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Comparison of Alvarado Score Evaluation and Clinical Judgment in Acute Appendicitis

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ABSTRACT

Background: Acute appendicitis is the most common surgical emergency in children, but its diagnosis is sometimes difficult. **The aim** of this study is to evaluate retrospectively the Alvarado score in relation to the surgical management based on clinical judgment. **Methods:** Medical files of 232 children who underwent appendectomy at Makassed General Hospital from January 1997 till December 2006 were reviewed. Demographic characteristics, symptoms and signs, laboratory results and imaging findings for all children were recorded. **Results:** The positive predictive value of our clinical judgment was 86.4% and the negative appendectomy rate was 13.6% based on the pathology results. The reliability of Alvarado score in our population found a PPV of 80.7% and a negative appendectomy rate of 11.3%. A multivariate analysis revealed that anorexia, neutrophils left shift and rebound tenderness are significantly correlated with a correct diagnosis of appendicitis ($p = 0.012$, 0.023 and 0.046 respectively). **Conclusion:** Although, Alvarado score provides measurably useful diagnostic information in evaluating children with suspected appendicitis, we found that good clinical judgment remain the main stay of correct diagnosis of appendicitis.

Key words: acute appendicitis, clinical judgment, Alvarado Score Evaluation.

1. INTRODUCTION

Acute appendicitis is the most common surgical emergency in children and adolescents (1-10). Despite its frequency, the diagnosis of appendicitis is sometimes difficult (1, 5, 11-15). Prompt diagnosis prevents complication by reducing the risk of perforation (5, 7, 14, 15). The most effective and practical diagnostic modality for appendicitis is primarily clinical based on history and clinical examination findings (6, 13, 16). The majority of children with acute appendicitis have a classic history of abdominal pain. Moreover, anorexia, nausea and vomiting are symptoms that are usually associated. Atypical clinical presentation of appendicitis may necessitate laboratory and imaging investigations to confirm the diagnosis (5). Various scoring systems have been developing for supporting the diagnosis of acute appendicitis in order to eliminate any risk of perforation which in turn increases the rate of post operative complications. One such scoring system is Alvarado score; a 10-point scoring system based on clinical signs and symptoms and a differential leukocytes count (17, 18). The aim of this study is to evaluate retrospectively the Alvarado score in relation to the surgical management based on clinical judgment.

2. MATERIAL AND METHODS

This retrospective study included 232 patients diagnosed with acute appendicitis who underwent appendectomy at Makassed General Hospital from October 1997 till December 2006. Medical files were reviewed to record: age, gender, season, onset of symptoms, hospital stay. In addition, family history, duration of symptoms before presentation, interval in hours from arrival to surgery consultation was all assessed.

Clinical symptoms such as vomiting, abdominal pain (periumbilical, diffuse, or right lower quadrant), abdominal distension, diarrhea, irritability, lethargy, grunting, anorexia, nausea and dysuria, were also collected. Temperature upon admission, right lower quadrant tenderness at Mc Burney point, rebound tenderness, pain on percussion, rigidity, guarding, positive cough sign, bowel sounds and gait were also noted. Laboratory data [CBCD where WBC and segmented neutrophils] were assessed in addition to CRP. All WBC count above 10000 were considered positive and segmented neutrophils left shift should be equal or greater than 75%. Moreover, radiological findings [KUB, ultrasound, and CT-scan] were noted. Medical treatment IV hydration, Nil per Os (NPO), IV antibiotics, and analgesics were also recorded. Surgical technique such as open surgery or laparoscopy was also collected. Complications such as wound infection, perforation, dehiscence, bowel obstruction, abdominal and pelvic abscess, sepsis, shock, and death were noted. Pathology result obtained from patients' medical charts was recorded as normal or abnormal.

The diagnosis of acute appendicitis was confirmed by histopathological assessment of the appendectomy spec-

imen. Finally the reliability of Alvarado scoring system was assessed using the 10 point scoring system based on clinical signs and symptoms and a differential leukocytes count. Then negative appendectomy rate (the proportion of operated patients having normal appendix removed) and positive predictive value (the proportion of operated patients having abnormal appendix removed) were analyzed.

