Original Article

Profile of computed tomography scan findings of patients diagnosed with pancreatic neoplasm at Dr. George Mukhari Academic Hospital, Ga-Rankuwa, Pretoria, South Africa

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Abstract

Background: The aim of this study is to determine the profile of abdominal computed tomography (CT) scan findings of patients diagnosed with pancreatic adenocarcinoma and other pancreatic neoplasm that simulates pancreatic adenocarcinoma, which constitute the majority of pancreatic neoplasm at Dr. George Mukhari Academic Hospital, Ga-Rankuwa, Pretoria, South Africa.

Materials and Methods: A prospective study of abdominal CT scans of 67 patients, aged 12 years and older, with histologically confirmed pancreatic neoplasms, including their medical records and laboratory results, from November 1, 2013 to June 30, 2017, was conducted. CT scan images were acquired with 128 slices, Philips, and GE CT scanners. Statistical analysis was made using a Statistical Program for the Social Sciences software SPSS (version 22.0).

Results: There were 36 females (53.7%) and 31 males (46.3%) in this series and four demised. The ages of the patients ranged from 12 to 90 years. The most common clinical presentation was obstructive jaundice (86.6%). The predominant histological diagnosis was adenocarcinoma (74.6%), followed by primary lymphoma of the pancreas (13.4%) and 65.7% of the pancreatic neoplasms were unresectable, while most of the other pancreatic neoplasms based on their CT scan findings masqueraded as pancreatic adenocarcinoma. Pancreatic adenocarcinoma demonstrated both typical and atypical CT scan findings.

Conclusion: Accurate diagnosis and appropriate management of pancreatic neoplasms are important because of their high morbidity and mortality. The majority of the pancreatic neoplasms were unresectable at the time of their presentation. A multidisciplinary management team is recommended since pancreatic neoplasms still remain a serious clinical challenge.

Keywords: Computed tomography scan, pancreatic neoplasm, South Africa

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INTRODUCTION

General practitioners are the first medical service delivery groups consulted by pancreatic neoplasm patients, whereby inadequate treatments, investigations, long patient appointments, and delay in accurate diagnosis, may be encountered. Pancreatic neoplasms usually do not cause

Access this article online	
Quick Response Code:	Website: www.wajradiology.org
	DOI: 10.4103/wajr.wajr_55_17

How to cite this article: Ozoh JO, Govender M, Towobola OA, Ogunbanjo GA. Profile of computed tomography scan findings of patients diagnosed with pancreatic neoplasm at Dr. George Mukhari Academic Hospital, Ga-Rankuwa, Pretoria, South Africa. West Afr J Radiol 2019;26:100-9.

recognizable symptoms in its early stages, and by the time, these patients are referred to the gastroenterologist, at Dr. George Mukhari Academic Hospital (DGMAH), the pancreatic neoplasms would have become unresectable.

Pancreatic cancer with a high mortality, in clinical practice is synonymous with pancreatic adenocarcinoma, accounting for over 90% of all primary malignant tumors arising from the pancreatic gland.[1] The authors of that study observed that the diagnosis of pancreatic carcinoma is frequently made in the late stages of the disease; this refers to more than 90% of the cases, and the role of the radiologist, therefore, is to facilitate early diagnosis and determine the resectability of the tumor. In most cases, pancreatic adenocarcinoma presents as solid tumors and the other common solid tumors in and around the pancreas, including: endocrine tumors of the pancreas, solid pseudopapillary tumors, plasmacytoma, ampullary adenocarcinoma, lymphoma, and metastasis.

Pancreatic neoplasm rarely occurs before the age of 40 years, and more than half of the cases occur in patients over 70 years.[2] The main reasons for the poor survival rates of pancreatic neoplasm patients are early local invasion because the pancreas is a soft organ without a capsule and nonpresentation of recognizable symptoms in its early stages.[3] Symptoms of pancreatic carcinoma include the following: jaundice with or without pain, pain in the abdomen or upper back, unexplained weight loss either from loss of appetite or loss of exocrine function resulting from poor digestion, compression of adjacent organs making it difficult for the stomach to empty with resultant nausea and vomiting, diabetic symptoms (50%), Trousseau's syndrome in which blood clots form spontaneously in the portal vessels, deep or superficial veins, weakness and tiring easily, dry mouth, sleep problems, and a palpable abdominal mass.[4,5] Exceptions to the late recognizable symptoms of pancreatic carcinoma are the neuroendocrine tumors of the pancreas where excess production of various active hormones will predispose to early diagnosis. Risk factors of pancreatic carcinoma include the following: age (most cases occur after 65–70 years), more common in men than women, cigarette smoking (best established avoidable risk factor), obesity (BMI greater than 35), family history of pancreatic carcinoma, or hereditary pancreatitis, chronic pancreatitis, and diabetes mellitus type 2.[4,6-8]

