

Diagnosis Of Acute Appendicitis At Mandeville Regional Hospital (MRH): Clinical Judgment Versus Alvarado Score

S Olakolu, C Lloyd, G Day, P Wellington

Citation

S Olakolu, C Lloyd, G Day, P Wellington. *Diagnosis Of Acute Appendicitis At Mandeville Regional Hospital (MRH): Clinical Judgment Versus Alvarado Score*. The Internet Journal of Surgery. 2010 Volume 27 Number 1.

Abstract

BACKGROUND: Appendicitis is a very common disease with a lifetime prevalence of 7-8%. The diagnosis of acute appendicitis is solely based on history, physical examination and few laboratory investigations (such as complete blood count, C-reactive protein and urinalysis). Differential diagnosis and management of patients presenting with right iliac fossa pain is a continuing surgical challenge. Radiological investigations might improve diagnostic accuracy; however, their use has not been shown to improve the outcome in acute appendicitis when compared to clinical judgment. A definitive diagnosis could only be obtained at surgery and after pathological examination of the surgical specimen. A negative appendectomy rate of 15-40% has been reported in literature and many surgeons would accept this rate as inevitable. Alvarado score is a simple, easy to apply, cheap tool and an effective means of stratifying patients according to the risk of acute appendicitis which helps to reduce the negative appendectomy rate. The aim of this study is to determine the rate of negative appendectomy and how it compares with the rate determined using Alvarado score. **SUBJECTS AND METHODS:** This is a prospective non-randomized study, conducted at the surgical wards of MRH over a period of six months (July 2009 to December 2009). All the patients that were admitted for suspicion of acute appendicitis during the period of study were included in the study. All the 53 subjects recruited gave verbal consent for participation and written consent for appendectomy. The Alvarado score for each subject was determined, but the decision to perform surgery was purely on clinical grounds. Subjects were operated by open appendectomy. Diagnosis was confirmed by histopathological findings. All data were analyzed by SPSS version 14. **RESULTS:** The age range of the subjects was 8 to 64 years (mean age 29.57 years, standard deviation 17.82 years, median 23 years). A total of 53 subjects were included in the study, of which 28 (52.8%) and 25 (47.2%) were male and female, respectively. The rate of negative appendectomy for clinical decisions was 35.8%, while the rate for the Alvarado score was 30.2%. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of Alvarado score using the study subjects were 82.4%, 52.6%, 75.7%, 62.5% and 71.7%, respectively. An increase in the accuracy of Alvarado score was observed when "appendicitis" and "no appendicitis" were diagnosed at scores ≥ 8 and ≤ 4 respectively. **CONCLUSION:** Application of Alvarado score, in our setting, appeared promising in improving the frequency of negative appendectomy and could be an objective instrument in decision making for both the emergency medical officers and the surgical residents.

INTRODUCTION

The appendix is a wormlike extension of the cecum.¹ Appendicitis is inflammation of the inner lining of the vermiform appendix that spreads to its other parts.¹ This surgical condition may occur for several reasons, such as an infection of the appendix, but the most important step is the obstruction of the appendiceal lumen.¹ Appendicitis is a very common disease with a lifetime prevalence of 7-8%.^{2,3} Its incidence is 1.5-1.9/1000 in male and female population.⁴ Appendicitis is one of the most common surgical emergencies, and it is one of the most common causes of abdominal pain.^{4,5} Surgery for acute appendicitis is the most frequent operation performed (10% of all emergency abdominal operations).⁴

The diagnosis of acute appendicitis is purely based on history, physical examination and few laboratory investigations (such as complete blood count, and urinalysis).⁴ Differential diagnosis and management of patient presenting with right iliac fossa pain is a continuing surgical challenge.² Difficulty in diagnosis of acute appendicitis arises in very young, elderly patients and females of reproductive age because they usually have atypical presentation and many simulating conditions.^{2,6} Even though, it is well over a century since McBurney reported his study on acute appendicitis with emphasis on early appendectomy, there has been no major improvement in diagnostic accuracy of acute appendicitis; which ranges from 25-90% and the optimum rate is 80%, which is less in

females than males.^{2,4} Radiological investigations might improve diagnostic accuracy; however, their use has not been shown to improve the outcome in acute appendicitis when compared to clinical judgement.^{2,4,7,8} A definitive diagnosis could only be obtained at surgery and after pathological examination of the surgical specimen.⁹

