



## Original Article

# Correlation of clinical data and the Alvarado's Score as predictors of acute appendicitis<sup>☆</sup>



Carlos Magno Queiroz da Cunha<sup>a</sup>, Giovanni Troiani Neto<sup>a</sup>, Andre Cavalcante Brasil<sup>a</sup>, Francisco Julimar Correia de Menezes<sup>a</sup>, Aline Veras Moraes Brilhante<sup>a</sup>, Rommel Reno Porcino Reinaldo<sup>b,\*</sup>

<sup>a</sup> Universidade de Fortaleza (UNIFOR), Fortaleza, CE, Brazil

<sup>b</sup> Hospital Distrital Evandro Ayres de Moura, Fortaleza, CE, Brazil

### ARTICLE INFO

#### Article history:

Received 15 August 2017

Accepted 4 November 2017

Available online 3 February 2018

#### Keywords:

Appendicitis

Appendectomy

Diagnosis

### ABSTRACT

**Objective:** To correlate the patient's clinical data and the Alvarado's Score as predictors of acute appendicitis.

**Methods:** This is an observational, descriptive and prospective study performed at a public urgency and emergency hospital in the city of Fortaleza, Ceará, between July and December 2016, with 34 patients undergoing open appendectomy with ages between 18 and 70 years. Statistical analysis was performed using the SPSS program.

**Results:** The following statistical correlations were performed: number of days with abdominal pain until the operative event and degree of inflammation according to a macroscopic analysis of the appendix, Alvarado's Score and number of days with abdominal pain until the operative event, Alvarado's Score and degree of inflammation according to a macroscopic analysis of the appendix, number of days with abdominal pain until the operative event, and number of days of hospitalization in the postoperative period, degree of inflammation according to a macroscopic analysis of the appendix, number of days of hospitalization in the postoperative period and Alvarado's Score, and number of days of hospitalization in the postoperative period; the first five correlations were statistically significant ( $p < 0.05$ ).

**Conclusion:** The use of this Alvarado's Score in health services emerges as a tool for the diagnosis of acute appendicitis.

© 2018 Sociedade Brasileira de Coloproctologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<sup>☆</sup> Study conducted at the General Surgery Service, Hospital Distrital Evandro Ayres de Moura, Fortaleza, CE, Brazil.

\* Corresponding author.

E-mail: [rommelreno@aol.com](mailto:rommelreno@aol.com) (R.R. Reinaldo).

<https://doi.org/10.1016/j.jcol.2017.11.004>

2237-9363/© 2018 Sociedade Brasileira de Coloproctologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Correlação de dados clínicos e a escala de Alvarado como preditores da apendicite aguda

### R E S U M O

*Palavras-chave:*  
Apendicite  
Apendicectomia  
Diagnóstico

*Objetivo:* correlacionar os dados clínicos do paciente e a pontuação do Escore de Alvarado como preditores da apendicite aguda.

*Métodos:* Estudo observacional, descritivo e prospectivo realizado em um hospital secundário de urgência e emergência da rede pública na cidade de Fortaleza-Ceará, entre julho a dezembro de 2016, com 34 pacientes submetidos à apendicectomia por via aberta com idade entre 18 e 70 anos. A análise estatística foi realizada utilizando o programa SPSS. *Resultados:* Foram realizadas as seguintes correlações estatísticas: número de dias com dor abdominal até o ato operatório e grau de inflamação segundo análise macroscópica do apêndice, Escore de Alvarado e número de dias com dor abdominal até o ato operatório, Escore de Alvarado e grau de inflamação segundo análise macroscópica do apêndice, número de dias com dor abdominal até o ato operatório e número de dias de internação no pós operatório, grau de inflamação segundo análise macroscópica do apêndice e número de dias de internação no pós operatório e Escore de Alvarado e número de dias de internação no pós-operatório, sendo as cinco primeiras estatisticamente significantes ( $p < 0,05$ ).

*Conclusão:* O uso desta escala nos serviços de saúde emerge como uma possibilidade de ferramenta para auxiliar o diagnóstico de apendicite aguda.

