Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 1579 - 1592
Received 20 January 2021; Accepted 08 February 2021.

Purpose of Multi-Detector Computed Tomography (MDCT) in Measurement of Focal Pancreatic Mass Lesions

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ABSTRACT

To determine the accuracy and efficacy of MDCT in the evaluation of focal pancreatic mass lesions. To document the effectiveness of MDCT in evaluating and characterizing various types of focal pancreatic lesions and correlate the MDCT findings with ultrasound and MRI findings and available surgical, cytological, histopathological findings where it is applicable. This study was carried out at Department of Radiodiagnosis, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry. The present study was carried on 30 patients of operated neck cancers. To assess the efficacy of MDCT in characterizing the pancreatic lesions leads to benign and malignant. To analyze the data and provide the sensitivity specificity and positive predictive value of MDCT in diagnosing focal pancreatic mass lesions with clinical, surgical / cytological findings as reference standards where it is available. Our results clearly show the detection and staging of pancreatic carcinoma, contrast enhanced MDCT plays an important role in malignant tumors in correlation with histopathological biopsy after surgery.

Keywords:
Computer tomography, computer tomography, pathology and adenocarcinoma.

1.Introduction

The anatomy of the pancreatic imaging has long been a challenge to clinicians and radiologists. The pancreas is a gland, located in the abdomen, about six inches long. It is shaped like a flat pear and is surrounded by the stomach, small intestine, liver, spleen and gallbladder. It's highly challenging due to the inability of visualizing the gland due to its retroperitoneal nature by conventional modalities. Pinpointing imaging plays a vital role in pancreatic imaging. [1-3] The various pathologies have to be differentiated to determine the definite management. Surgical biopsy or Endoscopic ultrasound biopsy or FNAC (Fine Needle Aspiration Cytology) can help in identifying the pathology. But due to the invasive nature, a noninvasive modality as sensitive and specific in determining the lesion could be the best alternative to these. [4] This study is aiming at determining the role of multi detector computed tomography (MDCT) in evaluation of focal pancreatic lesions. [5]

CT technology has improved during the past decade. Due to the fast image acquisition and better spatial resolution, the accuracy of CT for detecting different organ lesions including pancreas is increased. [6] With the use of high temporal resolution with the help of MDCT, Pancreas can be well imaged using. There is also an advantage that the study can be done with a short breath hold. [7] MDCT has thinner slice collimation, near isotropic resolution and multiphasic imaging. Hence it is a preferable modality. Also with the help of contrast enhancement MDCT, the finer details and the entire vascular structures related to the pancreas can be studied with the reduction in acquisition time and shorter volume acquisitions during superior contrast enhancement of major vessels. [8,9] MDCT is the best noninvasive primary tool in the assessment of benign and malignant pancreatic lesions.

Detection of small and large pancreatic lesions is possible with a short breath hold and peripancreatic structures are well evaluated with the help of MDCT. [10] It is also preferred in pancreatic neoplasms because it gives a detailed anatomical detail, regarding the location, size of

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the lesion, tumor morphology, ductal anatomy and its relationship to the nearby organs and vascular structures. [11] There are various pathologies in pancreas, benign and malignant and among malignant adenocarcinoma is the most common non-endocrine malignancy of the pancreas. Pancreatic Carcinoma is one of the most aggressive tumours, the seventh leading cause of death from cancer Worldwide. [12] The overall five-year survival rate is only 4%. Even though newer diagnostic modalities are available, it is difficult to identify the pancreatic malignancy in early stages. Unfortunately, most of the pancreatic tumors are diagnosed late and approximately 85% of tumors are unrespectable at the time of diagnosis. [13] Although serological tests add on to the diagnosis like serum marker CA 19.9 which is considered a sensitive but nonspecific marker for the diagnosis of adenocarcinoma of the pancreas, in tumors less than one cm in diameter it is rarely positive. Magnetic Resonance Imaging (MRI) is also used for diagnosing and characterizing pancreatic diseases. But the cost of the procedure and the duration needed for the procedure makes it less preferable. Other limitations of MRI are movement artifacts due to bowel peristalsis and breathing. [14-16]

2. Materials And Methods

Place and Duration of study: - The study was carried out in the Department of Radiodiagnosis and Imaging at Sri Lakshmi Narayana Institute of Medical Sciences over a period of 24 months (September 2008- September 2010).

