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EVALUATION OF FOCAL PANCREATIC MASS LESIONS USING MULTI DETECTOR COMPUTED TOMOGRAPHY

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Abstract

Background: Pancreatic lesions, encompassing a spectrum from benign cystic formations to malignant neoplasms, demand advanced diagnostic approaches. Multi-Detector Computed Tomography (MDCT) has emerged as a key modality for evaluating focal pancreatic mass lesions due to its enhanced accuracy.

Objective: This study aims to assess the accuracy of MDCT in distinguishing between benign and malignant pancreatic lesions, utilizing histopathological findings as a reference standard.

Methods: Over 18 months, 58 patients with suspected pancreatic pathology underwent MDCT at MMCRI. Demographic data, MDCT diagnoses, symptoms, lesion distribution, and histopathological findings were analyzed.

Results: MDCT diagnoses included pseudocysts (39.7%) and malignant lesions (37.9%). Pain abdomen was the predominant symptom (93.1%). Lesions were most commonly located in the head of the pancreas (25.9%). MDCT demonstrated high sensitivity (87%) and specificity (94.3%), with an overall accuracy of 91.3%.

Conclusion: This study highlights MDCT's efficacy in accurately diagnosing and characterizing pancreatic lesions. The findings support its role in clinical decision-making and contribute to improved patient outcomes.

Keywords: Multi-Detector Computed Tomography, Pancreatic Lesions, Diagnostic Accuracy, Histopathology, Clinical Management.

1. INTRODUCTION

Pancreatic lesions, characterized by their diverse spectrum ranging from benign cystic formations to malignant neoplasms, pose a significant clinical challenge necessitating advanced diagnostic techniques. Over the last decade, Multi-Detector Computed Tomography (MDCT) has emerged as a leading modality for the evaluation of focal pancreatic mass lesions, capitalizing on advancements in technology that promise enhanced accuracy and detailed characterization [1].

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This study aims to delve into the multifaceted role of MDCT in pancreatic imaging, with a primary focus on ascertaining its accuracy in distinguishing between benign and malignant lesions. The investigation will utilize histopathological findings, particularly Fine Needle Aspiration Cytology (FNAC) or biopsy, as a robust reference standard wherever applicable [2].

The continuous evolution of CT technology, prominently marked by the advent of MDCT, has significantly improved our ability to visualize and understand the complexities of abdominal structures, particularly the pancreas. The accelerated image acquisition and superior spatial resolution offered by MDCT not only expedite the diagnostic process but also enable the detailed examination of pancreatic lesions, facilitating their precise characterization. This is particularly relevant in the case of focal pancreatic masses, where accurate identification and differentiation between benign and malignant lesions are pivotal for optimal patient management [3,4,5].

The increasing incidence of pancreatic lesions underscores the urgency for accurate diagnostic methodologies. Ductal adenocarcinoma, accounting for a substantial majority (90%) of pancreatic neoplasms, presents a particular diagnostic challenge due to its histological variability, which includes the manifestation of cystic features in a subset of cases. Consequently, the overarching objective of this study is to rigorously assess the accuracy of MDCT in the evaluation of focal pancreatic mass lesions, contributing to the ongoing discourse on its reliability in the context of pancreatic pathology [6].

Moreover, as we navigate the complexities of pancreatic lesion characterization, it is essential to acknowledge the evolving landscape of treatment strategies. The ability of MDCT to not only identify lesions accurately but also to provide insights into their size, location, and vascular involvement is crucial for devising tailored therapeutic approaches. In an era where personalized medicine is gaining prominence, the information gleaned from MDCT scans can potentially guide decisions on surgery, targeted therapies, or other interventions, thereby optimizing patient outcomes [7].

In addition to evaluating accuracy, this research also seeks to determine the sensitivity and specificity of MDCT in differentiating between benign and malignant lesions. By employing histopathological outcomes from FNAC or biopsy as the reference standard, we aim to provide a nuanced understanding of MDCT's diagnostic performance. This approach aligns with the principles of evidence-based medicine, ensuring that imaging findings are not only clinically relevant but also validated against gold-standard pathological results.

Through a comprehensive literature review, meticulous data analysis, and consideration of recent technological advancements, this study endeavors to contribute substantively to the field of pancreatic imaging. The outcomes hold the potential to influence diagnostic paradigms, refine clinical decision-making, and ultimately improve patient outcomes in the realm of focal pancreatic mass lesions. By elucidating the capabilities and limitations of MDCT, we aspire to enhance its integration into routine clinical practice, fostering a more accurate and tailored approach to the diagnosis and management of pancreatic lesions [8].

