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15.1 Introduction

Congenital duodenal stenosis or atresia is one of the more common neonatal intestinal obstructions, which is increasingly more often already detected by prenatal ultrasound, demonstrating a distended stomach and bulbus duodeni. In the past it would be the typical double bubble sign on abdominal X-ray in neonates presenting with bilious vomiting [1, 2].

The obstruction may present as a stenosis or web, or true atresia, and should be discriminated from malrotation with or without volvulus. In 20 % duodenal atresia is associated with malrotation; 30 % of the patients have Down syndrome. Sometimes the duodenal atresia is seen in conjunction with esophageal atresia [1, 3].

Classical management of duodenal atresia is a side-to-side and diamond-shaped anastomosis between the proximal bulbus and the distal duodenum, bypassing the obstruction that is usually located at the level or just below the pancreas.

With the onset of minimal invasive surgery and increasing experience, the laparoscopic management of duodenal atresia has come into scope [2, 4].

15.2 Preoperative Workup

After confirmation of the diagnosis, the patient can be planned for operative correction as an elective procedure. The patient is lined up with a nasogastric tube to decompress the stomach and bulbus duodeni, an i.v. for fluid administration, and an arterial line, if possible, for monitoring during the laparoscopy. Nowadays, patients are also monitored by means of near-infrared spectrometry, to secure sufficient cerebral blood flow during the laparoscopic procedure. Antibiotics are given for 24 h.

15.3 Positioning on the Operating Table

The patient is positioned at the lower end of a short operating table to allow comfortable access for the surgeon. The operating table sheet is wrapped over the flexed legs to secure the patient from sliding from the table when it is placed in anti-Trendelenburg position.

15.4 Trocar Positioning

The first 5-mm trocar is introduced in an open way in the sub-umbilical fold. With the use of a 3×0 Vicryl suture, that is placed in the fascia in a U-shape, the trocar can be fixed to prevent it from falling out. A silicone tubing around the shaft of

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the trocar on the other hand can prevent the trocar from sliding in. The flow is maximized at 2–3 l/min and the maximum pressure is set to 5–8mmHg.

After insufflation two additional 3-mm trocars can be placed, one in the right lower quadrant and one in the left mid-abdomen. Beware not to place the trocar in the right lower quadrant too low, otherwise the freedom of moving the trocar is reduced. On the other hand, if the trocar is placed too high, it will lie above the level of the liver and duodenum and it will be difficult to handle the instrument. Therefore this trocar should be placed under direct vision to determine the best position.

15.5 Operative Procedure

The first step is to mobilize the right colonic flexure by blunt and/or sharp dissection. This should be sufficiently halfway to the transverse colon, in order to get a good access to the duodenum. If the bulbus duodeni is grossly distended, it is helpful to put a stay suture in the bulbus and extend it outside through the skin to pull away the bulbus from the pancreas and pars horizontalis in order to be able to sufficiently mobilize the distal duodenum. Bands and adhesions can be taken down by blunt traction. Try to avoid grasping the duodenum itself as much as possible to avoid damage to the duodenal wall. Determine carefully where the suspected obstruction is located; this may be an annular pancreas, a stenosis or a true atresia. By mobilizing the distal duodenum, a malrotation can be confirmed or excluded.

In case of a stenosis or a web, a longitudinal anti-mesenterial incision can be made over the stenosis or incisures. A stenosis can be simply closed transversely; a web should be exposed sufficiently to incise the web without damaging the Vater papilla. Liberally make use of stay sutures in the wall to be able to clearly discern all anatomic structures. The defect can be closed transversely.

