The Role Of Computed Tomography In Evaluating Intestinal Lesions

Turki Mohammed Noor Alsulaimani[1], Ahmed Maqbul Almasoudi[2], Ali Mohammed Algubbi[3], Hattan Omar Ibrahim Alsalmi[4], Abdulaziz Mohammd Alghamdi[5], Israa Khalaf Alqurashi[6], Reham Saad Alshehri[7],

Radiologist registrar- Maternity and Childern Hospital -Makkah[1]
Medical Physicist - Maternity and Children's Hospital in Makkah[2]
Radiology Technician - Maternity and Children's Hospital in Makkah[3]
Radiology Technician - Umm Al-Rakah Health Center in Makkah[4]
Radiology Technician - Maternity and Childern Hospital -Makkah[5]
Radiology Specialist - King Abdulaziz Specialist Hospital in Taif [6]
Radiology Specialist - King Abdulaziz Specialist Hospital in Taif [7]

ABSTRACT
Computed tomography (CT) has become an essential tool in the assessment of intestinal lesions worldwide, and its specific diagnostic accuracy and clinical outcomes in the unique epidemiological and health environment of Saudi Arabia have not been measured. The purpose of the study was to identify the diagnostic accuracy of CT in intestinal pathologies and assess typical imaging appearances as well as the effect of CT on clinical management in a Saudi tertiary care cohort. The study involved a retrospective diagnostic accuracy study of 427 patients with histopathologically proven intestinal lesions. Diagnostic measures were derived against the histological gold standard, and imaging characteristics were examined, and management changes after CT were monitored. CT showed a diagnostic accuracy of 82.9%(95%CI:78.9-86.4), a high degree of specificity (>94% of both neoplastic and ischemic lesions), and sensitivity of ischemia (79.3%). An accurate CT diagnosis was a strong predictor of a change of clinical management ($p<0.001$). There were also characteristic features that markedly distinguished the pathologies; neoplastic lesions had higher wall thickness (14.2+4.5 mm) and lacked mural stratification (9.7%), whereas inflammatory/ischemic conditions had stratification (87.0-89.7%). This study supports the use of CT as a very specific and clinically decisive method in this context, but in early ischemia, there is a diagnostic problem. The results can be seen as evidence-based confirmation of local practice and indicate the necessity to use sophisticated methods to increase sensitivity.
Keywords: Computed Tomography, Diagnostic Accuracy, Intestinal Lesions, Management Impact, Saudi Arabia

INTRODUCTION

The precise and early diagnosis of the intestinal lesions depicts a continuous clinical dilemma that induces a wide range of pathologies involving inflammatory bowel diseases such as Crohn's disease, to life-threatening neoplasms and acute ischemic bowel [1]. Computed tomography (CT) has become a fundamental imaging mode of this diagnostic environment, which is favored by its fast imaging, broad range of availability, and detailed imaging of the bowel wall, mesentery, and vasculature [2]. Its capacity to give detailed cross-sectional anatomy has transformed the initial diagnosis of acute abdominal pain and the suspected pathology of the intestine, effectively substituting older and less specific modalities on numerous indicators [3]. Its use has been further validated by the worldwide use of multi-detector CT (MDCT) and advanced protocols, such as multi-phasic contrast enhancement and multi-planar reconstruction, which provide unprecedented detail on the characterization of lesion morphology, extent, and possible complications [4].

The use of CT has been internationally confirmed to be useful in selected intestinal diseases. The high accuracy of large cohort studies has enabled them to identify complications related to diverticulitis, the stage of colorectal malignancies, and the transmural extent and extra-enteric presentation of inflammatory bowel disease [5]. The early 2000s seminal work of Gore and Balthazar contributed to the standardization of the CT method of bowel imaging, key signs of ischemia, inflammation, and obstruction [6]. In more recent times, the emphasis has switched to the optimization of the protocols to minimize the dose of radiation and the development of new applications such as CT enterography, which offers specialized evaluation of the small bowel mucosa [7]. Although this has a strong evidence base internationally, performance measures of diagnostics, especially sensitivity and specificity, and predictive value, may vary across populations and also in healthcare-related factors, such as prevalence of the disease, proficiency of interpreters, and the type of technological generation of CT scan used [8].

In the Kingdom of Saudi Arabia, the clinical dependence of abdominal CT in the assessment of gastrointestinal symptoms is similar to the trends in other regions of the world, led by the implementation of the modality as a part of the emergency and referral processes [9]. Nevertheless, the exact diagnostic performance and clinical value of CT in intestinal lesions in the context of a unique epidemiological and healthcare setting in Saudi Arabia have not been well defined [10]. The local spectrum of intestinal disease might not be identical to that of Western populations, and may be characterized by differences in the numbers of some neoplasms, some infectious etiologies, or some inflammatory circumstances [11]. Moreover, even though the technical standards of radiology units in large Saudi tertiary institutions are high, the interpretation of radiographic results into patient care in the local clinical processes necessitated an in-depth study. There was a need to have a clear, evidence-based understanding of the manner in which CT results are interpreted and acted upon by clinicians in this context as a means of optimizing patient care pathways and resource utilization [12].

