ORIGINAL ARTICLE

Comparative Analysis of Alvarado and Teicher Scores in the Diagnosis of Acute Appendicitis

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ABSTRACT

Objective	*To compare the efficacy of Alvarado and Teicher scores in the diagnosis of acute appendicitis, using postoperative histopathology as gold standard.*
Study design	*Comparative, cross sectional study.*
Place & Duration of study	*Department of surgery, Combined Military Hospital Rawalpindi, from 22nd June 2006 to 26th February 2007.*
Methodology	*Hundred cases of clinically diagnosed/suspected of acute appendicitis were included in the study by convenience (non-probability) sampling. Selected patients were graded according to Alvarado and Teicher scores, and underwent appendicectomy. All appendicectomy specimens were sent for histopathology reporting. A 2 x 2 table was used to determine sensitivity, specificity, positive and negative predictive values and diagnostic efficacy for both the scoring systems.*
Results	*Using Alvarado and Teicher scores, a sensitivity of 95% and 89.55%, specificity of 69.69% and 66.66%, positive predictive value of 86.48% and 85.71%, negative predictive value of 88.46% and 76.66%, negative appendicectomy rate of 13.5% and 15.49% and diagnostic efficacy of 87% and 83% were found, respectively.*
Conclusion	*Alvarado score has better diagnostic accuracy as compared to Teicher score in the diagnosis of acute appendicitis.*
Key words	*Acute appendicitis, Alvarado score, Teicher score, Appendicectomy.*

INTRODUCTION:

Acute appendicitis is a common surgical emergency that primary health care providers have to consider when a patient presents with right iliac fossa pain and is the most common diagnosis for hospital admission requiring laparotomy.[1] Approximately 6% of the population will suffer from acute appendicitis during their lifetime,[2] therefore much effort has been directed towards early diagnosis and intervention. A clinical decision to operate leads to the removal of a normal appendix in 14.3% of cases, although many surgeons would accept rate of 30% as inevitable.[4] Acute appendicitis is a clinical diagnosis and no laboratory or radiological tests are 100% accurate.[5] Despite recent advances in diagnostic medicine, the diagnosis of appendicitis is still doubtful in a number of cases.[3] Methods advocated to assist in the diagnosis of appendicitis include laparoscopy, scoring systems, computer programs, ultrasonography (USG), computerized tomography (CT) scanning and magnetic resonance imaging(MRI).

Clinical scoring systems have proved useful in the management of number of surgical conditions. In the past few years various clinical scoring systems have been developed to aid the diagnosis of acute appendicitis including Ohmann,[6,7] Lindberg,[8] Eskelinen.[9] Teicher[10] and Alvarado.[11] A significant reduction of negative appendicectomy rate to 7.8% was noted in studies when patients were subjected to scoring systems.[12]

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It has been claimed that diagnostic aids can dramatically reduce the number of appendicectomies in patients without appendicitis, the number of perforations, and the time spent in hospital. There are significant clinical and financial costs incurred by the treatment of presumed appendicitis, especially "negative" appendicectomy which is not a trivial problem.[13] Flum and Koespell assessed its impact in the United States. Length of hospital stay, rate of complications, and mortality were all significantly higher in the negative appendicectomy group, and the annual cost of a negative appendicectomy was calculated at 742 million dollars.[13]

In our country where population is comparatively poor, there is a need to adapt to a cost effective, safer and accurate diagnostic procedure, which is reliable and reproducible and which can be used in all conditions without expensive and complicated supportive diagnostic methods. Both Alvarado and Teicher scores are simple, fast and non-invasive. The objective of the study was to compare the diagnostic efficacy of both these scoring systems and to determine which of the two was more accurate in diagnosing acute appendicitis.

METHODOLOGY:

This comparative cross sectional study was carried out at the General Surgery Department of Combined Military Hospital (CMH) Rawalpindi from June 2006 to January 2007. The study participants were clinically diagnosed/suspected cases of acute appendicitis. Patients with age less than 12 years, those with appendicular mass and with history of previous abdominal surgery were excluded. History and thorough clinical examination were carried out. Blood samples were sent for complete blood count which included total and differential leukocyte counts.

Both Alvarado and Teicher scores were calculated for each patient. All the patients with clinical diagnosis of acute appendicitis as indicated by interpretation of Alvarado/ Teicher score (table I - IV) underwent appendicectomy. Appendicectomy was carried out by standard operative technique. In some cases where a normal appendix or alternate pathology like right ovarian torsion and right ovarian cyst; found appendicectomy still carried out, after dealing with the primary pathology.

