

Morphological Characteristics of the Duodenal Papilla and its Association with Complications Post-Endoscopic Retrograde Cholangiopancreatography (ERCP) in a Peruvian Hospital

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OPEN ACCESS

Citation:

Quiroga-Purizaca WG, Paucar-Aguilar DR, Barrientos-Pérez JA, Vargas-Blacido DA. Morphological Characteristics of the Duodenal Papilla and its Association with Complications Post-Endoscopic Retrograde Cholangiopancreatography (ERCP) in a Peruvian Hospital. *Rev Colomb Gastroenterol*. 2022;37(3):296-301. <https://doi.org/10.22516/25007440.859>

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Received: 10/12/2021

Accepted: 08/02/2022



Abstract

Introduction: several risk factors exist for complications post-endoscopic retrograde cholangiopancreatography (ERCP), and the morphology of the duodenal papilla is among those recently studied. **Objectives:** to evaluate the association between the morphological characteristics of the duodenal papilla and post-ERCP complications in patients seen in the gastroenterology unit of a Peruvian referral hospital. **Methods:** a prospective and analytical study including 138 patients who underwent ERCP, establishing a relationship between the type of duodenal papilla according to the endoscopic classification proposed by Haraldsson *et al.* and post-ERCP complications for up to 1 month of follow-up. **Results:** one hundred thirty-eight patients were included, 93 were females (68.42%), and 45 were males (31.58%), with 51.46 years of mean age. Type 1 was associated with less difficulty in cannulation, with an *odds ratio* (OR): 0.42 (confidence interval [CI]: 0.20–0.88). Type 4 had a significantly longer cannulation time (6.83 minutes). The post-ERCP ratio for pancreatitis was 2.9%; bleeding, 1.45%, and perforation, 0.72%. The perforation showed a statistically significant association with papilla type ($p = 0.009$). Type 2 showed higher rates of pancreatitis (9.09%) and post-ERCP perforation (9.09%). **Conclusion:** the duodenal papilla type is significantly associated with post-ERCP perforation. Type 2 showed higher complication rates.

Keywords

Endoscopic retrograde cholangiopancreatography, ampulla of Vater, adverse effects, endoscopy.

INTRODUCTION

Since the late 1960s, endoscopic retrograde cholangiopancreatography (ERCP) has been described as a new technique for diagnosing biliopancreatic diseases⁽¹⁾. A few years later, papillary sphincterotomy was described for bile tract lithotripsy removal^(2,3), specifying this procedure's diagnostic and therapeutic nature.

Although this endoscopic procedure is currently widely used to treat multiple pathologies such as choledocholithiasis or benign and malignant biliary stenosis, complications are not excluded, occurring in up to 15% of the procedures⁽⁴⁾ –post-ERCP pancreatitis is one of the most frequent complications.

There are multiple risk factors for each complication. However, a failed or difficult biliary cannulation is a com-

mon factor for these adverse events⁽⁵⁾ and is also closely related to the anatomy of the duodenal papilla.

Several duodenal papilla classification systems have been proposed over the past decade. These systems have been used to predict cannulation success, complication rates, and the need for more advanced access techniques^(6,7). However, so far, only the Haraldsson *et al* classification system (**Figure 1**), which classifies the duodenal papilla into 4 types, has been subjected to an intra- and inter-observer discordance study⁽⁸⁾, thanks to its simple classification scheme that admits within its types a wide variety of duodenal papilla presentation. Thus, any papilla can be categorized based on this classification. Additionally, this system is useful for predicting difficult biliary cannulation for experienced endoscopists and beginners, as it shows that types 2 and 3 papilla are the most difficult to cannulate⁽⁹⁾.

The European Society of Gastrointestinal Endoscopy (ESGE) defines *difficult cannulation* when one or more of

the following criteria is present: more than 5 contacts with the papilla while attempting to cannulate it, more than 5 minutes spent attempting to cannulate it after localizing the papilla, and more than one pancreatic duct involuntary cannulation or opacification⁽¹⁰⁾.

