

## Original Research Article

# Negative appendectomy rate in the era of computed tomography

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### ABSTRACT

**Background:** Acute appendicitis remains a diagnostic challenge. Historically, a negative appendectomy rate (NAR) of up to 20% was considered acceptable to avoid missed diagnoses. With increasing use of computed tomography (CT), the impact of routine preoperative imaging on NAR warrants further evaluation. This study assessed the negative appendectomy rate among patients undergoing preoperative CT and evaluated its diagnostic contribution.

**Methods:** A retrospective study was conducted including all adult patients who underwent emergency open or laparoscopic appendectomy between January 2023 and April 2025 at King Fahad Hospital Hofuf, Kingdom of Saudi Arabia. Demographic data, preoperative CT findings, inflammatory markers, operative findings, and histopathological results were reviewed. Statistical analysis was performed using statistical package for the social sciences (SPSS) version 24.

**Results:** A total of 386 patients were included (62.2% male), with a mean age of 29 years. All patients underwent preoperative CT imaging. A normal appendix was identified intraoperatively in five patients (1.4%). Histopathological examination revealed catarrhal appendicitis in 66%, suppurative appendicitis in 18.7%, perforated or phlegmonous appendicitis in 13%, gangrenous appendicitis in 0.6%, and normal appendix in 1.4%. One case of appendiceal carcinoid tumor was identified. Normal leukocyte counts were present in 16.6% of patients.

**Conclusions:** Routine preoperative CT imaging was associated with a very low negative appendectomy rate. These findings support the role of CT in reducing unnecessary appendectomies.

**Keywords:** Acute appendicitis, Negative appendectomy, Computed tomography, Diagnostic imaging

### INTRODUCTION

Acute appendicitis is among the most common surgical emergencies worldwide, with an estimated incidence of 160 per 100,000 individuals annually in the Middle East.<sup>1</sup> Despite being first described over two centuries ago, accurate diagnosis remains challenging.<sup>2</sup> Delayed or missed diagnosis is associated with increased morbidity and mortality, underscoring the importance of timely surgical intervention.<sup>3,4</sup> To enhance diagnostic accuracy, several adjuncts have been employed, including inflammatory markers, clinical scoring systems, and imaging modalities.<sup>5</sup>

Prior to the widespread availability of computed tomography (CT) imaging, a negative appendectomy rate of up to 20% was considered acceptable in order to avoid the complications of untreated appendicitis, such as perforation and sepsis.<sup>6</sup> However, unnecessary appendectomy is itself associated with avoidable morbidity, prolonged hospital stay, and increased healthcare costs.

CT imaging has become increasingly utilized in the evaluation of suspected acute appendicitis. It offers high sensitivity and specificity, is less operator-dependent than ultrasonography, and allows identification of alternative intra-abdominal pathology.<sup>7-9</sup> Nevertheless, concerns

remain regarding radiation exposure, cost, and selective use in specific populations.

While several studies have demonstrated a reduction in negative appendectomy rate (NAR) with increased use of CT imaging, others have reported no significant improvement.<sup>10-15,18</sup> Some evidence suggests that the benefit of CT may be more pronounced in female patients.<sup>8</sup> Given these inconsistencies, further evaluation of CT use in real-world clinical practice is warranted.

This study aimed to assess the negative appendectomy rate among patients undergoing routine preoperative CT imaging and to evaluate its impact on diagnostic accuracy in a single tertiary care center.

## METHODS

This retrospective single-center study was conducted at King Fahad Hospital Hofuf, Alahsa, Kingdom of Saudi Arabia, between January 2023 and April 2025. Ethical approval was obtained from the institutional review board prior to data collection.

Adult patients admitted under the general surgery service who underwent emergency open or laparoscopic appendectomy for suspected acute appendicitis were included in the study. Patients younger than 14 years and pregnant women were excluded.

The study procedure involved reviewing electronic medical records of eligible patients identified through hospital surgical records. Demographic variables including age, sex, and nationality were collected. Clinical and laboratory data including leukocyte count were reviewed at the time of admission.

All included patients underwent preoperative CT imaging as part of the diagnostic workup for suspected acute appendicitis. CT findings were reviewed and correlated with operative and histopathological findings.

Operative notes were evaluated to determine intraoperative findings such as inflamed appendix, perforation, gangrene, or grossly normal appendix. Histopathological examination reports were subsequently reviewed and categorized into catarrhal, suppurative, perforated/phlegmonous, gangrenous appendicitis, normal appendix, or neoplastic pathology.

The primary outcome of the study was the negative appendectomy rate, defined as histopathological absence of appendicitis in the removed appendix specimen.

