

# Ultrasound Observation of Postoperative Changes in the Roux Limb after Roux-en-Y Jejunostomy in Pediatric Patients: a Preliminary Report

Yasuharu OHNO,<sup>1</sup> Junichiro FURUI,<sup>1</sup> Takashi KANEMATSU,<sup>1</sup> Akira HAYASHI,<sup>2</sup> Shoichiro KAMAGATA<sup>2</sup>

<sup>1</sup> Division of Surgery, Nagasaki University Graduate School of Medical Sciences, Nagasaki, Japan

<sup>2</sup> Department of Surgery, Tokyo Metropolitan Kiyose Children's Hospital

The Roux limb is the most commonly used procedure for hepato-biliary surgery in pediatric cases. Notwithstanding, the postoperative status of the limb has not been well described. In this report, our group attempted to observe the Roux limb ultrasonically after performing a Roux-en-Y jejunostomy. Hepatic porto-jejunostomy and hepatico-jejunostomy were performed in 2 patients with biliary atresia and 4 patients with congenital bile duct dilatation, respectively. The Roux limb was observed by real-time ultrasonography from postoperative day (POD) 1 to POD 12. The wall thickness and luminal diameter of the Roux limb were measured, and the movement of the limb was observed. In the 2 hepatic porto-jejunostomy patients, the wall thickness was increased on POD 1 but thereafter improved from PODs 3 to 6. The lumen of the Roux limb was difficult to describe in one of the patients because of an inadequate amount of bile flow. Cooperative peristalsis appeared on PODs 4 to 6 following the commencement of irregular movement from PODs 2 to 3. In the 4 hepatico-jejunostomy patients, the wall thickness was increased by POD 1 but improved from PODs 2 to 6. Cooperative peristalsis appeared on PODs 4 to 5 following the commencement of irregular movement. In conclusion, ultrasound examination is useful for observing the postoperative morphological aspects of the Roux limb.

ACTA MEDICA NAGASAKIENSIA 51: 45 - 49, 2006

**Keywords:** Ultrasound; Roux limb, Roux-en-Y jejunostomy; Hepato-biliary surgery

## Introduction

The Roux limb is the most commonly used procedure for hepatic porto-jejunostomy (HPJ) for biliary atresia (BA) or performing a hepatico-jejunostomy (HJ) for congenital bile duct dilatation (CBD). The postoperative status of the Roux limb is easily influenced by intra-operative manipulation, bile flow and postoperative complications.<sup>1</sup> Notwithstanding, very few reports have described the status of the Roux limb after operations.<sup>1-3</sup> In this study we shed light on this issue by observing the Roux limb ultrasonographically in pediatric cases after performing Roux-en-Y HPJ for BA or HJ for CBD. We herein report our original findings.

## Patients and Methods

Two patients with BA (a 61-day-old girl and a 96-day-old boy) and 4 patients with CBD (a 1-month-old girl, two 3-year-old boys

and an 8-year-old girl) were studied. The diagnoses of BA and CBD were mainly established based on four diagnostic modalities: ultrasound, <sup>99m</sup>Tc-pyridoxyl-5-methyl-triisopropylamide scintigraphy, computed tomography and magnetic resonance cholangiopancreatography. The BA patients underwent Kasai's original HPJ<sup>4</sup> and the CBD patients underwent HJ.<sup>5</sup> The jejunostomy was performed under the following conditions: the jejunum was divided at a point 20 cm from the ligament of Treitz, the length of the Roux limb was 60 cm, the route was retrocolic, and the procedure was performed end-to-side. No serious postoperative complications occurred in any patients.

Real-time ultrasound was performed using either of two systems: an SSD-5000 ultrasound console with a 5.25 MHz convex array or 7.5 MHz linear array transducer (Aloka, Tokyo, Japan), or an SSA-340A ultrasound console with a 3.7-6.0 MHz convex array transducer (Toshiba, Tokyo, Japan). The ultrasound observations were performed at a fixed time once daily for about 15 minutes, and each session was recorded on videotape (SVO-9500MD4, Sony, Tokyo, Japan).

