Original Article

Relationship Between Appendicitis And White Blood Cells (Wbcs), C-Reactive Protein (CRP)

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Abstract

Background: The common surgical issue known as acute appendicitis (AA) is characterized by an acute-phase reaction. It is typically diagnosed clinically, Although the exact origin of acute appendicitis is unknown, luminal blockage, nutritional variables, and hereditary factors are all thought to play a part. It's unclear how blood tests factor into decision-making. Acute-phase proteins and cytokines have been demonstrated to be activated in earlier studies, and they may be used as markers for the severity of appendicitis. The objective of this study was to evaluate the diagnostic utility of preoperative assessment of white blood cells (WBCs) and C-reactive protein (CRP) in predicting the severity of AA.

Materials and methods: This study included 60 patients with appendicitis and 40 healthy controls. 60 patients had laparotomies for suspected AA. 5 ml of a sample of intravenous blood was taken from every patient and control, and 40 control blood samples were taken from healthy people. as well as blood samples were taken and placed in the anticoagulant tube and gel tubes. An automated hematology analyzer Blood Cell Counter was used to calculate the WBC, The Ichroma CRP device was used to measure C-reactive protein in patients and healthy samples.

Result: A blood test showed an elevated blood cell count and C-reactive protein (CRP) in acute appendicitis patients. WBC count and CRP correlated significantly with the severity of appendiceal inflammation.
Conclusion: It should be taken into consideration to incorporate laboratory data into the clinical evaluation. If used critically, CRP and WBC offer surgeons complementary data that aids in determining when urgent surgeries are necessary.

Keywords: Acute appendicitis, white blood cells (WBCs), C-reactive protein (CRP).

INTRODUCTION

An organ of the immune system that supports immune system function is the appendix(Chung, Chung, Hsu, & Lin, 2020). The only organ in the body without a fixed anatomical position is the vermiform appendix. Its worm-like look is where its name derives from. It is situated in the lower right quadrant of the abdomen (Jagdish & Ashoka, 2018). A worm-like tube loaded with lymphoid follicles (Mohammadi et al., 2017). A crucial component of this structure at a young age is the formation of large and numerous lymphoid follicles in both the mucosa and submucosa layers(Salih, Mehdi, & Abdullah, 2020). The vermiform appendix's lymphoid tissue is composed of a number of solitary lymphoid follicles that include B lymphocytes, a few T lymphocytes, dendritic cells, and macrophages.

According to some writers, the enteric nervous system (ENS) nerves may play a part in the regulation of the immune functions of gut-associated lymphoid tissue, such as the vermiform appendix (Radenković et al.). One of the most prolific makers of immunoglobulin A antibodies, which are essential for identifying and treating intracolonic infections, are B-cells, which are found in the appendix. The appendix contains additional populations of CD8 + T (T regulatory cells), which are crucial for preserving immunological tolerance, regulating inflammation, and the autoimmune system, as well as a large number of natural killer T cells that participate in TH-1 and TH-2 processes(De Costa, 2020). It has long been considered that the cecal appendix has some sort of immunological role because it contains a significant amount of immune tissue(Laurin, Everett, & Parker, 2011). Because of the significant amount of lymphoid cells, it contains, the vermiform appendix is frequently referred to as the tonsils of the abdominal cavity(Kisera et al., 2019). The appendix's removal may affect the gut's microbiome and immune system's performance. Acute sickness makes the intestinal epithelium more porous and apoptotic in susceptible people, which allows the gut microbiota to escape into the circulatory system and may trigger inflammatory reactions and organ damage. The gut microbiota may play a role in sepsis development, according to some evidence (Wu, Tsou, Lin, & Wei, 2020). Acute appendicitis is mostly diagnosed clinically, taking into account the patient's medical history, physical examination, and, in some circumstances, laboratory

