



Original Article

## Study of chronic pancreatitis in children

Kadviben Bhojabhai Chavda<sup>1\*</sup>, Rakesh Ashwinkumar Makwana<sup>1</sup>, Himesh R. Chauhan<sup>1</sup>, Nitin M. Parmar<sup>1</sup>, Ravi P. Gadani<sup>1</sup>, Dinesh M. Kumar<sup>1</sup>, Phanindra K. Dasi<sup>1</sup>

<sup>1</sup>Department of General Surgery, B.J. Medical College, Ahmedabad, Civil Hospital, Ahmedabad, India

### \*Corresponding author:

Kadviben Bhojabhai Chavda,  
Department of General Surgery,  
B.J. Medical College, PG  
Hostel, Civil Hospital Campus,  
Ahmedabad, 380016, India.

[kavitachavda1281998@gmail.com](mailto:kavitachavda1281998@gmail.com)

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### ABSTRACT

**Introduction:** Chronic pancreatitis (CP) in children and adolescents is an uncommon but increasingly recognized condition with etiological and clinical profiles distinct from adults.

**Material and Methods:** This prospective observational study included 20 patients aged <18 years diagnosed with CP and admitted to a tertiary care center in Ahmedabad between May 2022 and May 2024. Clinical features, laboratory parameters, imaging findings, etiology, management strategies, complications, and short-term outcomes were analyzed descriptively.

**Results:** The mean age was 12.4 years with a male predominance (70%). Abdominal pain was present in 100%, followed by weight loss (60%) and nausea/vomiting (55%). Etiology was idiopathic in 50%, post-traumatic in 20%, cholelithiasis and mumps infection in 10% each, and pancreatic divisum and choledochal cyst in 5% each. Elevated serum lipase and amylase were seen in 60% and 45%, respectively. Ultrasonography was abnormal in 100%, CT in 40%, and MRCP in 30%. Complications included parenchymal calcification (50%), ascites (20%), and pseudocyst (15%). Most patients were managed conservatively; 15% required surgical intervention.

**Conclusion:** CP in children and adolescents shows a high burden of pain and complications, with a large proportion labeled idiopathic, highlighting the need for genetic evaluation and multidisciplinary care.

**Keywords:** Chronic pancreatitis, Children, Etiology, Pancreatic calcification, Pseudocyst, Paediatric pancreatitis

### INTRODUCTION

Chronic pancreatitis (CP) is a progressive inflammatory disease of the pancreas, causing irreversible damage with pain and/or permanent exocrine or endocrine dysfunction, confirmed by imaging or histology.<sup>1-3</sup>

#### Relevance to the young population

In children, the most common causes of CP are trauma, heredity, systemic disease, and malformations of the pancreaticobiliary duct, such as pancreas divisum, annular pancreas, and choledocholithiasis. In addition, various unusual conditions, including metabolic disease, endocrine disorders, and inflammatory bowel disease 13, may cause the disorder.<sup>4-6</sup>

Certain congenital anomalies affect the pancreas and surrounding tissue, several of which are

associated with CP. Obstruction of pancreatic flow caused by a stenotic papilla of Vater and bile reflux resulting from a common channel are believed to be responsible for the resultant inflammation, which may be reversible if the obstruction is relieved. A relatively common cause of relapsing pancreatitis is pancreas divisum, in which most of the pancreatic fluid flows through the minor duct of Santorini, with the possibility of a relative obstruction to flow because of anatomy and flow dynamics. Some series have reported an increased incidence of pancreas divisum in patients with idiopathic CP.<sup>1-3</sup>

### Assessment in children

#### Assessment of malnutrition

- Anthropometry: weight, height/length, BMI-for-age, weight-for-age, and height-for-age z-scores (WHO growth charts).
- Clinical signs: muscle wasting, loss of subcutaneous fat, and edema.
- Dietary assessment: dietary recall or food frequency history.
- Laboratory parameters (if available): serum albumin, prealbumin, hemoglobin, micronutrient deficiencies (fat-soluble vitamins A, D, E).<sup>4-33</sup>

Annular pancreas, which results from an error of rotation or fixation of the embryologic pancreatic primordium, has also been associated with CP.

