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Efficacy of the Alvarado scale in patients with a diagnosis of acute apendicitis at the General Surgery Unit at hospital regional de Ciudad del Este, Paraguay

Eficacia de la escala de Alvarado en pacientes con diagnóstico de apendicitis aguda, en el Servicio de Cirugía General del Hospital Regional de Ciudad del Este

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ABSTRACT

Objective: Evaluate the efficacy of the Alvarado score in the diagnosis of acute appendicitis in patients at the General Surgery Unit at Ciudad de Este Hospital Regional, Paraguay. **Materials and methods:** observational, descriptive, cross-sectional study. The past medical histories of patients with preoperative diagnosis of acute appendicitis were included in the study, the Alvarado score was applied, and the score was associated with its subsequent macroscopic postoperative finding. Patients were operated on at the General Surgery Unit of the HR-CDE from January 2020 through September 2020. **Results:** a total 100 patients were included; 61% of whom were men. The Alvarado score was applied, and they were categorized into 4 groups, low risk (16%), possible risk (23%), probable risk (39%), and high risk (22%). According to the macroscopic postoperative finding they were categorized into congestive (14%), phlegmonous (42%), gangrenous (35%), and perforated appendicitis (8%). An 86% sensitivity rate, and a 29% specificity rate were obtained for this study. **Conclusion:** the Alvarado score is a simple tool, easy to apply, and a useful support in the diagnosis of this condition.

Keywords: acute appendicitis, Alvarado score, acute surgical abdomen.

RESUMEN

Objetivo: Evaluar la eficacia de la Escala de Alvarado para el diagnóstico de la Apendicitis aguda en pacientes dentro del Servicio de Cirugía General del Hospital Regional de Ciudad de Este. **Materiales y métodos:** Estudio observacional, descriptivo, de corte trasversal. Se incluyeron historias clínicas de pacientes con diagnóstico pre operatorio de Apendicitis aguda, fue aplicada la Escala de Alvarado y se correlaciono el puntaje con su posterior hallazgo macroscópico post operatorio, operados en el Servicio de Cirugía General del HR-CDE en el periodo de enero a septiembre de 2020. **Resultados:** Se incluyeron un total de 100 pacientes; donde 61% eran del sexo masculino. Fue aplicada la Escala de Alvarado y se los agrupo en 4 grupos, Riesgo bajo (16%), Riesgo posible (23%), Riesgo probable (39%) y Riesgo alto (22%), y según el hallazgo macroscópico post operatorio se los clasifico en apendicitis congestiva (14%), flegmonosa (42%), gangrenosa (35%) y perforada (8%). Se obtuvo una Sensibilidad del 86% y Especificidad del 29% para este estudio. **Conclusión:** La Escala de Alvarado una herramienta sencilla, de fácil aplicación y un apoyo útil para el diagnóstico de esta patología.

Palabras clave: Apendicitis aguda, Escala de Alvarado, Abdomen agudo quirúrgico.

INTRODUCTION

Abdominal pain is the most common cause for consultation at the emergency room: one in every 20 patients who go the emergency services have this symptom, being acute appendicitis (AA) one of the most common diagnostic suspicions.[1,2] The medical literature reports that 7% of the world population will have appendicitis in their life time, with an incidence peak between 10 to 30 years of age.[3,4] Despite of this, its diagnosis is no easy task since the typical chronology of symptoms or the recurring lab results are in 20% to 33% of the patients on average, which can often be seen in a rate of false positives of 30%.[1]

Early diagnosis of AA is considered as the most significant therapeutic measure to decrease the morbidity and mortality rates. It has been reported that the delay or failure in its diagnosis can lead to complications like cecal appendix perforation (40% to 5%), surgical site infections (15% to 8%), formation of intraabdominal abscesses (6% to 2%), even sepsis and death

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(5% to 0.5%). This leads to longer hospital stays with the corresponding higher costs at public healthcare level. Diagnosis of AA is mainly clinical through physical examination and the use of additional methods. However, it lacks uniformity of criteria given the irregularity of the symptoms and signs with which it presents.[5] That is why diagnostic scores like the Alvarado score (AS), RIPASA, and others are useful tools that can contribute to the early detection of AA cases.[6] The application of this score as an auxiliary method in the diagnosis of AA has contributed to decrease the percentage of non-therapeutic appendectomies in 8% and lower hospital costs in 10%.