investigations (such as white blood cell count or CRP level) (Al Awayshih, Nofal, & Yousef, 2019). In the elderly, appendicitis is now a common cause of abdominal pain. The elderly have a less noticeable history and clinical signs due to a decreased inflammatory response (such as leukocytosis and cytokine pool) (Bayrak et al., 2019). The total leucocyte count (TLC) is one of the tests that can be used to identify acute appendicitis. Acute, simple appendicitis is commonly accompanied with a little leucocytosis, between 10,000 and 18,000 cells per million, and a small polymorphonuclear predominance. Neutrophils make up more than 75% of the white blood cells, which are typically high. Approximately 10% of people with acute appendicitis have completely normal leukocyte counts and differentials. Indicators of gangrene or appendix perforation include a high white blood cell count (>20,000/mL)(Kamat & Dessai, 2019). The popularity of PLR (platelet-to-lymphocyte ratio) and NLR (neutrophil-to-lymphocyte ratio) measurements is rising. being inexpensive markers for identifying the activity of two inflammatory and immunological pathways. These traits have also been proposed as potential predictors for perforated appendicitis because they link to innate immunity, which has an early impact on the inflammatory process and a long-term immunological response. Although studies in adult and elder populations have been done, using these markers in pediatric populations has raised some concerns (Cruz-Vallejo, Quispe-Zaga, & Nieto-Gutiérrez, 2021). The acute-phase protein C-reactive protein (CRP) is widely utilized by surgeons to identify acute appendicitis (Msolli et al., 2018). In 1930, Tillet and Francis made the initial discovery of CRP. It is a protein that the liver produces during the acute phase. 8–12 hours after a disease or trauma, it increases. One of the strongest acute phase reactants, CRP is regulated by interleukin-6, and its plasma levels increase thousands of times in response to stress, a myocardial infarction, trauma, infection, inflammation, surgery, or neoplastic development (Kamat & Dessai, 2019). The acute-phase reactant C-reactive protein (CRP) is a laboratory component with a history of successfully diagnosing AA. Plasma CRP concentration reaches measurable levels 6–12 hours after the beginning of the inflammation. Even while a greater plasma level of measured CRP indicated a more severe inflammatory state and possibly even complex appendicitis, the test was not sufficiently sensitive or specific for early AA diagnosis (Shafagh, Barooni, Davoodabadi, Gilasi, & Hajian, 2022). This acute inflammatory protein can multiply 1,000-fold in an infection or a region of inflammation, The majority of CRP is created by hepatocytes in the liver, although it is also made by smooth muscle cells, macrophages, endothelial cells, lymphocytes, and adipocytes (Sproston & Ashworth, 2018). A new yet promising hematological intervention called the CRP to ALB ratio can assist differentiate between acute complicated and simple appendicitis. In response to inflammation and infection, the body produces serum C-reactive protein (CRP), which rises in blood levels within hours. , Inflammation reduces albumin content in the blood, which is correlated with the severity of the inflammation, the prognosis of the illness, and death. Albumin (ALB) is a negative acute phase reaction produced by the liver (Feng, Yang, Zhao, Li, & Cui, 2020). Hyperbilirubinemia can happen in cases of acute appendicitis without being brought on by liver disease or biliary obstruction. Although some studies have indicated that hyperbilirubinemia can be used to determine whether someone has an acute appendicitis, its practical application is still up for debate (Akai et al., 2019). It has been shown that using precision medicine techniques, such as metabolomics, proteomics, transcriptomics, and genomics (collectively referred to as "omics"), might increase the accuracy of diagnosis in inflammatory diseases like pediatric appendicitis. Thanks to recent developments in molecular and biochemical technology, multiple biomarkers can now be detected simultaneously in a single blood or urine sample. When combined, these multiple biomarkers have the potential to improve appendicitis diagnosis by increasing specificity and sensitivity; however, there are currently only a few trials demonstrating these sophisticated approaches for appendicitis diagnosis and prognosis (Hodge, Mickiewicz, Lau, Jenne, & Thompson, 2021).

METHODS

Collections of samples

The current investigation was carried out between December 2021 and March 2022. This study covered all patients admitted with the pain of the right iliac fossa at Al Ramady Hospital and Heet Hospital. The histology results were retrieved together with all of these patients' information. In the present study, 60 male and female between the ages of 10 and 38 who were diagnosed with appendicitis by a surgeon and underwent an appendectomy were included. Every patient and control had an intravenous blood sample taken; the 40 control blood samples came from healthy individuals. 5 ml of venous blood was drawn from patients and the control groups, and the blood samples were placed in EDTA tubes and Gel tube to be utilized for blood analysis.

Hematological test

Blood Parameters

Automated hematology analyzer Blood Cell Counter was used to calculate the indices of hemoglobin (Hb), packed cell value (PCV), platelet (PLT), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH), and mean corpuscular value (MCV) for erythrocytes (CBC). Using the same method, different leukocyte counts, including those of white blood cells (WBC), lymphocytes (LYM), basophils (BASO), monocytes (MONO), and neutrophils (NEU), were also determined. The device drew 50 µl of blood for testing, for each sample.

Immunological test

C-Reactive Protein (CRP)

The Ichroma CRP device was used to measure C-reactive protein in patients and healthy samples.

