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# Evaluation of the applicability of the Tokyo criteria for patients with an indication for cholecystectomy

*Avaliação da aplicabilidade dos critérios de Tóquio para pacientes com indicação de colecistectomia*

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**ABSTRACT**

**Introduction:** Acute cholecystitis is characterized by acute inflammation of the gallbladder, usually resulting from biliary obstruction. The main symptoms include right upper quadrant abdominal pain, nausea, vomiting, and fever. Diagnosis is often based on the Tokyo Criteria, which consider clinical, laboratory, and imaging indicators.

**Objective:** To evaluate the sensitivity, specificity, and accuracy of the 2018 Tokyo Criteria for the diagnosis of acute cholecystitis.

**Method:** Retrospective analysis of 825 medical records of patients undergoing cholecystectomy. Signs and symptoms at admission, laboratory and imaging tests, and the pathological results of the surgical specimen were analyzed.

**Result:** The most common symptom was right upper quadrant pain. Leukocytosis was observed in 35.70% of cases, and elevated C-reactive protein in 69.70%. Ultrasonography was the most frequently requested imaging test, with cholelithiasis as the most frequent finding. Pathological analysis revealed 19.90% acute cases and 80.10% chronic cases. The 2018 Tokyo Criteria demonstrated a sensitivity of 77.40%, a specificity of 58.40%, and an accuracy of 66.10% for the diagnosis of acute cholecystitis.

**Conclusion:** The 2018 Tokyo Criteria demonstrated usefulness in the diagnosis of acute cholecystitis, with satisfactory sensitivity. However, the specificity indicates some inaccuracy in excluding cases other than acute cholecystitis. Overall accuracy is acceptable for classifying the presence or absence of the condition.

**KEYWORDS:** Acute cholecystitis. Cholelithiasis. Clinical practice guideline. Diagnosis. Sensitivity. Specificity.

**Central Message**

*Acute cholecystitis is an inflammatory condition of the gallbladder and is a leading cause of acute abdomen and hospitalization. The distinction between chronic and acute conditions is fundamental, especially to guide appropriate clinical conduct. In this context, the Tokyo 2018 Criteria emerge as an auxiliary tool in the suspicion and diagnosis of acute cholecystitis, through the evaluation of 3 categories of signs: A (local inflammation), B (systemic signs of inflammation) and C (imaging findings).*

**Perspective**

*The diagnosis of acute cholecystitis, as well as its differentiation from chronic cholecystitis, can pose challenges. In this sense, the analysis of the efficacy of diagnostic criteria is essential to evaluate their applicability and reliability in medical practice. The use of the 2018 Tokyo Criteria suggests that there is an acceptable capacity to correctly classify the presence or absence of the disease, configuring it as a useful tool in clinical practice.*

**RESUMO**

**Introdução:** Colecistite aguda caracteriza-se pela inflamação aguda da vesícula biliar, geralmente decorrente da obstrução das vias biliares. Os principais sintomas incluem dor abdominal no quadrante superior direito, náuseas, vômitos e febre. O diagnóstico é frequentemente baseado nos Critérios de Tóquio, que consideram indicadores clínicos, laboratoriais e de imagem.

**Objetivo:** Avaliar a sensibilidade, especificidade e acurácia dos Critérios de Tóquio de 2018 para o diagnóstico de colecistite aguda.

**Método:** Análise retrospectiva de 825 prontuários de pacientes submetidos à colecistectomia. Foram analisados sinais e sintomas na admissão, exames laboratoriais e de imagem, além do resultado anatomopatológico do espécime cirúrgico.

**Resultado:** O sintoma mais comum foi dor do quadrante superior direito. Leucocitose foi observada em 35,70% dos casos e elevação da proteína C reativa em 69,70%. Ultrassonografia foi o exame de imagem mais solicitado, com colelitíase como achado mais frequente. A análise anatomopatológica revelou 19,90% de casos agudos e 80,10% crônicos. Os Critérios de Tóquio de 2018 demonstraram sensibilidade de 77,40%, especificidade de 58,40% e acurácia de 66,10% para o diagnóstico de colecistite aguda.

**Conclusão:** Os Critérios de Tóquio de 2018 demonstraram utilidade no diagnóstico de colecistite aguda, com sensibilidade satisfatória. No entanto, a especificidade indica alguma imprecisão na exclusão de casos que não são de colecistite aguda. A acurácia global é aceitável para a classificação da presença ou ausência da condição.

