Original Article

Evaluation of Serum Procalcitonin Levels and other Parameters in Iraqi Patients with Crohn's Disease and Ulcerative Colitis

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Abstract

Background: The present study was designed to assess procalcitonin in the serum of patients that are related to the etiology and pathogenesis of inflammatory bowel disease (IBD) in two groups of Iraqi patients (Crohn's disease [CD] and ulcerative colitis [UC]). **Materials and Methods:** A total of 157 subjects have been chosen, with all cases having a full history and complete examinations including gender, age, weight, height, and smoking status. The serum of procalcitonin (PCT) patients and controls was tested to confirm the diagnosis and assess the autoimmunity status in IBD patients. They were referred to the Consultant Clinic at the Gastroenterology and Hepatology Hospital. **Results:** Eighty-five IBD patients were enrolled; the results indicated CD was more common than that of UC, revealed the proportion of females was higher than males in patients as well as showed disease frequency in patients aged 30–39 years. According to BMI calculations, results revealed the highest percentage of 41 (48.23%) to be normal weight (BMI between 18.5 and 24.9). The results of smoking did not show any association between habits of smoking. The PCT level indicated a significant increase ($P \geq 0.05$) in two disease groups that were (1229.15 ± 332.0 and 1172.38 ± 309.50) pg/mL for CD and UC, respectively, while the total number of patients of IBD showed a significant increase (1208.44 ± 323.28) pg/mL compared with the control (957.43 ± 234.75) pg/mL. **Conclusion:** PCT levels were higher in the serum of patients who had CD and UC than controls. PCT will potentially be a useful inflammatory biomarker that is able to distinguish between infectious and autoimmune processes in inflammatory bowel disease.

Keywords: Crohn's disease, inflammatory bowel disease, procalcitonin, ulcerative colitis

Introduction

Inflammatory bowel diseases (IBD) are chronic inflammatory conditions of the gastrointestinal tract driven by unsuitable immune responses to a changed gut microbiome in heritably susceptible individuals. Crohn's disease (CD) and ulcerative colitis (UC) are the most extensively recognized kinds of IBD and have been the focus of attention due to their rising frequency.[1] CD, one of the main common kinds of inflammatory disease universally, is characterized in the mucosa by the creation of fistulas, strictures, ulcers, and granulomas.[2] UC is a further kind of IBD characterized by granularity, surface ulcerations, and a vascular pattern. In difference with the inflammation found in CD occurs throughout the entire GT, but in UC it is limited to the colon mucosal layer.[3] The main symptoms of active IBD are diarrhea mixed with blood, fever, abdominal pain, and weight loss; anemia can as well take place, as can rectal bleeding, which is less common in CD.[4] UC is commonly associated with rectal bleeding.[5,6] When complications may involve abnormal dilation of the colon (megacolon), colon cancer,[7,8] inflammation of the joints, eyes, and liver,[9] procalcitonin (PCT) is the precursor of calcitonin, a vital hormone included in calcium homeostasis. In physiological conditions, thyroid C cells synthesize preprocalcitonin, a 141 amino acid precursor of calcitonin, that is, endopeptidases-catalyzed quickly changed into procalcitonin (116 amino acids) by removal of the 25-amino acid signal sequence. Then,

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by the enzyme prohormone convertase (PC), the PCT is changed into the circulation of the mature hormone calcitonin (32 amino acids), katacalcin (21 amino acids), and N-terminal procalcitonin (57 amino acids).[10] In physiological conditions, there is a very low concentration of PCT in the blood. But, in patients with harsh infections of bacteria, an extra-thyroid PCT creation occurs in a number of organs, such as the lung, liver, kidney, pancreas, and intestine.[11] Another study indicates that procalcitonin holds better diagnostic accuracy and is more specific compared with C-reactive protein (CRP) for the infection of bacteria.[12] Therefore, the current study aimed to determine the serum level of procalcitonin and its evaluation as a biological marker in inflammatory bowel disease.