The common computed tomography (CT) scan findings of pancreatic carcinoma include the following: hypovascular mass, dilatation of the biliary and pancreatic ducts (double-duct sign), invasion of adjacent structures, and metastasis.[9] In the same study, uncommon CT scan findings were reported to include: cystic masses, masses without dilatation of biliary or pancreatic ducts, multiple masses, or lesions infiltrating most parts of the pancreas without any anatomic distortion.[9] Vascular encasement often determines unresectability and narrowing, displacement, or obliteration of the lumen of the vessel by surrounding cancer can be demonstrated on CT scan. The superior mesenteric, splenic, celiac, hepatic, gastroduodenal, and left renal arteries may be involved in pancreatic carcinoma in descending order of importance.[1] The same study reported that metastases to the surrounding organs may involve the liver (17%–55%), regional lymph nodes (38%–65%), peritoneum (ascites in 13%), and to a lesser extent the spleen, stomach, duodenum, splenic flexure, transverse mesocolon, porta hepatis, kidneys, and the spine. Pancreatic lesions that simulate pancreatic adenocarcinoma are the following: (1) chronic focal pancreatitis which presents as a solid focal mass often in the pancreatic head and can be differentiated from pancreatic adenocarcinoma by irregular pancreatic duct and pancreatic calcifications; (2) solid pseudopapillary tumor of the pancreas which can present as a solid hypodense mass on noncontrast CT scan; however, it demonstrates mild gradual enhancement on postcontrast scan which is not seen in pancreatic adenocarcinoma; (3) neuroendocrine tumor of the pancreas which frequently presents as a small hypodense solid mass on noncontrast CT scan but enhances on postcontrast scan, without dilatation of the pancreatic duct; (4) a duodenal gastrointestinal stromal tumor can mimic pancreatic carcinoma; however, it demonstrates intense contrast enhancement with rare pancreatic duct dilatation; (5) primary pancreatic lymphoma is bulky and often encases the vasculature but does not occlude it, and pancreatic duct dilatation and cystic changes are rare; and (6) metastasis to the pancreas are mainly from kidney (30%) and lung (23%).[10] Autoimmune pancreatitis presents with either diffuse or focal enlargement in the region of the head of pancreas, that is, isodense or hypodense with irregular wall thickening or narrowing of the pancreatic duct. This is associated with peripancreatic fat stranding and enhancement of the gallbladder and common bile duct.[10]

AIM AND OBJECTIVES OF THE STUDY

Aim

The aim of this study is to describe the profile of the abdominal CT scan findings of patients diagnosed with pancreatic neoplasm at DGMAH.

Objectives

The main objectives of this study were as follows:

1. To describe the common and uncommon abdominal CT scan findings of patients diagnosed with pancreatic adenocarcinoma, which constitute the majority of pancreatic neoplasms
2. To describe the CT scan findings of other pancreatic neoplasms in this series
3. To identify in the series how other pancreatic neoplasms simulate adenocarcinoma of the pancreas
4. To examine how CT scan findings correlate with histological diagnosis of the various types of pancreatic neoplasms.

Ethical clearance

1. Informed consent for the CT scan procedure was obtained routinely from each patient using the standardized DGMAH patient consent form for procedures
2. The Chief Executive Officer, at DGMAH, Ga-Rankuwa, Gauteng province gave permission to conduct the study
3. Ethical approval for the study was obtained from the Sefako Makgatho Health Sciences University Research Ethics Committee (SMUREC). Clearance number: SMUREC/M/231//2017: IR
4. Confidentiality and anonymity of the patients' hospital medical records were maintained during the study. Data were analyzed as group data, as no personal identifiers were reflected in the data collection sheet.

MATERIALS AND METHODS

Philips Ingenuity CT Scanner (128 slices) and GE Optima CT Scanner (128 slices) were used simultaneously for the acquisition of the CT scan images. The abdominal CT scans of 67 patients and their medical records, from November 1, 2013 to June 30, 2017, were prospectively evaluated. All patients aged 12 and older, who were diagnosed with histologically confirmed pancreatic neoplasm, were included in this study. For the convenience of this study, CT scan images were stored in DVD tapes as well as in the picture archiving and communication system of DGMAH. Data were collected using Excel spreadsheet and it contained all the variables (demographic characteristics, CT scan findings, clinical presentation, subdiagnosis, comorbidities, and histology of the pancreatic neoplasm). Data generated from the review were analyzed using descriptive statistics for demographic characteristics and identified variables. These were expressed as percentages, ranges, means, and standard deviation. All analyses of the variables from the records of the study were made using the Statistical Package for the Social Sciences (SPSS, version 22.0, IBM, New York City, USA) software program. Association of variables was done using Fisher's exact test due to the small sample size and a $P \leq 0.05$ was considered to be statistically significant. All abdominal CT scans of patients diagnosed with pancreatic neoplasm used in this study were read by a competent consultant radiologist. However, the principal researcher also read the scans again to correlate the findings independently.

RESULTS

The patients' ages ranged from 12 to 90 years with a mean (± standard deviation) of 56.4 years (±16.4) and females in the series were 36 (53.7%) and males 31 (46.3%) [Table 1].

The diagnostic types of pancreatic neoplasm detected among these patients show a preponderance of pancreatic adenocarcinoma [Figures 1-5] which made up 74.6% of all the cases. This is followed by 13.4% cases of lymphoma [Figures 6-8] and neuroendocrine tumor [Figures 9-11] was seen in 4.5% of the patients, while plasmacytoma [Figure 12] was seen in one case (1.5%). In addition, pseudopapillary tumor occurred in two patients (3.0%) and there was one case each (1.5%) of cystadenocarcinoma and ampullary adenocarcinoma [Table 2]. Obstructive jaundice is the most frequently observed clinical presentation among these patients and it accounted for 58 (86.6%) of the cases. Patients with pancreatic neoplasm also presented with abdominal pain (3.0%), chronic pain (6.0%), upper gastrointestinal bleed (3.0%), and one case (1.5%) of acute pain [Table 2].