2. MATERIALS AND METHODS

Source of Data: Patients with suspected pancreatic pathology referred to the radio-diagnosis department at MMCRI between January 2022 and June 2023 for diagnosis and evaluation were subjected to a multi-detector CT scan.

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Method of Collection of Data: The study adopted a prospective correlation design over an 18-month period from January 2020 to June 2021. The sample size, determined using the formula $n=d2\times P(Z\alpha/z)2\times Se(1-Se)$, where Z is the standard normal variate for a 5% alpha-error, Se is the sensitivity of MDCT in diagnosing pancreatic lesions (87.5% according to Hossain MS et al.), d is the absolute allowable error (5%), and P is the prevalence of pancreatic lesions in the hospital (5.56% according to hospital records), yielded an initial sample size of 30. Due to the availability of more cases, the final sample size was increased to 58.

Inclusion Criteria:
1. Patients with clinical findings/biochemical markers/ultrasound findings suggestive of pancreatic lesions.
2. Patients with incidentally detected pancreatic mass lesions.
3. Patients capable of understanding the study constraints and confirming with the guidelines of informed consent.

Exclusion Criteria:
1. Patients with an absolute contraindication for contrast administration.
2. Pregnant patients.
3. Patients with trauma.
4. Patients unwilling to provide written informed consent.

Protocol of Biphasic Contrast-Enhanced Computed Tomography Scan: The study was conducted using a Siemens Somatom Definition Edge-128 Slice Dual Energy CT Scanner. Patients received reassurance and a brief explanation of the procedure before written informed consent was obtained.

A biphasic dynamic scan of the pancreas, including the pancreatic parenchymal phase and portal venous phase, was performed optimally during a single breath hold. Neutral oral contrast (plain water) was routinely administered.

A topogram/scout image of the abdomen was obtained initially. CT without intravenous contrast covered the diaphragmatic dome to the pubic symphysis with 1-mm thick slices and a 0.5mm interval. An intravenous contrast (Ultravist 300mg iodine/ml) was administered using a Medrad Salient mechanical pressure injector at the rate of 4mL/second, followed by a flush of 20 ml of saline at 2ml/second. The region of interest was placed at the descending thoracic aorta just above the diaphragm. Computer-assisted bolus-tracking software determined the optimal scan delay for each patient.

- **Pancreatic Parenchyma Phase (Late Arterial Phase):** Obtained 40 to 45 seconds after contrast injection.
- **Portal Venous-Phase Scan:** Obtained 70 to 80 seconds after the initiation of contrast injection.
- **Delayed Scans:** Obtained 3 minutes after contrast injection through the liver and kidneys.

Scan Parameters:
- Tube voltage: 100 kV
- mAs: 250
- Raw data acquired at a section thickness of 1 mm
- Collimation: 128 x 6mm
- Pitch: 0.8

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- Gantry rotation time: 0.5s
- Gantry rotation speed: 5mm/s.

Source images were initially obtained, followed by volumetric reconstruction from raw data at slice thicknesses of 5mm and 1mm for coronal and sagittal reformations, suitable for viewing on a workstation.

3. RESULTS

Demographic Characteristics and MDCT Diagnoses

Age and Gender Distribution:

The study encompassed a diverse age distribution, with the most prevalent age group being 40-49 years (34.5%). Males exhibited a notable preponderance, constituting 70.7% of the study population.

MDCT Diagnoses:

MDCT revealed a spectrum of pancreatic lesions, with pseudocysts being the most prevalent (39.7%), followed by malignant lesions (37.9%). Other diagnoses included serous cystadenoma (6.9%), simple cysts (5.2%), IPMN (5.2%), mucinous cystadenoma (3.4%), and lipoma (1.7%).

Distribution of Benign and Malignant Lesions

Overall Distribution:

Analysis revealed that 62.1% of cases were benign, while 37.9% were malignant, emphasizing the need for accurate differentiation.

Age and Gender Distribution in Benign and Malignant Cases:

- **Benign Lesions:** Most common in the 40-49 age group (27.8%), with a male preponderance (72.2%).
- **Malignant Lesions:** Predominantly in the 40-49 age group (44.5%), with a male preponderance (68.2%).

Clinical Presentation and Symptoms

Various Symptoms Among the Study Population:

Pain abdomen was the predominant symptom (93.1%), followed by weight loss (29.3%), jaundice (20.7%), vomiting (8.6%), and fever (5.2%).

Symptoms in Benign and Malignant Cases:

- **Benign Lesions:** Mainly pain abdomen (91.6%), with a minimal presence of fever and vomiting.
- **Malignant Lesions:** Predominantly pain abdomen (95.4%), accompanied by weight loss (77.3%), jaundice (50%), and vomiting (13.6%).