Pancreaticobiliary malunion with or without choledocholithiasis may likewise result in relapsing CP.

In the past few years, several genes have been identified as being associated with hereditary and idiopathic CP: PRSS1, CFTR, and SPINK1. SPINK1 mutations were found predominantly in patients without a family history. These mutations were most common in those with idiopathic CP, whereas patients with hereditary CP predominantly had PRSS1 mutations.<sup>30-32</sup>

#### Assessment of exocrine pancreatic insufficiency

- Clinical features: steatorrhea, chronic diarrhea, bulky/foul-smelling stools, poor weight gain or weight loss.
- Stool tests: fecal elastase-1 (<200 µg/g suggestive of insufficiency; <100 µg/g severe).
- Indirect evidence: need for pancreatic enzyme replacement therapy (PERT).
- Fat-soluble vitamin deficiency as supportive evidence.

#### Assessment of endocrine pancreatic insufficiency

- Blood glucose testing: fasting plasma glucose.

- HbA1c for chronic glycemic status.
- Oral glucose tolerance test (OGTT) when indicated.
- Diagnosis: diabetes mellitus defined according to standard paediatric criteria.

#### Assessment of pain

- Pain history: frequency, duration, severity, and impact on daily activities.
- Pain scales (age-appropriate):
  - FLACC scale [face, legs, activity, cry, consolability (infants and young children).
  - Wong-Baker FACES pain scale.
  - Visual analog scale (VAS) or Numeric rating scale in older children.
- Analgesic requirement or hospital admissions as surrogate markers.

Malnutrition, pancreatic exocrine and endocrine insufficiency, and pain were assessed based on clinical records and available investigations; however, standardized assessment tools were not uniformly applied to all patients.

### AIMS AND OBJECTIVES

- To study the etiology and pathogenesis of CP in patients aged <18 years.
- To study the clinical features, management, and complications of study group patients.
- To assess the outcome.

### METHODOLOGY

**Study site:** Department of General Surgery, B.J. Medical College & Civil Hospital, Ahmedabad.

**Study type:** Prospective and Interventional.

**Study period:** 5 May 2022 to 5 May 2024.

**Sample size:** 20 patients (All patients meeting the inclusion criteria from 5 May 2022 to 5 May 2024 were included).

#### Method of data collection

All of the patients' records were prospectively collected from the patients and the indoor case records.

This was a prospective study conducted at a tertiary hospital in Ahmedabad as part of the author's thesis. Institutional ethical permission taken.

- All patients meeting the inclusion criteria and hospitalized for over 2 years were included in this study.
- The clinical, laboratory, and radiological data for all

patients aged <18 years admitted to this Institution with a diagnosis of CP were prospectively collected for this study within 24 h of admission.

**Inclusion criteria:** All patients aged <18 years admitted to this hospital with a diagnosis of CP, irrespective of etiology.