Back in 1986, Dr. Alfredo Alvarado conducted a retrospective study that analyzed the signs and symptoms of 305 patients treated with surgery due to acute appendicitis. He found 8 predictive factors to develop a score used when a case was suspected and facilitate the diagnosis of AA. This score consists of three symptoms, three signs, and two lab results. (See Figure 1). According to the score obtained, patients can be categorized in four groups: Low risk of developing AA (0-4 points), possible AA (5-6), probable AA (7-8), and high risk of AA (9-10).[2] In patients with up to 4 points, it is considered that less than 5% will develop acute appendicitis. Should this be the case, they can be discharged after being reassessed 24 hours later or in case of disease progression. With an AS score between 5 and 6, around 35% of the patients will have AA, which is why the patient's hospitalization is indicated and the use of auxiliary methods suggested to gain diagnostic certainty. With scores > 7, sensitivity goes up to 78% in women and 94% in men being immediate surgery indicated. Also, < 10% of all laparotomies will show an appendix without any alterations.[4,6] The AS is the most widely accepted score by emergency services worldwide, with an overall 68% sensitivity rate, and a 87.9% specificity rate.[2]

The objective of this paper was to assess the efficacy profile of the AS in patients hospitalized with suspected AA at the General Surgery Emergency Services at the Hospital Regional de Ciudad del Este (HR-CDE), Paraguay from January 2020 through September 2020.

MATERIALS AND METHODS

Observational, descriptive, and cross-sectional study that that reviewed the patients' past medical histories at the HR-CDE General Surgery Unit from January 2020 through September 2020. The data provided by the patients as kept anonymous and confidential. The study included all the patients with a preoperative diagnosis of AA who met the admission criteria, surgical procedure, and the postoperative hospital stay at the HR-CDE General Surgery Unit, and with macroscopic postoperative findings within the evolutionary stages of AA. The study excluded patients admitted to units different from the Surgical Unit and/or who underwent surgery at our unit and then were referred to a different healthcare center.

They were grouped based on the following variables: sex, age, length of treatment, and the AS applied consisting of 8 variables to which a score is assigned. Based on the score obtained, the patients were categorized into 4 different risk groups: low risk (0 to 4), possible risk (5 to 6), probable risk (7 to 8), and high risk (9 to 10). Based on the macroscopic postoperative finding described in the surgical technique, patients were categorized into congestive, phlegmonous, gangrenous, and perforated AA. The anatomopathological study of cecal appendix was not added since it was never conducted at our unit, which is why most patients did not have results.

Data were loaded onto an Excel 10 electronic spreadsheet where the statistical analysis was conducted based on sex, age, evolution time, points obtained in the Alvarado score, and the macroscopic finding, presented in the results of this research.

The case was considered positive in patients with an evolution stage higher than congestive AA, without any other surgical findings, and with an Alvarado Score > 5. These data were loaded onto a 2 x 2 table to estimate the sensitivity and specificity rates of this auxiliary method.

RESULTS

A total of 100 patients were included, 61% of whom were men with ages from 14 to 70 years old. The most common finding were young males between 14 and 26 years of age (54%) (see Table 1), with an evolution time from symptom onset until the moment they saw the doctor of a mean 36.2 hours. The time between consultation and the surgical act was 8.2 hours approximately.

A mean score of 6 and a mode of 7 were obtained in the AS (see Table 2). In addition, regarding aspects, it was seen that decompression pain, leukocytosis, and deviation of formula to the left were the most common represented aspects (see Table 3) with rates of 85%, 83%, and 82%, respectively**.**

All these patients underwent surgery based on the clinical examination and signs without considering the score obtained on the Score and based on the macroscopic postoperative finding. They were categorized into congestive, phlegmonous, gangrenous, and perforated AA. The most common finding was phlegmonous AA in 42% of the cases (see Table 4), followed by gangrenous AA (32%), congestive AA (14%), and perforated AA (8%). These data were associated with the score obtained in the Alvarado Score (see Table 4). Among the complications resulting

