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Original Research Article

Diagnostic Accuracy of CT Scan Abdomen in Differentiating Peritoneal Tuberculosis from Peritoneal Carcinomatosis, Taking Omental Biopsy as Gold Standard

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Abstract: *Peritoneal tuberculosis (PTB) and peritoneal carcinomatosis (PC) often present with overlapping clinical and radiological features, making differentiation challenging. In tuberculosis-endemic regions such as Pakistan, accurate non-invasive diagnosis is vital to guide appropriate treatment and avoid mismanagement.* ***Objective:*** *To assess the diagnostic accuracy of contrast-enhanced CT (CECT) in differentiating peritoneal tuberculosis from peritoneal carcinomatosis using omental biopsy as the gold standard.* ***Methods:*** *This cross-sectional analytical study was conducted at the Department of Radiology, Chaudhry Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, over a period of six months from April 2024 to September 2024. A total of 149 patients aged 30–65 years with suspected peritoneal disease were included. All participants underwent CECT followed by omental biopsy. CT findings were compared with histopathology. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated using SPSS version 25.* ***Results:*** *CT scan showed a sensitivity of 90.4%, specificity of 80.3%, PPV of 85.2%, NPV of 86.9%, and an overall diagnostic accuracy of 85.9%. Further stratified analysis revealed consistent diagnostic performance across age, gender, and residential status, supporting the modality's reliability in diverse subpopulations.* ***Conclusion:*** *CT scan is a reliable, non-invasive diagnostic tool for distinguishing PTB from PC, especially in TB-endemic settings like Pakistan. While omental biopsy remains the definitive diagnostic method, CT can play a pivotal role in guiding clinical decisions and reducing diagnostic delays.*

Keywords: Peritoneal Tuberculosis, Peritoneal Carcinomatosis, CT Abdomen, Omental Biopsy, Diagnostic Accuracy

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Introduction

Peritoneal tuberculosis (PTB) is an extrapulmonary manifestation of Mycobacterium tuberculosis infection, primarily involving the peritoneum, mesentery, and omentum. It is a significant public health concern in tuberculosis-endemic regions, including Pakistan, where the overall burden of TB remains alarmingly high. According to the World Health Organization Global TB Report 2023, Pakistan ranks fifth among the high TB burden countries globally, with an estimated 611,000 new TB cases annually, of which a significant proportion represents extrapulmonary tuberculosis (EPTB) manifestations, including abdominal TB (1).

Peritoneal carcinomatosis (PC), on the other hand, refers to the dissemination of malignant cells to the peritoneum from primary gastrointestinal or gynecological cancers. It presents with similar clinical features to PTB, including abdominal pain, distension, ascites, weight loss, and constitutional symptoms (2). The overlapping symptomatology and imaging findings of PTB and PC pose a diagnostic dilemma, particularly in resource-limited settings like Pakistan, where access to advanced diagnostic techniques may be restricted (3).

In clinical practice, differentiating PTB from PC is crucial as the management strategies differ significantly—anti-tubercular therapy for PTB versus systemic chemotherapy or palliative care for PC. Misdiagnosis may lead to unnecessary toxicity or a delay in appropriate treatment. Conventional diagnostic approaches include ascitic fluid analysis, adenosine deaminase (ADA) measurement, polymerase chain reaction (PCR), and histopathological examination, with omental biopsy regarded as the diagnostic gold standard due to its high specificity (4).

Radiological imaging, particularly contrast-enhanced computed tomography (CECT) of the abdomen, has emerged as a valuable non-invasive tool in the diagnostic algorithm for suspected peritoneal disease. Characteristic CT findings of peritoneal tuberculosis include smooth peritoneal thickening, nodular or "smudged" omental infiltration, and high-density ascites, whereas peritoneal carcinomatosis typically presents with irregular peritoneal thickening, omental caking, large soft-tissue masses, and loculated ascites (5, 6). However, despite advancements in imaging, considerable overlap still exists between these two conditions, necessitating validation of the diagnostic accuracy of CT in specific populations (7).

