RESEARCH PAPER

Diagnostic Accuracy of Multi-Detector Contrast-Enhanced Computed Tomography in Evaluation of Focal Pancreatic Lesions with Histopathological Correlation

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ABSTRACT

Background: Focal pancreatic lesions present a significant diagnostic challenge. Multi-detector computed tomography (MDCT) is the primary imaging modality for their evaluation. Accurate characterization and resectability assessment are critical for optimal management.

Aim: To determine the diagnostic accuracy of multi-detector contrast-enhanced CT in evaluation of focal pancreatic lesions with histopathological correlation.

Materials and Methods: This prospective observational study was conducted at the Department of Radio-Diagnosis, Mahatma Gandhi Medical College & Hospital, Jaipur, from April 2024 to September 2025. Eighty-six patients with focal pancreatic lesions on MDCT underwent histopathological confirmation. MDCT findings were correlated with histopathology to determine sensitivity, specificity, PPV, NPV, and diagnostic accuracy.

Results: The mean age was 58.70 ± 10.20 years with male predominance (54.65%). Malignant lesions constituted 83.72% (72/86), with pancreatic ductal adenocarcinoma being most common (52.33%). The pancreatic head was the most common location (44.19%). MDCT demonstrated sensitivity of 91.67%, specificity of 85.71%, PPV of 97.06%, NPV of 66.67%, and overall diagnostic accuracy of 90.70%. Among 72 malignant cases, 58 (80.56%) were resectable and 14 (19.44%) were unresectable. Vascular encasement (50%) was the most common cause of unresectability.

Conclusion: MDCT is a highly accurate imaging modality for characterisation of focal pancreatic lesions, with diagnostic performance comparable to international literature. It provides comprehensive evaluation including lesion detection, characterisation, vascular assessment, and resectability determination.

Keywords: Multi-detector computed tomography; Pancreatic lesions; Diagnostic accuracy; Histopathology; Pancreatic adenocarcinoma; Resectability

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INTRODUCTION

Pancreatic lesions, particularly pancreatic ductal adenocarcinoma, remain among the most lethal malignancies, with a 5-year survival rate of less than 10%.[1,2] The devastating prognosis is largely attributable to late-stage diagnosis, with the vast majority being unresectable at presentation.[3] Early and accurate characterisation of focal pancreatic lesions is therefore critical for timely intervention and improved outcomes.

Multi-detector computed tomography (MDCT) has emerged as the primary imaging modality for evaluation of pancreatic lesions due to its widespread availability, rapid acquisition, excellent spatial resolution, and comprehensive assessment capabilities.[4,5] The introduction of multi-phase imaging protocols, including arterial, pancreatic parenchymal, and portal venous phases, has significantly enhanced lesion detection and characterisation.[6] MDCT also plays a critical role in resectability assessment by accurately delineating vascular involvement and distant metastases.[7,8]

Despite advances in imaging technology, certain diagnostic challenges persist, including differentiation of mass-forming chronic pancreatitis from carcinoma, characterisation of small isoattenuating tumors, and accurate classification of cystic pancreatic neoplasms.[9,10]

The present study was designed to evaluate the diagnostic accuracy of MDCT in characterisation of focal pancreatic lesions using histopathological examination as the gold standard, in an Indian tertiary care setting.

AIM AND OBJECTIVES

Aim: To determine the diagnostic accuracy of multi-detector contrast-enhanced computed tomography in evaluation of focal pancreatic lesions with histopathological correlation.

Objectives:

1. To characterise focal pancreatic lesions on MDCT based on morphology, enhancement pattern, and associated features.
2. To correlate MDCT findings with histopathological diagnosis and determine diagnostic accuracy parameters.
3. To assess MDCT accuracy in resectability determination for malignant pancreatic lesions.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted at the Department of Radio-Diagnosis, Mahatma Gandhi Medical College & Hospital, Jaipur, from April 2024 to September 2025.

Study Population: Eighty-six patients with focal pancreatic lesions detected on MDCT who subsequently underwent histopathological confirmation were included. Patients with diffuse pancreatic disease, acute pancreatitis, prior pancreatic surgery, or contraindications to contrast administration were excluded.

