

MAIN FINDINGS IN LABORATORY TESTS DIAGNOSIS OF ACUTE APPENDICITIS: A PROSPECTIVE EVALUATION

Achados principais de exames laboratoriais no diagnóstico de apendicite aguda: uma avaliação prospectiva

Rafael Nunes **GOULART**, Gilson de Souza **SILVÉRIO**, Marcelo Borges **MOREIRA**, Orli **FRANZON**

From Hospital Regional de São José - Dr. Homero de Miranda Gomes, São José, SC, Brazil.

ABSTRACT - Background - Acute appendicitis is the most common surgical abdominal disease in the emergency room. Although the diagnosis is clinical the complementary tests may be useful in doubt. **Aim** - To evaluate the main laboratory tests in patients with acute appendicitis, as well as its relationship with the evolutionary stage of the disease. **Methods** - Prospective evaluation of patients with acute appendicitis who underwent surgical treatment. **Results** - A total of 179 patients participated in this study, most were male. The mean age was 26 years. For leukocyte count 46.9% had values <15.000/mm³. The mean percentage of polymorphonuclear cells was 81,7%, 1,2% of sticks, 1% eosinophils, lymphocytes 12,8% and 2,9% monocytes. C-reactive protein was required for 54 patients. It was <10 mg/dl in 19, between 10 and 50 mg/dl in 24 and greater than or equal to 50 mg/dl in 11. Regarding the evolutionary phase 64% patients had early stage (stages 1 and 2), 16,2% stage 3 and 35 stage 4. A total of 57% of patients with white blood cell count greater than or equal to 20.000/mm³ had appendicular perforation (p<0,05). The percentage of polymorphonuclear leukocytes from patients with early stages was lower than the later stages (79,8% and 85,1%, respectively), with p<0,05. Patients with advanced stages of acute appendicitis, the number of lymphocytes was lower than the initial stages (9,3% and 14,8%, respectively), with p<0,05. 94% of patients with C-reactive protein values <10 mg/dl showed early stages of appendicular inflammation (p<0,05). **Conclusion** - A significant association among total and differential leukocyte count, C-reactive protein values and evolutionary phase of appendiceal inflammation was found in this prospective analysis.

HEADINGS - Acute appendicitis. Laboratory tests.

Correspondence:

Rafael Nunes Goulart.
e-mail: goulart.m@gmail.com

Financial source: none
Conflicts of interest: none

Received for publication: 27/09/2011
Accepted for publication: 17/01/2012

DESCRITORES - Apendicite aguda. Exames laboratoriais.

RESUMO - Racional - Apendicite aguda é a doença abdominal cirúrgica mais comum nas unidades de emergência. Embora o diagnóstico seja clínico, a realização de exames complementares pode ser útil na dúvida diagnóstica. **Objetivo** - Avaliar as principais alterações de exames laboratoriais em pacientes com apendicite aguda, assim como sua relação com a fase evolutiva da doença. **Métodos** - Avaliação prospectiva de pacientes com diagnóstico de apendicite aguda submetidos ao tratamento cirúrgico. **Resultados** - Cento e setenta e nove pacientes participaram deste estudo, a maioria do sexo masculino. A idade média foi de 26 anos. Em relação à contagem de leucócitos, 46,9% apresentavam valores <15.000 mm³. A porcentagem média dos polimorfonucleares foi de 81,7%, de bastões 1,2%, de eosinófilos 1%, de linfócitos 12,8% e de monócitos 2,9%. A proteína C reativa foi solicitada para 54 pacientes. Ela foi <10 mg/dl em 19, entre 10 e 50 mg/dl em 24 e maior ou igual a 50 mg/dl em 11. Com relação à fase evolutiva 64% pacientes apresentaram estágio inicial (fases 1 e 2), 16,2% fase 3 e 35 fase 4. 57% dos pacientes com contagem de leucócitos totais maior ou igual a 20.000/mm³ apresentaram perfuração apendicular (p<0,05). A porcentagem de leucócitos polimorfonucleares de pacientes com fases iniciais foi menor em relação às avançadas (79,8% e 85,1%, respectivamente), com valor de p<0,05. Pacientes com fases avançadas de apendicite aguda a quantidade de linfócitos foi menor em relação às iniciais (9,3% e 14,8%, respectivamente), com valor de p<0,05. Noventa e quatro por cento dos pacientes com valores de proteína C reativa <10 mg/dl apresentaram fases iniciais de inflamação apendicular (p<0,05). **Conclusão** - Houve associações significativas entre contagem total e diferencial de leucócitos, valores de proteína C reativa e fase evolutiva de inflamação apendicular.

