J Robotic Surg (2017) 11:467–471
DOI 10.1007/s11701-017-0690-4

CASE REPORT

Bilateral robotic transabdominal adrenalectomy in a patient with intestinal malrotation

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Received: 17 November 2016 / Accepted: 10 March 2017 / Published online: 17 March 2017

Abstract Bilateral adrenalectomy is the preferred surgical approach for patients with failed treatments for pituitary-based Cushing's syndrome. Intestinal malrotation (IM) is a rare congenital anatomic variant that rarely affects adults. The abnormal abdominal anatomy is concerning to surgeons planning elective procedures in such patients. Here, we describe a bilateral robotic transabdominal adrenalectomy (RTA) in a patient with IM. A 29-year-old female presented with refractory pituitary-based Cushing's syndrome and was found to have IM on preoperative CT scan. The RTA was performed using one 10–12 mm camera trocar, two 8 mm robotic trocars per side and two midline 5 mm assistant ports. The 8 mm robotic cardiere forceps and the 8 mm robotic cautery hook were used on the left and right ports, respectively. Total operation time was 165 min (62 min on the right, 93 min on the left and 21 min for re-positioning). Total console time was 114 min (45 min on the right and 69 min on the left). Blood loss was minimal and there were no complications. She was discharged on post-operative day one. Anatomic variations were noted and the procedure modified. To our knowledge, this is the first reported case of bilateral RTA in a patient with IM. Surgeons should always review the anatomy on preoperative imaging. During the procedure, care should be taken to avoid damage to the multiple loops of small bowel located in the right upper quadrant. On the left side, the colonic splenic flexure is not encountered making access to the underlying left adrenal and kidney easier. The vascular anatomy was normal.

Keywords Da Vinci robotic system · Bilateral transabdominal robotic adrenalectomy · Intestinal malrotation

Introduction

Bilateral adrenalectomy has been selected as a main surgical treatment for patients with ACTH-dependent Cushing's syndrome who do not respond to other treatments [1, 2]. Intestinal malrotation (IM) is a rare but dreaded cause of life threatening bowel obstruction in children [3]. IM is most often diagnosed in children but can go unnoticed and asymptomatic to adulthood. This congenital anomaly affects the rotation of the mid-gut resulting in a shift of the small bowel to the right side of the abdomen while displacing the cecum from its usual position into the epigastrium and the ligament of Treitz is located inferiorly and rightward. Surgeons need to be mindful of the possibility of such anomalies during surgery and look for IM on preoperative radiographs.

Prior studies have described laparoscopic gastrectomy and Roux-en-Y gastric bypass in the setting of IM [4–6]. In these studies, the authors emphasize that surgeons need to be aware of this anatomic variant in advance and know how to handle it intraoperatively [5] as the operation requires visualization of the duodenojejunal angle and identification of the ligament Treitz before dividing the stomach and performing the Roux-en-Y or other reconstruction.

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To our knowledge, there are no previously published studies describing patients with IM who underwent bilateral RTA. Although adrenalectomy does not require complicated bowel anastomoses, the surgeon does need to know how to mobilize the surrounding solid organs and bowel to expose the adrenal gland. Herein, we present a patient with IM who underwent bilateral RTA.

Case

A 29-year-old female with refractory Cushing's disease was referred to our clinic for consideration of bilateral adrenalectomy. Her BMI was 31. She had failed a pituitary operation. She continued to have elevated cortisol and ACTH despite surgical and medical treatment. Her symptoms included weight gain, fatigue, weakness and lack of sleep. She felt well when she was on metyrapone but anytime she stopped the medication she had resurgence of her symptoms. She also desired to get pregnant and at the advice of her endocrinologist she was considering bilateral adrenalectomy. CT scan of the abdomen (with adrenal protocol) showed minimal left adrenal nodularity and bowel malrotation with the classic findings of lack of duodenum crossing midline, small bowel in the right and large bowel in the left hemi-abdomen (Fig. 1). The patients denied any chronic abdominal pain.

Surgical procedure

After appropriate consent, the patient was brought to the major operating suite and placed in a supine position. General endotracheal anesthesia was established. An arterial line and IVs, nasogastric tube and Foley catheter were placed.

