

ORIGINAL ARTICLE

**The Role of Absolute Neutrophil Count as Compared to
Computed Tomography Scan in the Diagnosis of
Suspected Acute Appendicitis: A Single Academic
Institution Experience**

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Abstract. The role of absolute neutrophil count as compared to computed tomography scan, in the diagnosis of suspected acute appendicitis was determined. This is a retrospective study of 565 patients who underwent appendectomy in King Abdulaziz University Hospital from January 2010 till December 2012. The patients were divided into three groups: Clinically diagnosed group; patients who had computed tomography scan and absolute neutrophil count; and finally those who had only absolute neutrophil count. Out of 565 patients, 60 (10.6%) of them were diagnosed clinically and were found to have normal appendix. In the 290 (51.4%) patients that had computed tomography scan and absolute neutrophil count, the computed tomography scan showed 60 (21%) patients to have normal appendix, while the absolute neutrophil count showed 54 (16%) patients. The computed tomography scan accurately diagnosed 213 (73.4%) patients to have appendicitis with a sensitivity of 98.2% and, specificity of 82.2%. In comparison, the absolute neutrophil count group showed 207 (71%) patients to have appendicitis with sensitivity of 95.4% and specificity of 74%. These results correlated well with each other.

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Accepted for publication: 18 May 2014. Received: 16 March 2014.

Absolute neutrophil count showed a significant impact on the diagnosis of acute appendicitis confirmed by histopathological findings and supported by computed tomography scan.

Keywords: Appendicitis, Absolute neutrophil count, Computed tomography scan.

Introduction

Acute appendicitis is an extremely common surgical presentation and affects 7% of the population during their lifetime^[1]. Although patients with acute appendicitis often present with a characteristic symptom complex and physical findings, atypical presentations are common^[2]. Over the years, many studies have looked at various simple blood tests and clinical criteria in an attempt to improve diagnostic accuracy^[3,4]. Authors of large prospective studies report a 22% - 30% removal rate of normal appendices at surgery^[4]. Studies in the adult population have found the white blood cell count (WBC) to also be elevated ($> 10\ 000$ per mm³/L is considered high) in 80% of all cases of acute appendicitis. In this study, the WBC level was compared with the pathological findings and the role of absolute neutrophil count (ANC) was examined in diagnosing acute appendicitis. These criteria were also compared with computed tomography (CT) scan and sonography findings to determine the accuracy of ANC as compared to the above diagnostic tools in diagnosing acute appendicitis confirmed by histopathology.

Some researchers point out the significance of CT scan and ultrasonography in diagnosing appendicitis and hence decreasing the negative appendectomy rate^[5], while others found that CT scan would not ensure surgical diagnostic accuracy^[6]. This study's aim is to find an alternative yet accurate way of diagnosing appendicitis, as well as reducing the hazards from the use of CT scan. The lifetime risk of radiation-induced cancer from a single abdominal scan was found to be 26.1 per 100,000 in females and 20.4 per 100,000 in males, based on probabilistic models designed with data from atomic bomb survivors^[7]. On the other hand, ultrasonography is operator dependent and hence is not a reliable tool in all cases^[8].

Methods

Retrospective analysis of 565 patients' records was carried out. All of the patients underwent appendectomy in the Department of Surgery, King Abdulaziz University Hospital, Jeddah, Saudi Arabia from January 2010 to December 2012. A designed data collection sheet was used and data were entered in an SPSS software program version 18, using analysis of variance (ANOVA) and Post-hoc tests for analysis.

Diagnosis of appendicitis was established using clinical features, laboratory, and radiological results. Demographic and clinical data included age, sex, and nationality, presenting symptoms and signs at the time of admission, complete blood count, and histopathological diagnosis post operatively.

A WBC level $> 11.0 \text{ cell/mm}^3$ and an ANC level $> 7.5/\text{mm}^3$ was considered abnormal as per King Abdulaziz University Hospital, Jeddah, Saudi Arabia laboratory reference. CT features that indicated appendicitis were: enlargement of the appendix ($> 6 \text{ mm}$ in the outer diameter), enhancement of the appendiceal wall, lack of pacification in an enlarged appendix, fat stranding in the periappendiceal region, and the presence of an appendicolith within the appendix. An approval from the ethical committee was obtained. The patients were divided into three groups: The clinically diagnosed group; patients who had CT and ANC; and finally, those who had only ANC (Table 1).

Table 1. Comparison of the results of the different groups.

Groups	Normal	False Negative	False Positive	Positive for Appendicitis	Total Number of Patients
Clinically Diagnosed CT/ANC	60	-	-	-	60
CT Results (n)	60	13	4	213	
ANC Results (n)	54	19	10	207	290
ANC Only (n)	10	43	10	152	215
					565

ANC = Absolute neutrophil count; CT = Computed tomography scan.

Note: All of the results were confirmed by histopathology.

Results

Out of 565 patients, 60 (10.6%) of them were diagnosed clinically and found to have normal appendix. For the 290 (51.4%) patients that had CT and ANC, the CT showed 60 (21%) patients to have normal appendix, while the ANC showed 54 (16%) patients. The false negative and false positive in the CT group were 13 (4.5%), and 4 (1.4%), respectively, compared to 19 (6.5%) and 10 (3.4%) patients in the ANC group. The CT accurately diagnosed 213 (73.4%) patients to have appendicitis with a sensitivity of 98.2% and, specificity of 82.2%. In comparison, the ANC group showed 207 (71%) patients to have appendicitis with sensitivity of 95.4% and specificity of 74%. These results correlated well with each other. On the other hand, out of 215 (38) patients who had ANC only 10 (4.6%) patients were normal, the false negative and false positive were 43 (20%) and 10 (4.6%), respectively. The ANC only group was confirmatory for the diagnosis of acute appendicitis in 152 (71%) patients (Table 1) with a significant P-value of 0.012.