The retrospective evaluation of the Alvarado score was compared with surgical findings.

Statistical analysis

Data are reported as mean, standard deviation (SD), median (range) or percentage. Multivariate analyses were used to identify the relationship between neutrophils left shift, rebound tenderness and anorexia. F-test was used to determine significance. Significance is reported if $p < 0.05$. Analyses were completed by using SPSS software version 11.0.

3. RESULTS

From total number in our sample 232 patients were included in the final data analysis with a 1.9 male to female ratio and a mean age of 9.17(±2.75). Table 1 represents the characteristics of children who underwent appendectomies.

Family history was irrelevant because of missing data from our charts. The age peak incidence was 8-12 years. 35.8% of appendectomies occurred in winter season during the study period.

Characteristics	Value
Age (years)	
Mean (±SD)	9.17 (±2.75)
Median [Min-Max]	9.6 [2-14]
Gender	
Females	79 (34.1%)
Males	153 (65.9%)
Seasonal incidence	
Winter	83 (35.8%)
Spring	69 (29.7%)
Summer	64 (27.0%)
Autumn	16 (6.9%)
Age incidence (years)	
[0 – 4]	9 (3.9%)
[4 – 8]	54 (23.3%)
[8 – 12]	118 (50.9%)
[12 – 16]	51 (22.0%)
Hospital stay (days)	
1-4	137 (59.10%)
4-8	73 (31.46%)
8-12	12 (5.17%)
12-16	10 (4.31%)
Duration of symptoms (hours)	
< 24	177 (76.3%)
24-48	42 (18.10%)
> 48	13 (5.50%)
Perforation	
Yes	39 (16.8%)
No	193 (83.2%)
Interval time to pediatric surgeon consultation (min)	
Mean (±SD)	71.15 (±78.64)
Median [Min-Max]	60 [10-720]

Table 1. Patients characteristics. Data are presented as mean (±SD), median [Min-Max] and number (%)

	Number of cases (%)
Vomiting	188 (81%)
Anorexia	184 (79.3%)
Abdominal pain	
Periumbilical	133 (57.3%)
Diffuse	76 (32.8%)
RLQ	216 (93.1%)
Nausea	192 (82.8%)
Diarrhea	33 (14.2%)
Irritability	30 (12.9%)
Lethargy	3 (1.3%)
Grunting	31 (13.4%)
Abdominal distension	14 (6%)
Dysuria	12 (5.2%)

Table 2. Clinical symptoms presented at ER. RLQ: Right Lower Quadrant. Data are presented as number (%)

Clinical symptoms in patients underwent appendectomies were presented in (Table 2), with RLQ, nausea, and vomiting were the commonest symptoms.

Physical examinations characteristics are presented in table 3 with a 97.4% of cases suffering from rebound tenderness (Table 3).

	Number of cases (%)
Rebound tenderness	226 (97.4%)
Mc Burney point positive	223 (96.1 %)
Temperature ≥ 37.5 °C	207 (89.2%)
Pain on percussion	182 (78.4%)
Positive cough sign	159 (68.5%)
Abnormal gait	135 (58.2%)
Guarding	125 (53.9%)
Rigidity of abdomen	13 (5.6%)

Table 3. Physical examination performed at ER. Data are presented as number (%)

The WBC counts were elevated in 201 cases (87.7%), a left shift with segmented in 183 cases (80%). There was a significance between white blood cells, left shift neutrophils and confirmation of acute appendicitis by histopathology result (p=0.020 and 0.010 respectively). CRP was only done in 51 cases of which 46 had high CRP values

	Pathology results		P-value
	Normal	Abnormal	
WBC (10^3/μL)			
> 10000	24	178	0.020
< 10000	8	19	
Segmented			
> 75 %	21	158	0.010
< 75%	11	21	
CRP value			
Positive	6	40	NS
Negative	1	4	

Table 4. Laboratory analysis. Postive CRP value > 0.3 mg/dl. NS not significant

Type of complication	Number of cases (%)
Peritonitis	22 (9.5%)
Sepsis	11 (4.7%)
Wound infection	7 (3%)
Dehisence	2 (0.9%)
Abdominal and pelvic abscess	2 (0.9%)
Shock	1 (0.4%)
Total	45 (19.3%)

Table 5. Postoperative complication of appendicitis. Data are presented as number (%)

(90.2%) (Table 4).