Study Type

It is a descriptive study in which 30 patients with clinical findings or ultrasound findings that are suggestive of pancreatic pathology were subjected to MDCT in the department of radiodiagnosis. The patients who were referred from outside clinicians with suspected pancreatic pathology were also subjected to MDCT. MDCT was performed with SEIMENS SOMATOM DEFINITION EDGE 32 slice scanner. [17] The findings in MDCT was compared with the ultrasonogram findings, with available surgical/ histopathological/cytological findings to determine the efficacy ofSEIMENS SOMATOM DEFINITION EDGE 32 slice scanner MDCT system with advanced workstation. Ethical Clearance was taken from Institutional ethical committee of hospital.

Inclusion criteria

Patients with pain in epigastrium, vomiting, jaundice with biochemical markers/ultrasound findings suggestive of pancreatic pathology, Patients referred from outside clinicians with suspected pancreatic pathology and Patients with incidentally detected pancreatic lesions.

Exclusion Criteria

Patients with absolute contraindication for contrast administration such as previous severe reaction to iodine contrast media, Debilitated patients and patients with renal failure, Pregnancy and Patients who are lost to follow cases were followed Clinically and radiologically as indicated. MDCT findings are compared with the clinical follow up, Ultrasonogram, FNAC (where applicable) /Surgery & Histopathology.

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Experimental

In this study 30 patients were evaluated with MDCT, following which the findings were compared with ultrasound findings, and Fine needle aspiration cytology or postoperative histopathology.

3. Results

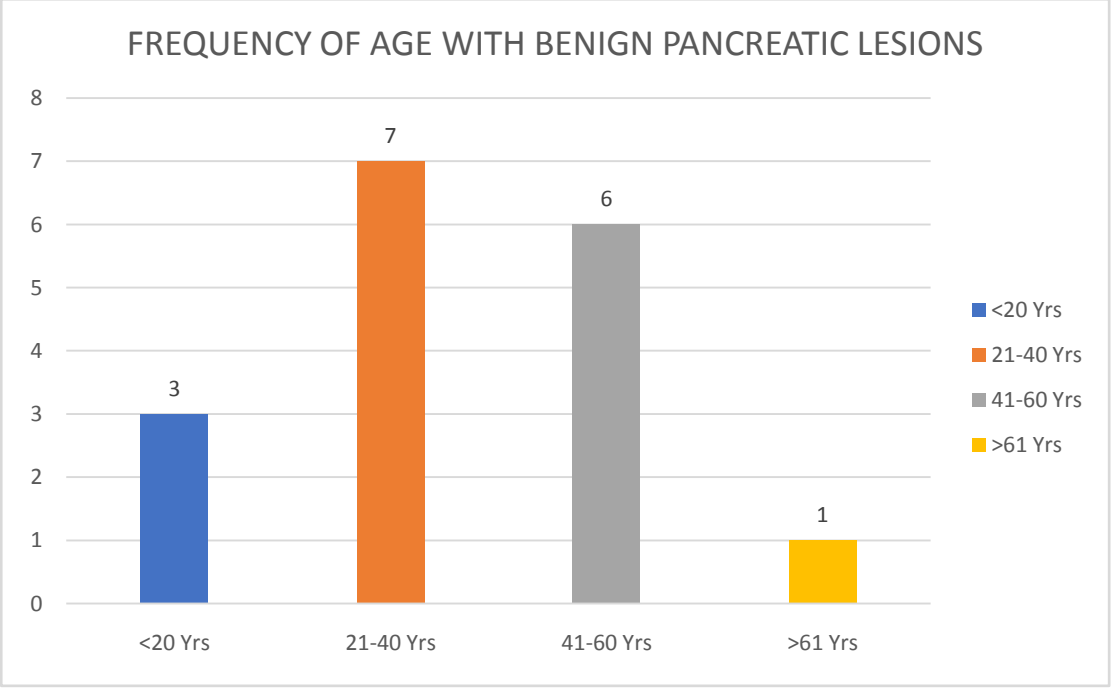
Age Distribution Of Patients

Table 1: Showing The Age Distribution of the Patients with Pancreatic Lesions

AGE GROUPS (Years)	FREQUENCY	PERCENTAGE %
<20	4	13.3%
20-40	6	19.8%
41-60	14	46.5%
>60	6	19.9%
TOTAL	**30**	**100**

The above table shows the age distribution of the total study population

Figure 1: Frequency of Age with Benign Pancreatic Lesions



Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 1579 - 1592
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Figure 2: Percentage Distribution of Malignant Pancreatic Lesions in Different Age Group