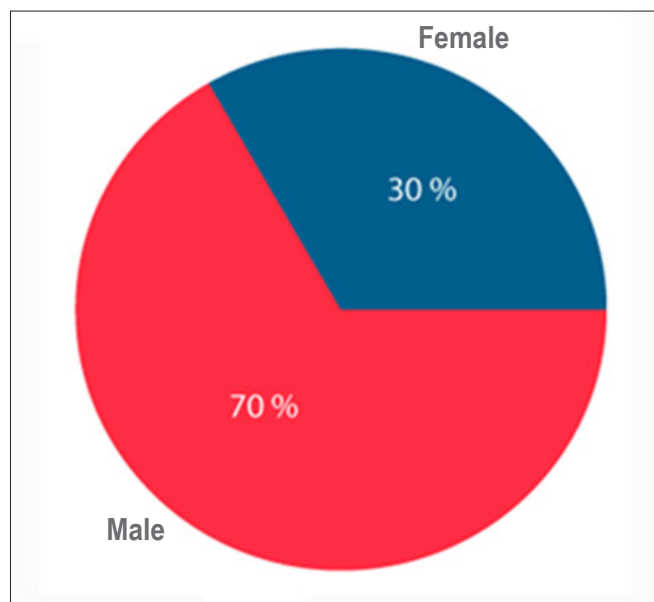
**Exclusion criteria:**

1. Age >18 years
2. Acute pancreatitis

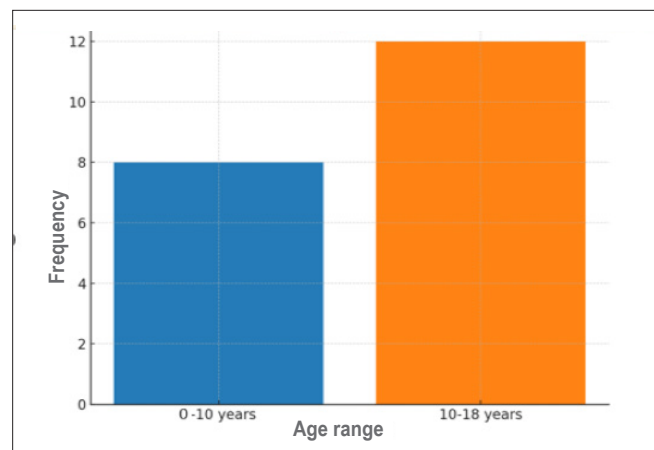
**Follow up**

Patients were followed up for 6 months after discharge from the institute or until death during the inpatient period.

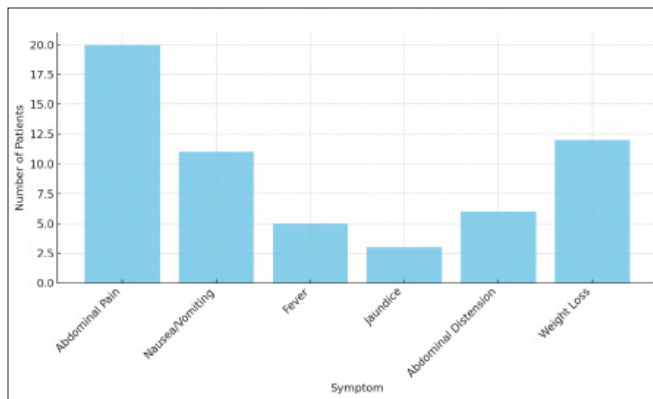
**OBSERVATION AND RESULTS**



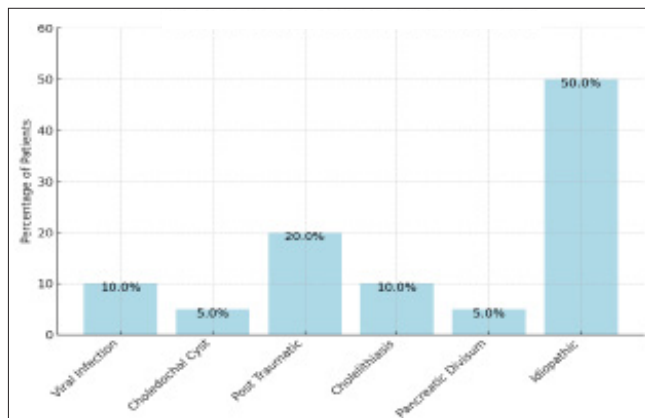
**Figure 1:** Sex distribution of patients. Figure 1 shows that there was male predominance with 70% males and 30% females.



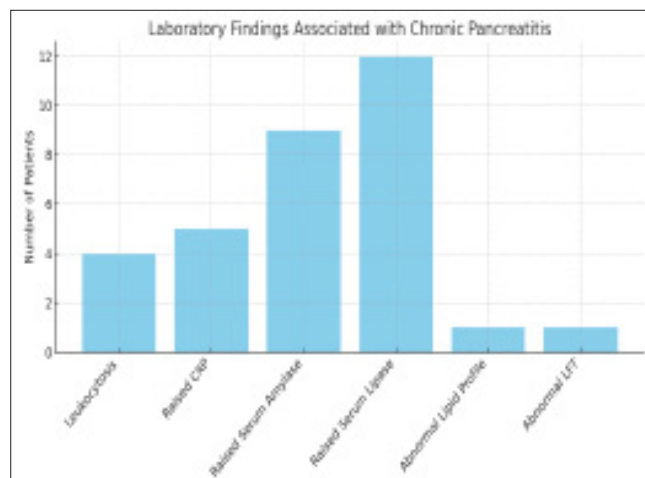
**Figure 2:** Age distribution. Figure 2 shows that most patients belonged to 13-18 years age group.