The protocol of C-reactive protein (CRP)

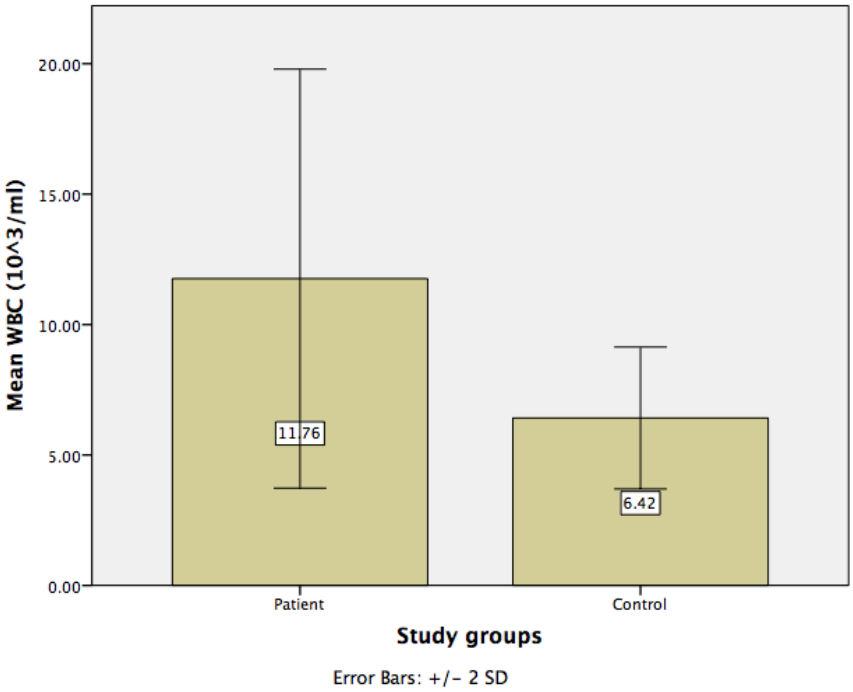
1- 10 µl of serum was taken by the sample collector and then mixed with the detection solution and shaken about 10 times or more.
2- The sample collector top cap was removed and two drops of reagent were disposed of on a paper towel before being placed on the cartridge.
3- Only two drops of the mixture were applied to the sample well from the cartridge.
4- Leave the cartridge at room temperature for 3 mins.
5- The cartridge was inserted into the reader and the reader automatically read it and the result was given.

RESULTS AND DISCUSSION

White Blood Cells (WBCs)

During in the course of this study, the average number of white blood cells in patients with acute appendicitis was 11.76 percent, with a standard deviation of 4.02 percentage points, whereas the average number of white blood cells in the healthy group was 6.42 percent, with a standard deviation of 1.36 percentage points. There was also a highly significant difference between the study groups (p-value=0.001**). As is evident from the aforementioned figure (1-1)

Figure 1-1: average of WBCs among study groups



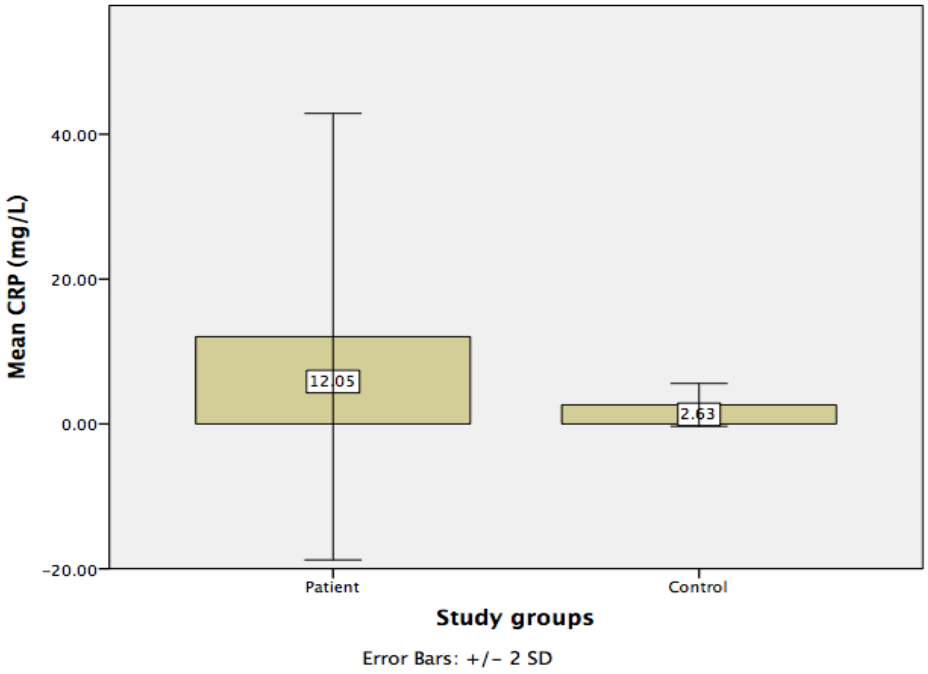
Acute appendicitis (AA), is a form of illness that is distinguished by a suppurative infection that occurs suddenly. It is essential to get an early diagnosis and begin therapy as soon as possible. In the longer term, acute appendicitis may result in systemic inflammation as well as serious consequences such as rupture as well as infection. The etiology of a disease is a complex interplay between genetic and environmental variables(Sadr Azodi, Andrén-Sandberg, & Larsson, 2009). It's possible that the signs of acute appendicitis in many people will be somewhat vague and resemble those of numerous other acute abdominal disorders. Given the high risk of morbidity and mortality associated with surgical intervention, the decision of whether or not to have surgery is likely to be critical but difficult (Kamran et al., 2008). The white blood cell count and neutrophil number are tests that are routinely used in practically every hospital due to the simplicity of interpretation. They are employed in the acute appendicitis diagnosis. However, their development can be seen in a wide range of different acute and chronic pathological disorders, not just this illness (Menteş, Eryılmaz, Harlak, Oztürk, & Tufan, 2012). The results of another study, which included three more participant groups, concur with those of our examination (patients with normal histopathology, abnormal histopathology, and healthy control). It was revealed that there is a significant difference in the number of WBCs between these three groups (Şahbaz et al., 2014). Another study that split the appendix into three groups—normal, slightly inflamed, and notably inflamed—and examined the WBC total count likewise revealed that the noticeably inflamed appendix had a mean WBC total count that was more than 9000 mm3 in comparison to the other groups (Khan, Nawaz, & Sultan, 2017). A retrospective case-controlled study that was developed compared two groups. Ninety-seven patients were diagnosed with acute appendicitis, while ninety-four patients made up the control group. It showed that there is a very large variation in the number of WBCs between these groups (Ulukent, Sarici, & Ulutas, 2016). Numerous studies support the notion that the first sign of appendix inflammation is an increase in white blood cells (Birchley, 2006). Nowadays, traditional indicators of inflammation are frequently used in conjunction with ultrasonographic or computed tomographic methods for the preoperative diagnosis of AA. However, the

