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Prevalence of Complicated Appendicitis and Associated Factors, in the Pediatric Surgery Service of the Vicente Corral Moscoso and Jose Carrasco Arteaga Hospitals

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Abstract: *Background:* Acute appendicitis is the most common surgical emergency in children. It constitutes a diagnostic challenge. Studies indicate that the determining factor for appendicitis complications is patient attributable factors such as waiting times before receiving hospital care. *Objective*: Determine the prevalence of Complicated Appendicitis and Associated Factors, in the Pediatric Surgery Service of the Vicente Corral Moscoso and Jose Carrasco Arteaga Hospitals. *Methods:* Quantitative, cross-sectional analytical study. The universe was all patients admitted with a diagnosis of acute appendicitis at Vicente Corral Moscoso and José Carrasco Arteaga Hospitals, May 2018 - April 2019. The association between variables was determined by Chi-square and the intensity of association by RP with 95% CI and P-value < to 0.05 as significant. *Results:* A total of 267 patients with a diagnosis of acute appendicitis were analyzed. The prevalence of acute appendicitis was 38.2%. Associated factors were initial misdiagnosis (RR 1.57 CI 1.16 - 2.14, P=0.01), and time from symptom onset to hospital arrival greater than 12 hours (RR 2.19 CI 1.34 - 3.59, P PZ0.01 revious medical assessments were shown to be a protective factor (RR 1.48 CI 1.07 - 2.04, P=0.01; and mean to high socioeconomic status (RR 0.71 CI 0.53 - 0.96, P= 0.03). *Conclusions:* The prevalence of complicated appendicitis was high and the significant associated factors were having an initial misdiagnosis and that the time since the onset of symptoms until arrival at the hospital is greater than 12 hours.

Keywords: Appendicitis, Postoperative Complications, Child, Procastination

1. Introduction

Acute appendicitis is the inflammation of the vermiform (worm-shaped) appendix [1]. It is the main cause of abdominal surgery in children. It also represents a diagnostic challenge due to the overlapping of symptoms of other diseases, particularly in younger patients, in whom the clinical signs and other symptoms can be unreliable and nonspecific. [2].

In the first year of life, the appendix has a funnel morphology, with a low predisposition to obstruction, because of the lymphoid follicles that can obstruct the appendix reach a maximum size during adolescence [1].

The delay in its recognition is associated with increased morbidity and mortality and medical costs. For a timely diagnosis, it is necessary to accurately evaluate the symptoms, signs based on the clinic, the complete physical examination of the child, medical observation in the Emergency Department, if possible, the Alvarado and PAS scales; and, in a few cases, it is necessary to use laboratory and imaging tests in children with suspected acute appendicitis. In this sense, it is necessary to know in detail the epidemiological and clinical characterization of this disease; which will help avoid delays in diagnosis and subsequent surgical management, minimizing any risk of complications. [2]

The exact pathogenesis of acute appendicitis is multifactorial, which main cause is the obstruction of the proximal lumen, produced by mucosal inflammation, lymphoid hyperplasia, or a fecalith, triggering an accumulation of mucosal secretions of the distal tract, with

an increase in intraluminal pressure, collapsing the venous system and its circulation, with suppurative transmural inflammation. If the obstruction persists, the congestion causes ischemia with gangrene and finally the appendix perforation. [1]

This disease represents a serious public health problem that puts patients at risk that would cause a fatal outcome if not treated promptly.

The literature reports that up to 20% of appendectomies are performed when their condition already presents significant complications. There are several studies that indicate that the determining factor for presenting complicated appendicitis are factors attributable to the patient, such as self-medication, waiting time before receiving medical care, residing in rural areas with difficult access to health services, and low socioeconomic conditions. In addition, misdiagnosis is described as a factor attributable to medical personnel, either due to ignorance of the variety of clinical presentations, or due to a short time of evolution. It is also known that non-specific clinical manifestations are related to the anatomical position of the vermiform appendix and the age of the child; those under five years of age have a higher rate of appendiceal perforation. [3]

Therefore, the objective of the present study was to establish the prevalence and associated factors of complicated appendicitis in patients admitted with a diagnosis of acute appendicitis at the Jose Carrasco Arteaga and Vicente Corral Moscoso Hospitals, during the period May 2018 - April 2019; with the hypothesis that the prevalence is greater than 30% and presents a positive association with the variables, self-medication; initial misdiagnosis; time elapsed from symptom onset to hospital arrival, the time elapsed from hospital arrival to surgical resolution; and negative association with urban residence, medium and high socioeconomic status; the person in charge of the child's care (parents), and previous medical evaluation.