MDCT Protocol: All examinations were performed using a 128-slice MDCT scanner with a standardised triple-phase protocol (arterial phase at 25–30 seconds, pancreatic parenchymal phase at 40–45 seconds, and portal venous phase at 65–70 seconds after contrast injection). Non-ionic iodinated contrast (1.5–2 ml/kg) was administered intravenously at 3–4 ml/sec. Thin-section contiguous images were reconstructed for multiplanar reformations.

Image Analysis: MDCT images were evaluated for lesion location, size, morphology (solid/cystic/mixed), enhancement pattern (hypo/hyper/isovascular), associated features (duct dilatation, vascular involvement, metastases), and resectability status as per NCCN guidelines.

Histopathological Confirmation: All 86 patients underwent tissue diagnosis through surgical resection (67.44%), EUS-guided FNAC (23.26%), liver biopsy (5.81%), peritoneal biopsy (2.33%), or CT-guided biopsy (1.16%).

Statistical Analysis: Data were analysed using SPSS. A 2×2 contingency table was constructed. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated. Chi-square test, McNemar's test, Fisher's exact test, and Kappa statistics were applied. A p-value <0.05 was considered significant.

RESULTS

A total of 86 patients with focal pancreatic lesions were evaluated. The demographic and clinical profile is summarised in Table 1. The mean age was 58.70 ± 10.20 years, with peak incidence in the 61–70 years age group (36.05%). Male predominance was observed (54.65%). Abdominal pain was the most common symptom (79.07%), followed by weight loss (54.65%) and jaundice (48.84%). The pancreatic head was the most common location (44.19%), and solid lesions predominated (63.95%). Hypovascular enhancement was observed in 83.72% of lesions.

The diagnostic accuracy parameters and lesion-specific accuracy of MDCT are presented in Table 2. MDCT demonstrated sensitivity of 91.67%, specificity of 85.71%, PPV of 97.06%, NPV of 66.67%, and overall accuracy of 90.70% (Kappa = 0.68). The highest lesion-specific accuracy was for solid pseudopapillary neoplasm and simple pancreatic cyst (100% each), while the lowest was for serous cystadenoma (81.82%).

The histopathological distribution is presented in Table 3. Malignant lesions constituted 83.72% (72/86), with pancreatic ductal adenocarcinoma being the most common diagnosis (52.33%). Among benign lesions (16.28%), serous cystadenoma was most common (12.79%). Among 72 malignant cases, 58 (80.56%) were resectable and 14 (19.44%) were unresectable. Vascular encasement was the most common cause of unresectability (50%).

A comparative analysis of MDCT diagnostic accuracy across published studies is presented in Table 4.

TABLES

Table 1: Demographic, Clinical, and Imaging Characteristics of Study Population (n=86)

Characteristic	Number (n)	Percentage (%)
Age Group (Years)		
21–30	02	02.33
31–40	04	04.65
41–50	12	13.95
51–60	28	32.56
61–70	31	36.05
71–80	09	10.47
Gender		
Male	47	54.65
Female	39	45.35
Clinical Symptoms*		
Abdominal Pain	68	79.07
Weight Loss	47	54.65
Jaundice	42	48.84
Incidental Finding	14	16.28
Lesion Location		
Head	38	44.19
Body	24	27.91
Tail	16	18.60

Characteristic	Number (n)	Percentage (%)
Neck / Uncinate	08	09.30
Nature of Lesion		
Solid	55	63.95
Cystic	29	33.72
Mixed	02	02.33
Enhancement Pattern		
Hypovascular	72	83.72
Hypervascular	10	11.63
Isovascular	04	04.65

*Multiple symptoms present in most patients

Table 2: Diagnostic Accuracy of MDCT and Lesion-Specific Accuracy

Parameter	Value (%)	95% CI
Overall Diagnostic Performance		
Sensitivity	91.67	82.80–96.90
Specificity	85.71	57.20–98.20
Positive Predictive Value	97.06	89.60–99.60
Negative Predictive Value	66.67	41.00–86.70
Diagnostic Accuracy	90.70	82.50–95.90
Lesion-Specific Accuracy	n / Correct	Accuracy (%)
Pancreatic Ductal Adenocarcinoma	45 / 42	93.33
Pancreatic Neuroendocrine Tumor	10 / 09	90.00
Mucinous Cystic Neoplasm	09 / 08	88.89
IPMN	06 / 05	83.33
Solid Pseudopapillary Neoplasm	02 / 02	100.00
Serous Cystadenoma	11 / 09	81.82
Simple Pancreatic Cyst	03 / 03	100.00