Materials and Methods

Subjects

One hundred and fifty-seven subjects were selected for this study which included patients tacked therapy (N = 85, 39 male and 46 female) aged from 15 to 68 years who suffered from IBD infection and were diagnosed by a consultant physician, depending on the clinical signs, colonoscopy, laboratory diagnosis, and endoscopist. In addition to having well-random subjects as the control group (N = 72, 35 male and 37 female), this work was completed in the private lab at the Gastroenterology and Hepatology Hospital, Baghdad, Iraq. All subjects were given a comprehensive study description and returned written informed consent for participation. A questionnaire sheet was done for each patient, involving individual information (Sex, age, weight, height, and smoking status).

Blood sample collection

From January to August 2022, a volume of 3–5 mL of blood was collected from each healthy control and patient by vein puncture using 5 mL disposable syringes. The 3 mL of blood is distributed into the gel tubes, which are then left at room, temperature for 30 min in order to initiate the clotting process. The serum is then separated by centrifugation at 3000 rpm for 10 min and stored at −20 °C until the time of the immunologic assay for procalcitonin.

Body mass index (BMI)

BMI of all groups was measured by two parameters: The subject's height (in meters) and the subject's weight (in kg) as the following equation:

$$\text{BMI} = \text{Weight (kg)}/\text{square of height } (\text{m}^2)$$

Each BMI person demonstrates his/her body fatness; studies illustrate a relation between BMI and body fat and the health risk in the feature, hence a significant body mass index for detecting obesity and health risks according to the following classification.[13]

Quantitative determination of procalcitonin (PCT)

The serum procalcitonin levels were measured by human ELISA kits (YLbiont, China) based on the Biotin double antibody sandwich technology, then by comparing the samples O.D. to the standard curve. The procalcitonin was quantified via the protocol of the manufacturer.

Ethical approval

This study was approved by the Ethics Committee in the College of Science, University of Baghdad (Ref.: CSES/0422/0063:2/4/2022).

Statistical analysis

Parametric variables were given as mean ± standard deviation (SD) using IBM SPSS computer software version 24. Differences between the groups were statistically analyzed by the ANOVA table. A P value≥ 0.05 was regarded as statistically significant.

Results

Distribution of subjects according to categories of IBD

A total of one hundred and fifty-seven subjects were included in this study. Eighty-five blood samples of IBD autoimmunity of patients taking therapy from Gastroenterology and Hepatology Hospital were collected. They were categorized into 54 (64%) patients with CD (30 males and 24 females), 31 (36%) patients with UC (9 males and 22 females), and 72 (45.85%) apparently healthy random subjects as the control group (35 males and 37 females) [Table 1].

Subject distribution according to sex

The sex of 85 IBD patients involved 30 (56%) males and 24 (44%) females of CD and 9 (29%) males and 22 (71%) females of UC. The collected specimen results showed that the percentage of male patients is highest compared with CD female patients. However, the percentage of female patients who develop UC is highest compared with male patients. Also, the sex of 72 control group males is 35 (49%) whereas females are 37 (51%) [Table 2]. The results of the subjects revealed that the proportion of females in 85 IBD patients was higher than that of males.

Table 1: Study subjects distribution

IBD autoimmunity of patients	Control
Total: N = 85 (54.14%)	Total: N = 72 (45.85%)
Suffering from Crohn's disease (CD)	Suffering from ulcerative colitis (UC)
N = 54 (64%)	N = 31 (36%)

Table 2: Distribution of subjects according to sex

Sample *N* = 157	Crohn's disease *N* = 54, %	Ulcerative colitis *N* = 31, %	Total *N* = 85, %	Controls *N* = 72, %
Gender				
Male	30 (56%)	9 (29%)	39 (4%)	35 (4%)
Female	24 (44%)	22 (71%)	46 (5%)	37 (51%)

Table 3: Distribution of groups studied by age (years)

