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# Pancreaticoduodenectomy following gastrectomy reconstructed with Billroth II or Roux-en-Y method: Case series and literature review



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## ABSTRACT

**INTRODUCTION:** The ideal reconstruction method for pancreaticoduodenectomy following a gastrectomy with Billroth II or Roux-en-Y reconstruction is unclear. **Methods:** We reviewed a series of seven pancreaticoduodenectomies performed after gastrectomy with the Billroth II or Roux-en-Y method. **Results:** While preserving the existing gastrojejunostomy or esophagojejunostomy, pancreaticojejunostomy and hepaticojejunostomy were performed by the Roux-en-Y method using a new Roux limb in all cases. Four patients experienced postoperative complications, although the specific complications varied.

**DISCUSSION:** A review of the literature revealed 13 cases of pancreaticoduodenectomy following gastrectomy with Billroth II or Roux-en-Y reconstruction. Three patients out of six (50%) in whom the past afferent limb was used for the reconstruction of the pancreaticojejunostomy and hepaticojejunostomy experienced afferent loop syndrome, while 14 previous and current patients in whom a new jejeunal limb was used did not experience this complication.

**CONCLUSION:** The Roux-en-Y method, using the distal intestine of previous gastrojejunostomy or jejunostomy as a new jejeunal limb for pancreaticojejunostomy and hepaticojejunostomy, may be a better reconstruction method to avoid the complication of afferent loop syndrome after previous gastrectomy with Billroth II or Roux-en-Y reconstruction if the afferent limb is less than 40 cm.

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## 1. Introduction

The present work has been reported in line with the PROCESS criteria [1].

Although the frequency of gastric resection for gastric or duodenal ulcers and gastric cancer is decreasing [2], surgery is an important treatment option for severe ulcer diseases and all stages of gastric cancer. The frequency of pancreaticoduodenectomy (PD) is increasing, along with the rising number of pancreatic or periampullary tumors [2] and the improvement of surgical techniques. Therefore, the likelihood of performing PD in patients who previously underwent gastrectomy will continue to increase. However, PD following gastrectomy is a difficult task, because of adhesions and the varying anatomical structures of the remaining organs. Reconstruction of PD following gastrectomy reconstructed with the Billroth I (B-I) method can be performed similarly to a clas-

sical PD, except for the smaller remnant stomach [3,4]. However, reconstruction of PD after Billroth II (B-II) or Roux-en-Y (R-Y) gastrectomy reconstruction needs special consideration regarding the bloodstream and length of the remnant intestine. This study retrospectively reviews our experience with PD following gastrectomy reconstructed with B-II or R-Y method, as well as perioperative complications.

## 2. Methods

We retrospectively reviewed all patients who had undergone PD between 2005 and 2015 at Kurashiki Central Hospital, in Okayama, Japan. Among 306 patients, 16 patients (5.2%) underwent gastrectomy before PD and seven of these (six males and one female) had their gastrectomy reconstructed with the B-II or R-Y method. We examined PD reconstruction and perioperative complications in this set of patients.

## 3. Results

Patient characteristics, diagnoses for the preceding gastrectomy, indications for PD, and perioperative results are summarized in Table 1. Methods of reconstruction after PD are illustrated in

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**Table 1**  
List of patients who underwent pancreaticoduodenectomy following gastrectomy with Billroth II or Roux-en-Y reconstruction.

case	age	sex	BMI	gastrectomy		pancreaticoduodenectomy								
				diagnosis	surgery	reconstruction	interval(yr)	diagnosis	operation time	blood loss	length*	postoperative hospital stay (days)	complication	prognosis (months)
1	74	M	23.3	gastric ulcer	distal	B-II	36	ca. of duodenal papilla	367	974	50	116	pancreatic fistula	87/alive
2	75	M	23.4	gastric cancer	distal	B-II	15	IPMN	267	349	50	29	wound dehiscence	63/alive
3	77	M	22	duodenal ulcer	distal	B-II	27	pancreatic cancer	267	656	50	71	ileus	17/dead
4	79	M	18.7	gastric ulcer	distal	B-II	45	IPMN	409	701	50	40	pancreatic fistula	13/alive
5	65	M	16.1	gastric cancer	total	R-Y	2	cholangiocancer	359	1028	50	17	none	26/alive
6	82	F	19	gastric cancer	total**	R-Y	4	pancreatic cancer	301	850	50	14	none	12/dead
7	75	M	18.6	gastric cancer	total	R-Y	11	pancreatic cancer	324	1005	60	11	none	2/alive