Anatomical Distribution of Lesions

Location Distribution:

The head of the pancreas was the most common location for both benign (25.9%) and malignant lesions (40.9%).

Final Histopathological Diagnosis

Histopathological Findings:

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Pseudocysts were most prevalent among benign lesions (36.2%), while pancreatic adenocarcinoma dominated among malignant lesions (29.3%).

Comparison of MDCT and Histopathological Examination
Diagnostic Accuracy:

- **Benign Lesions:** Sensitivity (94.3%), Specificity (87.0%), PPV (90.9%), NPV (91.7%), Accuracy (91.3%).
- **Malignant Lesions:** Sensitivity (87.0%), Specificity (94.3%), PPV (90.9%), NPV (91.7%), Accuracy (91.3%).

This comprehensive analysis provides a nuanced understanding of the demographic characteristics, clinical presentation, anatomical distribution, and diagnostic accuracy of focal pancreatic mass lesions. The study underscores the significance of MDCT in accurately diagnosing and distinguishing between benign and malignant pancreatic lesions.

Table 1 – Overall distribution of parameters

Parameters	Values
Age Distribution:	
Mean Age	43.7 years
Standard Deviation (SD)	14.111 years
Median Age	43.5 years
Minimum Age	11 years
Maximum Age	75 years
Gender Distribution:	
Male	70.7%
Female	29.3%
MDCT Diagnosis:	
Pseudocyst	39.7%
Malignant Lesion	37.9%
Serous Cystadenoma	6.9%
Simple Cyst	5.2%
IPMN	5.2%
Mucinous Cystadenoma	3.4%
Lipoma	1.7%

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Distribution of Lesions:	
Benign	62.1%
Malignant	37.9%
Age Distribution of Benign Lesions:	
40-49 years	27.8%
Age Distribution of Malignant Lesions:	
40-49 years	44.5%
Gender Distribution of Benign Lesions:	
Male	72.2%
Female	27.8%
Gender Distribution of Malignant Lesions:	
Male	68.2%
Female	31.8%
Symptoms Distribution:	
Pain Abdomen	93.1%
Weight Loss	29.3%
Jaundice	20.7%
Vomiting	8.6%
Fever	5.2%
Location Distribution of Lesions:	
Head	25.9%
Body	20.7%
Head and Uncinate Process	15.5%
Final Histopathological Diagnosis:	
Malignant Adenocarcinoma	29.3%
Malignant Mucinous Cystadenocarcinoma	6.9%
Malignant Neuroendocrine Neoplasm	3.4%
Lipoma	1.7%

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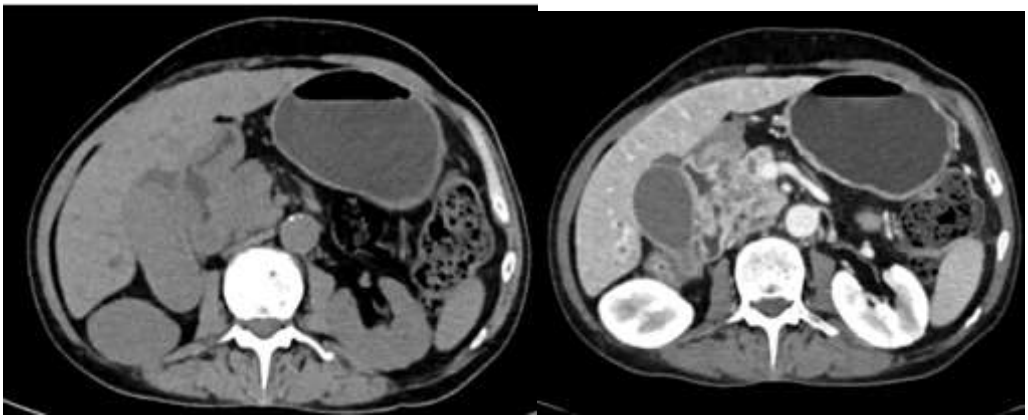
Benign Serous Cystic Lesion	6.9%
Benign Mucinous Lesion	6.9%
Simple Cyst	5.2%

Parameters	**Values**
MDCT Finding vs. Histopathological Findings	
Benign	36
Malignant	22
MDCT vs. Histopathological Examination	
Sensitivity	87.0%
Specificity	94.3%
PPV	90.9%
NPV	91.7%
Accuracy	91.3%
Mass-forming Pancreatitis	3.4%
Pseudocyst	36.2%

Table 2 - This table summarizes the comparison between MDCT findings and histopathological examination results for both benign and malignant pancreatic lesions.