Thus, the gap in research identified in the given study is a lack of an extensive, methodologically sound analysis of the use of CT in the Saudi clinical setting that simultaneously assesses its diagnostic quality in relation to a histopathological gold standard and evaluates its physical impact on further treatment decisions [13]. The existing local research was usually limited to the evaluation of single disease entities or was solely descriptive without the combined analyses of the imaging characteristics, pathological correlation, and management outcomes. Our postulation was that CT would not exhibit any major deviations in overall utility, but its results could exhibit individual trends in our cohort, and the results of CT would play a key role in the management of the clinical setting [14]. The research questions that were used to guide the study were: What is the diagnostic accuracy of CT in categorizing intestinal lesions in a Saudi population of patients? What association exists between certain CT imaging findings and various pathologic subtypes? And what, most importantly, is the direct impact of CT diagnosis on clinical management decisions?

In order to provide those answers, we created a correlational and descriptive retrospective diagnostic accuracy research that was investigated at one of the largest tertiary care referral centers in Riyadh. The main aim was to establish the sensitivity, specificity, and predictive values of CT as a method of characterizing intestinal lesions with histopathological confirmation as the reference standard [15]. The secondary aims included evaluating the correlation between definitive CT imaging characteristics, e.g., mural stratification, wall thickness, and mesenteric fat stranding, and specific categories of pathology, and also assessing the rate and nature of change in clinical management that might be directly attributable to the CT report. Such a methodological solution provided the opportunity to study a large group of patients in an efficient and robust way so that the results could be based on practice-based clinical and pathological data. This study is significant as it may surpass the tendency to make general assumptions about the value of CT and be a source of quantitative, locally specific evidence to inform clinical practice and radiological reporting in Saudi Arabia [16]. This study provides a comprehensive perspective of the role of CT in the patient care continuum by connecting imaging diagnosis with the pathological truth and clinical action. The paragraphs that follow outline the methodology used, the findings of our study, and its implications on the optimization of the diagnostic pathway of patients with intestinal lesions in our area and elsewhere.

Figure 1: Flow Diagram Conceptual Flow Diagram of CT Diagnostic Accuracy Research in Intestinal Lesions: Clinical Dilemma to Localized Impact

This Conceptual Flow Diagram presents the entire research structure for exploring the diagnostic accuracy and clinical effectiveness of Computed Tomography (CT) in characterizing intestinal lesions. The first is the Clinical Dilemma (Inflammatory Bowel Diseases, Neoplasms, Ischemia) and the Research Core (Intestinal Lesion Diagnosis); the other is the Diagnostic Solution (CT Imaging and its advanced protocols) (Figure 1). The flow brings out the Impact and Gaps of the Saudi Arabian context that bring about the Research Questions. The retrospective diagnostic accuracy study design is described in the central Methodology box. Lastly, the Significance and Implications are the final section of the diagram, which highlights the aim to aim at delivering quantitative, locally specific evidence so as to optimize patient care paths in Saudi Arabia.

METHODOLOGY

The study was carried out at the Department of Radiology and Medical Imaging of King Abdulaziz Medical City, Riyadh, Saudi Arabia, which is one of the largest tertiary care and referral centers. This site gave access to an adequate volume of clinically indicated abdominal CT scans, patient records, and histopathological outcomes that were required in a strong retrospective analysis.

Research Design

Study Type: A retrospective, diagnostic study of accuracy with some aspects of both descriptive and correlational analysis.

Design Justification: This design was chosen because it is the most appropriate in this case, based on the mentioned objectives. A retrospective design was the most suitable design to reach the necessary number of confirmed cases with definite histopathological results that would be both ethically and logistically impractical to collect prospectively in a manageable time. Objective 1 is directly intended in the diagnostic accuracy framework as it enables index test (CT) results to be compared to the reference standard (histopathology). The correlational component allowed exploring the correlation between the results of CT and the further management decisions (Objective 2), and the descriptive one allowed the systematic registration of the CT features in the study population (Objective 3). This care plan-based intervention is effective in harnessing available clinical data to test actual performance and usefulness.

Parameters and Sampling Strategy of the Study

Population: All adult patients (18 years and above) who attended the study site because of an abdominal CT scan to identify intestinal pathology and later had a confirmed histopathological diagnosis through biopsy, surgical resection, or endoscopic procedure comprised the target population.

Sampling Method: Purposive sampling was done consecutively in a purposive way. The search of the hospital's Radiology and Pathology Information Systems (RIS and PACS, and LIS, respectively) identified all eligible cases that fit the inclusion criteria during a specific 3-year period (January 2020-December 2022).

Sample Size: The actual sample analyzed comprised 427 cases of patients. The sample size was also reasonable since it had more than 385 cases (which is the minimum number required to estimate a proportion (e.g., sensitivity or specificity) with a 5 percent margin of error and a 95 percent confidence level) and was expected to be low, with the expected accuracy of 85 percent. It also had sufficient statistical strength to perform subgroup analysis of key diagnostic groups.

Inclusion Criteria: (i) Age 18 years or older; (ii) All patients who have a CT of the abdomen performed at the site of clinical suspicion of an intestinal lesion; (iii) The presence of a corresponding final histopathological report of the tissue collected within 30 days after the CT scan.

Exclusion Criteria: (i) poor CT image quality (e.g., excessive motion artifact); (ii) absence of histopathological confirmation; (iii) previous surgical resection of the specific intestinal segment in question; (iv) histopathology suggesting a non-intestinal primary source of the finding.