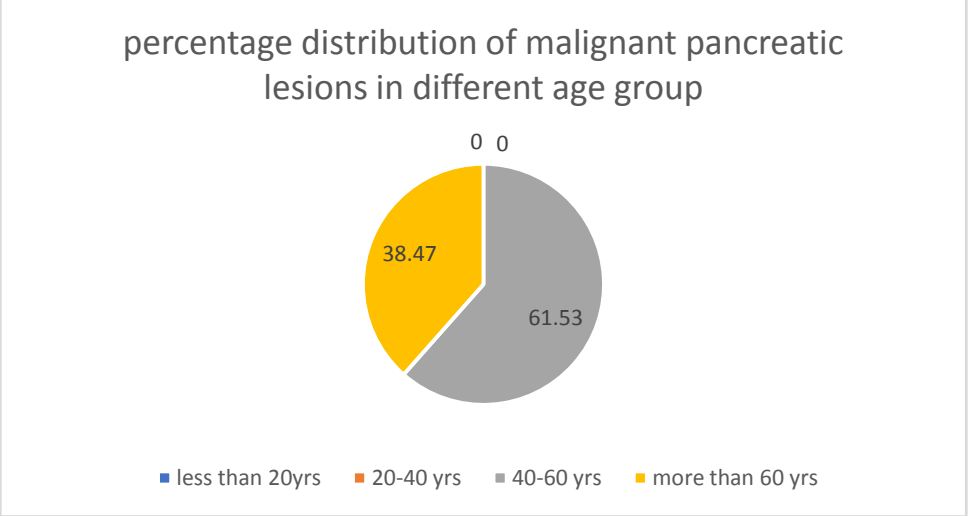
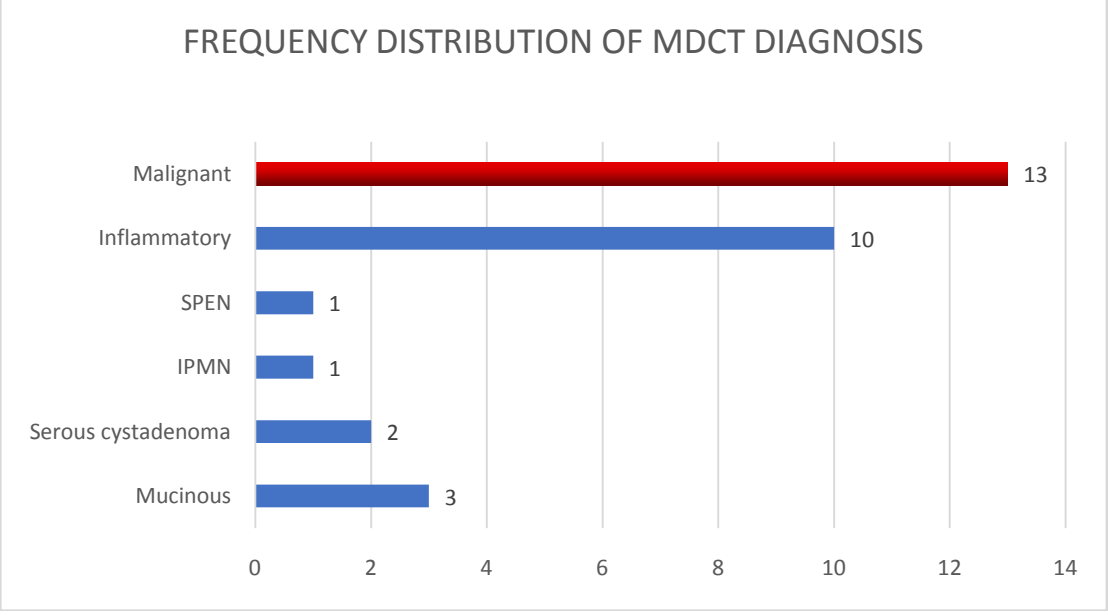


Table 2: Sex Distribution of Patients with Benign Pancreatic Lesions

SEX	FREQUENCY(n=17)	PERCENTAGE
MALE	**9**	**52.94%**
FEMALE	**8**	**47.05%**

Above table shows distribution of sex with benign pancreatic lesions.