Sample	Crohn's disease	Ulcerative colitis	IBD total	Controls
N = 157, age (15–68 years)	*N* = 54, %	*N* = 31, %	*N* = 85, %	*N* = 72, %
<20 years	5 (9.2%)	3 (9.6%)	8 (9.4%)	5 (6.94%)
20–29	17 (31.4%)	8 (25.8%)	25 (29.4%)	24 (33.3%)
30–39	17 (31.4%)	10 (32.2%)	27 (31.7%)	27 (37.5%)
40–49	9 (16.6%)	4 (12.9%)	13 (15.2%)	10 (13.8%)
50–59	3 (5.5%)	2 (6.4%)	5 (5.8%)	4 (5.5%)
≥60 years	3 (5.5%)	4 (12.9%)	7 (8.2%)	2 (2.7%)
Mean ± SD	33.35 ± 11.94[A]	36.19 ± 14.50[A]	34.39 ± 12.92[A]	32.76 ± 11.04[A]

[A]The similar letters referred to no significant differences ($P > 0.05$)

Subject distribution depending on age

The present work can demonstrate in Table 3 the distribution of 85 cases with IBD by age. The infection can occur in any age group; moreover, the IBD patients' infection indicated older incidences at ages 30–39 years compared to the ages of others [Figure 1]. The age mean ± SD of IBD patients was 34.39 ± 12.92 years, which was not as significant as that of the control (32.76 ± 11.04 years) [Table 3]. In general, both Crohn's disease and ulcerative colitis infection showed an older incidence at 30–39 years compared to the others ages [Figure 2].

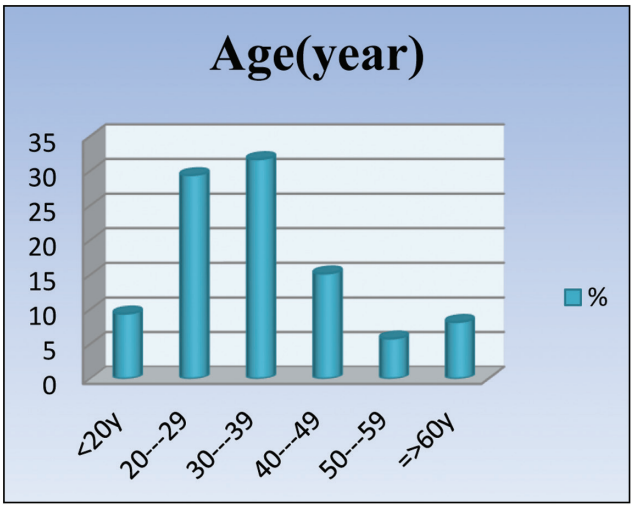

Figure 1: Distribution of IBD infection

Distribution of subjects according to body mass index (BMI)

According to BMI calculations by Flegal *et al.,*[13] the results revealed that in Crohn's disease, ulcerative colitis, and IBD total, the highest percentage was found to be of normal weight (BMI between 18.5 and 24.9) [Table 4, Figure 3].

Distribution of subjects between smoking and nonsmoking

Another demographic parameter investigated is smoking. The results of smoking in this study did not find any relationship between habits of smoking and the incidence or inflammation of bowel disease severity because a large number of our IBD patients didn't smoke but had disease; thus, smoking is not the main reason for disease. Also, there are no differences in the low rate of smoking prevalence between Crohn's disease patients and ulcerative colitis patients, as shown in Table 5.