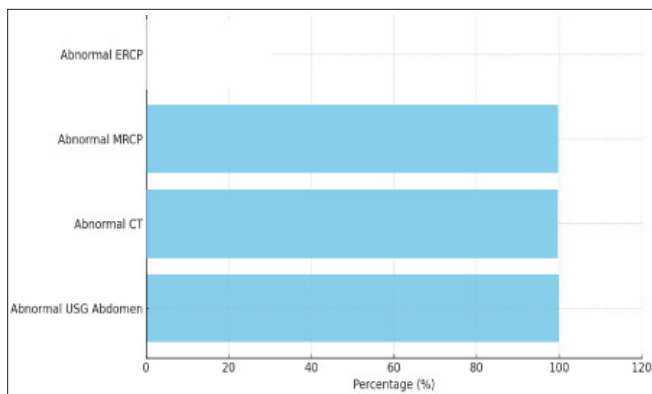
**Figure 3:** Clinical presentation of pancreatitis. Figure 3 shows that abdominal pain was present in all patients, followed by weight loss and nausea/vomiting.



**Figure 4:** Etiological factors. Figure 4 shows Idiopathic etiology was the most common cause of chronic pancreatitis.



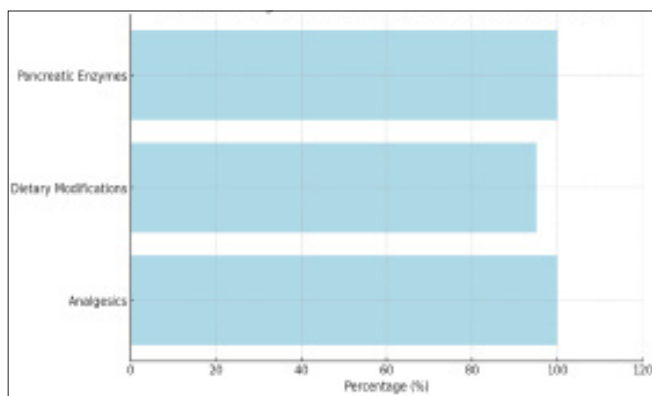
**Figure 5:** Laboratory findings. Figure 5 shows that raised serum lipase and amylase levels were observed in 60% and 45% of patients respectively.



USG: Ultrasonography; CT: Computed tomography; MRCP: Magnetic resonance cholangiopancreatography; ERCP: Endoscopic retrograde cholangiopancreatography

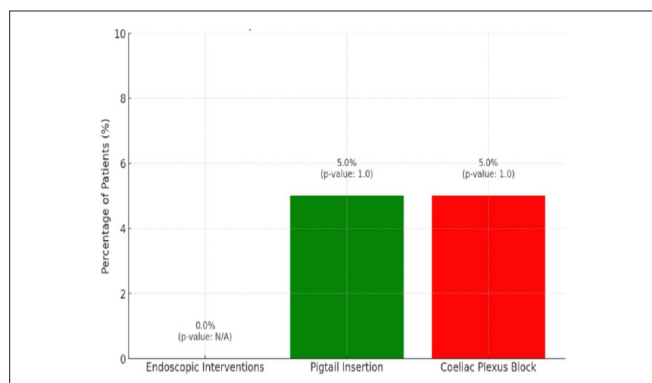
**Figure 6:** Imaging findings.

Ultrasonography was abnormal in all patients, while CT and MRCP showed abnormalities in selected cases [Figure 6].



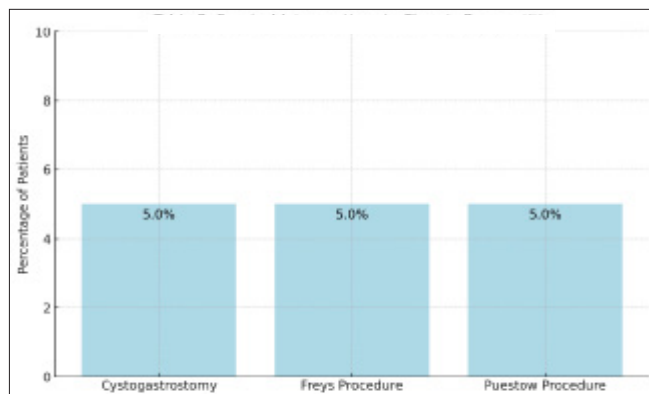
**Figure 7:** Management modalities.