This study aims to identify the relationship between the morphological characteristics of the duodenal papilla – according to the Haraldsson *et al* classification system and post-ERCP complications in patients treated in a gastroenterology unit of a referral hospital in Lima.

MATERIALS AND METHODS

A prospective and analytical study that included 138 patients who underwent ERCP at Hospital Guillermo Almenara Irigoyen in Lima, Perú, a referral hospital where approximately 500 ERCPs are performed per year, according to the system registry. This was a convenience sam-

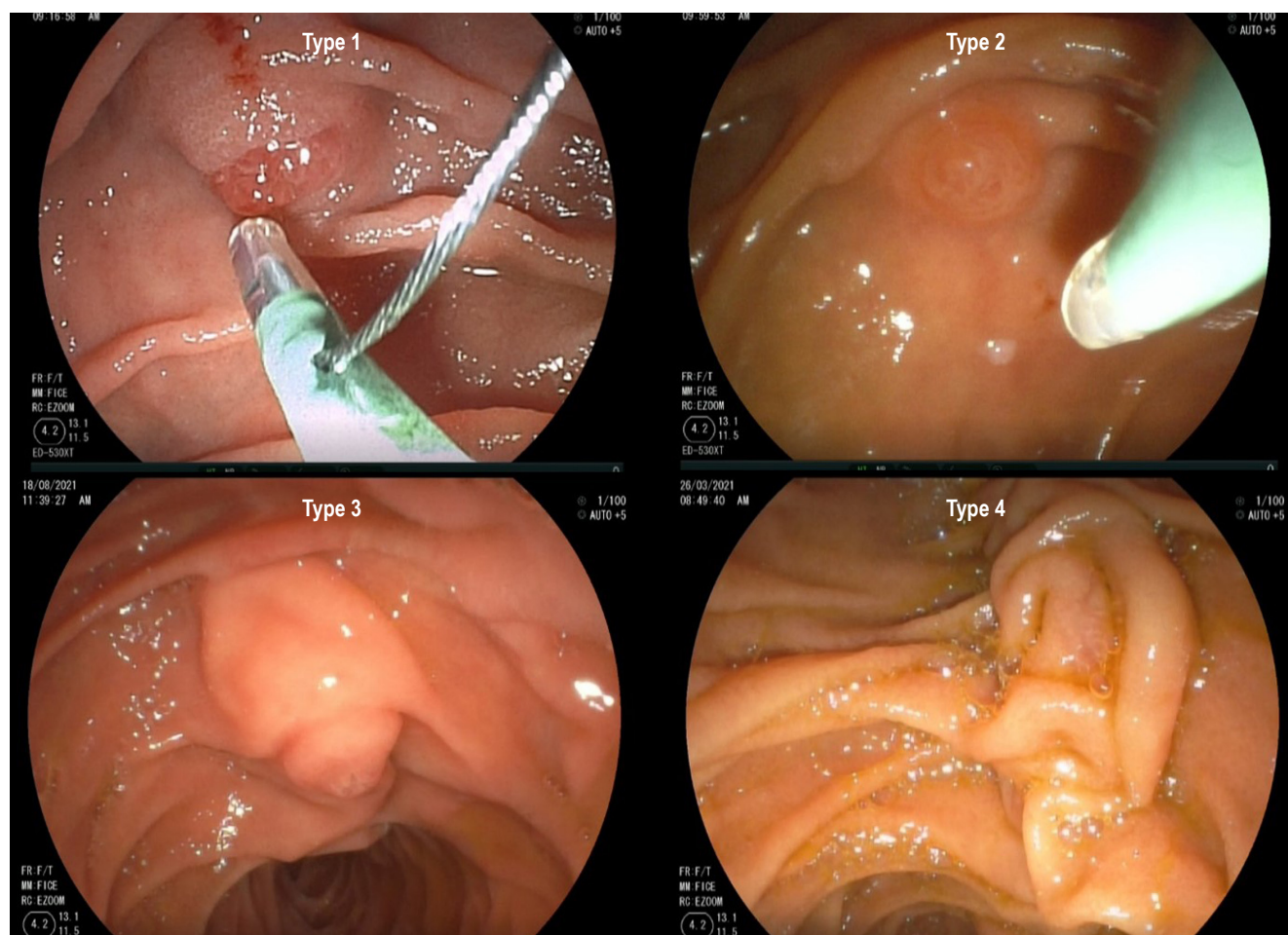


Figure 1. Types of duodenal papilla⁽⁸⁾. Type 1: “regular” appearance, without specific distinctive characteristics. Type 2: flat, with a diameter \leq 3 mm. Type 3: protruded, pendulous, with prominent infundibulum. Type 4: ridged or “creased”. Adapted from: Haraldsson et al. United Eur Gastroenterology J. 2017;5(4):504–10. Including images from the research group.

pling. Patients who signed informed consent and agreed to be part of the study were involved until the sample size was completed. On the other hand, patients with ERCP and previous sphincterotomy, with anatomy altered by previous gastroduodenal surgery, periampullary neoplasia, and pregnant women were excluded. Endoscopic and clinical data were collected for statistical analysis using central and association tendency measures such as odds ratio (OR), with a 95% confidence interval (CI). The association between the variables was measured with the Chi-square test, and a $p < 0.05$ value was considered statistically significant.

The equipment used was Olympus® and Pentax® video duodenoscopes. The materials for cannulation were Endo-flex® sphincterotomes, Endo-flex®, and Endo-med® balloons and extraction baskets. The x-ray equipment was a C-Arc from General Electric®, and the electrosurgical equipment was from ERBE®.