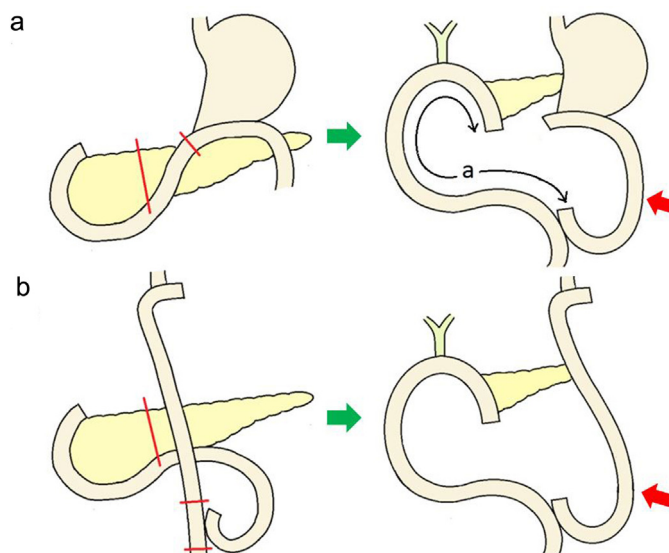
M: male, F: female, distal: distal gastrectomy, total: total gastrectomy, B-II: Billroth II reconstruction, R-Y: Roux-en-Y reconstruction.

IPMN: intraductal papillary mucinous neoplasm.

\*The length of jejunum from pancreaticojejunostomy to jejunojejunostomy.

\*\*Total gastrectomy with splenectomy.

All patients were reconstructed with modified Child method shown in Fig. 1.



**Fig. 1.** Reconstruction of pancreaticoduodenectomy following gastrectomy with a Billroth II or a Roux-en-Y. While preserving the existing gastrojejunostomy or esophagojejunostomy, we used a new Roux limb for pancreaticojejunostomy and cholangiojejunostomy. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)  
Red arrow: previous Roux limb.

**Fig. 1.** The median age of the patients in this case series was 75 years (range 65–82 years). The median BMI was 19.0 (range 16.1–23.4).

The primary indication for gastrectomy was gastric cancer in four, gastric ulcer in two, and duodenal ulcer in one patient. Distal gastrectomy was performed in four patients and all were reconstructed with the B-II method. Three patients underwent total gastrectomy, reconstructed with the R-Y method.

Indications for PD included pancreatic cancer in three, intraductal papillary mucinous neoplasm (IPMN) in two, carcinoma of the duodenal papilla in one, and cholangiocarcinoma in one patient. The interval between the two operations ranged from 2 to 45 years (median 15 years).

Median surgical time for PD was 324 min (range 267–409 min) and intra-operative blood loss was 850 ml (range 349–1028 ml). The Modified Child method was chosen while preserving the existing GJ or EJ, and the R-Y method using a new Roux limb for pancreaticojejunostomy (PJ) and hepaticojejunostomy (HJ) was utilized in all cases. The length of jejunum from PJ to jejunojejunostomy (JJ) (Fig. 1a) was 50 cm in six cases and 60 cm in one case. Postoperative complications greater than Clavien–Dindo classification grade 3 occurred in four patients. Pancreatic fistulae greater than International Study Group of Postoperative Pancreatic Fistula grade B occurred in two patients, wound dehiscence in one patient, and ileus in one patient. Patients with pancreatic fistula were treated with antibiotics and percutaneous drainage. The patient with wound dehiscence needed the resuture at the bed side. The patient with ileus was treated with nasogastric and nasoenteric tubes. They all recovered without relaparotomy and surgical intervention. All patients were discharged and the median length of hospital stay after PD was 29 days (range 11–116 days). Two patients were dead during the follow up time because of the recurrence of the cancer.