All patients were managed with analgesics and pancreatic enzyme supplementation [Figure 7].



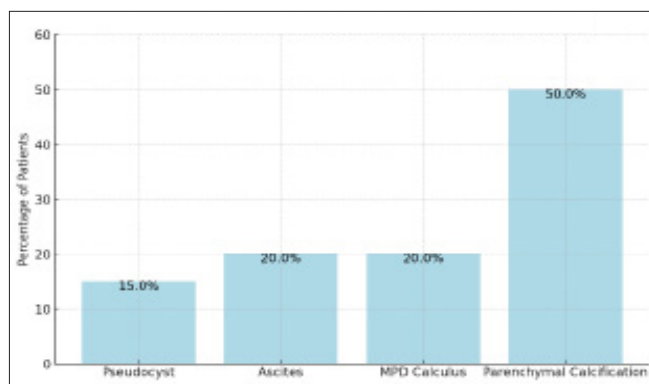
**Figure 8:** Endoscopic interventions.

Non-surgical interventions included pigtail insertion and coeliac plexus block [Figure 8].



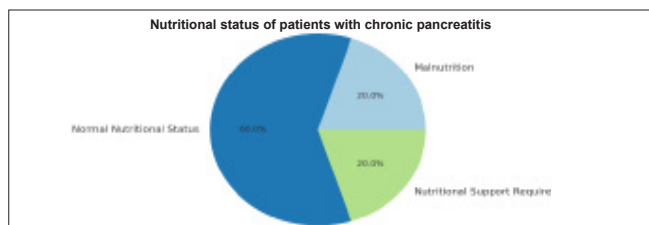
**Figure 9:** Surgical interventions.

Surgical procedures performed included cystogastrostomy, Frey's procedure, and Puestow procedure [Figure 9].



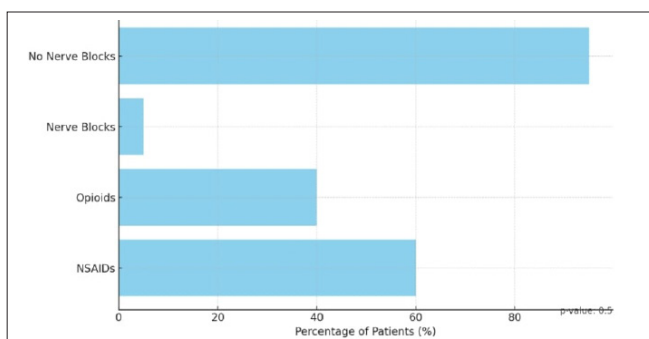
**Figure 10:** Complications.

Parenchymal calcification was the most common complication [Figure 10].



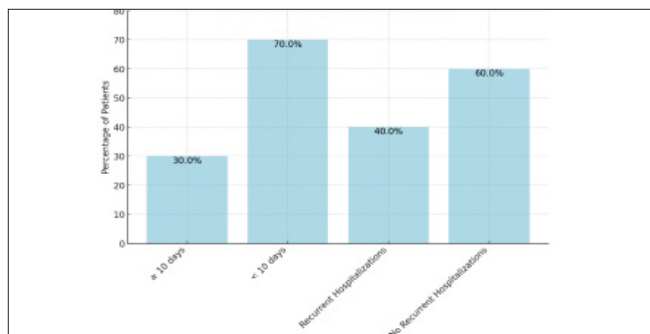
**Figure 11:** Nutritional status.

Malnutrition was present in 25% of patients [Figure 11].