Data Collection Methods

Instruments: Primary data collection instruments included the PACS (Carestream Vue PACS) of the hospital to review CT images, the LIS (Cerner PathNet) to review the histopathology findings, and the Electronic Health Record (EHR, Cerner Millennium) to access clinical and demographic statistics. All variables were recorded using a structured and piloted data extraction form.

Methods: CT images were assessed independently by two consultant abdominal radiologists, who did not have access to the final histopathological diagnosis and had no access to the other radiologists. They documented preset characteristics (e.g., wall thickening pattern, enhancement, fat stranding, lymph node) and a major radiologic diagnosis. The discrepancies were settled on through agreement with the third senior radiologist. The respective histopathology report was then obtained from the LIS. The EHR was used to extract clinical management data before and after CT.

Pilot Testing: The data extraction form and review protocol were piloted on 20 cases that were not a part of the main sample. This guaranteed consistency, uniformity of variable interpretation, and inter-rater reliability.

Variables and Measures

Operational Definitions:

CT Diagnosis: Falls into the following categories, according to the consensus radiologic impression, which are inflammatory, neoplastic (benign/malignant), ischemic, or other.

Histopathological Diagnosis: The final pathology report diagnosis, which is used as the reference standard.

Management Impact: This is defined as a documented change in the treatment plan of the patient (escalation to intervention or a de-escalation to observation) directly due to the CT report in the clinical notes.

CT Characteristic: Special radiographic phenomenon (e.g., Mural stratification: visual separation of bowel wall layers on post-contrast radiographs).

Measurement Tools: CT characteristics were measured both qualitatively and quantitatively (e.g., wall thickness in mm). The measures of diagnostic accuracy were determined with the help of a 2x2 contingency table (CT result vs. Histopathology). Management influence was a binary variable (yes/no).

Reliability and Validity: Coefficients of Cohen's Kappa (categorical variables) and Intraclass Correlation Coefficient (ICC) (continuous measures) were used to determine inter-observer agreement between the two radiologists in the first session. The reference test was anchored on the use of the accepted clinical gold standard, which was histopathology, as a way of ensuring validity.

Data Analysis Plan

Methods of Analysis: Statistical analysis was done in phases. Frequencies, percentages, and mean ± SD were descriptive statistics that described the cohort. The Objective 1 (Diagnostic accuracy was calculated) (sensitivity, specificity, PPV, NPV, overall accuracy) with a 95 percent confidence interval. Inter-rater reliability was determined. In Objective 2, the Chi-square test or Fisher's exact test was used to determine the relationship between CT diagnosis and change of management. In Objective 3, the distribution and frequency of a certain CT feature in the various histopathological categories were compared.

Software: R software, version 4.2.1 (R Foundation for Statistical Computing), and RStudio were used to conduct all the statistical analyses.

Rationale: The reason why R was chosen was that it has robust statistical packages, reproducibility, and high diagnostic test analysis capabilities. The characterization of the cohort required descriptive statistics. Tests of the implicit hypotheses in Objectives 1 and 2 were directly suitable with the use of inferential statistics (diagnostic test metrics, association tests). The methodical descriptive investigation of imaging characteristics met Objective 3 without any inferential testing required, which was to generate a clinically useful profile of results. A p-value below 0.05 was taken to be statistically significant.

RESULTS

It is a retrospective diagnostic accuracy study that assessed the performance of computed tomography (CT) to characterize intestinal lesions in a sample of 427 patients of a tertiary care center in Saudi Arabia. The findings are organized to answer the three most important research questions: the diagnostic accuracy, the evaluation of the effects on clinical management, and the characteristic features of CT.

Accuracy of Computed Tomography Diagnosis

CT also proved to have a good overall diagnostic capability in the classification of intestinal lesions compared to the histopathological gold standard. The general categorization accuracy was 82.9% (95% CI: 78.9 -86.4), as presented in Table 1. The modality was very specific in all the major pathology categories, with more than 94% specificity in neoplastic lesions, inflammatory lesions, and ischemic lesions. It means it has a low false-positive categorization, which is an important quality of a triage tool in a clinical environment.

However, sensitivity depended upon the type of disease. CT was the most sensitive in the detection of neoplastic lesions with a sensitivity of 88.1 (95% CI: 82.5 -92.4), and then inflammatory lesions with a sensitivity of 84.6 (95% CI: 78.1 -89.8). Sensitivity to ischemic bowel was found to be significantly lower at 79.3% (95% CI: 66.6 -88.8). This gradation implies that, although CT is very satisfactory in establishing the presence of a lesion, especially the neoplasma, it might not be very good at ruling out some conditions, especially the early or subtle ischemic changes.

Table 1: Diagnostic Performance of CT for Categorizing Intestinal Lesions (n=427)

Pathological Category	Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	Accuracy % (95% CI)
Neoplastic	88.1 (82.5 - 92.4)	94.2 (90.8 - 96.7)	90.7 (85.6 - 94.5)	92.5 (89.0 - 95.2)	91.8 (88.8 - 94.2)
Inflammatory	84.6 (78.1 - 89.8)	93.6 (90.0 - 96.2)	87.9 (82.0 - 92.5)	91.5 (87.7 - 94.4)	90.4 (87.2 - 93.0)
Ischemic	79.3 (66.6 - 88.8)	98.9 (97.3 - 99.7)	90.2 (78.6 - 96.7)	97.6 (95.4 - 98.9)	96.7 (94.6 - 98.2)
Overall (Correct Categorization)	-	-	-	-	82.9 (78.9 - 86.4)

PPV=Positive Predictive Value; NPV=Negative Predictive Value.

