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Case Report

Sufficiency of Nonenhanced Computed Tomography for the Diagnosis of Acute Appendicitis: A Case Report

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Abstract

Acute appendicitis is a surgical emergency disease that exhibits its highest incidence in adolescents. While contrast-enhanced computed tomography (CT) is frequently utilized for rapid diagnosis of acute appendicitis, the ability of nonenhanced CT is not well established. Herein we report two cases of adolescents who were successfully diagnosed with acute appendicitis by nonenhanced CT. Ultrasonography was unable to detect the appendix in both cases. Regarding imaging strategy, nonenhanced CT can be sufficient for detection of acute appendicitis, and ultrasonography is not always required. Immediate examination by nonenhanced CT before ultrasonography can be sufficient for rapid diagnosis of acute appendicitis.

Introduction

Acute appendicitis is a common gastrointestinal disease that shows its highest incidence in the age group of 10 – 19 years.[1] Rapid diagnosis is essential, because acute appendicitis is an emergency disease that can progress to perforation. Contrast-enhanced computed tomography (CT) using contrast media is commonly utilized to reveal inflammation of the appendix, while the ability of nonenhanced CT is not well established. Herein we report two cases of adolescents who were successfully diagnosed with acute appendicitis using nonenhanced CT. Ultrasonography did not detect the appendix in both cases.

Case report 1

A 12-year-old girl presented with repeated vomiting more than 10 times followed by abdominal pain. She had right lower quadrant rebound tenderness on physical examination. Her vital signs, including blood pressure and pulse rate, showed no abnormalities. Blood tests revealed elevated white blood cell count of 22,300 / mm^3 (neutrophils 20,670 / mm^3), while other indicators including C-reactive protein (CRP) were normal. The paediatric appendicitis score indicated 5 points (vomiting 1, right lower quadrant tenderness 2, leukocytosis 1, neutrophilia 1), suggesting that imaging examinations were required. Ultrasonography was unable to detect the appendix. Subsequently, the patient underwent nonenhanced CT, rather than contrast-enhanced CT, because neither the patient nor her parent consented to use of contrast media based on concerns for the risk of adverse reactions. The nonenhanced CT examination revealed swelling of the appendix to 11 mm, normally less than 7 mm, in diameter and two high density areas in the appendix (Figure 1). The appendix was located in an intrapelvic position that the ultrasonic waves could not reach.

Figure 1: Nonenhanced CT image for Case 1. The sagittal image showed swelling of the appendix to 11 mm in diameter and two high density areas within the appendix (arrowheads).

The patient underwent a laparoscopic appendectomy on the same day. The appendix was confirmed to be swollen (Figure 2a). The surgically removed appendix was approximately 60 mm in length (Figure 2b) and contained two appendicoliths (Figure 2c). The patient recovered without any complications.

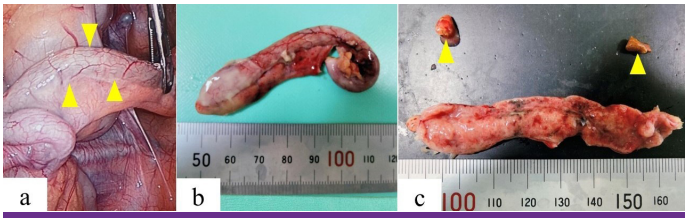

Figure 2: The appendix of Case 1. (a) The appendix appeared swollen under laparoscopy (arrowheads). (b) The appendix was surgically removed. (c) The appendix contained two appendicoliths (arrowheads).

Case report 2

A 13-year-old boy presented with abdominal pain followed by a slight fever. He had right lower quadrant rebound tenderness on physical examination. His vital signs showed no abnormalities. Blood tests revealed elevated white blood cell count of 15,200 / mm^3 (neutrophils 12,180 / mm^3), while other indicators including CRP were normal. The paediatric appendicitis score indicated 4 points (right lower quadrant tenderness 2, leukocytosis 1, neutrophilia 1), suggesting that imaging examinations were required. Ultrasonography was unable to show the appendix because the ultrasonic waves were obstructed by air. A subsequent nonenhanced CT examination revealed swelling of the appendix to 9 mm in diameter (Figure 3).

Figure 3: Nonenhanced CT image for Case 2. The axial image showed swelling of the appendix to 9 mm in diameter (arrowheads).

The patient received antibiotic therapy of 1,000 mg cefmetazole administered twice a day for five days. The patient recovered without any complications, and has not suffered any recurrence for > 18 months.

Discussion

The clinical courses of the present patients raise two important clinical issues. First, nonenhanced CT can be sufficient to diagnose acute appendicitis in adolescents. Second, ultrasonography is not always necessary for diagnosis of acute appendicitis.

Regarding the first issue, CT scans play a vital role in the accurate diagnosis of acute appendicitis.[2] In acute appendicitis, CT examination reveals swelling of the appendix. Contrast-enhanced CT is frequently employed for accurate confirmation of inflamed tissues.[3] However, adverse reactions to intravenous contrast media, such as urticaria, nausea, and dyspnea, are known to occur.[4] Immediate hypersensitivity reactions have been reported in 0.7% to 3% of patients. Severe reactions and fatal reactions have been reported in 0.02% to 0.04%, in 0.00001% to 0.0003%, respectively.[4] We recommend the performance of nonenhanced CT from a safety point of view.