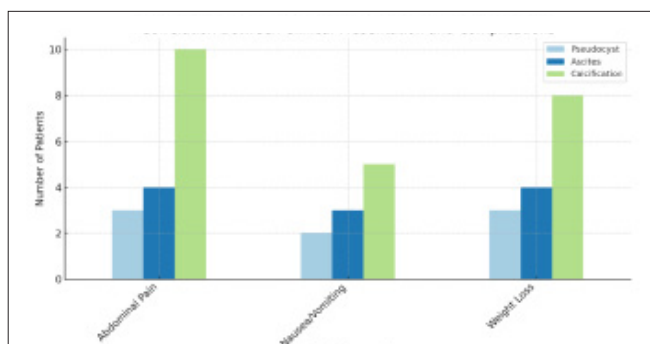


**Figure 12:** Pain management strategies.

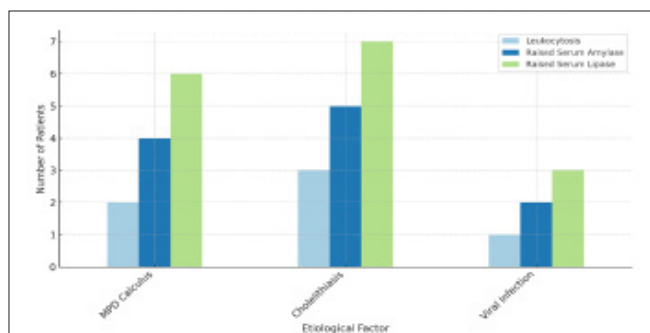
Most patients responded to NSAIDs or opioids for pain control [Figure 12].



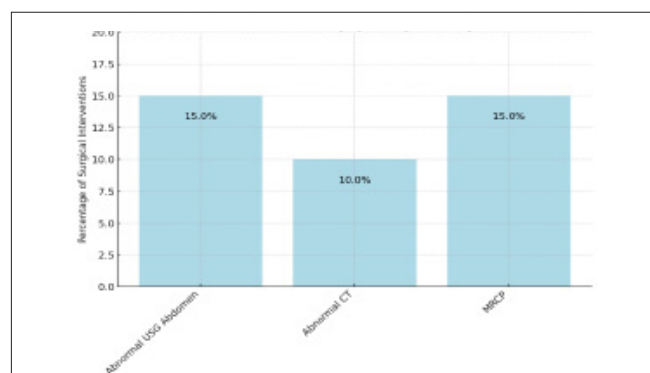
**Figure 13:** Hospitalization duration. Recurrent hospitalizations were noted in 40% of patients [Figure 13].



**Figure 14:** Correlation between clinical presentation and complications is shown in ([Figure 14])



**Figure 15:** Association between etiological factors and laboratory findings is shown in [Figure 15].



**Figure 16:** Correlation between imaging findings and surgical interventions is presented in [Figure 16].

Abdominal pain was the most common presenting complaint of patients with CP. The most common etiological factor was idiopathic, followed by blunt abdominal trauma and mumps (viral) infection. The most common complication following post-traumatic cause was pseudocyst, and the non-traumatic cause was calcification and its sequelae. USG and MRCP are investigations of choice in the paediatric age group of patients. CECT is advisable in case of acute exacerbation of CP and post-traumatic sequelae. Most of the patients were managed conservatively. Surgical intervention is required for complications like pseudocyst, calcification, and its sequelae, like MPD calculus. A longer duration of follow-up is required for assessment of complications, management, and outcomes.

## DISCUSSION

In the present study, 20 patients with CP were studied.

**Table 1:** Comparison of age and sex with other studies

Parameter	Present study	Schwarzenberg <i>et al.</i> <sup>30</sup>	Das <i>et al.</i> <sup>21</sup>	Choudhary <i>et al.</i> <sup>23</sup>
Mean age	12.4	13	15.3	15.3
Male	70%	57%	66%	60%
Female	30%	43%	34%	40%

In our study, the mean age of presentation was 12.4 years, and in the study by Schwarzenberg *et al.*,<sup>30</sup> was 13 years. In the study by Choudhary *et al.*,<sup>23</sup> from Vellore, it was 15.3 years, and in the study by Das *et al.*,<sup>21</sup> from AIIMS Delhi, it was 12.5 years. In our study, males (70%) were affected more than females (30%). Similar results were found in another study. In a study by Schwarzenberg *et al.*,<sup>30</sup> males (57%) and females (43%) were studied. In a study by Choudhary *et al.*,<sup>23</sup> males (60%) and females (40%), and in a study by Das *et al.*,<sup>21</sup> males (66%) and females (34%) [Table 1].