**Address correspondence:** Yasuharu Ohno M.D., Ph.D., Department of Pediatric Surgery, Saitama Medical School Hospital, 38 Morohongo, Moroyama, Iruma, Saitama 350-0495 JAPAN

TEL: +81-(0)49-276-1654, FAX: +81-(0)49-276-1654, E-mail: ohno\_y@saitama-med.ac.jp

Received January 28, 2006; Accepted May 8, 2006

The sequential observation of the Roux limb using ultrasound was begun on POD 1. The probe was positioned at the level of the right or middle epigastric region under sterile conditions to visualize the Roux limb through the liver parenchyma as an acoustic window. The wall thickness (WT) and luminal diameter (LD) of the fixed part of the Roux limb near the hepatic hilum were measured. The movement of the intestinal wall of the Roux limb was also serially examined. The term "cooperative peristalsis" describes the involuntary movements of the intestine in progressive wavelike contractions. "Irregular movements" are movements of the intestinal wall that do not appear to be correlated with each other. The timing of observations was unrestricted during periods of postoperative fasting. If feeding was commenced, the observations were performed before and after meals.

## Results

Figure 1 shows the ultrasonographic appearance of the Roux limb. Table 1 summarizes the postoperative changes in WT, LD and intestinal movements of the Roux limb in every patient. Feeding was commenced from POD 8 in HPJ patients and from PODs 2 to 4 in HJ patients.

In Patient 1 with HPJ, the WT was increased to 4.8 mm on POD 1 and thereafter shrank to less than 2.5 mm by POD 6. The lumen of the Roux limb was difficult to describe, probably due to an inadequate amount of bile flow (Figure 2). Intestinal contents resembling bile juice appeared on POD 3, when the LD was measured at 5.0 mm. Irregular movement of the wall appeared from POD 2 and cooperative peristalsis appeared on POD 6.

In Patient 2 with HPJ, the WT was increased to 4.0 mm on POD 1 and thereafter shrank to less than 2.0 mm by POD 3. The LD increased to 7.1 mm by POD 1 and 10.0 mm by POD 2, then improved somewhat by POD 3. These findings suggested that Patient 2 had experienced postoperative bleeding from the hepatic hilum and melena during the same period (Figure 3). Irregular movement of the wall appeared from POD 3 and cooperative peristalsis appeared from POD 4.

In the four patients undergoing HJ, the WT was increased to 2.1–6.3 mm by POD 1 and thereafter improved from PODs 2 to 6. The LD showed no tendency to converge with the course of time. Irregular movement of the intestinal wall appeared from PODs 1 to 4, then changed to cooperative peristalsis on PODs 4 to 5 and remained active after the start of feeding.

