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ORIGINAL ARTICLE

Radiological assessment of resectability status in patients with pancreatic cancer

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ABSTRACT

Introduction: Pancreatic adenocarcinoma is a major health concern as it is the third most common cause of cancer-related death. Surgery is the only curative option, but it is associated with a high rate of morbidity and mortality.

Objective: To accurately identify the patients with unresectable pancreatic cancer through the use of computed tomography imaging.

Material & Methods: This descriptive case series was conducted at Kuwait Teaching Hospital from July 2019 to June 2020. A total of 52 patients were evaluated with ages ranging from 11-90 years comprising 24 males and 28 females. CT scan abdomen with the pancreatic protocol was done on 16 slice Toshiba CT scanner in the Radiology department of Kuwait Teaching Hospital. Images were evaluated in axial, coronal and sagittal planes following pancreatic protocol. Data like patient age, gender, tumor location, size, venous and arterial involvement, lymph nodal and adjacent visceral involvement were collected and subjected to statistical analysis.

Results: Out of a total of 52 patients, pancreatic carcinoma was most prevalent in the head region which was observed in 35(67.3%) patients. The next common site was the uncinate process followed by the body and then the tail. In 57.7% the size of primary malignancy was more than 2 cm and in 42.3% of the patients, it was less than 2 cm. Superior Mesenteric Vein (SMV) was involved in pancreatic carcinoma in 7.7%, Inferior Vena Cava (IVC) in 3.8% and Portal Vein (PV) in 11.5% of the cases. The Celiac Artery was involved by the pancreatic tumor in 11.5% and Superior Mesenteric Artery (SMA) in 23.1% of the cases. Lymph nodal involvement was observed in 42.3% of the cases and adjacent visceral involvement was noted in 34.6% of the cases.

Conclusion: Pancreatic carcinoma was identified as surgically unresectable by CT scans in the majority of patients because of locally advanced disease having a size more than 2 cm, and with vascular, lymph nodal and adjacent visceral involvement.

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INTRODUCTION

Pancreatic carcinoma or pancreatic ductal adenocarcinoma (PDAC) is a leading cause of cancer-related deaths worldwide and is associated with a very poor prognosis.[1,2] It is the third most common cause of cancer-related deaths in western countries and by 2030 it is expected to be the second leading cause of death due to cancer.[3-5] Surgery can improve the chances of survival but unfortunately, only 20% of the patients fulfill the criteria of surgical resection at the time of diagnosis.[1]

Among the 80-85% of patients who are unsuitable for surgical resection due to local spread, vascular invasion, or metastatic disease, approximately 30% turned out to be inoperable during explorative laparotomy.[3,6,7] In addition, surgical procedure for pancreatic carcinoma itself is associated with a high frequency of morbidity and mortality. It is therefore highly important to accurately identify those patients with the unresectable disease.[1] Some authors have tried to identify the factors which will predict the resectibility of pancreatic ductal carcinoma at the time of diagnosis.

Carbonic antigen 19-9 (CA 19-9) levels, tumor size, and area of involvement like body or tail are the main pre-operative predictive factors.[3,8] Resection of pancreatic cancer is dependent upon the extent of tumor–vascular contact assessed on Computed Tomography (CT) or MRI images with the pancreatic protocol.[9,10] CT plays an important role in predicting pancreatic carcinoma resectibility.[11,12]

Pancreatic cancer staging is done using CT. Staging factors include size and location of the tumor, extent beyond the normal confines of the pancreas, contact / encasement or occlusion of adjacent vessels and distant metastasis (e.g., lung, liver, bone, lymph node and peritoneum). Distant metastasis will exclude the patients from curative resection. Curative resection is also dependent upon which vessel is involved and the extent of involvement. In CT scan abdomen with pancreatic protocol, the most important phase for diagnosing and staging pancreatic cancer is the pancreatic phase because in this phase there is an optimal attenuation difference between hypodense tumor and normal enhancing pancreas. Arterial involvement is also adequately assessed in this phase.

The Porto venous phase is useful for the assessment of liver metastasis which appears as hypodense nodules in the background of normal enhancing liver parenchyma.[13]

The mortality rate of pancreaticoduodenectomy (Whipple procedure) is less than 2.5% in a well-equipped oncological center but morbidity can be higher than 30% due to post-operative surgical complications; therefore, pre-operative accurate staging of pancreatic carcinoma is very important.[14]

The purpose of our study is to correctly identify the patients with the unresectable disease is to reduce the mortality and morbidity associated with surgery for pancreatic carcinoma.

