Diagnostic Accuracy of Computed Tomography Features for Acute Appendicitis: A Three-Year Retrospective Cross-Sectional Study at Surat Thani and Wiangsa Crown Prince Hospitals

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Abstract

Background: Acute appendicitis is among the most common causes of emergency abdominal surgery. Timely and accurate diagnosis of surgical management is crucial to avoid serious medical complication and reduce the rate of negative appendectomies.

Objective: This study aimed to evaluate the predictive value of four computed tomography (CT) features appendiceal diameter ≥6 mm, wall thickening, periappendiceal fat stranding, and appendicolith in diagnosing acute appendicitis using histopathology as the reference standard. Because the study included only surgically treated patients, diagnostic analysis was restricted to specificity and positive predictive value (PPV). These parameters were calculated to assess the confirmatory role of CT features in clinical practice.

Methods: A retrospective cross-sectional study was conducted at Surat Thani Hospital and Wiangsa Crown Prince Hospital between January 2022 and December 2024. Patients who underwent appendectomy with histopathological confirmation were included. CT scans were reviewed for the four predefined features. Specificity and PPV were calculated for each feature to assess their confirmatory diagnostic value.

Results: A total of 269 patients were analyzed. Appendicolith demonstrated the highest specificity (95.45%) and PPV (97.22%), indicating its strong role as a rule-in feature. Wall thickening (specificity 63.64%, PPV 94.37%) and periappendiceal fat stranding (specificity 45.45%, PPV 93.81%) also showed high PPV despite moderate specificity. Appendiceal diameter ≥6 mm had the lowest specificity (27.27%) but still demonstrated high PPV (93.73%).

Conclusion: CT features provide robust confirmatory value in diagnosing acute appendicitis in surgical patients. Appendicolith, in particular, is highly specific and predictive, while other features offer supportive diagnostic value. Integrating these parameters into diagnostic protocols can improve decision-making, reduce unnecessary appendectomies, lower healthcare costs, and enhance patient outcomes. Future prospective studies including non-operated patients are warranted to enable full evaluation of sensitivity and negative predictive value.

Keywords: Appendicitis, Computed tomography, Appendicolith, Appendiceal diameter

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Introduction

Acute appendicitis represents one of the most frequently encountered abdominal emergencies globally. It affects approximately 96.5 to 100 per 100,000 individuals annually[1]. The condition typically presents with right lower quadrant abdominal pain, nausea, vomiting, fever, and leukocytosis[2]. The pathophysiology of appendicitis often involves obstruction of the appendiceal lumen, leading to bacterial overgrowth, inflammation, and, if untreated, potential perforation[3].

Despite being a common condition, the diagnosis of acute appendicitis is not always straightforward. Clinical symptoms often overlap with other abdominal pathologies such as gastroenteritis, urinary tract infections, or gynecological disorders.

Historically, scoring systems like the Alvarado Score have been utilized to aid diagnosis. This score incorporates clinical signs and symptoms such as migratory pain, rebound tenderness, elevated temperature, and leukocytosis[4].

However, the diagnostic accuracy of clinical scoring systems, such as the Alvarado Score, is limited, particularly in atypical presentations and specific populations[5].

As of now, imaging is frequently employed to confirm the diagnosis of appendicitis in addition to Alvarado Scoring. Current clinical practice considers a negative appendectomy rate acceptable at less than 10% in male patients and less than 20% in female patients.

Delayed diagnosis and treatment of acute appendicitis increase the risk of abscess, peritonitis, and mortality[11]. Consequently, imaging, most notably CT, has become essential in improving diagnostic certainty. CT criteria of appendiceal diameter >6 mm, wall thickening [6], peri appendiceal fat stranding[7], and appendicolith[8] have shown to significantly enhance diagnostic performance when combined with clinical assessment[9,10].

Objective

This study aimed to quantify the predictive value of four specific CT features: appendiceal diameter, wall thickening, periappendiceal fat stranding, and the presence of an appendicolith, in diagnosing acute appendicitis, using histopathologic findings as the reference standard. Given the surgical cohort design, analysis was limited to evaluating specificity and positive predictive value (PPV).

By focusing on these parameters, the study highlights the confirmatory role of CT features in ruling acute appendicitis, supporting surgical decision-making, reducing unnecessary appendectomies, and lowering healthcare costs.

Materials and Methods

This study was approved by the Ethics Committee of Surat Thani Hospital (COA 057/2568) on April 18, 2025. The requirement for informed consent was waived due to the retrospective cross-sectional design of the study.