CASE 1: PANCREATIC ADENOCARCINOMA



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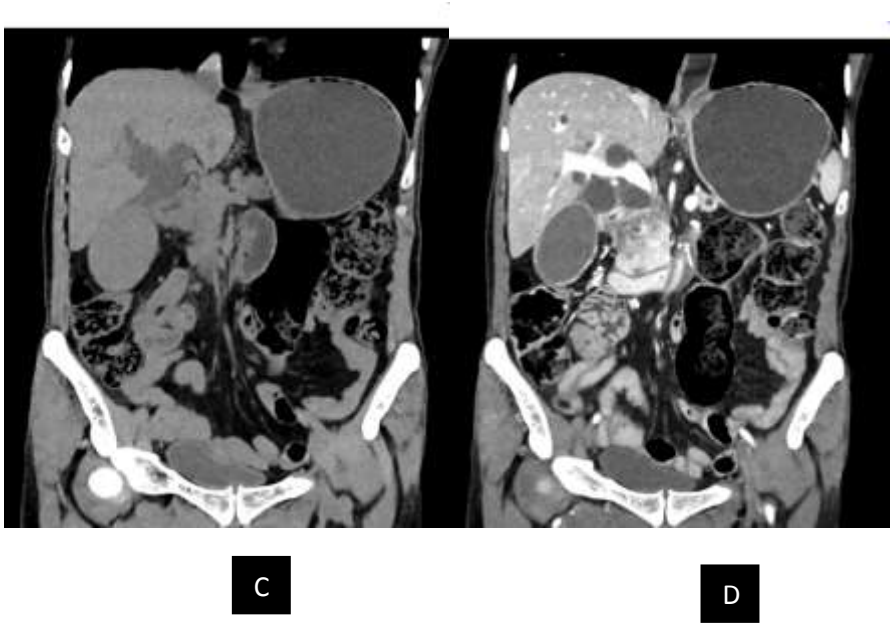
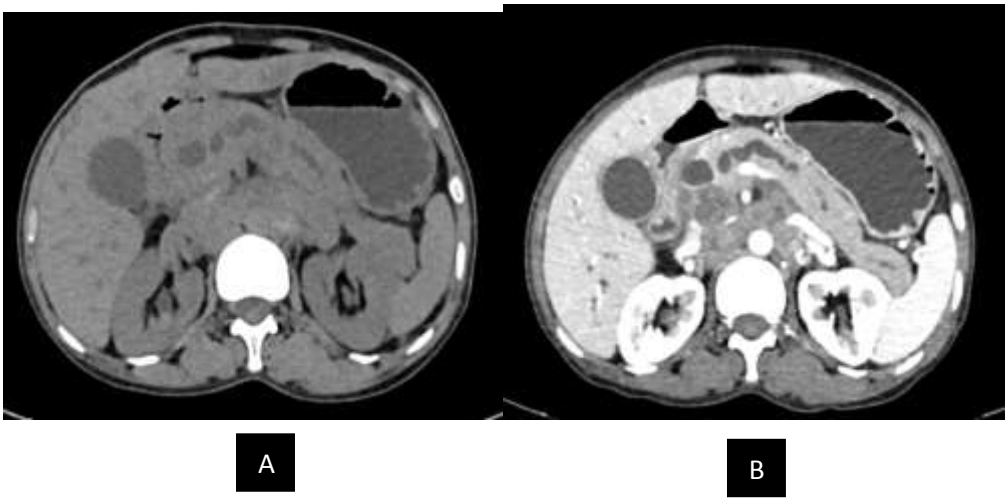


Figure 1: A-axial unenhanced, B-axial enhanced, C - coronal unenhanced and D- coronal enhanced CT images in 50 year old male showing well defined heterogeneously enhancing lesion in head and uncinate process of pancreas with upstream dilatation of CBD and MPD. Portal vein and superior mesentric vessels are free. HPE - Malignant neoplastic lesion, adenocarcinoma.

