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Robotic-assisted single-site cholecystectomy in children☆,☆☆

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ABSTRACT

Background: Though single incision laparoscopic cholecystectomy (SILC) is cosmetically appealing, it is technically a difficult operation. The recent introduction of robotic single-site cholecystectomy (RSSC) has made single incision cholecystectomy easier to perform. While a few papers have reported its application in adults, it has not been documented in children.

Methods: Data on seventeen consecutive children who underwent RSSC by a single surgeon over a ten-month period were retrospectively reviewed. Patient demographics, total operative time, console time, hospital stay, complications and reasons for procedural delay were recorded.

Results: Sixteen operations were completed robotically using the single incision robotic platform. No major postoperative complications were noted. Median total operative time was 94 minutes with interquartile range (IQR) being 81.5–119.5 minutes. The median console time was 39 minutes (IQR: 30–72 minutes). The median total operative time for the first eight cases was 118 minutes (IQR: 103–127 minutes) and for the next nine cases 90 minutes (IQR: 76–93 minutes). Common causes for procedural delay were slipped clips, bile spillage, bleeding and leaking Single-Site® port.

Conclusions: This unique series of RSSC documents its feasibility and safety in children. A short learning curve and operative times comparable to RSSC in adults and SILC in children were observed. Being technically easier, RSSC becomes an attractive alternative to SILC to sustain its cosmetic benefit.

Robotic-assisted surgery has been adopted into minimally invasive surgical practice for its advantages of stereoscopic optics and better maneuverability with wristed instruments. Though application of robotic-assisted surgery in children has been limited, several reports have described successful use in children [1–3]. Single incision laparoscopic surgery has gained popularity over the last few years for its cosmetic benefit [4–8]. However transition from multiport to single port surgery has been challenging owing to loss of ergonomics, counterintuitive instruments, unstable platform and long learning curve [9]. The introduction of the single incision robotic platform in 2011 has enabled surgeons to overcome some of these disadvantages and perform single incision cholecystectomy in adults safely without added complications [9–16]. In the absence of literature on robotic single-site cholecystectomy (RSSC) in children, this study was performed to evaluate safety and efficacy of RSSC in children.

1. Materials & methods

1.1. Methods

After obtaining approval from the institutional review board, data on 17 children who underwent RSSC by a single surgeon during a ten-month period from March 2014 to January 2015 were retrospectively evaluated. No exclusion criteria were applied. The author performed nineteen pediatric multiport robotic operations including the initial proctored cases prior to starting the pediatric single-site program. Institutional policy for single-site robotic program requires completion of additional robotic single-site training lab and three initial single-site supervised cholecystectomies, which were also included in the analysis. As the da Vinci single-site platform is currently FDA-approved only for cholecystectomy in general surgery, no other procedure was performed using this platform. Information collected included age, sex, body weight, diagnosis, total operative time, console time, hospital stay and complications. Dedicated robotic surgery charts maintained prospectively for quality control were accessed to detail reasons for procedural delay if any. All patients were reviewed by the operating surgeon one week after surgery to assess recovery, complications and cosmetic satisfaction.

1.2. Procedure

A 25 mm vertical or S-shaped incision was made through the umbilicus after which a vertical midline incision in the fascia was made to accommodate the da Vinci Single-Site® port. Even though Intuitive Surgical advises a 15 mm incision, a 25 mm incision is required to insert the Single-Site® port without causing trauma to the umbilicus or to the port. An 8 mm, da Vinci, zero degree high definition 3-D telescope was placed through the camera port. Curved 5 mm working ports, measuring either 250 mm or 300 mm, depending on the length of the patient's

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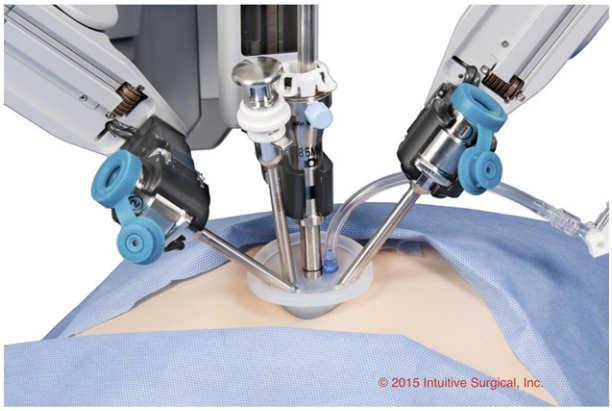

Fig. 1. Single-Site® gelport with docked ports.

abdomen, were introduced under vision in the prescribed manner [9]. The patient was positioned with a reverse Trendelenburg and mild left lateral decubitus position. The da Vinci SI robot (Intuitive Surgical, Inc., Sunnyvale, CA) was brought in over the right shoulder and docking accomplished. A 5 mm laparoscopic grasper was inserted through the fourth assist slot on the Single-Site® port (Fig. 1).