We started with the right adrenal gland. The patient was positioned in left lateral decubitus and her abdomen was prepped and draped in the usual sterile manner. The procedure begun using the Optiview technique utilizing a 10–12 trocar and entering the abdomen in the subcostal area at around the mid-clavicular line about 5 cm away from the costal margin. Two 8 mm robotic trocars were placed triangulated to the camera port (1 medial subcostal and 1 lateral subcostal). 5 mm assistant trocars were placed at subxiphoid and periumbilical areas (Fig. 2). The da Vinci robot was then docked (Intuitive Surgical, Sunnyvale, CA, USA). The 8 mm robotic cardiere forceps were used on the left side and the robotic cautery hook on the right side port. With the 30 degree camera looking down, the procedure usually begins by gently retracting the colon and visualizing the duodenum (Fig. 3a), but in this case we saw the absence of the typical duodenum over the cava and saw multiple loops of small bowel heading caudal confirming malrotation (Fig. 3b). The loops of small bowel present in the right upper quadrant were retracted caudally and medially. The liver was retracted and separated from the retroperitoneum by taking the peritoneal reflection. The adrenal gland was identified. Dissection began laterally, superiorly and the proceeded medially. The plane between the adrenal and the cava was carefully dissected and revealed the right adrenal vein. The right adrenal vein was circled with the robotic hook and then clipped with 5 mm green Hem-o-lok clips (Teleflex Medical, Morrisville, NC, USA) (Fig. 3c) and then divided (Fig. 3d) by the first assistant through the 5 mm periumbilical assistant port. After the adrenal gland was removed from the retroperitoneum, it was placed into an Endopouch Retriever (Ethicon Endosurgery, Cincinnati, OH, USA) and the string was exteriorized through the subxiphoid assistant port and secured

