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The Modified Alvarado Score Versus the Alvarado Score for the Diagnosis of Acute Appendicitis

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Abstract

Background: **Decision-making in cases of acute appendicitis may be difficult especially for junior surgeons. Failure to make a diagnosis is a primary reason for the persistent rate of morbidity and mortality. The likelihood of appendicitis can be ascertained by using the Alvarado score, which includes the left shift of neutrophil maturation, yielding a maximum total score of 10, but this parameter is not routinely utilized in many hospitals. In some studies the modified Alvarado score was helpful, reliable and practical in minimizing unnecessary appendectomy.**

Objective: **The purpose of this study was to evaluate and compare the diagnostic validity of the modified Alvarado score with the Alvarado score for the diagnosis of acute appendicitis.**

Materials and Methods: **A prospective study of 114 patients hospitalized with abdominal pain suggestive of acute appendicitis, from January 2005 to April 2005, was conducted . Data including clinical signs and symptoms and laboratory findings were recorded in Alvarado score and modified Alvarado score record form.**

Results: **Of 114 hospitalized patients, 106 (93%) had an appendectomy. Of these, 2 (2%) did not have acute appendicitis. In 104 patients who underwent operation, those with an Alvarado score of 9 to 10 (which were almost certain to have appendicitis) had a sensitivity of 48% and a specificity of 100%. Those with a score of 7 or 8 (which had a high likelihood of appendicitis) had a sensitivity of 98% and a specificity of 100%. For the modified Alvarado score, those with a score of 9 to 10 had a sensitivity and specificity of 57.7% and 100% respectively. Those with a score of 7 or 8 had a sensitivity of 98% and specificity of 90% respectively. The positive predictive value and accuracy of left shift were 94.1% and 61.4% in the Alvarado score. For extrasign (cough test, Rovsing sign and rectal tenderness) the figures were 94.7% and 83.3% respectively.**

Conclusions: **In the diagnosis of acute appendicitis, the Alvarado score and the modified Alvarado score are a fast, simple, reliable, noninvasive, repeatable and safe diagnostic modality without extra expense and complications. This study showed that the accuracy of the modified Alvarado score was slightly greater than the Alvarado score in the diagnosis of acute appendicitis.**

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Classical signs and symptoms of acute appendicitis were first reported by Fitz in 1886[1]. Since then it has been found to be a common cause of abdominal pain in all ages. Failure to make an early diagnosis is a main reason for the persistent rate of morbidity and mortality. Prompt diagnosis and surgical intervention reduce the risk of perforation and infectious complications. The complication rate in non-perforated appendicitis is less than 1% but it is as high as 5% or more in the young and elderly patients in whom diagnosis are delayed.[2]

The diagnosis of appendicitis can be difficult at times and is still based on the patient's history and physical examination. Various scoring systems have been devised to aid diagnosis. The Alvarado score was described in 1986[3] and has been validated in adult surgical patients.

The classical Alvarado score includes left shift of neutrophil maturation, which is not routinely done in many laboratories. The modified Alvarado score which includes extrasign (e.g. cough test, Rovsing sign and rectal tenderness) is helpful in minimizing unnecessary appendectomy and is practical, reliable and easily done. Some studies demonstrated that extrasign had a sensitivity of 68% and a specificity of 58% in the diagnosis of acute appendicitis[4]. The Alvarado score, with the left shift, showed a sensitivity and specificity of 71% and 68% respectively.[3]

The purpose of this study was to evaluate the diagnostic validity of the Alvarado score compared to the modified Alvarado score.

Materials and Methods

This study was a prospective study of 114 patients hospitalized with abdominal pain suggestive of acute appendicitis during January 2005 to April 2005 at Rajavithi, Lerdsin and Nopharut Hospital. Data including age, sex, symptoms, physical signs and laboratory findings such as white blood count and differential count, were recorded in Alvarado and modified Alvarado score form (Table 1, 2)[5,6]. Table 1 and 2 list the eight specific indications identified. Patients with a score of 9 to 10 are almost certain to have appendicitis, those with a score of 7 to 8 have a high likelihood of appendicitis and those with a score of 5 to 6 are compatible with, but not diagnostic of appendicitis. Patients with score of 0 to 4 are extremely unlikely (but not impossible) to have appendicitis.

Table 1 Alvarado Score Form

		Score	Yes/no
Symp :	Migratory of pain	1	
	Anorexia	1	
	Nausea/ vomiting	1	
Sign :	RLQ pain	2	
	Rebound tenderness	1	
	Elevation temp	1	
Lab :	Leukocytosis	2	
	Left shift	1	
		Total score	

Table 2 Modified Alvarado Score Form

		Score	Yes/no
Symp :	Migratory of pain	1	
	Anorexia	1	
	Nausea/ vomiting	1	
Sign :	RLQ pain	2	
	Rebound tenderness	1	
	Elevation temp	1	
	Extrasign (cough test, Rovsing sign rectal tenderness)	1	
Lab :	Leukocytosis	2	
		Total score	

All patients were prospectively evaluated and scored on the admission sheet. The Alvarado score and modified Alvarado score played no role in the management of these patients. The diagnosis of acute appendicitis was made clinically by the surgical team (residents and specialists). The scores were subsequently correlated with the clinical, operative and histopathological findings.

Results

Of 114 patients hospitalized, 8 (7%) were kept for observation and treated non-operatively. They were discharged with the diagnosis of possible nonspecific abdominal pain.

