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Original Research Article

Prospective observational study on pancreatic duct system diversity in different pancreatic diseases

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ABSTRACT

Background: Pancreatology and pancreatic surgery was developed on the basis of increase in knowledge of anatomy and physiology of the pancreas in the beginning of the 20th century. Although our knowledge of pancreatic head anatomy has increased, anatomical data characterizing the pancreatic ductal system remain limited. Furthermore, the relation of pancreatic ductal system anomalies and different pancreatic disorders remain to be evaluated.
Methods: The present study was conducted in Department of Paediatric, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Sri Amritsar from August 2014 to November 2016. Total 50 subjects were included. Study was done with aim to study cases clinically and segregate cases with pancreatic disorder which need evaluation by special imaging modalities and surgical management, to compare the nature of information obtained from various modalities to study various corollaries of modern imaging study, to study whether the information from various imaging modalities are complimentary, competitive and to study pancreatic ductal structure in different pancreatic diseases.
Results: In the present study, we have a total of 50 patients. Among them 25 (50%) suffer from chronic pancreatitis, 13 (26%) from acute pancreatitis, 6 (12%) from periampullary carcinoma, 3 (6%) from carcinoma head of the pancreas, 1 (2%) from pancreatic ascites following acute pancreatitis, 1 (2%) from annular pancreas and 1 (2%) from cystic neoplasm of pancreas. These patients were investigated by transabdominal USG, MDCT scan, ERCP and conventional and stimulated MRCP to study the pancreatic duct diversities in different pancreatic diseases and the advantage of lemon juice stimulated MRCP over conventional MRCP.
Conclusions: Pancreatic disorders were most frequently seen in male patients. Age group between 31 to 50 years were mostly suffering from inflammatory disorders like acute and chronic pancreatitis. The frequency of malignant condition was increased after 50 years of age. Most common pancreatic disorder in our study was chronic pancreatitis. Trans-abdominal USG was found to be very useful initial investigation for the evaluation of pancreatic duct morphology. Best investigation for malignant pancreatic condition was MDCT following pancreatic protocol.

Keywords: MRCP, Pancreatic, USG

INTRODUCTION

Pancreatology and pancreatic surgery was developed on the basis of increase in knowledge of anatomy and physiology of the pancreas in the beginning of the 20th century. Although our knowledge of pancreatic head anatomy has increased, anatomical data characterizing the pancreatic ductal system remain limited. Furthermore, the relation of pancreatic ductal system anomalies and different pancreatic disorders remain to be evaluated.

The pancreatic ductal system is formed by the fusion of the ventral and dorsal primordia. Frequently this fusion process is localized to the pancreatic head, variations may occur, result in structural diversities of the pancreatic ductal system. Before the development of MRC Pan

evaluation of the pancreatic duct often required injection of endoscopic retrograde contrast material. With the advent of MRCP, similar information can be quickly obtained with minimal risk. MRCP also allows imaging of the patients in whom ERCP is unsuccessful and reveals portion of the pancreatic duct upstream from an obstructing lesion.

ERCP is an invasive procedure done under sedation by a side viewing endoscope and requires injection of contrast material through the ampulla which can causes anaphylaxis, pancreatitis etc. The advantage of ERCP is that therapeutic procedure can be performed like stone extraction, stenting, brush cytology. MRCP is a noninvasive procedure where bile itself acts as a contrast material and it provides excellent anatomical delineation of pancreatobilliary systems but therapeutic intervention cannot be done. Stimulated MRCP after i.v. secretin or oral lemon juice is done for better evaluation of pancreatic ductal system by stimulating pancreatic secretion just prior to taking the image. MRCP images were generated before and at every 15 minutes interval for 90 minutes after oral administration of lemon/orange juice in a dose of 2 ml/kg. IV administration of secretin induces the secretion of fluid and bicarbonate by the exocrine pancreas. Thus ductal filling is increased and visualization of the pancreatic duct is improved.[1] In addition the extent of positive duodenal contrast induced by the drainage of pancreatic fluid via the ampulla can be assessed semi-quantitatively and may be used for the noninvasive evaluation of the exocrine function of the pancreas.[2] The extent of pancreatic fluid secretion over 10 minutes of imaging after secretin administration is classified by Punwani S et al in 2003 using the duodenal filling grade as follows:

- Grade 0: No fluid signal in the duodenum
- Grade 1: Fluid limited to the duodenal bulb
- Grade 2: Fluid filling up to the genu inferius
- Grade 3: Fluid filling beyond the genu inferius.[2]

Pancreatic exocrine function is considered reduced when the duodenal filling volume grade is less than Grade 3. Therefore in the present study, we have analyzed the adult pancreatic ductal diversities in different pancreatic diseases like: migration anomalies (annular, ectopic), fusion anomalies (pancreas divisum), duplication anomalies (number variation, form variation), inflammatory disorder (acute and chronic pancreatitis), neoplastic disorders (benign and malignant) and we have also assessed the utility of lemon juice stimulated MR pancreatography in the evaluation of the pancreatic ductal morphology and the advantages of stimulated MRCP over conventional MRCP.

Imaging diversities of pancreatic duct in different pancreatic disorder

The ventral and dorsal pancreatic primordia join together during the seventh week of embryogenesis and form the pancreatic duct system. The junction site as well as the relation between both ducts and pancreatic size varies between individuals. The pancreatic head is usually formed from both primordial, whereas isthmus, body, and tail are formed from dorsal primordium only. Embryonic development anomalies of the primordia result in diversion of duct.

knowledge of the pancreatic ductal system diversities is essential to help the surgeons perform pancreatic surgery safely and efficiently. It can be delineated by postmorterm pancreatogram or antimorterm by transcutaneous abdominal USG; MDCT upper abdomen; ERCP; conventional or stimulated by secretin or lemon juice stimulated MRCP.

The incidence of pancreatic duct bifurcation within the tail of the gland is about 10%. Occasional large second-degree ducts called ramus corporis superior or inferior draining a section of pancreatic parenchyma. There may be also anomalous duct from the isthmus of the gland and its seems to be a potential important feature in pancreatic surgery. Isthmus of the pancreas seems to be a safe location of pancreatic transection concerning its distance to potential anomalous ducts. During the pancreatic remnant anastomosis may causes obstruction of the anomalous duct causing local pancreatitis postoperatively. If duct to mucosa anastomosis is performed anomalous duct may causes pancreatic fistula in postoperative period if it is not adequately drained.

Pancreatic duct system diversities may be seen in paediatric patients. Pancreatic duct diversities within the gland or duplication observed in childhood may result in cyst formation and increased risk of pancreatitis. Some anomalies correlate with an increased incidence of pancreatitis.

Incomplete fusion of the buds causes pancreas divisum, present 5% to 14% of the population. Several large series shows relation between acute and chronic pancreatitis with different type of pancreas divisum.[3] The incidence of pancreatitis in pancreas divisum is about 2.3% to 27.8%. There are numerous evidences of pancreatic duct anomalies accompanying diseases like pancreatitis.[3,4]

Commonly encountered pancreatic disease include

- Inflammatory disorders: acute and chronic pancreatic
- Neoplastic disorders: periampullary cancer, pancreatic cancer, cystic neoplasm
- Fusion anomalies
- Migration anomalies.

METHODS

The present study was conducted in Department of General Surgery, Sri Guru Ram Dass Institute of Medical Sciences and Research, Vallah, Amritsar. Study patients included the ones admitted in SGRD Medical College

and Hospital, Amritsar. The duration of the study was from August 2014 to November 2016. 50 admitted patients with different pancreatic diseases who needed special radiological evaluation were included

Informed consent was taken from the patients before including them in the study. Ethical committee clearance was obtained from the Ethical Committee of this hospital.

Inclusion criteria

Patients with history suggestive of pancreatic diseases were selected on the basis of history (history of long standing alcohol intake, family history, upper abdominal radiate towards back, nausea, vomiting); clinical assessment (epigastric tenderness, cullen's sign, gray turner sign) and laboratory workup (raised serum amylase and lipase level). The patients were investigated with imaging studies (USG upper abdomen, ERCP, conventional and stimulated MR cholangiopancreatography). The pancreatic ductal diversities were then studies in different pancreatic diseases by analysis of different radiological images.

