



Alvarado's Criteria for Diagnosis of Children's Acute Appendicitis

Bruno César Fernandes*

Master in Health Teaching. Specialization in Nursing Auditing. Specialization in Intensive Care. Specialization in Family Health. Specialization in Neonatal and Pediatric Intensive Care. Bachelor of Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-1147-8224>

Raquel Borges de Barros Primo

PhD student in Health Sciences, Federal University of Grande Dourados, UFGD. Master in Health Sciences. Specialization in Nursing in Pediatric and Neonatal ICU. Specialization in Oncology Nursing. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the Professor Edgard Santos University Hospital (HUPES).

Orcid iD <https://orcid.org/0000-0001-7012-6707>

Anny Karoliny das Chagas Bandeira

Master's degree in Community Health, with an area of concentration in Epidemiology. Specialist in Intensive Care and High Complexity. Bachelor of Nursing. Professor at the Jorge Amado University Center.

Orcid iD <https://orcid.org/0000-0001-5618-9875>

Mariella Rodrigues da Silva

Specialization in Urgency and Emergency. Specialization in Family Health. Specialization in Patient Safety. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0003-1649-0094>

Carolina Calixto de Souza Andrade

Master in Human Development and Social Reason. Specialist in Public Health. Specialist in Professional Education in the Health Area. Family Health Specialist. Specialist in Intensive Care. MBA in Hospital Management and Hospital Infection Control. Specialist in Preceptorship in Health. Currently Health Care Manager of the Brazilian Hospital Services Company (EBSERH) at Professor Edgard Santos University Hospital (HUPES/UFBA/EBSERH). Graduated in Nursing.

Orcid iD <https://orcid.org/0000-0003-4026-8039>

Michelle Katiuscia Melo Mota

Master in Health Teaching. Specialization in Nursing in Surgical Center, Anesthetic Recovery and Material and Sterilization Center. Specialization in Occupational Nursing. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-2177-9119>

Kaio Guilherme Campos Paulo Ikeda

Master of the Graduate Program in Nursing, Federal University of Mato Grosso do Sul, UFMS. Specialization in Uniprofessional Residency in Obstetric Nursing. Specialization in Gynecology and Obstetrics Nursing. Graduated in Nursing. Obstetrician Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-4408-3958>

Alan Márcio de Brito Araújo

Medical student at the Central University of Paraguay, UCP. Multiprofessional Residency in Neurology. Specialization in Intensive Care Nursing. Specialization in Family Health. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-9874-5929>

Vanessa Rodrigues Moraes Delgado

Specialization in Stomatotherapy. Specialization in Health Management of the Healthy Person. Specialization in Urgency and Emergency. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-4692-8344>

Valeska Lopes Pereira

Specialization in progress in general ICU and management of intensive care for critically ill patients. Specialization in Nursing in Radiology and Imaging. Specialization in Occupational Nursing. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSERH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-9231-5768>

Ubirajara Medeiros Costa

Specialization (in progress) in Urgency and Emergency. Graduated in Nursing. Nursing Care, Brazilian Hospital Services Company - EBSEH, Federal University of Grande Dourados, Mato Grosso do Sul, Brazil.

Orcid iD <https://orcid.org/0000-0003-3144-9663>

Eusania Marcia Nascimento

Specialization in Multidisciplinary Nephrology. Specialization in Health of the Healthy Person. Specialization in Indigenous Health. Specialization in Food Surveillance and Nutritional Indigenous Health. Specialization in Family Health Program. Graduated from Nursing. Nursing technique, Brazilian Hospital Services Company - EBSEH, Federal University of Grande Dourados, Mato Grosso do Sul, Brazil.

Orcid iD <https://orcid.org/0000-0001-8359-8375>

Carmen Célia Neves de Souza

Specialization in Family Health. Specialization in Health Service Audit. Specialization in Public Health Management. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSEH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-8170-0329>

Rodrigo Alexandre Teixeira

Specialization in Health Education for SUS Preceptors. Specialization in Nursing in Urgency and Emergency. Graduated in Nursing. Care Nurse of the Brazilian Hospital Services Company (EBSEH) at the University Hospital of the Federal University of Grande Dourados (HU-UFGD).

