profiles were also recorded, and the results for (Total cholesterol, Triglyceride, HDL, LDL, and VLDL) were (%30.2, %42, %32, %77.9, %11, and %48) of total cases obtained from post-COVID-19 (Figure 6).
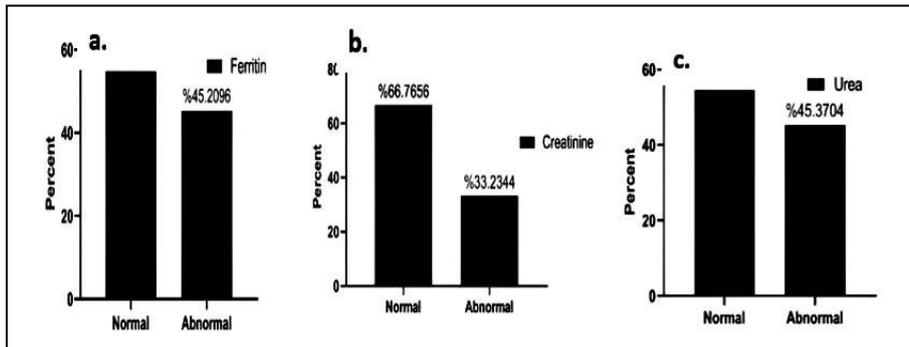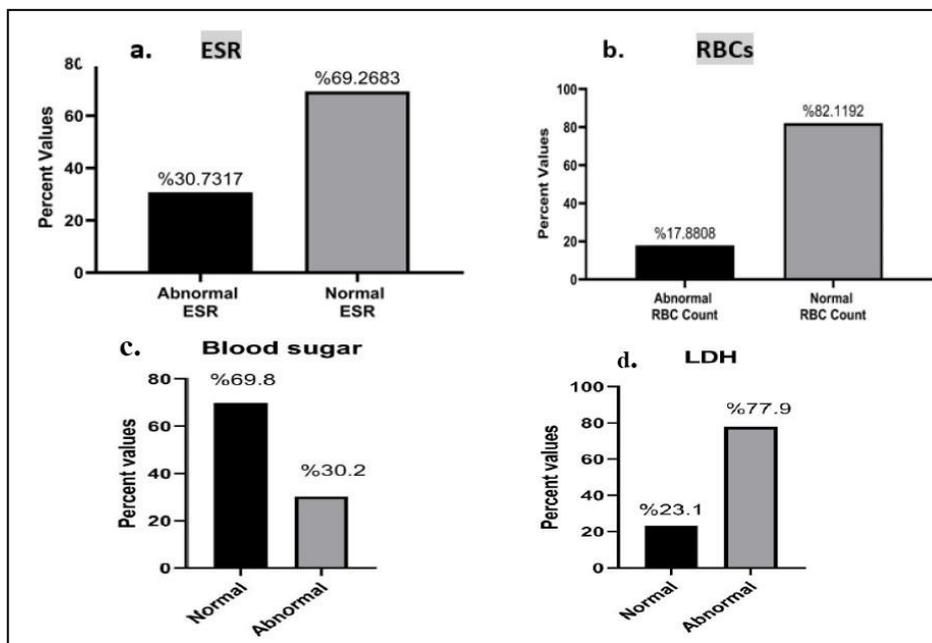
Figure 2. The Percent values of normal and abnormal laboratory findings in post-COVID-19 patients. Furthermore, represent the level of **a)** ferritin, **b)** creatinine, and **c)** blood urea nitrogen

Figure 3. The Percentage values of normal and abnormal liver function Laboratory findings in post-COVID-19 patients represent the level of **a)** ALT, **b)** AST, and **c)** ALP
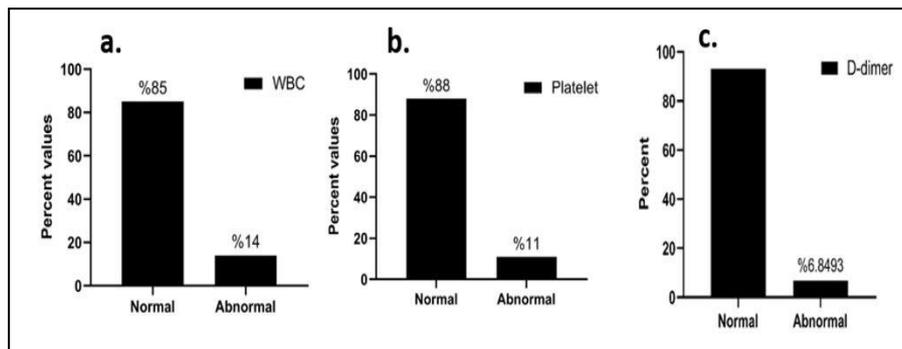
Figure 4. The Percentage values of normal and abnormal WBC count, Platelets, and D-dimer in post-COVID-19 patients represent the level of **a)** WBCs, **b)** Platelets, and **c)** D-dimer