© 2018 Sociedade Brasileira de Coloproctologia. Publicado por Elsevier Editora Ltda. Este é um artigo Open Access sob uma licença CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Despite being the most prevalent cause of acute surgical abdomen, the diagnosis of acute appendicitis is hampered by the absence of typical symptoms and of suggestive laboratory data in about 20–33% of the cases.<sup>1</sup> Detection failures can lead to both a negative appendectomy as to complications of the clinical picture.<sup>2,3</sup> In this sense, scoring tests for the diagnosis, such as the Alvarado's Score, can contribute to the early detection of cases of acute appendicitis, reducing individual damage as well as social and material costs.<sup>4-6</sup>

With the association of clinical data to a complete blood count, the Alvarado's Score can be determined (Table 1). With up to 3 points, less than 5% of patients will have acute appendicitis and, in such cases, they can be discharged, with guidelines for their return in case of progression, or for serial clinical exams. With an Alvarado's score of 4–6, a sensitivity of 35% is observed for acute appendicitis; the patient's hospitalization is then indicated for a more detailed investigation, especially in cases of children, the elderly and women of child-bearing age. With 7 or more points, sensitivity rises to 78% in women and to 94% in men, indicating an urgent surgical approach. In the latter group, a little more than 10% of the laparotomies or videolaparoscopies will reveal no alterations in the vermiform appendix.<sup>4-10</sup>

In the case of an early diagnosis, the surgery is usually of simple execution, without significant repercussions in the postoperative period. In cases of late diagnosis, there is usually a development until the occurrence of appendicular perforation and/or necrosis, with a higher prevalence of complications, extensive surgeries, prolonged admissions, and a

more difficult recovery in the postoperative period, with a higher social cost and also with higher costs for the health system.<sup>11-14</sup>

In view of this, our study sought to correlate the patient's clinical data and the results of the Alvarado's Score as predictors of acute appendicitis, which can be used in emergency care for the early detection of this problem.

## Method

### Study design and data collection

This is a prospective, observational, and descriptive study, performed at a secondary emergency and emergency hospital in the city of Fortaleza, Ceará. During the period from July to December 2016, 34 patients aged 18–70 years and submitted to open appendectomy were evaluated. According to resolution 510/2016, sociodemographic data, the Alvarado's Score (Table 1), the number of days with abdominal pain until the surgery, the degree of inflammation according to the macroscopic analysis of the appendix (Table 2), and the number of days of hospitalization in the postoperative period were collected. It was assumed that there is a correlation between the Alvarado's Score and the macroscopic analysis of the appendix (Table 3).

### Variables studied

As a primary variable, the Alvarado's Score was used. The secondary variables were macroscopic analysis of the appendix, number of days of abdominal pain, and days of hospitalization in the postoperative period.

**Table 1 – Statistical correlations between days of abdominal pain, Alvarado's Score, macroscopic degree of the appendix, and days of hospitalization in the postoperative period.**

Parameters evaluated	p-values	p <sup>a</sup>
1. Number of days with abdominal pain until the operative event vs. Degree of inflammation according to a macroscopic analysis of the appendix	0.722	0.001 <sup>a</sup>
2. Alvarado's Score vs. Number of days with abdominal pain until the operative event	0.466	0.005 <sup>a</sup>
3. Alvarado's Score vs. Degree of inflammation according to a macroscopic analysis of the appendix	0.515	0.02 <sup>a</sup>
4. Number of days with abdominal pain until the operative event vs. Number of days of hospitalization in the postoperative period	0.474	0.005 <sup>a</sup>
5. Degree of inflammation according to a macroscopic analysis of the appendix vs. Number of days of hospitalization in the postoperative period	0.485	0.004 <sup>a</sup>
6. Alvarado's Score vs. Number of days of hospitalization in the postoperative period	0.239	0.174

<sup>a</sup> p-values < 0.05.

**Table 2 – Parameters and Alvarado's scores.<sup>3</sup>**

Parameter	Alvarado's score
Migratory pain for RIF	1
Nausea and vomiting	1
Anorexia	1
Defense in RLQ	2
Pain from decompression in RIF	1
Fever	1
Leukocytosis	2
Left shift	1

RIF, right iliac fossa; RLQ, right lower quadrant.