Out of the 50 cases of pancreatic adenocarcinoma in this series, the common CT scan findings presented as nonenhancing pancreatic adenocarcinoma (40 cases, 80%); single mass in 42 cases (84%); and 30 cases (60%) with dilated pancreatic duct, and there were 34 cases (68%) which had dilated intrahepatic ducts [Figure 13]. The figure also shows the uncommon characteristics of CT scan findings of pancreatic adenocarcinoma. Such uncommon CT scan findings occurred as mixed enhancing pancreatic adenocarcinoma in 2 cases (4.0%), multiple masses in 2 cases, (4.0%), and nondilated pancreatic duct of 20 cases (40.0%) shown in Figure 14. There were also

Table 1: Demographic features of the patients

Variables	Results
Age (years)	
Range	12-90
Mean	56.4
SD	16.4
Gender, *n* (%)	
Females	36 (53.7)
Males	31 (46.3)

SD – Standard deviation

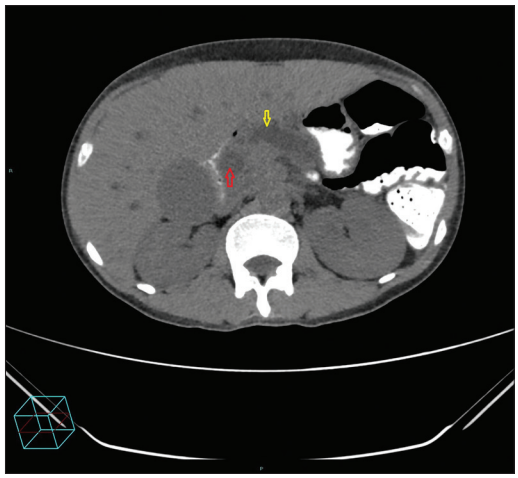

Figure 1: Axial noncontrast computed tomography abdomen showed dilated pancreatic duct (open yellow arrow) and common bile duct (open red arrow). Head of pancreas was bulky. No calcifications were seen at the level of L1

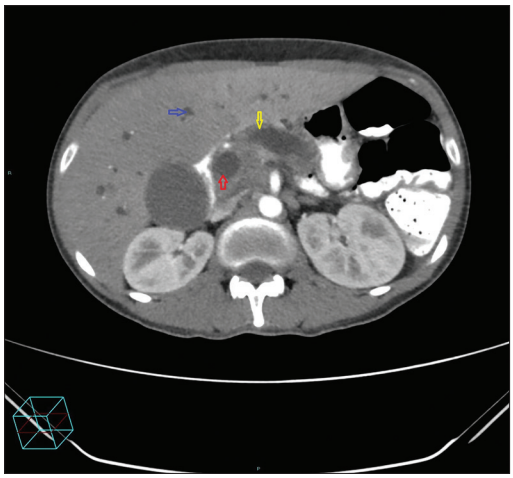

Figure 2: Postcontrast arterial phase computed tomography scan abdomen demonstrated dilated common bile duct, (open red arrow) dilated pancreatic duct (open yellow arrow), and prominent intra hepatic bile ducts (open blue arrow). Gallbladder was distended

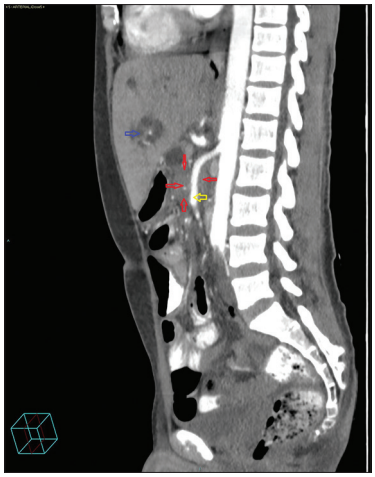

Figure 3: Sagittal postcontrast computed tomography scan abdomen showed encasement of the opacified superior mesenteric artery (open yellow arrow) by oval-shaped hypovascular adenocarcinoma of the pancreas (open red arrow). Dilated intrahepatic bile duct is shown by open blue arrow

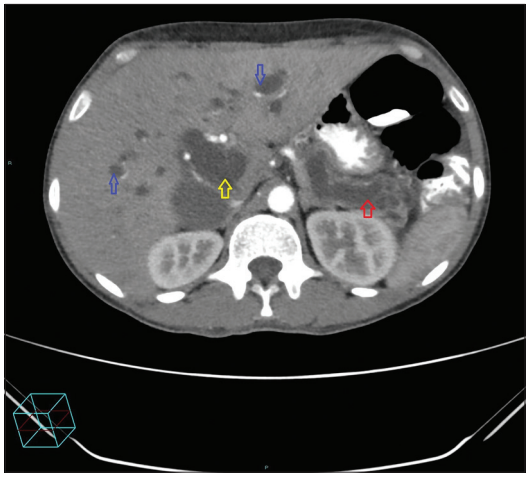

Figure 4: Postcontrast computed tomography scan abdomen, arterial phase showed dilated pancreatic duct (open red arrow), and dilated common bile duct (open yellow arrow). Open blue arrows showed dilated intrahepatic bile ducts

16 cases (32.0%) of nondilated intrahepatic duct and three cases (6.0%) of cystic masses as shown in Figure 15.

Figure 16 illustrates cases of pancreatic neoplasms masquerading as pancreatic adenocarcinoma based on CT scan findings. There were 9 cases (18.0%) of histologically confirmed diagnosis of lymphoma simulating pancreatic adenocarcinoma on CT scan. In addition, three cases (6.0%) of neuroendocrine tumor and two cases (4.0%) of pseudopapillary tumors also simulated pancreatic adenocarcinoma.

At the time of diagnosis of pancreatic neoplasm, 17 out of 63 patients (27.0%) had complications with 13 patients being the most noticeable (20.6%) and they had liver metastases [Figure 17]. There was also one case each (1.6%) of lung metastases, bone metastases, and acute and chronic pancreatitis [Figure 18].

