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Research Article

THE EFFICACY OF MDCT IMAGING IN THE EVALUATION OF PERIAMPULLARY TUMORS WITH HISTOPATHOLOGICAL CORRELATION

[1]Shameena Abdul Saleem, [2]Suresh Ashwathappa, [3]Madan Mohan Babu*, [4]Jaseem Ansari and [5]Priti Kodikala

[1]Resident in Radiodiagnosis Vydehi Institute of Medical Sciences and Research Centre
[2]Professor and HOD Department of Radiodiagnosis Vydehi Institute of Medical Sciences and Research Centre
[3]Madan Mohan Babu Associate Professor Department of Radiodiagnosis Vydehi Institute of Medical Sciences and Research Centre
[4]Resident in Medical Gastroenterology Vydehi Institute of Medical Sciences and Research Centre
[5]Professor Department of Radiodiagnosis Vydehi Institute of Medical Sciences and Research Centre a

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A B S T R A C T

BACKGROUND
The ampulla of Vater is an important anatomic landmark where the common bile duct (CBD) and main pancreatic duct (MPD) converge in the major duodenal papilla. Periampullary lesions arise within 2 cm of the ampulla in the duodenum and include lesions from pancreatic head, lower common bile duct, periampullary duodenum and from within ampulla itself. The lesions can be neoplastic or inflammatory. The visualization of the normal structures, differentiation periampullary tumors and evaluation of the extent of ampullary and periampullary tumors are important in treatment planning[1].
Imaging of the periampullary region poses a unique diagnostic challenge to radiologists because of the region's complex and variable. There are several imaging modalities available to evaluate patients with suspected periampullary tumors which include endoscopic ultrasound (EUS) , endoscopic retrograde cholangiopancreaticography (ERCP) , magnetic resonance imaging (MRI) and computed tomography (CT). Computed tomography has evolved as dominant modality for diagnosis and preoperative staging.[2] Currently, when biliary obstructive diseases are suspected, there is an emphasis on the combination of imaging approaches, such as conventional MRI with Magnetic resonance cholangiopancreatography (MRCP) for the improvement of diagnostic accuracy. However, MR examinations are not suitable for all patients, as some contraindications (incompatible cardiac pacemaker, aneurysm clips, severely ill, etc.) limit their clinical use .
As MDCT is easily available in most secondary and tertiary care centres, it is accessible for the general population.
The aim of our study was to evaluate periampullary tumor by MDCT and correlate with histopathologicalfindings.
OBJECTIVES
1. To determine the efficacy of MDCT imaging in evaluation of periampullary tumors and to correlate with histopathologicalfindings .
2. To differentiate between benign and malignant tumors.

MATERIALS AND METHODS Source of data : All patients with clinical suspicion of periampullary tumor referred to the Department of Radio-Diagnosis at Vydehi Institute of Medical Sciences & Research Centre, Bangalore for CT evaluation.
Method of collection of data :A comparative analytical study was conducted on 44 patients who came to Department of Radiodiagnosis and Imaging in Vydehi Institute of Medical Sciences and Research Centre, Bangalore for Radiography and Computed Tomography with clinical suspicion of periampullary tumors in a period of 1.5 years ranging from January 2017 to June 2019.
Inclusion criteria –
i. Patients who have given informed consent for the study.
ii. Patients having a clinical suspicion of periampullary pathology.
iii. Histologically proven cases of periampullary tumors by endoscopic or image guided biopsy.
Exclusion criteria –
1. Patients allergic to contrast.
2. Pregnant women.
3. Patients in end stage renal failure and hepatic failure.

Written informed consent was taken from all the patients included in the study. The study was conducted after approval by the ethics committee.
RESULT AND CONCLUSION : In our study maximum number of cases were observed in male patients in the 4th to 6th decade of life. 33 patients had malignant lesions and 11 had benign lesions in which cholangiocarcinoma was most common (11 cases 25%), followed by ampullary carcinoma (8 cases 18.2%), carcinoma of head of pancreas (7 cases 15.9%), carcinoma duodenum (5 cases 11.4%), mass forming pancreatitis (3 cases 6.8%), ampullary stricture (2 cases 4.5%), CBD stricture (2 cases 4.5%), groove pancreatitis (2 cases 4.5%), chronic pancreatitis (1 case 2.3%), focal pancreatitis (1 case 2.3%), metastatic lymph nodes (1 case 2.3%) and neuroendocrine tumour (1 case 2.5%).
Totally 44 cases were correlated with histopathology. With the sensitivity of 93.75%, specificity of 75%, Positive Predictive Value of 90.91%, Negative Predictive Value of 81.82%, Diagnostic Accuracy of 88.64% and Kappa agreement was 0.7059 for benign and malignant ampullary and periampullary lesions on MDCT.
Out of 32 subjects with malignant lesions in HPE, 93.8% were picked up by CT scan, and 6.2% were false negative. Out of 12 subjects with benign lesions in HPE, 25% were malignant and 75% were benign in CT.
So we conclude that there is significant association between CT scan diagnosis and HPE diagnosis in periampullarytumours.
MDCT is to be considered a promising imaging modality for the evaluation of ampullary and periampullarytumours and characterization as benign and malignant.

