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Multimodality imaging evaluation of pancreatic masses and their pathological correlation

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Abstract
Background: Aims and Objectives: To assess the role of multimodality imaging in evaluation of pancreatic lesions as a useful diagnostic tool. 2) To correlate the imaging findings with guided fine needle aspiration cytology (fnac)/ pathological findings of the pancreatic lesion.
Material and Methods: The present study was conducted for a period of two years in Department of Radiodiagnosis and Imaging of Sri Guru Ram Das Charitable Hospital, Sri Amritsar. 30 patients with clinically suspected pancreatic lesions admitted to various wards or attending OPD were included in the study.
Results: Provisional radiological diagnosis of adenocarcinoma was made in 21 cases (70%), however only 18 (60%)out of these cases were pathologically proven to be ductal adenocarcinoma, 2 out of them were actually mucinous cystic neoplasm, 1 out of them was a secondary metastatic deposits. In 2 (6%) cases diagnosis of pancreatic neuroendocrine tumor was made, and in 2 (6%) cases suggestion of serous cyst adenoma was made which was proven to be so on pathology. Suggestion of acute necrotic pancreatitis was made in one (3%) case and solid pseudopapillary neoplasm was made in another one case (3%) it was proven to be so on pathology.
Conclusion: Transabdominal ultrasonography was able to detect pancreatic lesion in 70% cases and in 100% cases on computed tomography. Multimodality imaging has high overall sensitivity and specificity for detecting benign and malignant lesions of pancreas i.e. 100% in our study, however it has good overall sensitivity and average specificity and accuracy for characterisation of lesions of pancreas i.e. sensitivity, specificity and accuracy were 82.14%, 50% and 80% respectively in our study. A need thus exists for multiple studies to produce significant in – road towards the appropriate imaging diagnosis of pancreatic pathologies.

Keywords: multimodality; pancreatic; fnac; pathology; benign; malignant

Introduction

Pancreatic cancer is the 12th most common cancer and the 4th leading cause of cancer-related deaths in the world [1]. Survival in patients with pancreatic cancer is generally low with the 1-year and 5-year relative survival rates for all stages being 29% and 7%, respectively [2]. The cause for such poor long-term outcomes is possibly related to the fact that the disease is largely asymptomatic in the early stages and by the time symptoms do develop, the disease is locally advanced or metastatic. Only 10-20% of patients have resectable pancreatic cancer at presentation [3]. To substantially improve pancreatic cancer survival rates, early detection strategies are urgently required.

Samita gupta *et al.* [4] Conducted comparative evaluation of ultrasonography and computed tomography in pancreatic lesions. Their study concluded that on sonography, inflammatory lesions were diagnosed in 15 cases (50%), and on CT scan, the diagnosis was made in 18 patients (60%). Combining the USG & CT findings of inflammatory lesions, the provisional radiological diagnosis of focal pancreatitis was made in 1 case but it was proven to be adenocarcinoma on FNAC. Provisional diagnosis of adenocarcinoma was made in 8 cases, lymphoma in 2 cases, macrocystic adenoma in 1 case and cystadenocarcinoma in 1 case on both USG and CT scan. However on FNAC, adenocarcinoma was proved in 10 patients, lymphoma was found in one case. Thus the provisional radiological diagnosis was correct in 28 patients (93.7%). Thus, sonography detected pancreatic pathology in 27 cases (90%) but CT scan detected pancreatic lesions in all the 30 patients (100%).

Objectives of our study was 1) to assess the role of multimodality imaging in evaluation of pancreatic lesions as a useful diagnostic tool.2) to correlate the imaging findings with fine needle aspiration cytology (fnac)/ pathological findings of the pancreatic lesion.

The pancreas is a retroperitoneal organ and hence the sensitivity of transabdominal ultrasound is poor in detecting pancreatic cancer. The sensitivity according to studies vary between 48% and 89% with lower specificity and accuracy, with variation in these rates with the size of the tumour and operator's level of experience [5].

MDCT takes reproducible multi-planar imaging which provides good spatial resolution and attenuation between tumour and background pancreatic parenchyma with wide anatomic coverage, and thus allowing comprehensive examination of local and distant disease in one single section.

