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RESEARCH ARTICLE

The Role of Anatomical Features and Variations of the Pancreaticobiliary Junction in the Etiology of Acute Biliary Pancreatitis

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ABSTRACT

Objective: Gallstone disease is among the most common known causes of acute pancreatitis. In our study, we examined the role of the length-diameter of the choledochus, the Wirsung diameter and the angle of the choledochal-Wirsung junction, which may cause obstruction in the etiology of acute pancreatitis. We aimed to recommend prophylactic cholecystectomy for asymptomatic patients whose anatomical features may affect acute attacks and to prevent attacks.

Materials and Methods: Patients who were diagnosed with uncomplicated cholelithiasis and patients who were diagnosed with acute biliary pancreatitis and admitted to our clinic between January 2019 and August 2022 were retrospectively examined. Conservative follow-up of patients with uncomplicated cholelithiasis continued. Patients with acute biliary pancreatitis were treated with treatments recommended by current guidelines. In the MRCP imaging performed in our hospital, the length-diameter, Wirsung diameter and junction angle with the common bile duct were measured and compared by a single radiologist.

Results: A total of 149 patients were included in the study. Among the groups, the age of the control group was found to be significantly lower ($p<0.001$). There was no significant difference between the groups in terms of common bile duct diameter or Wirsung diameter. Although the common bile duct length parameter was found to be high in patients with acute pancreatitis ($p=0.013$), the common bile duct-Wirsung junction angle was significantly lower ($p=0.036$).

Conclusion: In our study, a high Choledoc length increased the risk of acute biliary pancreatitis, and a low angle between the Choledoc and Wirsung increased the risk of acute biliary pancreatitis.

Keywords: Acute pancreatitis, Choledoc diameter, Choledoc length, Choledoc-Wirsung junction angle, pancreaticobiliary junction, Wirsung diameter

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INTRODUCTION

Acute pancreatitis is a disease that starts acutely in the pancreas and is accompanied by local and systemic complications. Its annual incidence in the United States (USA) ranges from approximately 4.9 to 35 cases per 100,000 people. [1] Although its clinical course varies, it can be fatal despite multidisciplinary treatment approaches.

Although many factors are implicated in the etiology of pancreatitis, the underlying mechanism remains unclear. Commonly accepted causes include obstruction, gallstones, alcohol use, hypertriglyceridemia, and trauma. The most common cause among these factors is obstruction, which can result from periampullary region tumors, external pressure, the hypertensive sphincter of Oddi, and gallstones,

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accounting for 40–70% of cases.[2] However, it causes acute pancreatitis in only 3–7% of people with cholelithiasis.[3]

Two mechanisms are responsible for initiating biliary pancreatitis. First, gallstones cause edema in the ampulla during their passage from the Choledoch to the duodenum, creating an obstruction. The second way is the obstruction of the ampulla by the stones themselves. As a result of both types of obstruction, inflammation begins in the pancreatic gland.[4]

Many studies on the etiology of acute biliary pancreatitis are available, but studies involving the anatomical features of the biliary tract and pancreaticobiliary junction are rare.[5–9] The authors, who examined the role of the Wirsung diameter and the angle between the choledochal and Wirsung in the formation of obstruction and acute biliary pancreatitis, believe that anatomical features may affect the etiology.[5–9]

There are no studies in the literature that included the effect of the diameter and length of the Choledoch on the etiology. We aimed to predict beforehand that the Wirsung diameter, the angle between Koledoch and Wirsung, and the diameter and length of the Choledoch increase the risk of pancreatitis attack.

MATERIALS and METHODS

Patient Population

Patients who presented to a tertiary care training clinic with a complaint of nonspecific abdominal pain or biliary colic between January 2019 and August 2022 and whose gallbladder stones were detected by imaging (Group 1) and who were diagnosed with acute biliary pancreatitis for the first time (Group 2) were included.

Patients who were under the age of 18 years, who were admitted to any clinic due to acute cholecystitis, acute cholangitis or recurrent biliary pancreatitis, who had undergone cholecystectomy, who had choledocholithiasis, those with a known or previous history of abdominal malignancy, and who had a pancreatic pseudocyst were excluded from the study.