This study reviewed medical records from January 1, 2022, to December 31, 2024, at two sites: Surat Thani Hospital and Wiangsa Crown Prince Hospital, Surat Thani Province. A total of 2,284 patients diagnosed with acute appendicitis (ICD-10: K35.3) at Surat Thani Hospital and 81 patients at Wiangsa Crown Prince Hospital were initially identified. Exclusion criteria included age below 15 years, above 80 years, incomplete laboratory data, pregnancy and cases managed with non-operative treatment. After applying these criteria, 1,936 patients at Surat Thani Hospital and 50 patients at Wiangsa Crown Prince Hospital who underwent appendectomy (ICD-9: 47.09) were eligible.

From this group, patients who had undergone preoperative contrast enhanced computed tomography (CT) scanning (ICD-9: 88.01) were selected. Additional exclusions were made for cases involving a ruptured appendix, absence of preoperative CT imaging, and administration of antibiotics for more than 24 hours prior to imaging. Following these exclusions, 248 cases from Surat Thani Hospital and 21 from Wiangsa Crown Prince Hospital with confirmed histopathological diagnoses were included. (Figure 1)

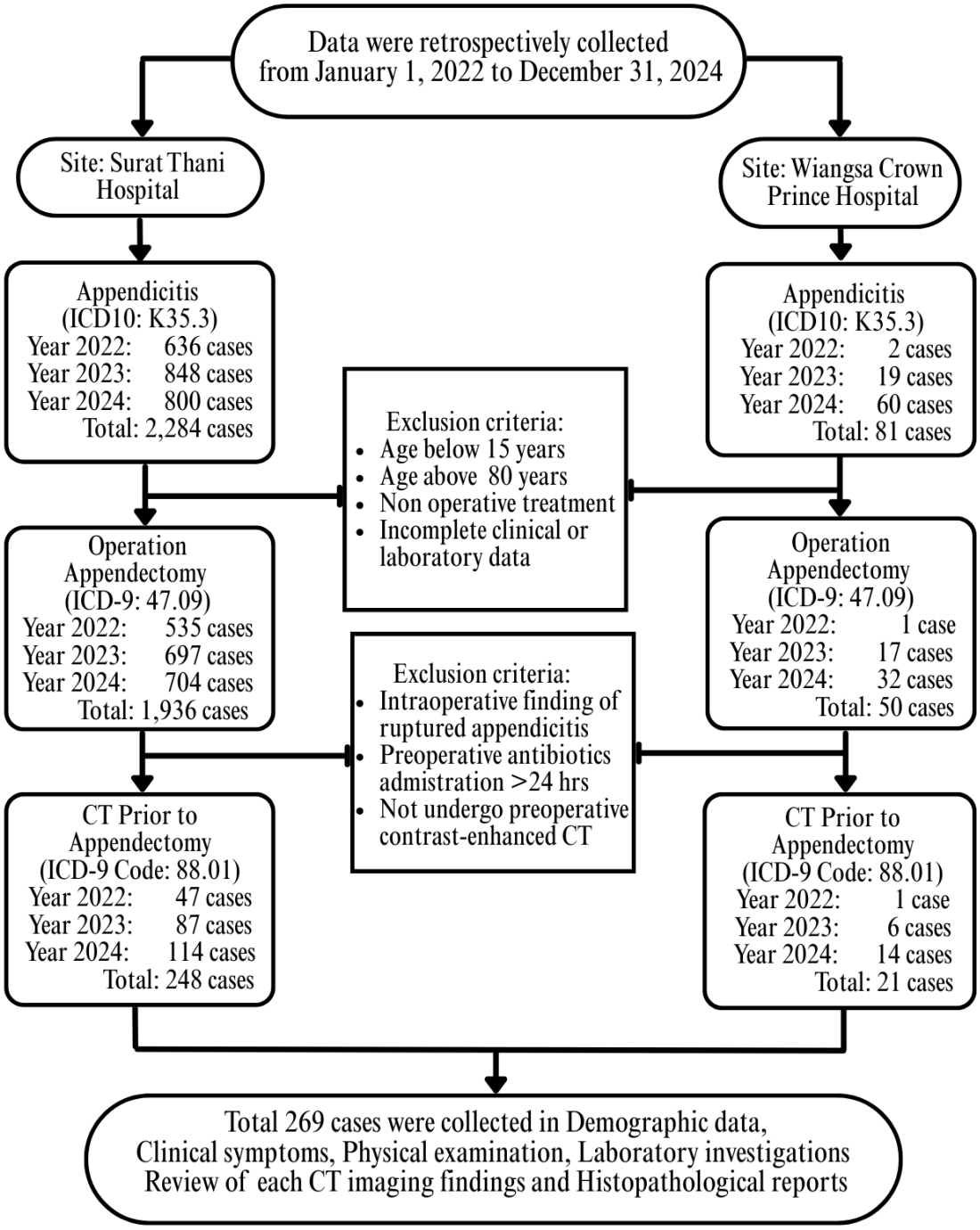
A final cohort of 269 patients was analyzed. Collected data included demographic characteristics, clinical symptoms and physical examination findings, laboratory parameters (white blood cell count and absolute neutrophil count) and additionally, calculation of the Alvarado score and histopathological findings were recorded for each patient.