The patients signed an informed consent form in compliance with the ethical principle of autonomy. All procedures included clear therapeutic medical instructions in compliance with the non-maleficence principle. A local ethics committee approved the study.

RESULTS

Of the 138 patients, 93 (68.42%) were females, and 45 (31.58%) were males. The mean age was 51.46 years (95%CI: 48.78–54.14). The most frequent type of papilla was type 1 with 81 patients (58.7%), followed by type 3 papilla in 40 patients (28.9%), and type 4 papilla was the least common, with 6 patients (4.35%). Type 4 papilla

required, on average, a longer cannulation time (6.83 min), while type 1 papilla required a shorter cannulation time (2.93 min). Although these results were not statistically significant, no differences were found in cannulation attempts and unintended passage to the pancreatic duct between the different types of duodenal papillae.

A statistically significant relationship was found between papilla type and precut performance ($p = 0.0001$). Precutting was performed in 18 patients (13.04%) and was more frequent in type 4 papilla (33% of the cases of this type of papilla) and type 3 (30% of the cases). The analysis of each type of papilla showed that type 1 had an OR = 0.11 (CI: 0.03–0.39); type 2, an OR = 0.65 (CI: 0.08–5.38); type 3, an OR = 6.57 (CI: 2.26–19.11), and type 4, an OR = 3.63 (CI: 0.61–21.41) (Table 1).

Type 1 duodenal papilla was associated with less difficulty during cannulation (OR = 0.42; $p = 0.02$) compared to the other types and was statistically significant. The other types of papillae showed more difficulties during cannulation. Overall, no association was found between papilla type and difficult cannulation ($p = 0.123$) (Table 2).

The overall rate of post-ERCP pancreatitis in our study was 2.9%. In the analysis for each type of papilla, type 1 showed an OR = 0.23 (0.02–2.22); type 2, an OR = 4.43 (0.39–43.48), and type 3, an OR = 2.53 (0.34–18.59) for post-ERCP pancreatitis, although no statistical significance was obtained ($p = 0.376$).

