

Research Article

The Role of Multidetector Computed Tomography in Assessing Resectability of Pancreatic Cancer

Dr. Vinod Sukumaran¹, Dr. Dayaakar², Dr. Bharath Chandran³

¹Professor Department Of Radiodiagnosis, Sree Mookambika Institute Of Medical Sciences, Kulashekaram, Kanyakumari – 629161, Tamilnadu, India

²Postgraduate resident Department Of Radiodiagnosis, Sree Mookambika Institute Of Medical Sciences, Kulashekaram, Kanyakumari – 629161, Tamilnadu, India

³Assistant professor Department Of Radiodiagnosis, Sree Mookambika Institute Of Medical Sciences, Kulashekaram, Kanyakumari – 629161, Tamilnadu, India

*Corresponding Author

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Abstract: **Introduction:** Pancreatic cancer remains one of the most lethal malignancies worldwide, often diagnosed late due to its silent clinical course. Accurate assessment of tumor resectability is vital to guide surgical decisions and avoid unnecessary procedures. This study aimed to evaluate the diagnostic performance of multidetector computed tomography (MDCT) in determining the resectability of pancreatic tumors. **Results:** Out of 63 patients, 36 (57.1%) were deemed unresectable based on MDCT findings, while 27 patients (42.9%) were considered suitable for surgical resection. Of these, 24 patients underwent surgery; 21 (87.5%) had successful tumor removal, whereas 3 patients were found intraoperatively to have unresectable tumors. Postoperative pathology confirmed clear resection margins in all 21 resected cases (100%). The positive predictive value of MDCT was 87.5%, with an overall diagnostic accuracy of 91.3%. **Conclusions:** MDCT is a valuable, non-invasive modality with high diagnostic accuracy for assessing the resectability of pancreatic cancer, guiding surgical decision-making and reducing unnecessary interventions.

Keywords: Pancreatic cancer Multidetector computed tomography (MDCT) Resectability assessment Imaging techniques

INTRODUCTION

Pancreatic cancer remains one of the most aggressive and lethal malignancies worldwide, with survival outcomes that have shown minimal improvement over the past decades. Often referred to as the “silent killer,” its insidious onset and rapid progression frequently result in delayed diagnosis. According to recent GLOBOCAN data, pancreatic cancer accounts for more than 450,000 new cases and a nearly equal number of deaths annually, placing it among the top causes of global cancer-related mortality. The overall 5-year survival rate continues to be dismally low, estimated at just 10%. [1].

Despite its global impact, pancreatic cancer tends to exert a greater burden in high-income countries. The reasons for this geographic disparity in mortality remain unclear but may involve variations in access to timely diagnosis, quality of treatment, and standardized cancer reporting[3]. The disease is often referred to as the “silent killer” due to its indolent progression, vague early symptoms, and rapid clinical deterioration once diagnosed[3].

The underlying causes of pancreatic cancer are not fully understood, although several risk factors have been consistently identified. These include cigarette smoking, long-standing diabetes mellitus, obesity, high-fat diets, chronic alcohol intake, increasing age, male gender,

certain genetic syndromes, a family history of cancer, Helicobacter pylori infection, non-O blood group, and chronic pancreatitis[3].

Pancreatic tumors are broadly classified into two types. The most common form—pancreatic ductal adenocarcinoma—originates from the exocrine glands and accounts for approximately 85% of cases. Less frequently, pancreatic neuroendocrine tumors (PanNETs) arise from the endocrine cells of the pancreas and make up less than 5% of cases. Pancreatic adenocarcinoma is associated with a particularly poor prognosis, with only about 24% of patients surviving the first year after diagnosis and just 9% living beyond five years[2].