Of 114 patients, 106 (93%) had an appendectomy. Of these, 2 (2%) did not have acute appendicitis (one of these showed signs of PID and the other had UTI). Of 104 patients who had acute appendicitis, 58 (56%) were male with mean age of 25.3 years (range 10-75

years), 46 (44%) were female with mean age of 19.1 years (range 9-76 years).

The pathological stages in 104 patients who underwent appendectomy with confirmed appendicitis by histopathology are summarized in Table 3. The last total score of 114 patients who had acute abdominal pain suggestive of acute appendicitis were recorded in score form and are summarized in each score range (Table 4). Patients with a score of 9 to 10 (almost certain to have appendicitis) showed a sensitivity and specificity of 48% and 100% in the Alvarado scoring system and 57.7% and 100% in the modified Alvarado scoring system respectively. Patients with a score of 7 or 8 show a sensitivity and specificity of 98% and 80% in the Alvarado scoring system, 98% and 90% in the modified Alvarado scoring system, respectively.

The evaluation of clinical and laboratory findings in acute appendicitis was listed. (Table 5) A differential white cell count with shift to the left and extrasign were useful indicators in acute appendicitis because they had a good predictive value (94.1% and 94.7%). Extrasign showed greater sensitivity and accuracy than left shift. However, specificity of extrasign and left shift were poor (50% and 60%)

Table 3 Pathological stage of acute appendicitis

Stage	No.	(%)
Inflammation	43	41.3
Suppurative	22	21.1
Gangrenous	8	7.7
Perforation	31	29.9
Total	**104**	**100**

Discussion

The diagnosis of acute appendicitis continues to be difficult in some patients due to variable presentation of the disease and lack of a reliable diagnostic test. Although there has been some improvement in the diagnosis of acute appendicitis over the past several decades, in the past few years various scores have been developed to aid in the diagnosis of acute appendicitis. The Alvarado score is a simple scoring system that improves the diagnosis of appendicitis. It was devised

Table 4 The last total score of 114 patients who had acute abdominal pain suggestive of acute appendicitis in each range of score

Range of scores	Alvarado score		Modified Alvarado score	
	Appendicitis	Other disease	Appendicitis	Other disease
0-4	1	0	1	0
5-6	1	8	1	9
7-8	52	2	42	1
9-10	50	0	60	0

Table 5 Evaluation of clinical and laboratory finding in acute appendicitis

	Sensitivity (%)	Specificity (%)	Predictive		Accuracy (%)
			Positive	Negative	
Migration of pain	76.9	50.0	0.94	0.17	74.6
Anorexia	88.5	70.0	0.96	0.37	86.8
Nausea/vomiting	85.6	40.0	0.93	0.21	81.3
RLQ pain	100.0	10.0	0.92	1	92.1
Rebound tenderness	86.5	50.0	0.94	0.26	83.3
Elevation Temp. (> 37.5)	60.6	70.0	0.95	0.15	61.4
Leukocytosis	89.4	30.0	0.93	0.21	84.2
Left shift*	61.5	60.0	0.94	0.13	61.4
Extrasign*	86.5	50.0	0.94	0.26	83.3

*Left shift: differential white blood count with shift to the left (neutrophill of more than normal range)
*Extrasign: cough test, Rovsing sign, rectal tenderness

by giving relative weight to specific clinical manifestation (Table 1).[5] Patients with scores of 9 to 10 are almost certain to have appendicitis, there is little advantage in further work-up, and they should go straight to the operating room. Patients with a score of 7 to 8 have a high likelihood of appendicitis, while a score of 5 to 6 indicates probable appendicitis, but is not diagnostic of it. CT scanning is certainly appropriate for patients with an Alvarado score of 5 and 6, and cases can be built for imaging those with a score of 7 and 8. On the other hand, it is difficult to justify the expense, radiation exposure, time and possible complications of CT scanning in those patients with scores of 0 to 4. It is extremely unlikely (but not impossible) for these patients to have appendicitis.

In a prospective study of 215 adults and children in Cardiff, the use of the Alvarado score decreased an unusually high false positive appendectomy rate of 44% to 14%.[7] Fengo et al reported a sensitivity of 90.2% and specificity of 91.4% and others reported a sensitivity of 73%, specificity of 87% with negative laparotomy rate of 17.5%.[8] To be useful, a scoring system must be both sensitive and specific. This study demonstrated that the modified Alvarado score is effective in the diagnosis of acute appendicitis and extrasigns were proved to be more accurate than left shift. All patients suspected of having appendicitis should be evaluated for extrasign because anatomical variation in the position of the inflammed appendix may be misleading. Cough test and Rovsing's sign also indicate peritoneal irritation. The diagnosis of acute appendicitis is more difficult in woman because of the presence of gynecological disorders. A pelvic examination is essential which may reveal the missing information. A rectal examination does not appear to be a reliable element in the diagnosis of acute appendicitis because of its low diagnosis weight.[3]

However, neither clinical scoring system gives a 100% certainty. There are no signs, symptoms or laboratory tests that are 100% reliable in the diagnosis of appendicitis. We can use the diagnostic score as a guide to decide if the patient needs observation or surgery. Patients with score of 5 to 6 may be observed and evaluated every four to six hours, if the score remains the same or increases after this re-evaluation, the patients may need laparotomy. If it is difficult to ascertain the diagnosis, CT scanning may be appropriate for these patients, Patients with score of 7 or 8 may require surgery.

Conclusions

From this study, the modified Alvarado score and the Alvarado score are useful complementary methods in the diagnosis of patients suspected to have acute appendicitis. The diagnostic value of the modified Alvarado score is higher than the Alvarado score in this study.

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