Upon surgeon's request, an abdominal radiograph (KUB) was performed in 118 cases with fecalith noted in 37 cases. In addition, ultrasonogram was performed in 63 children with 34 abnormal cases. A computed tomography scan was obtained in 6 patients of whom five were abnormal.

All cases were kept NPO and obtained IV hydration. They also received preoperative and postoperative IV analgesics and antibiotics. Open appendectomy has been performed in 220 cases (94.8%) where only 12 cases (5.1%) underwent laparoscopic appendectomy.

Abnormal pathology results confirmed the diagnosis of appendicitis in 200 cases (86.4%). The positive predictive value of our clinical judgment was 86.4% and the negative appendectomy rate was 13.6% based on the pathology results. 211 patients had Alvarado score ≥ 7, of whom 185 were histologically confirmed to have appendicitis. Thus, the reliability of Alvarado score in our population found a PPV of 80.7% and a negative appendectomy rate of 11.3%. The Alvarado score of ≤ 6 was recorded in 18 patients, of whom 12 had histologically proved appendicitis.

Multivariate analysis through logistic regression revealed that anorexia, neutrophils left shift and rebound tenderness are significant correlated to the correct diagnosis of acute appendicitis (p = 0.012, 0.023 and 0.046 respectively).

Postoperative complications are shown in (Table 5) with peritonitis as the commonest sequel (9.5%). There was a significant difference between duration of symptoms and perforation occurred (p=0.032).

4. DISCUSSION

Surgeons have tendency to operate when the diagnosis of acute appendicitis is probable rather than wait until it is certain because simple appendicitis may lead to perforation which is associated with a higher morbidity (17).

The main findings of our study showed that the clinical decision to operate in our institution led to a high positive predictive value of 86.4%.and the removal of a normal appendix in 13.6%. This figure is in accordance with previous studies, and it is within the accepted range of negative appendectomies (12-18%) (1, 10, 12, 19-23).

Although, appendectomy is considered to be a safe operation, it still has got associated complication such as wound infections, dehiscence, peritonitis and abdominal abscess. Therefore, there is an eager to reach an accurate diagnosis of acute appendicitis among surgeons relying on the fastest and the most cost effective diagnostic tool (21).

Various diagnostic aids have been used to increase the diagnostic accuracy of acute appendicitis but still the clinical diagnosis is superior. Ultrasonography has no advantage in diagnosing of acute appendicitis as shown in previous studies because of some limitation especially in obese children, retrocecal appendix surrounded by bowel gas and as it is operator depended (17, 19, 24). Thus, there is need for this aid in only atypical appendicitis and not as a routine test (1, 21, 24).

In accordance with previous studies, our clinical management found prophylactic antibiotics necessary in our children (100% acquire pre IV antibiotics) in reducing septic complication (25). In our opinion that choice of the surgical procedure between open and laparoscopic should be based on surgeon or patient preference for possible cosmetics reasons (26).

Our significant association between left WBC shifts in the diagnosis of appendicitis in children is in accordance with a study conducted by Wang et al in Boston, USA (11).

Alvarado scoring system in diagnosis of acute appendicitis can provide high degree of positive predictive value and consequently diagnostic accuracy. Based on our data, if we had applied Alvarado score to decide whether to operate or not, we could have missed 12 cases that showed pathological abnormal appendixes once operated on by our group. However, we could save six cases from being operated on due to their normal histopathological findings. This means that PPV of Alvarado score upon our cases would be 80.7% but the rate of negative appendectomy could be dropped to 11.3% whereas Alvarado evaluation in a similar study conducted by Schneider et al revealed a PPV of 58 % only (27).