The primary objective of our study was to evaluate the role of preoperative multidetector computed tomography (MDCT) in determining the local resectability of pancreatic cancer. In addition, we aimed to assess the diagnostic performance of MDCT by measuring its sensitivity, specificity, and overall accuracy. While the optimal management strategy for borderline resectable pancreatic cancer remains a subject of ongoing debate[4,5], current evidence supports the use of neoadjuvant therapy to enhance the likelihood of achieving a margin-negative (R0) resection and to facilitate appropriate surgical candidate selection. The

decision to pursue curative resection versus palliative management largely depends on clinical staging—most of which is based on imaging findings obtained prior to surgery[6].

Given the aggressive nature of pancreatic cancer and the risks associated with exploratory surgery, it is imperative to accurately assess tumor resectability through high-resolution imaging. A misinterpretation—particularly in cases involving suspected vascular invasion—may lead to patients either undergoing unnecessary procedures or being denied potentially curative surgery[7,8]. Therefore, MDCT plays a critical role in guiding therapeutic decisions and optimizing patient outcomes. Furthermore, the imaging evaluation of vascular reconstruction alternatives may be subjective. According to the National Comprehensive Cancer Network (NCCN) Guidelines (version 2.2017), a dedicated pancreatic imaging protocol using multidetector computed tomography (MDCT) is recommended for the initial evaluation of suspected pancreatic malignancy. This protocol typically includes both pancreatic parenchymal and portal venous phases, with emphasis on high-resolution axial imaging, multiplanar reconstructions (MPR), maximum intensity projections (MIP), and three-dimensional (3D) volume-rendered images to assess vascular involvement and tumor extent[9].

CT imaging has shown strong predictive value in determining the resectability of pancreatic tumors. To ensure consistency across institutions, various guidelines now define specific vascular structures to evaluate—such as the superior mesenteric artery (SMA), celiac axis, and portal vein—and describe tumor-vessel relationships using standardized terms like “abutment” (tumor contact $<180^\circ$), “encasement” ($>180^\circ$), and the feasibility of surgical reconstruction[10].

Despite these advances, accurately distinguishing malignant lesions from surrounding inflammation and precisely characterizing the circumferential and longitudinal involvement of tortuous vessels remains a diagnostic challenge. Moreover, assessing the technical feasibility of vascular reconstruction can sometimes be subjective and dependent on the interpreter’s experience[10].

The aim of our study was to determine the importance of preoperative MDCT categorization in evaluating the local resectability of pancreatic cancer, along with examining its sensitivity, specificity, and accuracy rates. To assess the local resectability of pancreatic cancer and determine its sensitivity, specificity, and accuracy levels.

MATERIALS AND METHODS

This prospective study was conducted between June 2023 and March 2025, involving 63 patients (28 females, 35 males) aged 34–82 years (mean age: 59.2 years) at Sree Mookambika institute of medical sciences. All were referred for preoperative MDCT evaluation of a

suspected pancreatic mass.

Inclusion criteria: Patients with GI-related symptoms and/or suspicious pancreatic lesions on prior imaging
Exclusion criteria: Chronic pancreatitis, renal impairment, contrast allergy, or pregnancy

CT Protocol: MDCT scans were performed using a Siemens Somatom go.Top 384-slice scanner with triple-phase contrast imaging and 0.5 mm slice reconstructions. Protocol included:

- Fasting 6 hours prior
- Oral water contrast (1L)
- IV contrast (Omnipaque 350, 1 mL/kg at 4–5 mL/s)
- Triple-phase scanning: arterial (5 s post-bolus), pancreatic (15 s), and venous phase (50 s)
- Thin slice reconstructions (0.5 mm) for multiplanar analysis

Image Analysis: Two senior radiologists reviewed the images using axial and multiplanar reconstructions. Tumor–vessel relationships were classified per NCCN 2017 criteria:

- Resectable: no arterial/venous contact
- Borderline: abutment ($<180^\circ$)
- Locally Advanced: encasement ($>180^\circ$) or vessel occlusion
- Metastatic: distant organ or non-regional lymph node involvement

Intraoperative findings and histopathology reports were later used as the reference standard.