Data were entered into Microsoft Excel and analysed using the statistical package for the social sciences (SPSS) version 24. Descriptive statistics were used to summarize demographic, laboratory, operative, and histopathological data.

## RESULTS

During the study period, 386 patients underwent appendectomy. Of these, 240 (62.2%) were male and 146 (37.8%) were female, with a mean age of 29 years. Saudi nationals accounted for 81.7% (Table 1).

**Table 1: Demographic characteristics.**

Characteristics	N (%)	
Gender	Male	240 (62.2)
	Female	146 (37.8)
Age (years)	14–25	184 (47.9)
	26–35	100 (26.0)
	36–45	60 (15.6)
	46–55	22 (5.7)
	>55	18 (4.7)
Nationality	Saudi	315 (81.7)
	Non-Saudi	71 (18.3)

Leukocyte counts were mildly to moderately elevated (10–16 k/ $\mu$ l) in 64.8% of patients, markedly elevated (>16 k/ $\mu$ l) in 18.7%, and within the normal range in 16.6%.

Intraoperative findings demonstrated an inflamed appendix in 85.5% of cases and perforation in 13%. A macroscopically normal appendix was identified in five patients (1.4%). Alternative diagnoses in these cases included ileal perforation, Meckel’s diverticulum, and gynecological pathology.

Histopathological analysis confirmed catarrhal appendicitis in 66% of cases, suppurative appendicitis in 18.7%, phlegmonous or perforated appendicitis in 13%, gangrenous appendicitis in 0.6%, and normal appendix in 1.4%.

One patient (0.3%) was diagnosed with an appendiceal carcinoid tumor (Table 2).

**Table 2: Laboratory results, operative and histopathological findings.**

Variables	N (%)	
Leukocyte count	Normal	64 (16.6)
	10–16 k/ $\mu$ l	250 (64.8)
	>16 k/ $\mu$ l	72 (18.6)
Surgical findings	Inflamed appendix	230 (85.0)
	Perforated appendix	50 (13.0)
	Gangrenous appendix	2 (0.6)
	Normal appendix	5 (1.4)
Histopathological findings	Catarrhal appendicitis	216 (66.0)
	Suppurative appendicitis	111 (18.7)
	Phlegmonous/perforated appendicitis	50 (13.0)
	Gangrenous appendicitis	2 (0.6)
	Normal appendix	5 (1.4)
	Cancer	1 (0.3)

## DISCUSSION

The role of CT imaging in the diagnostic pathway of suspected acute appendicitis remains debated. Some authors argue that careful clinical assessment supported by laboratory investigations is sufficient and that routine CT may delay operative management.<sup>19-22</sup> In contrast, others highlight the high diagnostic accuracy of CT and its ability to reduce diagnostic uncertainty and identify alternative pathology.<sup>23-25</sup>

Large observational and randomized studies have demonstrated that routine or liberal use of CT imaging is associated with reduced negative appendectomy and complication rates.<sup>26-29</sup> In multinational cohorts, implementation of mandatory imaging protocols resulted in substantial reductions in NAR.<sup>10,29</sup>

The negative appendectomy rate of 1.4% observed in this study is notably lower than rates reported in large national audits, such as the UK National Surgical Research Collaborative study (20.6%).<sup>32</sup> This difference likely reflects routine preoperative CT utilization, consistent with Dutch and other European guidelines recommending cross-sectional imaging in suspected appendicitis.<sup>33</sup>

Consistent with prior literature, the majority of negative appendectomies in this cohort occurred in female patients, likely due to gynecological conditions mimicking appendicitis.<sup>36,37</sup> However, sex-based differences in NAR remain inconsistently reported across studies.<sup>11,38,39</sup>

Importantly, 16.6% of patients had a normal leukocyte count, reinforcing evidence that inflammatory markers alone are insufficient to exclude appendicitis and should not supersede clinical judgment and imaging findings.<sup>40</sup>

### Limitations

This study has several limitations. First, its retrospective single-center design may limit the generalizability of the findings to other institutions or healthcare settings.

Second, the study did not include a comparison group of patients managed without preoperative CT imaging, which limits the ability to directly quantify the impact of CT on reducing the negative appendectomy rate.

Third, pediatric patients and pregnant women were excluded, and therefore the findings may not be applicable to these populations.

Finally, potential variability in radiological interpretation and surgeon decision-making could not be fully assessed.

## CONCLUSION

Routine preoperative CT imaging was associated with a very low negative appendectomy rate in this study. These findings support the integration of CT into the diagnostic

pathway for suspected acute appendicitis, particularly in settings aiming to minimize unnecessary surgery. Acute appendicitis should remain a diagnostic consideration even in patients with normal leukocyte counts when clinical suspicion persists.

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