Discussion

Appendicitis is a very common surgical disease with a lifetime occurrence of 7%^[1-4,9,10].

Clinical diagnosis still is the main tool for diagnosing acute appendicitis. However, the WBC and ANC play an important role in supporting the diagnosis. In this study, all 565 patients who were suspicious of acute appendicitis underwent clinical and laboratory evaluations with some also needing radiological investigations in the form of CT scans. Kwan and Nager^[9] found that the mean WBC counts were $15.3 \text{ cells} \times 1000/\text{mm}^3$ for patients with definitive appendicitis and $11.2 \text{ cells} \times 1000/\text{mm}^3$ for patients with no definitive appendicitis, $P < 0.001$. The mean (SD) ANCs were $12.7 \text{ cells} \times 1000/\text{mm}^3$ for patients with definitive appendicitis and $7.85 \text{ cells} \times 1000/\text{mm}^3$ for patients with no definitive appendicitis, $P < .001$ ^[5]. In this study the ANC above or equal to $7.5 \text{ cells} \times 1000/\text{mm}^3$ was taken to be the diagnostic level with a $P = 0.012$, which was significant. Memisoglu *et al.*^[10] studied 196 patients who underwent

appendectomy and they found WBC level to be high in 83% for patients with acute appendicitis and 6% for negative appendectomies. On the other hand, Cardall *et al.*^[2] found that WBC level were more than 10000 cells/mm³ with a sensitivity of 76% (95% CI: 65% - 84%), and a specificity of 52% (95% CI: 45% - 60%) which statistically showed poor association with the presence of appendicitis. In another study, Ishikawa^[11] also suggested that the WBC is of diagnostic value. The WBC usually exceeds 10,000/mm³^[9]. The sensitivity for ANC in this study was found to be comparable to CT at 95.4% and 98.2% respectively. Grönroos^[12] studied the role of WBC in diagnosis of acute appendicitis and found that elevated WBC level can't effectively establish the diagnosis, but he found that un-elevated values excluded it in elderly patients. In another sample of patients, Grönroos and Grönroos^[13] categorized patients into 3 groups (un-inflamed appendix, uncomplicated appendicitis, and complicated appendicitis) and they found that the WBC level was significantly higher (P value < 0.001) in uncomplicated appendicitis and complicated appendicitis than with un-inflamed appendix. The emphasis in most of the studies, as can be seen, is on WBC count and not ANC. This study found a very strong association of high ANC with the diagnosis of acute appendicitis.

A study conducted by Sengupta *et al.*^[3] suggests that patients with lower abdominal pain with normal WBC and C - reactive protein (CRP) level are unlikely to have acute appendicitis. They found that WBC level has high negative predictive value of 95% for diagnosing acute appendicitis. This study, in comparison, found raised ANC to have a high diagnostic accuracy with sensitivity of 95.4% and specificity of 74%.

Conclusion

ANC showed a significant impact on the diagnosis of acute appendicitis confirmed by histopathological findings and supported by CT. Hence we recommend ANC to be sufficient in patients with equivocal clinical signs, and CT to be employed in cases where the ANC is normal. Limitations of this study include smaller number and it being retrospective.

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دور العدد المطلق للعدلات بالمقارنة مع الأشعة المقطعية في تشخيص التهاب الزائدة الدودية الحادة المشتبه بها: تجربة وحيدة بمؤسسة أكاديمية

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جدة - المملكة العربية السعودية

المستخلص. إن دور العدد المطلق للعدلات بالمقارنة مع الأشعة المقطعية لتشخيص احتمالات الالتهاب الحاد للزائدة الدودية، قد اتضح في هذه الدراسة. تمت هذه بأثر رجعي على ٦٥٦ مريض، خضعوا لإجراء عملية استئصال للزائدة الدودية في مستشفى جامعة الملك عبدالعزيز من تاريخ يناير ٢٠١٠ حتى ديسمبر ٢٠١٢. وقسم المرضى الى ثلاث مجموعات، المجموعة الاولى وتم تشخيصها سريريا، المجموعة الثانية للمرضى الذين شخصوا بالأشعة المقطعية بالإضافة للزيادة في عدد العدلات المطلق، والمجموعة الثالثة التي تضم المرضى الذين شخصوا فقط بارتفاع عدد العدلات المطلق. من أصل ٦٥٦ مريض ٦٠% (٦,١٠%) منهم شخصوا سريريا ووجد أن الزائدة الدودية لديهم طبيعية، و ٢٩٠ مريض (بنسبة ٤,٥١%) عملوا الأشعة المقطعية بالإضافة الى معدل عدد العدلات المطلق، وبينت الأشعة المقطعية أن ٦٠ مريض (٢١%) لديهم الزائدة الدودية طبيعية مع وجود في عدد العدلات المطلق، وتم تشخيص ٢١٣ مريض

بنسبة (٤,٧٣%) يعانون من التهاب حاد في الزائدة الدودية وبنسبة حساسية ٢,٩٢% ونسبة خصوصية ٢,٨٢% بالمقارنة بعدد العدلات المطلق المرتفع. شخص ٢٠٧ مريض (٧١%) بأن لديهم التهاب حاد في الزائدة الدودية مع حساسية بنسبة ٤,٩٥% وخصوصية بنسبة (٧٤%). وهذه النتائج ترتبط مع بعضها البعض جيداً. تبين لنا أن عدد العدلات المطلق ذا أهمية وتأثير على تشخيص التهاب الزائدة الدودية الحاد ويتأكد ذلك بالاختبار التشريحي للانسجة المرضية مدعماً بالأشعة المقطعية.