Our results showed that four patients with a score of four had appendicitis. Thus, the Alvarado score would also lead to an increase number of inappropriate discharge compared with our clinical judgment (28). As our population is very young, it is maybe important to emphasize that judgment scoring may not be accurate because they were unable to give a proper history.

In general, we can provide based on our recording patients data, a structured form to be implemented in emergency room as a quick and practical tool to better diagnosis of acute appendicitis in children. This tool will count only on neutrophils left shift > 75 %, abdominal pain, anorexia, and rebound tenderness.

Our Children who were younger than four years have a lower incidence of appendicitis compared with children aged 4-14 years. This finding is consistent with a previous study conducted by Wang et al (11).

Many diagnostic scores have been advocated but most are complex and difficult to implement in a clinical situation (22, 27, 28). The Alvarado score is a simple scoring system that can be instituted easily in the outpatients setting (23). We found that good clinical acumen remains the main stay of correct diagnosis of appendicitis. This could be explained by the fact that Alvarado score was not very accurate in our population decreasing the PPV to 80.7% from our PPV of 86.4%). Delay in the diagnosis of appendicitis may increases the risk of perforation which in turn increases the rate of postoperative complications (5).

The Alvarado score can be used as an objective criteri-

on in children for admission with suspected appendicitis. However, our current practice suggests appendicitis sheet history and physical examination to be attached to every patient's medical file presenting to ER and suspected or confirmed having appendicitis.

Our study was retrospective in nature, and our analysis assumes good documentation in our medical files. It may well be that patients were given Alvarado score rather than computing it at the time of the conduction of the study.

A prospective study comparing Alvarado score to clinical judgment is suggested to confirm these findings.

5. CONCLUSION

Though Alvarado score provides measurably useful diagnostic information in evaluating children with suspected appendicitis but it did not provide sufficient PPV to be used in clinical practice as the sole method for determination of the need of surgery (27). The diagnosis of acute appendicitis remains primarily a clinical diagnosis based on the history, physical examination, and laboratory test.

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CONFLICT OF INTEREST: NONE DECLARED