In case of a pancreas annulare or true atresia, the distal duodenum can be incised longitudinally over 1–1.5 cm, approximately 1–2 cm

away from the obstruction. Either a longitudinal or transverse incision is made over the bulbus duodeni (Fig. 15.1). The content of the bulbus is removed with a suction device. When making a diamond-shaped anastomosis, the first Vicryl 5×0 suture is laid from the right corner of the bulbus (Fig. 15.2) to halfway to the right side of the distal duodenum (outside-in, inside-out). The stay suture in the bulbus is released far enough to allow a tension-free tying of the knot of this suture (Fig. 15.3). The long end of the suture is led out through the abdominal wall to stabilize the intestine and suture line. A second suture is laid from the left corner of the bulbus to halfway to the left side of the distal duodenum (outside-in, inside-out). After tying this suture, the needle is passed into the inside of the intestinal wall, and a running suture can be made over

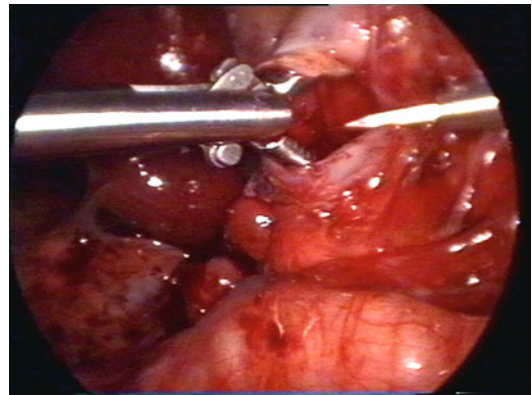


Fig. 15.1 Transverse incision in the bulbus duodeni

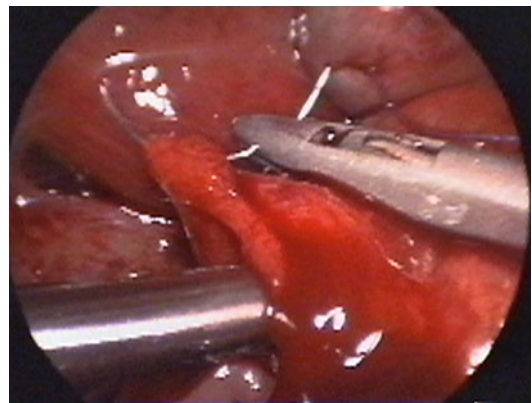


Fig. 15.2 First suture through the distal duodenum

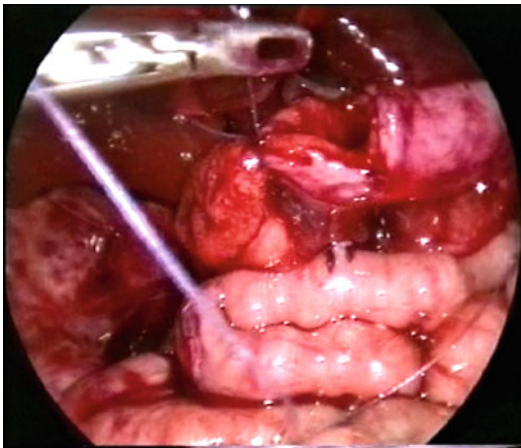


Fig. 15.3 Approximation of first suture from midway bulbous to superior edge of distal duodenum

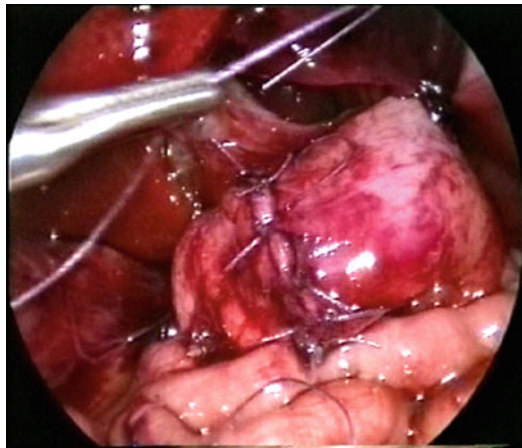


Fig. 15.4 Completion of anastomosis

the posterior wall from the inside. Usually by pulling on the short end of the left suture, the posterior wall will present itself nicely for the running suture. At the right end, the needle is led out and tied with the short end of the first suture. This same suture can usually be used to run back over the anterior wall and tied to the short end on the left side finishing the anastomosis (Fig. 15.4). There is no tapering of the bulbous duodeni. There is no exploration of the distal duodenum for other membranes or obstructions, as they are seldom [5]. The stay sutures are cut and all trocars are removed under direct vision. The U-shape suture in the umbilicus can be used to close this defect. The other fasciae are closed with a Vicryl 5×0 suture and Steri-Strips for the skin. No drain or any trans-anastomotic drain is left behind.