Exclusion criteria

Patients not suffering from pancreatic diseases and OPD patients were not included in the study. Present study was a prospective observational study.

Parameters to be studied

Pancreatic ductal diversities in different pancreatic diseases were evaluated by different imaging modalities. Sex distribution of the patients in relation to the pancreatic diseases, diameter of the main pancreatic duct and aberrant duct and there ratio, pathology found in (calcification, stone, stricture) and around (peripancreatic edema, fluid collection, etc.) the pancreas, direction and orientation (cephalic or caudal) of aberrant or anomalous pancreatic duct, improvement of image quality after lemon juice stimulated MR pancreatography over conventional MR pancreatography, duodenal filling grade in different pancreatic diseases and age distribution of the patients in relation to pancreatic diseases.

Study tools

- Detailed history of the patients, clinical assessment and laboratory workup.
- Evaluation of cases by USG/MDCT/ERCP/ conventional MRCP/lemon juice stimulated MRCP.

Study techniques

- The patients who were admitted in different wards with features suggestive of pancreatic diseases were selected on the basis of history (history of long standing alcohol intake, nausea, vomiting etc.), clinical examination (epigastric tenderness etc.) and laboratory work up (raised serum amylase and lipase level)
- The patients were investigated with modern imaging techniques (USG upper abdomen, ERCP, MRCP)
- The pancreatic duct system diversities were studied in different pancreatic disorders.

Plan for analysis of data

Collected data were analyzed by standard statistical method using SPSS software version 16. All continuous variables reported are number, mean, standard deviation, range, maximum, minimum. All categorical variables are reported as number (%) compared across groups using Chi-square test for independence of attributes. Comparison of pre-and post-lemon juice was done using paired t test and 95% confidence interval of difference was also calculated. A level of 5% has been taken as significant.

The objectives of this study were

- To study cases clinically and segregate cases with pancreatic disorder which need evaluation by special imaging modalities and surgical management
- To compare the nature of information obtained from various modalities
- To study various corollaries of modern imaging study
- To study whether the information from various imaging modalities are complimentary, competitive
- To study pancreatic ductal structure in different pancreatic diseases
- To study specific indication of different imaging techniques in the diagnosis and therapeutic planning of different pancreatic diseases
- To compare other advantages and disadvantages of these imaging modalities

Specific objectives

Study of pancreatic ductal system in different pancreatic diseases (no. of aberrant duct, direction and orientation of aberrant duct, diameter of main pancreatic duct) and advantages of lemon juice stimulated MRCP over conventional MRCP.

RESULTS

This present study is a prospective observational study, conducted at Department of General Surgery, Sri Guru Ramdas Institute of Medical Sciences, Amritsar over period of 27 months from august 2014 to November 2016. Total of 50 subjects were included.

In present study total 50 cases were included (n = 50), among which more than half that 56% were males and 44% (22) were female. As shown in Table 1, most cases of chronic pancreatitis were noted (50%), followed by

acute pancreatitis (26%). Cases of annular pancreas, CA pancreases and pancreatic ascitic was just 1%.

Table 1: Demographic profile sex distribution.

	Sex				
Pathology	**Female**	**Male**	**Total**	**P value**	**Significance**
Acute pancreatitis	9 (40.9%)	4 (14.3%)	13 (26%)		
Annular pancreas	0 (0%)	1 (3.6%)	1 (2%)		
Ca head pancreas	1 (4.5%)	2 (7.1%)	3 (6%)		
Chronic pancreatitis	8 (36.4%)	17 (60.7%)	25 (50%)	0.246	Not significant
Cystic neoplasm	1 (4.5%)	0 (0%)	1 (2%)		
Pancreatic ascites	0 (0%)	1 (3.6%)	1 (2%)		
Periampullary CA	3 (13.6%)	3 (10.7%)	6 (12%)		
Total	22 (100%)	28 (100%)	50 (100%)		

Table 2: Frequency of aberrant duct in different pancreatic diseases.