The appendicectomy specimen was submitted for the histopathology. The criterion for histopathological diagnosis of acute appendicits was presence of neutrophils in the muscularis propria of the appendix. Histopathology of appendix was taken as diagnostic reference "gold standard". A 2 x 2 table was used to determine sensitivity, specificity, positive predictive value, negative predictive value and diagnostic efficacy.

In this study, sensitivity was the percentage of cases in whom the histopathology proven acute appendicitis subjects were correctly identified by either Alvarado or Teicher score, while specificity was the percentage of histopathology proven normal appendix subjects that were correctly identified by either Alvarado or Teicher score.

RESULTS:

A total of 100 patients of clinically diagnosed acute appendicitis were included. There were 81 males and 19 females. The age range was 12 – 67 years with a mean age of 28 years. Of the 74 patients operated for acute appendicitis according to Alvarado scoring system 62 (83.78%) were males while 12 (16.22%) were females. Seventy one patients were subjected to appendicectomy according to Teicher score out of which 67 (94.37) were males while 4 (5.63%) were females.

Table I:Alvarado Score[11]

Clinical Parameters	Score
Symptoms	
Migratory RIF pain	1
Anorexia	1
Nausea & vomiting	1
Signs	
Tenderness RIF	2
Rebound tenderness RIF	1
Elevated temperature	1
Laboratory	
Leucocytosis	2
Shift to left (segmented neutrophils)	1
Total	10

Table II: Interpretation of Alvarado Score[11]

Score	Diagnosis
< 3	Appendicitis excluded
4 – 6	Appendicitis suspicious
> 7	Appendicitis definite

The distribution of the patients according to Alvarado scoring system both at presentation and after initial observation is given in Table V. Similarly, the distribution of the patients according to Teicher

Table III: Teicher Score[10]	
Clinical Parameters	**Score**
Predictors of positive appendicectomy	
Male	+2
Age > 50 years	+3
Duration 1.5 days	+2
Duration 2 days	+1
Involuntary right lower quadrant muscle spasm	+3
White cell count> 13 X 10^9/L	+2
Predictors of negative appendicectomy	
Female	-1
Age 20 – 39 years	-1
Duration 3 days	-3
Genitourinary symptoms	-3
No right lower quadrant spasm	-3
Right sided rectal mass	-3
White cell count < 10 X 10^9/L	-3

Table IV: Interpretation of Teicher score[10]	
Score	**Recommendation**
< -6	Search for an alternative diagnosis
- 6 – +2	Initial observation
> +2	Immediate operation

scoring system at presentation and after initial observation is given in Table VI. The number of cases overlooked using Alvarado score was 3, which included 2 males and 1 female. For Teicher score the total number of cases overlooked was 7, out of which 2 were males and 5 females.

Using Alvarado score we found a sensitivity of 95%, specificity 69.69%, positive predictive value 86.48%, negative predictive value 88.46% and diagnostic efficacy 87%. Negative appendicectomy rates was found to be 13.5%. Negative appendicectomy rates for females was 50% while 6.45% for males. Using Teicher score we found a sensitivity of 89.55%, specificity 66.66%, positive predictive value 84.50%, negative predictive value 75.86% and diagnostic efficacy 82%. Negative appendicectomy rate was 15.49%. For females it was 50% and for males 13.43% (table VII & VIII).

For females Alvarado score had a sensitivity of 85.71%, specificity of 50%, positive predictive value of 50%, negative predictive value of 85.71% and a diagnostic efficacy of 63.1%. Similarly for females Teicher score gave a sensitivity of 28.57%, specificity of 28.57%, positive predictive value of 50%, negative predictive value of 66.67% and a diagnostic efficacy of 63.15%. In case of males Alvarado score had a sensitivity of 96.67%, specificity of 80.95%, positive predictive value of 93.55%, negative predictive value of 89.47% and a diagnostic efficacy of 92.59%. While for males Teicher score gave a sensitivity of 96.67%, specificity of 57.14%, positive predictive value of 86.57%, negative predictive value of 85.71% and a diagnostic efficacy of 86.42%.

Table V: Distribution of the Patients According to Alvarado Score (n=100)			
	ALVARADO SCORE		
	< 3	4 – 6	> 7
At presentation	16	30	54
Final	16	10	74

Table VI: Distribution of the Patients According to Teicher Scoring System (n=100)			
	TEICHER SCORE		
	< 6	>-6 – < +2	> +2
At presentation	4	31	65
Final	4	25	71

DISCUSSION:

There is a persistent challenge for the general surgeon to arrive at an early accurate diagnosis of acute appendicitis, not only to prevent unnecessary delay which may result in perforation and associated morbidity, but also to prevent negative appendicectomies. These negative appendicectomies not only incur significant clinical but also financial costs to the patients.