**PALAVRAS-CHAVE:** Colecistite aguda. Colelitíase. Guia de prática clínica. Diagnóstico. Sensibilidade. Especificidade.

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## INTRODUCTION

Acute cholecystitis (AC) is a condition that involves sudden inflammation of the gallbladder. In 90-95% of cases it is related to cystic duct obstruction, mainly due to cholelithiasis. In the presence of gallstones, the clinical picture is called acute calculous cholecystitis.[1] Risk factors for gallstones include female sex, obesity, genetics, hormonal exposure (particularly to estrogen), and multiparity.[2-5] Inflammation can also occur in the absence of stones, characterizing acute alithiasic cholecystitis. This condition can also be classified as chronic (CC), resulting from recurrent episodes of AC.[6]

The clinical picture involves pain in the right upper quadrant, fever, nausea and vomiting. During physical examination, it is common to identify Murphy's sign.[1,7] In 25% of cases, after 24 hours of its onset, the gallbladder is palpable.[8] In the clinical context, it is important to distinguish pain resulting from cholelithiasis from that associated with AC, as well as to make the differential diagnosis with other causes of acute abdomen, such as acute appendicitis, perforated peptic ulcer, among others.[3,9] AC is one of the leading causes of acute abdomen and hospitalization worldwide; therefore, it is essential to conduct an evaluation that takes into account the signs of local inflammation and laboratory and radiological tests.[10,11]

The diagnosis is established by means of abdominal ultrasound, the gold standard for the detection of gallstones, which is preferred.[12,13] In clinical management, CT18 is a way to assist professionals in decision-making in relation to the disease. It considers 3 variables (A, B and C), with A being a picture with signs of local inflammation (Murphy's sign and/or pain/tenderness/mass in the right hypochondrium); B systemic signs of inflammation (fever and/or elevated CRP and/or leukocytosis); and C imaging findings compatible with CA. Suspicion is raised when there is at least 1 item in criterion A and 1 in B; the diagnosis is definitive when all criteria (A, B and C) are met.[14]

Gold-standard for the treatment of AC is videolaparoscopic cholecystectomy.[2,3] It stands out compared to laparotomy, due to reduced recovery time, postoperative pain, and infectious complications.[15] In the absence of adequate treatment, possible complications include gallbladder perforation, biliary peritonitis, pericholecystic abscess, and biliary fistula.[2,3]

The present study aimed to verify the sensitivity, specificity and diagnostic criteria of AC according to Tokyo Criteria (CT18), as well as to evaluate the clinical, laboratory and imaging differences between AC and CC.

## METHOD

The study was approved by the Research Ethics Committee of Faculdade Evangélica Mackenzie, Curitiba, PR, Brazil under number 6,082,824. The identities of the participants have been and will continue to be protected in accordance with the guidelines established in Resolution 466/12 of the National Health Council.

It consists of a retrospective cohort, with data collected from 825 electronic medical records. All patients who underwent cholecystectomy by the General Surgery Service of the Mackenzie Evangelical University Hospital, Curitiba, PR, Brazil, between January 2019 and January 2021, were included. Cases without an anatomopathological diagnosis of cholecystitis were excluded.

Information was collected on the presence of pain in the right upper quadrant, abdominal defense, nausea/vomiting, and Murphy's sign. Laboratory tests were also analyzed, which included leukocyte counts, CRP values, rodsis, AST levels, TGP, amylase, lipase and gammaGT. In addition, imaging tests and anatomopathological results were considered.

The sample was divided according to the anatomopathological result into AC and CC. All variables were analyzed in both groups, and the data collected were tabulated and evaluated according to the TC18. The criterion "fever", contemplated by the CT18, was excluded due to difficulty in obtaining it in the medical records analyzed.

### Statistical analysis

The data were analyzed with the IBM SPSS Statistics v.29.0 computer program. Quantitative variables were described as percentages. The Wald test was used to assess the significance of the variables, and the estimated measure of association was the Odds Ratio with 95% confidence intervals (95%CI). The quality of the diagnostic criteria in the prediction of the anatomopathological result (gold standard) was analyzed by estimating values of sensitivity, specificity, accuracy, and positive and negative predictive values. For the calculations of predictive values, the prevalence of CC estimated by the study sample was considered. In all statistical tests, p-values < 0.[05] indicated statistical significance.