Preoperative CT images were reviewed for four specific features: appendiceal diameter ≥6 mm, wall thickening, periappendiceal fat stranding, and the presence of an appendicolith. Histopathology served as the diagnostic

gold standard. Because only surgically managed patients with pathology results were included, CT-negative patients treated conservatively were not available for analysis. Consequently, diagnostic performance was limited to the calculation of specificity and positive predictive value (PPV) for each CT feature.

At Wiangsa Crown Prince Hospital, all CT examinations were performed using a 128-slice multidetector CT (MDCT) scanner with a slice thickness of 3 mm, while Surat Thani Hospital, imaging was conducted using either a 128-slice MDCT or a 64-slice MDCT scanner, with comparable scanning protocols to maintain consistency across sites. Each CT scan was independently reviewed by a single board-certified radiologist to ensure standardization in the evaluation of imaging features and to minimize interobserver variability. Data analysis was performed using SPSS version 20

Figure 1: Flow of Data Collecting



Results

A total of 269 patients who underwent appendectomy with histopathologic confirmation were included in the final analysis. Of these, 248 cases (92.2%) were from Surat Thani Hospital and 21 cases (7.8%) were from Wiangsa Crown Prince Hospital. The cohort comprised 88 males (32.7%) and 181 females (67.3%), with a mean age of 33.9 ± 14.4 years.

Common clinical symptoms included nausea or vomiting (57.2%), migratory right lower quadrant pain (40.1%), and anorexia (38.7%). On physical examination, right lower quadrant tenderness was present in 98.1% of patients, rebound tenderness in 33.5%, and fever >37.3°C in 25.3%. Laboratory findings revealed leukocytosis in 84.4% and left shift (neutrophil >75%) in 63.9% of cases. CT imaging revealed that appendiceal diameter ≥6 mm was the most frequent feature, observed in 255 patients (94.8%), with 42.8% measuring 6–10 mm and 51.3% exceeding 10 mm. Appendiceal wall thickening was detected in 142 cases (52.7%), periappendiceal fat stranding in 192 cases (71.3%), and appendicolith in 36 cases (13.3%) Histopathology confirmed acute appendicitis in 247 cases (91.8%), while 22 cases (8.2%) were negative (Table 1).

These CT findings were subsequently compared with pathology results to assess their diagnostic performance. Specificity and positive predictive value (PPV) were calculated for each CT feature using histopathology as the reference standard. Appendicolith showed the highest specificity (95.45%) and PPV (97.22%), making it the most reliable rule-in indicator of acute appendicitis. Appendiceal wall thickening demonstrated a specificity of 63.64% and PPV of 94.37%, while periappendiceal fat stranding had specificity of 45.45% and PPV of 93.81%. Appendiceal diameter ≥6 mm had the lowest specificity (27.27%) but still maintained a high PPV (93.73%) (Table 2).

Cross-tabulation analyses confirmed that most patients with each CT feature also had histopathologically proven appendicitis. Specifically, appendicolith was present in 35 of 36 positive CT cases, whereas wall thickening and fat stranding were seen in 134 of 142 and 182 of 194 histopathologically confirmed cases, respectively (Table 3,4,5,6).

Table 1: Baseline demographic and clinical characteristics of the study population, including Alvarado score components and laboratory parameters.