A negative appendectomy rate of 15-40% has been reported in literature and many surgeons would accept this rate as inevitable.^{2,4} Removing a normal appendix is an economic burden both on patients and health resources. Delay in diagnosis and surgery could lead to complications like perforation and peritonitis.^{4,10} Scoring systems are valuable and valid instruments for discriminating between acute appendicitis and non-specific abdominal pain.^{2,4} Several scoring systems have been devised to increase the sensitivity and specificity in diagnosis of acute appendicitis.^{2,4,8} Alvarado score is a simple, easy to apply, and cheap tool and an effective means of stratifying patients according to the risk of acute appendicitis. It is based on history, clinical examination, and few laboratory investigations, which helps to reduce negative appendectomy rate and improve patient quality of care.^{2,4} This study was designed to evaluate our clinical accuracy in diagnosing acute appendicitis, bearing in mind the availability of only a high dependency unit with limited capacity to manage any ensued complication; as a result of misdiagnosis or delayed surgical intervention. Alvarado score was validated in this setting for its future usage by the emergency medical officers for stratifying patients for admission into the surgical wards.

GENERAL OBJECTIVE

To determine the rates of negative appendectomy at MRH during the period of study

SPECIFIC OBJECTIVES

To compare the rates of negative appendectomy: using clinical judgement and Alvarado score

To determine the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Alvarado score

SUBJECTS AND METHODS

This is a prospective study conducted at the male surgical, female surgical and children surgical wards of MRH over six months (July 2009 to December 2009). All the patients that were admitted for suspicion of acute appendicitis, during the

period of study, were included in the study. All the 53 subjects recruited gave verbal consent for participation and written consent for appendectomy. History and physical examination were performed by the attendant surgical resident and decisions were made as to proceed with appendectomy or laparotomy as deemed necessary. The report of the complete blood count was considered by the surgical resident in decision making. The Alvarado score for each subject was determined (as in table1), but the decision to perform surgery was purely on clinical grounds.

Figure 1

Table 1

<i>Variables</i>	<i>Clinical features</i>	<i>Score</i>
Symptoms	Migratory RIF pain	1
	Anorexia	1
	Nausea and vomiting	1
Signs	Tenderness (RIF)	2
	Rebound tenderness	1
	Elevated temperature	1
Laboratory	Leucocytosis	2
	Shift to Left	1

Subjects were operated by open appendectomy. Diagnosis was confirmed by histopathological findings. The diagnosis on clinical grounds and the Alvarado score were correlated with the histopathological findings of the removed appendix; rates of negative appendicitis by clinical judgment and Alvarado score were determined. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of Alvarado score using the study subjects were determined. Sensitivity was defined as the proportion of truly diseased persons (histopathologically positive for appendicitis) in a screened population who are identified as being diseased (positive for appendicitis by Alvarado score) by the test.¹¹ Specificity is the proportion of truly non-diseased persons (histopathologically negative for appendicitis) who are so identified by the screening test (Alvarado score).¹¹ The negative predictive value is the proportion of patients with negative test results who are correctly diagnosed.¹¹ The positive predictive value is the proportion of patients with positive test results who are correctly diagnosed.¹¹

All data were analyzed by SPSS version 14.

RESULTS

The age range of the patients was 8 to 64 years (mean age 29.57 years), Standard deviation 17.82 years, median 23 years). A total of 53 patients were included in the study, of which 28 (52.8%) and 25 (47.2%) were male and female, respectively. Thirty-four patients had positive histology reports for inflamed appendix while 28 patients of 37 patients with Alvarado score ≥ 7 had positive histology reports.

Figure 2

Table 2: Comparison of clinical judgment with histologic findings among study patients

Variables	Clinical judgment	Histology reports
Positive	53	34
Negative	0	19
Total	53	53

The rate of negative appendectomy was:

$$19/53 \times 100 = 35.8\% \text{ for clinical decision.}$$

Figure 3

Table 3: Comparison of clinical judgment with Alvarado score among study patients

Variables	Clinical judgment	Histology reports
Positive	53	37
Negative	0	16
Total	53	53

The rate of negative appendectomy was:

$$16/53 \times 100 = 30.2\% \text{ for Alvarado score.}$$

Fig. 1 shows a 5.6% fall in the rate of negative appendectomy in comparing clinical decision with Alvarado score

