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USE OF A MODIFIED ALVORADO SCORE IN THE DIAGNOSIS OF ACUTE APPENDICITIS
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ABSTRACT

Background: **The negative appendicectomy rates have remained high. The integration of clinical scores into the diagnostic process in acute appendicitis has had the purposes of improving decision making and reducing the negative rates in this common condition. The performance of these score systems have however, not been uniform.**

Objective: **To assess the usefulness of a modified Alvorado score (1986) to predict groups of patients with suspected appendicitis for definite surgery, observation or discharge from hospital.**

Design: **Prospective study.**

Setting: **Kenyatta National Hospital (KNH), a central referral and teaching hospital in Nairobi, Kenya.**

Patients: **One hundred and eighty nine patients with suspected acute appendicitis were studied over a period of twelve months.**

Methods: **Five symptoms and four signs were assigned numerical values and the patients scored out of a total of 10 points. A score of >7 predicted mandatory operation, 5-6 observation and score 1-4 predicted those not considered for surgery. The decision to operate was the prerogative of the surgeon or surgical resident based on overall clinical suspicion and not the diagnostic score.**

Results: **The proportion of patients with scores >7 was 40.7%. The mean score was 6.02. The mean ages and the gender ratios were similar across score groups. The negative appendicectomy rate was 17.6% for group 1-4, 16.5% for 5-6 and 19.7% for > 7. These were similar to the overall negative rate of 18% based on clinical suspicion. The overall sensitivity and sensitivity for the scoring system was 80.3% and 16.8% respectively.**

Conclusion: **High scores were found to perform poorly in predicting diagnosis of acute appendicitis preoperatively and in the reduction of negative appendicectomies. The integration of a scoring system does not offer advantage over degree of clinical suspicion.**

INTRODUCTION

Reginald Fitz first described appendicitis in 1886 and a few years later, Charles McBurney described the clinical findings prior to rupture and advocated early surgical intervention (1). Today, over 100 years later, the accurate diagnosis still remains difficult. An average of 20% of appendices removed for presumed appendicitis are normal. While the diagnosis is relatively straightforward in young men, the error rate in pre-menopausal women can approach 40% (2,3). The morbidity and financial implications of these errors are immense. Attempts made to reduce these diagnostic errors have involved the creation of scoring systems based on a combination of historical factors, physical examination and laboratory variables elicited from the patient and given numerical values to predict the likelihood of appendicitis. The Alvorado, Mantrell, Christian, Fenyo scores are often quoted (4). These variables include the male sex, leucocytosis, neutrophilia, history of less than 24 hours, anorexia, nausea/ vomiting, shift of pain from epigastrium, rebound tenderness and localized guarding (4-6).

The incidence of appendicitis is increasing in the urban centers of countries in Africa (7). It is not clear whether diagnostic scores would be applicable for our groups of patients. Elsewhere, the performances of these score systems have ranged from good to poor (4).

This study evaluated a scoring system modified from that of Alvorado in consecutive patients undergoing appendicectomy for suspected acute appendicitis at the Kenyatta National Hospital.

MATERIALS AND METHODS

Setting: Kenyatta National Hospital, a 2000-bed tertiary referral facility and a University teaching hospital in the city of Nairobi.

Design and Duration: Single center evaluation with a prospective data base. The study was performed from July 2000 to June 2001.

Subjects: One hundred and eighty nine patients with clinical suspicions of acute appendicitis and undergoing appendicectomy were analysed. Patients were admitted into the general surgical wards from the Emergency department and reviewed by general

surgery residents who made the decisions to operate. The authors abstracted patient data by individual chart review. Data were collected on medical history, physical findings, demographics, diagnostic tests, operation findings and histopathological findings of removed appendices. An appendicitis score was calculated for each patient. The score covered 5 symptom variables and four signs given numerical values 1 or 2. The maximal cumulative value was 10: duration of symptoms <48 hours one, relocation of pain one, anorexia one, nausea/vomiting one, right iliac fossa pain one, right iliac fossa tenderness one, rebound tenderness/ rigidity/guarding one, fever one, Rovsing/Psoas sign one. The patients were divided into three score groups. The decision to operate was however not based on these scores but the clinical impression by the clinician taking charge of the patient.

Group I (score 7-10):- surgery, Group II (score 5-6):- admission and observation, Group III (score 1-4):- surgery not indicated.

Main Outcome Measures: The measures included the proportion of patients in each score group and the rate of positive histology. All the appendices removed were sent for histo-pathological examination.