Figure 3: Frequency Distribution of MDCT Diagnosis of Pancreatic Lesions



Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 1579 - 1592
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Diagnosis made by MDCT is distributed in the above chart where the malignant contributes 13 patients, 10 inflammtory,1 Intraductal Paplillary Mucinous Neoplasm/ IPMN,1 Solid Pseudopapillary Epithelial Neoplasm (SPEN),2 Benign Serous cystadenomata,3 Benign Mucinous cystadenoma.

Table 3: Various Symptoms of Patients

SYMPTOMS	NO OFCASES FREQUENCY	NO OF CASES PERCENTAGE %
ABDOMINAL PAIN (EPIGASTRIC PAIN)	26	86.7
VOMITING	23	76.7
JAUNDICE	10	33.3
LOSS OF WEIGHT	3	10
LOSS OF APPETITE	2	6.6
ASYMPTOMATIC	2	6.6

According to the table, most of the patients with benign and pancreatic lesions were presented with abdominal pain, followed by vomiting and jaundice. And jaundice was the presenting symptom in most of the malignant cases.

Table 4: Showing distribution of various final cytological diagnosis

CYTOLOGICAL/CLINICAL/ BIOCHEMICALDIAGNOSIS		FREQUENCY (n=30)	PERCENTAGE
Malignant		15	50%
Benign	Inflammatory	8	26.7%
	Mucinous cystadenoma	3	10%
	Serous cystadenoma	1	3.3%
	IPMN	1	3.3%
	SPEN	1	3.3%
	Simple cyst	1	3.3%

Above chart shows frequency distribution of lesions in histopathological examination.

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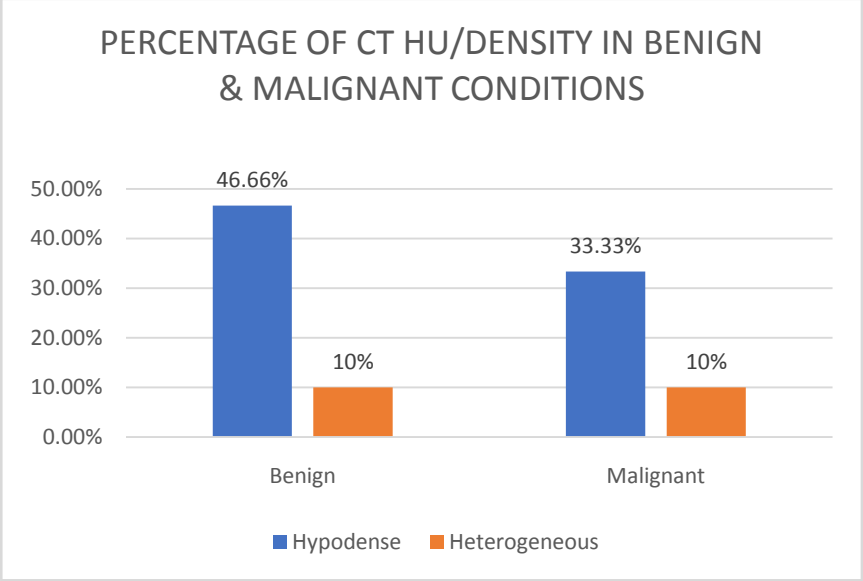
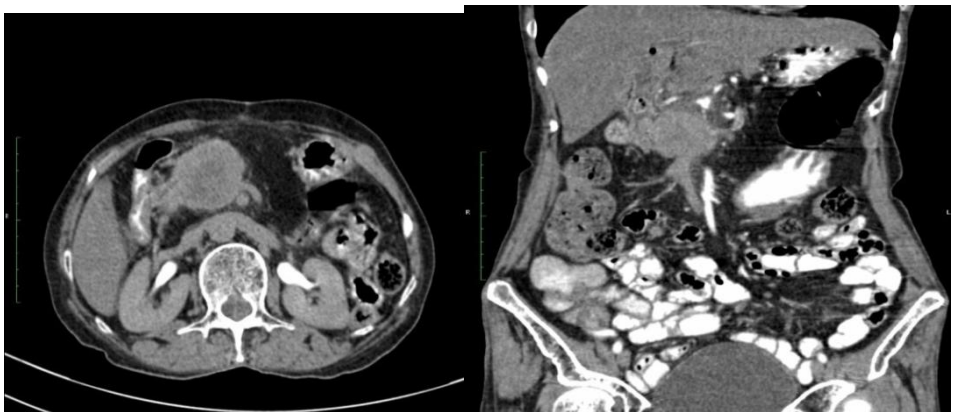
Figure 4: Percentage of Ct Value/Hu in Benign and Malignant Conditions



