ORIGINAL RESEARCH

Diagnosis and treatment of juxta-ampullary duodenal diverticulum

Chen, Qi¹
Li, Zhaodong²
Li, Shengwei¹
Ding, Xiong¹
Liu, Zuoqing¹
Wu, Chuanxin¹
Gong, Jianping¹
Zuo, Guoqing²

¹ Department of Hepatobiliary Surgery, The Second Affiliated Hospital of Chongqing Medical University, 76 Linjiang Road, Chongqing 400010, P.R. China.

² Department of Digestive Medicine, The Second Affiliated Hospital of Chongqing Medical University, 76 Linjiang Road, Chongqing 400010, P.R. China.

Manuscript submitted 7th April, 2010

Manuscript accepted 3rd August, 2010

Clin Invest Med 2010; 33 (5): E298-E303.

Abstract

Objective: To summarize the diagnosis and treatment of juxta-ampullary duodenal diverticulum (JAD) in our hospital.

Methods: Of 5000 consecutive endoscopic retrograde cholangiopancreatography (ERCP) performed in our department, 225 patients were diagnosed with JAD and treated. All patients were classified based on the location of Ampullae of Vater in relation to the duodenal diverticulum. Of the 225 JAD patients, 96 patients (43%) required surgery.

Results: The 225 patients with JAD were divided into Type A (146 cases, 65%) or Type B (79 cases, 35%). Type A patients presented with papillae near the diverticulum or in its margin. In this type, 36 patients (25%) presented with diverticulitis, bleeding, perforation or cholelithiasis, and were treated surgically. Type B patients presented with papillae inside the diverticulum. Among them, 60 patients (76%) had complications requiring surgery.

Conclusions: JAD can be divided into two types based on location of the papillae. ERCP was the primary method of diagnosing JAD and patients with severe complications required surgical intervention.

List of Abbreviations

JAD	Juxta-ampullary duodenal diverticulum
CBD	Common bile duct
ERCP	endoscopic retrograde cholangiopancreatography

Juxta-ampullary duodenal diverticulum (JAD) is commonly observed in clinical practice. The diagnosis of JAD has increased in recent years due to the use of endoscopic retrograde cholangiopancreatography (ERCP).^{1,2} In this study, 225 patients with JAD were diagnosed and treated in our hospital over the course of 27 years.

Materials and Methods

Patients

Of 5000 patients examined via ERCP in our hospital between January 1981 and July 2008, JAD was diagnosed in 225 patients: 74 males and 151 females (1:2 ratio), with an average age of 56 years old (range 18-78).

*Retrospective analysis of the clinical data**Types of diverticulum*

In the 225 cases, JAD was classified into juxtapapillary diverticulum (Type A) and intradiverticular papilla (Type B) based on the anatomic location between the diverticulum and the duodenal papilla. In Type A (146 cases, 65%), the papilla were located near the diverticulum or its margin. Type A cases were further subdivided, based on size and location of papillary. Of the 146 Type A cases, 50 exhibited papilla with an average distance of 0.6 cm from the diverticulum (range 0.4-1.1 cm) and diameter of 2.5 cm (range 1.1-4.3 cm). Twenty-five of these 50 patients displayed complications such as diverticulitis, bleeding, perforation, and paradiverticular abscess due to chymous retention, and 23 patients were treated surgically (23/50=46%). The other 96 Type A cases had papilla located less than 0.4 cm from the diverticular margin. These patients also had monodiverticulum but the average diameter of the diverticulum was 1.3 cm. Under these conditions the retention of chyme was rare and most patients did not present with any clinical symptoms. Only 14 displayed complications such as cholelithiasis and 13 of them received surgical therapy (13/96=14%).

In Type B (79 cases, 35%), the ampulla opened into the diverticulum. Patients with Type B had monodiverticulum as well, and the average diverticular diameter was about 2.1 cm (range 1.5-3.6 centimeters). Cholelithiasis, retrograde cholangitis or pancreatitis was obviously observed in 62 cases, of which 60 patients underwent surgery (60/79=76%).