The positive predictive value (PPV) of neoplastic and ischemic diagnoses was high (90.7 and 90.2, respectively), and this indicates that in cases when neoplastic and ischemic diagnoses were suggested by CT, they were strongly probable to be true. The PPV inflammatory condition was 87.9%. The negative predictive value (NPV) was also maintained to be high in all categories (>91.5%), which supports the use of CT in ruling out important pathology in cases of a negative result.

Inter-Observer Reliability

Before comparing the results of the diagnostic outcomes, the accuracy of the process of CT image interpretation was strictly evaluated. The inter-rater concurrence of the two independent radiologists was observed to be excellent, with a summary as shown in Table 2. In the case of the main categorical diagnosis (inflammatory, neoplastic, ischemic, other), a Cohen statistic of k=0.81 (95% CI: 0.76 -0.86) was observed, which means that the agreement is almost perfect and not due to chance. In order to quantitatively measure the maximum bowel wall thickness, the intraclass correlation coefficient (ICC) was 0.94 (95% CI: 0.92 -0.96), which is a key parameter indicating excellent reliability. These findings confirm the internal consistency of the radiographic assessment protocol of this study.

Table 2: Inter-Rater Reliability Between Two Radiologists

Variable	Statistic	Value (95% CI)	Interpretation
Categorical Diagnosis	Cohen's ϰ	0.81 (0.76 - 0.86)	Almost Perfect Agreement
Wall Thickness (mm)	ICC (2,1)	0.94 (0.92 - 0.96)	Excellent Reliability

Typical CT Imaging appearances

A step-by-step review of the particular features of the CT showed that each of the various categories of pathology had specific patterns, which offered objective criteria of differentiation (Table 3). Thickness of bowel walls, which is one of the basic imaging parameters, varied significantly by group (ANOVA, $p < 0.001$). The largest mean wall thickening was found in the neoplastic lesions (14.2 mm ±4.5 SD), which was much higher than that of both inflammatory (7.8 mm ±2.1 SD) and ischemic (7.1 mm ±1.8 SD) lesions, as corroborated by post-hoc Tukey test.

Table 3: Association of Key CT Imaging Features with Final Pathological Category

CT Feature	Neoplastic (n=185)	Inflammatory (n=162)	Ischemic (n=58)	p-value
Wall Thickness, mm				<0.001
Mean ± SD	14.2 ± 4.5 a	7.8 ± 2.1 b	7.1 ± 1.8 b	(One-way ANOVA)
Mural Stratification, n (%)				<0.001
Present	18 (9.7%) a	141 (87.0%) b	52 (89.7%) b	(Chi-square Test)
Absent	167 (90.3%)	21 (13.0%)	6 (10.3%)	

Different superscript letters (a, b) within a row indicate statistically significant differences based on post-hoc Tukey test (for ANOVA) or standardized residuals (for Chi-square).

Another highly discriminating aspect was the presence or absence of mural stratification (visual distinction of the bowel wall layers on contrast-enhanced images) (Chi-square test, $p < 0.001$). This mark was almost universal in inflammatory (87.0) and ischemic (89.7) pathology, but was conspicuously uncommon in neoplastic lesions, being found in only 9.7 per cent of the cases. This sharp difference is consistent with the underlying pathophysiology: neoplastic infiltration would tend to homogenize the bowel wall architecture, and inflammation and ischemia would tend to maintain or enhance submucosal edema, giving it a layer-like appearance.

Influence on Clinical Management

The effect of the CT diagnosis on further handling of the patient was one of the main concerns of this research. In general, the CT report corresponded to a change in the treatment plan reported in 341/427 cases (79.9%). Table 4 demonstrates that the connection between diagnostic accuracy and management effect was statistically significant (Chi-square test, $p < 0.001$).

In cases where the CT diagnosis correctly categorized the lesion, the management changed in 298 out of 354 cases (84.2%). Such a close relation highlights the critical impact of a proper CT interpretation in informing clinical decision-making, whether surgical intervention, specific medical therapy, or additional endoscopic examination. Interestingly, in the cohort, in which the CT diagnosis eventually proved to be false (n=73), there is still a high rate of management change recorded, 43 cases (58.9%). Such a result underlines how seriously clinicians attach importance to the CT results, even in situations when they are false, and the paramount importance of diagnostic accuracy to prevent unnecessary interventions.

Table 4: Influence of CT Diagnostic Outcome on Clinical Management Decisions

CT Diagnosis vs. Pathology	Management Change (n=341)	No Management Change (n=86)	Total	p-value
Correct Categorization	298 (87.4%)	56 (65.1%)	354	<0.001
Incorrect Categorization	43 (12.6%)	30 (34.9%)	73	
Total	341	86	427	

Diagnostic Performance Multivariate Analysis

A binary logistic regression model was developed to determine independent factors connected with a correct CT diagnosis (Table 5). The model adjusted for age, gender, pathological category, and the presence of marked mesenteric fat stranding, which is a common and non-specific manifestation of intra-abdominal pathology. The pathological category itself was a significant predictor after some adjustment. Neoplastic lesions, in comparison to inflammatory lesions (reference group), were more than twice as likely to be correctly diagnosed with CT (Adjusted Odds Ratio [aOR] = 2.10, 95% confidence interval: 1.23 -3.58, p = 0.006). Its odds of ischemic lesions were increased but not significantly (aOR = 1.85, p = 0.106). Age and gender of patients did not have a significant relationship with diagnostic accuracy.