MATERIALS & METHODS

This retrospective study was conducted in Kuwait teaching hospital from July 2019 to June 2020. All abdomen CT scans with pancreatic protocol had been done on 16 slice Toshiba (specification) with I/V contrast. Patients with malignant pancreatic masses were included in the study. Images were reviewed on the workstation in axial, sagittal and coronal cuts. Images with positive findings were reviewed by three radiologists and were discussed. Size and location of the lesion, vascular and lymph nodal involvement and distant metastasis were analyzed, categorized, and tabulated. Data collection and analysis were done by SPSS version 24.

RESULTS

A total of 52 patients with pancreatic cancer were included. Their ages were grouped in clusters of 10 years; 51-60 years age group was most represented, having 26.9% of the total patients. There were 24 male and 28 female patients.

Table 1: Age groups of the patients (n=52).

#	Age groups (years)	Frequency (%)
1.	11-20	02 (3.8)
2.	21-30	06 (11.5)
3.	31-40	04 (7.7)
4.	41-50	08 (15.4)
5.	51-60	14 (26.9)
6.	61-70	12 (23.1)
7.	71-80	02 (3.8)
8.	81-90	04 (7.7)

The pancreatic regions involved in pancreatic carcinoma were assessed and it was found that pancreatic carcinoma was most prevalent in the head region comprising 35 patients or 67.3% of the total. The next most common site was the Uncinate process comprising 12%. This was followed by the body and then the tail of the pancreas.

The sizes of the primary malignancies were also assessed; based on the 2 cm cutoff size by Kim et al,[19] two groups were made, i.e., less than 2 cm or more than 2 cm. It was found that in 57.7% patients the size of primary malignancy was more than 2 cm and in 42.3% patients the size was less than 2 cm. Venous involvement by the pancreatic carcinoma was analyzed and we found that Superior Mesenteric Vein (SMV) was involved in 7.7% patients, Inferior Vena Cava (IVC) was involved in 3.8% patients and portal vein was involved in 11.5% patients. Renal vein involvement was not seen in any of the patients. Arterial involvement by pancreatic carcinoma was also analyzed with the celiac axis being involved in 11.5% patients and Superior Mesenteric Artery (SMA) in 23.1% patients. Renal artery involvement was not seen in any patient. Lymph nodal metastasis was noted in 42.3% patients. Adjacent visceral involvement was seen in 34.6% patients.

Table 2: Radiological findings (n=52).

| #	Resectability Criteria	Frequency (%)
1	**Pancreatic area involved**	
	Pancreatic Head	35 (67.3)
	Body	3 (5.8)
	Tail	2 (3.8)
	Uncinate process	12 (23.1)
2	**Size**	
	Less than 2 cm	22 (42.3)
	More than 2 cm	30 (57.7)
3	**Venous involvement**	
	Superior mesenteric vein	4 (7.7)
	Inferior vena cava	2 (3.8)
	Portal vein	6 (11.5)
4	**Arterial involvement**	
	Superior mesenteric artery	12 (23.1)
	Celiac axis	6 (11.5)
5	**Lymph node involvement**	22 (42.3)
6	**Adjacent visceral involvement**	18 (34.6)
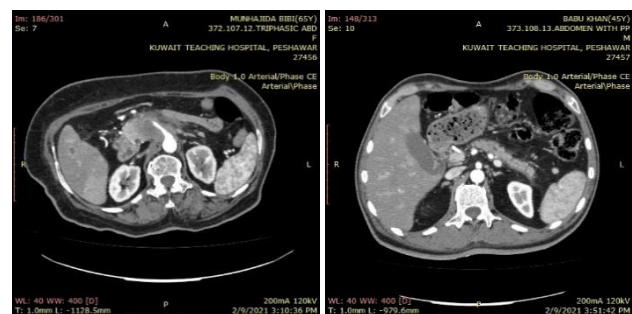
Figure 1 (A)   Figure 1 (B)

Fig 1 (A) shows a 3cm neoplastic lesion head of the pancreas has a mass effect on the second part of the duodenum, which is compressed however, fat planes are intact. Fat planes with adjacent vessels are also intact.

Fig 1 (B) shows a 45-year-old patient with carcinoma head of the pancreas. The pancreatic body and tail are atrophic with dilated pancreatic duct and enlarged peripancreatic lymph node.
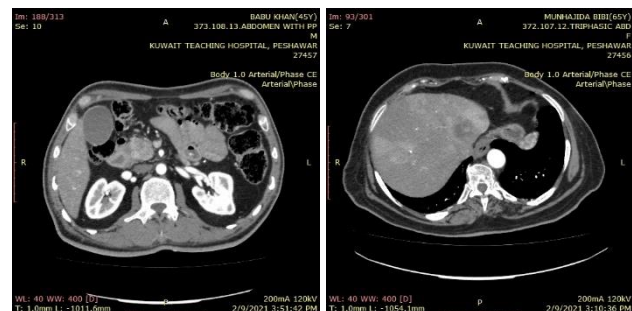

Figure 2 (A)   Figure 2 (B)

Fig 2 (A) shows a 5cm neoplastic lesion head of the pancreas and uncinate process, encasing the superior mesenteric artery. Common Bile Duct is dilated and fat planes with the second part of the duodenum are also lost.

