Distribution of haematological indices among subjects with *Blastocystis hominis* infection compared to controls

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**Abstract**

**Introduction:** Some studies suggest *Blastocystis hominis* is a potentially pathogenic protozoa. *Blastocystis hominis* contributed to anaemia in children aged 8–10 years old in one study.

**Aim:** To compare haematological indices in cases with *blastocystis hominis* infection with healthy controls.

**Material and methods:** From 2001 to 2012, 97600 stool examinations were done in 4 university hospitals. Parasites were observed in 46,200 specimens. Of these cases, subjects with complete laboratory investigation (complete blood count – CBC, ferritin, total iron binding capacity – TIBC, and serum) and *blastocystis hominis* infection were included in this study as the case group. Of these cases, 6851 cases had only *B. hominis* infection. In the control group, 3615 subjects without parasite infestation were included. Age, haemoglobin (Hb), serum iron, TIBC, white blood cell (WBC), platelet (PLT), mean corpuscular volume (MCV), haematocrit (HCT) and erythrocyte sedimentation rate (ESR) were recorded for cases and controls. SPSS software version 13.0 was used for analysis. Independent sample t-test and χ² tests were used for comparison.

**Results:** Erythrocyte sedimentation rate level was significantly higher in cases with *B. hominis* infection (*p* < 0.05). C-reactive protein level was positive in 1.46% of cases and 0.5% of controls, which was statistically significant (*p* < 0.05). Frequency of serum iron < 120 was significantly higher in cases with *B. hominis* infection compared to controls. Occult blood was positive in 0.93% of cases and in none of the controls (*p* < 0.05).

**Conclusions:** The ESR, CRP and occult blood was significantly higher in cases with *B. hominis* infection.

**Introduction**

*Blastocystis hominis* (*B. hominis*) is an obligate anaerobic protozoan found in the human large intestine and is the most common eukaryotic organism reported in human faecal samples [1]. The parasite is a zoonotic organism, found in birds and swine, and can be transmitted easily to humans via the oral-faecal route. The prevalence of *B. hominis* varies in different countries from 1.5% to 50% [2]. At first it was thought that the organism is a non-pathogenic yeast, but later *B. hominis* was classified as a protozoan of the stramenopiles line [3]. The pathogenicity of *B. hominis* is still in debate because this parasite is very common in the healthy population without causing any symptoms [4, 5]. However, some studies suggest that it is a potentially pathogenic protozoa and it was reported that *B. hominis* causes various problems such as watery diarrhoea, abdominal pain, bloating, fever, nausea and gastrointestinal problems [5, 6]. In addition, it was reported that *B. hominis* may contribute in colitis, terminal ileitis and rectal bleeding [7, 8]. *Blastocystis hominis* contributed to anaemia in children aged 8–10 years old as per one study [9].

**Aim**

The aim of the study was to compare haematological indices in cases with *blastocystis hominis* infection with healthy controls.
Material and methods
From 2001 to 2012, 97,600 stool examinations were done in 4 university hospitals. Parasites were observed in 46200 specimens. Of these cases, subjects with complete laboratory investigation (complete blood count – CBC, ferritin, total iron binding capacity – TIBC, and serum) were included in this study as the case. Of these cases, 6851 cases had only *B. hominis* infection. This retrospective study was carried out on 10786 subjects who visited the hospital for routine checkup. In this study, subjects who attended for routine checkup were included. Of 8761 cases with *B. hominis* infection, 6851 cases with complete laboratory examination were included. In this case control study, 6851 cases with *B. hominis* infection and 3615 controls were included. Age, haemoglobin (Hb), serum iron, TIBC, white blood cell count (WBC), red cell distribution width (RDW), platelet (PLT), mean corpuscular volume (MCV), haematocrit (HCT) and erythrocyte sedimentation rate (ESR) were recorded for cases and controls.

Statistical analysis
SPSS software version 13.0 (Chicago, IL, USA) was used for analysis. Independent sample *t*-test and *χ*² tests were used for comparison. A value of *p* < 0.05 was considered significant.

Results
Demographic features are shown in Table I. There were significant differences between the two groups regarding distribution of iron levels, with the exception of iron level range 120–140 μg/dl (Table I). For iron level < 80 μg/dl, the relative frequency was significantly higher in the case group. For iron level > 120 μg/dl, the relative frequency was significantly higher in the control group (*p* < 0.05).

Frequency of TIBC = 300–350 μg/dl and 400–450 μg/dl was higher among the cases, and the frequency of TIBC = 350–400 μg/dl was significantly higher among the controls (Table II). There was a significant difference between the two groups regarding platelet count, with the exception of PLT < 150,000/μl and PLT > 450,000/μl (Table II). Subjects with an eosinophil count of 1% were significantly more frequently in the case group than in the control group. The reverse was true for subjects with an eosinophil count of 2%. There was no significant difference between the two groups in eosinophil count in other ranges (Table II).