**Table 1.** The postoperative changes in the Roux limb in six patients

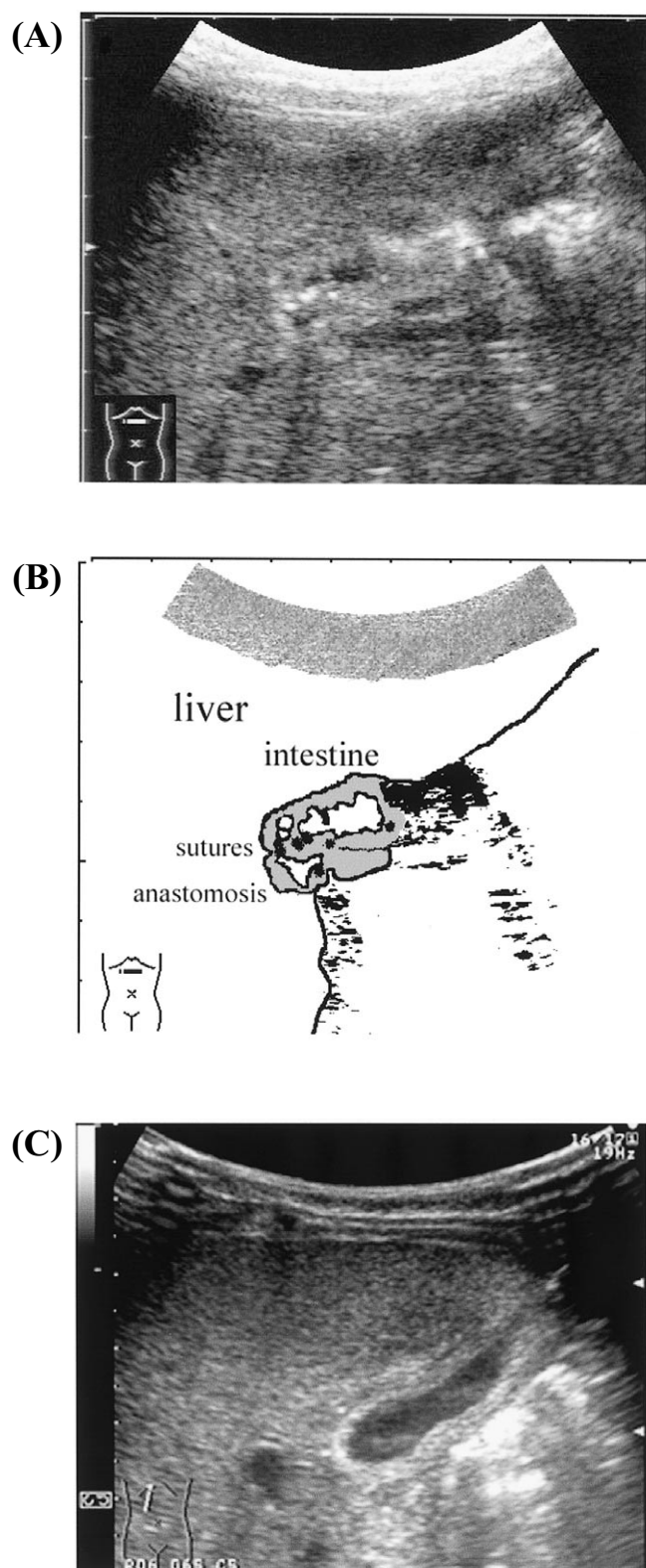
Patients	Operation <sup>a</sup>	Age <sup>b</sup> /Sex <sup>c</sup>	Parameter <sup>d</sup>	Postoperative day (POD)											
				1	2	3	4	5	6	7	8	9	10	11	12
1	HPJ	61D/F	WT (mm)	4.8	4.2	6.3	4.0	3.9	2.2	2.2	2.2	2.2	2.6	1.7	1.7
			LD (mm)	ND	ND	5.0	1.6	1.1	1.9	3.0	2.4	4.3	3.0	0.9	0.9
			Movement	-	±	±	±	±	+	+	+	+	+	+	+
2	HPJ	96D/M	WT (mm)	4.0	2.6	1.7	1.8		1.5	1.4		1.3			1.2
			LD (mm)	7.1	10	4.7	1.8		1.8	3.1		3.9			0.8
			Movement	-	-	±	+		+	+		+			+
3	HJ	1M/F	WT (mm)	2.1	2.0		1.5	1.7		0.9	1.2	1.2			1.6
			LD (mm)	10.6	3.7		6.4	6.4		5.6	6.3	8.0			7.7
			Movement	-	-		+	+		+	+	+			+
4	HJ	3Y/M	WT (mm)		4.3		3.5		2.4	1.8	2.5		3.0	2.9	3.1
			LD (mm)		4.8		2.3		1.8	1.6	1.0		1.4	1.5	1
			Movement	-	+		+		+	+	+		+	+	+
5	HJ	3Y/M	WT (mm)	6.3	3.0	2.4	2.3	3.3		3.0		2.9	3.0		4.0
			LD (mm)	4.0	3.2	4.3	2.4	2.5		3.2		5.6	5.0		5.7
			Movement	-	-	±	+	+		+		+	+		+
6	HJ	8Y/F	WT (mm)	4.1	2.3	2.3	2.0	2.5	2.1	1.6					
			LD (mm)	6.8	7.2	5.3	3.7	3.3	3.8	2.0					
			Movement	±	±	±	±	+	+	+					

<sup>a</sup>HPJ=Hepatic porto-jejunostomy; HJ=Hepatico-jejunostomy.

