



The Use of Computed Tomography In Non-Traumatic Acute Abdomen Cases: Clinical Necessity, Artificial Intelligence and Ethical Limits

Travmatik Olmayan Akut Batın Vakalarında Bilgisayarlı Tomografi Kullanımı: Klinik Gereklik, Yapay Zeka ve Etik Sınırlar

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ABSTRACT

Aim: This study aims to evaluate the necessity and limitations of computed tomography (CT) in non-traumatic acute abdomen cases, focusing on clinical indications, potential complications, and the ethical implications of overuse in vulnerable patient groups.

Material And Method: This theoretical article is based on current literature evaluating the role of contrast-enhanced CT in diagnosing non-traumatic acute abdominal conditions. A structured literature search was conducted in PubMed, Scopus, and Google Scholar using the keywords "acute abdomen," "computed tomography," "contrast nephropathy," "artificial intelligence," and "ethical imaging" for studies published between 2013 and 2024. Particular emphasis is placed on patient risk stratification, contrast-induced nephropathy, radiation exposure, and the integration of artificial intelligence (AI) in radiological assessment.

Results: CT remains a cornerstone in diagnosing conditions such as acute appendicitis, diverticulitis, epiploic appendagitis, omental infarction, and mesenteric ischemia. However, its application in elderly and comorbid patients carries risks of contrast-induced nephropathy. Recent studies show that implementing hydration protocols and risk-based selection criteria can mitigate such complications. Moreover, AI-supported imaging has shown promise in improving diagnostic accuracy and reducing unnecessary scans, although technical and ethical limitations persist. Discussion: The increasing reliance on CT in emergency departments has led to a "CT reflex," where imaging is often ordered preemptively without adequate clinical justification. While CT can improve diagnostic confidence, especially in atypical presentations, indiscriminate use contradicts ethical principles, particularly the tenet of primum non nocere. Emerging AI technologies may support decision-making, yet cannot fully replace clinical judgment, especially in complex or high-risk populations.

Conclusion: The use of CT in non-traumatic acute abdomen should be patient-centered, clinically justified, and ethically responsible. Alternatives such as ultrasonography should be prioritized when appropriate, and preventive measures must be taken to minimize complications in high-risk patients. CT should remain an essential, but not automatic, tool in emergency abdominal imaging.

Keywords: Acute abdomen, Computed tomography, Contrast nephropathy

ÖZET

Amaç: Bu çalışmada, travmatik olmayan akut karın olgularında bilgisayarlı tomografinin (BT) gerekliliği ve sınırlılıkları, klinik endikasyonlar, potansiyel komplikasyonlar ve hassas hasta gruplarında aşırı kullanımın etik sonuçlarına odaklanarak değerlendirilmiştir.

Gereçe Yöntem: Teorik makale, kontrastlı BT'nin travmatik olmayan akut abdominal durumların tanısındaki rolünü değerlendiren güncel literatüre dayanmaktadır. Hasta risk tabakalandırması, kontrasta bağlı nefropati, radyasyon maruz kalma ve yapay zekanın (YZ) radyolojik değerlendirmeye entegrasyonuna özellikle vurgu yapılmaktadır.

Bulgular: BT, akut apandisit, divertikülit, epiploik apandisit, omental enfarktüs ve mezenterik iskemi gibi durumların teşhisinde bir köşe taşı olmaya devam etmektedir. Bununla birlikte, yaşlı ve komorbid hastalarda uygulanması kontrast kaynaklı nefropati riski taşır. Son çalışmalar, hidrasyon protokollerinin ve riske dayalı seçim kriterlerinin uygulanmasının bu tür komplikasyonları azaltabileceğini göstermektedir. Ayrıca, teknik ve etik sınırlamalar devam etse de, yapay zeka destekli görüntüleme, tanısal doğruluğu artırma ve gereksiz taramaları azaltma konusunda umut vaat etmektedir.