After evaluating the evidence underpinning all of the widely used modalities for diagnosis, we have made a comparison of these modalities with gold standard.

Material and Methods

The study was conducted for a period of two years from October 2017 to October 2019 after getting approval from ethical committee of the institute. Thirty patients presenting with signs and symptoms of suspected pancreatic lesions admitted to various wards or attending outpatient departments of Sri Guru Ram Das Charitable Hospital attached to Sri Guru Ram Das Institute of Medical Sciences and Research, Sri Amritsar referred to Department of Radiodiagnosis and Imaging for transabdominal ultrasound / contrast enhanced computed tomography / magnetic resonance imaging / guided fine needle aspiration or biopsy of pancreatic lesion were included in the study.

Study Design

A prospective cross-sectional study was conducted on 30 patients with clinically suspected pancreatic lesions.

A complete history of patients was taken and detailed clinical examination was performed after obtaining the written informed consent in all the cases. Relevant laboratory investigations (to rule out coagulation disorders) as mentioned in the proforma were done. The patients were then subjected to transabdominal sonography and contrast enhanced computed tomography and pancreatic lesions were evaluated for location, consistency, echotexture/ attenuation, vascularity and secondary findings like CBD dilatation, MPD dilatation, presence of lymph nodes, vascular involvement, invasion of adjacent structures and presence of metastasis in each case and a provision radiological lesion characterization was done. Finally, this was followed by pathological examination of that pancreatic lesion after doing USG or CT guided FNAC/ biopsy of the suspicious lesion.

Equipments

Ultrasonography (USG) • Machine - Volison E8 Expert BT09 (Wipro GE) with SP10-16-D • with a 2.5-3.5MHz convex transducer

Computed tomography (CT) • Machine - SIEMENS (SOMATOM Scope, #91181) - multi slice spiral CT scanner.

Magnetic resonance imaging (MRI) • Machine –Philips Achieva.

Dstream 1.5 tesla MRI using Sense Body Coil

USG/CT guided FNAC or Biopsy:

- LP needle -22 gauge
- Cameco syringe holder
- BIOPSY gun

Sonographic Technique: Overnight fasting was advised a day before examination. The patient were made to lie down on the couch. A coupling agent was applied liberally to patient's skin to act as acoustic window removing the air between transducer and patient's skin surface and allowing swift movement of the transducer. A general abdominal survey was done with a 3.5 MHz convex transducer with transverse, longitudinal and other desired planes. Pancreas was visualized by transverse scans in midline below the xiphoid process using the related vascular landmarks to identify it. The probe was made oblique to visualize the gland in its entirety. Using left kidney as an acoustic window, the tail of pancreas was visualized anterior to its upper pole. Wherever required, pancreatic and left upper quadrant visibility was improved by having patient drink a glass of water or making the patient stand erect. Color Doppler was done for vascularity of pancreas, pancreatic lesion and associated vascular structures. Findings were recorded as per proforma. Following USG patient were subjected to CT examination.

Computed Tomography (CT) Technique: Patients were instructed to report after fasting for at least six hours. All patients were given oral contrast required for the opacification of duodenum and the bowel. Patients were positioned supine and scout image of abdomen were taken. The region of interest were defined and extended from the domes till lower poles of kidneys. Plain sections were taken of the pancreatic area. Contrast enhanced CT scan of abdomen were then obtained after intravenous administration of 80-120ml of non-ionic contrast medium (Iohexol) containing 300 mg/ml of iodine. The amount of contrast were varied according to the patient's body weight, clinical and renal status. Scan slices were taken as 10 mm contiguous sections (Pitch - 1.5) over the entire upper abdomen and the volumetric data acquired reconstructed with 3mm thin slices. Multiplanar reconstructions were done wherever required. Axial sections were studied in detail regarding size, shape, density, enhancing pattern of pancreas and pancreatic lesion, peripancreatic infiltration/fat planes, any vascular complications etc. Findings were recorded as per proforma. Finally, this was followed by pathological examination of that pancreatic lesion after doing USG or CT guided FNAC/ biopsy of the suspicious lesion.