Surgery: criteria and description

Of the 146 patients with Type A, 36 cases (25%) were treated surgically, including simple diverticulectomy or diverticula raphy (21 cases), cholecystectomy and/or choledocholithotomy with diverticulectomy (12 cases), subtotal gastrectomy with Billroth II gastroje-

junostomy (3 cases). Of the 79 patients with Type B, 60 cases (76%) underwent surgery, including cholecystectomy and/or choledocholithotomy with partial diverticulectomy and/or diverticula raphy (23 cases), simple cholecystectomy and/or choledocholithotomy (22 cases), choledochotransection with Roux-en-Y choledochojejunostomy (10 cases), endoscopic sphincterotomy (EST, 5 cases). The following are criteria for surgery for JAD:³⁻⁵

1. Frequent symptom such as abdominal pain that is not relieved after conservative treatment;
2. Recurrent cholangitis or pancreatitis;
3. JAD accompanied by cholecystolithiasis and/or choledocholithiasis;
4. JAD accompanied by complications such as bleeding, perforation, or paradiverticular abscess;
5. The diameter of JAD > 2 cm and the JAD compresses the bile or pancreatic duct;
6. The size of JAD is enlarged and there is an incomplete/complete duodenal obstruction;
7. JAD is accompanied by an unknown mass.

Evaluation of the standards for JAD treatment

Three standards/levels are commonly used for assessing patients' recovery from JAD. The first level, "Ideal", was used to describe patients who displayed no further clinical symptoms. The second level, "Reasonable", was used to describe patients who presented with symptoms that were relieved after symptomatic treatments. The third level, "Poor", was used to describe patients who presented with symptoms, such as abdominal pain or jaundice, that required further surgery.

Results*Complications and pathological characteristics of JAD*

At our institution, we treated 146 patients presented with juxtapapillary diverticulum. Patients presented

TABLE 1. Classifications, complications and pathological characteristics of JAD

Types	Description	Complications and pathological characteristics
A (n=146)	Papilla located near the diverticulum, or its margin	Formed diverticulitis, bleeding, perforation, paradiverticular abscess (27 cases, 19%); gallstones and/or CBD stones (15 cases, 10%)
B (n=79)	Ampulla opened into the diverticulum	Influence the function of sphincter of Oddi, formed retrograde cholangitis, pancreatitis, gallstones and/or CBD stones (62 cases, 79%), or stenosing papillitis (5 cases, 6%)

with severe diverticulitis (11 cases), bleeding (9 cases), perforation (4 cases), paradiverticular abscess (3 cases), gallstones and/or common bile duct (CBD) stones (15 cases), and other complications (4 cases). In the 79 patients presented with Intradiverticular papilla type, 62 cases had accompanied gallstones and/or CBD stones with cholangitis, in which 12 cases with chronic pancreatitis, and 5 cases with stenosing papillitis. (Table 1)

Clinical manifestations of JAD

Most patients treated for JAD did not exhibit the specific symptoms typically associated with this disease. Instead, the patients presented with right-upper-abdominal pain (33%), jaundice (30%), acute cholangitis (15%), acute pancreatitis (8%) and other forms such as haemorrhage of the upper alimentary tract (15%).

Follow-up study

The median follow-up for all the 225 patients treated for JAD was 5 years (range: 3 months-20 years). Of the 146 juxtapapillary diverticulum, 84 patients were considered to be in good condition, 43 patients to be in reasonable conditions, and 19 patients to be less than ideal condition. Of the 36 cases who had received surgery, 32 patients (89%) had a favorable recovery in comparison with the 19 patients that did not agree to surgical operations. For the 75 patients with intradiverticulum papillae, 45 patients received surgery and had favorable outcome, 29 patients were in reasonable conditions, and 5 patients were less than ideal. Among the 45 patients treated surgically, those who had

cholecystectomy and/or choledocholithotomy with (partial) diverticulectomy or diverticulorrhaphy showed the best recovery, while those who received choledochojejunostomy or EST showed good recovery. Patients who had a simple cholecystectomy and/or choledocholithotomy had reasonable outcomes, and the 5 patients who did not agree to surgery showed poor prognosis.

Discussion

Diagnosis and classification of JAD

ERCP is commonly used to diagnose JAD. Prior to the 1970s, JAD was diagnosed coincidentally during Barium Meal or surgery, and the discovery rate was low (estimated at less than 1%). After the 1970s, the widespread use of ERCP led to increased diagnosis of JAD. Previous studies showed a high prevalence of JAD (1.83% to 32.8%).^{1,2,6-14} In our study, 225 patients were diagnosis with JAD after the use of ERCP. We report a prevalence of 4.5% that is consistent with previous reports. Other effective means for the diagnosis of JAD include CT and MRI (MRCP). Franzen¹⁵ reported that JAD can be occasionally diagnosed using a contrast-enhanced CT scan. Balci¹⁶ reported JAD could be observed by CT or MRI when filled with gas or a combination of fluid and gas. Macari¹⁷ reported that radiologists may interpret a fluid-filled JAD observed by CT or MRI as a cystic pancreatic tumor. Mazziotti¹⁸ presented two patients with initial MRCP findings suggesting cystic pancreatic lesions, but oral administrations of a superparamagnetic iron oxide contrast agent allowed for correct diagnosis of JAD. CT or MRI examination are effec-