Tartışma: Acil servislerde BT'ye artan güven, görüntülemenin genellikle yeterli klinik gerekçe olmaksızın önleyici olarak istendiği bir "BT refleksine" yol açmıştır. BT, özellikle atipik sunumlarda tanısal güveni artırabilirken, gelişigüzel kullanım etik ilkelerle, özellikle de önce zarar verme ilkesiyle çelişmektedir. Gelişmekte olan yapay zeka teknolojileri karar vermeyi destekleyebilir, ancak özellikle karmaşık veya yüksek riskli popülasyonlarda klinik yargının yerini tam olarak alamaz. Sonuç: Travmatik olmayan akut batında BT kullanımı hasta merkezli, klinik olarak gerekçelendirilmiş ve etik olarak sorumlu olmalıdır. Uygun olduğunda ultrasonografi gibi alternatiflere öncelik verilmeli ve yüksek riskli hastalarda komplikasyonları en aza indirmek için önleyici tedbirler alınmalıdır. BT, acil abdominal görüntülemede gerekli ancak otomatik olmayan bir araç olmaya devam etmelidir.

Anahtar Kelimeler: Akut karın, Bilgisayarlı tomografi, Kontrast nefropatisi

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1.1 Clinical Evaluation

In emergency departments, non-traumatic acute abdomen cases are primarily evaluated with clinical findings and laboratory data. However, in many cases, radiologic imaging is required in addition to these investigations. The most common diagnoses include omental infarction, epiploic appendicitis, acute appendicitis, mesenteric ischemia and diverticulitis, which are directly related to general surgery.

Omental infarction (OI) is a rare cause of acute abdomen. It is often difficult to diagnose due to its low incidence, lack of awareness among clinicians and non-specific symptoms. Clinically, it usually presents with sudden onset of pain on the right side of the abdomen, nausea, vomiting, low-grade fever and/or palpable abdominal mass (1).

OI can be easily confused with other causes of acute abdomen, especially appendicitis and cholecystitis. However, the frequency of diagnosis has increased in the last 20 years thanks to advances in imaging technologies (1).

Epidemiologically, 15% of OI cases have been reported in pediatric and 85% in adult population. The majority of cases are classified as idiopathic primary OI in which no apparent cause can be identified (2,3).

Predisposing factors that play a role in the development of OI include obesity, excessive food intake, cough, hypermobility, hyperperistalsis, deep breathing and local trauma (1,4,5). Secondary causes such as thrombosis, vasculitis and omental torsion are more rarely involved in the etiology (1).

1.2 The Role of CT in the Diagnostic Process and Clinical Limitations of Use

Disproportionate thickening of the bowel wall on abdominal computed tomography is considered a sensitive but non-specific finding for omental infarction (OI). However, this imaging finding may also be similar to other inflammatory intra-abdominal diseases such as appendicitis, diverticulitis and epiploic appendicitis (6).

Epiploic appendicitis cases are mostly seen in male individuals aged 40–50 years and are defined as an oval fatty mass, usually smaller than 5 cm, with hyperattenuated margins and located in the paracolic region (2,6). In some cases, thrombosed veins or central hyperattenuated foci indicating intralesional hemorrhage may be detected (2,3).

Acute mesenteric ischemia is a common pathology especially in the elderly and requires rapid intervention. The overlap of clinical findings with other non-traumatic acute abdominal syndromes may complicate the diagnosis. Therefore, it is important to perform contrast-enhanced CT in these patients without delay to prevent necrosis due to intestinal hypoxia and unnecessary resections.

In cases of appendicitis, an enlarged, thick-walled and fluid-filled appendix is typical on CT. Radiologic 'target sign' appearance is valuable as a specific finding for this diagnosis.

In the diagnosis of diverticulitis, fluid accumulation around the sigmoid mesentery, striping of paracolic adipose tissue and thickening of the intestinal wall may be detected. In addition, the 'comma sign' indicating the presence of diverticulum and the 'centipede sign' formed by the prominence of mesenteric vessels also support the diagnosis (6).

Although CT is the most common imaging modality with high sensitivity and specificity in cases of acute abdomen (7), caution should be exercised in some patient groups. In the literature, it has been reported that the use of contrast media may increase the risk of contrast-induced nephropathy, especially in the elderly, individuals with chronic renal failure, diabetes, congestive heart failure or anemia (8–12). Common clinical conditions in this high-risk group include mesenteric ischemia, diverticulitis, cholecystitis and colorectal cancer-induced perforations (13).