For the second issue, an imaging examination should be rapidly employed in emergency cases. Ultrasonography and CT have become standard for the evaluation of patients with suspected acute appendicitis.[5] Ultrasonography is typically performed before CT, because less invasive examinations are conventionally employed before more invasive examinations. Ultrasonography can be helpful for ruling out acute appendicitis.[6] However, non-visualization of the appendix on ultrasonography can arise through air or stool interposition, fat constitution, and poor operator skills. Ashjaei et al reported that the appendix was not seen on ultrasonography in 13.9% of children who were suspicious to appendicitis.[6] Thus, a

negative ultrasonography examination does not necessarily exclude acute appendicitis. We recommend the performance of CT before ultrasonography for evaluation of adolescent patients with suspected acute appendicitis in emergency cases. If we had employed CT before ultrasonography in the present patients, we would have achieved the diagnosis more rapidly, given that ultrasonography was unable to detect any abnormalities in both cases.

While CT is a highly accurate diagnostic tool, the appropriate use of CT remains controversial.[2,3] Diagnostic radiation may be associated with a small risk of future cancer development.[7] However, there is no clear evidence proving that diagnostic radiation induces cancer.[8] Furthermore, the concept of radiation hormesis explains that low doses are beneficial, while high doses are harmful. Low levels of radiation not only have a low probability of causing DNA damage but also protect against DNA damage from endogenous sources, such as reactive oxygen species.[9] Use of CT is justified when the benefits for the patient surpass the disadvantages. While excessive use of CT should be avoided, irreparable situations can develop if conduction of a CT examination is delayed for too long when it is urgently required.

Conventional appendectomy remains the most common therapeutic strategy for acute appendicitis. However, accumulating evidence is currently indicating a change in clinical practice toward non-operative management.[10] One of the present patients underwent an appendectomy, while the other received antibiotic therapy. The patient who received antibiotic therapy has not suffered any recurrence of appendicitis.

Conclusion

In conclusion, nonenhanced CT can reveal acute appendicitis in adolescents, and ultrasonography is not always necessary. Further research should be undertaken to determine whether an imaging strategy of immediate nonenhanced CT before ultrasonography is sufficient for rapid diagnosis of acute appendicitis.

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Conflicts of interest: none

References

1. Wang X, Liu Y, Yan M, Gao M. Quality of guidelines for appendicitis in children: a systematic review. Asian J Surg. 2022;45:2514-6.
DOI: 10.1016/j.asjsur.2022.05.131
PMID: 35691799

2. Noori IF, Jabbar AS, Noori AF. Clinical scores (Alvarado and AIR scores) versus imaging (ultrasound and CT scan) in the diagnosis of equivocal cases of acute appendicitis: a randomized controlled study. Ann Med Surg. 2023;85:676-83.
DOI: 0.1097/MS9.0000000000000270
PMID: 37113930 PMCID: PMC10129239

3. Dowhanik A, Tonkopi E, Crocker CE, Costa AF. Diagnostic performance and radiation dose of reduced vs. standard scan range abdominopelvic CT for evaluation of appendicitis. Eur Radiol. 2021;31:7817-26.
DOI: 10.1007/s00330-021-07945-3
PMID: 33856521

4. Costantino MT, Romanini L, Gaeta F, Stacul F, Valluzzi RL, Passamonti M, et al. SIRM-SIAAIC consensus, an Italian document on management of patients at risk of hypersensitivity reactions to contrast media. Clin Mol Allergy. 2020;18:13.
DOI: 10.1186/s12948-020-00128-3
PMID: 32765190 PMCID: PMC7395340

5. Atema JJ, Gans SL, van Randen A, Lameris W, van Es HW, van Heesewijk JPM, et al. Comparison of imaging strategies with conditional versus immediate contrast-enhanced computed tomography in patients with clinical suspicion of acute appendicitis. Eur Radiol. 2015;25:2445-52.
DOI: 10.1007/s00330-015-3648-9
PMID: 25903701 PMCID: PMC4495262

6. Ashjaei B, Mehdizadeh M, Alizadeh H, Najm N, Moghtaderi M. Evaluating the value of different sonographic findings in diagnosis of acute appendicitis in children. Afr J Paediatr Surg. 2022;19:13-7.
DOI: 10.4103/ajps.AJPS_124_20
PMID: 34916345 PMCID: PMC8759413

7. Park JH, Salminen P, Tannaphai P, Lee KH. Low-dose abdominal CT for evaluating suspected appendicitis in adolescents and young adults: review of evidence. Korean J Radiol. 2022;23:517-28.
DOI: 10.3348/kjr.2021.0596
PMID: 35289145 PMCID: PMC9081692

8. White IK, Shaikh KA, Moore RJ, Bullis CL, Sami MT, Gianaris TJ, et al. Risk of radiation-induced malignancies from CT scanning in children who underwent shunt treatment before 6 years of age: a retrospective cohort study with a minimum 10-year follow-up. J Neurosurg Pediatr. 2014;13:514-9.
DOI: 10.3171/2014.2.PEDS12508
PMID: 24628509

9. Feinendegen LE. Evidence for beneficial low level radiation effects and radiation hormesis. Br J Radiol. 2005;78:3-7. DOI: 10.1259/bjr/63353075 PMID:15673519

10. Coccolini F, Fugazzola P, Sartelli M, Cicuttin E, Sibilla MG, Leandro G. Conservative treatment of acute appendicitis. Acta Biomed. 2018;89:119-34. DOI: 10.23750/abm.v89i9-S.7905.