All the patients were subjected to the following:

- i. Informed written consent All participants in our study were fully explained the risks and benefits of the protocol. Privacy and confidentiality of all patient information has been ensured. All data provision were supervised and used for scientific purpose only.
- ii. Full history and clinical examination Complaint Past history of any medical problem
- iii. General and abdominal examinations by the referral clinician
- iv. Laboratory investigations Complete blood count (CBC) Liver and renal function tests Serum amylase and lipase Tumor markers: serum CA 19-9 level
- v. Abdominal ultrasound

Imaging techniques:

The cases were examined by multidetector computed tomography (MDCT), in the radiology department by Siemens Somatom go.Top 384-slice MDCT system.

1. Patient Preparation Patients were instructed to remain nil per os (NPO) for at least 6 hours prior to the scan. To reduce bowel motility and improve visualization, an antispasmodic agent (Hyoscine butylbromide, 20–40 mg) was administered either intravenously at the time of the scan or intramuscularly 10–15 minutes beforehand.

2. **Oral Contrast**
A negative oral contrast (approximately 1000 mL of plain water) was administered shortly before imaging to help delineate the gastrointestinal tract, particularly the duodenum and pancreatic head.
3. **Intravenous Contrast**
Non-ionic iodinated contrast medium (Iohexol, 350 mg iodine/mL) was delivered using a power injector at a rate of 4–5 mL/sec. The total contrast dose was calculated at 1 mL per kilogram of body weight.
4. **Triple-Phase Protocol and Scan Timing**
A bolus-tracking technique was used, with scan initiation triggered when the contrast enhancement in the abdominal aorta reached 50 Hounsfield Units (HU) at the level of the celiac axis. The arterial phase commenced after a 5-second delay, followed by the pancreatic parenchymal phase at 15 seconds, and the portal venous phase at 50 seconds post-trigger.
5. **Image Acquisition and Reconstruction**
Thin-slice axial acquisitions (0.5–0.625 mm) were obtained in a craniocaudal direction. Automatic exposure control was used to adjust milliampere settings. Reconstructed images (5 mm axial, coronal, and sagittal) were transferred to the PACS system, and thin-slice (0.5 mm) data sets were reviewed on a dedicated workstation for detailed multiplanar and vascular assessment [11].

Image Analysis

All scans were reviewed on a dedicated workstation equipped with advanced post-processing tools. The

primary interpretation was performed using axial images, supplemented by multiplanar reconstructions (MPR), curved reconstructions (cMPR), maximum intensity projections (MIP), and 3D volume-rendered techniques for detailed vascular assessment.

Two radiologists with over 15 and 20 years of experience independently analyzed the images. Any discrepancies were resolved by consensus, with the senior radiologist making the final decision in case of disagreement.

Each case was categorized using the National Comprehensive Cancer Network (NCCN) guidelines (version 1.2017) into one of four classifications: resectable, borderline resectable, locally advanced, or metastatic. Tumor-vessel interaction was described using standardized terms:

- **Abutment:** Tumor contact involving $<180^\circ$ of the vessel circumference
 - **Encasement:** Tumor involvement $>180^\circ$ or deformity of the vessel wall
 - **Occlusion or thrombosis:** Complete vessel blockage
- Lymph nodes >1 cm in short axis or necrotic in appearance were considered metastatic. Regional nodes were defined based on tumor location (e.g., peripancreatic, hepatic, celiac, or splenic). Anatomical variants of major arteries (such as replaced hepatic arteries) were also noted due to their surgical relevance.

RESULTS

Among the 63 patients, 19 were resectable, as Fig: 1 illustrates a representative case from the resectable group. Axial MDCT (Fig. 1A) and coronal reformatted (Fig. 1B) venous phase images in a 64-year-old male demonstrate a pancreatic mass involving the head and body, abutting the portal vein and superior mesenteric vein (SMV) by less than 180° , without evidence of thrombosis. These findings met the NCCN criteria for resectability.”