Table 2: Diagnostic types and clinical presentations of pancreatic neoplasm

	Frequency (%)
Diagnosis	
Pancreatic adenocarcinoma	50 (74.6)
Lymphoma	9 (13.4)
Neuroendocrine tumor	3 (4.5)
Pseudo papillary tumor	2 (3.0)
Plasmacytoma	1 (1.5)
Cystadenocarcinoma	1 (1.5)
Ampullary adenocarcinoma	1 (1.5)
Clinical presentations	
Abdominal mass	2 (3.0)
Acute pain	1 (1.5)
Chronic pain	4 (6.0)
Obstructive jaundice	58 (86.6)
Upper gastrointestinal bleed	2 (3.0)

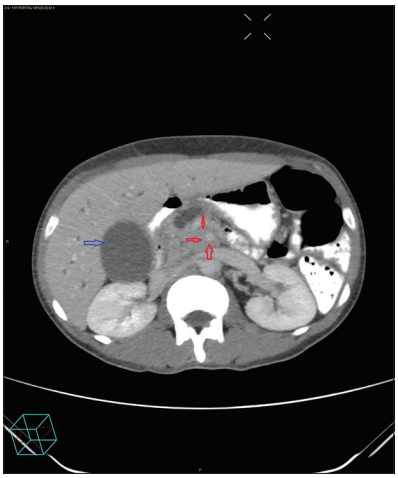

Figure 5: Postcontrast computed tomography scan abdomen portovenous phase, showed a hypovascular adenocarcinoma of the head of pancreas with encasement of the partially opacified superior mesenteric artery (open red arrow). Open blue arrow demonstrated distended gallbladder

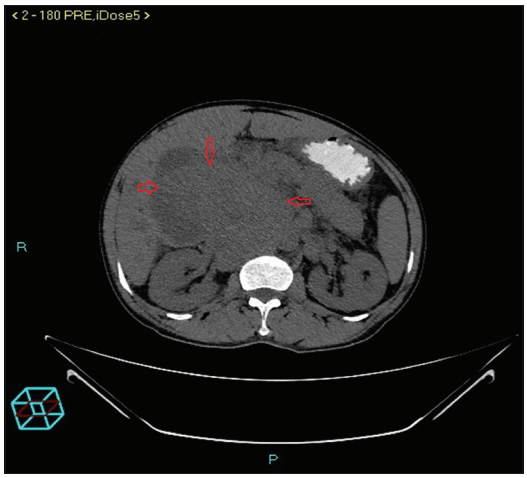

Figure 6: Axial computed tomography scan of the abdomen showed a very large lobulated hypodense mass (primary pancreatic lymphoma (open red arrows)

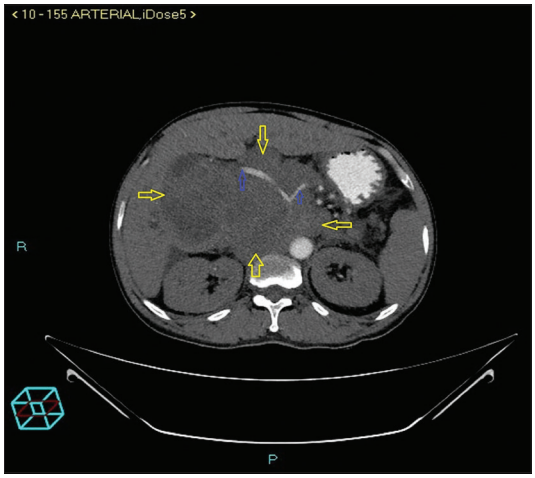

Figure 7: Axial postcontrast computed tomography scan of the abdomen (arterial phase) demonstrated mild enhancement of the lymphoma (open yellow arrows). Encasement of the right common hepatic and left gastric arteries were noted, but they were not occluded (open blue arrows). The aorta was minimally displaced toward the left side

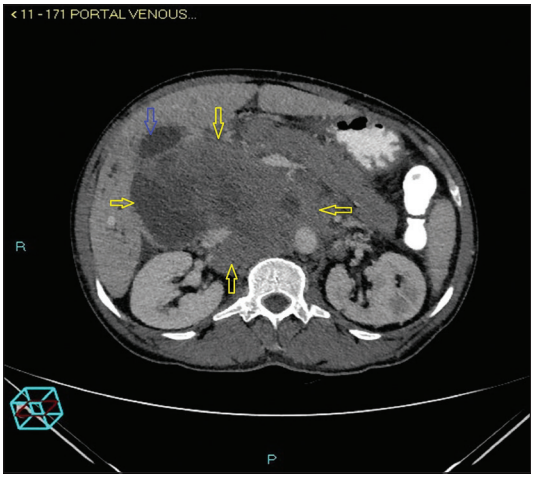

Figure 8: Axial postcontrast computed tomography scan (portovenous phase) showed dilated intrahepatic bile ducts (open blue arrow). There was mixed attenuation enhancement (open yellow arrows). Pancreatic duct was not dilated

Table 3: Profile of comorbidity and human immunodeficiency virus infection status of the patients

Comorbidity	Frequency (%)
Diabetes mellitus	4 (6.0)
Diabetes mellitus + hypertension	2 (3.0)
Hypertension	3 (4.5)
Hypertension + obesity	1 (1.5)
Neurofibromatosis	1 (1.5)
Human immunodeficiency virus (*n*=23)	
Positive	10 (43.5)
Negative	13 (56.5)
Unknown	44 (65.7)
No comorbidity	32 (47.8)

Eleven cases of concurrent comorbidity were found among the patients and these were type 2 diabetes mellitus (6%), diabetes mellitus and hypertension (3%), hypertension alone (4.5%), hypertension and obesity (1.5%), and neurofibromatosis (1.5%). Out of 23 patients whose HIV infection status was investigated, 10 patients (43.5%) were HIV positive. However, among the 67 patients in this series, 32 patients (47.8%) were without any comorbidity [Table 3].