Figure 5. The Percent values of normal and abnormal ESR, RBCs, Blood sugar, and LDH in post-COVID-19 patients
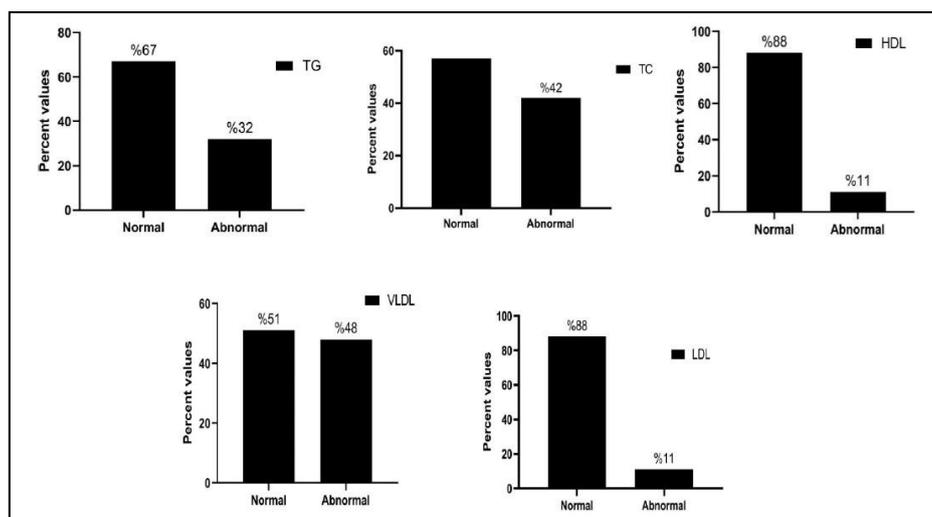
Figure 6. The percent values of lipid profile in post-COVID-19 patients

4. Discussion

The complications after post-COVID-19 are still a matter of debate between scientists. Most researchers suggested that they are still unsure exactly how long these symptoms can persist, but they may know that they can last at least six months or longer in some people (7). The overall results of the current study demonstrated the relation between chest pain and CRP positivity in post-COVID-19 patients and the high abnormal Ferritin and BUN in them.

The high blood urea nitrogen level in almost half of the recovered patients was unexpected in this study. Some research supports these findings because the virus's significant action is on the pulmonary system; however, it might alter the structure and function of multiple other organs, such as the renal system. The

long long-term effects of COVID-19 extrapulmonary symptoms have been reported. Their findings suggested that only 13% of hospitalized patients did not suffer from renal damage and possessed an average glomerular filtration rate except during the acute phase of Covid 19 onset.

Overall, the prevalence and severity of clinical sing of COVID-19 are already associated with hepatitis. Lympho-histiocytic inflammation of sinusoidal and central vein endothelium may also be a disease (8). The cytokine storm that occurs during infection is responsible for the vascular spreading of inflammatory mediators to multiple organs, including the liver (9). Another study found the opposite results via histological findings and reported that the liver is not the main target of the Covid 19 infection outcome (10). The follow-up for hematological variables is among the essential assessments for post covid 19 patients. Several investigations have revealed abnormal hematological complications after the short and long-term onset of Covid 19 (11, 12). The main complications are coagulopathies and hyperferritinemia, which appear to be associated with increasing the mortality rate (13). Chest pain was the predominant clinical manifestation in post-covid19 recovered patients and was significantly related to higher CPR levels. LDH, serum ferritin, and Blood urea nitrogen were abnormal in approximately half of the post covid19 recovered patients.

Authors' Contribution

Study concept and design: G. O. Q.

Acquisition of data: K. O. A.

Analysis and interpretation of data: B. A. S. and K. O. A.

Drafting of the manuscript: K. A. H. A.

Critical revision of the manuscript for important intellectual content: I. M. M.

Statistical analysis: H. J. T.

Administrative, technical, and material support: K. O. A.

Ethics

The human study was approved by the ethics committee of the Erbil Health and Medical Technical College, Erbil Polytechnic University, Erbil, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

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