Acute biliary pancreatitis was diagnosed among patients with characteristic symptoms, those with amylase and lipase levels 3 times or more above the upper limit, and those with characteristic acute pancreatitis findings on computed tomography (CT) or magnetic resonance imaging (MRI).

Ethical approval for the study was granted by the hospital in which the procedures were performed (IRB No: KAEK/2021.10.263). The study was conducted by all the authors in accordance with the Declaration of Helsinki.

Data Collection, Measurement and Interpretation

The demographic data (age, sex, BMI), comorbidities, and laboratory data (CRP, leukocyte, amylase, lipase, BUN, creatinine, AST, ALT, GGT, sodium, potassium, calcium, and total/direct bilirubin values) of the patients in Group 1 at the time of admission to the outpatient clinic and during hospitalization in Group 2 were recorded.

MRCP was performed with a Siemens Aera 48-channel 1.5 Tesla magnetic resonance device in the radiology department. Choledoch length (Fig. 1) and diameter (Fig. 2), the Wirsung-Choledoch junction angle (Fig. 3) and the Wirsung diameter at this junction (Fig. 4) were measured by a single radiologist on MRCP. Channel lengths and diameters were calculated in "mm", and Wirsung-Choledoch junction angles were measured in degrees "°".

Choledoch diameter and length, Wirsung diameter, Wirsung and Choledoch junction angle values obtained by MRCP, demographic data of patients (such as age, sex, BMI, and comorbidities) and laboratory values were compared between groups.

Statistical Analysis

For the statistical methods, the frequency and percentage for categorical variables, the mean and standard deviation for normally distributed continuous variables, and the median, range and IQR for nonnormally distributed continuous variables were calculated. The normality of the variables was checked with the Shapiro-Wilk test. The Mann-Whitney U test was used for comparisons between independent groups of continuous variables that did not show normal a distribution. The chi-square test was used to compare categorical variables between groups. All analyses were performed with the Social Science Statistical Package 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA), and results with a $p<0.05$ were considered significant.

RESULTS

Demographic Data

A total of 149 patients, 68 (45.6%) in Group 1 and 81 (54.4%) in Group 2, were included in the study. In the entire study group, 104 (69.8%) patients were female and 45 (30.2%) were male.

The median age of Group 1 was 45.5 (19–80, IQR: 25), and the median age of Group 2 was 59 (24–96, IQR: 27.5). There was a significant difference in age between the groups ($p<0.001$). A comparison of demographic data and additional diseases between groups is given in Table 1.

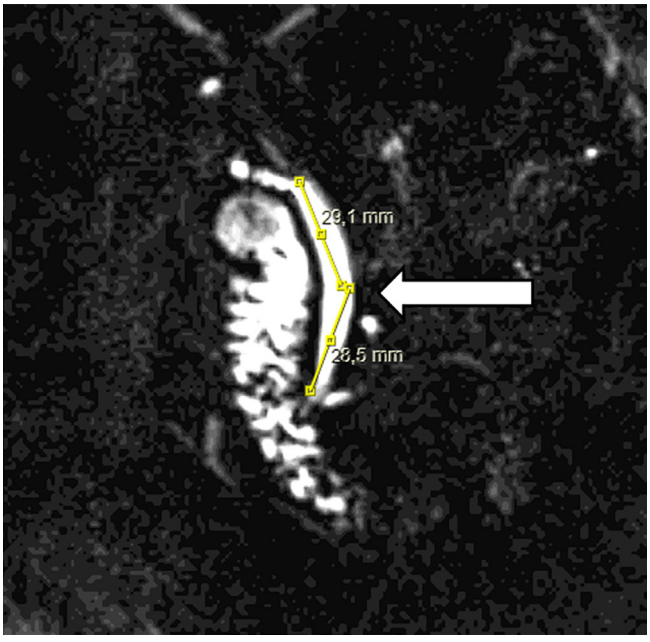

Figure 1. Choledoch length measurement

University of Health Sciences, Kanuni Sultan Suleyman Training and Research Hospital, General Surgery Clinic Archive – MRCP Imaging