Orcid iD <https://orcid.org/0000-0002-0003-2913>

Nayara Andrade de Oliveira

Curriculum: Specialization in Health Care with an emphasis on Indigenous Health (Multiprofessional Residency at HU-UFGD). Specialization in Urgency and Emergency. Specialization in Nursing in Neonatal and Pediatric ICU. Graduated in Nursing. Assistant Nurse at the University Hospital of the Federal University of Grande Dourados, linked to the Brazilian Hospital Services Company (HU-UFGD/EBSEH)

Orcid-Id: <https://orcid.org/0000-0001-6742-5175>

Abstract

Acute abdomen in children is a condition that causes great distress to parents, and appendicitis is its most common cause, being more frequent at school age. This pathology is the cause of numerous visits to public and private hospitals around the world, and brings several complications. It is important that the health team is aware of the possibility of appendicitis in children, due to its high incidence and difficulty in establishing its diagnosis, because the symptoms are nonspecific and there are different clinical presentations. Objective: to

explain the importance of the Alvarado criterion for the diagnosis of acute childhood appendicitis. Methodology: This is an integrative bibliographic review, in articles published in the PubMed, Virtual Health Library and Google Scholar databases. For the search for data, the descriptors "Acute abdomen", "Appendicitis", "Children" and the keyword "Alvarado score" were used. Data were collected in December 2020. Results: 16 articles were selected as the final sample for analysis of the review, six in English, nine in Portuguese and one in Spanish. Conclusion: Through this review it can be concluded that the use of the Alvarado Score for the diagnosis of acute appendicitis in children is useful and effective, avoiding the use of imaging tests in patients with a score above 7 on this scale.

Keywords: Acute abdomen; Acute appendicitis; Alvarado score; child.

1. Introduction

Acute appendicitis is the most common cause of surgical abdomen in children, being a pathological process of inflammatory origin that occurs in any age group, from the newborn to the elderly, being more common in school age. This pathology is the cause of numerous visits in public and private hospitals in the world, and also promotes several complications. This condition was already reported in ancient Egypt, and was discussed in the middle of the Western European Renaissance, when the Cecal Appendix was discovered as an anatomical entity (Arredondo, 2014).

Although it is common in childhood and adolescence, the disease is also prevalent in young adults (19 to 44 years), especially in males (Lima *et al.*, 2016). The overall prevalence rate of the disease is approximately 7% and the peak incidence varies according to the gender and age group of children and adolescents, being 10-14 years in females and between 15-19 years in males (Lima *et al.*, 2016).

In a historical context it is worth saying that the first surgical removal of the appendix was performed by Amayand in 1735, with James Parkinson being the first in the English language to scientifically describe the pathology of appendicitis (Arredondo, 2014). He described in detail, in 1812, the fatal case of one of his patients, a 5-year-old boy, who he had observed for some time, with health problems, but made no particular complaint until two days before his death, when he suddenly began vomiting and great prostration. The abdomen became very turgid and sore when pressed, the face pale and the wrist almost imperceptible. The death, preceded by extreme restlessness and delirium, occurred within 24 hours (Pearn and Gardner-Thorpe, 2001).

Pearn and Gardner-Thorpe (2001) explain that Parkinson's performed the autopsy of the boy in the case cited, and described his findings saying there was a slight adhering between the peritoneum covering the viscera and the wall of the abdomen, where the viscera, regardless of inflammation of its peritoneal covering, appeared in a perfectly healthy state, except for the vermiform appendix of the cecum. Also, according to the authors, Parkinson (1812) reported that no sick appearance was seen near the cecum, however, about an inch of its extremity was considerably enlarged and thickened, its internal surface ulcerated and a small opening of ulceration was found at the beginning of the sick part, around the central part of the appendix, through which it appeared as a thin fluid, dark-colored and highly fetid had vased into the abdominal cavity. When opening

the appendix, hardened objects were found impacted on the part that was between the opening and the part of the appendix.

Still, appendicitis is of great importance and all health team should be aware of the possibility of appendicitis in children, due to its high incidence and difficulty in establishing its diagnosis, due to the symptoms being nonspecific and having different clinical presentations (Peyvasteh *et al.*, 2017).

There is a major problem when appendicitis affects preschool children and neonates. In these smaller ranges, patients may present more atypical symptoms, being confused with gastroenteritis, and may evolve rapidly to more severe complications such as perforation, abscesses and necrosis (Song *et al.*, 2018). It is commonly known that in children under five years of age the incidence of appendicitis is usually lower, however, its clinical diagnosis is much more complicated (Arredondo, 2014), this is partly explained by the anatomical characteristics that these children present, such as short momentum, disabling the effective blockade of intraperitoneal infectious processes evolving faster to septic conditions (Song *et al.*, 2018).