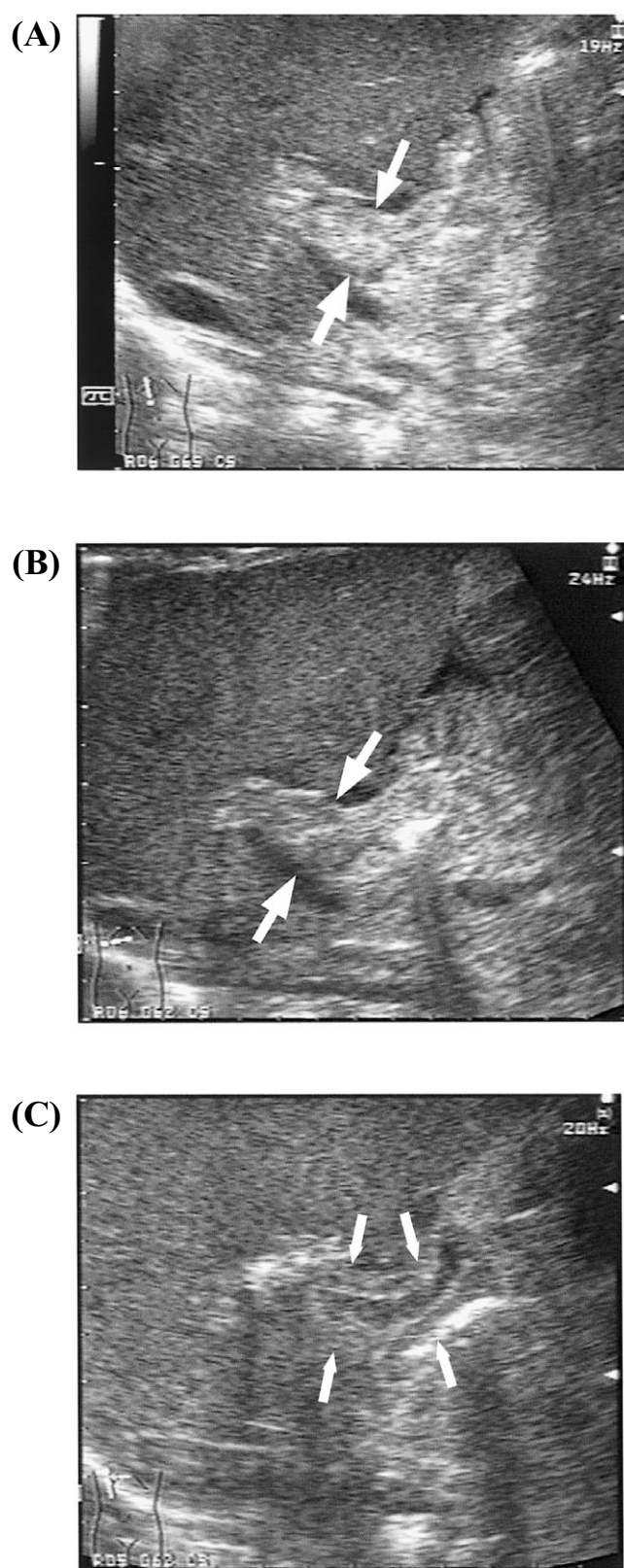
<sup>b</sup>D=Day; M=Month; Y=Year.

<sup>c</sup>F=Female; M=Male.