Figure 1. Alvarado Score for the clinical diagnosis of acute appendicitis

ASPECT	CLINICAL MANIFESTATIONS OR LABORATORY	SCORE
Symptoms	Migration of pain to the right iliac fossa	**1**
	Anorexia	**1**
	Nauseas and/or vomiting	**1**
Signs	Pain to the right iliac fossa	**1**
	Decompression pain to the right iliac fossa	**2**
	Fever	**1**
Laboratory	Leukocytosis (> 10 000 cells/mm3)	**2**
	Neutrophilia (>70%)	**1**
Total score		**10**
Score reached for the diagnosis of AA		**Risk of AA**
< 4	Low chances	**Low**
5-6	Consistent but not diagnostic	**Possible**
7-8	High chances	**Probable**
9-10	Almost certainty of appendicitis	**High**

Table 1. Distribution based on the age of patients diagnosed with acute appendicitis (N = 100)

AGE	FREQUENCY	PERCENTAGE
14 - 26	54	54%
27 - 59	41	41%
> 60	5	5%
Total	100	100%

Table 2. Distribution based on the score obtained in the Alvarado Score of patients with a diagnosis of acute appendicitis (N = 100)

AS Score	Risk	N	%
< 4	Low	16	16%
5-6	Possible	23	23%
7-8	Probable	39	39%
9-10	High	22	22%
Total		**100**	**100%**

Table 3. Distribution based on the Alvarado Score parameters of patients diagnosed with acute appendicitis (N = 100)

AS aspects	N	%
Decompression pain	85	85%
Leukocytosis	83	83%
Deviation to the left (neutrophilia)	82	82%
Pain migration	77	77%
Anorexia	69	69%
Nauseas and/or vomiting	69	69%
Pain in RIF	36	36%
Fever	18	18%

from a delayed diagnosis of AA, we should mention the appendicular plastron. Only 1 out of the 100 cases reviewed was categorized with this postoperative diagnosis and an AS score of 8.

Regarding congestive AA (see Table 5), 5 cases (35.7%) obtained a concomitant finding with cecal appendix inflammation, all of them in fertile women. Three of them were associated with inflammatory pelvic disease (60%) with AS scores of 2, 4, and 9. One case (20%) was associated with right adnexitis with a score of 9 and another case (20%) with a ruptured right ovarian cyst with a score of 2 in the Alvarado Score. Regarding phlegmonous AA, distribution within the AS shows vast predominance within the possible risk group with 30.9% and 38.1% of the cases respectively. Out of the overall number of cases reviewed, only 1 obtained the top score (10 points), which is included in this group. (See Table 5).

Within gangrenous AA, score distribution is also seen homogeneously, with a slight prevalence of the probable risk group (34.3%) followed by 28.6% of the cases with high risk. Of all the cases reviewed, 8 reported perforated AA as the postoperative finding, ***none of the cases attained the top AS score and evolutionary stage within the AA associated with most cases of probable risk. (See Table 5)***

Regarding the estimate of sensitivity and specificity, the following parameters were used: patients with a more advanced evolutionary stage compared to congestive AA were considered "true positive" cases, not associated with other postoperative findings, and scored > 5 points in the AS. Those cases with concomitant findings to congestive AA and scores < 5 were considered "true negative cases." Cases with scores > 5, but with macroscopic findings consistent with congestive AA, were considered "false positives" and those with score < 5, but with macroscopic findings consistent with advanced AA stages were considered "false negative" regarding the AS. With these data, in this manuscript, we obtained an AS sensitivity rate for AA diagnosis of 86% and a 26% specificity rate (See Table 6).

DISCUSSION

A total of 100 patients were included for this study. Patients admitted to the HR-CDE General Surgery Unit with a preoperative diagnosis of acute appendicitis (61%) were men while 39% were women, a relatively homogeneous distribution, which is consistent with the medical literature that shows a prevalence of masculine sex.[2,4,7,8] The age range showed a mean 28.6 years and

Table 4. Distribution based on the macroscopic finding and AS score of patients diagnosed with acute appendicitis (N = 100)

Macroscopic finding	N	%	AS score			
			< 4	5-6	7-8	9-10
Congestive AA	14	14%	4	2	5	3
Phlegmonous AA	42	42%	4	13	16	9
Gangrenous AA	35	35%	6	7	12	10
Perforated AA	8	8%	2	1	5	0
Appendicular Plastron	1	1%	0	0	1	0
Total	**100**	**100%**	**16**	**23**	**39**	**22**

Table 5. Distribution based on the score obtained in the Alvarado Score according to the macroscopic finding of AA