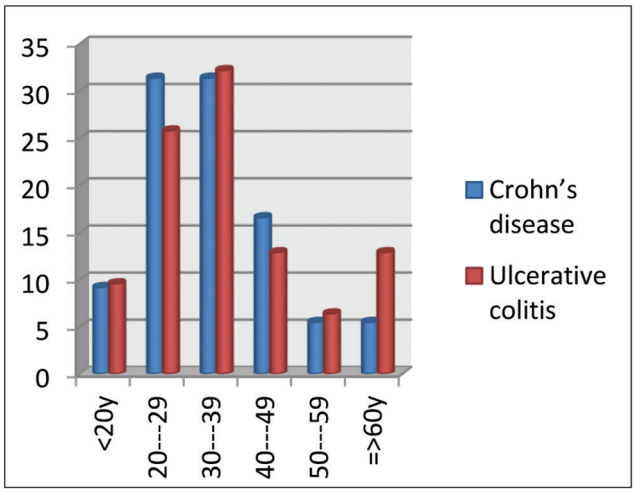

Figure 2: Distribution of CD and UC infections according to age

Table 4: Percentage of subjects from BMI calculations

	Crohn's disease *N* (%)	Ulcerative colitis *N* (%)	IBD Total *N* (%)	Control *N* (%)
Underweight: BMI ≤ 18.5	4 (7.40%)	0%	4 (4.70%)	0%
Normal weight: BMI = 18.5–24.9	28 (51.8%)	13 (41.9%)	41 (48.23%)	38 (52.7%)
Overweight: BMI = 25.0–29.9	13 (24.07%)	10 (32.2%)	23 (27.05%)	20 (27.7%)
Obese: BMI ≥ 30.0	9 (16.6%)	8 (25.8%)	17 (20%)	14 (19.4%)

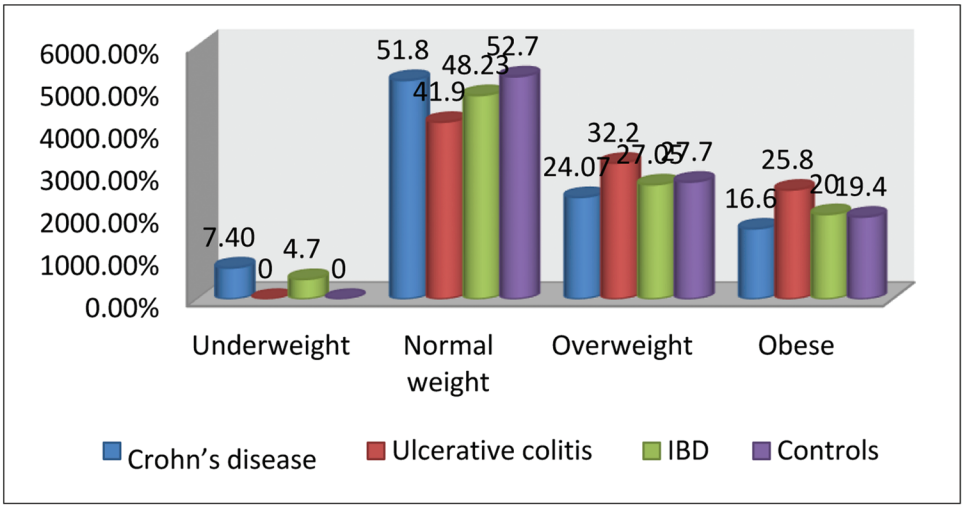

Figure 3: Percentage of subjects from BMI calculations

Table 5: Distribution of subjects between smoking and nonsmoking

Sample *N* = 157	Crohn's disease *N* = 54, %	Ulcerative colitis *N* = 31, %	IBD total *N* = 85, %	Controls *N* = 72, %
Smoking habits				
Yes	14 (25.9%)	8 (25.8%)	22 (25.8%)	7 (9.72%)
No	40 (74.07%)	23 (74.19%)	63 (74.11%)	65 (90.2%)
X	(25.037)	(14.516)	(39.553)	(93.444)
P value	(5.6×10^{-7})	(1.4×10^{-4})	(3.2×10^{-10})	(4.2×10^{-22})

Quantitative determination of procalcitonin by ELISA

The serum level of procalcitonin was assessed in two groups of patients in comparison with the healthy control. The procalcitonin levels demonstrated a significant increase ($P \geq 0.05$) in two groups which were (1229.15 ± 332.0 and 1172.38 ± 309.50) pg/mL for Crohn's disease and ulcerative colitis, respectively, while the total number of patients with IBD showed a significant increase (1208.44 ± 323.28) pg/mL compared with the control (957.43 ± 234.75) pg/mL.