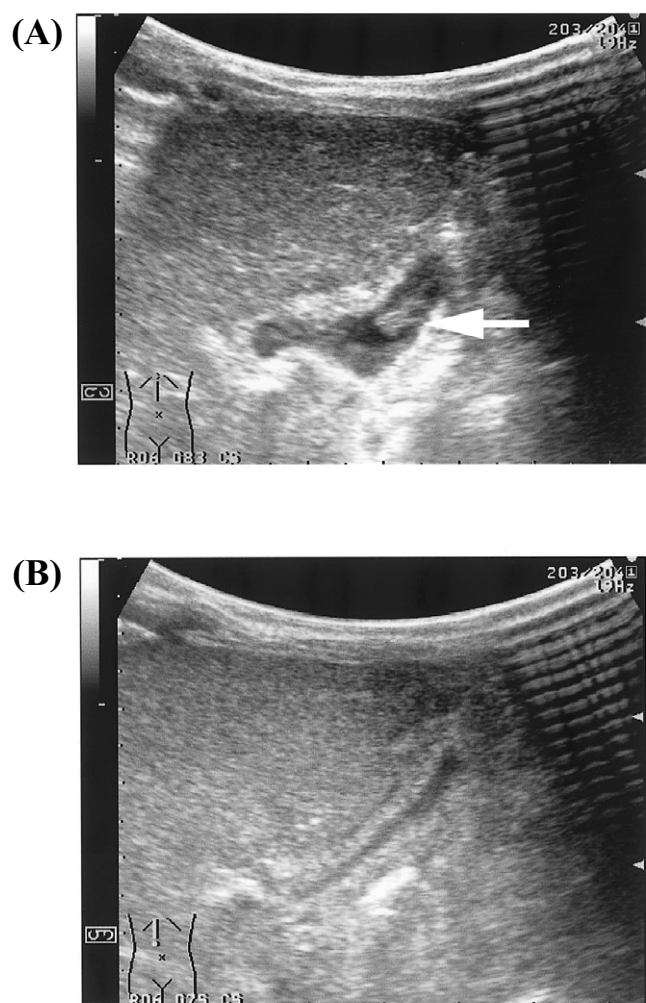
<sup>d</sup>WT=Wall thickness; LD=Luminal diameter; ND=Not detected; -=No movement; ±=Irregular movement; +=Cooperative peristalsis. Empty spaces denote no measurements.



**Figure 1.** The ultrasonographic appearance of the Roux limb. (A) At the anastomosis portion on POD 5 in Patient 4. (B) The schematic presentation of (A). (C) On POD 9 in Patient 3.



**Figure 2.** The ultrasonographic appearance of the postoperative changes in the Roux limb in Patient 1. (A) The lumen of the Roux limb is difficult to describe on POD 2; the arrows indicate the Roux limb near the hepatic hilum. (B) The appearance on POD 4 is similar to that on POD 2. (C) The lumen is well visualized on POD 9.



**Figure 3.** The ultrasonographic appearance of the postoperative changes in the Roux limb in Patient 2. (A) The lumen is dilated on POD 2 and the hyperechoic lesions in the lumen are indicative of blood clotting (arrow). (B) The dilatation of the lumen improves on POD 4.

## Discussion

The walls of the small intestine are hardly visible by ultrasound under normal conditions, chiefly due to the disturbance of the sonographic reflection by endoluminal gas. This is why transabdominal ultrasound examinations of the small intestine have not been introduced as a routine investigative modality. In some pathological conditions, however, transabdominal real-time ultrasound has been proven effective in visualizing various segments of the intestinal loops. The most notable of these conditions are colonic diverticulitis, inflammatory bowel disease and intestinal obstruction.<sup>6-9</sup>

In adult patients, the small bowel has been defined as abnormal when the WT equals or exceeds 3 mm or the LD equals or exceeds 25 mm.<sup>10</sup> Based on ultrasonographic measurements of the small bowel in 128 patients, Haber et al.<sup>11</sup> reported that the WT increased significantly with age, reaching a maximum ileum WT of 1.5 mm in subjects ranging from 10 to 14 years old.

The present report describes the ultrasonographic appearance of the Roux limb after a Roux-en-Y jejunostomy in pediatric patients. The Roux limb could be easily visualized through the hepatic parenchyma as an acoustic window. It thus becomes possible to observe the sequential changes in the WT and LD of the Roux limb after a Roux-en-Y jejunostomy. The authors speculate that the increased WT on PODs 1 to 2 in our patients may indicate postoperative edematous changes in the intestinal wall around the site of anastomosis. We also observed that the increased WT quickly recovered within 2 or 3 days after surgery, suggesting a prompt improvement of the local circulatory disturbance.

The monitoring of the postoperative changes in the intestinal movement was also interesting in this study. We were able to recognize differences between the irregular movements and cooperative peristalsis by real-time ultrasound. In patients with BA, the development of the cooperative peristalsis seemed to be retarded by a small volume of bile flow. The luminal bleeding from the hilum may accelerate the peristalsis, however, as described in Patients 1 and 2. The significance of the LD unfortunately proved difficult to assess, chiefly due to the wide variability in this parameter and lack of any discernable trend over time. We had no concern about the visualizations of the details of the multilayered structure of the intestinal wall in this study.