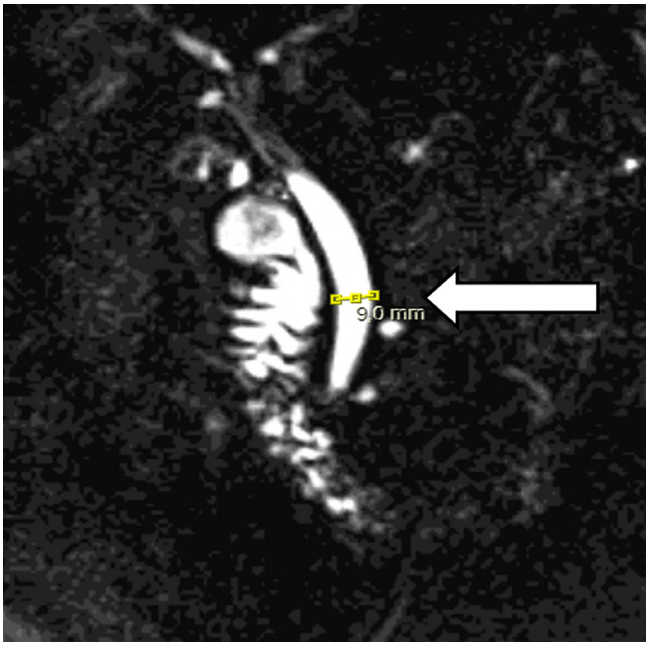

Figure 2. Choledoch diameter measurement

University of Health Sciences, Kanuni Sultan Suleyman Training and Research Hospital, General Surgery Clinic Archive – MRCP Imaging

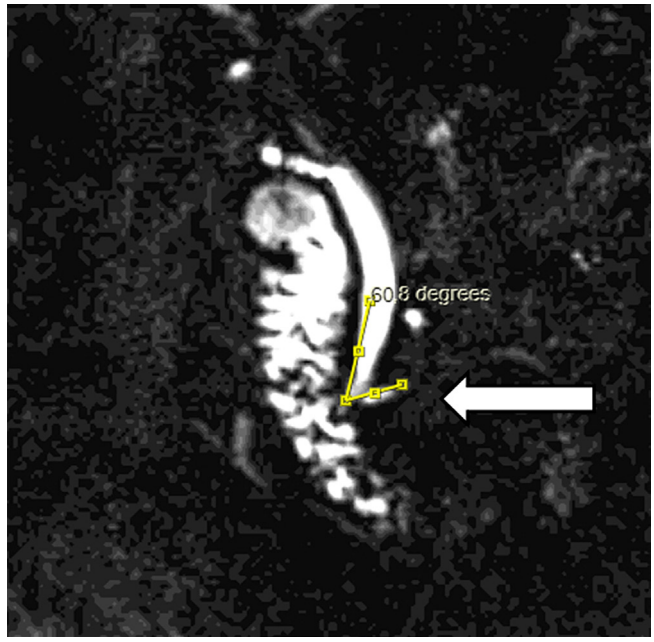

Figure 3. Choledoch-Wirsung junction angle measurement

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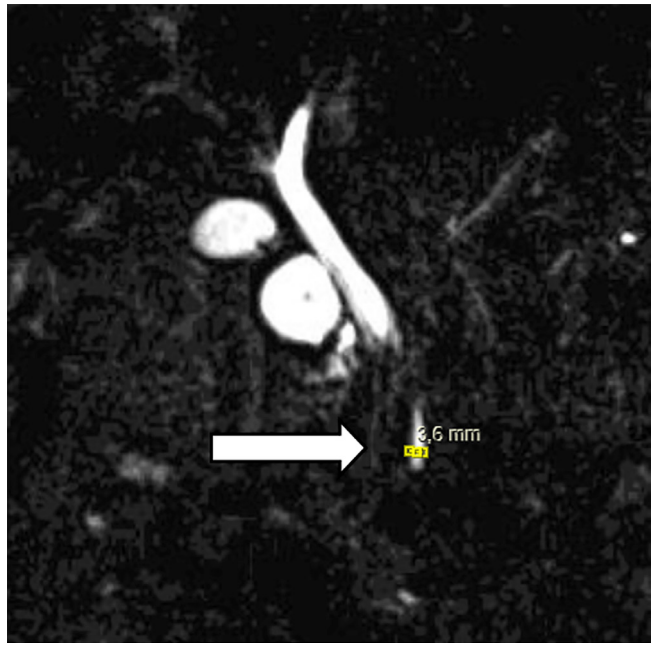