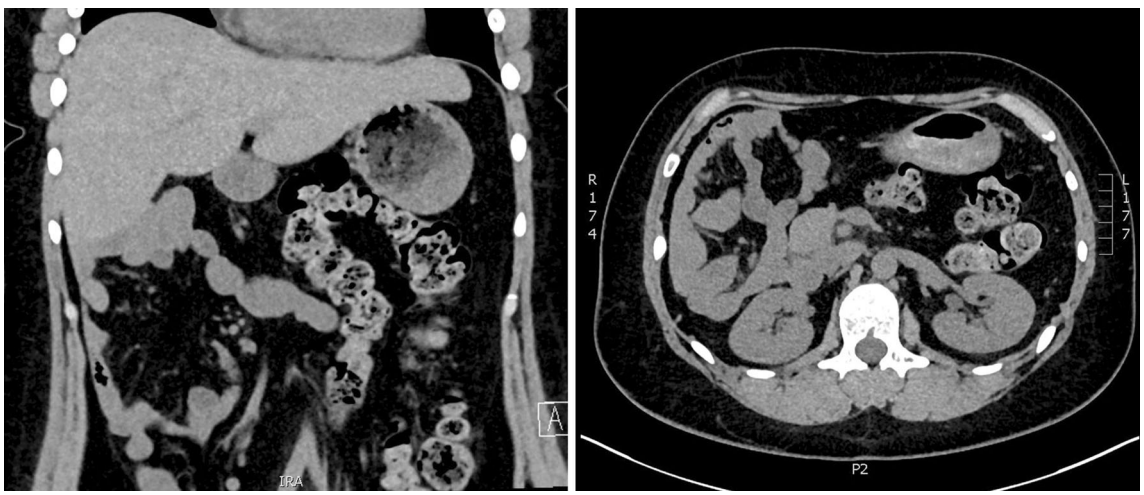

Fig. 1 CT scan showing asymptomatic IM

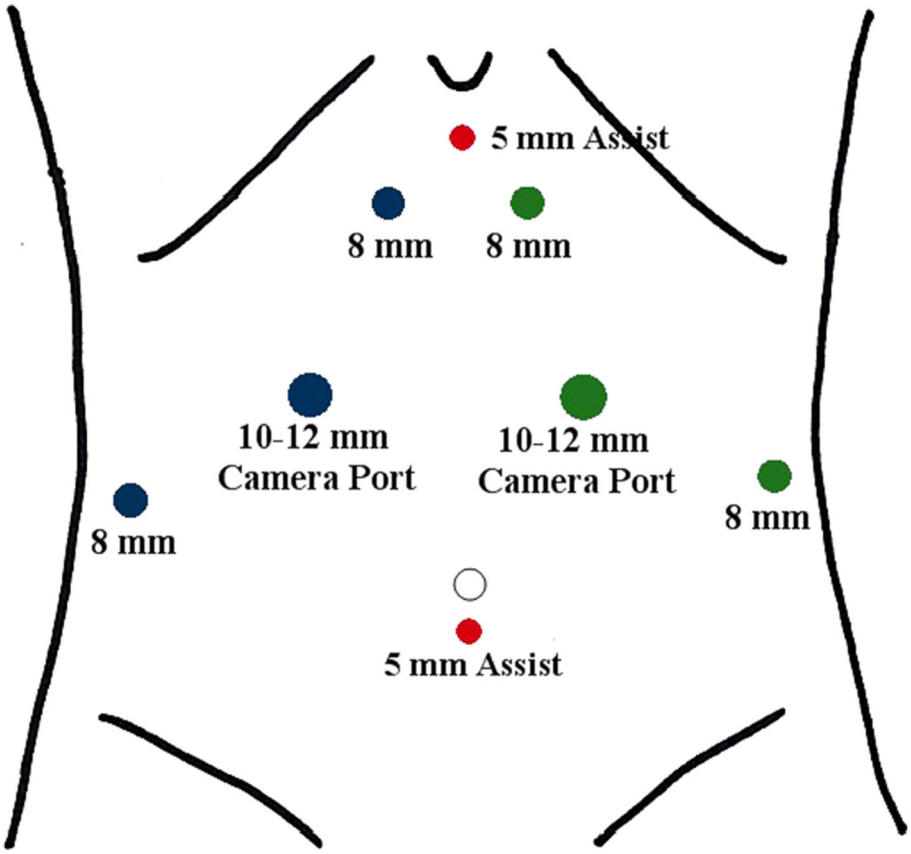

Fig. 2 Trocar placement for bilateral transabdominal robotic adrenalectomy

to the skin to maintain contact with the bag. The lateral ports were closed. The subxiphoid and periumbilical assistant ports were temporary closed with staples and covered for sterility as they were going to be used subsequently for the left adrenalectomy.

The patient was repositioned in right decubitus with the left side up. The left adrenalectomy begun by entering the abdomen using the Optiview technique and we triangulated two robotic 8 mm ports (Fig. 2) and the 2 assistant port sites were reused. The procedure usually begins by mobilizing the splenic flexure (Fig. 4a), but this part of the procedure was not necessary because in malrotation the left colon does not fixate to the retroperitoneum in the same fashion, rather just a thin layer of mesentery was mobilized (Fig. 4b). The attachments between the spleen/pancreas and the kidney and adrenal gland were dissected and the spleen and pancreas were medialized. The adrenal tissue was identified and separated from the pancreas superiorly, continuing the dissection medially and inferiorly until the adrenal vein was found clearly emptying into the renal vein. We did not encounter any adrenal vascular anomalies. The adrenal vein was encircled, clipped and divided (Fig. 4c, d). The adrenal gland was then separated with a rim of surrounding fat off of the retroperitoneum and placed in an Endopouch. Both bags were then marked left and right and removed through the assistant port in the periumbilical area. After all CO_2 was evacuated, all port sites were closed.

Results

Total operation time was 165 min (62 min on the right, 93 min on the left with 21 min for re-positioning and re-prep). Total console time was 114 min (45 min on the right and 69 min on the left). Blood loss was minimal and there were no complications. Length of hospital stay was one day. Pathology showed benign left and right adrenal glands without significant histopathological changes. The left gland measured 7.2 cm and weighed 16.1 g and the right gland measured 6.5 cm and weighed 12.3 g. The patient has been followed for 6 months and is doing well without complications.

