Laparoscopic repair of congenital duodenal obstruction is feasible even in small-volume centres

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ABSTRACT

INTRODUCTION It has been suggested that laparoscopic repair of congenital duodenal obstruction (CDO) should be restricted to a limited number of designated centres of expertise. After gaining extensive experience with intracorporeal suturing in other procedures, we evaluated the feasibility of this approach at the Royal Hospital for Sick Children (RHFSC; Edinburgh, UK).

METHODS We conducted a retrospective review of all cases of CDO presenting to the RHFSC from 2012 to 2014. Cases were identified from our electronic database using standardised codes. Data comprised: gestation; birth weight; associated anomalies; patient age and weight at surgery; operative time; complications; postoperative course.

RESULTS Five consecutive non-selected cases of isolated CDO were repaired laparoscopically, and all were carried out by the senior surgeon. The male:female ratio was 4:1. Corrected gestational age at surgery was 35–38 weeks, and the weight at surgery was 1.7–3.1 kg. None of our patients had significant associated anomalies.

CONCLUSIONS The present study demonstrates the feasibility of laparoscopic repair of CDO in small-volume centres, and is the first report of laparoscopically managed congenital duodenal atresia in twins.

KEYWORDS

Congenital duodenal obstruction – Double bubble – Small-volume centre – Dizygotic male twins

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Congenital duodenal obstruction (CDO) occurs in ≈ 1 in 6000 live births and can be associated with trisomy-21 and cardiac malformations. Up to 50% of such patients are premature and have low birth weight.¹ Increasingly, the diagnosis is made using antenatal ultrasound.² After birth, the classic ‘double bubble’ appearance on plain radiographs confirms the diagnosis.

Due to improvements in neonatal intensive care, parenteral nutrition, and surgical methods, mortality due to CDO in the UK is now $\approx 5\%$.^{3,4} This figure is related mostly to the associated complex cardiac anomalies.

Standard repair remains the Kimura diamond-shaped duodenoduodenostomy.⁵ Laparoscopic duodenoduodenostomy was described first in 2001.⁶ The complex anatomy and small operating space poses a challenge for surgical repair employing minimally invasive methods. Therefore, it has been suggested that laparoscopic repair of CDO should be restricted to a limited number of designated centres of expertise.⁷ After gaining extensive experience with intracorporeal suturing in other procedures (eg pyeloplasty), we evaluated the feasibility of this approach at the Royal Hospital for Sick Children (RHFSC; Edinburgh, UK).

Methods

We conducted a retrospective review of all cases of CDO presenting to the RHFSC from 2012 to 2014. Cases were identified from our electronic database (Lothian Surgical Audit system) using standardised codes. Data comprised: gestation; birth weight; associated anomalies; patient age and weight at surgery; operative time; complications; postoperative course.

Our surgical approach is similar to that described by Rothenberg.⁸ A 4.5mm telescope was inserted inferiorly through a 5mm umbilical port using the open Hasson method. Pneumoperitoneum to 8mmHg with carbon dioxide was established. Two 3.5mm working ports were inserted: one in the right iliac fossa and one in the left iliac fossa. A 4-0 polydioxanone suture was placed through the abdominal wall, through the proximal duodenum, and back out through the abdominal wall to display the duodenum, as described previously.^{7,8} A diamond-shaped Kimura anastomosis with interrupted 6-0 vicryl sutures was undertaken (Fig 1). Intracorporeal knot-tying was instigated. Knots were placed on the luminal side of the posterior wall and on the

Figure 1 View of the anastomotic setup showing: A, suspension suture in the dilated first part of the duodenum; B, luminal view of completed posterior wall of the anastomosis; C, a 10cm segment of a nasogastric tube (used to probe distally); D, collapsed third part of the duodenum.

extraluminal side of the anterior wall of the anastomosis. A 10cm segment of a 5F nasogastric feeding tube was introduced into the peritoneal cavity via a working port. Then, this segment was used to probe distally via the enterotomy, before completion of the anastomosis, to exclude other atresias in the distal duodenum or proximal jejunum. Air or saline insufflation was not used.

Results

Five consecutive non-selected cases of isolated CDO were repaired laparoscopically during the study period, and all

Table 1 Patient demographics

Case	Date	Sex	Operative gestation (weeks)	Operative weight (kg)	Associated anomalies
1	February 2012	Female	36 + 6	2.6	None
2	November 2013	Male	35 + 2	2.1	PFO, ASD
3	November 2013	Male	35 + 4	1.7	PFO, ASD
4	May 2014	Male	38 + 4	3.1	None
5	December 2014	Male	38 + 0	2.7	None

PFO = patent foramen ovale; ASD = atrial septal defect

were carried out by the senior surgeon. The male:female ratio was 4:1. The corrected gestational age at surgery was 35–38 weeks, and the weight at surgery was 1.7–3.1kg (Table 1). None of our patients had any significant associated anomalies. Cases 2 and 3 were dizygotic male twins with anatomically discordant atretic anomalies.