## RESULT

Data were collected from 825 electronic medical records of patients undergoing cholecystectomies at the hospital. However, 20 were excluded due to lack of compliance with the CT18 inclusion criteria. Thus, the analysis was conducted with a total of 805 patients. The laparotomy approach was the most used approach, corresponding to 84.30% of the cases (n=674), while the laparoscopic approach was the most used approach, corresponding to 15.80% (n=126). In the study, 160 patients were diagnosed with AC (19.90%) and 645 with WC (80.10%), based on the anatomopathological result.

According to the CT18 data mentioned above, criterion A corresponds to signs of local inflammation; B to systemic signs mediated by inflammation; and C to imaging findings compatible with CA.

Regarding criterion A, 98.70% reported pain in the region of the upper right quadrant of the abdomen, positive Murphy's sign in 35.80%, and abdominal defense in only 2.60%. It is relevant to highlight that 100% of the patients evaluated had alterations in criterion A.

There was statistical significance ($p<0.001$) for Murphy's sign, as it was positive in 49.30% of those with AC, while in those with CC, the percentage was 29.60% (RE 2.31, 1.54 - 3.48, Table 1). When this criterion was evaluated in relation to the anatomopathological result, all patients with AC presented alterations, resulting in a sensitivity of 100%, specificity of 0%, and overall accuracy of 31.30%, which indicates an unsatisfactory overall performance of this criterion in the diagnosis of AC (Table 2).

When analyzing criterion B, it was observed that 62.80% had a leukocyte count in the normal range (3,600 to 11,000/mm3), 35.70% leukocytosis (leukocytes >11,000/mm3) and 1.50% leukopenia (leukocytes <3,600/mm3). Statistical analysis of the data referring to criterion B revealed that leukocytosis was 2.93 times more likely to occur in cases of AC compared to cases of CC. In 69.70% of the cases, the CRP was altered. The results indicated that the increase was more prevalent in CC (82.80%) than in AC (59.50%, p=0.001). The variable fever was excluded from the analysis. Criterion B was shown to be altered by 54.90%. A little more than 75% of those with AC presented alterations in criterion B, while in CC, only 43% (Table 1). When evaluating criterion B, the sensitivity obtained was 75.30%, the specificity was 57%, and the overall accuracy was 63.8% (Table 2).

Regarding criterion C, 99.20% of the cases presented alterations in the imaging exam. Abdominal ultrasonography was used in 80.80% (n=516), being the most common examination. Regarding the results of imaging exams, lithiasis was identified in 85.60%, followed by other findings (27.70%) and thickening (21.90%, Table 1). Criterion C had high sensitivity (99.30%), low specificity (0.80%) and overall accuracy of 23.90% (Table 2). The finding of gallbladder thickening on imaging was highly significant ($p<0.001$), with an OR of 8.69 (5.58 – 13.5, Table 1).

Considering the combination of criteria, as suggested by the TC18, the sum of the "A+B" criteria showed alteration in 56.40% of the cases, while "A+B+C", 56.10% (Table 1). When analyzed together in relation to the AP result, the "A+B" criteria were shown to be sensitive (76.40%), specificity of 56.90% and overall accuracy of 64.80% (Table 2). The results reveal a notable association, with an OR of 4.29 (2.66 - 6.91, $p<0.001$). In this context, 76.40% of the cases of AC met both criteria based on anatomopathological analysis, while in those with CC the percentage was 43.10% (Table 1). When analyzing the "A+B+C" criteria in relation to pathological results, the sensitivity obtained was 77.40%, specificity of 58.40% and overall accuracy of 66.10% (Table 2). The results highlight an even more significant association when the 3 criteria were associated (OR 4.82, 2.93 - 7.90, $p<0.001$). Thus, changes in the sum of the "A+B+C" criteria were observed in 77.40% of the patients diagnosed with AC, while with CC this percentage was 41.60% (Table 1).