	Anomalous duct (AD) present or absent				
Pathology	**Absent**	**Present**	**Total**	**P value**	**Significance**
Acute pancreatitis	12 (29.3%)	1 (11.1%)	13 (26%)		
Annular pancreas	1 (2.4%)	0 (0%)	1 (2%)		
CA head pancreas	3 (7.3%)	0 (0%)	3 (6%)		
Chronic pancreatitis	19 (46.3%)	6 (66.7%)	25 (50%)	0.701	Not significant
Cystic neoplasm	1 (2.4%)	0 (0%)	1 (2%)		
Pancreatic ascites	1 (2.4%)	0 (0%)	1 (2%)		
Periampullary CA	4 (9.8%)	2 (22.2%)	6 (12%)		
Total	41 (100%)	9 (100%)	50 (100%)		

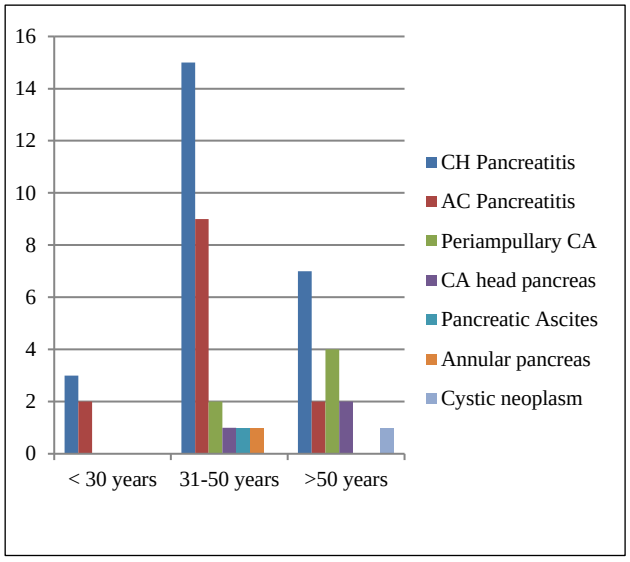
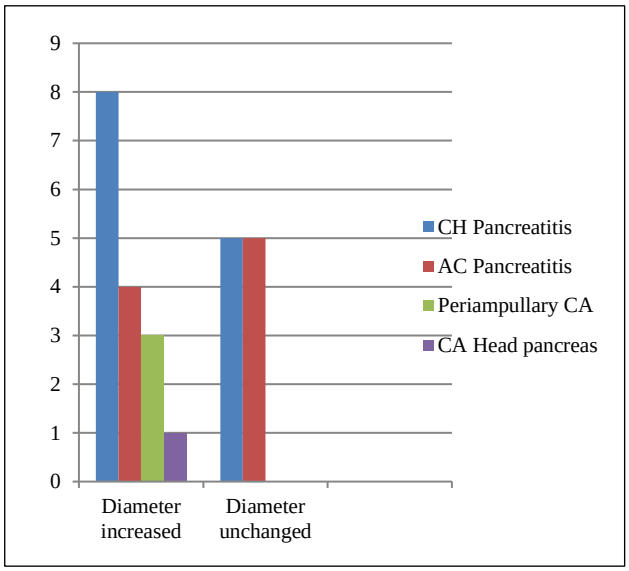


Figure 1: Age wise distribution of disease.

In present study among total 50 patients, maximum aged between 31 to 50 years with mean age of 44.94 years. Patients in age group of less than 30 years were less.



n -26 (no of patients undergo lemon juice stimulated MRCP); Diameter increased - n16 (61.53%); Diameter unchanged - n10 (38.46%); MPD - Main pancreatic duct; CA - Carcinoma

Figure 2: Pattern of change in MPD diameter following stimulation.

Table 3: Overall comparison of diameter of aberrant duct (AD), MPD and MPD/AD and post lemon juice MPD diameter and post lemon juice best image time.

	Descriptive statistics					
	N	**Minimum**	**Maximum**	**Range**	**Mean**	**SD**
Diameter of AD (mm)	9	0.4	1	0.6	0.61	0.20
Pre-lemon juice diameter of MPD (mm)	50	1	19	18	6.68	3.99
MPD/AD	9	4	25	21	13.96	6.49
Post lemon juice MPD diameter (mm)	16	12.5	3	15.5	7.18	3.22
Post lemon juice best image quality (min)	16	30	60	30	51.56	9.44

Table 4: Distribution of post lemon juice (in min) best image quality in different pancreatic diseases.