The time of diagnosis in preschool patients and neonates in hospital services is of paramount importance, but there are still some barriers in the process of diagnosing the disease, such as difficulty in communicating and skills of professionals on physical examination when faced with an acute abdomen in children, as well as in the identification of symptoms of the condition. Therefore, it is necessary to have the knowledge of the main abdominal disorders in children, with their specific presentations, diagnoses, and treatments with minimally invasive actions with the lowest possible costs (Song *et al.*, 2018).

In this case, the test of choice to better assist in the diagnosis of Acute Appendicitis is contrast computed tomography, as it presents high sensitivity and specificity (Do Nascimento *et al.*, 2018). However, it is notorious that its use presents a high cost to the public health system and may provide the child with a high amount of radiation, causing harmful effects to different cells.

As a result of the difficulty, whether due to financial resources in the public health system, or by the inability of the hospital service, to easily provide imaging tests and in order to facilitate the identification of inflammatory abdomen by physical examination, different classification scales were created for the diagnosis of acute appendicitis (Do Nascimento *et al.*, 2018; Peyvasteh *et al.*, 2017).

In 1986, Dr. Alfredo Alvarado observed more frequent signs and symptoms for the diagnosis of Acute Appendicitis, and from then on developed, through studies, his own scale (Adorno *et al.*, 2016). Several studies (Adorno *et al.*, 2016; Do Nascimento *et al.*, 2018; Peyvasteh *et al.*, 2017) show the association between the Alvarado Score scoring criterion and the diagnostic confirmation of Acute Appendicitis. In the study by Do Nascimento *et al.* (2018) The Alvarado score proved to be a good method for diagnostic screening in Acute Appendicitis, using as a cutoff point score greater than or equal to six that were associated with a higher probability of diagnostic confirmation to histopathology.

Thus, the social relevance of this research is justified by the fact that acute appendicitis represents the most common surgical condition in the world, with a high incidence mainly in the school age group, between 10 and 20 years of age. Diagnosis should be made based on the clinical evaluation of the patient and is an emerging condition in children, but its timely and early diagnosis remains a problem (Song *et al.*, 2018).

In view of the above, this review aimed to determine the importance of the Alvarado criterion for the diagnosis

of acute infantile appendicitis.

2. Methodology

The study was developed through an integrative bibliographic review, with the collection of data in published articles, searched through the PubMed databases, Virtual Health Library and Google Scholar. The inclusion criteria for this review were articles with free text available in full, in Portuguese, Spanish and/or English without limitation of publication date, that is, the studies published throughout the period allowed by the selected databases, because the purpose was to cover as many articles as possible. The repetitions and documents that did not meet the research objective were excluded from the sample, remaining only once.

For the selection of articles, a consultation was made to the Descriptors in Health Science (DeCS), and the following descriptors were identified, selected and used in Portuguese: "Acute abdomen", "Appendicitis" and "Children". With the interest in analyzing a comprehensive production about publications related to the theme of this review and in order to expand the sample of analysis, the keyword "Alvarado Score" was also used as a search strategy, having as its guide axis the inclusion and exclusion criteria, previously established to maintain coherence in the search for articles and avoid possible vieses. These terms were crossed from the Boolean AND or OR operators.

In December 2020, therefore, searches were performed using the descriptors and the keyword in the databases selected in this review.

After a pre-selection of the articles resulting from these searches, readings of the titles and abstracts of the total sample were made, applying the inclusion and exclusion criteria.

After doing this process, 16 articles were selected as the final sample of review analysis. From the material obtained, a thorough reading of its contents was carried out in order to deepen the knowledge on the subject and achieve the proposed objective.

The articles selected for review were organized by means of an instrument, not validated, elaborated by the authors, containing: title, year of publication, category and focus of the study with the objective of summing up, extracting and analyzing the data.

3. Results and Discussion

16 articles were selected as a data source for the present scientific study, six in English, nine in Portuguese and one in Spanish. The results of the publications selected in this review are described in Table 1.