Fig 2 (B) shows a patient with carcinoma head of the pancreas with numerous hepatic metastatic deposits.
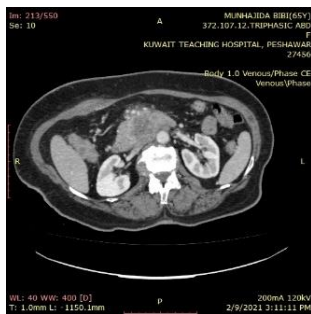
Figure 2 (C)

Fig 2(C) shows a patient with carcinoma head of the pancreas and uncinate process with right renal vein thrombosis.

DISCUSSION

In this study, evaluations were done of CT scans of abdomen performed with a pancreatic protocol in patients of biopsy-proven adenocarcinoma of the pancreas. CT is the most important modality to assess pancreatic cancer resectability. The pancreatic phase was used for staging pancreatic cancer and the Porto venous phase was used to assess hepatic metastasis and to evaluate the rest of the abdomen and peritoneal metastasis.

Pancreatic carcinoma is the most common cause of cancer-related deaths. Surgery can improve the chances of survival but unfortunately, only 25% of patients fulfill the criteria of surgical resection at the time of diagnosis. Resectability factors include size and location of the tumor, peripancreatic spread, involvement of adjacent vessels, and distant metastasis. For preoperative evaluation of tumor extension and surgical resectability, the National Comprehensive Cancer Network (NCCN) guideline of pancreatic carcinoma is widely used.[15] The resectability of the tumor is primarily based on the presence or absence of tumor invasion of the vascular structures. Based on this, the NCCN guidelines may classify the tumor as resectable, borderline resectable, or unresectable. A study found the overall survival of the borderline resectable cases to be significantly lower in comparison to the resectable cases.[16] Hence, considering the vascular involvement based on the NCCN guidelines, the cases in the present study were classified as to whether the pancreatic adenocarcinoma was surgically resectable or unresectable. Involvement of SMV, IVC, and arteries like the Celiac axis and SMA made the surgical resection highly unlikely.

Furthermore, the study looked at the radiological findings including the pancreatic area involved, tumor size, arterial or venous involvement, lymph node status and spread to viscera. Pancreatic carcinoma was found in the pancreatic head in 67.3%

of the cases. These results are comparable with a study conducted by Maulat C et al[3] in 2020 that found its incidence to be 59.3%. This is also comparable with another study conducted by Joo I et al,[11] in 2019 who quoted its incidence as 61.8% in the head or uncinate process, 21.8% in the body, and 16.4% in the tail region.

CT has sensitivity of about 67–100% for the detection of Pancreatic Ductal Adenocarcinoma (PDAC) > 2 cm in size. This, however, drops down to 50–78% in the case of smaller tumors.[17,18] It is noteworthy that Kim et al. developed and also validated a score for predicting outcomes in PDAC patients that underwent surgery. The score includes five variables to predict the prognosis at 1-year for patients that showed resectable PDAC on radiology and had surgery right away. The score is based on CT scan features. Among many other features, it includes tumor size (cutoffs of 2 cm and 4 cm).[19] The validity of the score is likely due to the correlation between CT features, pathologic findings, and prognosis in PDAC. There is a need for the radiologists to be aware of the clinical implications and relevance of these CT features. In this study, an attempt was made to accurately identify the patients with the unresectable disease based on the NCCN guidelines which is very important to reduce the mortality and morbidity associated with surgery for pancreatic carcinoma.

The present study also assessed the size of the pancreatic tumor, based on the 2 cm cut off size by Kim et al; it was noted that the size of the primary tumor was more than 2 cm in 57.7% of the cases and in 42.3% of the cases it was less than 2 cm.

Next, venous involvement by pancreatic cancers was documented and evaluated; it was observed that SMV was involved in 7.7% of the patients, IVC in 38% and PV in 11.5%. Arterial involvement by pancreatic adenocarcinoma was also assessed and documented; celiac axis involvement was found in 11.5% and SMA in 23.1%. These findings were in contradiction to the findings of the study conducted by Toesca DAS et al[14] in 2019 where tumor contact with SMV/PV was present in 82% of the patients, SMA in 48%, and CA/CHA in 37% of the patients. Additionally, in the present study, lymph nodal involvement was observed in 42.3% cases while adjacent visceral involvement was seen in 34.6% patients.

CONCLUSION

Surgical Resection remains the only curative intervention for Pancreatic Ductal Adenocarcinoma. PDAC was found to be surgically unresectable when presenting the head region of the pancreas, size > 2 cm, and with vascular involvement.

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