15.6 Postoperative Care

The patients are kept nil per mouth for 24 h, after which feeding is started with 8×10 ml, irrespective of any gastric retention. Feeding is extended according to age and weight over the following days. Retentions up to 30 cc are accepted and given back. It is better not to measure retentions, but observe the child clinically and adjust feeding regimen accordingly.

Feeding and admission times are usually more dependent on concomitant anomalies like cardiac abnormalities or Down syndrome.

15.7 Personal Experience

We described the first case of laparoscopic repair of duodenal atresia in 2001 [4]. In a first series from 2000 to 2005, 22 children were operated laparoscopically. In four cases the procedure was converted. In five patients there was leakage of the anastomosis. This was reason to stop the laparoscopic approach at that moment until the procedure was adjusted sufficiently to ban out any more leakage.

With increasing experience and changing to a running suture that secured the anastomosis, we picked up the procedure again. From 2008 to March 2015, another 22 children were operated laparoscopically without any more complications. All procedures could be completed laparoscopically [3].

15.8 Discussion

Repair of duodenal atresia is one of the most complex minimal invasive procedures. This is mainly because of the limited space available. In

thoroscopic repair of esophageal atresia, the rigid thoracic cage secures some space. In the abdomen with low pressures of 5–8 mmHg, the overlying liver and moving intestines, next to gas leakage along the trocars, leaves a limited space for moving around. Often an extra trocar is placed in the epigastrium to lift up the liver to give additional exposure. Also the liberal use of stay sutures gives more stability to the operating field. It helps if the assistant that holds the camera pulls on the umbilical trocar to give additional space. The major step forward in determining success was the use of running sutures that give an even tension along the whole anastomosis. Since adjusting this technique, we have seen no more incidents of leakage.

Another issue is the endoscope. In open surgery an incision is made directly over the underlying duodenum. In laparoscopy the view is fixed from the umbilicus, giving another angle at which the anomaly is approached. Good anatomical knowledge of the course of the duodenum is obligatory. Good exposure is important. Therefore the first step is to mobilize the overlying right colonic flexure sufficiently away, that is, it does not fall back constantly in front of the duodenum and pancreas head.

The second step is to identify the bulbus duodeni and pancreas head. It often is helpful when a stay suture is placed in the bulbus to lift it away from the pancreas head and distal duodenum.

When mobilizing the distal duodenum, try not to grasp the duodenal wall, but take down the bands and adhesions between two grasping forceps just adjacent to the duodenum. When the duodenum is sufficiently mobilized, a longitudinal incision can be made with straight scissors or a pylorotomy knife. In open surgery a diamond-shaped anastomosis is advocated, although some authors claim that a simple side-to-side anastomosis is just as well. A diamond-shaped anastomosis is well feasible in laparoscopy, but there is no objection to make a side-to-side anastomosis.

No effort is made to advance a trans-anastomotic tube or explore more distal membranes, because they occur only seldom, and if

they do, they can be addressed in a separate procedure, or even by balloon dilatation under fluoroscopy if the membrane is not too thick [5].

Some authors advocate tapering of the bulbus duodeni [6]. In our view it is questionable if this will give any advantage to restoration of the passage of gastric contents. In our experience we have never had to taper the bulbus in any of our patients. Obviously the bulbus is distended and will always remain distended. However, if this does not lead to feeding problems, there is no reason to make a procedure more complicated than necessary. On the contrary, we start feeding the children as of the second postoperative day and accept retentions up to 30 cc, as there will always be some pooling of gastric and duodenal content in the distended bulbus. Usually, the children tolerate the feeding very well, and oral intake can usually be increased like in all neonates of their gestational age.

In conclusion the laparoscopic management of duodenal obstruction is feasible and has a good outcome. The procedure is technical demanding and usually requires an experienced laparoscopic surgeon.

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