Discussion
Occult blood was more common in the group with *B. hominis* infection compared to the control group. This may be due to colitis from the *B. hominis* infection. Leder et al. studied over 2800 healthy people over 15 months [10]. They did not find significant correlation between clinical symptoms and the presence of *B. hominis*. In the study by Zuckerman et al., colonoscopy did not show any significant abnormality [11]. In the study by Wakid on 1238 workers in the western region of Saudi Arabia, no significant correlation was found between blastocystis infection and occult blood [12]. Our samples were collected from hospitals. These differences may be due to selection bias.

In our study the frequency of iron level < 80 was significantly higher in subjects with *B. hominis* infection. In the study by El Deeb et al. on pregnant woman with iron deficiency anaemia compared to those without iron

| Parameter | Cases (n = 6851) | Controls (n = 3615) | Value of *p* |
|-----------|-----------------|---------------------|--------------|
| Gender    |                 |                     |              |
| M = 4134, F = 3037 | M = 1459, F = 2156 |
| Age range [years] |                     |                     |              |
| 0–10 | 5741 (83.80) | 2977 (82.4%) | 0.069 |
| 11–20 | 322 (4.70%) | 265 (7.3%) | < 0.001 |
| 21–30 | 292 (4.27%) | 193 (5.3%) | 0.015 |
| 31–40 | 240 (3.50%) | 75 (2.1%) | < 0.001 |
| 41–50 | 125 (1.82%) | 46 (1.3%) | 0.040 |
| 51–60 | 80 (1.17%) | 34 (0.9%) | 0.256 |
| 61–70 | 35 (0.52%) | 17 (0.5%) | 0.977 |
| 71–80 | 14 (0.2%) | 8 (0.2%) | 0.907 |
| 81–90 | 2 (0.02%) | 0 (0.0%) | NA |
| Parameter     | Case (n = 6851) | Control (n = 3615) | Value of p |
|---------------|-----------------|-------------------|------------|
| **ESR, mean ± SD** | 11.16 ±8.67     | 10.32 ±5.01       | < 0.01     |
| Occult blood  | 34 (0.49%)      | 0                 | < 0.001    |
| **Hb (NL = 11–18 g/dl)** |                |                   |            |
| < 10          | 12 (0.16%)      | 11 (0.3%)         | 0.120      |
| 10            | 98 (1.43%)      | 70 (1.9%)         | 0.063      |
| 11            | 427 (6.23%)     | 325 (9.0%)        | < 0.001    |
| 12            | 1120 (16.35%)   | 830 (23.0%)       | < 0.001    |
| 13            | 1122 (16.37%)   | 585 (16.2%)       | 0.826      |
| 14            | 1143 (16.70%)   | 323 (8.9%)        | < 0.001    |
| 15            | 2671 (39.00%)   | 1411 (39.0%)      | 0.986      |
| 16            | 194 (2.83%)     | 48 (1.3%)         | < 0.001    |
| 17            | 45 (0.65%)      | 6 (0.2%)          | 0.001      |
| 18            | 15 (0.22%)      | 5 (0.1%)          | 0.215      |
| 19            | 4 (0.06%)       | 1 (0.0%)          | 0.353      |
| **Fe [μg/dl]** |                |                   |            |
| 20–40         | 19 (0.27%)      | 0 (0%)            | 0.002      |
| 40–60         | 206 (3.00%)     | 8 (0.2%)          | < 0.001    |
| 60–80         | 5888 (85.94%)   | 2702 (74.7%)      | < 0.001    |
| 80–100        | 674 (9.83%)     | 761 (21.1%)       | < 0.001    |
| 100–120       | 58 (0.84%)      | 136 (3.8%)        | < 0.001    |
| 120–140       | 6 (0.08%)       | 8 (0.2%)          | 0.152      |
| **TIBC (NL = 240–450 μg/dl)** |            |                   |            |
| < 240         | 11 (0.16%)      | 8 (0.2%)          | 0.697      |
| 240–300       | 693 (10.11%)    | 374 (10.3%)       | 0.778      |
| 300–350       | 3031 (44.24%)   | 1492 (41.3%)      | 0.003      |
| 350–400       | 2003 (29.23%)   | 1486 (41.1%)      | < 0.001    |
| 400–450       | 1099 (16.04%)   | 250 (6.9%)        | < 0.001    |
| > 450         | 14 (0.21)       | 5 (0.1%)          | 0.271      |
| **PLT (NL = 150000–450000/μl)** |            |                   |            |
| < 150000      | 134 (1.95%)     | 75 (2.1%)         | 0.611      |
| 150000–200000 | 468 (6.83%)     | 328 (9.1%)        | < 0.001    |
| 200000–250000 | 751 (10.97%)    | 263 (7.3%)        | < 0.001    |
| 250000–300000 | 4127 (60.23%)   | 2336 (64.6%)      | < 0.001    |
| 300000–350000 | 905 (13.20%)    | 251 (6.9%)        | < 0.001    |
| 350000–400000 | 199 (2.90%)     | 168 (4.6%)        | < 0.001    |
| 400000–450000 | 151 (2.20%)     | 114 (3.2%)        | < 0.001    |
| > 450000      | 118 (1.72%)     | 80 (2.2%)         | 0.079      |
deficiency, the frequency of *B. hominis* was significantly higher in the first group [13]. In another study by Yavasoglu et al., the rate of *B. hominis* infection was significantly higher among cases with iron deficiency anaemia [14]. In the study by Cheng et al. haemoglobin, neutrophil count and haematocrit were decreased in subjects with *B. hominis* infection [15]. In the recent study by El Deeb and Khodeer, the frequency of parasites was significantly higher in cases with iron deficiency (anaemia) compared to non-anaemic patients [16].