Figure 4. Wirsung diameter measurement

University of Health Sciences, Kanuni Sultan Suleyman Training and Research Hospital, General Surgery Clinic Archive – MRCP Imaging

Table 1. Comparison of demographic data between groups

	Group 1		Group 2		p
	n	%	n	%	
Age (year)[a]	45.5 (19–80)		59 (24–96)		<0.001
BMI (kg/m^2)[a]	27.39 (22.34–40.48)		27.54 (15.05–49.60)		0.628
Sex[b]					
Female	47	69.1	57	70.4	0.868
Male	21	30.9	24	29.6	
Co-morbidities[b]					
No	39	57.4	39	48.1	0.532
<2	12	17.6	17	21	
≥2	17	25	25	30.9	

[a]: Mann-Whitney U Test; [b]: Chi-Squae. Continuous variables that did not show a normal distribution are expressed as medians (min-max), and categorical variables are expressed as n (%)

MRI Measurements

The median Choledoch length of the study group was 48 (27–85) mm (IQR: 14), the median Choledoch diameter was 6.8 (2.6–16) mm (IQR: 3.35), the median Wirsung diameter was 2.7 (1.1–5.3) mm (IQR: 1.3), the median Choledoch-Wirsung junction angle was 32 (16–66.3) degrees (IQR: 13.45) (Table 2).

Comparison of MRI Data between Group 1 and Group 2

The median Choledoch diameter was 6.2 (2.7–16) mm in Group 1 (IQR: 3.38), 7.1 (2.6–11) mm in Group 2 (IQR: 3.05), and the median Wirsung diameter was 2.7 (1.1–5.30) mm in Group 1 (IQR: 1.35), while in Group 2, it was 2.7 (1.1–4.90) mm (IQR: 1.25). There was no significant difference between the groups in terms of the Choledoch and Wirsung diameters.

The median choledochal length was 44 (27–85) mm (IQR: 15) in Group 1 and 49 (30–74) mm (IQR: 13) in Group 2. There was a significant difference between the groups in terms of choledoch length (p=0.013). It was found to be significantly greater in group 2.

The median Choledoch-Wirsung junction angle was 32.5 (20–66.30) (IQR: 13.60) in Group 1 and 30.3 (16–57.90) (IQR:11.55) in Group 2. There was a significant difference between the groups for the angle parameter (p=0.036). It was significantly greater in Group 1 (Table 3).

Table 2. Anatomical measurement parameters of patients

	Median (min-max)	IQR
Choledoch length (mm)[a]	48 (27–85)	14
Choledoch diameter (mm)[a]	6.8 (2.6–16)	3.35
Wirsung diameter (mm)[a]	2.7 (1.1–5.3)	1.3
Koledok-Wirsung junction angle (°)[a]	32 (16–66.3)	13.45

[a]: Mann-Whitney U Test. IQR: Interquartile range

DISCUSSION

Many studies in the literature have investigated the etiology of acute biliary pancreatitis. Most of these studies consist of studies on gallstones or obstructions in the periampullary region. In addition, studies evaluating the effect of the anatomical features of the bile ducts and pancreatic ducts on obstruction are very rare. For this reason, we first examined the biliary anatomy and characteristics of the patients in our study.

Table 3. Comparison of anatomical parameters

	Group 1	Group 2	p
Choledoch length (mm)[a]	44 (27–85)	49 (30–74)	0.013
Choledoch diameter (mm)[a]	6.2 (2.7–16)	7.1 (2.6–11)	0.267
Wirsung diameter (mm)[a]	2.7 (1.1–5.3)	2.7 (1.1–4.9)	0.951
Koledok-Wirsung junction angle (°)[a]	32.5 (20–66.30)	30.3 (16–57.9)	0.036

[a]: Mann-Whitney U Test. Continuous variables that were not normally distributed are expressed as medians (min-max)

MRCP, which allows the pancreatobiliary junction to be evaluated clearly, is a versatile and noninvasive imaging technique.[10] In a study by Shingh et al.,[11] MRCP was more sensitive than abdominal USG, with a rate of 80.77% versus 100%, respectively, in the diagnosis of benign biliary diseases. In another study, the sensitivity rate of MRCP was 85–100% in the evaluation of the pancreatic ductal system.[12] In our study, we used MRCP to investigate the anatomical features of Choledoch and Wirsung.