CASE 2: PANCREATIC ADENOCARCINOMA



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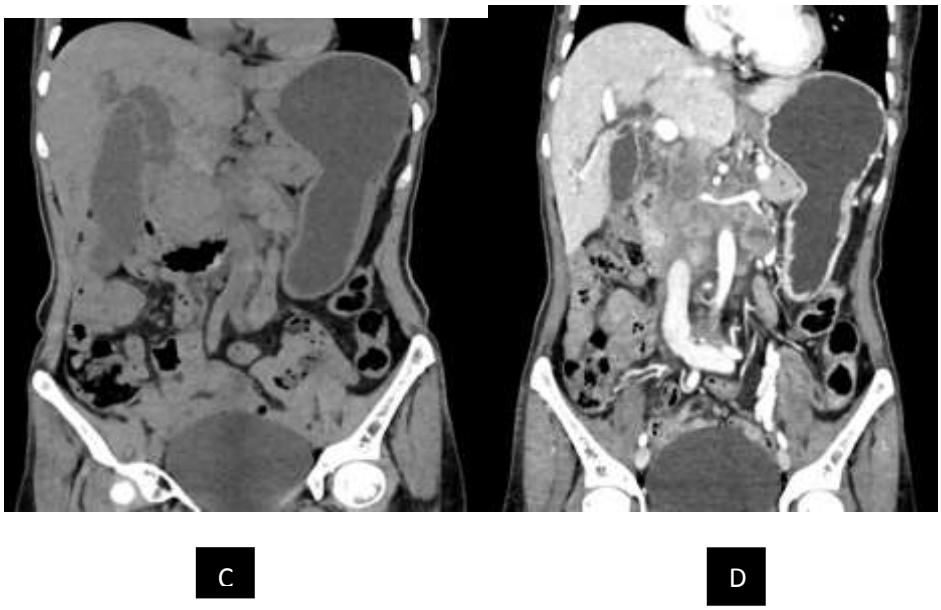
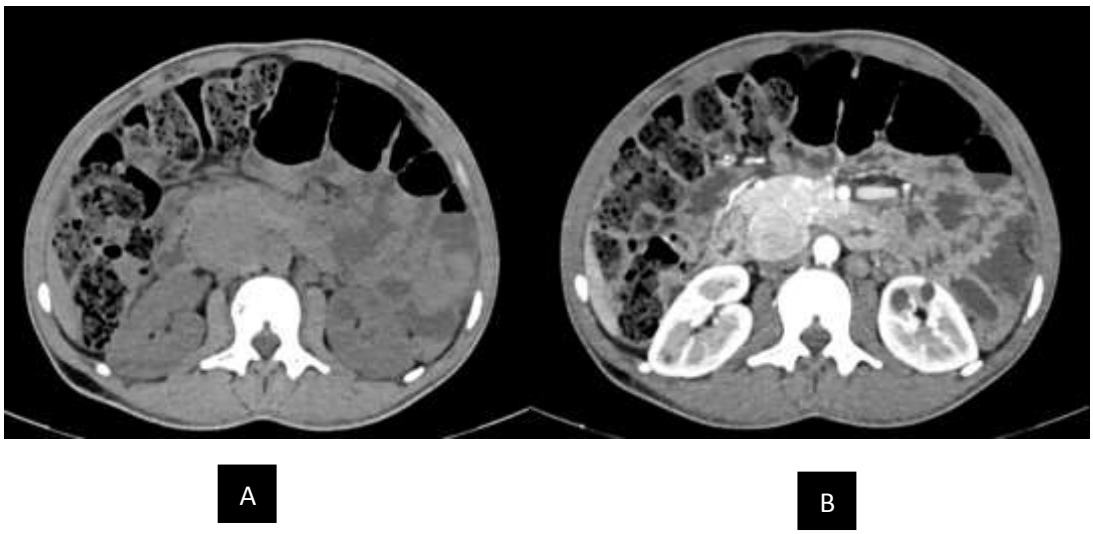


Figure 2: A-axial unenhanced, B-Axial enhanced, C - coronal unenhanced and D- coronal enhanced CT images in 42years old female showing Ill-defined heterogeneously enhancing lesion in head and uncinate process of pancreas with upstream dilatation of CBD and MPD. The lesion in encasing main portal vein and right renal vein and abutting superior vessels with peripancreatic and paraaortic lymphadenopathy. HPE-Malignant neoplastic lesion, adenocarcinoma.