Although the exact mechanism of iron deficiency in subjects with *B. hominis* was not understood, some studies showed invasion of *B. hominis* in the gastrointestinal tract and subsequent blood loss [8]. In the literature, *B. hominis* was reported as the possible cause of acute abdomen in children [17]. There is evidence regarding the presence of inflammation when *B. hominis* is present [18]. Yavasoglu et al. did not find evidence that supported the invasion of mucosa [14].

Another mechanism that may lead to the development of anaemia in blastocystis is that infected subjects may return to the molecular structure of *B. hominis*. Stenzel et al. showed that in the endocytic pathway of *B. hominis* cationic ferritin is essential [19].

### Table II. Continued

| Parameter | Case (n = 6851) | Control (n = 3615) | Value of p |
|-----------|----------------|-------------------|------------|
| Eosinophil (%) | | | |
| 1 | 719 (10.49%) | 440 (12.2%) | 0.008 |
| 2 | 5387 (78.63%) | 2751 (76.1%) | 0.003 |
| 3 | 316 (4.61%) | 189 (5.2%) | 181 |
| 4 | 150 (2.19%) | 94 (2.6%) | 0.185 |
| 5 | 98 (1.43%) | 58 (1.6%) | 0.484 |
| 6 | 49 (0.71%) | 20 (0.6%) | 0.527 |
| 7 | 58 (0.84%) | 35 (1.0%) | 0.440 |
| 8 | 21 (0.30%) | 6 (0.2%) | 0.287 |
| 9 | 19 (0.27%) | 10 (0.3%) | 0.700 |
| 10 | 19 (0.27%) | 6 (0.2%) | 0.491 |
| > 10 | 15 (0.22%) | 6 (0.2%) | 0.788 |
| WBC count (NL = 4000–11000 cells/μl) | | | |
| 2000–2999 | 58 (0.84%) | 66 (1.82%) | < 0.001 |
| 3000–3999 | 447 (6.52%) | 238 (6.59%) | 0.907 |
| 4000–4999 | 878 (12.81%) | 352 (9.73%) | < 0.001 |
| 5000–5999 | 1491 (21.76%) | 823 (22.77%) | 0.239 |
| 6000–6999 | 1487 (21.70%) | 806 (22.30%) | 0.486 |
| 7000–7999 | 903 (13.18%) | 553 (15.30%) | 0.002 |
| 8000–8999 | 864 (12.61%) | 516 (14.27%) | 0.016 |
| 9000–9999 | 550 (8.02%) | 210 (5.80%) | < 0.001 |
| 10000–10999 | 96 (1.40%) | 33 (0.92%) | 0.031 |
| 11000–11999 | 29 (0.42%) | 5 (0.14%) | 0.042 |
| 12000–12999 | 27 (0.39%) | 8 (0.23%) | 0.140 |
| 13000–13999 | 21 (0.30%) | 5 (0.13%) | 0.100 |
| CRP | Pos: 100 (1.46%) | 18 (0.5%) | < 0.001 |
Although there have been several published studies regarding *B. hominis* infection, there are few publications on its association with haematological indices. Limitations – the method of this study was retrospective, and this is the main limitation.

Conclusions

*Blastocystis hominis* is a possible factor in haematological abnormalities. Another cohort study on a healthy population is recommended for determination of the cause and effect relationship.

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