Statistical Tools

The statistical software "SPSS version 20 statistical package for windows" was used for the analysis of the data. Microsoft word and excel were used to form graphs, tables and flowcharts. Sensitivity, specificity, positive predictive values, negative predictive values and accuracy were calculated for the data obtained.

Observations and Results

The pancreatic cancer showed significant age predilection. The age of the patients ranged from 25-80 years, (GRAPH NO I) maximum numbers of patients diagnosed with pancreatic cancer were in the age group of 61-70 years i.e. 13 patients (43%). Out of 30 patients, the number of male patients were more than female patients. 19 (63.3%) male patients were part of the study, whereas 11 (36.7%) patients were females. Most of the patients came with more than one clinical complaint. Pain abdomen was the most common symptom seen in 25 patients i.e. in 83%. Next common symptom was nausea and vomiting in 17 patients i.e. in 57%. Weight loss / history of loss of appetite was observed in 13 patients i.e. in 43 %. Yellowish discolouration was complained by 12 patients i.e. in 40 %. Many patients presented with more than one sign and no significant abnormality was detected on clinical examination of 9 patients. Most common positive clinical sign was icterus seen in 8 patients, followed by pallor seen in 7 patients. Per abdomen examination revealed hepatomegaly in 3 patients, fullness in right hypochondrium in 2 patients and epigastric

tenderness in 1 patient (GRAPH NO II).

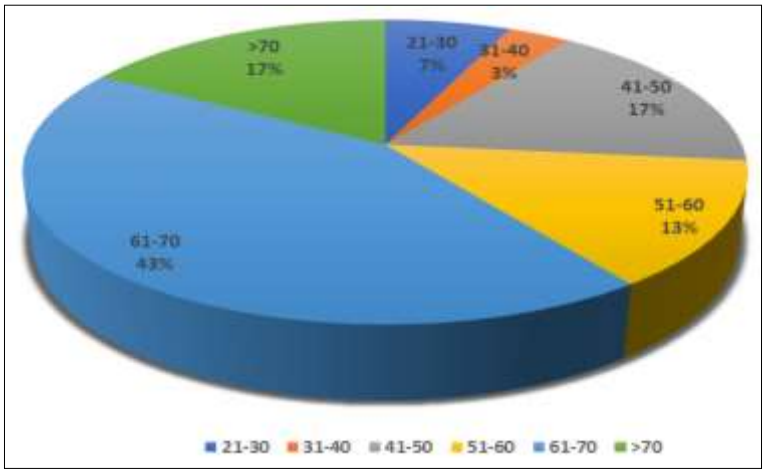

Fig 1: I Decade Wise Age Distribution of Patients (In Years).