tive methods for the diagnosis of JAD that reveal essential information such as size, amount of JAD, and the anatomic relationship to the papilla. Patients suffering from recurrent cholangitis or pancreatitis without a cause, and persistent abdominal pain caused by biliopancreatic disease after surgery should consider an ERCP examination for suspicion of JAD. If an ERCP is not available, CT or MRI examination, hypotonic duodenography or a Barium Meal for alimentary tract can be used for JAD diagnosis. In addition, these examination procedures should be performed for JAD diagnosis if patients are presented with severe cardiopulmonary or renal dysfunction, acute pancreatitis or acute aggravation of chronic pancreatitis, severe biliary infections or allergic reactions to iodine agents.

Currently, there is not a standard for classifying the different types of JAD. Chandy¹⁹ classified JAD into three different types: inside (also known as intradiverticulum papilla type), in the margin of, and near the diverticulum. This classification is generally accepted; however, Greene²⁰ suggested that intradiverticulum papillae should be categorized as a third type of Congenital Cyst of Bile Duct. We classified JAD into Juxtapapillary diverticulum type A and Intradiverticular papilla type B, based on the anatomic location between the diverticulum and the papilla, the clinical manifestations and the pathological characteristics. This classification system also has certain guiding significance for therapy. For instance, Juxtapapillary diverticulum, especially when the papilla is near the diverticulum, presents with a widened bottom but a stenosing opening. Complications such as diverticulitis, bleeding, and perforation can occur readily, because of the chymous retention, and requires diverticulectomy or diverticulerhaphy. When the ampulla is located near the diverticular margin, patients usually show no clinical manifestation due to the lack of retention. Therefore, no special management is needed. In comparison, patients with Intradiverticular papilla type require special management because of retrograde cholangitis, pancreatitis, gallstones and/or CBD stones.

Relationships between biliary diseases and JAD

It is generally accepted that biliary diseases may be associated with JAD. Panteris²¹ showed there was a strong correlation between diverticulum and choledocholithiasis. Additionally, Chandy¹⁹ observed JAD in 794 cases with choletithiasis, about 44 patients with primary choledocholithiasis, 70% of whom had accompanied JAD. This correlation was not observed in the remaining 750 patients, with cholecystolithiasis combined with choledocholithiasis, where the incidence of JAD was 25%. Their studies have also showed the incidence of choletithiasis was highly correlative to the size of JAD. Egawa¹² showed the high incidence of cholecystolithiasis (73.3%) when the diameter of the diverticulum was above 2 centimeters in JAD patients. Our study further revealed that the formation of cholelithiasis was more frequent in the Intradiverticulum papilla type of JAD. In our study analyzing 225 JAD patients, 77 patients presented with cholelithiasis (34%). In 79 patients with Intradiverticulum type, 62 patients had accompanied cholecystolithiasis and/or choledocholithiasis (79%). We speculate that JAD may be associated with incidences of choletithiasis or biliary disease by one or more of several mechanisms. First, Intradiverticulum papilla type of JAD could affect sphincter of Oddi function. This may lead to reflux formation in the ductus hepatobiliaropancreaticus and cause biliopancreatic disease. Using biliary manometry, the muscular tone and contractions of the sphincter have shown to be decreased in JAD patients,²² and this may be attributed to the sustained mechanical compression of the lower CBD by a distended JAD, suggesting there may be a possibility of JAD reflux.^{11,22,23} Second, biliary infection may be associated with JAD especially in the Intradiverticulum papilla type. Endotoxins such as lipopolysaccharide have been shown to activate β -glucuronidase to induce biliary pigmentation that can lead to bile pigment stones.²⁴ Osnes²⁵ found that the level of lipopolysaccharide in JAD patients was higher than in the control group. This indicates that

lipopolysaccharide is an important factor for β -glucuronidase activation and bile pigment stone formation. Chandy¹⁹ suggested that JAD is correlated with choletithiasis incidence because of the retention and infection of the bile duct. Third, stenosing papillitis induced by JAD could affect the spontaneous process of removing stones through the ampulla.

