

# Validity of leukocyte count to predict the severity of acute appendicitis

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## ABSTRACT

**Objective:** To ascertain whether white blood cell (WBC) count with differential analysis may predict severity of disease in acute appendicitis.

**Methods:** We conducted this retrospective study on appendectomy patients from 1996 to 2001, at King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. We reviewed patient's age, gender, duration of symptoms, temperature on admission, WBC count including differential and the histological diagnosis of the appendicular specimen. We further analyzed the data of those patients found to have acute, gangrenous and perforated appendicitis to determine the correlation between a high WBC count and a more advanced form of appendicitis.

**Results:** Out of an aggregate of 232 patients, 162 were males and 70 females with a mean age of 23.7 years (range, 12–70 years). Mean duration of symptoms was

1.9 ± 1.1 days, mean temperature 37.8 ± 1.4°C, with reported elevated WBC count in 167 (71.9%) and normal in 65 (28.1%) cases. Mean WBC counts in acute were 14.5 ± 7.3 × 10<sup>9</sup>/L, gangrenous 17.1 ± 3.9 × 10<sup>9</sup>/L and perforated appendicitis 17.9 ± 2.1 × 10<sup>9</sup>/L. This reflected a persistently higher WBC count in the complex (gangrenous, perforated) appendicitis compared with acute appendicitis (*p*<0.05). The differential analysis showed neutrophilia in 123 (53%) and lymphopenia in 112 (48%) cases and out of these, 116 (94%) with neutrophilia and 107 (95%) with lymphopenia were reported to have appendicitis.

**Conclusion:** A high WBC with differential count is a reliable indicator of the severity of appendicitis and signifies a more advanced stage.

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Acute appendicitis is the most frequent cause of persistent and progressive abdominal pain;<sup>1</sup> it affects all age groups, with an overall incidence of 11 cases/10,000 population per year.<sup>2</sup> Appendicitis still poses a diagnostic challenge and the negative appendectomy rate remains as high as 30%.<sup>3</sup> A failure to diagnose and therefore to manage can lead to a progression of disease with its associated morbidity and mortality. Particularly, a perforated appendix can manifest as free peritonitis, phlegmon, or abscess for which the treatment usually incorporates a combination of surgical and medical therapies. Therefore, we have developed several diagnostic tools and scoring systems

to diagnose early appendicitis, characterized as non-invasive, understandable, user-friendly and cost-effective.<sup>4-6</sup> Reports show the finding of an elevated white blood cell (WBC) count, resulting from the associated inflammatory response in 70-90% of patients with acute appendicitis.<sup>7</sup> The object of the present study was to assess the predictive significance of WBC count in the severity of appendicitis, which may help enhance the diagnostic accuracy and decision making.

**Methods.** This retrospective review included those patients who underwent consecutive appendectomies, under one consultant, from 1996 to

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2001 at King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. The parameters considered were patient's demographic details, duration of symptoms, temperature on admission, differential WBC count and the histological diagnosis of the appendicular specimen. The baseline data were subsequently examined to analyze the correlation between a high WBC count and the severity of appendicitis, namely, acute appendicitis, gangrenous appendicitis, and appendicular perforation with a localized or diffuse peritonitis.<sup>8</sup> Those patients who underwent appendectomies as part of other surgical procedures were excluded from the study. Acute appendicitis was diagnosed only on histological grounds according to the following criteria: Macroscopic signs include intravascular injection of serosa, fibrinous and purulent film; edematous, necrotic changes of the wall; and blood or pus on opening the appendix. Microscopic signs include focal or expanded erosion, ulceration, abscess, fistula and necrosis or perforation.<sup>9</sup> A WBC count of  $3.9-10.9 \times 10^9/L$  was accepted as normal and greater than  $11 \times 10^9/L$  as elevated. Neutrophil count  $>73\%$  (normal range, 48-73%) and lymphocyte count  $<18\%$  (normal range, 18-48%) were considered abnormal. The statistical analysis was performed by using SPSS 10.0 software package (SPSS Inc., Chicago, IL). For statistical analysis, student's t test was used and a probability value of  $<0.05$  was assigned to indicate the statistical significance.