**Table 2:** Comparison of etiological factors with other studies

Etiological factors	Present study (%)	Schwarzenberg <i>et al.</i> <sup>30</sup> (%)	Das <i>et al.</i> <sup>21</sup> (%)
Idiopathic	50	8	60
Blunt trauma	20	0	13.3
Cholelithiasis	10	4	6.7
Mumps	10	0	0
Pancreatic divisum	5	20	0
Choledochal cyst	5	0	0
Drugs	0	1	12.5
Genetic	0	67	7.5

Etiological factors in our study were idiopathic (50%), post-traumatic (blunt trauma)(20%), cholelithiasis (10%), viral infection (mumps) (10%), choledochal cyst(5%), and

pancreatic divisum (5%). In a study by Schwarzenberg *et al.*,<sup>30</sup> genetic (67%), pancreatic divisum (20%), cholelithiasis (4%), and drug (1%). In a study by Choudhary *et al.*,<sup>23</sup> idiopathic (95.9%). In a study by Das *et al.*,<sup>21</sup> idiopathic (60%), cholelithiasis (6.7%), blunt trauma (13.3%), drugs (12.5%), and mumps (0%) [Table 2].

**Table 3:** Comparison of symptoms with other studies

Symptoms	Present study (%)	Das <i>et al.</i> <sup>21</sup> (%)
Abdominal pain	100	100
Nausea/vomiting	55	75
Fever	25	26
Jaundice	15	6.7
Weight loss	60	33
Abdominal distension	30	13.3
Drugs	0	1
Genetic	0	67

In our study, abdominal pain was present in all patients (100%). Other symptoms like nausea/vomiting (55%), weight loss (60%), fever (25%), jaundice (15%), abdominal distension (30%) of patients suggest complication like pseudocysts or ascites. In study by Das *et al.*,<sup>21</sup> abdominal pain (100%), nausea/vomiting (75%), abdominal distention (13.3%), fever (26%), jaundice (6.7%), weight loss (33%) [Table 3].

**Table 4:** Comparison of laboratory findings with other studies

Parameter	Present study (%)	Werlin <i>et al.</i> <sup>6</sup> (%)	Srikant das <i>et al.</i> <sup>21</sup> (%)
Serum lipase	60	60	100
Serum amylase	45	45	66.7

Laboratory findings in our study, such as elevated serum amylase and lipase in 45% and 60% respectively. A study by Werlin *et al.*<sup>6</sup> found similar elevation in serum lipase and amylase. A study by Das *et al.*<sup>21</sup> serum lipase 100% and serum amylase 66.7% [Table 4].

**Table 5:** Comparison of imaging findings with other studies

Imaging finding	Present study (%)	Das <i>et al.</i> <sup>21</sup> (%)	Choudhary <i>et al.</i> <sup>23</sup> (%)
Positive USG	100	92.9	10
Positive CT	40	100	-
Positive MRCP	60	100	-
Positive ERCP	Not done	100	-

Imaging findings in our study showed that all patients had positive USG findings (100%), abnormal CT findings in 40% of patients, and MRCP results in 60% patients. In a study by Das *et al.*,<sup>21</sup> positive USG, CT, MRCP, and ERCP findings were 92.9%, 100%, 100%, and 100%, respectively. In a study by Choudhary *et al.*,<sup>23</sup> positive USG findings were found in 100% patients.

**Table 6:** Comparison of conservative management with other studies

Management	Present study (%)	Kumar <i>et al.</i> <sup>32</sup> (%)	Choudhary <i>et al.</i> <sup>23</sup> (%)
Analgesics	100	100	100
Dietary modification	100	100	100
Pancreatic enzyme supplementation	100	100	100

In our study, management strategies were used where 100% patients received analgesics, dietary modification, and pancreatic enzyme supplementation. Similar management patterns were reported by Kumar *et al.*<sup>32</sup> (2016) and others. Study by Husain SZ *et al.*<sup>34</sup>, Garipey *et al.*<sup>31</sup>, and Morinville *et al.*<sup>33</sup> for pain management in children with CP [Table 6].