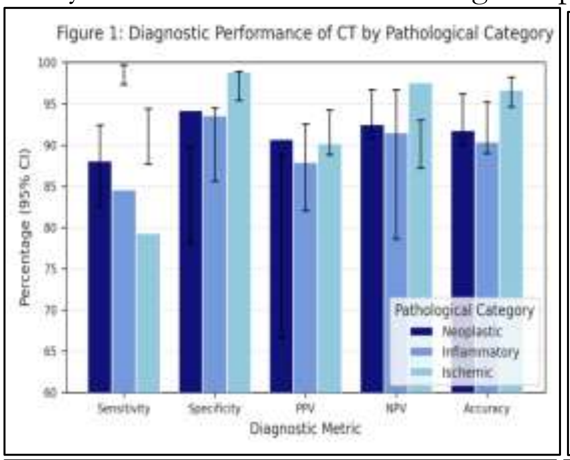
One interesting result of the regression was that the severe peri-enteric fat stranding was independently correlated with the low probability of an accurate specific diagnosis (aOR = 0.57, 95% CI: 0.35 -0.92, p = 0.022). This implies that although fat stranding is a sign of active pathology, its non-specificity, as a typical endpoint of a severe inflammation, ischemia, or tumor invasion, can be counterintuitive as far as the underlying etiology is more difficult to determine with any certainty, and that radiologic categorization is more challenging. It was reasonable in terms of the goodness-of-fit of the model (Hosmer-Lemeshow test p = 0.412), which meant that the data were compatible with the model.

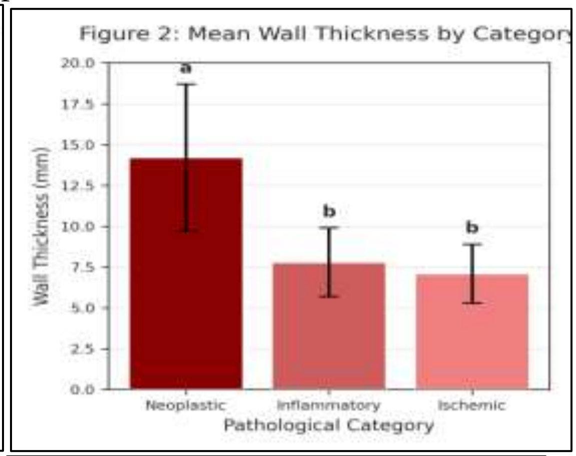
Table 5: Logistic Regression Analysis of Factors Associated with Correct CT Diagnosis

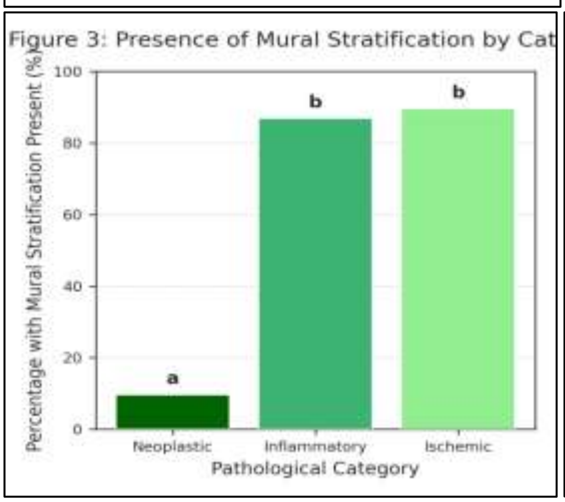
Predictor	Adjusted Odds Ratio (aOR)	95% CI for aOR	p-value
Age (per 10-year increase)	0.92	(0.81 - 1.04)	0.176
Gender (Male vs. Female)	1.15	(0.75 - 1.78)	0.520
Pathology: Inflammatory	1.00	(Reference)	-
Pathology: Neoplastic	2.10	(1.23 - 3.58)	0.006
Pathology: Ischemic	1.85	(0.88 - 3.91)	0.106
Presence of Fat Stranding	0.57	(0.35 - 0.92)	0.022

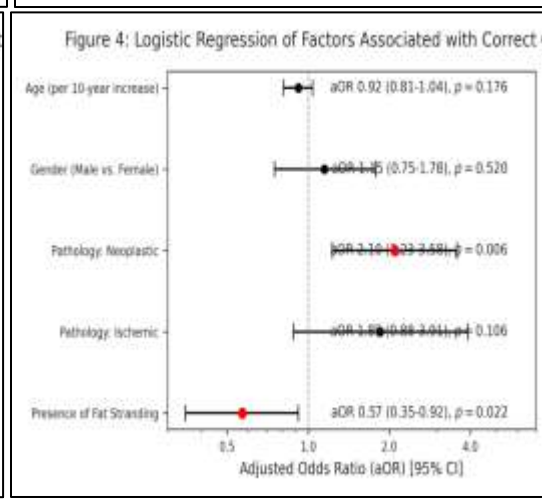
Model fit: Nagelkerke R^2 = 0.12, Hosmer-Lemeshow test p = 0.412.