In Pakistan, the diagnostic value of abdominal CT in differentiating PTB from PC remains underexplored. Studies from other regions report varying sensitivity and specificity, often influenced by the skill of the radiologist, imaging quality, and population characteristics (8). Moreover, due to a higher background prevalence of TB and associated stigma, clinicians may lean towards empirical anti-TB therapy in ambiguous cases without definitive diagnosis, which not only delays cancer treatment in actual carcinomatosis cases but also adds to the burden of drug resistance (9).

Multidisciplinary consensus highlights the importance of early and accurate diagnosis using accessible modalities. While histopathology remains the gold standard, it is invasive, not always feasible, and associated with potential complications. In contrast, a validated imaging modality like CT can serve as a frontline diagnostic tool, especially in tertiary care centers with limited pathology support (10). Moreover, CECT is relatively affordable, widely available in urban radiology departments of Pakistan, and allows for non-invasive assessment of the entire abdominal cavity (11).

Recent international studies have evaluated the role of imaging biomarkers and radiological scoring systems to improve CT diagnostic yields in differentiating peritoneal pathologies (12, 13). In the local context, however, such initiatives are scarce, with very few studies providing diagnostic accuracy metrics specific to the Pakistani population. The need to contextualize global diagnostic standards to our population is evident, given the differences in TB prevalence, dietary habits, health literacy, and access to care (14).

This study was conducted at Chaudhry Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, a tertiary-level center catering to a diverse population across southern Punjab. The region, marked by both urban and rural demographics, provides an ideal cohort to assess diagnostic tools applicable across Pakistan. The study aimed to determine the diagnostic accuracy of CT abdomen in differentiating peritoneal tuberculosis from peritoneal carcinomatosis using omental biopsy as the reference standard. The findings are expected to help bridge the gap in evidence-based imaging utilization and reduce the rate of empirical management in peritoneal pathologies.

In Pakistan's TB-endemic setting, it is critical to validate and promote cost-effective, non-invasive, and widely accessible diagnostic modalities such as abdominal CT scan for early differentiation between peritoneal tuberculosis and peritoneal carcinomatosis. This would facilitate timely, appropriate therapy, reduce complications associated with diagnostic delays, and optimize resource allocation in high-burden healthcare systems. This study fills the existing gap in local literature by providing evidence on CT accuracy within the Pakistani demographic, potentially impacting national clinical protocols and imaging guidelines.

Methodology

The present study was conducted at the Department of Radiology, Chaudhry Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, to evaluate the diagnostic accuracy of CT scan in differentiating peritoneal tuberculosis from peritoneal carcinomatosis, taking omental biopsy as the gold standard. It was designed as a cross-sectional analytical study and included a total of 149 patients. The study duration spanned six months, from April 2024 to September 2024. Ethical approval was obtained from the institutional review board, and written informed consent was taken from all participants prior to enrollment.

The inclusion criteria comprised patients of either gender, aged between 30 and 65 years, presenting with radiological suspicion of either peritoneal tuberculosis or peritoneal carcinomatosis and undergoing omental biopsy for definitive histopathological diagnosis. Patients with a known history of abdominal malignancy, previously treated peritoneal tuberculosis, or contraindications to CT contrast media were excluded. A consecutive sampling technique was employed to enroll eligible patients until the desired sample size was achieved.

All patients underwent a contrast-enhanced CT scan of the abdomen using a standardized protocol. Imaging was performed using a multidetector CT scanner, and scans were analyzed by experienced radiologists blinded to the final histopathological diagnosis. Imaging features such as peritoneal thickening, omental caking, ascites, lymphadenopathy, and nodularity were assessed and used to formulate a provisional diagnosis of either peritoneal tuberculosis or carcinomatosis based on characteristic radiological patterns.

Following imaging, all patients underwent diagnostic laparoscopic or open surgical omental biopsy. The biopsy specimens were sent to the pathology department for histopathological examination, which was considered the gold standard for final diagnosis. Based on histopathological findings, cases were confirmed as either peritoneal tuberculosis or peritoneal carcinomatosis.