#### 4. Discussion

Performing PD in a patient with a history of gastrectomy, especially with the B-II or R-Y method, is a challenging task because of adhesions, varying anatomical structures, atypical vascular patterns, and length of the remnant intestine. We performed seven

PD surgeries under these conditions. Surgical times and estimated blood loss volumes were acceptable in all cases. An average hospital stay of 29 days was also acceptable in Japan because under the Japanese insurance system, patients are generally allowed to stay in the hospital until they can live in their homes without professional support.

In the reconstruction of PD, we utilized the R-Y method using the distal intestine of the past GJ or JJ as a new jejunal limb, avoiding the use of the remnant afferent jejunum. When making a new jejunal limb, ischemia of the jejunum distal to the previous EJ or GJ (Fig. 1, red arrows) must be taken into consideration. Therefore, it is important to preserve at least one jejunal artery to this limb and check the bloodstream by clamping the marginal arteries before resection of the mesentery. Four complications greater than Clavien–Dindo grade 3 occurred, but none of them were related to ischemia of the preserved jejunum.

A PubMed search on May 2016 with the key words “pancreaticoduodenectomy” and “gastrectomy” revealed seven English-language reports [4–10] describing 13 cases of PD following gastrectomy reconstructed with the B-II or R-Y method. These cases are summarized in Table 2. In seven cases, the reconstruction

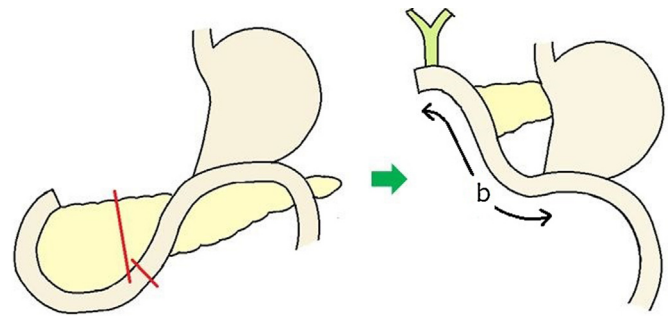


Fig. 2. An example of reconstruction of pancreaticoduodenectomy using the past afferent limb for pancreatic and biliary reconstruction. a: the length of the afferent limb.

of PD was similar to ours, preserving the existing GJ or EJ and performing PJ and HJ by the R-Y type method making a new jejunal limb. In the other six cases, the previous afferent limb was used for pancreatic and biliary reconstruction (Fig. 2). Interestingly, three patients out of six (50%) using the past afferent limb for

**Table 2**  
List of reported patients who underwent pancreaticoduodenectomy following gastrectomy with Billroth II or Roux-en-Y reconstruction.