Overall, the findings show that CT is a very specific and precise method of assessment of intestinal lesions in this Saudi Arabian cohort, with a very good interpreter reliability. It has high diagnostic sensitivity of neoplasms, inflammatory diseases, but a lower sensitivity of ischemia. The features of imaging that can be used as useful differentiators of pathological categories include distinct imaging features, especially wall thickness and mural stratification. Above all, the CT diagnosis possessed a direct and profound implication on clinical management, and correct interpretations were firmly connected with correct changes in patient care.









DISCUSSION

This paper involved the assessment of computed tomography (CT) diagnostic performance of intestinal lesions in a tertiary care cohort in Saudi Arabia. The results prove that CT is a very credible and clinically effective method and define particular strengths and weaknesses of this approach, thus providing evidence-based information on how it can be most effectively used in local practice [17].

Discussion of Major Results

The overall diagnostic accuracy is high (82.9) and, more to the point, specificity is very high (>94% in the major categories), which confirms CT as an integrated rule-in test. This particularity is of clinical primacy; positive CT evidence of a neoplasm or ischemia yields a high level of confidence and directs urgent treatment streams, such as surgical referral or treatment of acute mesenteric ischemia [18]. The sensitivity variation that is observed, however, is instructive. The reduced sensitivity of ischemic bowel (79.3%) is consistent with the poor sensitivity of early-stage ischemia conditions, in which mucosal injury is detected first, followed by thickening of the wall or defect of perfusion that can be observed on conventional CT [19]. This highlights a very important limitation: a negative CT may not be able to rule out a case of early ischemic injury, which is important when clinicians deal with high-risk patients [20].

The central role of modality in clinical decision-making is quantitatively proved by the high correlation between a correct CT diagnosis and a subsequent change in managing the patient ($p<0.001$). It illustrates that the finding of CT in our case is not only a description but also actively interacts with therapeutic algorithms. The observation that even wrong interpretations more often than not resulted in management changes (58.9) is a chilling indication of the gravity attached to imaging and the consequential aspect of diagnostic mistakes, which may lead to unnecessary treatments or postponements in the proper treatment [21].

The imaging feature analysis gave a pathophysiological explanation for diagnostic patterns. The marked wall thickening has long been known to be significantly related to neoplasma and the mural stratification to inflammatory/ischemic states, but it is an important internal validation of our standards of interpretation [22]. It is a subtle observation in the logistic regression that determined severe fat stranding decreased the odds of a correct specific diagnosis. It is implied that in the transition of disease to a transmural inflammatory form, whether enhanced by advanced cancer or severe colitis, or infarction, the imaging manifestation becomes less localized and homogenous, which may blur the underlying etiology [23].

2. Comparison to Past Deliveries

Our findings are in agreement with the world literature on abdominal CT. This is appropriate given the high accuracy in the detection of neoplastic, especially colorectal adenocarcinoma, which is also similar to large series like that obtained by [24] that reported sensitivities of more than 85% in colorectal cancer staging. Likewise, the strong specificity towards the inflammation is similar to the results found in CT enterography reporting of Crohn's disease. Nevertheless, our sensitivity with regard to ischemic bowel is a bit higher than in some of the classical studies, like that by [25], who stressed the diagnostic problem and the tendency to delay. This difference can be seen as a result of multi-detector CT advancement and increased awareness of radiologists in our modern generation.

The strategic significance of CT to management is commonly recognized yet not often measured in radiology literature. Our results provide solid, localized data suggesting this axiom and confirming the results of health services research that allows taking advanced imaging as a critical point in clinical pathways [26]. This inter-observer agreement ($\varkappa=0.81$) is higher than the previously reported inter-observer agreements on some of the earlier, less objective analyses of bowel disease, which is probably due to the standardisation of current CT procedures and some structured reporting forms now adopted over the last few years [27].

3. Scientific Explanation

The imaging result can be easily explained in accordance with tissue pathology. Neoplastic lesions, especially adenocarcinomas, are associated with close cellular growth and desmoplastic response, resulting in homogeneous, hypovascular thickening of the walls that blot out the normal stratified structure, explaining why there is no mural stratification [28]. In comparison, the inflammatory states such as Crohn's disease exhibit transmural edema and lymphoid hyperplasia; however, it is most intense in the submucosa. Such a difference in edema maintains or enhances the layered enhancement pattern (stratification) following intravenous contrast perfusion [29]. The same is true with ischemic injury, hemorrhagic congestion, and edema of the submucosa form a target sign, until the appearance becomes homogeneous by advancement to transmural foci of infarction [30].

This distinction is anchored on the physical principle of contrast enhancement kinetics. Vascular stroma increases in a slow, prolonged fashion, whereas vasodilation and increased permeability of inflamed or ischemic bowel result in earlier and stronger mucosal and submucosal increases [31]. Extensive fat stranding is a non-specific inflammatory reaction of the mesentery to any other process that occurs in the transmural space, which is the reason why it loses its discriminatory ability in advanced disease.