Discussion

Congenital IM is typically diagnosed among infants. In the USA, approximately one in every 500 newborn is diagnosed with IM. IM can also occur in older children and adults [3, 7] but up to 90% of those afflicted are diagnosed by age one. A minority of patients with IM will be asymptomatic until they have imaging for other conditions later in life. IM is a congenital anomaly of rotation of the mid-gut with the following anatomical findings: (1) the duodenal–jejunal junction and loops of small bowel are on the right side of the abdomen (the duodenum does not cross the midline); (2) the colon and

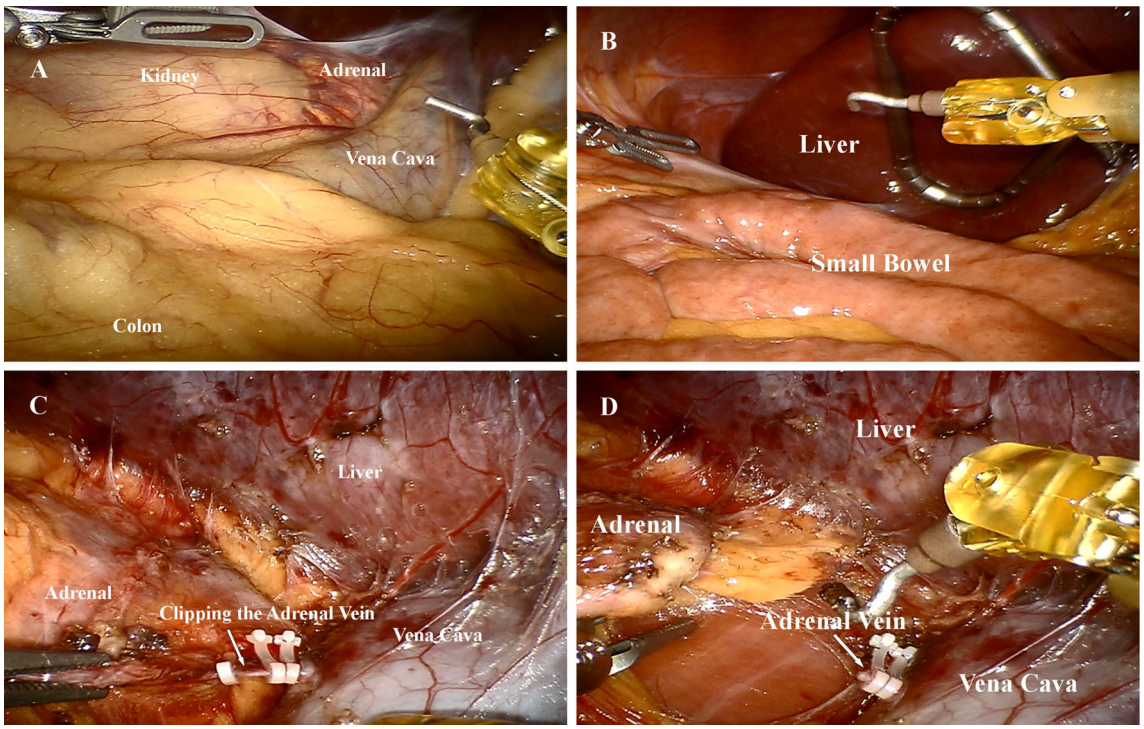

Fig. 3 **a** Right upper quadrant without IM. **b** Right upper quadrant with IM (loops of small bowel over the right kidney). **c** Clipping of the right adrenal vein. **d** Dissection of right adrenal gland