2. Population and Methods

2.1. Type of Study

A prospective cohort study was carried out since its purpose is to determine the relationship or possible non-causal association that occurs between two or more variables and establishes the possible causes of the phenomenon to be studied.

2.2. Study Area

The study was carried out at the Jose Carrasco Arteaga (IESS) and Vicente Corral Moscoso (MSP) Hospitals, a pediatric surgery service. These are reference medical centers at the level of the province of Azuay and the south of the country, in the period of time May 2018 April 2019.

Dependent variable: complicated appendicitis.

Independent variables: self-medication; initial misdiagnosis; previous medical assessment, time elapsed between the onset of symptoms and arrival at the hospital; time elapsed between arrival at the hospital until surgical resolution, socioeconomic status.

Moderating variables: age, sex, place of residence, person in charge of child care (parents).

2.3. Universe and Sample

The universe corresponds to the total number of children hospitalized due to a diagnosis of acute appendicitis in the pediatric surgery service between the period May 2018 - April 2019. The entire population was studied, a total of 267 cases. The determination of the sample size was carried out based on the calculation to estimate a proportion, the criteria set were: estimated population: 267. The level of confidence: for a security of 95%=1.96. Accuracy: 3%. Estimated sample size in the Epidat 3.1 program= 50 patients.

2.4. Inclusion Criteria

1) All patients admitted to the pediatric surgery service of the Jose Carrasco Arteaga and Vicente Corral Moscoso Hospitals, with a diagnosis of acute appendicitis during the study period.
2) Patients whose parents have signed the informed consent accepting to participate in the study. These patients provided information to obtain socioeconomic status through the INEC form.

2.5. Exclusion Criteria

1) Patients with additional comorbidities such as: abdominal surgical history, self-medication in the last 7 days due to conditions other than abdominal, patients with neoplastic pathologies.
2) Patients with incomplete records.

2.6. Information Collection Procedures

1. To obtain informed consent from the patient's tutor or representative, in order to provide information to obtain socioeconomic status through the INEC form.
2. The information was collected in a form designed exclusively for the study, the information on the socioeconomic condition was provided by the tutor, while the information related to the associated factors was taken from the clinical history. Subsequently, it was entered into a database with individual identification.

During the study period, all pediatric patients admitted with a diagnosis of acute appendicitis were identified. A review of the clinical records was carried out, the identification of the cases, complicated and uncomplicated, and the data of the different variables under study. For the investigation of the information regarding the socio-economic condition, the interview was used with the application of the socioeconomic level stratification questionnaire of the National Institute of Statistics and Censuses (INEC).

2.7. Research Technique

Survey, documentary review, interview with patient

caregivers, interview with patients, consultation of clinical history.

2.8. Analysis Technique

All these data were organized with the statistical program SPSS, version 15, for analysis and tabulation.

The prevalence of complicated appendicitis was obtained from the extraction of the proportion represented by gangrenous and perforated appendicitis, in relation to the total number of cases of appendicitis. The value obtained was amplified by one hundred.

The qualitative variables sex, residence, socioeconomic status, caregiver in charge, previous medical assessment, self-medication, initial misdiagnosis, anatomical location of the vermiform appendix, phase of acute appendicitis, are presented in absolute and relative frequencies. In the quantitative variables age, time elapsed from the onset of symptoms to arrival at the hospital, time elapsed from arrival at the hospital to surgical resolution, the range was obtained and treated with measures of central tendency and dispersion. To determine the association between variables, cross tables were used, placing the appendiceal complication in the columns and each of the analyzed factors in the rows.

To determine the association between variables, the Chi2 square test was performed, considering a value of $P < 0.05$ as statistically significant. The intensity of the statistical association was obtained through the prevalence ratio with a 95% confidence interval; they were considered conclusive or positive when the prevalence ratios were greater than the value of 1 and negative with values less than 1.