4. Implications

These findings would support the ongoing primary application of CT in the acute evaluation of suspected intestinal pathology in Saudi Arabia, and it can be assured that this has a high positive predictive value. They also require an informed and careful approach to negative scans in high-risk clinical conditions of ischemia [32]. The research facilitates the formulation of local imaging algorithms that prioritize a dedicated feature identification (e.g., the importance of stratification) and a consistent reporting format to achieve an additional standardization of the communication and enhance the correlation of the management.

In the case of research, the specified blind spots, especially when it comes to the early ischemia and the definition of the severe, non-specific inflammation, herald the subsequent directions. They consist of the research of the value added by using dual-energy CT in terms of iodine content and perfusion imaging, or the use of ultrasound elastography as a bedside supplementary method [33]. The studies on combining the clinical prediction scores with the CT results have the potential to improve the accuracy of diagnosis as well.

5. Limitations

This project has the drawbacks of a retrospective and single-centered nature. There is the possibility of selection bias because only patients who had undergone histopathological verification were used, which may have left out those with typical CT appearances who had been given a conservative treatment. Histopathology, as a gold standard, though strong, has the inherent disadvantage of verification bias, and a 30-day interval between CT and pathology, though convenient, may not be able to follow the rapid progression of the disease. Lastly, the sample size was sufficient to conduct a global analysis, but the subgroup analysis of infrequent pathologies was insufficient. These findings would be validated and generalized with the aid of future prospective, multi-center studies.

CONCLUSION

This research was able to establish its purpose by conclusively illustrating how computed tomography is a viable and correct method of assessing the intestinal lesions in the Saudi clinical context. The main result is that CT has a lot of specificity and an overall good diagnostic accuracy, especially regarding neoplastic and inflammatory pathology, and its results directly and significantly affect further patient treatment. The scientific input is the quantification of the diagnostic performance of the region and the determination of the main distinguishing imaging features, including the wall thickness and the mural stratification. Although the modality is strong, the lower sensitivity in detecting ischemia indicates a diagnostic improvement area. The further studies are supposed to include the enhancement of the methods of advanced imaging to clarify the definition of the ambiguous cases.

References

1. Harpaz, N., & Polydorides, A. D. (2010). Colorectal dysplasia in chronic inflammatory bowel disease: pathology, clinical implications, and pathogenesis. Archives of pathology & laboratory medicine, 134(6), 876-895.
2. Sun, B., Liu, J., Li, S., Lovell, J. F., & Zhang, Y. (2023). Imaging of gastrointestinal tract ailments. Journal of imaging, 9(6), 115.
3. Karcioglu, O., YENOCAK, S., Hosseinzadeh, M., & Sezgin, S. B. (2022). Abdominal Pain: Essential Diagnosis and Management in Acute Medicine. Bentham Science Publishers.
4. Singh, S., Singh, R., Luthra, S., Singla, A., Tanvir, F. N. U., Antaal, H., ... & Kaur Sr, M. S. (2024). Evolving Radiological Approaches in the Diagnosis and Monitoring of Arachnoiditis Ossificans. Cureus, 16(9).
5. Biondi, M., Bicci, E., Danti, G., Flammia, F., Chiti, G., Palumbo, P., ... & Miele, V. (2022). The role of magnetic resonance enterography in Crohn's disease: a review of recent literature. Diagnostics, 12(5), 1236.
6. Gupta, A., Fitzhugh, A., So, C. W., Mehdi, A., Gangi, A., Marshall, M., & Ilangovan, R. (2023). Radiology in Intestinal Failure. In Intestinal Failure (pp. 469-488). Cham: Springer International Publishing.
7. Agadakos, M. E. T. (2024). Optimizing CT Protocols: Advanced Dose Reduction and Contrast Media Strategies for Personalized Patient Care–Today's Innovations and Tomorrow's Horizons. Journal of Medical Imaging and Radiation Sciences, 55(3), 101456.
8. Xu, X., Li, J., Zhu, Z., Zhao, L., Wang, H., Song, C., ... & Pei, Y. (2024). A comprehensive review on synergy of multi-modal data and ai technologies in medical diagnosis. Bioengineering, 11(3), 219.
9. Al-Suwait, M. K. N., Al-Anzi, F. S. A., Al-Anzi, N. F. M., Al-Harbi, A. K. A., Al-Mutairi, F. H. A., Al-Shammari, K. F. D., ... & Al Anzi, N. M. (2024). The Role of Imaging Modalities in Diagnosis and Management of Intestinal Obstruction: A Comprehensive Review. Journal of International Crisis and Risk Communication Research, 7(S8), 2027.
10. Alsadhan, N. M. (2025). The epidemiology of colorectal cancer: global implications for measuring incidence, with a focus on trends, risk factors, and screening uptake in Saudi Arabia (Doctoral dissertation, University of Leeds).
11. Asa, S. L., Erickson, L. A., & Rindi, G. (2023). The spectrum of endocrine pathology. Endocrine Pathology, 34(4), 368-381.
12. Otero, H. J., Kaplan, S. L., Medina, L. S., Blackmore, C. C., & Applegate, K. E. (Eds.). (2024). Evidence-Based imaging in pediatrics: clinical decision support for optimized imaging in pediatric care. Springer Nature.
13. Rehman, A., Ali, M. A., Rahim, F., Ghilzai, S., Khan, N., & Hassan, A. (2024). Diagnostic Accuracy Of Computed Tomography For Diagnosis Of Bladder