		Descriptive statistics					
Pathology		**n**	**range**	**min**	**max**	mean	sd
Acute pancreatitis	Diameter of AD (mm)	1	0	1	1	1.00	.
	Diameter of MPD (mm)	13	4	2	6	3.65	1.03
	MPD/AD	1	0	4	4	4.00	.
	Post lemon juice best image quality (min)	4	15	45	60	52.50	8.66
	Post lemon juice mpd diameter (mm)	4	2.8	5.2	8	6.18	1.26
Annular pancreas	Diameter of ad (mm)	0					
	Diameter of MPD (mm)	1	0	5	5	5.00	.
	MPD/AD	0					
	Post lemon juice best image quality (min)	0					
	Post lemon juice MPD diameter(mm)	0					
CA head pancreas	Diameter of AD (mm)	0					
	Diameter of MPD (mm)	3	4	1	5	2.73	2.05
	MPD/AD	0					
	Post lemon juice best image quality (min)	1	0	45	45	45.00	.
	Post lemon juice MPD diameter (mm)	1	0	3	3	3.00	.
Chronic pancreatitis	Diameter of AD (mm)	6	0.4	0.4	0.8	0.56	0.17
	Diameter of MPD (mm)	25	17	2	19	9.24	4.02
	MPD/AD	6	17.5	7.5	25	16.18	6.20
	Post lemon juice best image quality (min)	8	30	30	60	50.62	11.16
	Post lemon juice MPD diameter (mm)	8	11.7	3.8	15.5	8.46	3.88
Cystic neoplasm	Diameter of AD (mm)	0					
	Diameter of MPD (mm)	1	0	4	4	4.00	.
	MPD/AD	0					
	Post lemon juice best image quality (min)	0					
	Post lemon juice MPD diameter (mm)	0					
Pancreatic ascites	Diameter of AD (mm)	0					
	Diameter of MPD (mm)	1	0	5	5	5.00	.
	MPD/AD	0					
	Post lemon juice best image quality (min)	0					
	Post lemon juice MPD diameter (mm)	0					
Periampullary CA	Diameter of AD (mm)	2	0.1	0.5	0.6	0.54	0.08
	Diameter of MPD (mm)	6	6	2	8	5.58	1.96
	mpd/ad	2	4.6	10	14.6	12.29	3.24
	post lemon juice best image quality (min)	3	15	45	60	55.00	8.66
	post lemon juice mpd diameter(mm)	3	3.8	4	7.8	6.47	2.14

Most common cases with aberrant duct were of chronic pancreatitis, followed by acute pancreatitis and minimum 1% associated with neoplasms, pancreatitis ascitis and cystic neoplasms. The association of different pancreatic pathology and increased in MPD diameter following stimulation was not significant (p value 0.307). Among

total 50 subjects, it was observed that only 61.5% cases diameter increased and in 38.46% it remained unchanged. Difference of pre-and post-lemon juice MPD diameter was significant (p value <0.001). Table 3 shows overall comparison of aberrant duct diameter variability.

Table 4 shows detailed distribution of best images in different pancreatic diseases following post lemon juice imaging. All the pancreatic disease was included.

Table 5: Percentages distribution of patients in different grades of duodenal filling.

	Duodenal filling grade						
Pathology	**0**	**1**	**2**	**3**	**Total**	**P value**	**Significance**
Acute pancreatitis	0 (0%)	0 (0%)	3 (60%)	6 (54.5%)	9 (32.1%)		
Annular pancreas	0 (0%)	0 (0%)	0 (0%)	1 (9.1%)	1 (3.6%)		
CA head pancreas	0 (0%)	0 (0%)	0 (0%)	1 (9.1%)	1 (3.6%)	0.010	significant
Chronic pancreatitis	4 (100%)	8 (100%)	2 (40%)	0 (0%)	14 (50%)		
Periampullary CA	0 (0%)	0 (0%)	0 (0%)	3 (27.3%)	3 (10.7%)		
Total	4 (100%)	8 (100%)	5 (10)	11 (100%)	28 (100%)		

There was a significant relation between the grades of duodenal filling and different pancreatic pathologies (p value - 0.010). p value was found to be statistically significant.