3. Results

General characteristics of the patients in the sample: 267 patients admitted with a diagnosis of acute appendicitis were investigated; determining a prevalence of 38.2% cases of complicated appendicitis. Of the total population studied, the highest percentage corresponds to the male sex, corresponding in the same way to the population with the highest percentage of complications (53.92%). The most representative age group corresponds to ages between 10 and 15 years, and there is a greater frequency of inhabitants of the urban area. In addition, it was observed that the typical average socioeconomic status, and that the person in charge of the child's care were their parents in most of the patients studied.

In the study it can be observed that the most common appendicular phase found during the surgical act corresponds to the phlegmonous phase (42.6%), and the most frequent location corresponds to the retrocecal. Of the total of complicated appendicitis (102 cases), those that were in retrocecal location, represent 85.29%.

Table 1. *Características Socio demográficas.*

Variables		**No.**	**%**
Sexo	Hombres	141	54.8%
	Mujeres	126	47.2
Edad (años)[1]	2 a 4	12	4.5
	5 a 9	85	31.8
	10 a 15	170	63.7
Condición socioeconómica	Alta	1	0.4
	Media alta	21	7.9
	Media típica	149	55.8
	Media baja	93	34.8
	Baja	3	1.1
Residencia	Urbana	138	51.7
	Rural	129	48.3
Cuidador	Padres	259	93.6
	Hermanos	6	2.2
	Otro familiar	10	3.7
	Otros	1	0.4

1 Mediana: 11 años

Table 2. *Distribución según fase apendicular y localización del apéndice vermiforme.*

		Total	**Complicada**	**%**
Fase apendicular	Inflamatoria	51	0	0
	Flegmonosa	114	0	0
	Gangrenada	30	30	11.23
	Perforada	72	72	26.96
Ubicación	Pélvica	11	4	3.92
	Subcecal	24	10	9.81
	Retrocecal	229	87	85.29
	Retrocólica	2	1	0.98
	Pre ileal	1	0	0

After analyzing the association between possible associated factors and complicated appendicitis, it can be seen that complicated appendicitis was positively associated with having an initial erroneous diagnosis and presenting a time elapsed

from the onset of symptoms until arrival. to the hospital greater than 12 hours, presenting 1.57 and 2.19 times greater risk of presenting complicated conditions, respectively. On the other hand, it was evidenced as a protective factor having had a medical evaluation prior to arrival at the hospital, and having medium and high socioeconomic status.

The self-medication variable did not show a statistically significant association; however, it should be noted that the most used medications were analgesics: antispasmodics (31.68%) and NSAIDs (26.73%).

4. Discussion

In the present investigation, the prevalence of complicated appendicitis was high, and it is statistically significantly associated with the variables of misdiagnosis and having a time elapsed from the onset of symptoms to arrival at the hospital greater than 12 hours. While having a previous medical evaluation and medium and high socioeconomic status behaved as protectors.

Table 3. *Distribución de los Factores Asociados a Apendicitis Complicada.*

Variables		Apendicitis Complicada				P	RP	IC 95%	
		Presente		Ausente					
		F	%	F	%				
Automedicación	Si	44	44.40	55	55.60	0.11	129	0.95	1.74
	No	58	34.50	110	65.60				
Diagnóstico Inicial erróneo	Si	31	53.45	27	33.97	0.01	1.57	1.16	2.14
	No	71	33.97	138	66.03				
Valoración médica previa	Si	64	44.76	79	55.24	0.01	1.48	1.07	2.04
	No	38	30.65	86	69.35				
Tiempo inicio de los síntomas y llegada al hospital > 12 horas 1	Si	88	44.44	110	55.56	0.001	2.19	1.34	3.59
	No	14	20.29	55	79.71				
Tiempo llegada al hospital hasta intervención quirúrgica > 12 horas 2	Si	22	41.50	31	58.50	0.58	1.11	0.77	1.60
	No	80	37.40	134	62.60				
Residencia urbana	Si	46	33.33	92	66.67	0.09	0.77	0.56	1.04
	No	56	43.41	73	56.59				
Condición socio económica media alta	Si	57	33.33	114	66.67	0.03	0.71	0.53	0.96
	No	45	46.88	51	53.13				
Padres cuidadores	Si	98	39.20	152	60.80	0.20	1.67	0.70	3.98
	No	4	23.53	13	76.47				

