Robot-assisted resection of gastric duplication cysts in a child: a detailed case report

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Abstract

Gastric duplication cysts (GDCs) represent 4-9% of alimentary tract duplications. Early diagnosis and surgical excision are essential to avoid morbidity or neoplastic degeneration. Robotic-assisted excision of GDCs has never been described in childhood.

We report an asymptomatic male patient with 2 gastric cystic masses at ultrasonography (US)-study (diameter 25mm and 8mm), increasing in size at follow-up. At 20 months of age, magnetic-resonance-imaging-scan confirmed 2 round gastric masses (44×35mm and 16×12mm, respectively). Two months later, an elective robotic-assisted excision of GDCs was completed without complications. The patient was discharged at day 6 after procedure. Histology confirmed the diagnosis of GDCs. At a 2-year follow-up, US-study did not evidence any issue. In this first reported case of robotic-assisted cystectomy for CGD in childhood, the procedure seems safe, effective, and feasible. This approach improves the movements of the surgical instruments with better 3-D visualization in comparison with the laparoscopic approach.

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Introduction

Duplications of the alimentary tract are rare congenital anomalies, as they represent 0.1-0.3% of all congenital malformations.[1] Gastric duplication cysts (GDCs) represent from 4 to 9% of all alimentary tract duplications.[2] They usually become symptomatic before 2 years of age and the early diagnosis with subsequent surgical excision in neonatal or infantile period is usually advocated to avoid potential morbidity and neoplastic degeneration, as described in adulthood.[1,2]

In the pediatric literature there are few reports about laparoscopic resection of GDCs. However, to the best of our knowledge, a robot-assisted surgery for this condition has never been reported in detail. We report the first detailed case of robot-assisted excision of a double GDC in childhood.

Case Report

An asymptomatic male patient has presented soon after birth an incidental ultrasonographic finding of two antero-superior abdominal cystic masses originating from the anterior gastric wall (maximal diameter 25 mm and 8 mm). Both the cystic masses have increased in size over an ultrasound study follow up. However, the patient did not show any gastrointestinal or respiratory symptoms during his growth. At 20 months of age, an MRI-scan under general anesthesia confirmed the presence of two gastric masses (44×35 mm and 16×12 mm, respectively), without any compression of the surrounding structures. These formations showed roundish morphology, thin and regular walls. Both masses had a homogeneously hypointense content in T1 and hyperintense in T2, in relation to the liquid nature of the same, with a more dense appearance in the declivous portions.

Two months later, while the patient reached a body weight of 11.5 kg, an elective robot-assisted excision of the cysts combined with the suture of the muscular layers was completed using the da Vinci System XI (Intuitive Surgical, Inc.1020 Kifer Road Sunnyvale, CA). In detail, the child was placed in a supine anti-Trendelemburg position, an 8-mm optique robotic trocar was placed trans-umbilical, two 8-mm robotic ports were placed on the transverse umbilical line at 5-cm leftward and rightward from the umbilicus, with a third 5-mm laparoscopic accessory port in right iliac fossa. The following robotic instruments were used: a fenestrated grasper, a monopolar hook, and a needle holder. Furthermore, as laparoscopic instruments, we used a grasping forceps, a monopolar hook, and a suction instrument. Pneumoperitoneum was achieved with a flow of 1 liter per minute and a pressure of 10 mmHg. As soon as the stomach was pulled down, the two cysts were identified

on the gastric fundus, with the major one (4.5 cm) nearby the cardias. A complete lysis of the adhesions between the gastric fundus and the diaphragmatic wall was performed and an accurate enucleation of both the formations was completed with a partial removal of the muscle wall, thanks to a monopolar hook and a fenestrated grasper (Figure 1). Therefore, an integrity test of the gastric mucosa was performed with pneumatic gastric insufflation through a naso-gastric tube and the muscle layer of the gastric wall was repaired with interrupted sutures in 3/0 Vicryl™ (Figure 2). The masses were finally extracted intact through the umbilical port thanks to an endo-bag. No intra-operative complications occurred. The docking was achieved in 15 minutes, the console time resulted in 115 minutes, and the total time of surgery has resulted in 205 minutes.

Postoperative period was uneventful, with resumption of enteral feeding by naso-gastric tube from the first postoperative day. Full oral feeding was achieved in the third postoperative day. Ultrasonographic control study was performed on the sixth postoperative day and it did not show any leakage or gastric wall alteration. The patient was then discharged home on regular oral feeding on the same day.

Histologic findings confirmed a diagnosis of gastric duplication cysts with gastric and respiratory epithelium. At a two-year follow up, both clinical visit and ultrasound study did not evidence any issue or late complication.

Discussion

Gastric duplications are extremely uncommon in children, as they represent the most unusual site among all the digestive tract (less than 4% of intestinal duplications). They are generally cystic, with a rare communication with the stomach lumen. GDCs can be found in any part of the stomach, however common sites are the greater curvature, the antrum, or the pylorus.