Kappa (κ) = 0.68 (Substantial Agreement); McNemar's test p = 0.157 (no systematic bias)

Table 3: Histopathological Distribution, Resectability, and Causes of Unresectability

Parameter	Category	n	Percentage (%)
Histopathological Diagnosis			
Malignant (n=72)		72	83.72
	PDAC	45	52.33
	PNET	10	11.63
	MCN	09	10.47
	IPMN	06	06.98
	SPN	02	02.33
Benign (n=14)		14	16.28
	Serous Cystadenoma	11	12.79
	Simple Pancreatic Cyst	03	03.49
Resectability (Malignant, n=72)			
	Resectable	58	80.56
	Unresectable	14	19.44
Causes of Unresectability (n=14)			
	Vascular Encasement	07	50.00
	Liver Metastases	05	35.71
	Peritoneal Carcinomatosis	02	14.29

Table 4: Comparative Analysis of MDCT Diagnostic Accuracy Across Studies

Study	Year	n	Sn (%)	Sp (%)	PPV (%)	Acc (%)
Present Study	2024	86	91.67	85.71	97.06	90.70
Hossain et al.	2023	39	87.50	–	–	–
Choi et al.	2020	193	90.7–92.7	100	–	85.7–91.8
Hossain et al.	2016	47	91.66	87.50	94.38	80.80
Arabul et al.	2012	43	93.00	88.00	–	–
Hilendarov et al.	2012	56	79.48	68.75	86.11	–
Vargas et al.	2004	25	–	–	87.00	99.00

Sn = Sensitivity; Sp = Specificity; PPV = Positive Predictive Value; Acc = Accuracy

FIGURES

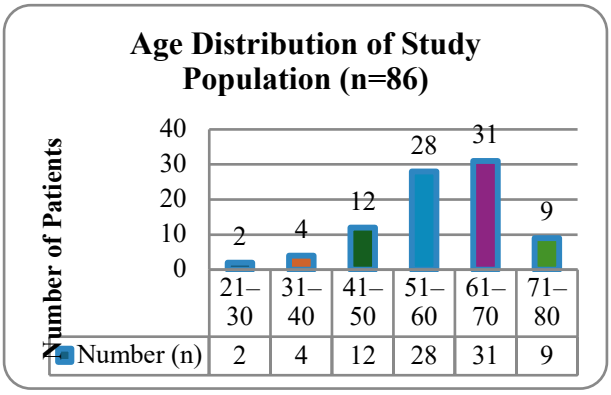

Figure 1: Age Distribution of Study Population (n=86)