CASE 3: PANCREATIC NEUROENDOCRINE TUMOR



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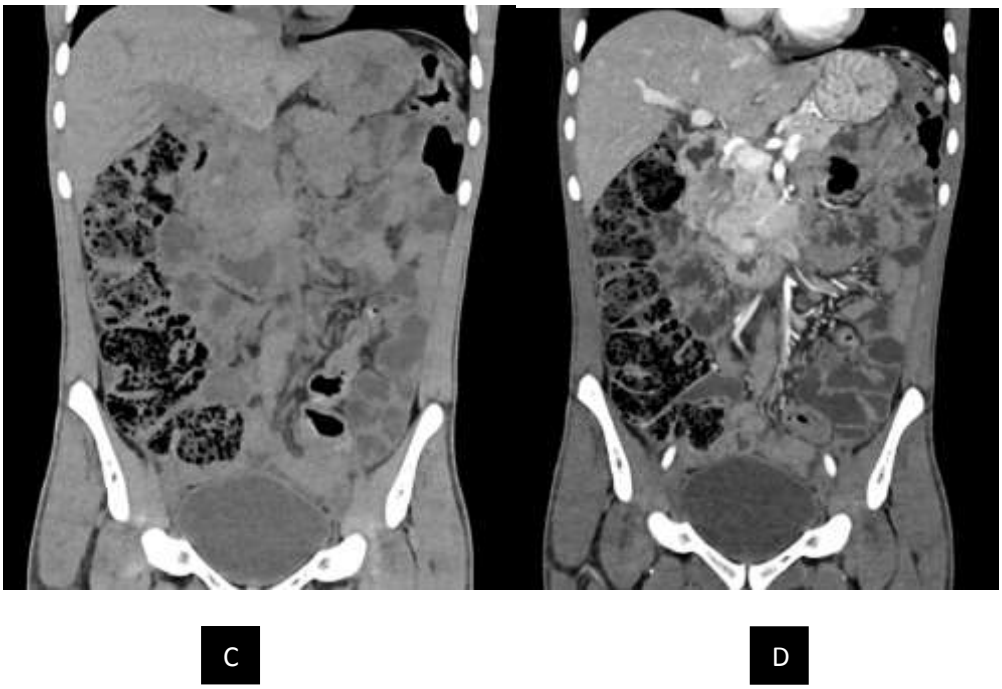
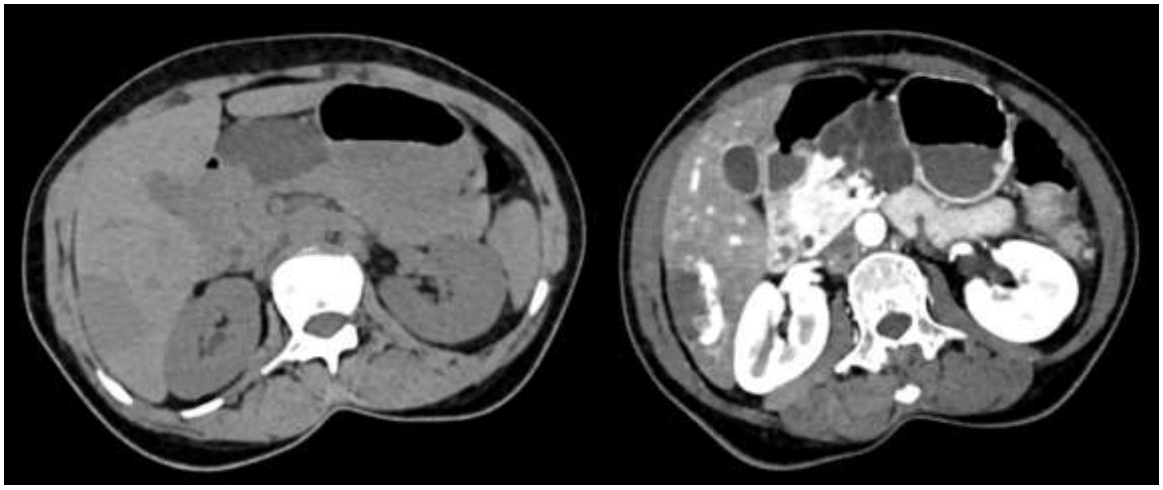


C D

Figure 3: A-axial unenhanced, B-axial enhanced, C - coronal unenhanced and D- coronal enhanced CT images in 29years old male showing fairly well defined intensely enhancing soft tissue density lesion in head and uncinate process of pancreas. HPE- malignant neoplastic lesion, neuroendocrine tumor.

CASE 4: MUCINOUS CYSTADENOMA.