Treatment strategies

We believe treatment strategies should be planned according to the types, clinical presentations and complications of JAD. For Juxtapapillary diverticulum type, most patients (75%) did not show any obviously clinical manifestations. This group of patients needed no surgery, but simply conservative management. Patients presenting with JAD accompanied with severe complications such as retention, cholelithiasis, bleeding, or perforation were recommended for surgical treatment (25%). Diverticulectomy or Diverticula Rhaphy is necessary, but cholecystectomy and/or Choledocholithotomy should be performed to remove the stones. There is a high injury risk to the bile duct, pancreatic duct, or the duodenum when resecting the diverticulum because of the complicated papillary anatomic structure or bad adhesion. Therefore, avoiding any injuries to the biliopancreatic duct or the duodenum during surgeries may be difficult. For such cases, partial gastrectomy and gastrojejunostomy should be considered to reduce complications caused by retention. This strategy may increase the chances of a favorable outcome. Aggressive surgery is needed for patients exhibiting Intradiverticulum type because of cholecystolithiasis and/or choledocholithiasis associated with biliopancreatic diseases (76%). Patients with these conditions are more difficult to treat surgically than those with Juxtapapillary diverticulum type. Therefore, performing Simple Diverticulectomy or Diverticulerhaphy is essential, and Cholecystectomy and/or Choledocholithotomy may be necessary as well. Choledochotranssection with Roux-en-Y choledochojejunostomy may be required if there is grave

bile duct reflux or a narrow opening of the papilla. Combined diverticulo-sphincteroplasty may also be used to treat these conditions. Combined diverticulo-sphincteroplasty is performed using an inverted V pattern excision between the opening of the ampulla and the opening of the diverticulum. The procedure is safe and effective for treating JAD since stenosing of the ampulla is released which prevents chymous retention. In our study, endoscopic sphincterotomy (EST) is effective for treating elderly patients or those with choledocholithiasis accompanied with mild papilla stenosing. Besides the traditional open surgery treatment of JAD, favorable outcomes may also be achieved using nonoperative or endoscopic treatment,^{26,27} and laparoscopic diverticulectomy surgery.²⁸⁻³⁰

References

1. Fogel EL, Sherman S, Lehman GA. Increased selective biliary cannulation rates in the setting of periampullary diverticula: main pancreatic duct stent placement followed by pre-cut biliary sphincterotomy. *Gastrointest Endosc.* 1998;47(5):396-400.
2. Novacek G, Walgram M, Bauer P, Schofl R, Gangl A, Pötzi R. The relationship between juxtapapillary duodenal diverticula and biliary stone disease. *Eur J Gastroenterol Hepatol.* 1997;9(4):375-9.
3. Ferri L, Feldman L. Obstructing duodenal diverticula. *J Am Coll Surg.* 2002;195(6):888-9.
4. Yin WY, Chen HT, Huang SM, Lin HH, Chang TM. Clinical analysis and literature review of massive duodenal diverticular bleeding. *World J Surg.* 2001;25(7):848-55.
5. Harthun NL, Morse JH, Shaffer HA Jr, Minasi JS. Duodenal obstruction caused by intraluminal duodenal diverticulum and annular pancreas in an adult. *Gastrointest Endosc.* 2002;55(7):940-3.
6. Tyagi P, Sharma P, Sharma BC, Puri AS. Periampullary diverticula and technical success of endoscopic retrograde cholangiopancreatography. *Surg Endosc.* 2009;23(6):1342-5.
7. Boix J, Lorenzo-Zuniga V, Ananos F, Domenech E, Morillas RM, Gassull MA. Impact of periampullary duodenal diverticula at endoscopic retrograde cholangiopancreatography: a proposed classification of periampullary duodenal diverticula. *Surg Laparosc Endosc Percutan Tech.* 2006;16(4):208-11.