In a retrospective study by Sherifi et al.,[5] the anatomical features of the pancreaticobiliary junction and the frequency of its variations, were examined, and the mean Choledoc-Wirsung junction angle was calculated to be 35.6° (SD±21.1°). They calculated the Choledoc-Wirsung junction angle according to age and sex but found that there was no statistically significant difference.

Liu et al.[6] similarly evaluated the Choledoc-Wirsung junction angle in the etiology of acute pancreatitis. They did not find a significant difference in the angle measured according to the joint type, but they found that the angle in the pancreatitis attack group was greater than that in the control group (51.45°±13.51° vs. 65.76°±15.61°). In light of this study, they mentioned that as the resultant angle increases, the sphincter may not work properly, the reflux flow into the pancreatic duct may increase, and therefore, the risk of pancreatitis may increase.

We found that the Choledoc-Wirsung junction angle was significantly greater in the control group than in the acute biliary pancreatitis group. In contrast to the findings of previous studies, this study suggested that as the junction angle decreases, stones and edema may facilitate obstruction via a valve mechanism and increase the risk of pancreatitis attack. Again, according to the same result, pancreatic secretion through the Wirsung canal may cause stasis in the Wirsung canal, as the flow of the Choledoc may be difficult in people with small confluence angles.

Aljiffry et al.[7] calculated the mean pancreatic duct diameter in acute pancreatitis patients and found it to be 2.22±1.5 mm (range: 0.5–13 mm), but they did not evaluate it in terms of acute pancreatitis etiology.

Pascual et al.[8] reported that the pancreatic duct had a normal diameter on MRCP in patients with acute pancreatitis. Similarly, Peng et al.[9] measured the diameters of the pancreatic duct in different parts, such as the head, body and tail. They found no significant difference between the acute pancreatitis and control groups in terms of the diameter of the middle part of the pancreatic duct. In the same study, they classified patients with pancreatitis according to the APACHE II and MRSI scoring systems and did not find a significant difference between them in terms of pancreatic duct diameter. We found the median Wirsung value to be 2.7 (1.1–5.3) mm. There was no statistically significant difference in the Wirsung diameter between patients with acute pancreatitis and those in the control group. This finding was consistent with the literature.

Although there are many studies on the etiology of pancreatitis in the literature, the effect of the diameter and length of the Choledoch on the etiology has not been investigated. In our study, we found the median diameter of the Choledoch to be 6.8 (2.6–16) mm. We found that the choledochal diameter in patients with acute pancreatitis was not significantly different from that in controls.

We found that the median choledochal length was 48 (27–85) mm, and the choledochal length was significantly greater in patients with acute pancreatitis than in controls. It is known that in the etiology of pancreatitis, calculus causes pancreatitis through obstruction or edema. We believe that in patients with longer choledochal lengths, a longer duration of stone or sludge falling from the gallbladder to the choledochal canal may trigger both etiological effects.

CONCLUSION

The results of our study suggest that a long Choledochal length and small Wirsung-Choledoch junction angle may be effective in determining the etiology of acute biliary pancreatitis.

Disclosures

Ethics Committee Approval: The study was approved by the University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital Clinical Research Ethics Committee (No: 2021.10.263, Date: 13/10/2021).

Authorship Contributions: Concept: C.Ö., S.Y., E.B., M.A.B.; Design: C.Ö., S.Y., M.A.B., E.B., H.B., S.S., E.S., A.K.; Supervision: C.Ö., S.Y., M.A.B., E.B., H.B., S.S., E.S., A.K.; Data Collection or Processing: C.Ö., E.B., H.B., M.A.B., E.S.; Analysis or Interpretation: S.Y., M.A.B., S.S.; Literature Search: C.Ö., S.Y., M.A.B., E.B., H.B., S.S., E.S., A.K.; Writing: C.Ö., S.Y., M.A.B., E.B., H.B., S.S., E.S., A.K.; Critical review: C.Ö., S.Y., M.A.B., E.B., H.B., S.S., E.S., A.K.

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