Only one third of GDCs can present in the newborn period. In the majority of cases the symptomatic onset is before 2 years of age. The most common symptoms are melena and hematemesis, which may be the indicator of an acute gastric perforation. Other symptoms, such as gastrectasia, abdominal mass, and vomiting are unusual. However, larger cysts can cause abdominal pain and discomfort.[3]

Pathological diagnostic criteria are the presence of a gastrointestinal mucosa lining, surrounded of smooth muscle coat, and attached to the gastrointestinal tract. The communication with the gastric lumen is variable, and the GDC usually shares a common vascularization with the stomach.[4] Diagnostic work-up includes ultrasound study, contrast-enhanced barium-meal, CT-scan or MRI-scan. Some authors reported an evaluation using scintigraphy with ^{99m}Tc, which is useful in detecting ectopic gastric mucosa, with a sensitivity approaching 85%.[5]

The differential diagnosis includes pancreatic cyst or pseudocyst, choledocal cyst, intramural tumor of the stomach, hypertrophic pyloric stenosis, ovarian or mesenteric cysts, and adrenal hemorrhage.[6]

Resection of the cyst followed by the repair of the muscle wall without entering the stomach has been suggested as the treatment of choice. These can be achieved through an open or a minimally invasive approach.[7]

Nineteen patients with GDCs treated by a laparoscopic approach have been reported in the pediatric literature up to now (Table 1).[1-3,8-14] Three cases had a prenatal diagnosis and more than two-thirds were symptomatic. The age at surgery ranged between one hour of life and fourteen years of age. A perforation of the gastric mucosa during laparoscopy occurred in 4 cases (21%), with a GDC ranging from 3 to 8 cm. In one of these cases, a 2-month-old male was referred with non-bilious projectile vomiting. An MRI-scan showed an 8×3×3 cm cyst in the left upper peritoneal cavity. Laparoscopic resection of the gastric duplication cyst was then performed. However, the authors resected the duplication cyst through the full thickness of the gastric wall, since the wide lesion sheared the muscular layer with the stomach and because of inflammation-related adhesions between the gastric mucosa and the sheared muscular layer. The patient was discharged home on the ninth postoperative day without any complications.[2] In two cases a mini-laparotomy was performed to pull out the cysts.[8] Data about operative time are rarely reported, but usually the procedure has lasted less than 2 hours. Length of hospital stay ranged between 3 and 9 days, with a mean full oral feed on the third postoperative day. No postoperative complications have been reported. One patient deceased because of a late respiratory failure unrelated to the GDC excision.[3]

A single robotic-assisted excision of GDC was reported in a table in a study by Meehan *et al.*, where authors resumed their personal robotic experience in small children (weight less than 10 kg).[11]

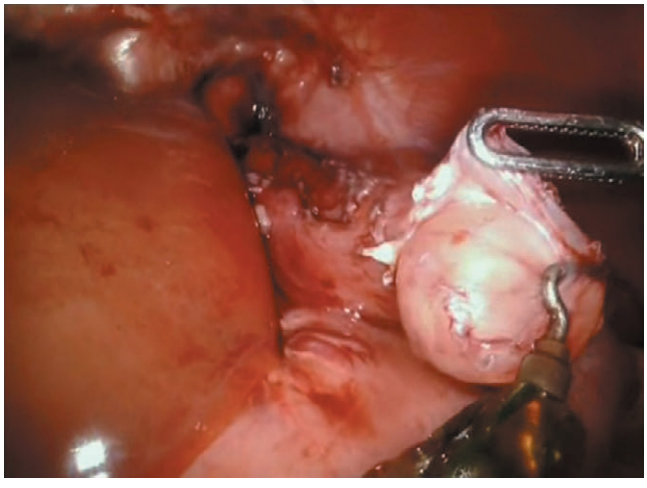

Figure 1. Accurate enucleation of the gastric duplication cysts.

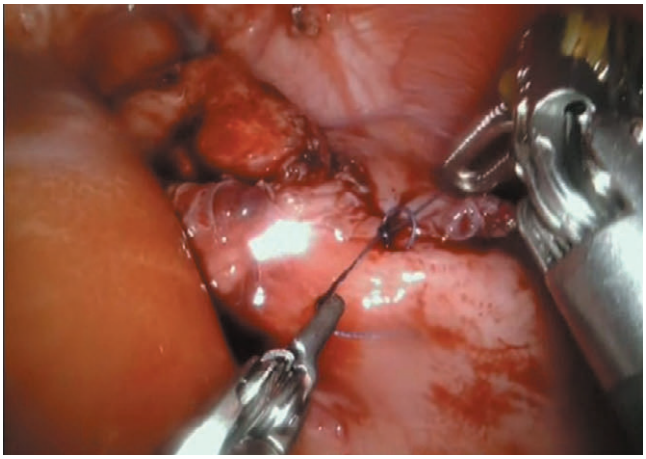

Figure 2. Closure of the muscle layer of the gastric wall with interrupted sutures.

Two further cases were only mentioned by Mattioli *et al*.[15] However, no details have been reported in both these studies.