Figure 4

Table 4: Comparison of Alvarado score with histology findings among study patients

Alvarado score	Histopathology +ve	Histopathology -ve	Total
≥ 7	28	9	37
< 7	6	10	16
Total	34	19	

$$\text{Sensitivity: } 28/34 \times 100 = 82.4\%$$

$$\text{Specificity: } 10/19 \times 100 = 52.6\%$$

$$\text{Positive Predictive Value: } 28/37 \times 100 = 75.7\%$$

$$\text{Negative Predictive Value: } 10/16 \times 100 = 62.5\%$$

$$\text{Accuracy: } 38/53 \times 100 = 71.7\%$$

The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of Alvarado score using the study subjects were 82.4%, 52.6%, 75.7%, 62.5% and 71.7% respectively.

Figure 5

Table 5: Percentage accuracy for each Alvarado score among study patients

Alvarado score	Histology report		Total	% Accuracy
	Inflamed	Not inflamed		
3	0	3	3	100
4	1	2	3	67
5	1	1	2	50
6	4	4	8	50
7	5	4	9	55
8	16	1	17	94
9	5	2	7	71
10	0	2	2	0

Table 5 shows an equivocal % accuracy for scores 5-7 and high % accuracy at score 8 and 9.

Figure 6

Table 6: Comparison of modified Alvarado score with histology findings among study patients

Modified Alvarado score	Histopathology positive	Histopathology negative
≤ 4	1	5
≥ 8	23	4

$$\text{Accuracy: } 28/33 \times 100 = 84.8\%$$

An increase in the accuracy of Alvarado score was observed when “appendicitis” and “no appendicitis” were diagnosed at scores ≥ 8 and ≤ 4 respectively.

DISCUSSION

In our setting, the application of Alvarado score has appeared promising in cutting down the rate of negative appendicitis. Its application will also provide a uniform clinical platform for admission of patients into the surgical wards for acute appendicitis from accident and emergency department (A&E). This is more pertinent, and should be

embraced, since Alvarado score is a simple, easy, economical, non-invasive diagnostic method. It is reliable, safe, repeatable and less dependent on applicants' experience^{12,13}. Lack of resources and personnel would also increase the applicability of Alvarado score in our practice and similar practices.

Even though high rates of negative appendectomy were found in this study, a significant reduction in the rates from 35.8% to 30.2% was noticed when the subjects were scored using Alvarado score. The high rates of negative appendectomy in this study could be attributed to the high proportion of female subjects [25 (47.2%)] recruited in this study. High negative appendectomy rates have been observed among females in the literature. The only case who had a normal appendix at score >7 in the study by Ahmed et al.² was a female. Literature supports the observation that in females additional investigations are needed to support diagnosis, as Lamparelli et al.¹⁴ combined the Alvarado score with selective laparoscopy in adult females to increase the diagnostic accuracy and to avoid negative appendectomy¹⁴. In his study it was 0% at score >7. Malik and Wani¹⁵, however, reported the use of Alvarado score with positive predictive value at score of >7 of 80% as it had a very high negative appendectomy rate in females giving a sensitivity of 61% in females.

The sensitivity, positive predictive value, negative predictive value and accuracy in this study were comparable to other previously published studies using Alvarado score. Sensitivity at score ≥ 7 was 82.4%, comparable to 79% by Pruekprasert et al¹⁵. Positive Predictive Value at score ≥ 7 was 75.7% in this study, which is comparable to 82.7% reported by Crnogorac and Lovrenski¹⁷ and 83.5% by Khan et al.⁴. Several studies validated the Alvarado score, but on the other hand many studies recommend taking the cut-off point at 4 or 6. This study, using the 'Mandeville Modification' (MM) of Alvarado score showed increased accuracy from 71.7% to 84.8% at ≤ 4 and ≥ 8 . Scores 5, 6 and 7 were considered in MM for observation as their accuracies were borderline (between 50 and 55%). This indicates that high scores (from eight on) could be used in deciding the need for immediate appendectomy especially for junior surgeons.

CONCLUSION

Clinical findings and the surgeon's experience are of importance in diagnosing acute appendicitis. Alvarado score

is a useful tool in the diagnosis of acute appendicitis, especially close to both ends of the scale. The diagnosis in patients with equivocal features can be difficult, and in our sub-population, Alvarado scoring cut-off should be at ≤ 4 and ≥ 8 , which readily increases the accuracy of Alvarado score in diagnosing acute appendicitis.