Statistics: Descriptive summary statistics for age and appendicitis scores were performed. X^2 analysis was used to analyse differences in the proportions of negative appendicectomies between the diagnostic score groups. The student t-test analysis was utilised to compare mean scores across groups. $p<0.05$ was considered statistically significant.

RESULTS

One hundred and eighty nine patients who underwent appendicectomy for suspected acute appendicitis were analysed. There were 116 males (61.4%) and 73 females. The average age was 27.8±13 years (range 5-80 years of age). The peak age category was 21-30 years (36.5%).

The appendicitis scores ranged from two to ten. The mean score was 6.06±2. The proportion of patients with scores ≥7 was 40.2%. The proportion that scored 5-6 was 41.8%. Thirty four patients (18.0%) had a score of 1-4. The mean age was 26.9 years for score group 1-4, 28.5 years for group 5-6 and 27.8 years for the score group 7-10. The gender proportions were similar across the groups (males comprised 64.5% of group 7> 55.7% of group 5-6 and 65.8% of group 1-4; $p > 0.05$) (Table 1).

Histological evidence of inflammation was obtained in 88.4% of appendices in score group I-4 and 83.5% of score group 5-6 ($p = 0.877$). Positive histology was obtained in 80.3% of patients in group ≥7. When dichotomised into less or greater/equal to 7, the proportion of positive histology of the combined group l-6 did not differ significantly from score group 7-10 ($p = 0.608$). Conversely the negative appendicectomy rates of 17.6% in group 1-4,16.5% in groups 5-6 and 19.7% in group 7-l0 (Figure 1), were comparable to the overall negative appendicectomy rate of 18.0% based on physician judgment alone.

The overall sensitivity of the modified score in this study was high (80.3%) but the specificity was low (16.8%). The signs and symptoms predictive of appendicitis also had high sensitivities but suffered from low specificities (Table 2a,b). Pain in the right lower quadrant had a sensitivity and sensitivity of 80.6% and 14.3% respectively. Abdominal rigidity had a sensitivity of 84.4% and specificity of 25%. Migration of pain from the peri-umbilical region had a sensitivity of 83.3% and specificity of 22.2%. The overall sensitivity was highest among males (94.0% while that in females was 70.4%). The results of the white cell count analysis are shown in Table 3. The mean leucocyte count showed a significant difference between the groups 1-4 and 5-6 (17.6×10^9/l vs 14.025×10^9/l; $p = 0.004$). The low acuity group of patients (l-4) also had a higher mean leucocyte count when compared to group 7-10 (15.74×10^9/l). For categorical groups for gender, faecolith presence and symptom duration, X^2 analysis did not demonstrate any statistically significant difference in the leucoyte data. There were faecoliths in 29.4% of appendices in score group 1-4, 39.24% of appendices in 5-6 and 40.8% in score group 7-10.

Table 1

Characteristics of clinical score groups

		1-6 (n=l13)	7-10 (n=76)	p-value
Inflammation	Yes	94	61	0.608
	No	19	15	
Sex	Male	66	50	0.307
	Female	37	26	
Faecolith	Present	41	31	
	Absent	79	45	0.532
Complication	Yes	18	5	
	No	95	71	0.054

Table 2 a

Symptom profile across clinical score groups

Characteristic	1-4(n=34)	5-6(n=79)	7-10 (n=76)
Pain duration (≤ 2 days)	6(17.6)	23(67.1)	56 (73.7)
Umbilical pain	23(67.6)	50(63.3)	71 (93.4)
Right iliac fossa pain	16(47.0)	71((89.9)	75 (98.7)
Anorexia	9(36.0)	20(25.3)	38 (50)
Nausea/vomiting	21(61 .8)	48(60.8)	57 (75)
Fever	3(8.8)	11(13.9)	11 (14.5)
Right iliac tenderness	10(29.4)	75(94.9)	76 (100)
Rebound/guarding	18(52.9)	64((81)	75 (98.7)
Psoas/Rovsing	0(0)	6 (7.6)	27 (35.5)

Figure 1

Negative appendicectomy rates in score groups

Table 2b

Sensitivity and specificity of clinical findings for the diagnosis of acute appendicitis

Finding	Sensitivity (%)	Specificity (%)
Migration pain	83.3	22.2
Right lower quadrant pain	80.6	14.3
Anorexia	85.6	19.6
Nausea/vomiting	83.3	4.8
Gurading/rigidity	84.4	25.0
Rebound tenderness	85.0	21.3
Right quadrant tenderness	80.1	7.6