To the best of our knowledge, this is the first detailed case report in the pediatric literature of a robot-assisted gastric duplication cystectomy. The decision to postpone surgery at 20 months of age was supported by the absence of symptoms during the postnatal follow up. Thanks to a regular increasing in both body weight and height of the patient over this period, a robotic approach has been conceivable at that point. As a matter of fact, no difficulties deriving from the disproportion among robotic system and the soma of the patient has been encountered during the procedure. However, a certain number of recent papers support the idea that the weight of the patients would not represent a limitation to the use of a robotic approach for smaller children.[11,16,17] As technology improves together with the experience of pediatric surgeons using the robotic system, the ability to bring this type of surgery to even smaller patients with a wider variety of cases has been expanding over the last years. For these purposes, a careful planning of patient position, trocar location, and trocar depth are essential to optimize the full range of motion of the current da Vinci articulating 5-mm or 8-mm instruments.[16] Furthermore, as per our consuetude, we planned a preoperative use of both robotic and laparoscopic instruments in order to decrease costs, the over-use of robotic instruments, and the operative time.

In our single case experience, we have showed that this procedure seemed safe, effective, and feasible. We did not face any particular difficulties or complications throughout the surgery and the duration of console time was similar to the laparoscopic approach (less than 2 hours). However, as usual in robot-assisted procedures, the total time of surgery was lengthened in comparison with the laparoscopic approach mostly because of the docking and de-docking of the robotic instruments.

Nevertheless, as for other procedures, robot-assisted approach adds to standard laparoscopic procedure smooth, consistent, and precise movements of articulated wristed surgical instruments, with seven degrees of freedom, ergonomic comfort, and better 3-D visualization for the surgeon. These represent the main advantages of robotic-assisted procedure in comparison with the available laparoscopic armamentarium of 3 mm, 5 mm, and single port instruments, which are regularly used in these cases.[13,14]

All these ameliorations could bring to a reduced risk of gastric perforation or other intraoperative complications. As a matter of fact, in our single case the robot-assisted procedure was completed without any mucosal opening or perforation. Conversely, the gastric opening or perforation has been reported in one out of five cases treated by a laparoscopic approach. It could entail the risk of gastric spreading within the abdominal cavity and a consequent possible delay in resuming the oral feeding as well as in lengthening the hospital stay. On the other hand, the laparoscopic approach seems to be quicker than the robotic-assisted procedure, with similar length of hospital stay.[13,14]

Conclusions

The robotic-assisted excision of gastric duplication cysts seems to represent a safe and effective alternative to the laparoscopic procedure. This approach could be considered in infants and

Table 1. Case series of laparoscopic minimally invasive surgery for gastric duplication cysts reported in pediatric literature.

Author(Year)	Case #	Age at surgery	Symptoms	Cyst size (mm)	Type of surgery	Intra-operative complications	Lenght of stay (p.o. day)	Post-operative complications
Sasaki *et al.* (2003)[12]	1	14 y	Abdominal pain	/	VLS (cystectomy)	None	/	None
Ford *et al.* (2004)[1]	2	2 m	Asymptomatic	22	VLS (cystectomy)	None	4	None
Take *et al.* (2008)[14]	3	3 y	/	/	VLS (cystectomy)	/	/	/
Laje *et al.* (2010)[10]	4	17 m	/	/	VLS (cystectomy)	None	/	None
Lima *et al.* (2012)[8]	5	1 y	Asymptomatic	/	VLS (cystectomy) + laparotomy	None	/	None
	6	4 y	Abdominal pain	/	VLS (cystectomy) + laparotomy	None	/	None
	7	1 y	Asymptomatic	/	VLS (cystectomy)	None	/	None
Takazawa *et al.* (2015)[2]	8	2 m	Emesis	80×30×30	VLS (partial gastrectomy)	Mucosal perforation	9	None
Biebl *et al.* (2015)[13]	9	8 y	Abdominal pain	37×26×12	VLS (partial gastrectomy)	Mucosal perforation	6	None
Ren *et al.* (2017)[3]	10	1 h	Saliva bucking	20×30×35	VLS (cystectomy)	None	3	Death
	11	1 d	Emesis	20×30×30	VLS (cystectomy)	Mucosal perforation	/	None
	12	26 d	Emesis	50×40×30	VLS (cystectomy)	None	/	None
	13	28 d	Asymptomatic	20×30×40	VLS (cystectomy)	None	/	None
	14	24 d	Emesis	20×25×20	VLS (cystectomy)	None	/	None
Balakrishnan *et al.* (2017)[9]	15	5 y	Emesis -pain	50	VLS (partial gastrectomy)	Mucosal perforation	/	None
	16	2 y	Asymptomatic	/	VLS (cystectomy)	None	/	None
	17	10 y	Abdominal pain	/	VLS (cystectomy)	None	/	None
	18	9 y	Emesis-pain	/	VLS (cystectomy)	None	/	None
	19	12 y	Abdominal pain	/	VLS (cystectomy)	none	/	None

VLS, Video laparoscopic surgery.

children with an adequate body weight and height, in case of voluminous cysts, and in centers with an appropriate robotic training. However, the role of the robot-assisted approach in treating gastric duplication cysts needs to be further evaluated in symptomatic newborn patients, due to the disproportion between the actual size of the robotic system and the soma of the patients.

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