

# Laparoscopic Repair of Duodenal Atresia: Revisited

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## Abstract

**Background** Since the initial reports of laparoscopic repair of duodenal atresia in neonates, further reports have been scant. Could this be because of unacceptable rates of complications, like anastomotic leakage, as mentioned in later reports? In the present study the laparoscopic repair of duodenal atresia in neonates is revisited.

**Patients** Group 1 consisted of 22 patients with duodenal obstruction between 2000–2005 until the laparoscopic approach was abandoned. Of these 22 patients, 10 had Down syndrome and 8 had concomitant malformations. In this group 18 patients were operated laparoscopically. Four patients underwent an open procedure. Group 2 consisted of six patients that underwent operation between 2008 and February 2010.

**Results** In group 1 there were four conversions. In 14 patients the procedure could be completed laparoscopically. In five patients postoperative leakage occurred. The complication rate was found to be unacceptably high, and the laparoscopic approach was abandoned. After gaining additional experience in intracorporeal suturing and adjusting the technique, the procedure was started up again in 2008. Since then six consecutive neonates have undergone laparoscopic repair of duodenal atresia without complications.

**Conclusions** Laparoscopic repair of duodenal atresia is one of the most demanding pediatric laparoscopic surgical procedures. After initial promising results at the beginning of the twenty-first century a relative “radio silence” followed, apparently caused by unsatisfactory results. Only considerable adjustments in technique and extensive improvement in

experience has led to acceptable outcomes more recently. Laparoscopic repair of duodenal atresia should therefore be restricted to pediatric centers with extensive experience in laparoscopic surgery and intracorporeal suturing.

## Introduction

The first reports of laparoscopic repair of duodenal atresia date from the beginning of the twenty-first century, when shortly after each other Bax et al. [1], and Rothenberg [2] described their initial experience with the novel procedure. Normally after such publications other reports follow on similar successful techniques and larger series are presented. However, not in this case: a scant case report here and there, but nothing more. Then, in 2007 and 2008 a Kansas group reported first results with an alternative technique using U-clips, because of “unacceptably” high rates of leakage with the original procedure [3, 4].

Because our initial experience with the technique of laparoscopic repair of duodenal atresia was not satisfactory, the laparoscopic approach was discontinued in 2005. Only after gaining considerable experience with intracorporeal suturing and making adjustments to the operative technique we restarted use of the laparoscopic procedure in 2008. In this article we revisit the outcome of laparoscopic repair of duodenal atresia.

## Patients and procedures

### Group 1

Between 2000 and 2005 22 patients with duodenal obstruction underwent operation at the Department of

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Pediatric Surgery, Wilhelmina Children's Hospital. The co-morbidity is listed in Table 1. In 18 patients the procedure was set up as a laparoscopic procedure. The laparoscopic procedure was converted in four patients.

**Table 1** Data in two groups of patients with duodenal atresia

Group 1 2000–2005 (n = 22)	Group 2 2008– February 2010 (n = 6)
<b>Demographics</b>	
Mean age 37 3/7 weeks	Mean age 36 1/7 weeks
Mean birth weight 2,580 g	Mean birth weight 2,895 g
Male/female ratio 13/9	Male/female 4/2
Median age at operation 3.9 days	Median age at operation 3.5 days
<b>Co-morbidity</b>	
10 Down syndrome	1 Down
4 malrotation	2 ASD
2 esophageal atresia (type C)	1 VACTERL
1 esophageal atresia (type A)	1 hypospadias
1 total aganglionic colon	1 Chromosome 2 abn.
1 AVSD	
1 open ductus Botalli	
<b>Operative data</b>	
Mean operative time 3.10	Mean operative time 1.40
Mean time to feeding—all without leak 3.1 days	Mean time to feeding 3.3 days
<b>Conversion</b>	
1 type A esophageal atresia	None
1 associated malrotation	
1 difficulties web	
1 convenience	
<b>Postoperative results</b>	
<b>Complications</b>	
Leakage 5	None
2 combined esophageal/duodenal repair	
1 accidental extubation	
1 10 days postop.	
1 total aganglionic colon	
1 associated malrotation	
1 extra stitch	
<b>Re-operation 1</b>	
1-year old child with Down syndrome and stenosis probably due to cicatrization from electrocautery	None
Mean hospital stay—all without leak 8.2 days	Mean hospital stay 7.6 days

## Group 2

Between 2008 and February 2010 six neonates underwent laparoscopic duodenal atresia repair.

Demographics and co-morbidity are listed in Table 1. There were no conversions. Patients in groups 1 and 2 were comparable for gestational age, birth weight, and sex.