F: Frecuencia. RP: Razón de Prevalencia. IC: Intervalo de Confianza. 1: media 48 horas. 2: media 8 horas

The prevalence of complicated appendicitis obtained in a sample of 267 children in the present study was 38.2% in relation to what was observed in the work of Macías-Magadán et al [4]. in Mexico, who identified 33% of complicated conditions. In the same way as in the research carried out in Peru by Jimmy et al. (41%), and Cardenas in the city of Cuenca (34.90%). [5]

The prevalence of acute appendicitis varies according to the geographical location and characteristics of each population, however, in the studies carried out in this city, similar results to those found in the present investigation are evident. As acute appendicitis is a frequent reason for care, it is important to know the expected number of complicated cases to alert medical personnel to abdominal pain, thus avoiding possible complications.

It was reduced that there is a higher frequency of acute appendicitis in males, with 52.8%. Related data is evidenced in the investigation of Soldevila - Paredes, in Peru (61%) [6]; Bustos et al in Colombia (56.50%) [7]. While, in Ecuador, Tipan et al [2], like Cordova et al [10], in the city of Cuenca, found similar data to the present investigation with 56.5% and 54.1% respectively.

Regarding age, the highest frequency of cases of appendicitis was identified in the age group located between 10 to 15 years (63.76%); Parque in his study conducted in Peru [9], found that the highest percentage was in the age group between 11 and 16 years.

Tipan et al. [2], in their research in this city, found that the most frequent age group was between 13 and 15 years of age, while Cordova et al [8] determined that the highest frequency of cases of appendicitis is in the age group located between 6 and 11 years (54.1%).

In the present study it was shown that having an erroneous initial diagnosis increases the risk of developing complicated appendicitis by 1.57 times, similar data was found by Cárdenas [5] in his study in Cuenca. Several studies such as Sanabria et al. [10] in Colombia, García et al. [11] in Azogues, Valderrama [12] in Peru, Macias Magadan in Mexico, investigated this relationship without finding a statistically significant association. Therefore, subsequent studies with a similar methodology should be carried out to ratify this association.

The fact that a time elapses from the onset of symptoms to arrival at the hospital greater than 12 hours increases the risk of presenting complicated appendicitis by 2.19 times. The study carried out by Cruz Días, et al. [13]; and Rodríguez Campos [14] in Peru, found similar data; Like Cárdenas [4] in Ecuador, it could be explained that, when symptoms persist, people seek other professional criteria with the consequent extension of the diagnosis time and the increased risk of complications.

If we consider that complicated appendicitis is a problem that must be resolved by surgical intervention, the opportunity to access surgical treatment will largely depend

on the population's behavior towards the problem; that is, having a better socioeconomic level would allow a greater perception of risk. Therefore, timely care seeking is a protective factor; data that are corroborated in the present investigation proving to be a protective factor. This is consistent with the study carried out in Mexico by Cortés [7], which indicates that belonging to the average socioeconomic status is a protective factor; however, it has certain limitations as it corresponds to a population with different characteristics and different stratification of the variable. There are no other investigations in this regard, and more studies are needed to corroborate this information.

Previous medical assessment also behaved as a protective factor in our investigation; the Cárdenas [5] study, in the city of Cuenca, also investigated this variable, without finding a statistical association. However, although there are no other studies in the pediatric population that determine this condition, our results may be an approximation to future research in this regard.

5. Conclusions

The prevalence of complicated appendicitis was elevated. The initial misdiagnosis, the time from the onset of symptoms to arrival at the hospital greater than 12 hours were shown to be the factors associated with complications of acute appendicitis, what could correspond to the nonspecific clinical presentation in children, as well as difficulties in communicating with them, inadequate physical examination, irritability, and overlap of symptoms with other common childhood illnesses, contribute to the late diagnosis of acute appendicitis and high rate of misdiagnosis. Previous medical assessment and upper middle socioeconomic status were associated protective factors.

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