Other laboratory findings were analyzed. The hepatic markers AST and AST were altered in 43.70% and 52.40%, respectively; gammaGT, 64.60%; pancreatic enzymes, 49.10% in lipase and 27.40% in amylase; roadsis altered by only 7.10%; GOT, TGP and lipase, identified by OR of 0.41 (0.25 - 0.69), 0.43 (0.26 - 0.70) and 0.45 (0.27 - 0.75) respectively. Therefore, it

**TABLE 1** — Tokyo Criteria (CT18) variables and sum of A+B and A+B+C in relation to anatomopathological results

| | | | Everyone | Chronic cholecystitis | Cholecystitis acute | | |
|---|---|---|---|---|---|---|---|
| Criterion | Variable | Classif. | n (%) | n vs. CC | n (% vs. CA) | p* | OR (95%CI) |
| A | QOD pain (n=453) | No | 6 (1.30%) | 4 (1.30%) | 2 (1.40%) | 0.916 | 0.91 (0.17 - 5.04) |
| | | Yes | 447 (98.70%) | 307 (98.70%) | 140 (98.60%) | | |
| | Murphy+ (n=453) | No | 291 (64.20%) | 219 (70.40%) | 72 (50.70%) | <0.001 | 2.31 (1.54 - 3.48) |
| | | Yes | 162 (35.80%) | 92 (29.60%) | 70 (49.30%) | | |
| | Abdominal defense (n=453) | No | 441 (97.80%) | 305 (98.10%) | 136 (95.80%) | 0.168 | 2.24 (0.71 - 7.08) |
| | | Yes | 12 (2.60%) | 6 (1.60%) | 6 (4.20%) | | |
| | Criterion A Changed (n=453) | No | 0 (0.00%) | 0 (0.00%) | 0 (0.00%) | - | - |
| | | Yes | 453 (100%) | 311 (100%) | 142 (100%) | | |
| B | Leukocytes (n=395) | <3600 | 6 (1.50%) | 183 (73.50%) | 71 (48.60%) | <0.001 | 2.93 (1.91 - 4.5) |
| | | 3600-11000 | 248 (62.80%) | 183 (73.50%) | 71 (48.60%) | | |
| | | >11000 | 141 (35.70%) | 66 (26.50%) | 75 (51.40%) | | |
| | CRP (n=198) | <1 | 60 (30.30%) | 45 (40.50%) | 15 (17.20%) | 0.001 | 3.27 (1.67 - 6.42) |
| | | >1 | 138 (69.70%) | 66 (59.50%) | 72 (82.80%) | | |
| | Criterion B Changed (n=395) | No | 178 (45.10%) | 107 (40.90%) | 36 (27.70%) | <0.001 | 4.06 (2.58 - 6.37) |
| | | Yes | 217 (54.90%) | 154 (59.10%) | 110 (75.30%) | | |
| C | Lithiasis (n=575) | No | 83 (14.40%) | 56 (12.90%) | 27 (19.30%) | 0.062 | 0.62 (0.37 - 1.02) |
| | | Yes | 492 (85.60%) | 377 (87.10%) | 113 (80.70%) | | |
| | Thickening (n=575) | No | 449 (78.10%) | 384 (88.30%) | 65 (46.40%) | <0.001 | 8.69 (5.58 - 13.5) |
| | | Yes | 126 (21.90%) | 51 (11.70%) | 75 (53.60%) | | |
| | Another finding (n=575) | No | 416 (72.30%) | 327 (75.20%) | 89 (63.60%) | 0.008 | 1.74 (1.15 - 2.61) |
| | | Yes | 159 (27.70%) | 108 (24.80%) | 51 (36.40%) | | |
| | Criterion C Changed (n=618) | No | 5 (0.80%) | 4 (0.80%) | 1 (0.70%) | 0.855 | 1.23 (0.14 - 11.08) |
| | | Yes | 618 (99.20%) | 469 (99.20%) | 144 (99.3%) | | |
| A+B | Changed (n=349) | No | 152 (43.60%) | 119 (59.40%) | 33 (32.60%) | <0.001 | 4.29 (2.93 - 7.90) |
| | | Yes | 197 (43.60%) | 82 (40.60%) | 107 (76.40%) | | |
| A+B+C | Changed (n=330) | No | 145 (43.90%) | 115 (58.40%) | 30 (22.60%) | <0.001 | 4.82 (2.93 - 7.90) |
| | | Yes | 185 (56.10%) | 82 (41.60%) | 103 (77.40%) | | |

QSD = right upper quadrant of the abdomen; *=univariate logistic regression model and Wald test, p<0.05