INTRODUCTION

The ampulla of Vater is an important anatomic landmark where the common bile duct (CBD) and main pancreatic duct (PD) converge. Periampullary lesions can arise from the pancreatic head, lower common bile duct, periampullary duodenum or from the ampulla. The lesions can be neoplastic or inflammatory. Therefore differentiating benign from malignant lesions with the evaluation of the extent of the tumour is an important step in the management of such cases. [1]

Corresponding author:* **Madan Mohan Babu
Madan Mohan Babu Associate Professor Department of Radiodiagnosis Vydehi Institute of Medical Sciences and Research Centre

Imaging of the periampullary region poses a unique diagnostic challenge to radiologists because of the complexity and variable the anatomy. There are several imaging modalities available to evaluate patients with suspected periampullarytumours, which include endoscopic ultrasound (EUS), Endoscopic retrograde cholangiopancreaticography (ERCP), Magnetic resonance imaging (MRI) and Computed tomography (CT). CT has evolved as a predominant modality for diagnosis and preoperative staging.[2,3] Currently, when biliary obstructive diseases are suspected, there is an emphasis on the combination of imaging approaches, such as conventional MRI with Magnetic resonance cholagiopancreaticography (MRCP) for the improvement of diagnostic accuracy. However, MR examinations are not

suitable for all patients, as some contraindications like incompatible cardiac pacemaker implants, aneurysm clips, severely ill patients which limit their clinical use.[4,5]

At present, multi-detector row computed tomography (MDCT) with sub-millimetre imaging, isotropic or near isotropic reconstruction has greatly improved the ability to evaluate the biliary system compared with that of conventional transaxial CT only. [6,7,8]

There have been very few studies conducted in the Indian sub-continent correlating the CT and the histopathological findings. With this background, this work was undertaken to evaluate the CT findings and correlate with histopathological studies for better understanding of the periampullary lesions for early diagnosis and management.

Objective

To determine the efficacy of MDCT imaging in the evaluation of periampullarytumors by correlating with histopathologicalfindings.

MATERIALS AND METHODS

A comparative analytical study was conducted on the patients who came to Department of Radio diagnosis and Imaging in Vydehi Institute of Medical Sciences and Research Centre, Bangalore for Radiography and Computed Tomography with clinical suspicion of periampullary tumors during a period from January 2017 to June 2019.

Sample size was estimated with considering the Sensitivity of the test to be at 92% and at 8% precision of the study at 95% confidence interval the estimated sample size was 44.
Patients undergoing CT abdomen with a clinical suspicion of periampullary pathology who also underwent biopsy from the periampullary lesion were included in the study after an informed consent was taken.

Patients with contrast allergy, pregnant women and patients with end stage renal failure or acute kidney injury were excluded from the study.

Computed tomography (CT) images were obtained with a 128-slice MDCT scanner (SIEMENS – SOMATOM Definition AS). MDCT machine with 5mm collimation, 1mm reconstruction, and a gantry speed of 0.06 sec, pitch of 1.2 sec, 120 Kvp and 345 effective mAs. Plain CT will be performed initially. Non-ionic contrast injection 80-100 mL of IOHEXOL will be given after a test dose. Each CT examination is performed within a single breath hold and axial sections are taken. All image dataset will be transferred to a 3D workstation and sagittal, coronal and 3D images were reconstructed wherever necessary. The size, location, extent, pre and post contrast attenuation values, mass effect and invasion into adjacent structures were evaluated.

For all the cases the location and extension of tumors, the adjacent organ involvement, ductal status, vascular invasion, distant metastasis, lymph nodal metastasis and post contrast enhancement of the tumors were documented.The site of origin of the lesion from the CT was determined on the basis of largest site of tumor.

The status of the intrahepatic biliary radicles, the common bile duct and the pancreatic duct was analyzed. The lesions in the periampullary region usually lead to dilatation of these ducts depending on the location of the lesion [double duct sign]. However, significant dilatation was not observed in benign conditions.