At the time of presentation in hospital, 44 cases (65.7%) were adjudged to be unresectable, [Figures 3 and 5], 16 (23.9%) had surgical resection made up of 13 cases of pancreaticoduodenectomy, and 3 cases of central pancreatectomy. One patient underwent laparotomy (small bowel intussusception) and 6 patients (9.0%) received chemotherapy. Among the 67 patients diagnosed with pancreatic neoplasm, 4 of them demised – 2 of these patients were among those with unresectable neoplasm. The

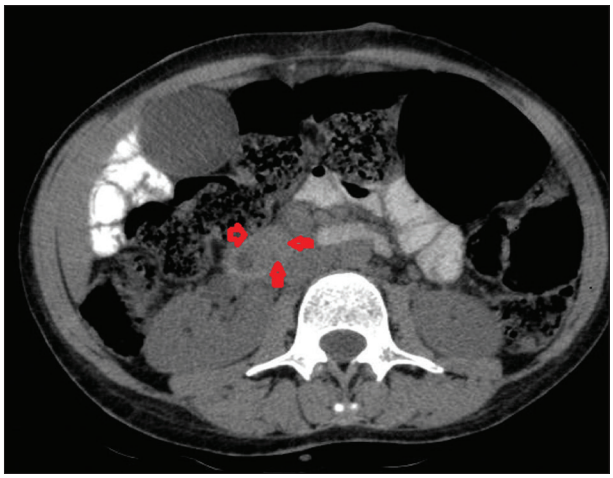

Figure 9: Precontrast scan demonstrated oval-shaped low attenuation mass at the head of pancreas, (neuroendocrine tumor pancreas; open red arrows) with mildly distended gallbladder

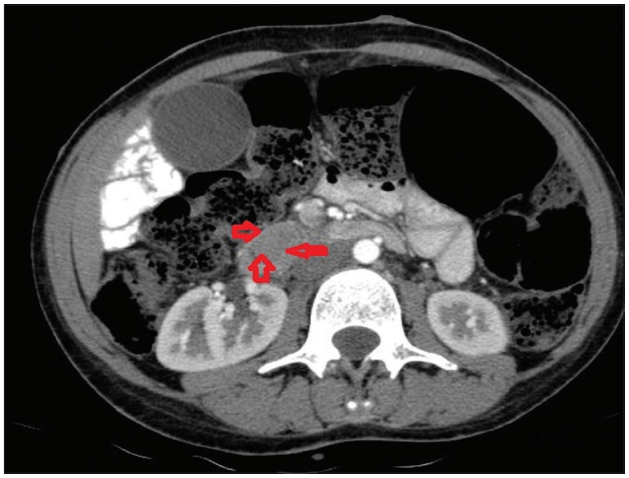

Figure 10: Postcontrast arterial phase showed enhancement of the neuroendocrine tumor (open red arrows). Pancreatic duct was visible but not dilated. Mildly distended gallbladder noted

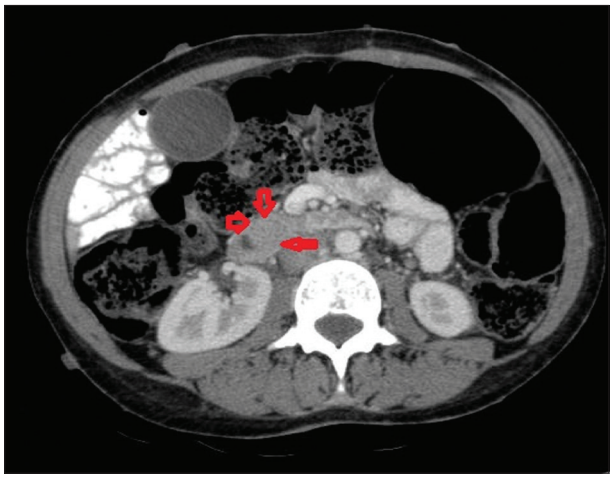

Figure 11: Postcontrast axial computed tomography abdomen showed enhancement of the neuroendocrine tumor at the head of pancreas (open red arrows). There was mildly distended gallbladder

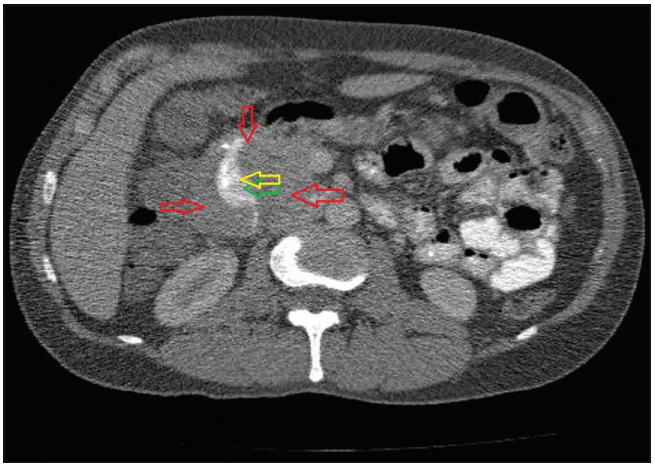

Figure 12: Axial postcontrast computed tomography scan of the abdomen demonstrated a large hypovascular mass (extramedullary plasmacytoma; open red arrows) at the head of the pancreas. There was a marked circumferential narrowing of the second part of the duodenum due to infiltration of the plasmacytoma into the second part of the duodenum. The hyperdense linear structure at the center of the plasmacytoma (open yellow and green arrows) represented residual lumen of the second part of the duodenum

remaining 2 out of the 4 patients that demised – 1 presented with small bowel intussusception and had laparotomy, and the other patient was on chemotherapy [Table 4].

The CT scan findings for patients with pancreatic neoplasm revealed majority (53, 79.1%) of the cases with nonenhancing mass, 45 cases (67.2%) of dilated common bile duct, 44 cases (65.7%) of dilated pancreatic duct, and there were 47 scans (70.1%) which showed dilated intrahepatic bile duct [Figures 2 and 4]. There were also 7 CT scans (10.4%) showing cystic mass, 4 scans (6.0%) with enhancing mass, 3 scans (4.5%) with mixed attenuation mass, and 3 scans (4.5%) of multiple masses [Table 5].