Patients show lymph node involvement out of 30 cases in which 9 were malignant lymphadenopathy where the peri gastric, peripancreatic, periportal, paraaortic lymph nodes are affected, and 2 were due to pancreatitis where periportal and peripancreatic lymphadenopathy was observed all patients with clinical findings/biochemical markers/ultrasound findings suggestive of pancreatic lesions has to undergo MDCT for further characterization of the lesions, as benign and malignant. This valuable information should be used to provide effective way for further management and treatment.

Figure 5: Case 1Pancreatic Adenocarcinoma



Axial and coronal MDCT images showing poorly defined hypoenhacing malignant mass lesion in the head of pancreas causing biliary and pancreatic duct obstruction. The lesion is invading the portal vein formation, proximal portal vein and superior mesenteric vein. There is complete atrophy of body and tail ofpancreas.

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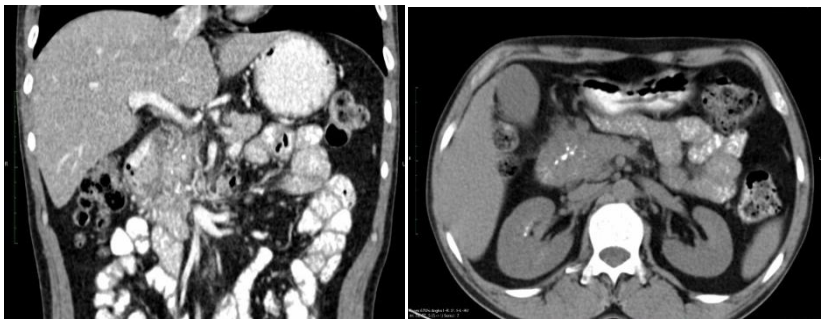
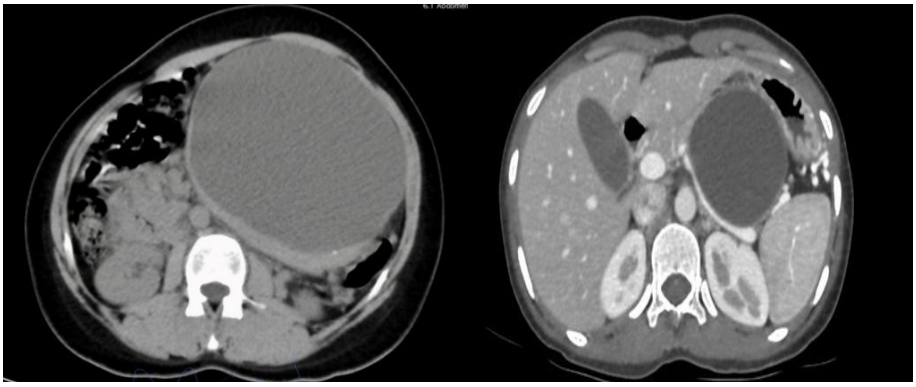
Figure 6: Case 2Pancreatic Adenocarcinoma



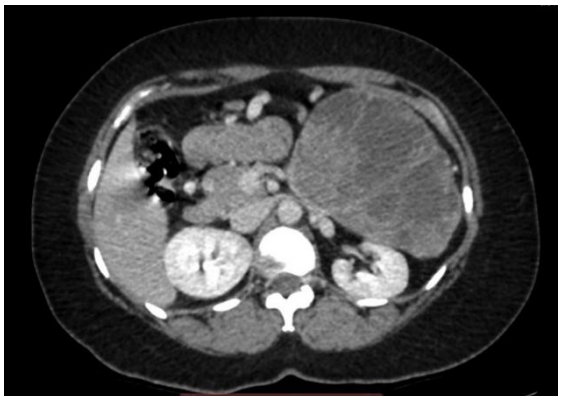
Contrast enhanced axial and coronal MDCT images showing diffuse heterogenous lesion with fat standing and calcification with dilated CBD and pancreatic duct.

Figure 7: Case 3 Mucinous Cystadenoma



Axial and coronal MDCT images showing well defined hypodense cystic lesion with wall enhancement in the body ofpancreas.