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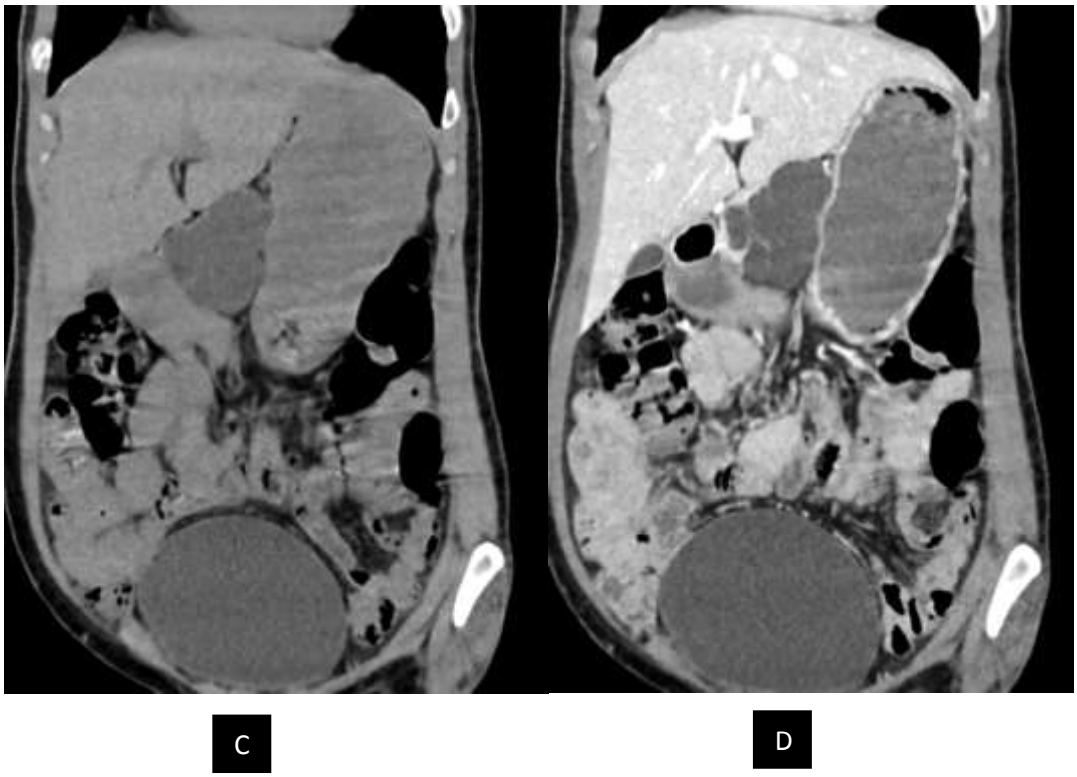

Figure 4: A-axial unenhanced, B-axial enhanced, C - coronal unenhanced and D- coronal enhanced CT images in 42years old female showing a well-defined peripherally enhancing multiloculated hypodense cystic lesion in body of pancreas with enhancing thin internal septations. HPE- mucinous cystadenoma

4. DISCUSSION

When pancreatic mass is suspected clinically, various imaging modalities have been employed for further evaluation of this mass. The use of non-invasive techniques including US and CT permits a more frequent diagnosis of pancreatic neoplastic lesions. Recent improvements in imaging techniques have made it possible to improve the diagnostic accuracy for detection, staging, and indicating surgical resectability of pancreatic cancer [9]. Multislice CT is the most efficient non-invasive technique in the assessment of pancreatic lesion. It allows excellent visualization of the pancreatic lesions during the different phases of contrast enhancement, thereby facilitating the detection of small pancreatic lesions and the evaluation of peripancreatic structures [10]. In our study, which included 58 patients, all of them were evaluated with MDCT for focal pancreatic lesions, and the results were compared with histopathology results.

The various MDCT diagnoses given are malignant lesions in 22 patients, pseudocysts in 23 patients, serous cystadenoma in 4 patients, mucinous cystadenoma in 2 patients, intraductal papillary mucinous neoplasm in 3 patients, simple cystic lesion in 3 patients, and lipoma in 1 patient. Among the 58 patients, 36 patients had benign lesions and 22 patients had malignant lesions. The mean age group of the study population is 43.7, ranging from 11 years to 75 years. The mean age of the patients (n = 36) with benign lesions is 39.6 years, ranging from 11 to 64 years, and the mean age of the patients (n = 22) with malignant lesions is 50.4 years, ranging from 29 to 70 years. In a study by Jemal et al, it was found that the age group 60-80

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years is the most affected group with pancreatic malignant neoplasm and is uncommon in those younger than 40 years. Out of the total 58 patients, 41 were male and 17 were females, corresponding to 70.7% males and 29.3% females.

Out of the 41 male patients, 26 patients had benign lesions and 15 patients had malignant lesions. Out of the total 17 female patients, 10 patients had benign lesions and 7 patients had malignant lesions. This finding was comparable to a study by Hossain MS et al, which included 47 patients using a 16-slice multi-detector CT. Multi-slice showed that pancreatic lesions were more common in males (78.7%) than females (21.3%) [11]. The various symptoms with which the patients presented were abdominal pain, obstructive jaundice with elevated bilirubin levels, loss of weight, fever, vomiting, and few presented with no symptoms. Pain abdomen was the most common complaint seen in 93.1% of the population. In a study done by Mahmoud Abdelaziz Dawoud et al, which included 20 patients with 16 males and 4 females, pain abdomen was the most common complaint accounting for about 60% among the examined patients [12].