Table 1. Summarization of the studies selected for the review

n°	Title of the study	Year	Study category	Study focus
1	Case of diseased vermiform appendix	1812	Case Report	Report of a clinical case of evolution to death of a 5-year-old child with involvement of the vermiform appendix. The child's signs and symptoms are described in the 72-hour period until death.
2	Appendicitis in	1942	Case report	Description of the fundamental principles and

	acute abdomen syndrome		and experience with empirical narrative	guiding concepts capable of guiding the physician in the diagnosis and treatment of acute appendicitis. We will remember, however, that such knowledge should always be, together with a good clinical experience, because the ability to accurately identify and take advantage of the different diseases is not acquired in lectures, but by continuous contact and rational observation of patients.
3	James Parkinson (1755- 1824): a pioneer of child care.	2001	Literature review	Study of primary sources with critical analysis and description of the extensive contributions of James Parkinson (1755–1824), Parkinson's disease, to child clinical care and his pioneering defense of child welfare, protection and safety. He pioneered data description of the pathophysiology and pathology of appendicitis in children.
4	Validation of the Alvarado score in the diagnosis of acute appendicitis in children and adolescents at the Maternal and Child Institute of Pernambuco, IMIP.	2003	Original article	Validation study of diagnostic method (clinical and laboratory score for diagnosis of acute appendicitis) with histopathological examination as the gold standard. The sample consisted of 81 children and adolescents admitted to the pediatric emergency room of IMIP with abdominal pain suspected of acute appendicitis, from March to October 2002. The patients were treated in the pediatric emergency room and evaluated for the Alvarado score. However, the surgical decision was made by the surgeon responsible. The objective was to determine the accuracy of the Alvarado score for the diagnosis of acute appendicitis in children and adolescents admitted to the emergency of the Maternal and Child Institute of Pernambuco (IMIP).
5	Acute appendicitis: is there a relationship between the evolutionary degree, age and the time of	2005	Original article	Retrospective analysis of 272 patients submitted to appendectomy regarding the evolutionary degree of appendicitis and its respective hospitalization period. The evolution of the inflammatory process was classified by histopathological examination in four degrees: catarrhal, phlegmonous, suppurative

	hospitalization?			and gangrenous in order to identify a possible relationship between the evolutionary degree of acute appendicitis, chronological age and duration of hospitalization period.
6	Apendicitis y apendicectomías em pediatria. Prevalencia en un hospital de segundo nivel.	2014	Original article	Retrospective cohort study of pediatric patients operated on appendicitis conducted over a period of 3.5 years. Among other things, age of presentation, days of hospitalization, time of evolution and morbidity were investigated.
7	Correlation between the Alvarado Scale and the macroscopic aspect of the appendix in patients with appendicitis	2014	Original article	The study aimed to evaluate the possible association between the Alvarado scale (AS) and the macroscopic appearance (MA) of the appendix in patients with acute appendicitis. After receiving the diagnosis of acute appendicitis, AS data were collected. During appendectomy, MA data were collected. Data from patients without appendicitis were excluded. Spearman's correlation test was used to compare AS with Appendix MA ($p < 0.05$). Other variables were represented by simple frequency. The 95% confidence interval (CI) was calculated for the correlation test.
8	Alvarado scale for the clinical diagnosis of acute appendicitis.	2016	Literature review	Retrospective observational study with recovery and critical analysis of the literature with the objective of presenting a proposal for improvement in the quality of care to patients with acute appendicitis, punctuality and diagnostic efficiency, and especially in outpatient and emergency care, where there are no high-level auxiliary means, such as imaging. The study concluded that the Alvarado scale is useful as a diagnostic tool for acute appendicitis, has high sensitivity, good specificity and adequate predictive value. It is simple, reliable and non-invasive, low cost and can be used in emergency or inpatient services.
9	Risk stratification to decrease	2016	Original article	Prospective study of interrupted time series comparing the use of images during 3 time periods:

	unnecessary diagnostic imaging for acute appendicitis.			historical baseline, passive intervention and active intervention. The study was conducted in a tertiary hospital with a pediatric emergency room with 90,000 visits per year and approximately 500 cases of appendicitis per year. The moderate and high-risk groups presented lower proportions of computed tomography (CT) in the periods of passive and active intervention compared to the historical control group. Proportions of patients undergoing ultrasound in all 3 risk groups showed an increase in relation to the historical baseline. Time series analysis confirmed that time trends in any individual period were not significant; therefore, incidental secular trends over time do not seem to explain the decreased use of CT.
10	Modified Alvarado score in children diagnosed with appendicitis.	2017	Original article	Four hundred children with initial diagnosis of appendicitis were randomly selected from patients undergoing appendectomy. The modified Alvarado score was used to evaluate the condition, which was confirmed by histology. The aim of this study was to evaluate the sensitivity, specificity, positive predictive value and negative predictive value of the modified Alvarado score in children submitted to appendectomy.
11	Risk factors associated with complications of acute appendicitis.	2017	Original article	A control case study aimed at identifying the main risk factors associated with the development of complications in patients with acute appendicitis from data from the medical records of 402 patients hospitalized with acute appendicitis in a secondary level hospital, separated into two groups: control group, with 373 patients who evolved without postoperative complications (Group 1) and study group, with 29 patients who presented complications (Group 2). Demographic data, signs and symptoms of the disease, imaging tests and hospitalization data were evaluated.
12	A clinical score to	2017	Original	Observational study aimed at developing a clinical

	predict appendicitis in older male children		article	score to predict appendicitis in older male children who report to the emergency room with suspected appendicitis. Patients with suspected appendicitis were prospectively included in 9 pediatric emergency departments. A total of 2,625 enrolled patients; a subset of 961 male patients, aged between 8 and 18 years, was analyzed in this secondary analysis. The results were determined using pathology, surgical reports and follow-up calls. Clinical and laboratory predictors with <10% of absent data and kappa > 0.4 were inserted in a multivariate model. The resulting β coefficients were used to develop a clinical score. The performance of the test was evaluated by calculating sensitivity, specificity, positive predictive value, negative predictive value and probability ratios.
13	Bacterial culture and antibiotic susceptibility in patients with acute appendicitis	2018	Original article	With the premise that, to treat acute appendicitis effectively, it is important to identify the microorganism of acute appendicitis and evaluate effective antibiotics, the authors selected 694 patients submitted to appendectomy by acute appendicitis and with positive microbial result between 2006 and 2015. For microbial evaluation, the luminal content of the appendix was scrubbed after appendectomy. In patients with periappendicular abscess, samples were obtained from the abscess fluid. Patient characteristics, operative data, antibiotic use, microbiology results, and postoperative morbidities, including surgical site infection (SSI) were retrospectively reviewed.
14	Association between Alvarado score, surgical findings and histopathological aspect of acute appendicitis.	2018	Original article	Observational study of a cross-sectional design of 101 patients aged 14 years or older submitted to urgent appendectomy. The evaluation contained the Alvarado score, score on the score, gender, age, ethnicity of the patients and time of evolution. The surgical aspect of the appendix, data on postoperative complications and the results of

				histopathological examination were obtained. The pre-established confidence interval was 95%. Sensitivity, specificity, positive and negative predictive value of the score were calculated, and an analysis was performed using the ROC curve. The objective was to compare the results of the Alvarado score with the surgical findings and with the results of the histopathological examination of the appendix of patients operated for acute appendicitis.
15	Correlation of clinical data and the Alvarado's Score as predictors of acute appendicitis.	2018	Original article	This is an observational, descriptive and prospective study conducted in a public emergency hospital in the city of Fortaleza, Ceará, between July and December 2016, with 34 patients undergoing open appendectomy aged between 18 and 70 years. The aim of this study was to correlate the patient's clinical data and Alvarado's score as predictors of acute appendicitis.
16	Appendicitis in pediatrics: age is important	2019	Original article	In order to investigate the influence of the patient's age on the diagnosis and treatment of appendicitis, as well as to evaluate the frequency of complications depending on the age group, a retrospective analysis of the 1,736 pediatric patients who underwent laparoscopic appendectomy was performed in a tertiary hospital from January 2000 to December 2013. The patients were divided into groups according to their age: group A were children, group B were preschoolers, group C were older than five years of age and group D were under five years of age. It was considered statistically significant p-value <0.05.