## Operative procedure

### Initial procedure

The procedure began with introduction of a 6 mm trocar through the inferior fold of the umbilicus and insufflation with CO<sub>2</sub> (5 mmHg, 2 l/min). Then two additional 4 mm trocars for instrumentation with 3 mm instruments were inserted under direct vision in the lower right quadrant and left middle quadrant. An additional 3 mm grasping forceps can be introduced in the left epigastric quadrant without trocar for lifting the liver.

The first surgical step is to mobilize the colon to the left side of the abdomen to gain access to the area of the bulbus duodeni. It can sometimes be of advantage to introduce one or two stay sutures transcutaneously into the bulbus to move the bulky part of the bulbus out of the way and allow viewing onto the distal duodenum. If this technique is applied it is necessary to beware of perforation if too much traction is applied.

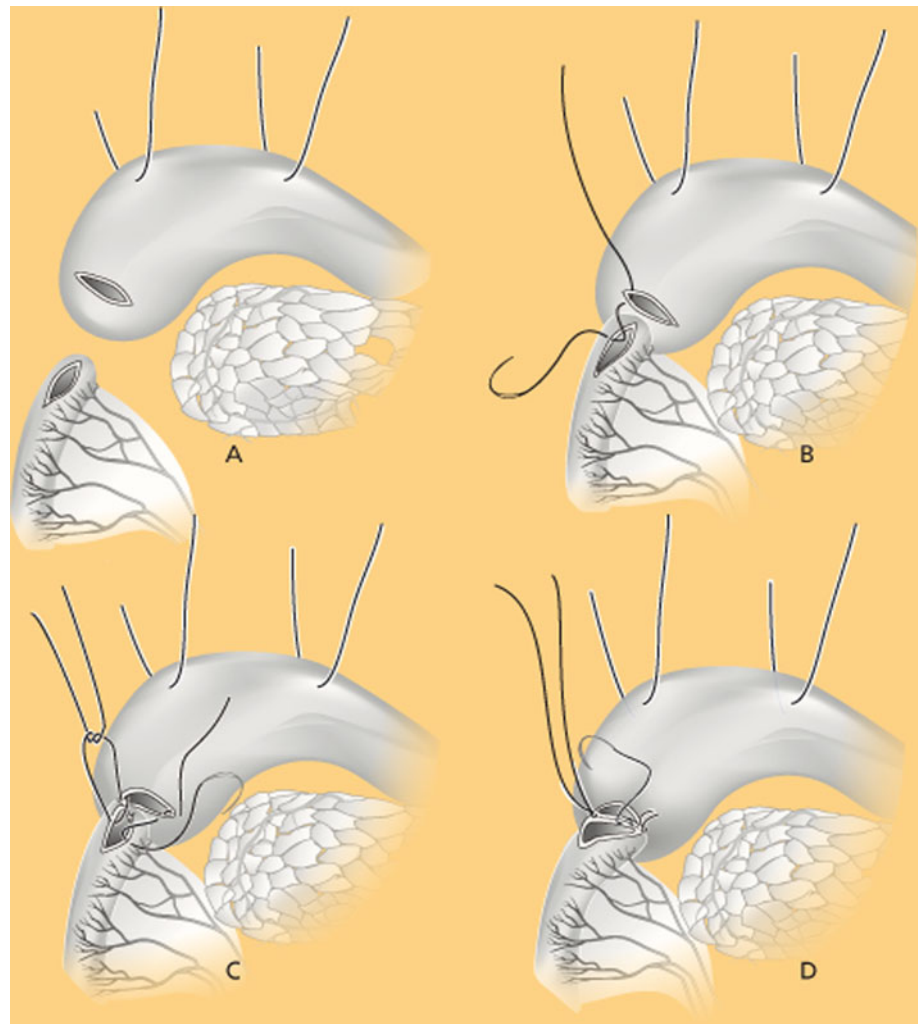
The distal duodenum is then mobilized using a “no-touch” technique as much as possible to avoid damage to the duodenal serosa. Adhesive bands are taken down and the distal duodenum is mobilized sufficiently to allow a tensionless anastomosis.

The second surgical step is to incise the distal duodenum longitudinally with scissors and open the bulbus at a convenient place transversely for easy anastomosis. The third step is to start making the anastomosis from the distal end of the distal duodenum halfway down the lower end of the bulbus with standing Vicryl 5 × 0 sutures. From there on the anastomosis is continued distally toward the distal corner of the bulbus, and then forward toward the proximal corner of the bulbus. Finally, the ventral part of the anastomosis is laid to complete the anastomosis. The colon is laid back over the duodenum and the trocars are removed under direct vision. The defects are closed with Vicryl 4 × 0 sutures.