Table 4: Management options used in treating the patients

Options	Frequency (%)
Chemotherapy	6 (9.0)
Laparotomy (small bowel intussusception)	1 (1.5)
Resected (*n*=16)	16 (23.9)
Pancreaticoduodenectomy (*n*=13)	
Central pancreatectomy (*n*=3)	
Unresectable (*n*=44)	44 (65.7)
Patients demised (*n*=4)	4 (6.0)
Patient on chemotherapy (*n*=1)	
Patient who had laparotomy (*n*=1)	
Unresectable patients (*n*=2)	

Among the 63 cases with definitive information of the location of neoplasm, 46 (73.0%) were at the pancreatic head and these were predominantly pancreatic adenocarcinoma, 3 (4.8%) were located at the pancreatic neck, 4 (6.3%) at the tail, and 6 (9.5%) were located at the uncinate process. The CT scan findings also

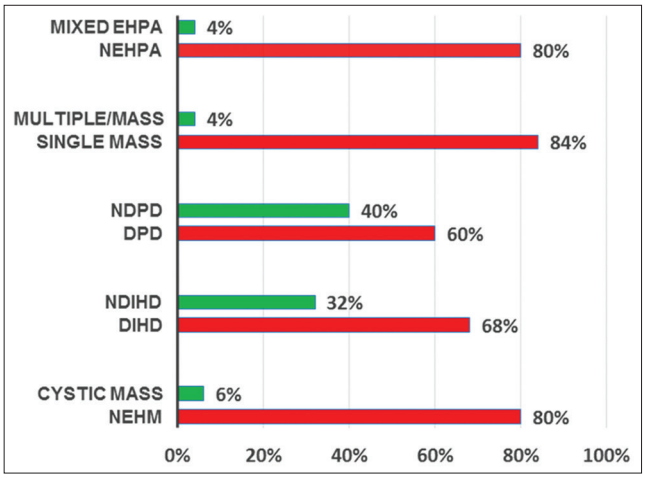

Figure 13: Common and uncommon abdominal computed tomography scan findings of pancreatic adenocarcinoma

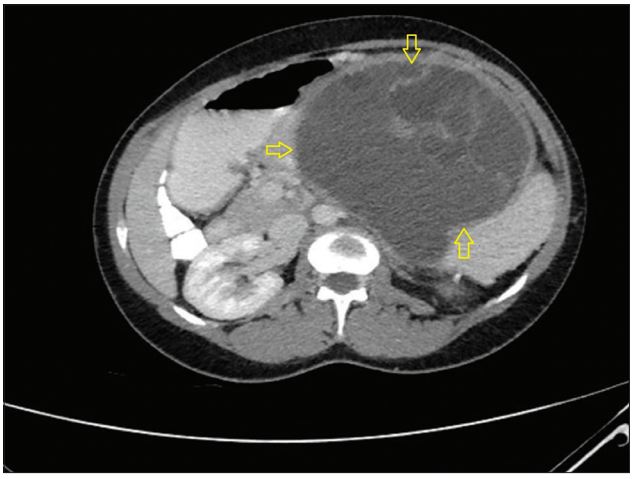

Figure 15: Axial postcontrast computed tomography scan of the abdomen demonstrated a large lobulated cystic mass with multiple enhancing septae, marginated by a thick smooth enhancing capsule at the tail of the pancreas (multicystic pancreatic adenocarcinoma; yellow open arrows). Pressure effects were noted on the spleen and the abdominal aorta. Abdominal aorta was displaced to the right side

Table 5: Computed tomography findings of pancreatic neoplasm

Characteristics	Frequency (%)
Nonenhancing mass	53 (79.1)
Enhancing mass	4 (6.0)
Mixed	3 (4.5)
Dilated common bile duct	45 (67.2)
Dilated pancreatic duct	44 (65.7)
Cystic mass	7 (10.4)
Multiple mass	3 (4.5)
Dilated intrahepatic bile duct	47 (70.1)

showed one case located at the head/uncinate, one at head/neck/body of the pancreas, one located at the head/body/uncinate, and one case at the body/neck/uncinate. At each of the anatomical locations, pancreatic neoplasm presented mainly as pancreatic adenocarcinoma [Table 6].

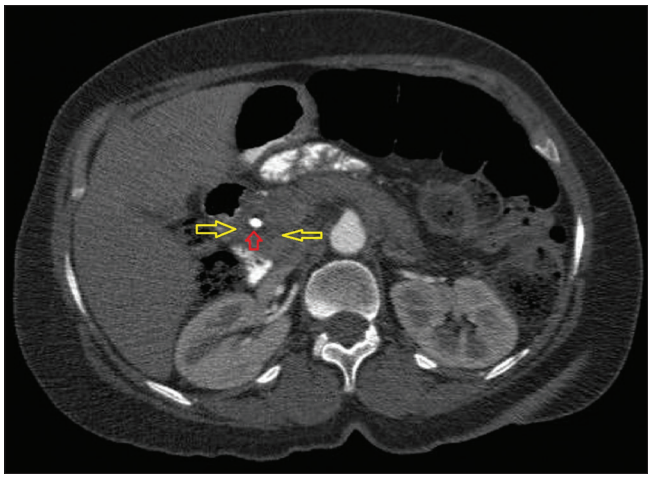

Figure 14: Axial postcontrast arterial phase computed tomography scan of the abdomen demonstrated low attenuation mass at the head of pancreas, (atypical pancreatic adenocarcinoma; open yellow arrows) without dilatation of the pancreatic duct. A stent is *in situ* in the dilated common bile duct (open red arrow)