INTRODUCTION

RESULTS

Acute appendicitis is the most common surgical disease presented in patients at emergency unities^{4,6,11,12,13,15}. Defined as the presence of transmural infection of the cecal appendix, it is an infection that can be presented in initial stage as edematous or suppurative appendicitis or late with gangrene or perforation^{5,18}.

Although acute appendicitis diagnosis is clinical, in some situations (diagnosis doubt) complementary tests might be useful. Only half of the patients present the classical clinical diagnosis of appendix infection^{3,6,14}.

The retardation or misdiagnosis of this illness is harmful to the patient, which can present serious complications inherent to the evolution process of the appendix infection, which contributes to the increase of the morbimortality^{6,13,15,17,19}.

The objective of this study was to evaluate the main alterations of laboratory tests in patients with acute appendicitis, as well as its relation to the disease's evolution, in order to provide a possible early diagnosis of this illness.

METHODS

The present study was approved by the Ethics and Research Committee of the hospital where it was carried out.

In a prospective and observational way all the patients with clinical suspicion of acute appendicitis admitted in the emergency of the Hospital Regional de São José – Dr Homero de Miranda Gomes, in the period of May 2010 to July 2011 were included in a protocol. From all the patients only the ones with the intra-operative diagnosis of acute appendicitis participated on this study, which in a consented way had their informations analyzed in this research.

The exclusion criteria were: patients aged 14 or less, clinical suspicion of acute appendicitis who didn't undergo surgical treatment, absence of diagnosis at the operation and patients who refused to participate on the study.

The following variables were analyzed: gender; age; total and differential count of leukocytes (polimorfonuclear, eosinophilic, band, lymphocytes, monocytes); C reactive protein (CRP) and intra-operative evolution stage (1: edematous, 2: suppurative, 3: gangrenous, 4: perforative).

The results were evaluated through the Pearson's chi square for categorical variables and Student t test for continuous variables. The statistic analysis was carried out by using applicative Microsoft Excel and Epiinfo 6.04. The differences when value $p \leq 0,05$ were considered significant (Kirwood, 1988).

A total of 179 patients participated on this study. The average age was 26 years old (15 to 82). Most of the patients were male (60,9%).

All the patients in the study were asked for a leukogram when they were admitted. In relation to the leukocytes count 84 (46,9%) patients presented values $< 15.000 \text{ mm}^3$, 81(45,3%) levels between 15.000 and 20.000/ mm^3 and 14 (7,8%) $\geq 20.000/\text{mm}^3$. The average percentage of the polymorphonuclear was 81,7% (40-90%), rod cells 1,2% (0-18%), eosinophils 1% (0-3%), lymphocytes 12,8% (4-52%) and monocytes 2,9% (1-6%).

Although it was part of the research protocol, CRP was requested to only 54 (30,1%) patients. This data was $< 10 \text{ mg/dl}$ in 19 (10,6%) participants, between 10 and 50 mg/dl in 24 (13%) and higher or equal to 50 mg/dl in 11 (6,1%).

In relation to the evolution stage of the appendix infection, 115 (64%) presented initial stage of appendicitis (stage 1 and 2), 29 (16,2%) stage 3, and 35 (19,6%) stage 4.