### Adjustment as of 2008

The first and second steps remained the same, because it is important to place the stay suture(s) in the bulbus, thereby making the approach to the anastomosis convenient. The first Vicryl 5 × 0 suture is approximately 10 cm long. The first bite is taken from the distal end of the bulbus to halfway

**Fig. 1** **A** Stay sutures (s) in bulbus duodeni. **B** First suture (a) from lateral border of incision in bulbus duodeni (x) to halfway lateral border of distal duodenum (x'). The suture is led out through the abdominal wall. **C** Second suture (b) from medial border of bulbus duodeni (y) to half way medial side of distal duodenum (y'). **D** After bringing the suture (b) to the inside of the duodenum a running suture runs from y to x, where the suture is brought outside again and tied with a



down the back side of the distal duodenum and tied. The long end with the needle is then led out through the skin at a convenient place to function as a stay-suture. The second suture is approximately 8 cm long, and it is laid from the proximal corner of the bulbus to halfway down the ventral side of the distal duodenum (Fig. 1a–d). That suture is brought in intraluminally, and by pulling on the short end of the suture the back side of the two duodenal walls come parallel to each other and with a continuous running suture, the back side of the anastomosis is made. The suture is brought outside again and tied with the short end of the distal suture. The ventral anastomosis is also made as a running suture from distal to proximal. Again, by carefully pulling on the short end of the proximal suture the two edges come parallel, facilitating the anastomosis.

## Results

The demographics of the two groups were comparable. In group 1 there were four conversions (Table 1). In group 2

there were no conversions anymore. There were no intra-operative complications, but in group 1 five patients developed postoperative leakage. In two patients with both esophageal and duodenal atresia, the repairs were accomplished endoscopically, and leakage occurred after accidental extubation and reintubation in the esophagus on day 3 in one child and on day 10 in the second. One patient turned out to have a total aganglionic colon, causing blow-out of the anastomosis. In one patient at laparoscopic re-exploration a single additional suture was necessary for complete closure. Most leaks occurred on the posterior side.

In one patient a redo operation was necessary for recurrent stenosis of the anastomosis. In that patient it was believed that electrocautery was the cause for excessive cicatrization. In group 2 there were no postoperative complications. Oral feeding was started 2–4 days postoperatively and all children were on total oral nutrition 5–8 days postoperatively (Table 1), except for the child with Down syndrome who required 10 days to total oral feeding.

The follow-up is now between 6 months and 2½ years and no further complication have been noted.

## Discussion

“Long-term follow-up is necessary” is an oft-heard conclusion after initial reports of new techniques. This certainly was true for the laparoscopic repair of duodenal atresia.

After our initial report, we enthusiastically proceeded to treat our patients laparoscopically. However, on evaluation of the results in 2005, we found the complication rate unacceptably high and abandoned the laparoscopic approach in order to examine the procedure. It was obvious that most leakages occurred at the posterior side of the anastomosis. Apparently estimation of the distance between the separate sutures is difficult. Making a running suture forecloses this risk. Also, when using the distal suture as a stay suture, this stabilizes the anastomosis, and pulling on the short end of the proximal suture brings the two ends of the intestine into parallel, facilitating the anastomosis of the posterior wall. This change of technique improved the quality of the anastomosis, and no further leakages have occurred. This modified technique is now also used for repair of esophageal atresia.

That leakage apparently was not an uncommon complication was indirectly confirmed when another group presented an alternative technique using U-clips [3, 4]. After they described the technique, they presented a series of 29 patients with congenital duodenal obstruction, where they compared the open and laparoscopic technique between 2003 and 2008. Although not noted in their article, as the first description of the technique dates from July 2006, it can be assumed that they started the new technique as of 2006 and that all the patients undergoing operation prior to that date were treated by the open technique.

More recently, Rothenberg’s group also presented their follow-up [5] and again there was a time lapse between the first report, where four patients were described operated on between March and July 2001, and the second report that describes a patient group operated on between January 2004 and January 2008. The good results they achieved may well be due to the fact that in a number of patients

they used the continuous suture technique. It appears that this technique provides a more watertight closure and does not induce anastomotic stenosis, as might be feared by some surgeons.

Laparoscopic repair of duodenal atresia is a very elegant way of restoring continuity of the duodenum. The patient seems to benefit from the laparoscopic approach, because recovery is quick and oral feeding resumes earlier, leading to a quick return to a full oral diet and discharge, as was shown in this series. Similar results have been reported by others [4].

It is important to note that all results obtained so far have been reported by very experienced pediatric endoscopic surgical groups. In an era when governments, patient groups, insurance companies, and medical societies are all applying increasing pressure to provide quality care by concentrating specific procedures in “large quantity and quality centers,” the laparoscopic repair of duodenal atresia—and, in this sense, perhaps esophageal atresia as well—should be limited to designated centers with extensive experience in pediatric endoscopic suturing.

In conclusion, in revisiting the laparoscopic repair of duodenal atresia, it has become clear that laparoscopic treatment should be restricted to a limited number of designated centers of expertise.

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