risks of unsuccessful appendectomy and perforated appendicitis are still rather high, ranging about 15% (Goldin et al., 2011).

C-reactive protein

During the course of this study, there was a significant disparity between the two groups in terms of the mean level of C-reactive protein (12.05±15.41 mg\L versus 2.63±1.48 mg\L for the control group), and there was also a statistically significant difference (p-value=0.001**) between the patient and control groups. In accordance with what is shown in figure number (1-2).

Figure 1-2: C-reactive protein concentration among study groups



In this study, the inflammatory marker C-reactive protein (CRP) was looked into. It is an important indicator that could help in the early recognition of acute appendicitis, which is a stage one sickness. The diagnosis of appendicitis must be reevaluated using other clinical tests, such as diagnostic laparoscopy and ultrasonography, to determine whether it is normal. The diagnosis is deemed to be accurate if such tests produce negative results. The usual trio of three diagnostic methods, including a patient's medical history, a clinical examination, and CRP, may typically be used to diagnose appendicitis with a higher level of accuracy (Lateef, Arshad, Misbah, & Hamayun, 2009).

The creation of C-reactive protein in the liver as a response to any form of bodily injury, including inflammation, causes an increase in the level of the protein, which in turn causes an increase in the amount. In comparison to ESR and leucocyte count used together, CRP has a higher diagnosis accuracy for inflammatory diseases. As a result, when appendicitis is suspected, tests like a CRP assessment may help the practitioner better identify the illness (Khairy, 2009). The results of our study are consistent with those of other studies, which showed that patients with acute appendicitis and healthy groups had significantly different concentrations of C-reactive protein (Ulukent et al., 2016). As part of prospective, cross-sectional analysis, CRP levels were assessed prior to surgical excision in 100 patients with acute appendicitis. These data show that 62 out of 100 subjects had high levels of C-reactive protein (Ramrao, Gajbhiye, Vaidya, Akther, & Padmawar, 2020). A further study, which involved 447 people, also discovered that there is a significant distinction between the results of patients with appendicitis who tested negative for the disease and those who did not and those who tested positive for the condition in terms of CRP (Al-Abed, Alobaid, & Myint, 2015). A plasma cytokine called interleukin-6 plays a crucial role in mediating inflammation and is a crucial stimulant for the acute-phase response. For instance, IL-6 is in charge of causing the liver's synthesis of C-reactive protein, a known inflammatory marker (Sproston & Ashworth, 2018). In this study, there were substantial differences in WBC count and C-reactive protein concentration between patients with acute appendicitis and those that appeared to be healthy, indicating that these indicators may aid surgeons in the diagnosis of acute appendicitis cases.

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