Table 6: Frequencies of different imaging modalities used.

Investigation	No. of patients	Percentage
USG	42	84%
CT scan	18	36%
MRCP	26	52%
ERCP	2	4%

Most commonly used was USG, followed by MRCP and minimum ERCP is used.

Table 7: Frequencies of different pancreatic disorders.

Pathology	Frequency	Percent
Acute pancreatitis	13	26%
Annular pancreas	1	2%
CA head pancreas	3	6%
Chronic pancreatitis	25	50%
Cystic neoplasm	1	2%
Pancreatic ascites	1	2%
Periampullary CA	6	12%
Total	**50**	**100%**

Pancreatic diseases noted in subjects included in this study (n = 50).

Most common diseases seen was chronic pancreatitis (50%) followed by acute pancreatitis (26), Periampullary carcinoma (12%), CA pancreases (6%) and minimum 2% cases of cystic neoplasms, pancreatic ascitis and annular pancreas

DISCUSSION

In the present study, we have a total of 50 patients. Among them 25 (50%) suffer from chronic pancreatitis, 13 (26%) from acute pancreatitis, 6 (12%) from periampullary carcinoma, 3 (6%) from carcinoma head of the pancreas, 1 (2%) from pancreatic ascites following acute pancreatitis, 1 (2%) from annular pancreas and 1 (2%) from cystic neoplasm of pancreas. These patients were investigated by transabdominal USG, MDCT scan, ERCP and conventional and stimulated MRCP to study the pancreatic duct diversities in different pancreatic diseases and the advantage of lemon juice stimulated MRCP over conventional MRCP.

Among all the investigations the most common and usually first investigation for evaluation of different pancreatic diseases was transabdominal USG (84%) followed by MDCT scan (52%), MRCP (52%) and ERCP (4%) in descending order.

The mean age was 44.94 years. About 10% patients were less than 30 years of age, 58% patients were between 31 to 50 years and 32% patients were more than 50 years of age. The p value of affection of different pancreatic diseases and age group was not significant (0.544).

46% of the study population males and 44% were females. The p value of affection of males and females with different pancreatic diseases was not significant (0.246).

Analysis of the 50 patients revealed that 9 patients (18%) had atypical duct joining the main pancreatic duct. Six aberrant ducts were cranial (66.66%) to the main pancreatic duct and three were caudal (33.33%). The mean size of the main pancreatic duct was 6.68 mm (from 1 to 19 mm; SD = 3.99). The mean aberrant duct size was 0.61 mm (from 0.4 to 1 mm; SD = 0.20). The mean of the ratio of main pancreatic duct and aberrant

duct was 13.96 (from 4 to 25; SD = 6.49). Hac S and co-workers published their literature in 2009 which revealed that aberrant duct was present in about 9.9% patients and 7 of the aberrant ducts were cranial and 2 were caudal to the main pancreatic duct; the mean size of the main pancreatic duct was 2.22 mm (from 1.2 to 3.0 mm; SD = 0.43); the mean aberrant duct size was 0.94 mm (from 0.44 to 1.8, SD = 0.35).

In the present study among the 6 patients (66.7%) having aberrant duct directed cranially, 4 had chronic pancreatitis, 1 had acute pancreatitis and 1 patient had periampullary carcinoma. Among the 3 patients (33.33%) having the aberrant duct directed caudally, 2 had chronic pancreatitis and 1 had periampullary carcinoma. The association between aberrant duct with pancreatic diseases was not found to be significant (P value 0.687).

26 (52%) patients of the present study had undergone lemon juice stimulated MRCP. Among them acute pancreatitis, chronic pancreatitis, carcinoma head pancreas and periampullary carcinoma were 34.6%, 50%, 3.8% and 11.5% respectively. The diameter of main pancreatic duct was calculated pre-and post-lemon juice stimulation at 15 minutes intervals. The increase in diameter of main pancreatic duct in acute pancreatitis, chronic pancreatitis, carcinoma head of the pancreas and periampullary carcinoma were 25%, 50%, 6.2% and 18.8% respectively. The mean difference in main pancreatic duct diameter in pre-and post-lemon juice stimulation was 1.425, SD = 0.6904, range: 1.057 to 1.79 and p value was significant (<0.001). The mean time of best image quality in post lemon juice stimulation period was 51.56 minutes (from 30 minutes to 60 minutes, range: 30, SD = 9.44). Till now there was no data to show the advantages of secretin stimulated MRCP over lemon juice stimulated MRCP. As secretin is not readily available in India and being costly, we performed stimulated MRCP by oral lemon juice stimulation only.