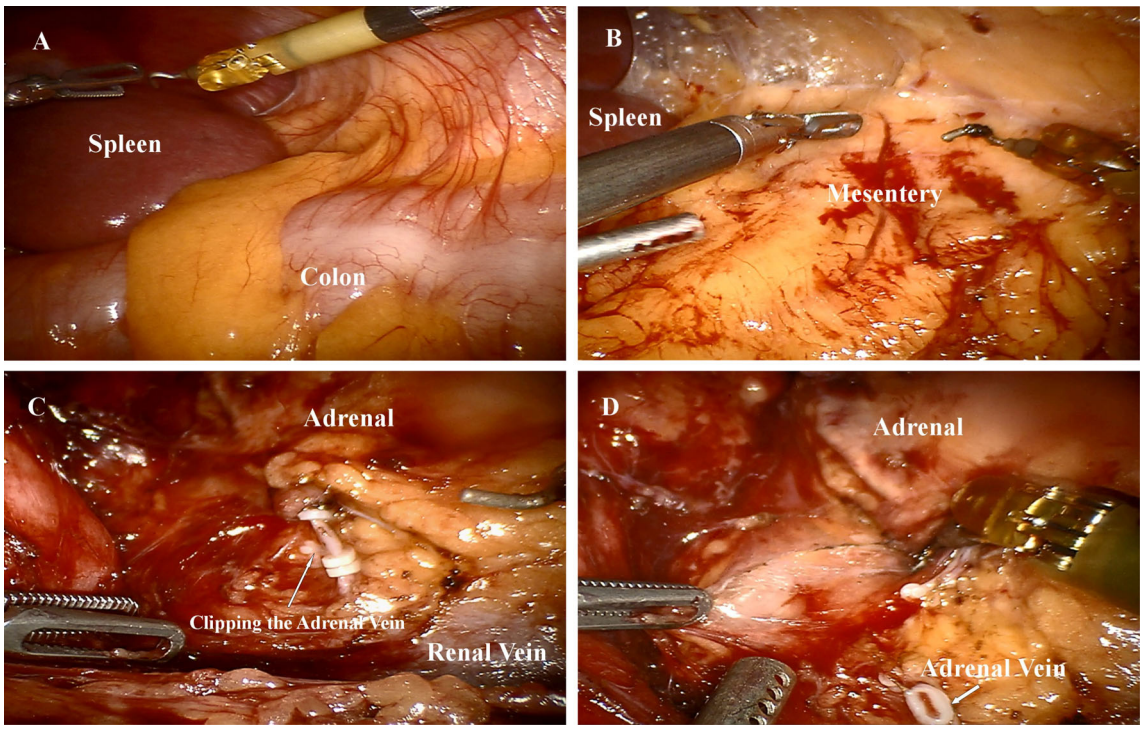

Fig. 4 **a** Left upper quadrant without IM. **b** Left upper quadrant with IM. **c** Clipping of the left adrenal vein. **d** Dissection of left adrenal gland

mesentery are on the left side of the abdomen; (3) there is aplasia of the pancreatic uncinate process and absence of the transverse colon crossing the abdomen [5, 8]. All these anatomical changes will affect surgical abdominal invasive procedures and surgeons are better prepared when they are aware of the condition before the planned procedure.

Bilateral adrenalectomy has been selected as the principal surgical treatment for patients with ACTH-dependent Cushing's syndrome who have failed other treatments [1, 2]. Horgan and Vanuno reported the first robotic transabdominal adrenalectomy (TA) in 2001 [9]. Since then, RTA gained popularity as an alternative to laparoscopic TA, and has been widely used due to the advantages of the robotic approach. As soon as we became aware this patient had IM, we researched the literature to adequately prepare for the procedure. To our surprise, we could not identify any published studies discussing and describing the surgical steps of laparoscopic or robotic adrenalectomy in patients with IM. We present this case report to show the surgical areas on the left and right of the abdomen in IM patients as compared to non-IM patients. RTA may be easier to perform in the patients with IM when compared to non-IM patients, especially the left adrenalectomy, because the left colon is not draped over the left kidney making access to the left adrenal gland more expedient. Furthermore, we did not encounter any adrenal vascular anomalies.

Preopertive CT imaging (adrenal protocol non-contrast image-Fig. 1) on this patient revealed that the small bowel was in the right abdomen and when the abdominal cavity was entered the typical duodenal c loop was not observed. Instead, the duodenum coursed caudally joining multiple small bowel loops. The small bowel loops were present in the right upper quadrant and were retracted caudal and medial (Fig. 3a vs. b) to expose the surgical field. This allowed the procedure to proceed as it does in patients with no IM. On the left side, the procedure usually begins by mobilizing the splenic flexure (Fig. 4a vs. b) to expose the kidney and its hilum, but on this patient there was no colon present in this area making the procedure easier. The pancreatic tail was prominent, possibly compensating for the uncinate process aplasia but this change did not affect our dissection around the left adrenal gland. Furthermore, we did not encounter any other procedural differences when compared to patients without IM.

Conclusion

To our knowledge, this is the first reported case of bilateral RTA on a patient with IM. Our experience from this case reinforces the importance of prior knowledge of anatomic variance associated with IM. During adrenalectomy in patients with IM, the surgeon should avoid small bowel injury on the right abdomen and should expect no need to mobilize the colon on the left side. The adrenal vasculature was normal.

Compliance with ethical standards

Conflict of interest Zuliang Feng and Carmen C. Solórzano declare that they have no conflict of interest.

Funding No funding was received for this study.

Ethical approval The procedure performed in this study involving a human participant was in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Written informed consent was obtained from the patient for publication of this Case Report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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