**Table 7:** Comparison of conservative management with other studies

Complication	Present study (%)	Choudhary <i>et al.</i> <sup>23</sup> (%)
Calcification	50	71.6
pseudocyst	15	17.1
Ascites	20	9.1

The complications observed in our study included calcification (50%), ascites (20%), and pseudocyst (15%), while in the study by Choudhary *et al.*,<sup>23</sup> complications were observed: calcification (71.6%), pseudocyst (17.1%), and ascites (9.1%) [Table 7].

**Table 8:** Comparison of management

Parameter	Present study (%)	Morinville <i>et al.</i> <sup>33</sup> (%)
Surgical intervention	15	39
ERCP	0	62
Ascites	20	9.1

In our study, endoscopic procedure use in the management of CP (0%), pigtail insertion (5%), and surgical intervention was done in (15%), and the rest were managed conservatively in the study by Morinville *et al.*<sup>33</sup> for endoscopic and surgical

management of CP [Table 8].

### Study limitation

This study has several limitations that must be acknowledged. Firstly, the relatively small sample size of 20 patients limits the generalizability of the findings. A larger cohort would provide more robust data and allow for more comprehensive statistical analysis. Secondly, this study was conducted at a single tertiary care center, which may limit the applicability of the results to other settings, particularly in regions with different healthcare resources and practices.

Another limitation is the lack of genetic testing, which could provide insights into the hereditary factors contributing to CP. Additionally, the absence of a control group prevents a direct comparison with other populations, such as those with acute pancreatitis or other gastrointestinal conditions, which could help delineate the specific characteristics of CP.

The study also lacked long-term follow-up data, which is crucial in chronic conditions like pancreatitis to assess outcomes such as the progression of the disease, long-term complications, and the effectiveness of different management strategies. Finally, the limited use of advanced imaging modalities, such as endoscopic ultrasound (EUS), genetic study, and ERCP, in all patients may have led to an underestimation of certain etiological factors and complications.

### Study strengths

Despite its limitations, this study has several strengths. The comprehensive analysis of multiple clinical parameters, including laboratory and imaging findings, management modalities, and complications, allows for a holistic understanding of the disease's presentation and progression. The study's findings also highlight the importance of a multidisciplinary approach to managing CP, which includes medical, nutritional, and surgical interventions. Additionally, the use of correlation analysis provides valuable information on the relationships between clinical symptoms, etiological factors, and complications, which can guide future research and clinical practice.

### CONCLUSION

CP is a known entity in the paediatric age group of patients. In the present study, 20 patients with CP were studied. Among 20 patients, males (70%) were more commonly affected than females (30%). The mean age of presentation was 12.4 years. Abdominal pain was present in all of the patients (100%), 12 patients (60%) had weight loss, 11 patients (55%) had nausea/vomiting, five patients (25%) had fever, and three patients (15%) had jaundice. 60% of patients had elevated serum lipase levels, and 45% had elevated serum amylase levels. All

patients (100%) had positive USG findings, and CECT(A+P) was done in 8 patients (40% of patients). All eight patients (100%) had positive CT findings, and MRCP was done in 6 patients (30% of patients); all six patients (100%) had positive MRCP findings. Out of 20 patients, four patients (20%) had blunt trauma, two patients (10%) had cholelithiasis, two patients (10%) had mumps infection, one patient (5%) had pancreatic divisum, and one patient (5%) had choledochal cyst as an etiological factor. Out of 20 patients, 10 patients (50%) had no identifiable cause and were classified as idiopathic etiology [as a genetic study was not done in this study]. All patients were receiving dietary modifications, analgesics, and pancreatic enzyme supplementation. Among 20 patients, only three patients (15%) were managed with surgical intervention [cystogastrostomy, Frey's procedure, Puestow procedure], 01 patients managed with pigtail insertion. While the rest of the patients were managed conservatively.

**Author contributions:** KC: Contributed to study design, data collection, analysis, and manuscript preparation; RM and HC: Assisted in data analysis and manuscript drafting; NP and RG: Contributed to patient management and data interpretation. DK and PD: Provided critical review and final approval of the manuscript.

**Ethical approval:** The research/study was approved by the Institutional Review Board at B.J. Medical College, Ahmedabad, number 139/2024, dated 05/08/2024.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent.

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**Use of artificial intelligence (AI)-assisted technology for manuscript preparation:** The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

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