AS score	Congestive AA		Phlegmonous AA		Gangrenous AA		Perforated AA	
	N	%	N	%	N	%	N	%
< 4	4	28.6%	4	9.5 %	6	17.1 %	2	25 %
5-6	2	14.3 %	13	30.9 %	7	20 %	1	12.5 %
7-8	4	28.6 %	16	38.1 %	12	34.3 %	5	62.5 %
9-10	4	28.6%	9	21.4 %	10	28.6 %	0	0
Total	**14**	**100%**	**42**	**100 %**	**35**	**100 %**	**8**	**100 %**

Table 6. Estimate of Sensitivity and Specificity of the Alvarado Score (N = 100)

	Positive for AA	Negative for AA
Positive for AS	74	10
Negative for AS	12	4
Total	86	14

a mean age of 31.8 years, which is consistent with the medical literature that describes a prevalence under 40 years.[2,4,7,8]

Our study observed that the prevailing signs and symptoms associated with AA were pain to decompression in the right iliac fossa and leukocytosis with significant neutrophilia, unlike different reference sources where aspect distribution was found in a variable way. Therefore, we confirmed the lack of criteria uniformity regarding the clinical diagnosis of this condition and the tremendous irregularity of symptoms and signs at its presentation.[4,7] Delayed diagnosis leads to the onset of postoperative complications and longer hospital stays. One of the factors that predisposes to this delay is consultation delays. This study saw a mean 36.2 hours of disease progression from symptom onset until consultation compared to several other studies with means between 10.2 hours and 16 hours.[1,2]

To facilitate diagnosis, several support scores were implemented like the Alvarado Score. Regarding the scores obtained, in this study it was reported that the possible and probable AA risk groups were predominant, representative of 62% of the cases.

It is estimated that, in the routine clinical practice, high scores within the Score are associated with advanced stages of the disease and could be associated with cecal appendix perforation.[1] In our study, 39% of the patients scored between 7 and 8 being the most common postoperative finding phlegmonous AA. Within the group with scores between 9 and 10, gangrenous appendix was the most common postoperative finding. We observed that, in cases of congestive AA, the score distribution within the Alvarado Score was similar, not so in the case of perforated AA, where there is a large prevalence of higher scores. Still, none of the cases obtained the top score within the Alvarado Score, which would be equivalent to the fact that the evolution time of the clinical picture does not condition disease progression, and that the score obtained within the Alvarado Score is not associated with the inflammatory stage of the cecal appendix, which is similar to what has been reported in the medical literature reviewed.[1,8]

Several authors conclude that the best cut-off value to consider positive cases within the Alvarado Score are scores > 5 points.[2,3,8,9] in view of this, it was decided to consider as positive cases all those patients with scores >5 points and macroscopic findings consistent with phlegmonous AA onwards since 35.5% of the cases of congestive AA were associated with other conditions of an origin different than appendicular and we didn't have anatomopathological confirmation for the remaining cases. With these data we obtained 86% sensitivity and 29% specificity rates for the Alvarado Score, a huge difference compared to other bibliographic references where rates are significantly higher considering that such studies had anatomopathological confirmation of acute appendicitis in most cases.[1,7,10]

CONCLUSION

Men and young patients were prevalent, with a mean evolution time of 36 hours and an 8.2 hour wait for the surgical act.

The AS was applied and we saw that predominant aspects were pain to the right iliac fossa, leukocytosis and neutrophilia, aspects that are characteristic of but not exclusive to AA. Therefore, we turned something as subjective as physical examination into something objective. Most subjects studied were positioned in the probable risk group within the AS, and we saw that postoperative finding most often described was phlegmonous AA.

Therefore, we concluded that, though AA is one of the most common conditions seen at the General Surgery Unit, strictly clinical diagnosis and subsequent timely surgical treatment is still challenging due to the wide variability of clinical presentations. Therefore, we suggest using support in auxiliary Scores to facilitate diagnosis.

The application of simple diagnostic scores that are easy to apply like the Alvarado Score, are a reliable alternative to facilitate diagnosis. Also, we suggest using scores > 5 as the cut-off value in the decision to implement immediate surgical treatment without delaying its application any longer.

With this paper we can conclude that the Alvarado Score is a useful method when used as a backup for the diagnosis of AA that we should not rule out.

As a bias, we should mention that we do not routinely have pathological anatomy in our hospital. Therefore, it could not be included as a study variable.

The authors did not declare any conflicts of interests associated with this study, and they all have contributed equally to the study.

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