Comparing the variables analyzed to the evolution stage of acute appendicitis, gender, age, quantity of band, eosinophilic and monocytes reaction presented no statistic difference. In 57% of the patients with a leukocyte total count higher or equal to 20.000/ mm^3 there was appendix perforation ($p < 0,05$).

The average value of patients polymorphonuclear leukocytes who presented initial stages of appendix infection was 79,8% (IC: 78-81) and the ones with advanced stage (corresponding to the 3 and 4 stages) was 85,1% (IC: 83-86%), which presented statistic relevance ($p < 0,05$).

In the case of patients with advanced stages of acute appendicitis the quantity of lymphocytes was significantly lower related to the initial ones (9,3%; IC: 8,2-10,4 and 14,8%; IC: 13,2-16,4, respectively), with value of $p < 0,05$.

When excluded the patients who didn't have CRP requested in admission, 94% of the patients with values of CRP $< 10 \text{ mg/dl}$ presented initial stages of appendix infection ($p < 0,05$).

DISCUSSION

Acute appendicitis is a common diagnosis in the emergency unities^{4,6,13,15}. Most of the cases occur in younger populations. According to Yui-Rwei Y 90% of the cases of appendix infection occur in patients under 60 years old¹⁹. In those data, 108 (60,3%) were young adults (< 30 years old) and only 5 (2,7%) were elder.

Appendix infection is slightly more common in men (1,4:1,0)⁶, although some authors described the prevalence in women³. The present study had prevalence of the male gender (1,6:1,0).

As a helpful tool on acute appendicitis diagnosis, the leukogram is usually part of diagnosis. In general, patients with it present moderate total count of leukocytes ($15.000/\text{mm}^3$), with prevalence of neutrophils. Leukocytosis superior to $20.000/\text{mm}^3$ can indicate complications^{3,6,8,15,16}. Just as shown in literature, in this analysis 57% of the patients with total count of leukocytes equal or higher than $20.000/\text{mm}^3$ presented appendix perforation, with value of $p < 0,05$.

With the objective of an earliest and most accurate diagnosis of acute appendicitis, mainly in most advanced stages, some authors have described the relation of the percentage of polymorphonuclear leucocytes with necrosis and appendix perforation^{1,2,9}. According to these authors a value of segments above 85% would be related to the advanced stages of appendix infection. In the present study, patients on stages 3 and 4 presented and average percentage of polymorphonuclear leucocytes of 85,1% ($p < 0,05$), just like published by Anderson¹.

Neutrophilia with deviation to the left is frequently associated to lymphopenia and can be presented along with monocytosis, characteristic of acute infection^{3,8}. According to Markar et al.¹⁰ the presence of lymphopenia associated to clinic history can have an accuracy superior to the count of leukocytes or CRP in diagnosis of acute appendicitis. Although no relevant data was found in literature comparing lymphopenia and evolution stage of appendix infection, these results show lower quantities of lymphocytes in the advanced stages related to the initial ones (9,3% e 14,8%, respectively), with value of $p < 0,05$.

Present in situations of systemic infection, bastonetosis in the leukogram compared to the evolution stage of acute appendicitis wasn't relevant statistically, neither was the quantity of eosinophils and monocytes. Data related to these variables were not identified in literature.

CRP levels are also related to the evolution stage of appendicitis, according to literature. Values above 50 mg/dl are related to appendix necrosis and perforation^{1,7,16}. In those cases, CRP data were not requested as a routine to patients with suspicion of acute appendicitis, possibly because the study wasn't know by the different doctors in their shifts. When excluded the patients who didn't have their CRP requested in admission, 94% of the ones with values of CRP < 10 mg/dl presented initial stages of appendix infection, and most of the patients with values above 50 mg/dl presented necrosis and/or perforation of the appendix (55%), both with values above $p < 0,05$.

CONCLUSION

There are significant associations between the total and the differential count of leukocytes, CRP values and evolution stage of appendix infection.