The remaining were identified as 8 borderline, 9 locally advanced, and 27 metastatic. 24 patients underwent surgery; 21 had successful resections. All 21 resected tumors had tumor-free margins.

Sensitivity: 100%, Specificity: 66.7%, PPV: 87.5%, Accuracy: 82.3%

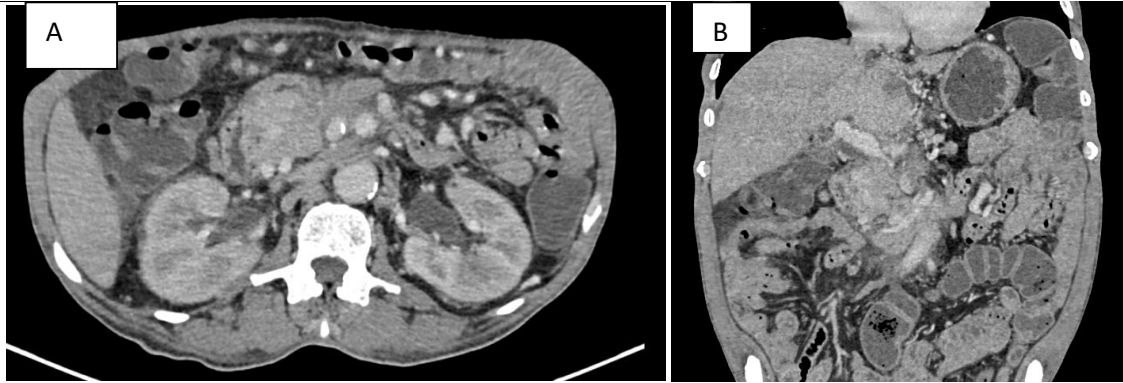


FIG:1-fig (A) Axial MDCT and fig (B) coronal reformatted images(venous phase) in a 64-year-old male reveal a pancreatic mass involving the head and body, abutting the portal vein and superior mesenteric vein (SMV) by less than 180°, without evidence of thrombosis which are the CT features that indicate tumor resectability

Table:1 Preoperative Resectability Classification (n = 63)

Classification	Count	Percentage
Resectable	19	30.2%
Borderline Resectable	8	12.7%
Locally Advanced	9	14.3%
Metastatic	27	42.8%

Table:2 Surgical Outcomes (n = 24 surgeries performed)

Surgical Outcome	Count	Percentage
Successfully resected	21	87.5%
Inoperable during surgery	3	12.5%

Three patients among the resectable/borderline group declined surgery.

Table:3 Histopathological Margins (n = 21 resections)

Margin Status	Count	Percentage
Tumor-free margins	21	100%
Involved margins	0	0%

Table :4 Demographic and Clinical Factors in Comparison to MDCT Resectability Criteria (n = 63)

Factor	Category	Resectable	Borderline	Locally Advanced	Metastatic
Gender	Male	10	3	6	16
	Female	9	5	3	11
Age Group	30–39	1	0	1	1
	40–49	2	1	1	1
	50–59	5	1	2	8
	60–69	6	2	1	9
	70–79	3	1	2	6
	80–89	1	2	2	2
Tumor Location	Head/Neck	18	7	7	21
	Body/Tail	1	1	2	6
Tumor Size	<2 cm	0	0	0	0
	2–4 cm	12	4	2	9
	4–6 cm	5	2	3	7
	>6 cm	2	2	4	11
Biliary Effect	Not dilated	3	1	0	8
	Dilated	12	5	4	6
	Stent	4	2	5	9

Table :5 Degree of arterial, venous, and lymphatic involvement vs. MDCT classification