Data were recorded on a structured proforma, including demographic details, CT scan findings, and histopathological results. Statistical analysis was performed using SPSS version 25.0. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of CT scan were calculated against histopathology as the reference standard. Stratification by age, gender, and residential status was also performed to evaluate the consistency of diagnostic performance across subgroups. A p-value less than 0.05 was considered statistically significant. The study adhered to the principles of the Declaration of Helsinki and was designed to maintain the confidentiality and privacy of all participants.

Results

A total of 149 patients were enrolled in this cross-sectional study at the Department of Radiology, Chaudhry Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, to evaluate the diagnostic accuracy of CT scan in differentiating peritoneal tuberculosis from peritoneal carcinomatosis, using omental biopsy as the gold standard.

The mean age of the participants was 47.6 ± 9.2 years, with the age range spanning 30 to 65 years. There were 84 females (56.4%) and 65 males (43.6%). A total of 86 patients (57.7%) resided in urban areas, while 63 (42.3%) were from rural regions. (Table 1)

CT scan diagnosed 88 patients (59.1%) with peritoneal tuberculosis and 61 (40.9%) with peritoneal carcinomatosis. On histopathology, 83 (55.7%) were confirmed as tuberculosis, and 66 (44.3%) as carcinomatosis. (Table 2)

Table 1: Demographic Profile of Study Participants (n = 149)

Variable	Category	Frequency (n)	(%)
Age (years)	Mean ± SD	47.6 ± 9.2	
Gender	Male	65	43.6
	Female	84	56.4
Area of Residence	Urban	86	57.7
	Rural	63	42.3

Table 2: Diagnostic Comparison of CT scan with Histopathology (n = 149)

Diagnosis	CT scan Finding	Histopathology Finding	Frequency (n)	(%)
Peritoneal Tuberculosis	Positive	True Positive	75	50.3
	Positive	False Positive	13	8.7
	Negative	False Negative	8	5.4
	Negative	True Negative	53	35.6
	• **Sensitivity:** 90.4% • **Specificity:** 80.3% • **PPV:** 85.2% • **NPV:** 86.9% • **Diagnostic Accuracy:** 85.9%			

Table 3: Diagnostic Accuracy of CT Scan Abdomen Against Histopathology (n = 149)

Parameter	Value (%)
Sensitivity	90.4
Specificity	80.3
Positive Predictive Value (PPV)	85.2
Negative Predictive Value (NPV)	86.9
Diagnostic Accuracy	85.9

Table 4: Stratified Diagnostic Performance of CT scan by Demographics

Subgroup	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Age < 50 years	91.2	78.6	83.3	88.0	85.1
Age ≥ 50 years	89.5	81.4	87.5	85.2	86.3
Male	88.6	81.6	84.2	86.4	85.0
Female	91.7	79.2	86.1	87.1	86.0
Urban Residence	89.7	82.1	86.0	86.9	86.0
Rural Residence	90.9	78.8	84.6	87.5	85.7

To assess the robustness of CT scan as a diagnostic modality, stratified analysis was performed across age groups, gender, and residential areas. The results showed only minor variations in sensitivity and specificity, reaffirming CT's reliability. (Table 3)

The stratified data (Table 4) demonstrates that CT scan maintained high sensitivity and specificity across all key demographic groups. The differences observed were statistically insignificant ($p > 0.05$), indicating that CT is a consistently reliable diagnostic tool for differentiating peritoneal TB from carcinomatosis, regardless of age, gender, or residential background in the Pakistani population. (Table 4)

Discussion

This study assessed the diagnostic performance of contrast-enhanced CT (CECT) in differentiating peritoneal tuberculosis (PTB) from peritoneal carcinomatosis (PC), taking histopathological confirmation via omental biopsy as the reference standard. In our sample of 149 patients from Chaudhry Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, the CT scan demonstrated a sensitivity of 90.4%, specificity of 80.3%, positive predictive value (PPV) of 85.2%, negative predictive value (NPV) of 86.9%, and an overall diagnostic accuracy of 85.9%. These results are significant in the context of Pakistan's TB burden and the challenge of timely diagnosis in patients presenting with ascites and peritoneal involvement.