In the study performed by Chu ZQ et al in 2010 it was shown that the diameter of the main pancreatic duct was augmented after oral lemon juice stimulation and the difference in the mean value before and after oral lemon juice were highly significant at both sites in volunteers and patients (P <0.01).[1] Among 20 volunteers and 26 patients, after juice administration the best visualization of the pancreatic duct was achieved at 58.98 min (SD = 14.96 min) and 59.41 min, (SD = 13.79 min) respectively and overlap imaging of oral juice was especially observed at 42.86 min (SD = 10.92 min) and 41.63 min (SD = 9.23 min) respectively.

In the present study, duodenal filling grade was assessed in 28 patients by doing MRCP (26) or ERCP (2). Among them acute pancreatitis, chronic pancreatitis, carcinoma head pancreas, periampullary carcinoma and annular pancreas cases were 32.1%, 14%, 3.6%, 10.7% and 3.6% respectively. Among duodenal filling Grade 0, 4 patients had chronic pancreatitis (14.28%); Grade 1 had 8 patients of chronic pancreatitis (28.57%); Grade 2 had 3 patients of acute pancreatitis (60%) and 2 patients of chronic pancreatitis (40%) and Grade 3 had 6 patients of acute pancreatitis (54.5%), 3 patients of periampullary carcinoma (27.3), 1 patient of annular pancreas, and 1 patient of carcinoma head of the pancreas. Assessment of the noninvasive method of exocrine function test of the pancreas by duodenal filling grade showed the P value to be significant (0.010). Punwani S and co-workers measured the pancreatic exocrine function by noninvasive method, namely secretin stimulated MRCP and calculated the pancreatic apparent diffusion coefficient (ADC).[2] Threshold values of non-stimulated enhanced ADC for pancreatitis discrimination were calculated and analysis showed P value was not significant. Another study published by Czako L et al assessed pancreatic exocrine function by stimulated MRCP and increase in post-stimulated duodenal diameter.[5] In this study, duodenal filling was significantly reduced in patients with mild or severe exocrine pancreatic insufficiency as compared to the volunteers (4.12±1.33 and 1.70±0.77 versus 15.38±1.73, respectively).

There was no significant difference in pancreatic T2 signal intensity changes or duodenal filling in patients with mild or severe exocrine pancreatic insufficiency. There was significant correlation between the pancreatic T2 signal intensity changes and the duodenal filling and the results of the Lundh test (r = -0.616 and -0.78).

CONCLUSION

The management of colorectal cancer has progressed over pancreatic disorders were most frequently seen in male patients.

- Age group between 31 to 50 years were mostly suffering from inflammatory disorders like acute and chronic pancreatitis.
- The frequency of malignant condition was increased after 50 years of age.
- Most common pancreatic disorder in the present study was chronic pancreatitis.
- Trans-abdominal USG was found to be very useful initial investigation for the evaluation of pancreatic duct morphology.
- Best investigation for malignant pancreatic condition was MDCT following pancreatic protocol.
- MRCP is the best noninvasive investigation for detailed evaluation of detailed pancreatic ductal system.
- Aberrant duct when present, was mostly directed cranial to MPD.
- There is no specific relation of the aberrant ductal system with the different pancreatic diseases.
- Lemon juice stimulated MRCP had definite advantages over the conventional MRCP for diagnosis of different pancreatic disorders in the

form of better delineation of the pancreatic ductal system, particularly MPD and aberrant duct.

- Lemon juice stimulated MRCP can be effectively used for the evaluation of exocrine pancreatic reserve by measuring duodenal filling grade.
- Post lemon juice best image quality was seen 51.56 min after oral lemon juice ingestion.

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Ethical approval: The study was approved by the institutional ethics committee

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