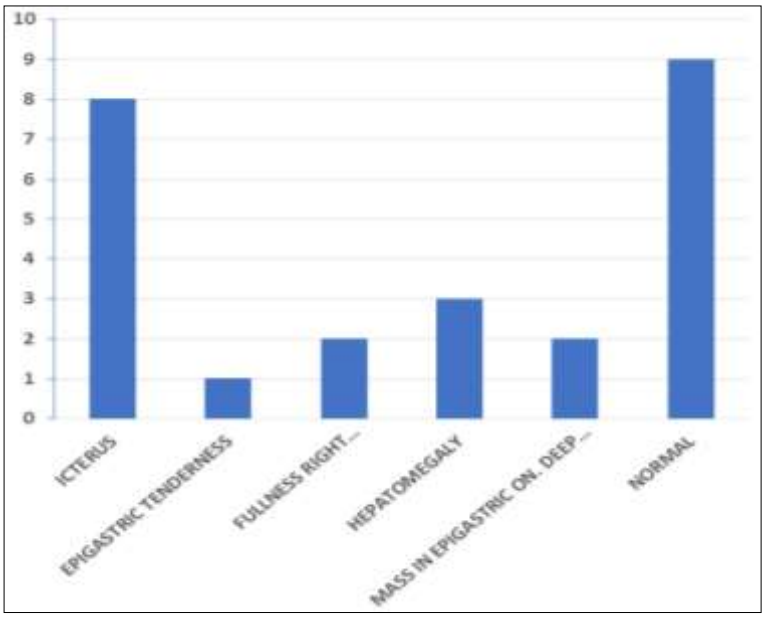

Fig 2: Distribution of Subjects According To Clinical Presentation

Sonographic Observation

Transabdominal ultrasonography was able to detect pancreatic lesion in 22 (70%) out of 30 patients. (TABLE I) In 8 patients pancreas could not be visualised as it was obscured by overlying bowel gases. Hence in these 8 cases, pancreatic lesions could not be detected on transabdominal ultrasonography, computed tomography was advised. Majority of the lesions were seen in the region of head of pancreas(11 cases i.e. 36%), followed by body of pancreas (5 cases i.e. 16%), followed by uncinate process of pancreas (3 cases i.e. 10%)and least were seen in the region of tail (2 cases i.e. 16%).(GRAPH NO III) On transabdominal ultrasonography majority of the lesions i.e.16 cases (53.3%) were hypoechoic in echotexture, heteroechoic in 4 cases (13.3%), hyperechoic in 1 case. (3.3%). On transabdominal ultrasonography solid – cystic lesions were seen in 9 cases comprising 30% of the total cases. Entirely solid appearing lesions were seen in another 9 cases (30%). 2 cases (6.6%) showed evidence of solid lesion with calcification within and 1 case (3.3%) showed multicystic appearance. On colour Doppler flow imaging,(TABLE II) no significant vascularity was detected in majority of cases i.e. 14 in number, however pancreatic lesion in 3 cases showed evidence of peripheral vascularity and in 1 case central vascularity was evident and in another 1 case mild internal vascularity was noted. Pancreatic duct dilatation was seen in 10 patients; however in 20 patients no such evidence was seen on transabdominal ultrasonography. Hepatic metastases were detected in 15 cases (50 %), however no metastasis were detected in rest 50% cases. Features of obstructive biliopathy in form of extrahepatic and intrahepatic biliary dilatation was seen in 13 cases. While remaining 17 cases gave no such evidence on transabdominal ultrasonography. On transabdominal ultrasonography, enlarged lymph nodes were seen in 7 cases and in remaining 23 cases no evidence of lymphadenopathy was noted. Evidence of involvement of peripancreatic major vessels- PV/IVC/SMV /SMA were detected in just 3 cases (10%) on sonography. Invasion/involvement of adjacent structures was noted in just 3 cases (10%) on sonography.

Table 1: Distribution of Patients According To Presence of Pancreatic Lesion on Sonography

Presence of Pancreatic Lesion on Sonography	No. of patients	Percentage
Lesion Detected	21	70
Obscured Pancreas Due To Bowel Gases	9	30
Total	30	100

Table 2: Distribution of Patients According To Pattern of Colour Flow of Pancreatic Lesion on Sonography

Pattern of Colour Flow On Sonography	No. of Patients	Percentage
Central	1	3.3
Mild vascularity	1	3.3
Lesion not detected	11	36.7
No significant vascularity detected	14	46.7
Peripheral vascularity	3	10
Total	30	100

Observations on Computed Tomography (CT scan)

Pancreatic lesions were detected in all thirty patients on CT scan. 8 cases which were not visualised on sonography were also seen on CT. Focal involvement of head was seen in 11 cases followed by body in 7 cases and least common in the region of uncinate process and tail i.e. Only 6 cases each. (GRAPH NO III) The lesions seen on CT were either homogenously hypodense or heterogeneous. 13 cases showed presence of heterogenous lesions comprising 43% of cases. 17 cases showed homogenously hypodense lesions comprising 57% of cases. Maximum number of cases showed no significant enhancement on post contrast CT scans i.e. 11cases(36%) and minimal enhancement in 9 cases (GRAPH IV)This was followed by peripheral enhancement in 5 cases (16.7%), central stellate type of enhancement in 2 cases and avid peripheral enhancement in another 2 cases. The calibre of pancreatic duct more than 3mm was considered dilated for any age. Main pancreatic duct (MPD) was normal in 15 cases (50%) and dilated in remaining 15 cases. Features of obstructive biliopathy in form of extrahepatic and intrahepatic biliary dilatation was seen in 15 cases. While remaining 15 cases gave no such evidence. Enlarged lymph nodes were seen in 28 cases. And in remaining 2 cases no evidence of lymphadenopathy was noted on computed tomography. Involvements of the peripancreatic major vessels –portal vein/IVC/SMV/SMA were seen in 17 patients including portal vein thrombus, encasement of PV/SMV/SMA and thrombosis of SMA /SMV and splenic vein. In 16 cases there was evidence of invasion of adjacent structures while remaining 14 cases showed no such evidence on computed tomography.(TABLE III) Hepatic metastases were seen in 13 cases of pancreatic lesions, one case showed evidence of peritoneal deposits another one case showed evidence of adrenal deposits.(TABLE IV)