Factor	Type	Resectable	Borderline	Locally Advanced	Metastatic
Arterial Involvement	No contact	17	4	2	10
Arterial Involvement	Abutment	2	4	1	1
Arterial Involvement	Encasement	0	0	6	16
Arterial Involvement	Occlude	0	0	0	0
Venous Involvement	No contact	8	1	0	2
Venous Involvement	Abutment	10	5	1	3
Venous Involvement	Encasement	1	2	5	10
Venous Involvement	Occlude	0	0	3	12
Lymphatic Involvement	No contact	5	3	0	1
Lymphatic Involvement	Regional	3	4	0	1
Lymphatic Involvement	Encasement	0	7	2	19
Lymphatic Involvement	Occlude	0	8	2	19

DISCUSSION

Our study highlights the critical role of MDCT in the initial staging and surgical planning of pancreatic cancer. Among the 63 patients evaluated, 36 (57.1%) were classified as unresectable based on MDCT criteria, predominantly due to distant metastases and extensive vascular involvement. Specifically, 27 patients presented with metastatic disease and 9 with locally advanced tumors, reflecting the well-established trend of late presentation in pancreatic cancer. These findings are consistent with prior literature, including studies by Low et al[12]. and Khattab et al., which similarly report that only a minority—approximately 15–20%—of pancreatic cancer cases are resectable at diagnosis.

The imaging findings in our representative resectable case (Fig. 1) exemplify the value of MDCT in precisely characterizing the relationship between the tumor and adjacent vasculature. Identification of less than 180° venous abutment without thrombosis is a key determinant for proceeding with surgical planning. This observation aligns with previous reports by Hong et al. and Khattab et al., who demonstrated that detailed vessel–tumor interface assessment is a strong predictor of surgical feasibility.

In our cohort, vascular encasement emerged as the most common barrier to resectability, affecting 61.1% (22/36) of the non-resectable cases. This aligns with observations by Zakharova et al., who noted that loss of fat planes and

vascular encroachment are strong predictors of unresectability. Additionally, distant metastases—particularly hepatic—were present in 75% of those with metastatic spread, reinforcing the liver’s role as the primary site for hematogenous dissemination. Our findings corroborate those of Frelove and Walling, who also emphasized that vascular invasion and metastatic burden are the main contraindications for curative surgery[13,14].

When correlating MDCT findings with surgical outcomes, our results demonstrate the high diagnostic value of the modality. Among the 24 patients who underwent surgery, MDCT accurately predicted resectability in 21 cases, yielding a sensitivity of 100%, a specificity of 66.7%, and an overall diagnostic accuracy of 82.3%. The positive predictive value was 87.5%, underscoring MDCT’s reliability in selecting candidates for curative intervention.

It is also worth noting that all patients who underwent successful resection had negative surgical margins on histopathology, further supporting MDCT’s utility in anticipating operability. However, three patients who were deemed resectable by imaging were found to have inoperable disease intraoperatively, highlighting the inherent limitations of imaging in fully capturing microscopic or perivascular tumor spread[15]. Taken together, these findings affirm that MDCT is not only pivotal for initial staging but also instrumental in guiding multidisciplinary treatment strategies.

Nonetheless, the challenge remains in better characterizing borderline tumors and refining imaging protocols to reduce false positives. Continued advancement in imaging technology, including perfusion studies and dual-energy CT, may help improve the distinction between inflammatory and neoplastic changes and further enhance surgical planning[16].

CONCLUSION

Multidetector computed tomography (MDCT) remains an indispensable tool in the preoperative assessment of pancreatic cancer. Its ability to accurately delineate tumor extent, assess vascular involvement, and classify resectability plays a pivotal role in guiding surgical decision-making. By helping to identify truly operable cases, MDCT minimizes the risk of unnecessary surgeries and associated morbidity.

Despite its strengths, challenges persist—particularly in evaluating borderline resectable tumors. Larger, multicenter studies are needed to validate and refine existing imaging criteria, especially for this subset of patients. Based on our findings, MDCT continues to demonstrate high diagnostic accuracy and reliability, reaffirming its essential role in modern pancreatic cancer management.

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