Scoring systems represent inexpensive, non-invasive and easy to use diagnostic aid.[7] The simplicity of the score for acute appendicitis is quite appealing. Amongst them, Alvarado score has gained wide acceptance because it is simple to use and easy to apply. Chan[14] in a previous study found that patients with low Alvarado score (less than 5) did not have appendicitis. In a prospective study in Cardiff by Owen et al, use of the Alvarado score decreased an unusually high false-positive appendicectomy rate of 44% to14%.[15] Al Qahtani et al have found that the Alvarado score worked well in men. However in women it had a high false positive rate (23% of women with scores of 6 or more, did not have appendicitis while in men only 3%).[16] The same

Table VII: 2 x 2 Table Showing Accuracy of Alvarado Score in Diagnosis of Acute Appendicitis (n=100)

		Histopathology of Appendix	
		Appendicitis	No appendicitis
Alvarado score	Appendicitis	64	10
	No Appendicitis	3	23

Table VIII: 2 x 2 Table Showing Accuracy of Teicher Score in Diagnosis of Acute Appendicitis (n=100)

		Histopathology of Appendix	
		Appendicitis	No appendicitis
Teicher Score	Appendicitis	60	11
	No Appendicitis	7	22

result has been concluded in prospective study done by Reza and Mitra.[17]

Though a lot of work has been done on validating Alvarado scoring system but none on Teicher scoring system. Teicher based his scoring system on seven statistically significant predictors.[10] The cutoff score selected for this study was determined by balancing improved diagnostic accuracy against risks to the patient. The intent of the scoring system is not to establish a primary diagnosis of appendicitis, but simply to discriminate between the two groups when there is uncertainty as to indication for surgery or observation.

In our study Alvarado score sensitivity of 95% is comparable with literature.[18,19] The negative appendicectomy rate was 13.5% and 15.49% for Alvarado and Teicher scores. This rate for Alvarado score is comparable with the results of other studies. On comparing the negative appendicectomy rates on the basis of gender we found that for males Alvarado score gave a significantly low negative appendicectomy rate of 6.45% while for females it was very high (50%) even higher than Kalan, who reported a negative appendicectomy rate of 33%.[4] This observation is consistent with what found in literature.[16,17] Of the 12 females falling in immediate appendicectomy group 5 had alternate pathologies, 3 had salpingitis while 2 had ruptured ovarian cyst. We also found that Alvarado score had a positive predictive value of 86.48% which is in consistent with what seen in literature.[4,20]

On comparing both scoring systems in our study we found out that Alvarado score had better diagnostic efficacy for diagnosing acute appendicitis than Teicher score but if we calculate these parameters separately for both sexes we found out that Alvarado score had a very high sensitivity but a low specificity for females when compared with Teicher score, an observation also noted in a study by Nagarjan G.[21] This observation was strengthened by the fact that when looking into the cases overlooked by both scoring systems (the cases who had acute appendicitis), we found out that the number of cases overlooked by Alvarado score were 3, and by Teicher score were 7. Further more both scoring systems had similar sensitivities for males though Alvarado score had a relatively high diagnostic efficacy. Moreover we found Teicher score to be a cumbersome score with negative and positive predictors of acute appendicitis, having negative and positive scores. Whereas Alvarado score is simple to calculate and interpret.

We certainly understand the limitations of our study. The very high negative appendicectomy rate observed in females was because of the fact that the females included (n-19) in our study cannot be the true representatives of female population. Our setup being a military hospital generally deals with the serving men and pensioners. Also due to the exclusion of paediatric population because of the fact that we have a separate paediatric unit, had some effects on the overall results. Moreover where there are a number of studies validating Alvarado Score in diagnosis of acute appendicitis, less work found in literature on Teicher score.

In our study we observed that both the scoring systems did not do well in female which is reflected by the high negative appendicectomy rates. Hence

it is recommended that females, especially in childbearing age should undergo additional investigations like abdominal ultrasound to improve the diagnostic accuracy. Literature also supports this observation.[22]

CONCLUSIONS:

Based on this study it can be concluded that Alvarado score has a better diagnostic accuracy as compared to Teicher score in diagnosis of acute appendicitis. Its routine usage will definitely lower the rate of negative appendicectomy.

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