Discussion

The CD was more common than the UC in IBD patients. This consequence was the same as that of the study by Weigert *et al.*[14] in which the incidence of patients with active disease was Crohn's disease (64%) and ulcerative colitis (38.7%). Also, the proportion of females among 85 IBD patients was higher than that of males, as it is not completely understood why there are differences in the way men and women experience IBD, but research is ongoing.[15] The sex and IBD had a physically influential connection. Depending on Pradhan and Olsson's Biology of Sex Variations describes sex-related variances, including differences in hormone composition, inheritance, lifestyle, environmental factors, and other physiological features between male and female bodies.

Olsson's Biology of Sex Variations describes sex-related variances, including differences in hormone composition, inheritance, lifestyle, environmental factors, and other physiological features between male and female bodies.[16–18] Crohn's disease and ulcerative colitis infection showed an older incidence at 30–39 years compared to the other ages.

These results agreed with the study by Hou *et al.*[19] WHO found the peak incidence of age-specific CD and UC rates was in the 25- to 34-year age-group. However,[20] WHO reported a mean age of CD and UC at diagnosis is approximately 28 or 29 years, respectively, even though some people are being diagnosed in their 50s, 60s, and 70s. The difference in the source of infection, environmental risk factors, and geographical distribution may be important in variations in age rates in Crohn's and ulcerative colitis diseases and suggest that this led to a mean age of 34.39 years, which this result agreed with the studies by Sonnenberg[21] and Alraeai *et al.*[22] People in these ages think that they have weak immune systems, and weak health may be the reason they are extra at risk of IBD severity infections and the human immune system's protective mechanisms opposing bacterial infections.[23] The different BMI category distributions, in every phenotype group indicated overweight patients were most generally seen in the ulcerative colitis group compared to the Crohn's disease; none of the patients with UC were underweight. However, most Crohn's disease and ulcerative colitis patients had the same highest percentage of normal weight. When considered together, overweight and obesity were seen in CD and UC patients,[24] indicated the distribution of BMI was as follows: obesity 5.0%, overweight 6.7%, and normal weight 65.0%. Normal BMI was the most general, regardless of severity of disease.[25] At appearance, 9.4% were overweight, 71% had a normal BMI, and 7.2% were obese.[26] clarified that the incidence of smokers was significantly lower in ulcerative colitis patients than in healthy controls (20.9% vs. 30.4%, $P < 0.01$); however, there was no variation between Crohn's disease patients and controls (19.8% vs. 22.1%, $P = 0.60$). Smoking does not influence Crohn's disease occurrence but is related to further aggressive behavior which consequences in a higher surgical rate. In contrast,[27,28] reported that smoking and the period of cigarette smoking significantly affected ulcer formation and the degree of affected tissues. The serum levels of procalcitonin showed a significant ($P < 0.05$) increase in diagnosed IBD patients compared to controls, suggesting that bacterial infections and sepsis lead to increased procalcitonin levels.[29] There are a number of studies showing that serum procalcitonin level is functional as a marker in several inflammatory disorders.[30,31] Also, demonstrated that procalcitonin concentrations reflect the derangement function of the gut barrier in acute pancreatitis patients. Also, Sarbinowski *et al.*[32] demonstrated that levels of procalcitonin increase extensively subsequent to colorectal surgery. Those results suggested that infectious disease and inflammation of the bowel might elevate procalcitonin levels. This finding agrees with several studies that reported similar higher procalcitonin levels in serum IBD patients.[33] This was similar to a study by Oussalah *et al.*[34] that showed that procalcitonin was significantly higher in IBD patients compared with controls. Koido *et al.*[35] showed that PCT was ~3-fold elevated in patients.

Conclusion

Procalcitonin can be used as a biomarker of inflammation, which can distinguish between infectious and autoimmune processes in inflammatory bowel disease. Also, the crucial role of detailed microbiological assessment should be critically appraised.

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Nil.

Conflicts of interest

All the authors certify that they have no conflict of interest to disclose in relation to the subject matter or materials discussed in the present study.

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