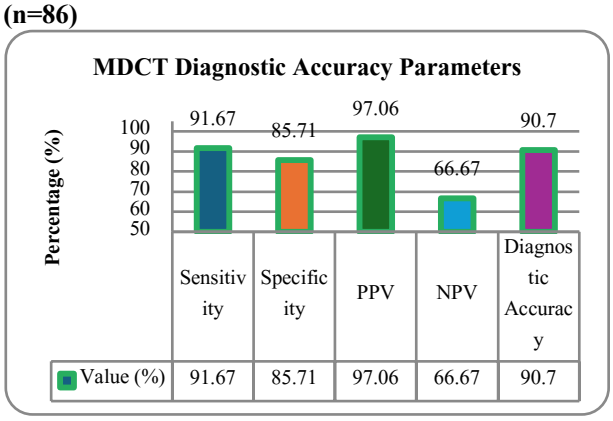

Figure 2: Diagnostic Accuracy Parameters of MDCT

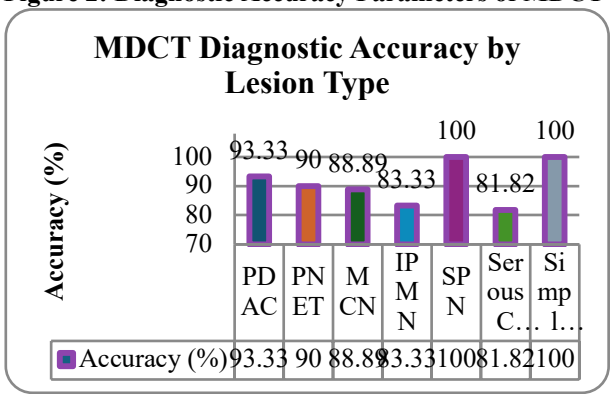

Figure 3: MDCT Diagnostic Accuracy by Lesion Type

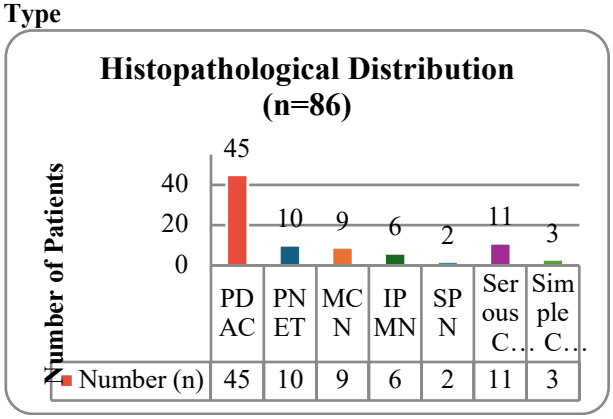

Figure 4: Histopathological Distribution of Pancreatic Lesions (n=86)

DISCUSSION

The present study demonstrated excellent diagnostic performance of MDCT for focal pancreatic lesion characterisation, with an overall accuracy of 90.70%. The mean age of 58.70 years and male predominance are consistent with Hossain et al.[11] (peak at 56–65 years) and Park et al.[12] (mean age 59 years). The predominance of pancreatic head lesions (44.19%) aligns with Hossain et al.[11] (63.8% head involvement).

The sensitivity of 91.67% and specificity of 85.71% are comparable to Hossain et al.[11] (91.66% sensitivity, 87.5% specificity) and Arabul et al.[13] (93% sensitivity, 88% specificity). The high PPV of 97.06% provides confidence in positive diagnoses. However, the relatively lower NPV (66.67%) suggests that negative MDCT findings, particularly for small or isoattenuating lesions, warrant further evaluation with EUS or MRI, as demonstrated by Choi et al.[14] who found MRI offers improved detection of small solid pancreatic lesions.

The predominant hypovascular enhancement pattern (83.72%) is characteristic of pancreatic ductal adenocarcinoma and correlates with the degree of fibrosis, as demonstrated by Takeshita et al.[15] D'Onofrio et al.[16] emphasised that quantitative CT analysis increases detection even for small isoattenuating tumors. Luo et al.[17] confirmed that hypoenhancement (OR=22.1) strongly correlates with PDAC diagnosis.

For resectability assessment, our findings are consistent with Vargas et al.[18] who reported 87% resectability prediction accuracy and 100% NPV for vascular invasion. Park et al.[12] reported 92–94% accuracy for vascular assessment. Kim et al.[19] demonstrated PPV of 87.5% for resectability determination. Raman et al.[20] emphasised that MDCT accuracy decreases when imaging is performed more than 25 days before surgery.

Regarding cystic lesions, Sahani et al.[21] reported MDCT sensitivity of 93.6% for detecting septa and 86.4% for ductal communication. The differentiation of mass-forming pancreatitis from carcinoma remains challenging, though Chen et al.[22] demonstrated that dual-energy MDCT improves this differentiation.

CONCLUSION

MDCT is a highly accurate imaging modality for characterisation of focal pancreatic lesions, with sensitivity of 91.67%, specificity of 85.71%, PPV of 97.06%, and overall accuracy of 90.70%. The findings are comparable to international literature, validating MDCT as the cornerstone imaging technique for pancreatic lesion evaluation, resectability assessment, and surgical planning. Complementary modalities such as EUS and MRI should be considered for equivocal cases, particularly small isoattenuating tumors and complex cystic lesions.

LIMITATIONS

1. Single-centre design may limit generalizability.
2. The sample size (n=86) precluded detailed subgroup analyses for rare lesion types.
3. Direct comparison with MRI or EUS was not performed.
4. Interobserver variability was not formally assessed.
5. Time interval between imaging and surgery was not specifically analysed.

DECLARATIONS

Ethics Approval: Approved by the Institutional Ethics Committee, Mahatma Gandhi Medical College & Hospital, Jaipur. Written informed consent obtained from all participants.

Conflict of Interest: None declared.

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