Table 3

White cell count versus score group inflammation and faecolith presence

		Mean count	SD	P-value
Score group	1-4	17.7	2.7	
	5-6	14.0	1.9	0.004
	1-6	15.2	2.7	-
	7-10	15.7	3.5	0.654
Faecolith	Yes	15.16	3.5	0.647
	No	15.6	2.7	-
Gender	Male	15.0	3.1	0.436
	Female	15.9	3.0	-
Symptom duration				
	24 hours	15.7	3.1	0.293
	24-48 hours	12.7	2.1	-
	>48 hours	13.7	0.35	-

DISCUSSION

Our results show that 40.2% of the patients satisfied the criteria for a definite diagnosis of acute appendicitis. Another 41% for probable appendicitis. Nearly a fifth (18%) of the patients were predicted to have alternative diagnoses. The clinical score had a high sensitivity (80.3%) but suffered from low (16.8%) specificity. Of patients with scores of ≥7 the negative appendicectomy rate was 19%. The overall error rate of 18% (from clinical suspicion) was similar to that predicted by scoring.

Our results have failed to validate the use of a clinical score in predicting appendicitis. Patients with acutely inflamed appendices did not fulfill more clinical criteria than those without. The overall sensitivity (proportion of group >7 with positive histology) was 80.3%. The specificity (proportion of those 1-6 with negative histology) was only 16.8%. In a study of 68 patients, Crnogorac *et al.* found a large proportion (82.7%) of patients with Alvorado score 7 or more. The score was found useful with sensitivity and specificity levels of 87% and 60% respectively being achieved (8).

The similar rates of positive histology for both high and low total scores in our study indicate that the accuracy of a diagnosis of appendicitis is not improved by a combination of historical and physical examination findings. These findings appear to support the results by Izbicki *et al.* (9). In their study, the male sex, white cell count greater than 11 X 10^9/l, history of less than 24 hours, rebound tenderness, shift of pain from epigastrium and localised guarding were predictive retrospectively, but were characterised by low specificities and sensitivities when applied prospectively. Combining the scores did not improve their predictive power. The authors concluded that the accurate diagnosis of appendicitis depended largely on the experience of the surgeon and not by application of a score system that included the above variables (9).

The limited utility of the clinical parameters due to low specificities may be due to the protean nature of presentation of appendicitis and a myriad of other diagnoses mimicking appendicitis. No single clinical variable can therefore guarantee the correct diagnosis. Literature suggests that the signs and symptoms that seem to be most predictive of appendicitis include pain in the right lower quadrant, abdominal rigidity, migration of pain from the umbilical region to the right lower quadrant (10) and a short history (11). For right lower quadrant pain and rebound tenderness the sensitivity values approach 81% and 63% respectively. The specificities approach 53% and 69% (10). The low specificity of symptoms and peritoneal signs leaves clinical experience as the most helpful item in proving the diagnosis of acute appendicitis which ought to be operated upon (12). The high sensitivities of peritoneal signs may mean that their absence may be more useful in ruling out the diagnosis of acute appendicitis.

The lower overall sensitivity of the score in females is expected. Bhattacharjee *et al.* (13), analysing 110 patients, found a sensitivity of 94.1% in males and lower value of 71.9% in females for a modification of the Alvorado score. Pre-menopausal females have a number of gynaecological conditions with presentations similar to appendicitis. The common misdiagnoses include pelvic inflammatory disease, gastroenteritis, urinary tract infection, ruptured ovarian follicle and ectopic pregnancy (14). For their group of women with normal appendices who underwent operation, alternative diagnoses included pelvic inflammatory disease, ruptured follicular cysts, twisted

ovarian cysts and ruptured ectopic pregnancy (13).

The mean white cell count was highest for the low acuity patients (score 1-4). All the patients who had this examination carried out (16.9% of the total) demonstrated leucocyte counts more than 11 X 10^9/L. The mean white cell counts did not differ across the groups. The leucocyte count was also similar for those with or without appendicitis. These findings support the contention that although 70-90% of patients with acute appendicitis have an elevated count, leucocytosis is also characteristic of several other acute abdominal and pelvic diseases and thus has poor specificity for the diagnosis of acute appendicitis (15-18).

In conclusion, this prospective study has shown that a diagnostic scoring system does not improve upon physician judgment in patients with abdominal pain suggestive of appendicitis. Superiority and reliability of history and examination is most important in differentiating acute appendicitis from other causes of acute abdomen.

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