Demographic data	
Total Patients 269 cases	
Surat Thani Hospital (n, %)	248 (92.2)
Wiangsa Crown Prince Hospital (n, %)	21 (7.8%)
Gender	
Male (n, %)	88 (32.7%)
Female (n, %)	181 (67.3%)
Mean Age ± SD (years)	33.88 ± 14.43
Mean White blood cells ± SD (cells/ul)	14,206 ± 4,651
Mean Absolute Neutrophil Count ± SD (cells/ul)	10,999 ± 4,616
Mean Alvarado Score ± SD	6.18 ± 1.59
Patient symptoms	
Migratory Pain (n, %)	108 (40.1%)
Anorexia (n, %)	104 (38.7%)
Nausea or Vomiting (n, %)	154 (57.2%)
Physical examinations	
Right lower Quadrant tenderness (n, %)	264 (98.1%)
Rebound tenderness (n, %)	90 (33.5%)
Fever > 37.3°C (n, %)	68 (25.3%)
Laboratory results	
Leukocytosis (n, %)	227 (84.4%)
Leukocyte Left Shift (Neu>75%) (n, %)	172 (63.9%)
Computed Tomography findings	
Appendiceal diameter	
-Appendiceal diameter <6 mm (n, %)	14 (5.2 %)
-Appendiceal diameter 6 to 10 mm (n, %)	115 (42.8%)
-Appendiceal diameter >10 mm (n, %)	138 (51.3%)
Appendiceal wall thickening (n, %)	142 (52.7%)
Periappendiceal Fat Stranding (n, %)	192 (71.3%)
Appendicolith (n, %)	36 (13.3%)

Table 2: Primary outcome Specificity and positive predictive value) for each CT imaging feature evaluated against pathology-confirmed appendicitis

Features	Specificity	Positive Predictive value
CT: Appendiceal diameter (more ≥6 mm)	27.27%	93.73%
CT: Appendiceal wall thickening	63.64%	94.37%
CT: Periappendiceal Fat Stranding	45.45%	93.81%
CT: Presence of Appendicolith	95.45%	97.22%

Table 3: CT Diameter ≥ 6 mm and Pathology Confirmed Appendicitis Crosstabulation

		Pathology confirmed Appendicitis (cases)		Total (cases)
		Yes	No	
CT Diameter (cases)	≥6 mm	239	16	255
	< 6 mm	8	6	14
Total		247	22	269

Table 4: CT Appendiceal wall thickening and Pathology Confirmed Appendicitis Crosstabulation

		Pathology confirmed Appendicitis (cases)		Total (cases)
		Yes	No	
CT Appendiceal wall thickening (cases)	Yes	134	8	142
	No	113	14	127
Total		247	22	269

Table 5: CT Periappendical fat stranding and Pathology Confirmed Appendicitis Crosstabulation

		Pathology confirmed Appendicitis (cases)		Total (cases)
		Yes	No	
CT Periappendical fat stranding (cases)	Yes	182	12	194
	No	65	10	75
Total		247	22	269

Table 6: CT Appendicolith and Pathology Confirmed Appendicitis Crosstabulation

		Pathology confirmed Appendicitis (cases)		Total (cases)
		Yes	No	
CT Appendicolith (cases)	Yes	35	1	36
	No	212	21	233
Total		247	22	269

Discussion

In this retrospective cross-sectional study, we evaluated the diagnostic performance of individual CT features in a surgical cohort. Because CT-negative patients who were managed conservatively did not undergo histopathological confirmation, sensitivity and negative predictive value (NPV) could not be assessed. Our analysis therefore focused on specificity and positive predictive value (PPV), which are particularly relevant for confirming the diagnosis and guiding operative decisions.

Among the CT features assessed, appendicolith demonstrated the highest specificity (95.45%) and PPV (97.22%), establishing it as the strongest confirmatory indicator of acute appendicitis. Wall thickening (specificity 63.64%, PPV 94.37%) and periappendiceal fat stranding (specificity 45.45%, PPV 93.81%) also showed high PPV despite only moderate specificity, supporting their role as adjunctive findings. Although appendiceal diameter ≥6 mm had the lowest specificity (27.27%), it still demonstrated a high PPV (93.73%), indicating that appendix enlargement, while nonspecific, remains clinically useful in predicting appendicitis among surgical candidates.

Overall, these findings highlight the value of CT features especially appendicolith in providing strong confirmatory evidence for acute appendicitis. In surgical practice, the consistently high PPV across all parameters underscores their reliability in ruling in the disease, supporting timely operative decision-making, reducing unnecessary surgery, and improving surgical outcomes. Future prospective studies that include non-operated patients are needed to provide a full spectrum of diagnostic performance, including sensitivity and NPV.

Future prospective studies including non-operated patients are warranted to allow comprehensive evaluation of sensitivity and NPV, thereby providing a full spectrum of diagnostic accuracy.