Various postoperative complications with Roux-en-Y jejunostomy have been reported in the literature, including anastomotic stricture (necessitating reoperative reconstruction),<sup>1</sup> retrograde intussusception of the Roux limb (evading detection and diagnosis up to the point of laparotomy)<sup>12-14</sup> and internal herniation.<sup>15</sup> Patients with postoperative complications generally exhibit morphological changes in the Roux limb. Under the situations of such complications, increasing WT, dilated LD and/or disappearance of cooperative peristalsis may occur.

In conclusions, we propose that our findings would contribute to postoperative management in hepato-biliary surgery. However, since this is only a small, non-randomized preliminary report, a prospective study is called for.

## References

1. Gardikis S, Antypas S, Kambouri K et al. The Roux-en-Y procedure in congenital hepato-biliary disorders. *Rom J Gastroenterol* 14: 135-140, 2005
2. Berrocal T, Fernandez-Zubillaga A, Prieto C, Lemos RR, Santamaria ML. A pictorial review of conventional and new applications of duplex Doppler sonography in the pediatric abdomen. *Curr Probl Diagn Radiol* 32: 11-41, 2003
3. Puylaert JB. Ultrasound of acute GI tract conditions. *Eur Radiol* 11: 1867-1877, 2001
4. Ohi R. Surgery for biliary atresia. *Liver* 21: 175-182, 2001
5. Hara H, Morita S, Ishibashi T, Sako S, Otani M, Tanigawa N. Surgical treatment for congenital biliary dilatation, with or without intrahepatic bile duct dilatation. *Hepatogastroenterology* 48: 638-641, 2001
6. Ripolles T, Agramunt M, Martinez MJ, Costa S, Gomez-Abril SA, Richart J. The role of ultrasound in the diagnosis, management and evolutive prognosis of acute left-sided colonic diverticulitis: a review of 208 patients. *Eur Radiol* 13: 2587-2595, 2003
7. Valette PJ, Rioux M, Pilleul F, Saurin JC, Fouque P, Henry L. Ultrasonography of chronic inflammatory bowel diseases. *Eur Radiol* 11: 1859-1866, 2001
8. Grunshaw ND, Renwick IG, Scarisbrick G, Nasmyth DG. Prospective evaluation

- of ultrasound in distal ileal and colonic obstruction. *Clin Radiol* 55: 356-362, 2000
9. Ogata M, Imai S, Hosotani R, Aoyama H, Hayashi M, Ishikawa T. Abdominal ultrasonography for the diagnosis of strangulation in small bowel obstruction. *Br J Surg* 81: 421-424, 1994
10. Pallotta N, Baccini F, Corazziari E. Contrast ultrasonography of the normal small bowel. *Ultrasound Med Biol* 25: 1335-1340, 1999
11. Haber HP, Stern M. Intestinal ultrasonography in children and young adults: bowel wall thickness is age dependent. *J Ultrasound Med* 19: 315-321, 2000
12. Whipple OC, Stringer EF, Senkowski CK, Hartley M. Retrograde intussusception of the efferent limb after a pancreaticojejunostomy. *Am Surg* 69: 353-355, 2003
13. Ko SF, Shieh CS, Ng SH, Tiao MM, Lee TY, Wan YL. Posttraumatic retrograde jejunojejunal intussusception involving a Roux-en-Y loop. *J Pediatr Gastroenterol Nutr* 29: 604-606, 1999
14. Chen CC, Huang SC, Shieh CS. Retrograde intussusception as a complication of Roux-en-Y anastomosis for choledochal cyst - report of one case. *Zhonghua Min Guo Xiao Er Ke Yi Xue Hui Za Zhi* 35: 546-551, 1994
15. Kawakami M, Mukaiya M, Kimura Y et al. Obstructive jaundice due to internal herniation: a case report and review of the literature. *Hepatogastroenterology* 49: 1030-1032, 2002