REFERENCES

1. Anderson M, Anderson RE. The appendicitis inflammatory response score: a tool for the diagnosis of acute appendicitis that outperforms the Alvarado Score. *World J Surg* 2008.
2. Anderson RE, Hugander AP, Ghazi SH. Diagnostic value of disease history, clinical presentation, and inflammatory parameters of appendicitis. *World J Surg* 1999; 23:133-140.
3. Anderson REB. Meta-analysis of the clinical and laboratory diagnosis of appendicitis. *Br J Surg* 2004; 91:28-37.
4. Franzon O, Piccoli MC, Neves TT, Volpato MG. Apendicite aguda: análise institucional no manejo peri-operatório. *ABCD, arq. bras. cir. dig.* [online]. 2009, vol.22, n.2, pp. 72-75.
5. Goffi FS, Tolosa EMC. Técnica cirúrgica: bases anatômicas, fisiopatológicas e técnicas da cirurgia. 4. ed. São Paulo: Atheneu, 2007, p. 612.
6. Humes DJ, Simpson J. Acute appendicitis – clinical Review. *BMJ* 2006; 333:530-534.
7. Jangjoo A, Varasteh AR, Bahar MM, Meibodi NT, Aliakbarian M, Hoseininejad M, Esmaili H, Amouzehi A. Is C-reactive protein helpful for early diagnosis of acute appendicitis? *Acta Chir Belg.* 2011 Jul-Aug;111(4):219-22.
8. Kamran H, Naveed D, Nazir A, Hameed M, Ahmed M, Khan U. Role of total leukocyte count in diagnosis of acute appendicitis. *J Ayub Med Coll Abbottabad* 2008; Jul-Sep;20(3):70-1.
9. Keskek M, Tez M, Yoldas O, Acar A, Akgul O, Gocmen E, Koc M. Receiver operating characteristic analysis of leukocyte counts in operations for suspected appendicitis. *Am J Emerg Med* 2008 Sep;26(7):769-72.
10. Markar SR, Karthikesalingam A, Falzon A, Kan Y. The diagnostic value of neutrophil: lymphocyte ratio in adults with suspected acute appendicitis. *Acta Chir Belg* 2010 Sep-Oct;110(5):543-7.
11. Marudanayagam R, Williams GT, Rees BI. Review of the pathological results of 2660 appendicectomy specimens. *J Gastroenterol* 2006; 41:745-749.
12. Mazeh H, Epelboym I, Reinherz J, Greenstein AJ, Divino CM. Tip appendicitis: clinical implications and management. *Am J Surg.* 2009, Feb;197(2):211-5.
13. Memisoglu K, Karip B, Mestan M, Onur E. The value of preoperative diagnostic tests in acute appendicitis, retrospective analysis of 196 patients. *World J Emerg Surg.* 2010, Feb 11;5:5.
14. Panebianco NL, Jahnes K, Mills AM. Imaging and laboratory testing in acute abdominal pain. *Emerg Med Clin North Am* 2011, May;29(2):175-93.
15. Paulson EK, Kalady MF, Pappas TN. Suspected appendicitis. *N Engl J Med* 2003; 348(3):236-242.
16. Sengupta A, Bax G, Paterson-Brown S. White cell count and C-reactive protein measurement in patients with possible appendicitis. *Ann R Coll Surg Engl* 2009; Mar;91(2):113-5.
17. Torres, OJM, Lins AAL, Nunes PMS, Corrêa FCF, Carvalho-Júnior OS, Casto FC. Avaliação ultra-sonográfica da apendicite aguda. *Rev Col Bras Cir.* 2001; 28(1):39-43.
18. Townsend CM, Beuchamp RD, Evers BM. *Sabiston Tratado de Cirurgia.* 18ª edição, Elsevier 2010, pag 1252-1263.
19. Young YR, Chiu TF, Chen JC, Tung MS, Chang MW, Chen JH, Sheu BF. Acute appendicitis in the octogenarians and beyond: a comparison with younger geriatric patients. *Am Med Sci* 2007; 334 (4): 255-259.