The bleeding rate was 1.45%, and the perforation rate was 0.72%. Type 2 reported a higher complication rate with 9.09% of pancreatitis and 9.09% perforation. In the general analysis, perforation presented a statistically significant

Table 1. Characteristics of the population according to the type of duodenal papilla

Characteristics		Type of papilla				p value
		Type 1	Type 2	Type 3	Type 4	
Median age (years) (95% CI)		52,89 (49,42-56,36)	53,68 (44,17-63,19)	48,11 (43,04-53,18)	50,5 (38,18-62,82)	0,4615
Gender	Female, n (%)	53 (65,43 %)	7 (63,64 %)	30 (75 %)	3 (50 %)	0.554
	Male, n (%)	28 (34,57 %)	4 (36,36 %)	10 (25 %)	3 (50 %)	
Average cannulation time (minutes)		2,93	3	3,67	6,83	0,1202
Average cannulation attempts		2,94	3,18	3,33	3,83	0,3955
More than 1 passage to the duct of Wirsung		9 (11,11 %)	0 (0 %)	5 (12,5 %)	1 (16,67 %)	0,645
Precut, n (%)		3 (3,7 %)	1 (9,09 %)	12 (30 %)	2 (33,33 %)	0,0001
Total, n (%)		81 (58,7 %)	11 (8,05 %)	40 (28,9 %)	6 (4,35 %)	

CI: confidence interval.

association with papilla type ($p = 0.009$). Still, the risk for each type could not be determined due to the lack of events in some types of papillae (Table 3).

DISCUSSION

Findings showed that the duodenal papilla type is significantly associated with post-ERCP perforation. Type 2 showed higher rates of pancreatitis (9.09%) and post-ERCP perforation (9.09%). There was an association between the type of duodenal papilla and precutting, and it is more likely to be performed in types 3 (OR = 6.57) and 4 (OR = 3.63).

Over the last few years, several studies have been published comparing different difficulty levels of biliary cannulation according to the duodenal papilla morphology^(17,19,20). However, these studies differ in the type of classification. They are based on different parameters such as the Viana classification, which divides the type of papilla according to the parameter combinations such as the papilla shape, the oral segment protrusion of the papilla, the number of transverse folds, and the presence of a diverticulum⁽⁷⁾. Other studies classify the type of papilla according to the oral protrusion and papilla pattern⁽¹¹⁾. Moreover, other simpler and more classic studies, such as Canard's classification⁽¹²⁾ and according to the primary characteristic of the duodenal papilla (large, small, and protruded)⁽⁶⁾, are different from the classification proposed by Haraldsson *et al* which is the only one that has undergone a discordance intra- and inter-observatories study so far.

A retrospective study published in China in 2020 reveals that type 2 and 3 papillae require more time for cannulation and have a higher failed cannulation rate (12% and 11.1%, respectively) compared to type 1 and type 4 papillae (1.7% and 6.25%)⁽¹³⁾. Conversely, our results show that the types of papillae requiring more cannulation time were type 4 (6.83 minutes) and type 3 (3.67 minutes), although it was not statistically significant.

In 2019, Haraldsson *et al* found that type 2 and 3 papillae were more difficult to cannulate (OR = 1.89 and 1.61, respectively) compared to type 1 and 4 papillae. In addition, the median cannulation time was significantly longer for type 2 papilla (269 seconds) and type 3 papilla (245 seconds), both with a $p < 0.05$ value, compared to type 1 papilla (139 seconds)⁽⁹⁾. In Canada, a retrospective study was conducted using the Haraldsson classification and found that the OR for difficult cannulation was higher for type 2 (AOR = 3.73; 95%CI: 1.28–10.84) and type 3b (AOR = 3.97; 95%CI: 1.76 to 8.99). Additionally, these types were associated with post-ERCP pancreatitis (AOR = 7.28 and 4.25, respectively)⁽¹⁴⁾, unlike our study, which found that only type 1 papilla was less difficult to cannulate (OR = 0.42). However, we found no association between the type of papilla and difficult cannulation. Meanwhile, the average cannulation times shown in our study were higher, especially for type 4. We found no association between the type of papilla and post-ERCP pancreatitis.