Our findings are consistent with those reported in a study by Singh et al., who evaluated CT diagnostic accuracy in Indian patients and reported a sensitivity of 88.7%, specificity of 78.4%, and accuracy of 84.3% for distinguishing PTB from PC (15). Their conclusions emphasized that imaging features like smooth peritoneal thickening and high-attenuation ascites were more predictive of PTB, while nodular omental caking and large soft-tissue peritoneal masses favored carcinomatosis. These imaging patterns were also prominently noted in our study and helped guide initial diagnostic impression.

Similarly, a study conducted in Pakistan by Qureshi et al. at Dow University Hospital demonstrated a CT sensitivity of 87.5% and specificity of 81.3% in diagnosing PTB vs PC, further validating CT as a robust imaging tool in TB-endemic regions (16). Their study also highlighted the risk of empirical anti-TB therapy initiation in cases misdiagnosed without biopsy confirmation—underscoring the value of improved radiological diagnostics as emphasized in our analysis.

In a more recent prospective evaluation by Ahmed et al. in Lahore, CT scans were assessed for diagnostic accuracy using similar histopathological endpoints. Their reported sensitivity and specificity were 91.1% and 77.2%, respectively, showing comparable reliability in CT-based differentiation of peritoneal pathology (17). The slight variability between their data and ours may stem from differences in sample demographics, disease staging, and CT scanner protocols.

Importantly, our study contributed additional value by stratifying diagnostic performance by age, gender, and area of residence, which is not commonly analyzed in prior regional studies. We found consistently high diagnostic accuracy across subgroups, including sensitivity above 89% in both males and females, and accuracy >85% in rural vs urban populations. This suggests that CT performance is not significantly affected by demographic variability, making it a broadly applicable diagnostic tool in both rural and urban healthcare settings.

International studies have also echoed these findings. A multicenter meta-analysis by Goenka et al. (2021) demonstrated pooled sensitivity and specificity of CT imaging for PTB diagnosis as 89.3% and 80.1%, respectively, closely matching the metrics observed in our study (18). Moreover, in a large-scale Iranian study by Ebrahimian et al., CT diagnostic accuracy for differentiating peritoneal disease exceeded 85%, reinforcing the global reliability of CT scans for such differential diagnoses (19).

Despite the strong diagnostic performance of CT scan, it must be noted that overlapping radiologic features still pose challenges. For instance, both PTB and PC can present with ascites and omental involvement, although their patterns may vary. Hence, while CT can serve as an excellent frontline tool, histopathological confirmation remains essential, particularly in ambiguous cases or where empirical treatment has failed.

A major strength of our study is the inclusion of histologically confirmed cases and the application of standardized radiological protocols, ensuring objective comparison. Limitations include the single-center setting, which may affect generalizability, and the lack of inter-observer variability analysis among radiologists. Future studies could explore radiomic scoring tools or integrate MRI with CT to further improve specificity, especially in atypical presentations.

our findings reaffirm the clinical utility of CT scan as a highly accurate, non-invasive, and widely accessible imaging modality for differentiating PTB from PC in the Pakistani population. Given the diagnostic accuracy nearing 86%, and consistent performance across demographic subgroups, CT abdomen should be prioritized in diagnostic protocols for patients presenting with peritoneal involvement in TB-endemic areas.

Conclusion

CT scan of the abdomen demonstrates high sensitivity, specificity, and diagnostic accuracy in differentiating peritoneal tuberculosis from peritoneal carcinomatosis when compared to the gold standard of omental biopsy. Its consistent performance across different demographic groups reinforces its value as a frontline diagnostic tool in resource-limited, TB-endemic regions like Pakistan. However, histopathological confirmation remains essential in ambiguous cases.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-23)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AA (PGR)

Review of Literature, Data entry, Data analysis, and drafting article. Manuscript drafting, Study Design,

NP (Assistant Professor)

Study Design, manuscript review, critical input.

Conception of Study, Development of Research Methodology Design

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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