**Results.** A total of 232 patients were enrolled in this series. There were 162 male and 70 female patients with a mean age of 23.7 years. The duration of symptoms (anorexia, nausea, vomiting and migratory pain in the right lower quadrant) was found to be  $1.9 \pm 1.1$  days. Histologically, 25 (10.7%) appendicular specimens were reported to be normal, whereas 189 (81.4%) showed acute inflammation, 10 (4.2%) gangrenous appendicitis and 8 (3.4%) perforated appendicitis. This study revealed a mean WBC count of  $14.6 \pm 1.3 \times 10^9/L$ ; elevated in 167 (71.9%) and normal in 65 (28.1%) subjects with a differential analysis of neutrophilia in 123 (53%) and lymphopenia in 112 (48%) cases. The mean WBC count of patients with gangrenous appendicitis ( $17.1 \pm 3.9 \times 10^9/L$ ) and perforated appendicitis ( $17.9 \pm 2.1 \times 10^9/L$ ) was higher than those with acute appendicitis ( $14.5 \pm 7.3 \times 10^9/L$ ). Overall, 18 (7.7%) cases presented with gangrenous or perforated appendicitis, or both, with a mean WBC count of  $18.1 \pm 1.9 \times 10^9/L$ .

**Discussion.** Acute appendicitis has an overall incidence of 6-20% in the general population, with the risk of developing this condition falling from one in 5 at birth to less than one in 100 by the age of 70.<sup>10</sup> Appendicitis with its protean manifestations may simulate various acute abdominal illnesses sufficient

enough to frustrate the treating physician. Our study revealed a negative appendectomy rate of 10.7%, which is much less than the published figures.<sup>11</sup> Of all the recently introduced diagnostic tools, only laparoscopy, ultrasonography and computer-aided diagnoses demonstrate promising results, but all have their own drawbacks.<sup>12</sup>

Initial demargination of peripheral WBCs caused by catecholamine and cytokine release accounts for leukocytosis in most patients with acute appendicitis. A substantial number of scoring systems quote WBC count as an inflammatory marker for the evaluation of acute appendicitis.<sup>6,9,13</sup> This study surfaced a mean WBC count of  $18.1 \pm 1.9 \times 10^9/L$  for patients with a more advanced stage of appendicitis (gangrenous and perforated appendicitis) which is markedly higher than a mean WBC count of  $14.5 \pm 7.3 \times 10^9/L$  encountered in acute appendicitis. Such observation reflects the predictive profile of an elevated WBC count to determine worsening appendicitis. A generalized inflammatory response characterized by neutrophilia and lymphopenia accompanies acute appendicitis.<sup>14</sup> In our series, the differential leukocyte count showed neutrophilia in 123 (53%) cases and out of those, 116 (94%) reported to have histological evidence of appendicitis, while the remaining 7 (0.05%) patients revealed normal appendix. Furthermore, 112 (48%) patients demonstrated lymphopenia, while we found 107 (95%) subjects in this group to have histologically proven appendicitis. Although an increase in temperature and marked leukocytosis are not diagnostic of any particular illness, their presence should suggest certain specific surgical ailments.<sup>15</sup> Similarly Gil et al<sup>16</sup> reported that leukocytosis was the test that had the best agreement indices of clinical validity in the diagnosis of acute appendicitis. This study showed that 9 (3.8%) patients with normal appendices had elevated WBC count, which led to diagnostic confusion and resultant negative appendectomies. This emphasizes the need for multicenter, randomized controlled clinical trials to reduce the high diagnostic error rates, although we now increasingly practice laparoscopy to establish the diagnosis of certain acute abdominal affections including appendicitis.<sup>17</sup>

To conclude, the WBC count, with its differential reflects the severity of disease in acute appendicitis. When integrated with the clinical findings, WBC count augments the diagnostic accuracy with subsequent reduction in perioperative morbidity and mortality.

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