Fifty-four patients had abdominal pain, out of which 33 patients had benign lesions and 21 patients had malignant lesions. Twelve patients presented with jaundice, out of which 1 patient had a benign lesion and the rest of the 11 patients had malignant lesions. Seventeen patients presented with loss of weight, and all these patients had only malignant lesions. Fever was seen in 3 patients who were diagnosed with pancreatic pseudocyst. Five patients presented with vomiting, among them 2 patients had benign lesions and 3 patients had malignant lesions. Three patients had no symptoms at all, among them 2 had a simple cyst and 1 had a lipoma. The location distribution of different lesions was in the region of the head, neck, uncinate process, body, tail, head and uncinate process, head and neck, head and body, neck and body, body and tail. A total of 15 lesions were present in the head region, out of which 6 lesions were benign and the remaining 9 lesions were malignant. One lesion was seen in the uncinate process, which was a benign lesion. Two lesions were present in the neck, and both lesions were benign. Twelve lesions were present in the body region, out of which 7 lesions were benign and 5 lesions were malignant. Four lesions were seen in the tail region, and all of those were benign lesions. A total of 9 lesions were seen in the head and uncinate process, out of which 5 lesions were benign and the remaining 4 were malignant. Five lesions were in the head and neck region, out of which 4 lesions were benign and the remaining 1 was malignant. One lesion was seen in the head and body region, which was benign. In the region of the neck and body, 4 lesions were present, 2 lesions were benign and 2 lesions were malignant [13]. Five lesions were seen in the body and tail region out of which 4 were benign and 1 was malignant. In our study, 25.9% of pancreatic lesions were located in the head of the pancreas, which was the most common location.

In a study done by Becher and Stommer, most lesions were in the head of the pancreas, accounting for 60% [14]. MDCT imaging findings were correlated with histopathological examination in all patients. In the present study, MDCT imaging findings showed 36 benign pancreatic lesions, out of these 33 were benign and 3 turned out to be malignant pancreatic lesions in histopathology. Our imaging diagnosis did not correlate with the 67 histopathological diagnosis in 3 benign lesions. The 3 benign lesions were 2 pseudocysts and 1 IPMN which on histopathology were diagnosed as mucinous cystadenocarcinoma. Among 22 MDCT diagnosed malignant pancreatic lesions, 20 were malignant and 2 turned out as benign lesions in histopathology. Our imaging diagnosis did not correlate with the histopathological diagnosis in 2 malignant lesions. The two malignant lesions on histopathology were diagnosed as mass forming pancreatitis.

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Among 23 malignant lesions diagnosed on histopathology, the final histopathological diagnosis was adenocarcinoma in 17 patients (74%), 4 patients (17.4%) had mucinous cystadenocarcinoma, and 2 patients (8.7%) had neuroendocrine neoplasm. Adenocarcinoma was found to be the commonest pathological diagnosis which was in concordance with the study done by Scaglion et al and Cascinu et al [15]. Scaglion et al stated pancreatic adenocarcinoma accounts for 80-90% of all pancreatic tumors and mainly located in the pancreatic head region. A study done by Cascinu et al showed that adenocarcinoma accounts for up to 70% of the pancreatic malignancies. Among the 23 patients with malignant lesions on histopathology, MDCT detected the presence of vascular invasion in 11 patients. Regional lymph nodes were seen in 13 patients and distant metastases were present in 12 patients. A total of 16 patients (69.5%) with pancreatic cancer had unresectable tumors. Seven patients (30.4%) with malignant lesions were resectable which showed no evidence of vascular invasion, lymph nodal involvement, and distant metastasis who underwent surgery [16].
This was comparable with a study done by Mahmoud Abdelaziz Dawoud et al in which a total of 14 (70%) patients with pancreatic cancer had unresectable tumors and 6 (30%) patients had tumors that were resectable, the causes were hepatic metastasis, vascular invasion, distant lymph nodes involvement [17]. Final statistical analysis revealed sensitivity, specificity, positive, negative predictive values, and accuracy of MDCT in the evaluation of benign pancreatic mass lesions were 94.3%, 87%, 91.7%, 90.9%, and 91.3% respectively. For malignant pancreatic mass lesions sensitivity, specificity, positive, negative predictive values, and accuracy were 87%, 94.3%, 90.9%, 91.7%, and 91.3 respectively. These results were comparable with a study by Hossain MS et al and Scaglion et al. A study by Hossain MS et al resulted in a sensitivity of about 87.5%, specificity of 66.6%, Positive predictive value was 84.8%, Negative predictive value was 71.4%, and diagnostic accuracy was 80.8% in the evaluation of pancreatic mass lesions. Scaglion et al reported sensitivity of MDCT as high as 97% in the detection of pancreatic malignant masses [18]. Contrast-enhanced multiphase pancreatic imaging by multislice computerized tomography with its post-processing techniques represents the imaging modality of choice for the diagnosis and evaluation of pancreatic masses.

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