As Cerruti (1942) explains, acute inflammation of the appendix causes lesions, which are simple at first, but which become progressively more severe in a few hours, providing different anatomopathological classifications, which correspond to the succession of stages of organ inflammation. Thus, are described by the author:

The initial lesion (primaerdefetke) is located in a crypt or deep fold of the mucosa of the appendix. Through this erosion there is invasion of the organ wall by an inflammatory process that extends, in the form of a wedge,

more in the muscular and serous layer than properly in the mucosa and submucosa. Such microscopic alteration corresponds macroscopically to a hyperemiated or even normal-looking appendix. This is catarrhal appendicitis. With the progress of the process there is generalization of inflammation with involvement of other crypts and the various tunics of the appendix which, entirely infiltrated by an exudate of neutrophil polynuclear, constitutes the picture of phlegm appendicitis. [...] In earlier phases appear complicated forms of acute appendicitis. There is, then, purulent fluidification with abscesses forming on the wall of the appendix that can be opened in its light or through serous and, at the expense of very small perforations, largely contaminate the peritoneum. It's the suppuration appendicitis drilled. Finally, in certain cases there is edema and inflammation of the mesoappendix, thrombosis of the appendicular artery, which being terminal causes gangrene of the appendix to a variable extent. It is gangrenous appendicitis with organ perforation. This is the most serious modality of appendicitis [...] (Cerruti, 1942, p. 8-9).

Thus, with regard to histopathological description, a reference is the classification cited by Fisher *et al.* (2005), in degree of evolution, such as: catarrhal phase (grade 1); phlegmonous phase (grade 2); suppurative phase (grade 3) and gangrenous phase (grade 4). The macroscopic description of the appendix can be performed according to the criteria described in the study by Souza-Rodrigues *et al.* (2014), to the following grades: 1) appendix without perforation and minimal modifications; 2) appendix without perforation and the presence of gangrene suppuration or necrosis; 3) appendix with perforation and peritonitis or abscess at the site; and 4) appendix with perforation and diffuse peritonitis.

Borges *et al.* (2003) say that appendicitis affects the male sex more, at a ratio of 3:2, with a higher incidence in family members. As the researchers explain, Aneiros *et al.* (2019), age makes a difference in the diagnosis in cases of acute appendicitis, because it is verified that, due to its presentation being rare in children under 5 years of age, it is often misdiagnosed, which increases its morbidity. In the study of these authors, although their clinical presentation varies between infants and preschoolers, the researchers did not observe statistically significant differences in the proportion of perforated appendages or in postoperative complications.

It is medical knowledge that the diagnosis of acute appendicitis is clinical. A good anamnesis and an adequate physical examination may be resolute for early discovery. However, the use of tools such as imaging exams is increasingly common in ready-to-care services in Brazil. In this sense, radiological examination has a limited role, while ultrasonography (US) has the advantage of being a noninvasive procedure, that there is no exposure of the patient to radiation, however, it does not provide a well-defined image, especially in obese patients and when the intestinal loops are distended in addition to requiring an examiner with skill and experience (Adorno *et al.*, 2016).

Incorrect diagnosis is more common in children and the elderly, and its late diagnosis is not very uncommon, due to atypical presentation in the disease with 40% of children misdiagnosed, so it presents as a challenge to professionals. Late-term appendicitis represents severe pathological progressions related to systemic complications, longer hospitalization time, increased morbidities and/or mortality, representing higher costs to the public health system, and loss of life, thus on the health services (Iamarino *et al.*, 2017).

In addition, the use of clinical study through anamnesis and physical examination has been abandoned by professionals, either by insecurity or unpreparedness. With this, there is an excessive increase in the use of

radiological examination in pediatric hospitals. The use of computed tomography (CT) already represents 21% to 49% of cases. According to a study conducted by Kharbanda *et al.* (2017), the potential for CT use is problematic, due to risks with radiation, by induction of malignancy, especially in young women. Thus, it is consensus to limit its use.

One option is the use of the Alvarado scale for the diagnosis of acute appendicitis. Symptomate and laboratory parameters with different scores are included in this scale; migratory pain in the right iliac fossa (1), nausea and/or vomiting (1), fever (1), anorexia (1), right lower quadrant wall defense (QID) (2), decompression pain (1), Leukocytosis >10,000 (2) and left deviation (1). It is observed that each characteristic is worth one (1) point, except leukocytosis and wall defense in QID, which are worth two (2), thus totaling 10 points (Adorno *et al.*, 2016).

In relation to the Alvarado score, Adorno *et al.* (2016) explain that those who have a score greater than or equal to 7 have indication for surgical treatment; when between 5 and 6, the probability of acute appendicitis is high, therefore, simple imaging tests such as USG or CT are indicated to confirm the diagnosis; if the score is less than 4, the probability of appendicitis is low. It is noteworthy that inflammation of the appendix rarely presents a score lower than 4.