The diagnosis was suspected antenatally in two cases due to dilatation of proximal bowel. These two cases were confirmed with a classic double bubble on plain radiographs of the abdomen. In three cases there was no double bubble and the diagnosis was confirmed using a contrast study.

The obstruction was complete in three cases (cases 1, 3, and 5) and incomplete in the other two cases (cases 2 and 4). The anatomy was highly variable. Atresias have been classified by Gray and Skandalakis.⁹ The first case was a type-III atresia (complete separation of atretic ends with a mesenteric defect) within the second part of the duodenum. This was a pre-ampullary atresia, suspected to be due to non-bilious nasogastric aspirates, and confirmed intraoperatively. The second case was a stenosis in the third part of the duodenum. Case 3 and case 5 were type I (mucosal membrane with intact muscle wall) in the third part of the duodenum. Case 4 was a stenosis in association with an annular pancreas, and was managed in the same way as the other cases (diamond duodenoduodenostomy).

Operative time was that recorded by the anaesthetist from initial operative start to final skin closure. The

Table 2 Outcome data

Case	Type	Operative duration (min)	Postoperative ventilation	TPN (days)	Full feeding	Complications	Discharge from hospital
1	III	180	None	11	Day 10	None	Day 12
2	Stenosis	195	43 h	12	Day 14	None	Day 25
3	I	175	17 h	8	Day 10	Chylous ascites	Day 34
4	Annular pancreas	140	None	9	Day 10	None	Day 12
5	I	193	None	11	Day 13	None	Day 18

TPN = total parenteral nutrition
 Type-III atresia denotes complete separation of atretic ends with a mesenteric defect.
 Type-I atresia denotes membranous atresia with an intact bowel wall.

operative time was 140–195min (Table 2). All cases were completed laparoscopically, and there were no intraoperative complications.

All patients had a central venous catheter inserted peripherally and received parenteral nutrition as shown in Table 2. Enteral feeding was started at ≈ 5 days postoperatively when nasogastric aspirates had reduced. Time to full feeding was 10–14 days.

There were no anastomotic leaks, and no missed distal atresias. One patient developed chylous ascites, which was noted incidentally with milky fluid seen in a patent processus vaginalis during semi-elective repair of a presumed inguinal hernia just before hospital discharge. This patient tolerated full feeding before the diagnosis, and was subsequently cared for conservatively with 2 weeks of feeding with medium-chain triglycerides.

Discussion

Minimally invasive methods are being applied to an increasing number of neonatal conditions. Several authors have reported shorter recovery times, shorter hospitalisation, reduced pain, and improved cosmetic effect.^{10–12} In patients with duodenal atresia, the proximal nature of the obstruction and resultant collapsed distal bowel allows for excellent workspace even in small, premature neonates. Comparative series have demonstrated a significantly shorter time to initiation of feeding, time to full feeding, and shorter hospitalisation in patients having laparoscopic procedures.¹¹

The complex variable anatomy and need for extensive intracorporeal suturing poses a considerable challenge to surgeons. Some authors have reported an unacceptably high prevalence of leaks using conventional suturing and have, therefore, suggested that laparoscopic duodenoduodenostomy be restricted to designated centres of expertise.⁷ Other scholars have employed the U-clip to accomplish the anastomosis laparoscopically, and achieved good short-term outcomes.^{11,15}

After gaining extensive experience of intracorporeal suturing in other conditions (eg minimally invasive pyeloplasty and repair of oesophageal atresia), we wanted to evaluate the feasibility of laparoscopic duodenoduodenostomy at

the RHFSC. We prefer to use interrupted sutures for the anastomosis to replicate open repair and to minimise the risk of anastomotic strictures. Despite being undertaken infrequently at the RHFSC (five cases in 35 months), we have demonstrated comparable outcomes to other, larger series.

With further experience, we would expect our operative times to continue to shorten, as we have seen with our other laparoscopic, retroperitoneoscopic and thoracoscopic cases (though we have not published those data).

The present study demonstrates the feasibility of laparoscopic repair of CDO in small-volume centres, and is the first report of laparoscopically managed congenital duodenal atresia in twins.

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