REFERENCES

1. Kosloske AM, Love CL, Rohrer JE, Goldthorn JF, Lacey SR. The diagnosis of appendicitis in children: outcomes of a strategy based on pediatric surgical evaluation. Pediatrics. 2004; 113: 29-34.
2. Callahan MJ, Rodriguez DP, Taylor GA. CT of appendicitis in children. Radiology. 2002; 224: 325-332.
3. Green R, Bulloch B, Kabani A, Hancock BJ, Tenenbein M. Early analgesia for children with acute abdominal pain. Pediatrics. 2005; 116: 978-983.
4. Dado G, Anania G, Baccarani U, Marcotti E, Donini A, Risaliti A, Pasqualucci A, Bresadola F. Application of a clinical score for the diagnosis of acute appendicitis in childhood: a retrospective analysis of 197 patients. J Pediatr Surg. 2000; 35: 1320-1322.
5. Pena BM, Taylor GA, Fishman SJ, Mandl KD. Effect of an imaging protocol on clinical outcomes among pediatric patients with appendicitis. Pediatrics. 2002; 110: 1088-1093.
6. Mullins ME, Kircher MF, Ryan DP, Doody D, Mullins TC, Rhea JT, Novelline RA. Evaluation of suspected appendicitis in children using limited helical CT and colonic contrast material. AJR Am J Roentgenol. 2001; 176: 37-41.
7. Foley TA, Earnest F 4th, Nathan MA, Hough DM, Schiller HJ, Hoskin TL. Differentiation of nonperforated from perforated appendicitis: accuracy of CT diagnosis and relationship of CT findings to length of hospital stay. Radiology. 2005; 235: 89-96.
8. Huffman GB. Improving the Diagnosis of Appendicitis in Children. American Academy of Family Physician. 2000.
9. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ. Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Ann Intern Med. 2004; 141: 537-46.
10. Khan MN, Davie E, Irshad K. The role of white cell count and C-reactive protein in the diagnosis of acute appendicitis. J Ayub Med Coll Abbottabad. 2004; 16: 17-19.
11. Wang LT, Prentiss KA, Simon JZ, Doody DP, Ryan DP. The use of white blood cell count and left shift in the diagnosis of appendicitis in children. Pediatr Emerg Care. 2007; 23: 69-76.
12. Kessler N, Cyteval C, Gallix B, Lesnik A, Blayac PM, Pujol J, Bruel JM, Taourel P. Appendicitis: evaluation of sensitivity, specificity, and predictive values of US, Doppler US, and laboratory findings. Radiology. 2004; 230: 472-478.
13. Sack U, Biereder B, Elouahidi T, Bauer K, Keller T, Trobs RB. Diagnostic value of blood inflammatory markers for detection of acute appendicitis in children. BMC Surg. 2006; 6: 15.
14. Hardin DM Jr. Acute appendicitis: review and update. Am Fam Physician. 1999; 60: 2027-2034.
15. Nance ML, Adamson WT, Hedrick HL. Appendicitis in the young child: a continuing diagnostic challenge. Pediatr Emerg Care. 2000; 16: 160-162.
16. Lowe LH, Penney MW, Stein SM, Heller RM, Neblett WW, Shyr Y, Hernanz- Schulman M. Unenhanced limited CT of the abdomen in the diagnosis of appendicitis in children: comparison with sonography. AJR Am J Roentgenol. 2001; 176: 31-35.
17. Douglas CD, Macpherson NE, Davidson PM, Gani JS. Randomised controlled trial of ultrasonography in diagnosis of acute appendicitis, incorporating the Alvarado score. BMJ. 2000; 321: 919-922.
18. Winn RD, Laura S, Douglas C, Davidson P, Gani JS. Protocol-based approach to suspected appendicitis, incorporating the Alvarado score and outpatient antibiotics. ANZ J Surg. 2004; 74: 324-329.
19. Baidya N, Rodriques G, Rao A, Khan SA. Evaluation of Alvarado score in Acute Appendicitis: A Prospective Study. The Internet Journal of Surgery. 2007; 9: 1528-1542.
20. Asfar S, Safar H, Khoursheed M, Dashti H, al-Bader A. Would measurement of C-reactive protein reduce the rate of negative exploration for acute appendicitis? J R Coll Surg Edinb. 2000; 45: 21-24.
21. Khan I, Rehman A. Application of Alvarado scoring system in diagnosis of acute appendicitis. J Ayub Med Coll Abbottabad. 2005; 17: 41-44.
22. Chan MY, Tan C, Chiu MT, Ng YY. Alvarado score: an admission criterion in patients with right iliac fossa pain. Surgeon. 2003; 1: 39-41.
23. Owen TD, Williams H, Stiff G, Jenkinson LR, Rees BI. Evaluation of the Alvarado score in acute appendicitis. J R Soc Med. 1992; 85: 87-88.
24. Haddad MC, Azzi MC, Hourani MH. Current diagnosis of acute appendicitis. Leb Med J. 2003; 51: 211-215.
25. Gorecki WJ, Grochowski JA. Are antibiotics necessary in nonperforated appendicitis in children? A double blind randomized controlled trial. Med Sci Monit. 2001; 7: 289-292.
26. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg. 2005; 242: 439-448.
27. Schneider C, Kharbanda A, Bachur R. Evaluating Appendicitis Scoring Systems Using a Prospective Pediatric Cohort. Ann Emerg Med. 2007; In Press.
28. Sooriakumaran P, Lovell D, Brown R. A comparison of clinical judgment Vs the modified Alvarado score in acute appendicitis. Int J Surg. 2005; 3: 49-52.