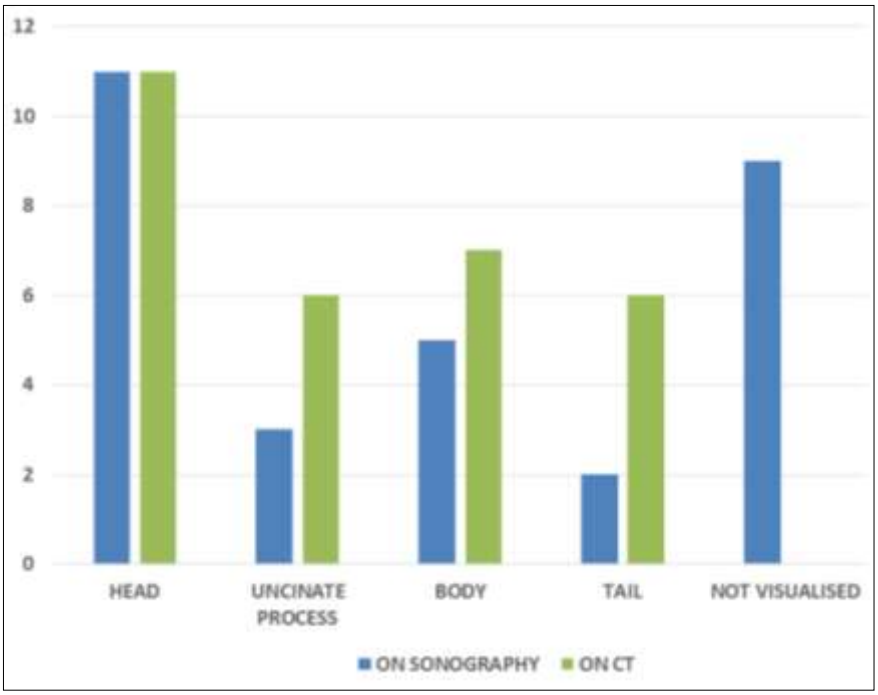

Fig 3: Distribution of Subjects According to Site of Lesion on Sonography and CT

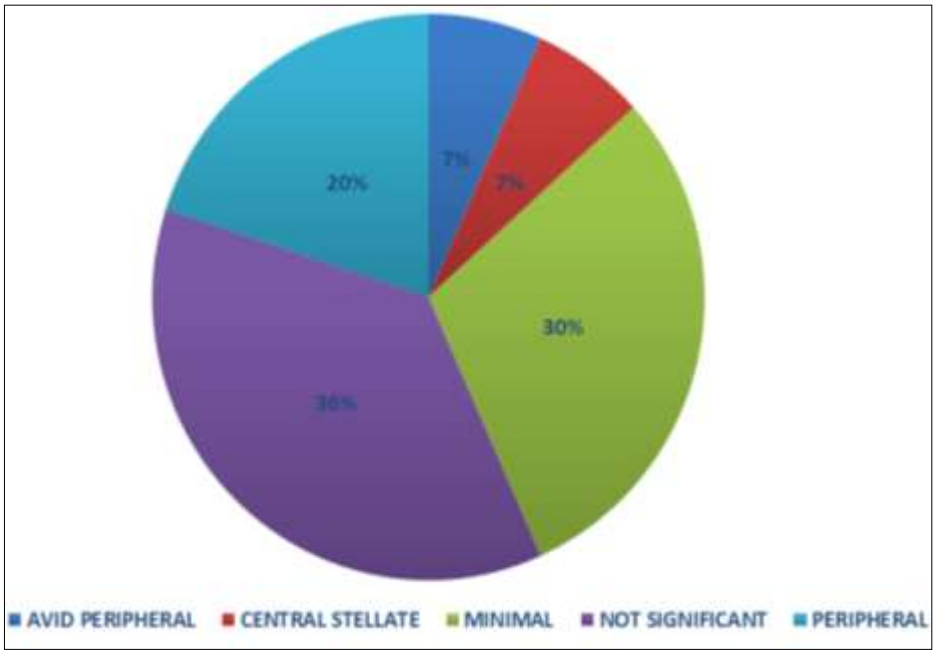

Fig 4: Distribution of Patients According To Enhancement Pattern of Pancreatic Lesion on Ct

Table 3: Distribution of Patients According To MPD, CBD Dilatation, Lymphadenopathy, Ivollvement of Vascular and Adjacent Structures on Sonography and Ct

	On Ultrasonography		On Computed Tomography	
	No.	%age	No.	%age
Pancreatic duct dilatation	10	33.3	15	50
CBD dilatation on sonography	13	43.3	15	50
Lymphadenopathy	7	23.3	28	93.3
Invasion of vascular involvement	3	10	17	57
Invasion of adjacent structures	3	10	16	53.3

Table 4: Distribution of Patients According To Metastasis Detected On Sonography and Ct

	On sonography		on ct	
	No.	%age	No.	%age
Metastasis detected	15	50	14	3
Peritoneal deposits			1	3
Not dtected	15	50	15	50
Total	30	100	30	100

Results

In accordance with the imaging findings on transabdominal ultrasonography and computed tomography, provisional radiological diagnosis was made in all the 30 patients. Provisional radiological diagnosis of ductal adenocarcinoma was made in 21 cases, in 3 cases lesions were characterised as metastatic deposits, in 2 cases provisional imaging diagnosis of neuroendocrine was made, in another 2 cases suggestion of serous cyst adenoma was made, in 1 case other benign pathology was suggested and in 1 case suggestion solid psuedopappilary neoplasm was made. Most common pathological type in our study group was ductal adenocarcinoma diagnosed in 18 cases followed by metastatic deposits seen in 4 cases followed by pancreatic neuroendocrine tumor in 2 cases, serous cyst adenoma in 2 cases and least common were solid psuedopappilary neoplasm in 1 case and necrotic inflammatory pathology in 1 case. The pancreatic lesions detected on USG and CT were classified into inflammatory and neoplastic lesions. 