On the one hand, the overall post-ERCP adverse events rate was higher in type 2 papilla (18.18%), while no adverse events were observed in type 4 papilla in our study, contrary to what Balan *et al* presented, they obtained a significantly higher rate for patients with type 4 papilla⁽¹²⁾. Conversely, in his multicenter study, Canena concluded no significant difference in the adverse events rate between the different papilla types. However, they used a different classification system⁽⁷⁾.

Pancreatitis was the most frequent adverse event, with a higher rate in type 2 papilla (9.09%). This finding was similar to what Chen *et al* found. Their study showed that type 2 papilla had the highest percentage of post-ERCP pancreatitis (20% compared to 6.78% for type 1; 1.59% for type 3, and 6.25% for type 4; $p = 0.020$)⁽¹³⁾. In 2019, Haraldsson *et al* also reported a higher rate of pancreatitis for type 2 papilla (9.4%), but with no significant differences compared to the other papillae⁽⁹⁾. In turn, Mohamed *et al* used Haraldsson's classification with a modification: they divided type 3 papilla into 3a (protruding or bul-

Table 2. Papilla type and difficult cannulation

Papilla Type	Difficult cannulation		OR (95%CI)	p = 0,123
	Yes	No		
1	19 (23,46 %)	62 (76,54 %)	0,42 (0,20-0,88)	0,02
2	4 (36,36 %)	7 (63,64 %)	1,29 (0,36-4,66)	0,698
3	17 (42,5 %)	23 (57,5 %)	2,05 (0,95-4,42)	0,066
4	3 (50 %)	3 (50 %)	2,3 (0,44-11,89)	0,308

CI: confidence interval; OR: odds ratio.

Table 3. Type of papilla and complications

	Type 1	Type 2	Type 3	Type 4	Total	p value
Pancreatitis	1,23 %	9,09 %	5 %	0 %	2,9 %	0,376
Bleeding	2,47 %	0 %	0 %	0 %	1,45 %	0,699
Perforation	0 %	9,09 %	0 %	0 %	0,72 %	0,009
Total	81	11	40	5	138	

ging) and 3b (pendulous or redundant), and separated papillae associated with periampullary diverticula into type D. For them, pancreatitis was also the most frequent adverse event, it was significantly higher in type 2 and 3 papillae⁽¹⁴⁾. Another study conducted in Shanghai considered 5 types of papillae, where findings showed that pancreatitis was also the most frequent adverse event, showing the highest rate for papillae classified as flat, equivalent to type 2 (6.3%)⁽¹⁶⁾.

Our study did not observe acute cholangitis as a complication, an adverse event reported in other studies with rates between 0.6% and 1.75%^(9,13,15). We found a statistically significant association between papilla type and fistulotomy-like precutting as a rescue technique in case of failed conventional cannulation, and it was more frequent in types 4 (33.33%) and 3 (30%). The cannulation success rate, including fistulotomy, was 100%, similar to that of Wen *et al*, who chose the precut according to the morphologic characteristics of the papilla and the entry into the pancreatic duct. They recommend the fistulotomy for a protruding

papilla (type 3)⁽¹³⁾. Different studies found a 100% cannulation success rate for fistulotomy-type precut^(18,21).

CONCLUSIONS

The duodenal papilla morphology can be classified using the system proposed by Haraldsson *et al*. The duodenal papilla type is associated with post-ERCP perforation. Type 2 papilla has higher rates of pancreatitis and post-ERCP perforation than other types.

The type of papilla is associated with advanced cannulation techniques such as pre-cutting, and types 3 and 4 are more likely to be used. Although, due to the low number of type 4 papillae affecting statistical analysis, these results should be taken with caution.

Conflict of interest and financing

None of the authors have reported any conflict of interest. This research was self-funded.

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Revista colombiana de Gastroenterología
vol. 37, no. 3, p. 296 - 301, 2022
Asociación Colombiana de Gastroenterología,
ISSN: 0120-9957
ISSN-E: 2500-7440

DOI: <https://doi.org/10.22516/25007440.859>