With cranial traction of the gall bladder by the assistant, a robotic fundus grasper and a hook monopolar diathermy were used to delineate the Calot's triangle. Hem-o-lok clips (Telaflex Medical, Research Triangle Park, NC) were placed to divide the isolated cystic duct and artery. The gall bladder was dissected off the liver using a hook dissector. The laparoscopic assist instrument was used to hold the disconnected gall bladder while the robot was undocked and ports withdrawn. The gall bladder was retrieved along with the gelport through the umbilical incision. Meticulous closure of the incision was done to prevent an incisional hernia. All patients received a single preoperative dose of inj. cefazolin. An added dose was administered postoperatively for those patients who had intraoperative bile spillage.

2. Results

The patient characteristics are detailed in Table 1. Median age was 16 years. The 6 year old who had multiple medical comorbidities underwent cholecystectomy because of abdominal pain without other diagnosed causes apart from cholelithiasis. He had symptom relief after surgery. 65% were female and 41% had close family members who were operated upon for gall bladder disease. All but one had a preoperative diagnosis of cholelithiasis. Pathology report indicated cholecystitis in 65% of patients, including one who was operated upon for biliary dyskinesia. Apart from 1 patient who required placement of 2 additional laparoscopic ports, all operations were completed robotically using the single incision platform. Two patients returned to the hospital for constipation, likely narcotic analgesic induced, one requiring admission for abdominal pain.

Median total operative time was 94 minutes with interquartile range (IQR) being 81.5–119.5 minutes. The median console time was 39 minutes (IQR: 30–72 minutes). The median total operative time for the first eight cases was 118 minutes (IQR: 103–127 minutes) and for the next nine cases 90 minutes (IQR: 76–93 minutes). No wound infection or incisional hernia was observed during the postoperative visit. Patients were asked to review in the event of either. Except for the six year old, who was developmentally delayed, all patients expressed satisfaction with the single incision scar (Fig. 2).

Dedicated quality control charts were maintained prospectively with comments recorded at the end of each operation. Causes of procedural delay noted helped brainstorm measures to improve technique. Inadequate grip on the gall bladder with a robotic crocodile grasper induced change to a robotic fundus grasper for gall bladder traction in subsequent cases. While slipped clips, bile spillage and liver bed bleed can be adequately resolved intra-operatively with no adverse effect on patient

Table 1
Patient characteristics, operative details and outcome.

Patient	Age (yrs)	Sex	Weight (kgs)	Diagnosis (preop/additional pathology)	Family history—GB disease	OP time (min)	Console time (min)	Hospital stay	Complications	Reasons for procedural delay
1.	18	M	138	Cholelithiasis/cholecystitis	Father, 2 sisters, uncle	121	39	OP	None	Bile spillage, slipped clips
2.	18	F	87	Cholelithiasis	None	127	71	OP	None	Bile spillage, leaking gelport
3.	12	F	62	Cholelithiasis/cholecystitis	Mother	65	29	OP	None	None
4.	11	F	70	Cholelithiasis/cholecystitis	None	103	46	OP	None	Poor grip on GB, liver bed bleed
5.	17	F	68	Cholelithiasis/cholecystitis	None	108	77	OP	POD3 – constipation with abdom pain – 24 hr admission	Liver bed bleed
6.	19	M	91	Cholelithiasis/cholecystitis	None	118	73	OP	None	Bile spillage, leaking gelport following damage from assist port
7.	15	F	143	Cholelithiasis/cholecystitis	None	118	56	OP	None	Slipped clips
8.	16	F	83	Cholelithiasis	None	183	113	30 hours	2 additional laparoscopy ports; POD3 ER visit for constipation	Leaking gelport, inadequate pneumoperitoneum, adherent intrahepatic GB, bile spillage
9.	17	F	78	Cholelithiasis/cholecystitis	None	79	29	OP	None	None
10.	6	M	16	Cholelithiasis	None	73	28	5 days*	None	Bile spillage
11.	18	M	67	Biliary dyskinesia/ cholecystitis	None	70	35	OP	None	None
12	14	F	68	Cholelithiasis	Both grandmothers	92	31	OP	None	None
13.	16	M	103	Cholelithiasis	None	90	27	OP	None	None
14.	16	M	127	Cholelithiasis/cholecystitis	Mother, uncle	90	40	OP	None	Slipped clips
15.	16	F	54	Cholelithiasis/cholecystitis	Mother	94	37	OP	None	Bile spillage
16.	12	F	56	Cholelithiasis/cholecystitis	Mother, grandfather	84	32	OP	None	None
17.	18	F	66	Cholelithiasis	Father, mother	134	85	OP	Cystic artery bleed	Bleeding, slipped clips

GB-Gall bladder; POD-Post operative day; OP-outpatient; ER-emergency room.
* Associated medical problems including developmental delay, seizure disorder, asthma & constipation delayed discharge.