1 patient had inflammatory pathology i.e acute necrotising pancreatitis. 29 patients had neoplastic pathology out of which 27 were diagnosed as malignant and 2 were diagnosed as benign. The sensitivity and positive predictive value of multimodality imaging in detecting inflammatory or neoplastic lesions of pancreas were 100% and 100% respectively. (TABLE VI) Provisional radiological diagnosis of adenocarcinoma was made in 21 cases, however only 18 out of these cases were proven to be ductal adenocarcinoma, 2 out of them were actually mucinous cystic neoplasm, 1 out of them was a secondary metastatic deposits. In 2 cases diagnosis of pancreatic neuroendocrine tumor was made which was proven to be so on pathology. In 2 cases suggestion of serous cyst adenoma was made which was proven to be so on pathology. Suggestion of acute necrotic pancreatitis was made in one case it was proven to be so ie necrotic inflammatory pathology. Suggestion of solid pseudopapillary neoplasm was made in one case it was proven to be so on pathology. (TABLE V)The sensitivity, specificity and accuracy of multimodality imaging in characterisation of pancreatic lesion were 82.14%, 50% and 80% respectively. (TABLE VII)

Table 5: on Correlating Characterisation of Lesion on Radiological Imaging with Pathological Findings

	Pathological diagnosis	Radiological diagnosis
Ductal adenocarcinoma	18	21
Metastatic deposits	4	3

Mucinous adenocarcinoma	2	-
Necrotic inflammatory pathology	1	1
Pancreatic neuroendocrine tumor	2	2
Serous cyst adenoma	2	2
Solid pseudopapillary neoplasm	1	1

Table 6: Sensitivity and Positive Predictive Value on Correlating Imaging Findings with Pathological Findings