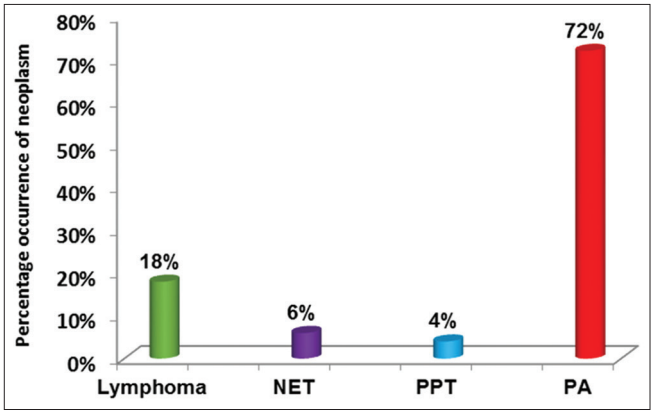

Figure 16: Pancreatic neoplasm that simulates pancreatic adenocarcinoma. NET – Neuroendocrine tumor; PPT – Pseudopapillary tumor; PA – Pancreatic adenocarcinoma

Three major CT scan classifications are apparent in this series: nonenhancing mass, dilated common bile duct, and dilated pancreatic duct. Among the 53 scans which showed nonenhancing masses, pancreatic adenocarcinoma made up 83% of the cases, followed by 13.2% of lymphoma and 1.9% each of cystadenocarcinoma and ampullary adenocarcinoma. In CT scans classified as dilated common bile duct, pancreatic adenocarcinoma again constituted 84.4% with very few cases diagnosed as lymphoma (6.7%), plasmacytoma (2.2%), cystadenocarcinoma (2.2%), neuroendocrine tumor (2.2%), and ampullary adenocarcinoma (2.2%). The pattern is similar for scans classified as dilated pancreatic duct in which pancreatic adenocarcinoma constituted 84.1%. In this group, there were 4.5% of lymphoma, 4.5% of neuroendocrine tumor, and 2.3% of plasmacytoma, cystadenocarcinoma, and ampullary adenocarcinoma [Table 7].

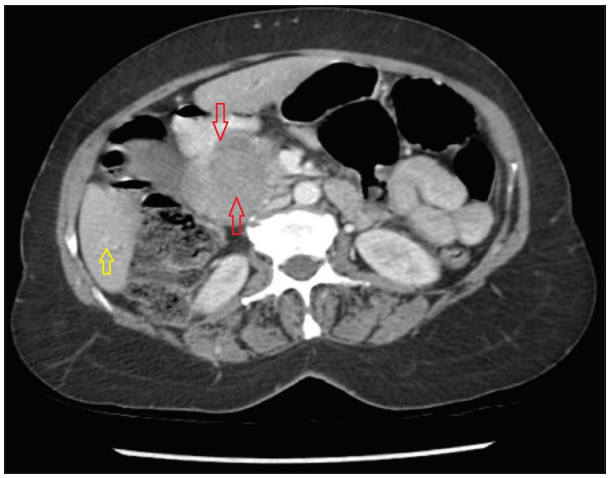

Figure 17: Axial postcontrast computed tomography scan abdomen showed oval-shaped hypovascular mass at the head of the pancreas (pancreatic adenocarcinoma; open red arrows) with mixed attenuation metastatic lesion in the liver (open yellow arrow). No dilated intrahepatic bile ducts were seen

Table 6: Anatomical locations and types of the pancreatic neoplasm (*n*=63)

Location/type of neoplasm	Frequency (%)
Head (*n*=46)	46 (73.0)
Cystadenocarcinoma (*n*=1)	
Neuroendocrine tumor (*n*=2)	
Pseudopapillary tumor (*n*=2)	
Lymphoma (*n*=3)	
Ampullary adenocarcinoma (*n*=1)	
Pancreatic adenocarcinoma (*n*=37)	
Head/uncinate (*n*=1)	1 (1.6)
Head/neck/body (*n*=1)	1 (1.6)
Head/body/uncinate (*n*=1)	1 (1.6)
Body/neck/uncinate (*n*=1)	1 (1.6)
Neck (*n*=3)	3 (4.8)
Pancreatic adenocarcinoma (*n*=3)	
Tail (*n*=4)	4 (6.3)
Pancreatic adenocarcinoma (*n*=3)	
Lymphoma (*n*=1)	
Uncinate (*n*=6)	6 (9.5)
Pancreatic adenocarcinoma (*n*=5)	
Lymphoma (*n*=1)	

The linkage between histologically diagnosed pancreatic pathology ad CT scan findings was evaluated using Fisher's exact test and a 2 × 2 contingency table [Table 8]. The calculated level of significant difference in the two methods used for linkage (histology vs. CT scan findings) resulted in a $P = 0.7404$. This translates to good agreement between histological diagnosis and assessment of CT scan findings as either typical or atypical for pancreatic adenocarcinoma and other types of pancreatic neoplasms.

DISCUSSION

The mean age of 56.4 years obtained in this study is similar to the findings from a previous study which had