Figure 8: Case 4: Intraductal Papillary Mucinous Neoplasm



Contrast enhanced axial and coronal MDCT images showing multiloculated, hypodense, cystic lesion with wall enhancement and connected to the main pancreatic duct.

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Figure 9: Case 5: Simple Cyst of Pancreas

Cyst in the tail of pancreas with no septations or mural nodules.

Axial MDCT image showing hypodense lesion with small lobulations, in the neck and body of pancreas, few tiny calcifications within. **PSEUDOCYST OF PANCREAS:** Axial and coronal MDCT images showing large pseudocyst with enhancing wall anterior to tail of pancreas.

4. Discussion

MDCT has become the modality of choice in the preoperative diagnosis and staging, in treatment planning and follow-up of patients with pancreatic tumours [(18)]. Thin sections in a single-breath hold, Short acquisition times, postprocessing techniques, multiphasic contrast imaging method, retrospective calculation of thinner or thicker sections from the raw data are highly beneficial for complete preoperative diagnosis and management of pancreatic lesions [(18)]. Tumor tissue identification, visualization of pancreas and the surrounding structures and determining the presence of vascular infiltrations are must to assess the respectability of the tumour and to plan the management [(19)]. To visualize infiltration to the nearby structures and distant metastasis, contrast-to-noise ratio should be good.

All the 30 patients involved in our study were evaluated with MDCT for focal pancreatic lesions and findings were documented. These patients were followed up, and the results were compared with ultrasound and histopathology results. In our study the various MDCT diagnosis made were, malignant lesions in 13 patients, Inflammatory lesions including pseudocysts in 10 patients, Serous cystadenoma in 2 patients, Mucinous cystadenoma in 3 patients, Intraductal papillary mucinous neoplasm in 1 patient and Solid Papillary Epithelial Neoplasm in 1 patient.

Among the 30 patients with pancreatic lesions 17 lesions were benign and 13 were malignant. The mean age group of the study population is 48.9 which ranged from 17 years to 89 years. The average age of the patients (no = 17) with benign lesions is 44.6 years ranging from 18 to 70 years and mean age of the patients (n=13) with malignant lesions is 60.1 years which ranged from 50 to 75 years. This finding was comparable with the study done by**Jemal et al [(20)].** Out of the total 30 patients, 16 were male and 14 were females which corresponded to 53.3% males and 46.6 % females. Signifies that pancreatic lesions are common in males than females, which was comparable with the study by **Saha et al [(21)].** Among that16 male patients, 9 patients had benign lesions and 7 patients had malignant lesions. Out of the total 14 female patients, 8 patients had benign lesions and 6 patients had malignant lesions. This finding was also comparable with the abovementioned study.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 1579 - 1592
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Location distribution of different lesions were in the region of head, uncinate process, body, tail, head and uncinate process, head and neck, head and body, neck and body, body and tail. A total of 8 lesions were also seen in the head region, out of which 1 lesion was benign lesion and the remaining 7 lesions were malignant. The uncinate process had 3 lesions, out of which 2 were benign lesions and 1 was malignant lesions. 3 lesions were present in the body region, out of which all the three lesions were benign. 1 lesion was seen in the tail region which was a benign lesion. [22] None of the malignant lesions were seen in the tail region. A total of 4 lesions were seen in the head and uncinate process, out of which 2 lesions were benign and the remaining 2 were malignant. 1 lesion was in the head and neck region which turned out to be a malignant lesion. 5 lesions were seen in the head and body region of which 3 were malignant and 2 benign. A total of 8 patients were seen in the body and tail region. Finally, most of the malignant lesions were located in the head region and most of the benign lesions were also seen in the head region. This was in comparison with the study by **Becher and Stommer etal [23]**

The head of the pancreas was the most involved part of the lesions followed by body and the least affected part was tail in the current study which is comparable to the study done by **Becher and Stommer et al [14]**, 60% of pancreatic tumors were found involving the head of pancreas, 10% in the body of pancreas , and the tail of the pancreas was least affected with about 5% in the tail, and the remaining 25% were diffuselyinvolved. The various symptoms with which the patients presented were abdominal pain mainly in the epigastric region, jaundice which was obstructive with elevated bilirubin levels, loss of appetite, loss of weight, fever, vomiting and few presented with nil symptoms. Pain was the most common complaint seen in 86.7 % of the population. This was in concordance with study by **Mahmoud Abdelaziz Dawoud et al** [16,25]. Total of 26 patients had abdominal pain (epigastric region), out of which 17 patients had benign lesions and 15 patients had malignant lesions. Total of 9 patients presented with jaundice, out of which 1 patient had benign diagnosis and rest of the 8 patients had malignant lesions. Total of 2 patients presented with loss of appetite and 3 patients had loss of weight and all these patients had only malignant lesions.23 patients presented with vomiting, nausea, patient had 17 benign lesions and 8 had malignant lesion. Totally 2 patients were totally asymptomatic and the lesions were made out incidentally.