case	age	sex	gastrectomy			interval(yr)	pancreaticoduodenectomy			length*
			diagnosis	surgery	reconstruction		diagnosis	reconstruction	complication	
1 <sup>(5)</sup>	52	M	duodenal ulcer	distal	B-II	20	cholangiocarcinoma	Whipple	none	N.A
2 <sup>(5)</sup>	44	M	gastric ulcer	distal	B-II	3	islet cell tumor	Whipple	ALS	10
3 <sup>(5)</sup>	77	M	gastric ulcer	distal	B-II	15	islet cell cancer	**	none	N.A
4 <sup>(3)</sup>	69	M	gastric cancer	total	R-Y	3	pancreatic cancer	Whipple	ALS	N.A
5 <sup>(3)</sup>	46	M	gastric ulcer	total	R-Y	1	pancreatic gastrinoma	Whipple	none	N.A
6 <sup>(4)</sup>	71	M	gastric cancer	total	R-Y	10	pancreatic cancer	modified Child	none	N.A
7 <sup>(5)</sup>	68	M	gastric cancer	total	R-Y	4	cholangiocarcinoma	Whipple	none	N.A
8 <sup>(6)</sup>	69	M	gastric cancer	total	R-Y	10	pancreatic cancer	modified Child	ALS	20
9 <sup>(7)</sup>	56	M	gastric cancer	total	B-II	4	pancreatic cancer	N/A	none	N.A
10 <sup>(8)</sup>	75	F	gastric ulcer	distal	B-II	N.A	ca. of duodenal papilla	Child	none	50
11 <sup>(6)</sup>	59	F	duodenal ulcer	distal	B-II	N.A	ca. of duodenal papilla	Child	none	50
12 <sup>(9)</sup>	62	M	gastric cancer	total	R-Y	10	pancreatic cancer	Child	none	40-50
13 <sup>(9)</sup>	68	M	gastric cancer	total	R-Y	12	IPMN	Child	none	40-50

Shaded cases indicate reconstruction using the previous afferent jejunal limb for pancreaticoduodenectomy and cholangiojejunostomy.

M: male, F: female, B-II: Billroth II reconstruction, R-Y: Roux-en-Y reconstruction, ALS: afferent loop syndrome, N/A: not available.

\*Length of the new afferent limb (Fig. 2b) in shaded cases and jejunum from pancreaticojejunostomy to jejuniojejunostomy in nonshaded cases (Fig. 1a).

\*\*Pancreaticojejunostomy using the past afferent limb and cholangiojejunostomy using a new jejunal limb.

the reconstruction of PD experienced afferent loop syndrome (ALS) while another 14 patients, including our patients, did not experience this complication. Afferent loop syndrome mostly develops after B-II reconstruction with gastrectomy [11], but also develops after PD [12]. The etiology of ALS is multifactorial, involving such factors as radiation enteropathy, markedly angulated or fixed afferent limb placement resulting in luminal obstruction, surgical technique, adhesions, and intestinal ischemia [12]. A short afferent limb and obstruction distal to the JJ caused by adhesions have been suggested to cause ALS [4] after PD following gastrectomy reconstructed with the B-II or R-Y method. Although the length of the afferent limb (Fig. 2, b) is not mentioned in all previously reported cases, two out of three ALS cases had only quite short afferent limbs. By using the remaining part of the afferent loop for PJ and HJ, we can reduce the number of intestinal anastomoses. However, when the afferent limb is short, torsion or kinking as a result of adhesion could occur, resulting in a luminal obstruction that can cause ALS. The determination the most appropriate length of afferent limb for PJ and HJ is difficult, but at least 50 cm is necessary, and we should not use the remnant afferent jejunum for the PJ and HJ if it is less than 50 cm, in order to avoid ALS.

## 5. Conclusion

To the best of our knowledge, there have been no previous English reports concerning the reconstruction following PD in patients who have previously undergone distal gastrectomy with Billroth II or Roux-en-Y reconstruction. The Roux-en-Y method, using the distal intestine of previous gastrojejunostomy or jejunojejunostomy as a new jejunal limb for pancreaticojejunostomy and hepaticojejunostomy, may be a better reconstruction method to avoid the complication of afferent loop syndrome for those patients if the afferent limb is less than 50 cm. However, the number of cases is small. Sufficient size study is necessary to establish a standard reconstruction procedure for these conditions.

## Conflict of interest statement

The authors have no conflicts of interest.

## Consent

Written informed consent was obtained from the patient for publication of this case series.

## Authors contributions

Yusuke Kawamoto, Yusuke Ome, Taebum Park, and Kazuyuki Kawamoto performed the operation. Yusuke Kawamoto wrote the manuscript, Yusuke Koda and Kennichi Saga collected the data, while Yusuke Ome and Kazuyuki Kawamoto critically revised it.

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## Ethical approval

Ethical approval not required.

## Registration of research studies

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## Guarantor

Yusuke Kawamoto.

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