Post-contrast acute kidney injury is defined as a sudden deteri-

oration in renal function that develops within 48 hours following iodinated contrast material administration. Because of this risk, some radiologists may avoid contrast-enhanced CT even in patients with minimally elevated serum creatinine levels. However, it is of great importance to perform CT without delay in patients in whom a definitive diagnosis cannot be made with clinical and laboratory data.

In such cases, especially in high-risk patients, preventive measures such as providing adequate hydration before the examination may significantly reduce the development of contrast nephropathy. In addition to hydration, randomized controlled trials have demonstrated that agents such as N-acetylcysteine and sodium bicarbonate may offer protective effects against contrast-induced nephropathy, particularly in high-risk patients. However, evidence on their efficacy remains mixed, and clinical practice varies accordingly (14).

Most non-traumatic acute abdomen patients admitted to emergency surgery are elderly, dehydrated and hypotensive. Although these clinical features are not a reason to completely exclude CT, they indicate the need for appropriate preparation beforehand. In these patients, early hydration should be provided before imaging and nephrotoxic drugs and anticoagulants should be temporarily discontinued if possible (15).

Since delays in diagnosis may directly increase morbidity and mortality rates, CT should be considered as a more prioritized and accessible tool than surgical diagnostic methods such as laparoscopy or laparotomy. Therefore, radiologists should not avoid performing CT even in patients at risk of nephropathy, accompanied by necessary precautions (15).

On the other hand, ultrasonography should be initially preferred in cases of suspected acute appendicitis. However, in practice, it is common for emergency physicians, especially those who are concerned about missed diagnosis, to order CT without general surgery consultation. This approach leads to unnecessary exposure of patients to radiation and also causes loss of time and labor (16).

1.3 The Role of Artificial Intelligence Based Imaging Models in the Diagnosis of Acute Abdomen

Diagnosis of non-traumatic acute abdomen is often difficult because many pathologies such as appendicitis, cholecystitis, diverticulitis, intestinal obstruction and perforation present with similar clinical findings. In this context, imaging methods play a critical role in differential diagnosis.

In recent years, artificial intelligence (AI) supported algorithms have been developed to support this diagnostic process. Deep learning-based AI systems show promising performance especially in tasks such as lesion detection, segmentation and classification in CT images.

In the literature, it has been shown that AI models achieve accuracy rates comparable to radiologists in the evaluation of conditions requiring emergency surgery such as pneumoperitoneum with conventional radiography. For example, a deep learning model developed by Park et al. was able to identify pneumoperitoneum with high specificity and sensitivity in both supine and standing radiographs (17,18). However, Brejnebo et al. reported that an AI model developed to detect pneumoperitoneum from CT images had high specificity but moderate sensitivity (19). This shows that algorithms may be limited especially in the presence of small volumes of free air.

AI-assisted analysis has also been shown to be effective in acute conditions such as intestinal obstruction. Deep learning models help radiologists in automatic detection of transition zones and can reduce reporting time (20). In common cases such as appendicitis, diagnostic models developed by AI with both CT and ultrasound-based data offer high accuracy and generalizability (21,22). However, performance is limited in ultrasound-based AI applications due to the dynamic and operator-dependent nature of imaging (22).

AI models developed for specific conditions such as necrotizing enterocolitis and intussusception in pediatric patients are also promising. These models both facilitate the diagnostic process for radiologists and provide guidance for less experienced clinicians (23). Likewise, in gallbladder inflammation or complication risk, AI can support the diagnosis with data obtained from imaging and contribute to appropriate surgical decisions (24).

Furthermore, the role of AI in supporting the diagnostic process has been demonstrated in other non-traumatic pathologies such as pancreatitis, renal colic and aortic aneurysm (25). In particular, radiomic analysis has the potential to increase diagnostic sensitivity by revealing details that the human eye cannot distinguish (26).