Among 15malignant lesions, the final pathological diagnosis was adenocarcinoma in 14 patients, 1 patient had neuroendocrine neoplasm. Adenocarcinoma was found to be the commonest pathological diagnosis out of the total population, which was in concordance with the study doneby**scaglionatal[24]**. **Scaglion et al [24]** in his study, suggested that the sensitivity of MDCT is 90 to 97% in the detection of pancreatic malignant masses. The sensitivity of staging pancreatic malignant lesions was 93% and positive predictive value was between 89 -100% for detecting surgical unresectability. According to him, Pancreatic ductal adenocarcinoma accounts for 80-90% of all pancreatic tumours. The results in our current study is comparable to this study.

Amongthe15patientswithmalignantlesions, MDCT detected the presence of vascular invasion in 10 cases had arterial involvement, among them 2 were benign where the celiac artery was stretched in a case of diagnosed serous cystadenoma, another was a huge pseudocyst and the same cases showed abutment of the inferior venacava by the mass and SMV thrombosis respectively. Vascular involvement in patients with pancreatic carcinoma is around 65% according to the present study where the venous involvement is slightly more than arterial involvement. This fact is in agreement with the study done by **Omar Hassanen et al [25]**, a study with a population of 82 patients and out of 177 vessel invasion they assessed arterial and venous invasion as their infiltration is the major criteria for unresectability of tumour. In the current study we adopted the same method and evaluated the arterial and venous invasion separately. The

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arteries analyzed were celiac artery (CA), superior mesenteric artery (SMA) and common hepatic artery (CHA). [26]

In our study, all the arterial and venous involvement by malignancy were in the form of direct invasion of the arteries namely celiac artery splenic artery superior mesenteric artery, and common hepatic artery CA 2, SMA 4, SA 1, COMMON HEPATIC ARTERY 1. splenic vein, superior mesenteric vein and portal vein in the form of direct invasion or tumour thrombosis of the vessels. This study was also correlating with the study done by **Buchs et al [27]** to assess the Vascular invasion in pancreatic cancer with different imaging modalities, preoperative diagnosis and surgical management. Superior mesenteric vessels were the most frequently involved due to the close proximity of it with the pancreas by location. Similarly, with axial source data with VR and curved MPR images are highly helpful in determining the relationship between the superior mesenteric vessels and the lesions. This goes in concordant with the study done by **Brugel et al [28]**, and **Vargas et al [29].**

According to the study made by **Carriere et al [30],** the common bile duct was the most frequently found dilated duct (n = 94) followed by both the pancreatic and common bile ducts (n = 30). CBD and MPD dilatation in MDCT is nonspecific in determining the true dilatation when compared to endoscopic ultrasound and among the total study population of 140 there were 32 patients who didn't have CBD and MPD dilatation in endoscopic ultrasonogram, which was diagnosed to have dilatation with MDCT. Among the 56 patients with real MPD/PD dilatation, 36 were benign and 18 were malignant/premalignant conditions. In our study, out of 7 people with CBD dilatation 5 were due to malignant causes, and 2 due to benign. MPD was dilated in 12 people out of 30 in which 7 were due to malignant lesions and 5 due to benign. MPD and PD infiltration is also visualized in 2 cases which were malignant. Same study has also given the mean age of the study population as 64.03 ± 14.96 years. The most common presenting symptom being abdominal pain same as in our study.

In our study, 11 patients showed lymph node involvement out of 30 cases in which 9 were malignant lymphadenopathy where the peri gastric, peripancreatic, periportal, paraaortic lymph nodes are affected, and 2 were due to pancreatitis where periportal and peripancreatic lymphadenopathy was observed. Regional lymph nodes were seen in 9 patients and distant metastases was present in9 patients who all were managed by palliative therapy.