**Table 3 – Macroscopic analysis of the appendix.<sup>3</sup>**

Finding	Grade
Inflamed	I
Gangrenous, suppurated or necrotic	II
Perforated, with localized free liquid or a local abscess	III
Perforated with diffuse peritonitis	IV

### Statistical analysis

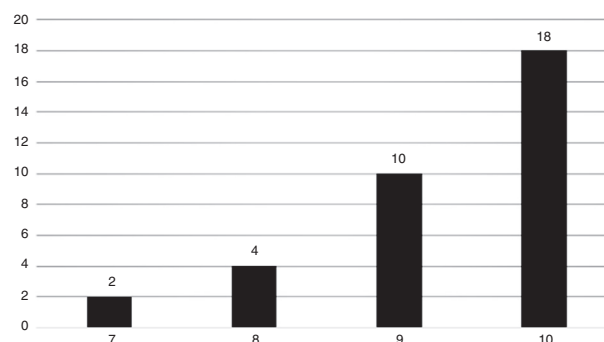
Statistical analysis was performed using the SPSS v.22 program from IBM, with the use of descriptive statistics and the Spearman coefficient ( $\rho$ ), as follows: strong ( $\rho > 0.7$ ), moderate ( $\rho = 0.4-0.69$ ) and weak ( $\rho < 0.4$ ) correlation. We considered  $p < 0.05$  as significant.

### Ethical aspects

The project was approved by the ethics committee of the institution and received a favorable opinion under number 0345.2016.1.

### Results

Of the 34 patients in the study, 73.5% were males, mean age =  $30.8 \pm 11.83$  years. The mean of the Alvarado's Score was  $9.29 \pm 0.906$ , with a distribution according to Fig. 1. In relation to the macroscopic analysis of the appendix, a mean =  $3.15 \pm 0.989$  was obtained; finally, for the number of days of hospitalization in the postoperative period, a mean of  $3 \pm 1.015$  days was found.

**Fig. 1 – Number of patients per Alvarado's score.**

The results of the Spearman coefficient analysis show a statistical correlation between number of days with abdominal pain until the surgery and degree of inflammation according to the macroscopic analysis of the appendix ( $p = 0.001$ ); Alvarado's Score and number of days with abdominal pain until the surgery ( $p = 0.005$ ); Alvarado's Score and degree of inflammation according to the macroscopic analysis of the appendix ( $p = 0.002$ ); number of days with abdominal pain until the surgery and number of days of hospitalization in the postoperative period ( $p = 0.005$ ); and between the degree of inflammation according to the macroscopic analysis of the appendix and the number of days of hospitalization in the postoperative period ( $p = 0.004$ ). No correlation was found between the Alvarado's Score and the number of days of hospitalization in the postoperative period (0.174). These results are summarized in Table 1.

### Discussion

In view of the similarity of the symptoms of acute appendicitis with other conditions that are seen in medical emergencies, it is not uncommon for misconceptions and delays in the diagnosis of the condition, especially in its initial periods, which negatively affects the related morbidity and mortality.<sup>13,15-17,10</sup> Based on the findings and experience of the surgeon, the decision to be taken should be decided as quickly as possible, and the Alvarado's Score is a good tool to guide the best option between hospital discharge, deepening of the diagnostic investigation or surgical approach. This situation

carries with it an important responsibility since both a wrong approach in negative cases and a delayed diagnosis in positive cases can have deleterious effects on the patient, besides generating avoidable costs for the health services.<sup>14,18-20</sup>

It is known that the greater the number of days of evolution of acute appendicitis, the greater the inflammatory process.<sup>13,19,21</sup> In the present study, in those subjects with more days of abdominal pain, higher macroscopic degrees of inflammation in the vermiform appendix were observed, which was supported by a robust and statistically significant correlation.

Thus, our findings confirm the hypothesis tested in this study, that is, the existence of a correlation between the Alvarado's Score and the macroscopic findings of the appendix. These findings indicate the use of the Alvarado's Score as a viable possibility to be used by clinicians and emergency physicians for the early detection of cases of acute appendicitis. There is also the possibility of carrying out a study to evaluate the use of the Alvarado's Score in health services, in order to evaluate its cost-effectiveness ratio.

## Conclusion

The faster the therapeutic definition of acute appendicitis, the lower the chance of occurrence of necrosis or abscess formation in the appendix, and the shorter the length of hospital stay in the post-operative period. In this way, we can consider the Alvarado's Score as an accessible and effective tool for optimizing the approach to patients with a suggestive picture of appendicitis. In addition, the Alvarado's Score may also suggest the degree of inflammation of the appendix, but it has a weak correlation in relation to the days of hospitalization in the post-operative period.

## Conflicts of interest

The authors declare no conflicts of interest.