Signs of malignant stricture include relatively abrupt narrowing of the biliary and/or pancreatic duct with irregular margins in the distal narrow segment. Gradual tapering of the distal parts of the ducts with smooth contours and without total obstruction was characterized as benign stricture. Dilatation of the ducts down to the level of ampulla was considered to be an inconclusive finding as this can be caused by malignant as well as benign conditions.

Adjacent organ involvement was determined by indistinct or ill-defined fat planes with the tumors.Vessel infiltration describes infiltration of superior mesenteric vessels, portal vein and splenomesenteric confluence. This was determined by ill-defined fat planes with the tumor/encased vessel with tumor producing concentric or eccentric narrowing or occluded vessel or thrombosis of affected vessels.

Distant metastases to liver and peritoneum was evaluated. Liver metastases were defined as > 1cm focal, solid appearing lesions. Multiple subcentimetric lesions without typical benign appearance were also classified as metastases. Ascites or contrast enhancing peritoneal nodules were considered as evidence of peritoneal tumor spread. Enhancing lymph nodes with short axis >1cm outside the peripancreatic draining chains were also considered as signs of metastatic disease.

The HU value of pancreatic head carcinoma was slightly lower than the normal pancreatic parenchyma. The arterial and venous phases showed a slight early enhancement, but lower than in normal pancreatic parenchyma. The internal necrotic area was not significantly enhanced and boundary was unclear. In distal cholangiocarcinoma, the thickening of the wall showed isodensity. Obvious delayed enhancement was noted in such lesions. In ampullary carcinoma, the lesion issignificantly enhanced. The enhancement degree in ampullary carcinoma was higher than in pancreatic cancer and lower than in cholangiocarcinoma. Benign lesions did show enhancement, however, they were not significant.

Biopsy from the periampullary lesion was sent for histopathological examination which was correlated with the CT finding.

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram. Agreement between two or more observers/ between two or more methods or instruments and equipment's was assessed by using Kappa statistics

RESULTS

A total of 44 study subjects were analyzed and evaluated to meet the mentioned objective of the study.

Table 1 Social Profile of the study subjects

		Count	%
Age	<40 years	11	25.0%
	41 to 50 years	10	22.7%
	51 to 60 years	13	29.5%
	61 to 70 years	7	15.9%
	>70 years	3	6.8%
Sex	Female	10	22.7%
	Male	34	77.3%

Mean age of subjects was 51.02 ± 12.863 years. Majority of subjects were in the age group 51 to 60 years (29.5%). In the study 22.7% were females and 77.3% were males.

In the study the primary site of origin of the lesion was the ampulla in 20.5% of the cases, distal common bile duct (CBD) in 31.8%, head of pancreas in 27.3%, Pancreaticoduodenal Groove in 9.1% and Second part of duodenum in 11.4%. 79.5% had dilated intrahepatic biliary radicles, 86.4% had dilated CBD and 65.9% had dilated pancreatic duct (PD). Nearly 4.5% had Vascular Invasion, 13.6% had Distantmetastasis,34.1% had Adjacent Organ Involvement, 79.5% had Lymph Nodal Involvementand 90.9% had Post Contrast Enhancement.

Table 2 CT Diagnosis of Distribution of subjects

		Count	%
CT Diagnosis	Ampullary Carcinoma	8	18.2%
	Ampullary Stricture	2	4.5%
	Ca Duodenum	5	11.4%
	Ca Pancreatic Head	7	15.9%
	CBD Stricture	2	4.5%
	Cholangiocarcinoma	11	25.0%
	Chronic Pancreatitis	1	2.3%
	Focal Pancreatitis	1	2.3%
	Groove Pancreatitis	2	4.5%
	Mass Forming Pancreatitis	3	6.8%
	Metastatic Lymph Nodes	1	2.3%
	Neuroendocrine Tumour	1	2.3%
Benign/Malignant	Benign	11	25.0%
	Malignant	33	75.0%

On CT scan, most common diagnosis was Cholangiocarcinoma (25%), followed by Ampullary Carcinoma (18.2%) and Carcinoma Pancreatic Head (15.9%). On CT scan, 75% of lesions were malignant and 25% were benign.

Table 3 HPE Diagnosis Distribution of subjects

		Count	%
HPE Diagnosis	Adenocarcinoma/Cholangiocarcinoma	32	72.7%
	Chronic Non Specific Duodenitis	1	2.3%
	Chronic Pancreatitis	9	20.5%
	Villous Adenoma With High Grade Dysplasia	2	4.5%
Benign/Malignant	Malignant	32	72.7%
	Benign	12	27.3%

On HPE, 72.7% were diagnosed to have Adenocarcinoma/Cholangiocarcinoma, 2.3% had Chronic Non Specific Duodenitis, 20.5% had Chronic Pancreatitis and 4.5% had Villous Adenoma with High Grade Dysplasia. In the study on HPE, 72.7% were malignant and 27.3% were benign lesions.