RECOMMENDATION

Scoring of patients should be done at the accident and emergency unit and general practice offices for objective decision making on acute appendicitis.

Score: 1-4 – could be observed as outpatient

Score: 5-6 – admit for observation

Score: 7 – decision solely on surgical experience

Score ≥ 8 – immediate appendectomy

This would help us to provide quality care without financial burden for removing normal appendices.

References

1. Santacroce L, Ochoa JB: Appendicitis. eMedicine General Surgery. Available from <http://emedicine.medscape.com/article/195778-overview> (Accessed 21/07/2010).
2. Ahmed AM, Vohra LM, Khaliq T, Lehri AA: Diagnostic accuracy of Alvarado score in the diagnosis of acute appendicitis. *Pak J Med Sci*; 2009; 25(1): 118-121.
3. Kemal M, Bora K, Metin M, Ender O: The value of preoperative diagnostic tests in acute appendicitis, retrospective analysis of 196 patients. *World Journal of Emergency Surgery*; 2010, 5: 5doi:10.1186/1749-7922-5-5.
4. Khan I, Rehman A: Application of Alvarado scoring system in diagnosis of acute appendicitis. *J Ayub Med Coll Abbottabad*; 2005; 17(3).
5. 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(3).
6. Horzic M, Salamon A, Kopljak M, Skupnjak M, Cupurdija K, Vanjak D: Analysis of scores in diagnosis of acute appendicitis in women. *Coll Antropol*; 2005; 29: 133-8.
7. West WM, Brady-West DC, McDonald AH, Hanchard B, Fearon-Booth D: Ultrasound and white blood cell counts in suspected acute appendicitis. *West Indian Med Journal*; 2006; 55(2).
8. Goldman RD, Carter S, Stephens D, Antoon R, Mounstephen W et al.: Prospective validation of the Pediatric appendicitis score. *J Pediatr*; 2008; 153(2): 278-82.
9. Dado G, Anania G, Baccarani U, Marcotti E, Donini A, Risaliti A et al.: Application of a clinical score for the diagnosis of acute appendicitis in childhood. *J Pediatr Surg*; 2000; 35: 1320-2.
10. McDonald GP, Pendarvis DP, Wilmoth R, Daley BJ: Influence of preoperative computed tomography on patients undergoing appendectomy. *Am Surg*; 2001; 67: 1017-21.
11. Simon D, Boring III JR: Sensitivity, Specificity, and Predictive Value. In: *Clinical Methods: The History*,

Physical, and Laboratory Examinations, Walker HK, Hall WD, Hurst JW, eds. Butterworths, 3rd edition, 1990.

12. Denizbasi A, Unluer EE: The role of the emergency medicine resident using the Alvarado score in the diagnosis of acute appendicitis compared with the general surgery resident. *Eur J Emerg Med*; 2003; 10: 296-301.

13. Hsiao KH, Lin LH, Chen DF: Application of the MANTRELS scoring system in the diagnosis of acute appendicitis in children. *Acta Paediatr Taiwan*; 2005; 46: 128-31.

14. Lamparelli MJ, Hoque HM, Pogson CJ, Ball AB: A prospective evaluation of the combined use of the modified Alvarado score with selective laparoscopy in adult females

in the management of suspected appendicitis. *Ann R Coll Surg Engl*; 2000; 82: 192-5.

15. Malik AA, Wani NA. Continuing diagnostic challenge of acute appendicitis: Evaluation through modified Alvarado score. *Aust N Z J Surg* 1998;68:504-5.

16. Pruekprasert P, Maipang T, Geater A, Apakupakul N, Ksuntigij P: Accuracy in diagnosis of acute appendicitis by comparing serum C-reactive protein measurements, Alvarado score and clinical impression of surgeons. *J Med Assoc Thai*; 2004; 87: 296-303.

17. Crnogorac S, Lovrenski J. Validation of the Alvarado Score in the diagnosis of acute appendicitis. *Med Preg* 2001;54:557-61.

Author Information

SS Olakolu, FWACP

General Surgery Department, Mandeville Regional Hospital

CL Lloyd, DM-General Surgery

GN Day, FRCS, DM- General Surgery

PM Wellington, FRCS, FACS