According to Depinet *et al.* (2016), although the accuracy of clinical factors for the diagnosis of appendicitis is reported in 70% to 87%, the use of diagnostic images, including CT, has become widespread. Despite the current recommendation of ultrasound as the preferred test for diagnosis of appendicitis imaging, and the small increased lifetime risk of malignancy associated with ionizing radiation, CT is still commonly used in some areas for imaging diagnosis in these cases.

Borges *et al.* (2003) used a sample of 81 children and adolescents, with the cut-off point of >5. The results of their study demonstrated that the Alvarado score is a procedure that is not invasive, simple, fast and reproducible, and with a minimum score of 5 points, is presented as a high-value instrument in the screening of children and adolescents with suspected diagnosis of acute appendicitis.

Similarly, the study conducted by Cunha *et al.* (2018) also evaluated the efficacy of the Alvarado score in an emergency hospital in the city of Fortaleza, concluding that its use in health services emerges as an accessible and effective tool to optimize the approach of patients with a condition suggestive of appendicitis. In addition, the Alvarado score may also suggest the degree of inflammation of the appendix. The authors also recall that the faster the therapeutic definition of acute appendicitis, the lower the chance of necrosis or abscess formation in the appendix and the shorter the length of hospital stay in the postoperative period.

Regarding clinical signs, in the study conducted by Do Nascimento *et al.* (2018), the most frequent symptom was decompression pain, presented by 92% of the patients evaluated, followed by leukocytosis in 84.2% of patients, anorexia in 77.2% and nausea and vomiting in 75.2%. The least frequent were migratory pain in 56.4%, wall defense in QID in 47.5%, fever in 38.6%, and left deviation to leukogram in 15.8% of the patients evaluated.

In the study by Souza-Rodrigues *et al.* (2014), the most frequent symptom among the patients evaluated was wall defense in QID, presented by 91% (61 out of 67) of patients, followed by fever in 85.1% (57/67), anorexia in 85.1% (57/67), leukocytosis in 83.6% (56/67), nausea and vomiting in 80.6% (54/67) and decompression

pain in 62.7% (42/67).

In the study conducted by Iamarino *et al.* (2017), the most frequently diagnosed symptom was migratory pain, found in 96% of patients who had uncomplicated appendicitis and in 93% of those with complication appendicitis. Among the complications, which are due to the evolution of the acute inflammatory process, the authors mention: suppuration, perforation with or without hemorrhage and gangrene of the appendix.

Decompression pain was the second most common symptom of the study by Iamarino *et al.* (2017), presented by 80% of patients without complications, and by 93% of patients with complications. Then, nausea and vomiting were presented by 73% of patients without complications, and by 83% of those with complications. Regarding fever, 44% of patients without complications had this symptom, while 72% of those who had complications also had fever. It is noteworthy that the authors did not evaluate the other symptoms of the Alvarado Score, bringing only the results already mentioned.

In another study, conducted by Peyvasteh *et al.* (2017), the most common symptom was wall defense in QID, found in 91.4% of patients. Then came leukocytosis, demonstrated by 89.3% of patients. The symptomatology of nausea and vomiting was the third most frequent, with 84.3% of them presenting these symptoms. Anorexia was found in 73.6% of patients, and fever was the least frequent, being verified in 49.3% of the patients evaluated by the authors. However, as in the study by Iamarino *et al.* (2014), these authors also did not evaluate the other symptoms of the Alvarado Score.

Thus, when comparing the results of studies by Peyvasteh *et al.* (2017), Do Nascimento *et al.* (2018), Iamarino *et al.* (2017) and Souza-Rodrigues *et al.* (2014), it is observed that there are variations between the frequencies found of the symptoms presented by the patients, but some agreements were found, and the symptoms of nausea and vomiting, pain to decompression and leukocytosis as the most frequently found, while migratory pain in the right iliac fossa and the left deviation to the leukogram would be the least common.

4. Conclusion

Through the data presented here, it can be concluded that the use of the Alvarado Score for the diagnosis of acute appendicitis in children is useful and effective, avoiding the use of imaging tests in patients with a score above 7.

Therefore, in case of acute abdomen in children, imaging should not be performed without need, since when the Alvarado score is equal to or above 7 it is already indicative of surgery, therefore, such tests are unnecessary. If confirmation is still desirable, especially when in children under 5 years of age, where the diagnosis is less accurate, the examination of choice should be US, and no tests such as radiography and CT are indicated for children's exposure to ionizing radiation.

5. References

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