## REFERENCES

- Montandon ME, Montandon C, Fiori GR, Ximenes CA, Cruz FC. Apendicite aguda: achados na tomografia computadorizada – ensaio iconográfico. *Radiol Bras.* 2007;40:193-9.
- Gore RM, Miller FH, Pereles FS, Yaghmai V, Berlin JW. Helical CT in the evaluation of the acute abdomen. *AJR Am J Roentgenol.* 2000;174:901-13.
- Franzon O, Piccoli MC, Neves TT, Volpato MG. Acute appendicitis: institutional evaluation in the peri-operative management. *ABCD Arq Bras Cir Dig.* 2009;22:72-5.
- Graff L, Russell J, Seashore J. False-negative and false-positive errors in abdominal pain evaluation: failure to diagnose acute appendicitis and unnecessary surgery. *Acad Emerg Med.* 2000;7:1244-55.
- Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med.* 1986;15:557-64.
- Owen TD, Williams H. Evaluation of Alvarado score in acute appendicitis. *J R Soc Med.* 1992;65:67-8.
- McKay R, Shepherd J. The use of the clinical scoring system by Alvarado in the decision to perform computed tomography for the acute appendicitis in the ED. *Am J Med.* 2007;25:489-93.
- Von-Muhlen B, Franzon O, Beduschi MG, Kruehl N, Lupselo D. Avaliação do escore de AIR para apendicite aguda. *ABCD Arq Bras Cir Dig.* 2015;28:171-3.
- Sousa-Rodrigues CF, Rocha AC, Rodrigues AKB, Barbosa FT, Ramos FWS, Valões SHC. Correlação entre a Escala de Alvarado e o aspecto macroscópico do apêndice em pacientes com apendicite. *Rev Col Bras Cir.* 2014;41:336-40.
- Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. *BMC Med.* 2011;9:139.
- Katkhouda N, Friedlander MH, Grant SW, Achanta KK, Essani R, Paik P, et al. Intraabdominal abscess rate after laparoscopic appendectomy. *Am J Surg.* 2000;180:456-60.
- Kraemer M, Ohmann C, Leppert R, Yang Q. Macroscopic assessment of the appendix at diagnostic laparoscopy is reliable. *Surg Endosc.* 2000;14:625-33.
- Jean-Pierre Gonçalves JP, Cerqueira A, Martins S. Diagnóstico apendicite aguda em crianças e adolescentes. *Acta Med Port.* 2011;24:583-8.
- Nutels DBA, Andrade ACG, Rocha AC. Perfil das complicações após apendicectomia em um hospital de emergência. *ABCD Arq Bras Cir Dig.* 2007;20:146-9.
- Borges PSGN, Lima MC, Falbo Neto GH. Validação do escore de Alvarado no diagnóstico de apendicite aguda em crianças e adolescentes no Instituto Materno Infantil de Pernambuco. *IMIP. Rev Bras Saúde Mater Infant.* 2003;3:439-45.
- Fisher CA, Pinho MSL, Ferreira S, Milani CAC, van Santen CR, Marquardt RA. Apendicite aguda: existe relação entre o grau evolutivo, idade e o tempo de internação? *Rev Col Bras Cir.* 2005;32:136-8.
- Bundy DG, Byerley JS, Liles EA, Perrin EM, Katznelson J, Rice HE. Does this child have appendicitis? *JAMA.* 2007;298:438-51.
- Neves LJVA, Wainstein AJA, Mathias WC, Costa FPD, Castro JH, Savassi-Rocha PR. Ligadura simples ou ligadura com confecção de bolsa e sepultamento para tratamento do coto apendicular: estudo comparativo prospectivo randomizado. *ABCD Arq Bras Cir Dig.* 2011;24:15-9.
- Ximenes AMG, Mello FST, Lima-Junior ZB, Ferreira CF, Cavalcanti ADF, Dias-Filho AV. Tempo de internação após apendicectomia aberta por três técnicas cirúrgicas diferentes. *ABCD Arq Bras Cir Dig.* 2014;27:188-90.
- Kirkil C, Karabulut K, Aygen E, Ilhan YS, Yur M, Binnetolu K, et al. Appendicitis scores may be useful in reducing the costs of treatment for right lower quadrant pain. *Ulus Travma Acil Cerrahi Derg.* 2013;19:13-9.
- Goulart RN, Silvério GS, Moreira MB, Franzon O. Achados principais de exames laboratoriais no diagnóstico de apendicite aguda: uma avaliação prospectiva. *ABCD Arq Bras Cir Dig.* 2012;25:88-90.