Table 4 CT Final Distribution of subjects

		HPE Final Diagnosis					
		Malignant		Benign		Total	
		Count	%	Count	%	Count	%
CT Final diagnosis	Malignant	30	93.8%	3	25.0%	33	75.0%
	Benign	2	6.2%	9	75.0%	11	25.0%
	Total	32	100.0%	12	100.0%	44	100.0%

χ 2 = 22.000, df = 1, p = < 0.001*

In the study out of 32 subjects with malignancy in HPE, 93.8% were diagnosed as malignant in CT and 6.2% were diagnosed as Benign. Out of 12 subjects with benign lesions on CT 25% were malignant and 75% were benign. There was significant association between CT scan diagnosis and HPE diagnosis.

Table 5 Validity of CT scan in diagnosis with respect to HPE diagnosis

Parameter	Estimate	Lower - Upper 95% CIs
Sensitivity	93.75%	(79.85, 98.27)
Specificity	75%	(46.77, 91.11)
Positive Predictive Value	90.91%	(76.43, 96.86)
Negative Predictive Value	81.82%	(52.3, 94.86)
Diagnostic Accuracy	88.64%	(76.02, 95.05)
Cohen's kappa (Unweighted)	0.7059	(0.4109 - 1.001)

CT scan had a Sensitivity of 93.75%, Specificity of 75%, Positive Predictive Value of 90.91%, Negative Predictive Value of 81.82%, Diagnostic Accuracy of 88.64% and Kappa agreement between CT scan and HPE was 0.7059 (Substantial agreement)

DISCUSSION

Our study was conducted to determine the efficacy of MDCT in the characterization of periampullarytumors as benign or malignant and correlate the MDCT findings with histopathology.

In our study mean age of the patients with periampullarytumors was 51.02 years. Majority of the patients with periampullary carcinoma were in the 5th decade, which constituted 29.5% of the total patients. This was followed by patients under 40 years of age. Similar study by Zhao *et al*[9] showed mean age of 65.6 years among patients with periampullary carcinoma. Another study by Anderson *et al* also showed mean age of 67 years.

Our study was consistent with the study by Anderson *et al*[10]which also showed male predominance. However, study by Zhao *et al* [9]showed female predominance, whereas study by Sugita *et al* showed no sex predominance.

In our study majority of the patients with periampullarytumors were found to have distal CBD lesion constituting 31.8% of the total cases. This was followed by lesions in the head of pancreas, the ampulla and the second part of the duodenum respectively. Our findings were consistent with the study by Zhao *et al*[9], which showed majority of the lesions in the distal CBD followed by head of pancreas. Another study by Anderson *et al*[10] also showed majority of the malignant cases had carcinoma head of pancreas, followed by ampullary carcinoma and then distal CBD cholangiocarcinoma. Among benign diagnosis chronic pancreatitis and bile duct calculi were the commonest.

Intrahepatic biliary radicles were found to be dilated in majority of the patients. Common bile duct and pancreatic duct dilatation was also found in the 86.4% and 65.9% of the patients respectively. In the study by Zhao *et al*,[9] double duct sign was present in 90% of the cases. Severe IHBR dilatation was also noted among the patients with terminal CBD cholangiocarcinoma. Only 30.8% of the cases had pancreatic duct dilatation with malignant lesion on CT. There was no obvious intrahepatic, extrahepatic duct dilatation among patients with benign lesions.

The commonest diagnosis on CT was cholangiocarcinoma followed by ampullary carcinoma and pancreatic head malignancy. Majority of the patients who underwent biopsy were found to have adenocarcinoma. This was followed by chronic pancreatitis and nonspecific duodenitis.

Out of 32 cases proven malignant by histopathological studies, 30 cases (93.8%) had features of malignancy on CT. Out of 12 benign cases on histopathological studies, 9 cases were correctly diagnosed as benign on CT and 2 cases turned out to be malignant on HPE.

As per our study and analysis, CT had a sensitivity of 93.75% with a positive predictive value of 81.82%. Study by Anderson *et al*[10] showed that CT had a sensitivity of 100 % and a positive predictive value of 81%.

CONCLUSION

We conclude that there is significant association between CT findings and HPE diagnosis in periampullarytumors. MDCT is to be considered a promising imaging modality for the evaluation of periampullary tumors.

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