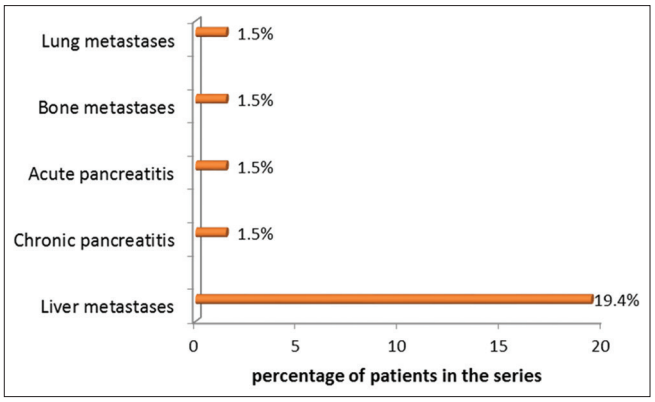

Figure 18: Complications at the time of presentation of pancreatic carcinoma

shown that pancreatic neoplasm is rare before 40 years of age.[11] In the same study, male preponderance was found, contrary to the findings in the present study, in which females were more predominant (36 females; 53.8%), as against (31 males; 46.2%). In the present series, pancreatic adenocarcinoma accounted for 74.6% of all the pancreatic neoplasms and Mergo *et al*.[12] found 90% of all the pancreatic neoplasms to be pancreatic adenocarcinoma. Primary pancreatic lymphoma was a distant second (13.4%) in our study, while Coakley *et al*.[10] found only 0.5% of primary pancreatic lymphoma in their study. Regarding the most common clinical presentation of pancreatic neoplasm which is jaundice, there is agreement between our findings and that of Martin and Semelka[13] who also found that 60% of the pancreatic neoplasms were located in the head of pancreas, as against 46 cases which translated to 73.0% in our study. Unresectability of pancreatic neoplasm in our series was 44 cases (65.7%), while Ros and Mortelé[14] obtained a higher value of 75%. In this study, the liver was the organ to which most primary neoplasms of the pancreas frequently metastasized (13 cases; 20.6%), and this is in agreement with the findings of a previous study which reported liver metastasis of (17%–55%).[1]

Common and uncommon CT scan findings of pancreatic adenocarcinoma, other pancreatic neoplasms, including those that mimic pancreatic adenocarcinoma of the pancreas have been evaluated in this study. The CT scan findings obtained were very similar to those of Yang *et al*.[9] and Coakley *et al*.[10] Pancreaticoduodenectomy is the only curative treatment available for adenocarcinoma of the pancreas, with a mortality rate of 40%. Therefore, clear understanding of CT scan findings of pancreatic neoplasm is mandatory in order to ensure early and accurate diagnosis since some of the pancreatic neoplasm such as primary pancreatic lymphoma is treatable.[9,10]

Table 7: Computed tomography scan findings in relation to the type of pancreatic neoplasm

CT findings, neoplasm	Frequency (%)
Nonenhancing mass (*n*=53)	
Pancreatic adenocarcinoma	44 (83.0)
Lymphoma	7 (13.2)
Cystadenocarcinoma	1 (1.9)
Ampullary adenocarcinoma	1 (1.9)
Dilated common bile duct (*n*=45)	
Pancreatic adenocarcinoma	38 (84.4)
Lymphoma	3 (6.7)
Plasmacytoma	1 (2.2)
Cystadenocarcinoma	1 (2.2)
Neuroendocrine tumor	1 (2.2)
Ampullary adenocarcinoma	1 (2.2)
Dilated pancreatic duct (*n*=44)	
Pancreatic adenocarcinoma	37 (84.1)
Lymphoma	2 (4.5)
Neuroendocrine tumor	2 (4.5)
Plasmacytoma	1 (2.3)
Cystadenocarcinoma	1 (2.3)
Ampullary adenocarcinoma	1 (2.3)

CT – Computed tomography

Table 8: Correlation of histological diagnosis and computed tomography scan findings of pancreatic neoplasms

	CT scan findings		
	Typical	A-typical	Total
Histological diagnosis of pancreatic neoplasms			
Pancreatic adenocarcinoma	40	10	50
Other types of neoplasms	13	4	17
Total	53	14	67

CT – Computed tomography

The current study reveals that most of the pancreatic neoplasm encountered, nonenhancing mass, and dilated biliary and pancreatic ducts were pancreatic adenocarcinoma and ranged from 83% to 84.4% [Table 7]. These findings were corroborated by the studies of Yang *et al*.[9] and Coakley *et al*.[10] There was only one case of plasmacytoma of the pancreas in this series, and this further emphasizes its extreme rarity as a pancreatic neoplasm.[15] CT appearance of pancreatic plasmacytoma is a multilobular homogenous solid hypodense tumor, and the present study revealed that CT scan findings of pancreatic plasmacytoma are not specific and may mimic pancreatic adenocarcinoma, other pancreatic carcinomas, islet cell tumors, lymphoma, and metastatic lesions to the pancreas.[15] CT scan findings of two pseudopapillary pancreatic tumors in this study are in agreement with the findings of Xu M and Sethi A[16] who demonstrated similar CT features of large solid and cystic tumor of the pancreas, sharp edges, the solid parts of the tumor show progressive enhancement, and a few with hemorrhage and calcifications. It is usually a neoplasm of young female patients;[16] however, atypical findings were demonstrated in this series with occurrence in two male patients. Neuroendocrine tumor of the pancreas can mimic pancreatic adenocarcinoma, with CT features of hypodense mass on noncontrast CT scan, followed by strong enhancement on arterial phase with usually absent dilatation of the pancreatic duct.[9] The three cases of neuroendocrine tumors of the pancreas found in this study, namely hypodense mass, enhancing mass, and mixed attenuation mass, represent typical and atypical presentations contrary to the findings from previous studies.[9] The reported CT scan findings of a large solid hypodense mass (2–15 cm), usually in the head of the pancreas, with low or mixed attenuation presentations, and encasement of vessels without occlusion, (postcontrast) are features of primary pancreatic lymphoma.[10,15,16] These CT presentations of primary pancreatic lymphoma are similar to the CT scan findings in the current study. This study further illustrates the correlation of the two independent procedures (CT scans and histological diagnosis) for identifying various forms of pancreatic neoplasms. The good correlation reported in the current study ($P = 0.7404$) in which both the CT scans and the histopathologic diagnosis of pancreatic neoplasms were similar in their accuracy to identify pancreatic adenocarcinoma and the other types of neoplasms is in line with previous report by Botcha *et al*.[17]

CONCLUSION

The predominant histological type was adenocarcinoma and lymphoma was a distant second. Obstructive jaundice was the most common clinical presentation and the majority of the pancreatic neoplasms were seen at the head of pancreas. There were instances in this study when a number of pancreatic neoplasms masqueraded as pancreatic adenocarcinoma. At the time of presentation of the patients in this series, most of the pancreatic neoplasms were unresectable, most likely due to late presentation of clinical symptoms, early metastasis, and late consultation of patients with hepatobiliary Surgeons.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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