8. Tham TC, Kelly M. Association of periampullary duodenal diverticula with bile duct stones and with technical success of endoscopic retrograde cholangiopancreatography. *Endoscopy*. 2004;36(12):1050-3.
9. Rajnakova A, Goh PM, Ngoi SS, Lim SG. ERCP in patients with periampullary diverticulum. *Hepatogastroenterology*. 2003;50(51):625-8.
10. Zoepf T, Zoepf DS, Arnold JC, Benz C, Riemann JF. The relationship between juxtapapillary duodenal diverticula and disorders of the biliopancreatic system: analysis of 350 patients. *Gastrointest Endosc*. 2001;54(1):56-61.
11. Lobo DN, Balfour TW, Iftikhar SY. Periampullary diverticula: consequences of failed ERCP. *Ann R Coll Surg Engl*. 1998;80(5):326-31.
12. Egawa N, Kamisawa T, Tu Y, Sakaki N, Tsuruta K, Okamoto A. The role of juxtapapillary duodenal diverticulum in the formation of gallbladder stones. *Hepatogastroenterology*. 1998;45(22):917-20.
13. Vaira D, Dowsett JF, Hatfield AR, Cairns SR, Polydorou AA, Cotton PB, Salmon PR, Russell RC. Is duodenal diverticulum a risk factor for sphincterotomy? *Gut*. 1989;30(7):939-42.
14. Chang-Chien CS. Do juxtapapillary diverticula of the duodenum interfere with cannulation at endoscopic retrograde cholangiopancreatography? A prospective study. *Gastrointest Endosc*. 1987; 33(4):298-300.
15. Franzen D, Gurtler T, Metzger U. Solitary duodenal diverticulum with enterolith as a rare cause of acute abdomen. *Swiss Surg*. 2002;8(6):277-9.
16. Balci NC, Akinci A, Akun E, Klor HU. Juxtapapillary diverticulum: findings on CT and MRI. *Clin Imaging*. 2003;27(2):82-8.
17. Macari M, Lazarus D, Israel G, Megibow A. Duodenal diverticula mimicking cystic neoplasms of the pancreas: CT and MR imaging findings in seven patients. *AJR Am J Roentgenol*. 2003;180(1):195-9.
18. Mazziotti S, Costa C, Ascenti G, Gaeta M, Pandolfo A, Blandino A. MR cholangiopancreatography diagnosis of juxtapapillary duodenal diverticulum simulating a cystic lesion of the pancreas: usefulness of an oral negative contrast agent. *AJR Am J Roentgenol*. 2005;185(2):432-5.
19. Chandy G, Hart WJ, Roberts-Thomson IC. An analysis of the relationship between bile duct stones and periampullary duodenal diverticula. *J Gastroenterol Hepatol*. 1997;12(1): 29-33.
20. Greene FL, Brown JJ, Rubinstein P, Anderson MC. Choledochocoele and recurrent pancreatitis, diagnosis and surgical management. *Am J Surg*. 1985;149(2):306-9.
21. Panteris V, Vezakis A, Filippou G, Filippou D, Karamanolis D, Rizos S. Influence of juxtapapillary diverticula on the success or difficulty of cannulation and complication rate. *Gastrointest Endosc*. 2008;68(5):903-10.
22. Tomita R, Tanjoh K. Endoscopic manometry of the sphincter of Oddi in patients with Lemmel's syndrome. *Surg Today*. 1998;28(3):258-61.
23. Sugiyama M, Atomi Y. Periampullary diverticula cause pancreatobiliary reflux. *Scand J Gastroenterol*. 2001;36(9):994-7.
24. Echenique-Elizondo M. Juxta-ampullary intraluminal diverticulum and acute pancreatitis. *JOP*. 2004;5(3):148-50.
25. Osnes T, Sandstad O, Skar V, Osnes M. Lipopolysaccharides and beta-glucuronidase activity in choledochal bile in relation to choledocholithiasis. *Digestion*. 1997;58(5):437-43.
26. Lee SH, Park SH, Lee JH, Park DH, Chung IK, Kim SJ, Kim HC. Endoscopic diverticulotomy with an isolated-tip papillotome (Iso-Tome) in a patient with intraluminal duodenal diverticulum. *Gastrointest Endosc*. 2005;62(5):817-9.
27. Eeckhout G, Vanstiphout J, Van Pottelbergh I, Leyman P, Vandervoort J, De Man M, Van der Spek P, Lepoutre L. Endoscopic treatment of a perforated duodenal diverticulum. *Endoscopy*. 2000;32(12):991-3.
28. Graur F, Bala O, Bodea R, Geczi-Toth I, Vlad L, Iancu C. Laparoscopic resection of duodenal diverticulum, a case report. *Rom J Gastroenterol*. 2005;14(4):405-8.
29. Tagaya N, Shimoda M, Hamada K, Ishikawa K, Kogure H. Laparoscopic duodenal diverticulectomy. *Surg Endosc*. 2000;14(6):592.
30. Coelho JC, Sousa GS, Salvalaggio PR. Laparoscopic treatment of duodenal diverticulum. *Surg Laparosc Endosc*. 1999;9(1):74-7.

Correspondence to:

Zuo Guoqing, MD, Prof.
 Digestive Department,
 The Second Affiliated Hospital of Chongqing Medical University,
 76 Linjiang Road, Chongqing 400010, P.R. China.
 Phone: +86-23-13508309327
 Fax: +86-23-63693015, 63832133
 E-mail: cqzgqly@163.com