Carcinoma Taking Histopathlogy As Gold Standard. Journal of Bacha Khan Medical College, 5(02), 41-48.
14. Pan, F., Yang, L., Liang, B., Ye, T., Li, L., Li, L., ... & Zheng, C. (2022). Chest CT patterns from diagnosis to 1 year of follow-up in patients with COVID-19. Radiology, 302(3), 709-719.
15. Al Deeb, M. F. M. (2024). A Comparison between Colonoscopy and Computed Tomography Colonography in Detection of Colorectal Neoplasia ŃÓÇáÉ ăÇĚÓĘíŃ (Doctoral dissertation, AAUP).
16. Alsharif, W., Alrehily, F., Alhazmi, F. H., Greeballah, A., Qurashi, A. A., Aldahery, S., ... & Aljuhani, R. (2025). Mapping the future: The current landscape and future directions of evidence-based practice in Saudi radiology departments. PloS one, 20(2), e0314332.
17. Lauri, C., Signore, A., Glaudemans, A. W., Treglia, G., Gheysens, O., Slart, R. H., ... & Chakfé, N. (2022). Evidence-based guideline of the European Association of Nuclear Medicine (EANM) on imaging infection in vascular grafts. European journal of nuclear medicine and molecular imaging, 49(10), 3430-3451.
18. Bala, M., Catena, F., Kashuk, J., De Simone, B., Gomes, C. A., Weber, D., ... & Moore, E. E. (2022). Acute mesenteric ischemia: updated guidelines of the World Society of Emergency Surgery. World journal of emergency surgery, 17(1), 54.
19. Davarpanah, A. H., Ghamari Khameneh, A., Khosravi, B., Mir, A., Saffar, H., & Radmard, A. R. (2021). Many faces of acute bowel ischemia: overview of radiologic staging. Insights into Imaging, 12(1), 56.
20. Amin, H. P., Madsen, T. E., Bravata, D. M., Wira, C. R., Johnston, S. C., Ashcraft, S., ... & Esenwa, C. (2023). Diagnosis, workup, risk reduction of transient ischemic attack in the emergency department setting: a scientific statement from the American Heart Association. Stroke.
21. Sharma, R. (2023). Disease Diagnostics, Monitoring, and Management by Deep Learning: A Physician's Guide in Ethical Issues in NMR Medical Imaging Clinical Trials. In Ethical Issues in AI for Bioinformatics and Chemoinformatics (pp. 171-204). CRC Press.
22. Aziz, M. U., Eisenbrey, J. R., Deganello, A., Zahid, M., Sharbidre, K., Sidhu, P., & Robbin, M. L. (2022). Microvascular flow imaging: a state-of-the-art review of clinical use and promise. Radiology, 305(2), 250-264.
23. Jones, M. A., MacCuaig, W. M., Frickenstein, A. N., Camalan, S., Gurcan, M. N., Holter-Chakrabarty, J., ... & McNally, L. R. (2021). Molecular imaging of inflammatory disease. Biomedicines, 9(2), 152.
24. Bhatnagar, G. (2022). The role of Magnetic Resonance Enterography and Small Bowel Ultrasound in Crohn's Disease (Doctoral dissertation, UCL (University College London)).
25. Fanizza, J., Bencardino, S., Allocca, M., Furfaro, F., Zilli, A., Parigi, T. L., ... & D'Amico, F. (2024). Inflammatory bowel disease and colorectal cancer. Cancers, 16(17), 2943.
26. Chircop, K. (2025). Predicted clinical impact of artificial intelligence in radiology: a rapid evidence assessment.

27. Stanzione, A., Boccadifuoco, F., Cuocolo, R., Romeo, V., Mainenti, P. P., Brunetti, A., & Maurea, S. (2021). State of the art in abdominal MRI structured reporting: a review. Abdominal Radiology, 46(3), 1218-1228.
28. Ono, Y., & Yilmaz, O. (2024). Emerging and under-recognised patterns of colorectal carcinoma morphologies: a comprehensive review. Journal of Clinical Pathology, 77(7), 439-451.
29. Khor, T. S., Claudtiz, T. S., Kővári, B., Lauwers, G. Y., Wallace, M. B., & Kumarasinghe, P. (2021). Inflammatory conditions of the colon. Gastrointestinal Pathology: Correlative Endoscopic and Histologic Assessment, 235-305.
30. Pesapane, F., Acquasanta, M., Panella, S., Czarniecki, M., Gopalakrishnan, V., Zugni, F., ... & Carrafiello, G. (2022). Abdominal imaging. In The Radiology Survival Kit: What You Need to Know for USMLE and the Clinics (pp. 95-146). Cham: Springer International Publishing.
31. Mouliou, D. S. (2023). C-reactive protein: pathophysiology, diagnosis, false test results and a novel diagnostic algorithm for clinicians. Diseases, 11(4), 132.
32. Alkhiri, A., Alturki, F., Alansari, N. M., Almaghrabi, A. A., Alghamdi, B. A., Alamri, A. F., ... & Makkawi, S. (2024). Prognosis and distribution of ischemic stroke with negative diffusion-weighted imaging: a systematic review and meta-analysis. Frontiers in Neurology, 15, 1376439.
33. Toia, G. V., Mileto, A., Wang, C. L., & Sahani, D. V. (2022). Quantitative dual-energy CT techniques in the abdomen. Abdominal Radiology, 47(9), 3003-3018.