**TABLE 2** — Sensitivity, specificity, accuracy, and positive and negative predictive values of criteria A, B, and C and the sum of A+B and A+B+C

| Parameter | A | B | C | A+B | A+B+C |
|---|---|---|---|---|---|
| Sensitivity (95%CI) | 100% (-) | 75.30% (68.4% - 82.3%) | 99.30% (98% - 100%) | 76.40% (69.4% - 83.5%) | 77.40% (70.3% - 84.5%) |
| Specificity (95%CI) | 0.00% (-) | 57.00% (50.9% - 63.2%) | 0.80% (0.2% - 1.7%) | 56.90% (50.2% - 63.7%) | 58.40% (51.5% - 65.3%) |
| Accuracy (95%CI) | 31.30% (-) | 63.80% (59.1% - 68.5%) | 23.90% (20.6% - 27.3%) | 64.80% (59.7% - 69.8%) | 66.10% (61.0% - 71.2%) |
| VP+ (95%CI) | 19.90% (-) | 30.30% (26.9% - 34.1%) | 19.90% (19.7% - 20.2%) | 30.60% (26.9% - 34.6%) | 31.60% (27.7% - 35.8%) |
| VP- (95%CI) | - (-) | 90.30% (87.3% - 92.6%) | 83.20% (35.7% - 98.8%) | 90.70% (87.6% - 93.1%) | 91.20% (88.1% - 93.6%) |

**TABLE 3** — Laboratory variables and symptoms in relation to the result of the anatomopathological examination

| Variable | Classification | All n (%) | Chronic cholecystitis n (%) | Acute cholecystitis n (%) | p* | OR (95%CI) |
|---|---|---|---|---|---|---|
| Vomiting (n=607) | No | 348 (57.30%) | 288 (63.00%) | 60 (40.00%) | <0.001 | 2.56 (1.75 - 3.73) |
| | Yes | 259 (42.70%) | 169 (37.00%) | 90 (60.00%) | | |
| Nausea (n=607) | No | 330 (54.40%) | 279 (61.10%) | 51 (34.00%) | <0.001 | 3.04 (2.07 - 4.48) |
| | Yes | 277 (45.60%) | 178 (38.90%) | 99 (66.00%) | | |
| Rods (n=378) | Unchanged | 351 (92.90%) | 269 (96.60%) | 122 (85.50%) | 0.001 | 4.46 (1.90 - 10.5) |
| | Changed | 27 (7.10%) | 8 (3.40%) | 19 (13.50%) | | |
| AST (n=284) | Unchanged | 160 (56.30%) | 97 (48.50%) | 63 (69.50%) | 0.001 | 0.41 (0.25 - 0.69) |
| | Changed | 124 (43.70%) | 92 (51.40%) | 32 (30.50%) | | |
| TGP (n=188) | Unchanged | 137 (47.30%) | 70 (40.10%) | 67 (60.30%) | 0.001 | 0.43 (0.26 - 0.70) |
| | Changed | 151 (52.40%) | 109 (60.20%) | 42 (39.30%) | | |
| Amylase (n=277) | Unchanged | 201 (72.60%) | 124 (70.10%) | 77 (72.00%) | 0.221 | 0.70 (0.39 - 1.24) |
| | Changed | 76 (27.40%) | 54 (29.80%) | 22 (22.90%) | | |
| Lipase (n=281) | Unchanged | 143 (50.90%) | 64 (43.90%) | 79 (64.40%) | 0.002 | 0.45 (0.27 - 0.75) |
| | Changed | 138 (49.10%) | 82 (56.10%) | 37 (36.60%) | | |
| GamaGT (n=277) | Unchanged | 98 (35.40%) | 62 (34.40%) | 36 (37.10%) | 0.658 | 0.89 (0.53 - 1.49) |
| | Changed | 179 (64.60%) | 118 (65.60%) | 61 (62.90%) | | |

*Univariate logistic regression model and Wald test. p<0.05

is possible to deduce that CC has a more pronounced association with the alteration of these enzymes compared to AC. On the other hand, among those diagnosed with CC, 3.40% had high levels of rods, while in the AC group, this percentage increased significantly (p=0.001) to 13.50%. This difference resulted in an OR of 4.46 (1.90 - 10.5), indicating that AC is more strongly associated with abnormal rod levels compared to CC (Table 3).