Final statistical analysis revealed sensitivity, specificity, positive and negative predictive values of MDCT in evaluation of benign pancreatic mass lesions were 100%, 86.66%, 88.23% and 100%, malignant pancreatic mass lesions were 88.8%,100%,100%,86.6% respectively. Among the 25 patients with benign lesions, 23 lesions were concordant and 2 lesions were discordant with the final cytological diagnosis. Among the 15 patients with malignant lesions, 13 lesions were concordant with the final cytological diagnosis which were proved as malignant lesions. These results were comparable with study by **Hossain et al [31] Arabul etal [27].**

Ultrasound is less sensitive in detecting lesions and characterizing lesions because of the retroperitoneal location and failure to give fine details like in CT. CT was able to pick the small lesion measuring even less than 2cm in diameter. [31] CT provides very good depiction of enhancement of the pancreatic parenchyma and also describing small vessels. For assessment of vascular invasion CT is considered superior that it could detect the encasement of the vessels. CT was more superior for detecting mesenteric lymph node involvement. Several draw backs in ultrasound are operator dependent, failure to visualize the gland because of bowel gas, underestimation of involvement of major blood vessels, lymph node stations, underestimation of distantmetastases.[32] Multidetector computed tomography provides with three dimensional multiplanar reconstruction. Hence exact and accurate description of the involvement by the tumor

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into the common bile duct, main pancreatic duct peripancreaticregion and vascular invasion to the nearby vasculature. Multiphase imaging helps in differentiating the tumor type and the vessel involvement be better evaluated.

Our study of 30 patients the results were also comparable with the study by**Mahmoud Abdelaziz Dawoud et al** [33], which included 20 patients with pancreatic masses, 16 were males and 4 were females, age ranged from 30-70 yearswith a mean age of 58 years.Thepatients underwent contrast enhanced mutislice CT (32 slice machine) and the results were compared with histopathology and operative data. Pain is the most common complaint as observed in this study accounting for about 60%among the examined patients. In this study among the selected 20 patients, multi slice CT had a sensitivity of 97.7 % in detecting pancreatic lesions. Pancreatic neoplasms were found to be more common in males 80% than females 20%. In this study the age group mostly affected by pancreatic neoplasm was 60–70 Years. This study also showed that Adenocarcinoma as reported by pathological studies was the most common pathological finding in about 40% of the patients. A total of 14 (70%) patients with pancreatic cancer had unresectable tumors and 6 (30%) patients had tumours that were resectable, the causes were hepatic metastasis, vascular invasion, distant lymph nodes involvement andascites, same as in our study.

Peijie et al [29] Studied the differentiation of adenocarcinoma with cystic neoplasms of the pancreas, and determined the sensitivity of the MDCT in differentiating them which was comparable with our study. According to a study made by **Hossain MS and colleagues** [31] **Role** of MDCT Scan in the Evaluation of Pancreatic Mass with Histopathological Correlation, support that the excellent soft tissue resolution, better evaluation of peripancreatic fat plane disruption or fascial plane thickening and extension or invasion of growth proved CT scan may be a useful tool for assessing and characterization of pancreatic mass lesions.

5. Conclusion

Multidetector computed tomography with Contrast-enhanced multiphase pancreatic imaging along with its postprocessing techniques is regarded as the imaging modality of choice for diagnosis of pancreatic mass lesions and characterizing them into solid, cystic, inflammatory and in case of malignancy further playing a role in determining the respectability. In detection and staging of carcinoma pancreas, Contrast enhanced MDCT plays an important role. Better optimization of the imaging protocols with thinner sections aids in better resolution, thereby enabling for accurate determination of benign and malignant pancreatic lesions and also in tumour staging. In our study we prospectively studied the role of MDCT in evaluation of focal pancreatic mass lesions wherein we compared the MDCT findings with follow up and clinical findings / surgical/ cytological/ histopathological findings and finally sensitivity, specificity, positive and negative predictive values of MDCT in evaluation of benign pancreatic mass lesions 100%, 86.66%, 88.23% and 100%, malignant pancreatic mass lesions were 88.8%,100%,100%,86.6% respectively.

Funding: No funding sources

Ethical approval: The study was approved by the Institutional Ethics Committee

6. Conflict of Interest

The authors declare no conflict of interest.

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Received 20 January 2021; Accepted 08 February 2021.

7. Acknowledgments

The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

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