Statistic	Value (%)	95% CI
Sensitivity	100	94% to 100%
Positive Predictive Value	100	94% to 100%

Table 7: Showing Sensitivity, Specificity, Ppv, Npv, Accuracy of Imaging against Pathological Findings

Statistic	Value (%)	95% confidence interval
Sensitivity	82.14	63.11% to 93.94%
Specificity	50	1.26% to 98.74%
Positive predictive value	95.85	85.05% to 98.94%
Negative predictive value	16.67	3.89% to 49.70%
Accuracy	80	61.43% to 92.29%

Discussion

We have evaluated and compared the suitability and accuracy of the current diagnostic modalities that exist for pancreatic cancer. We are currently lacking effective diagnostic and screening modalities to diagnose pancreatic cancer at an early, and therefore more likely curative stage. Therefore, it is valuable to have a thorough understanding of the currently available diagnostic technology, including its benefits and limitations, in order to provide direction for future research. Our study showed similar results as study done by Samita gupta *et al* [4]. in which there were 30 subjects out of which 18 (60%) males & 12 (40%) females. pain abdomen was the most frequent symptom seen in 25 patients i.e. in 83% in our study. This was incongruent to study done by Fiona m walter *et al* [6]. out of 391 participants, 54% patients had multiple first symptoms whereas 41% patients had a solitary first symptom. In this referred population, no initial symptoms were reported more frequently by patients with cancer. Several subsequent symptoms predicted pancreatic cancer: jaundice in 49% with pancreatic cancer. The results were incongruent due to a huge sample size by the cohort study done by these researchers. In 8 (30%) patients pancreas could not be visualised as it was obscured by overlying bowel gases which were subsequently detected by CT. Our study correlates with study done by Ju Hyun Jeon *et al*, [7] they concluded the overall detection rate of TAS was 88.3% (940/1064) which got significantly improved after CT, MRI, or EUS. Karlson BM *et al.* [8] In their prospective cohort study concluded the sensitivity of US in the detection of all tumors in the pancreatic area was 88.6%. Regarding lesion site, our study showed similar results as study done by *Low G et al.* [9] which showed 60%–70% lesions located in the pancreatic head, 10%–20% in the body, and 5%–10% in the tail. Vargas R *et al.* [10] in their study concluded MDCT has shown the best performance for the evaluation of vascular involvement, which is the most important factor for predicting the tumor resectability. The reported positive cases of pancreatic cancer with vessel involvement was 89%. In our case series, out of 30 cases, diagnosis of ductal adenocarcinoma was correctly made in majority i.e. 18 cases(60%) which is in concordance with Jemal *et al.* [11] in global cancer statistics stated that Pancreas ductal adenocarcinoma (PDAC) accounts for 85–90% of all pancreatic neoplasms and is one of the leading causes of death worldwide. Fisher WE *et al.* [12] concluded that specific diagnoses based on CT findings alone were correct in an average of 39% of the cases. Even when diagnoses were dichotomized as benign (43%) or potentially malignant (57%, papillary mucinous neoplasms, mucinous cystic neoplasms, cancer), determinations based on CT alone were accurate in an average of 61% of cases. When all clinical information available was considered together as a single dichotomous indicator of malignant potential, the indicator was accurate in 90% of the cases. In our case series, imaging findings were correct in 90% of the cases in lesion characterisation. However, when diagnosis were dichotomised as inflammatory (3%) or neoplastic (total 97%, benign 6%, malignant 91%), determinations based on multimodality imaging were accurate in 100% of cases.

Our study mounted the following points

- Multimodality imaging has high overall sensitivity and specificity for detecting benign and malignant lesions of pancreas i.e. 100% in our study.
- Multimodality imaging has good overall sensitivity and average specificity for characterisation of lesions of pancreas i.e. sensitivity, specificity and accuracy were 82.14%, 50% and 80% respectively in our study.
- Thus CT and sonography are complementary imaging modalities in the evaluation of suspected pancreatic lesions. Thus in all the cases of pancreatic lesions, besides clinical examination; both these modalities (Sonography and CT scan) have their own role in detecting and differentiating lesions of pancreas and should be used in combination for accurate diagnosis and management.

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None

Conflicts of interest

None

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