Data was collected from a provincial (Surat Thani Hospital) and a district hospital (Wiangsa Crown Prince Hospital), both in the Surat Thani province, allowing for a broader representation of patient demographics. Diagnostic accuracy was assessed against histopathology, the gold standard for appendicitis.

This study has several limitations. First, due to its retrospective cross-sectional design, the study cohort consisted solely of patients who underwent appendectomy with histopathological confirmation. Patients with negative CT findings who were managed conservatively were not included; therefore, histopathological outcomes for this group were unavailable. As a result, sensitivity and negative predictive value (NPV) could not be calculated, since false negative cases were not verifiable. Nevertheless, specificity and positive predictive value (PPV) were estimable, providing clinically relevant information for ruling in acute appendicitis. Future prospective studies incorporating non-operated patients would help to overcome this limitation and enable a more comprehensive assessment of diagnostic performance.

Our findings are consistent with Thirawiroon's study in Surin Hospital[12], which reported high diagnostic accuracy of 64-MDCT in patients with negative ultrasound. Similar to that study, appendiceal enlargement and fat stranding were the most frequent findings. However, our study evaluated CT as the primary diagnostic tool and quantified the predictive values of four CT features.

Similarly, Piyawong et al. that conducted in Thammasat University [13] that highlighted CT's role in evaluating right lower quadrant pain, with appendicitis being the most common diagnosis. Consistent with their observations, we found appendiceal enlargement and fat stranding to be highly suggestive of appendicitis. However, unlike their focus on diagnostic spectrum, our study specifically assessed the diagnostic performance of CT features.

Likewise, our results align with Wongwaisayawan et al.[14], who demonstrated excellent CT performance (AUC 0.988) using a standardized reporting system. While their study focused on a CT certainty score in a tertiary center, we analyzed individual CT features against histopathology in a multicenter setting, enhancing the generalizability of our findings.

Overall, four CT features appendiceal diameter, wall thickening, fat stranding, and appendicolith showed significant diagnostic value. Incorporating these parameters into diagnostic protocols may improve accuracy, support surgical decision-making, and reduce unnecessary appendectomies for surgeons.

Conclusion

In this study, CT-based parameters including appendiceal diameter, wall thickening, periappendiceal fat stranding, and the presence of an appendicolith demonstrated predictive value for diagnosing acute appendicitis. Among these features, appendicolith provided the

highest specificity (95.45%) and positive predictive value (97.22%), making it the strongest rule-in indicator. Wall thickening and periappendiceal fat stranding also yielded high PPV despite moderate specificity, while appendiceal diameter ≥6 mm showed limited specificity but consistently high PPV. These findings highlight the confirmatory role of CT in patients selected for surgery.

Integrating these CT features into diagnostic protocols can improve accuracy, optimize surgical management, reduce unnecessary operations, lower healthcare costs, and enhance patient outcomes. Future prospective studies including non-operated patients are warranted to evaluate sensitivity and NPV and to establish a more comprehensive diagnostic framework.

Recommendations

Recommendations for implementation

Based on the findings of this study, computed tomography (CT) features demonstrate strong confirmatory value in the diagnosis of acute appendicitis, particularly in patients selected for surgical management. The presence of an appendicolith showed the highest specificity and positive predictive value, supporting its role as a robust rule-in imaging feature. Therefore, CT should be utilized as an important adjunct to clinical assessment and scoring systems, such as the Alvarado score, to enhance diagnostic confidence and support timely surgical decision-making.

Emphasis should be placed on systematic evaluation and standardized reporting of key CT features, including appendiceal diameter ≥ 6 mm, appendiceal wall thickening, periappendiceal fat stranding, and the presence of an appendicolith. Incorporating these parameters into diagnostic protocols may help reduce negative appendectomy rates, optimize resource utilization, and improve overall patient outcomes, particularly in secondary and tertiary care settings.

Recommendations for Future Research

Future studies should adopt a prospective design and include patients managed non-operatively or those with negative CT findings to allow comprehensive assessment of diagnostic performance, including sensitivity and negative predictive value. Such an approach would provide a more complete evaluation of the role of CT in the diagnostic pathway of suspected acute appendicitis.

In addition, further research should explore the integration of CT imaging features with clinical scoring systems or standardized CT reporting frameworks to develop predictive models applicable to routine clinical practice. Multicenter studies comparing diagnostic performance across different hospital levels and CT scanner capabilities would also enhance

the generalizability and applicability of future findings.

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