In the light of all these data, the application potential of AI in acute abdomen cases is increasing. However, factors limiting model generalizability, variability in data set quality, interpretability deficiencies and difficulties in integration into clinical workflow remain important. Nevertheless, given its integration into clinical decision support systems and its potential to accelerate workflows, AI is expected to be incorporated into clinical applications on a larger scale in the near future (25).

1.4 Unnecessary CT Use in Acute Abdominal Cases and Its Ethical Dimension

Computed tomography (CT) is a commonly used imaging modality in the diagnosis of non-traumatic acute abdomen patients due to its high sensitivity and rapid results. However, the routine use of CT in every clinical situation is an approach that should be questioned not only medically but also ethically. Long-term radiation-related risks especially in young patients and complications such as the possibility of contrast-induced nephropathy in elderly and comorbid individuals are important concerns (15,27).

In emergency departments, CT order rates are increasing due to patient density, diagnostic uncertainty and malpractice concerns. Over time, this tendency has become a habit defined as 'CT reflex', which leads to an almost automatic request for imaging in every case of abdominal pain (16). This situation may contradict the principle of *primum non nocere* ('first do no harm'), one of the basic ethical principles of modern medicine.

From an ethical point of view, radiation-exposing advanced imaging modalities such as CT should only be used on the basis of appropriate clinical indications. In pediatric patients, the long-term risks of ionizing radiation—including increased lifetime cancer risk—should be carefully weighed before ordering CT scans. Adherence to the ALARA principle ("As Low As Reasonably Achievable") is essential when imaging is required.

In pregnant patients, magnetic resonance imaging (MRI) should be considered as a safer alternative when clinically feasible, as it provides detailed anatomical information without exposing the fetus to ionizing radiation. This decision should be based on the patient's presenting symptoms, age, comorbidities and individual risk factors. At the same time, the patient should be given clear, understandable and balanced information about the imaging to be performed, and the informed consent process should be completed by providing information about possible radiation and contrast complications.

International clinical guidelines also recommend that decision-making processes should be individualized and guided by algorithmic supports in this direction (28). In this way, not only patient safety is ensured, but also ethical and efficient use of healthcare resources becomes possible.

In conclusion, decisions regarding the use of CT in non-traumatic acute abdomen should be based on medical necessity and ethical responsibilities. Unnecessary examinations should be avoided, less invasive methods should be used to reach a diagnosis, and CT should only be used when clinically necessary. This approach will be a holistic approach that considers both individual patient benefit and rational use of social health resources.

Even though advanced imaging techniques such as CT are covered by national healthcare systems, their unnecessary use contributes to increased overall healthcare spending. Avoiding redundant imaging can support more efficient allocation of public health resources and promote ethical responsibility in clinical decision-making.

1.5 Conclusion and Recommendations

In conclusion, radiologic evaluation preferences for non-traumatic acute abdomen cases should be made on a patient-specific basis. Imaging decisions in patients with non-traumatic acute abdominal pain should be guided by structured clinical reasoning.

Before ordering a CT scan, physicians are encouraged to consider the following: Do the patient's history, physical examination, and laboratory findings strongly suggest a specific diagnosis? Can ultrasonography provide sufficient information without exposing the patient to radiation? Is the patient at increased risk for contrast-related complications such as advanced age or renal insufficiency?

This patient-centered approach promotes ethical use of diagnostic tools and helps avoid unnecessary imaging.

In patients with a prediagnosis of acute appendicitis, it would be an appropriate approach to perform ultrasonographic evaluation first and to perform CRT after general surgery consultation and when deemed necessary. It will be possible to minimize possible complications such as nephropathy by making the necessary preliminary preparations and taking protective measures before performing CRT, especially in elderly and high-risk patients.

Despite all the artificial intelligence-based developments in radiologic imaging techniques in recent years, we believe that the approach to acute abdomen cases without knowing the patient's history, physical examination findings and laboratory values will still be incomplete and inadequate.

Author contributions

Conception/Planning: ST
Data collection/Processing: RA, YFA, ST
Data analysis and interpretation: YFA, ST
Literature review: RA, ST
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