Regarding the symptoms, vomiting (42.70%) was almost equal to nausea (45.60%); 280 individuals (46.10%) did not report any symptoms; in those with CC, 37% had vomiting and AC, 60%. A significant association was found between vomiting and the type of cholecystitis (p<0.001). The OR value was 2.56 (1.75 - 3.73), indicating that AC is more associated with the presence of vomiting than CC. In relation to nausea, a positive association was shown (p<0.001), resulting in an OR of 3.04 (2.07 - 4.48). Therefore, it can be inferred that symptoms of nausea and vomiting are more prevalent in patients diagnosed with AC when compared to cases of CC (Table 3).

## DISCUSSION

Although laparoscopic cholecystectomy is the gold standard for the definitive treatment of AC, the majority (84.30%) of the cholecystectomies performed were laparotomy. The discrepancy of this data in relation to the established gold standard - laparoscopic cholecystectomy - may be associated with limited access to technology in the Brazilian public health system, as well as the lack of emphasis on training in laparoscopy.

In its isolated form, Murphy's sign was positive in 49.30% of the patients with AC and 29.60% with CC, totaling 35.80% of the patients analyzed. The study demonstrated that although Murphy's sign has little relevance in the general context, it is more strongly associated with the condition of AC (OD of 2.31). Pain in the right upper quadrant occurred in 98.70% of the total, with no significant differences between the AC and CC groups (p=0.916). In general, criterion A alone was not significant for the diagnosis of AC.

It was observed that 35.70% of the patients had leukocytosis, with a probability 2.93 times greater of occurring in cases of AC than CC. Elevated CRP was found in more than 82% of AC cases. The results emphasize the importance and efficacy of criterion B variables in the Tokyo Classification. The absence of the fever variable, an element of criterion B, was due to the fact that the database had temperature records only when there was a report of fever or hyperthermia confirmed at admission. This resulted in the absence of information in most of the medical records.

In the present study, 99.30% of the patients had abnormal imaging studies. There was no statistically significant association between imaging findings and the differentiation between AC and CC (p=0.855). However, only the finding of gallbladder thickening, present in 21.90% of the cases, proved to be significant for the diagnosis of AC (OR 8.69). These results emphasize the relevance of gallbladder thickening as a differential marker between the 2 types of cholecystitis. It should be taken into account that imaging findings may vary according to the ultrasound device, operator, and criteria used. It is also important to emphasize that it is recommended as the diagnostic method of choice for morphological evaluation of AC (Recommendation 1, level C).[14]

In this study, the confirmatory diagnosis for AC (criteria A+B+C) in relation to cases confirmed by anatomopathological study revealed sensitivity of 77.40%, specificity of 58.40%, and overall accuracy of 66.10%. Thus, it is concluded that the combination of the 3 criteria offers reasonable performance in the detection of AC, presenting a higher probability of correct diagnosis when compared to the isolated criteria, or even with the combination of criteria A+B.

In addition, a statistically significant finding - despite the scarcity of evidence in the literature to support it - concerns the levels of AST and ALT. Laboratory abnormalities of these markers showed a greater association with CC. In the same sense, the previous presence of elevation in lipase levels is correlated with AC; therefore, patients without altered lipase have a lower relative risk of having AC (36.60%) compared to CC (56.10%). Although AC can result in elevated lipase and amylase levels, these 2 values are commonly associated with any pancreatic inflammation and are not specific to the diagnosis of AC.[1] In addition, it was found that only 13.50% of the cases of AC presented alterations in rods, although this variable was statistically significant ($p<0.001$). Rodsis was more prevalent in AC than CC (OR 4.46), as well as nausea and/or vomiting (OR 2.56).

## CONCLUSION

The results of this study indicate that the 2018 Tokyo Criteria demonstrated good sensitivity for the diagnosis of AC, although its specificity was relatively low. Even so, the global accuracy observed suggests that these criteria have an acceptable capacity to correctly classify the presence or absence of the disease, configuring themselves as a useful tool in clinical practice. Secondarily, other data not included in the CT18 can help in the diagnosis of AC, such as the presence of nausea or vomiting and the finding of gallbladder thickening on ultrasound.

**Authors' contributions**

*Guilherme Andrade Coelho – Conceptualization, Research*
*Bernardo Huçulak Melo – Methodology,*
*Maria Eduarda Barcik Lucas de Oliveira - Supervision*
*Bruna Corchak da Silva – Conceptualization, Writing (original draft)*

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