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First cases of combined full robotic partial nephrectomy and colorectal resections: Results and new perspectives

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Abstract

Background: Nowadays the robotic platform is widespread in general surgery, urology, and gynecology. Combined surgery may represent an alternative to sequential procedures and it allows the treatment, at the same time, of coexisting lesions; in this perspective, full-robotic multiorgan surgery is starting to gain interest from surgeons worldwide.

Methods: Between April and June 2019, two patients presenting with synchronous colorectal and kidney cancers underwent, respectively, full-robotic right colectomy with right partial nephrectomy and anterior rectal resection with left partial nephrectomy. Surgeries were performed by both the general surgery and urology team.

Results: No intraoperative complications were registered and the postoperative course was uneventful in both cases.

Conclusions: Combined multiple organ surgery with full robotic technique is safe and offers oncological adequate results. A multi-team surgical pre-planning is mandatory to reduce invasiveness and operative time. To the best of our knowledge, these are the first reports of full robotic partial nephrectomy combined with colorectal procedures.

KEYWORDS

combined robotic multiorgan procedures, robotic colorectal resection, robotic partial nephrectomy, synchronous colorectal and renal cancer

1 | INTRODUCTION

Robotic-assisted surgery had a widespread diffusion among specialties. The technical advantages of the robotic platform could be exploited at their best in combined multiorgan procedures, traditionally requiring different interventions with separated surgical accesses. Combined minimally invasive surgery may represent an alternative to sequential procedures and allow to treat at the same time coexisting lesions, especially when considering the recent increase in detection of synchronous cancers, due to advances in screening, diagnostics, and imaging technologies.[1] Surgical removal is the standard of care for most of the abdominal malignancies and this is the case for both renal masses and colorectal cancer.

Although not routinely performed, robotic multiorgan surgery is starting to gain interest from surgeons worldwide. However, studies concerning simultaneous robotic procedures are still limited to case reports and small series, with a lack of standardization and sequencing of the involved steps.[2-5]

We herein report our experience with a full robotic combined approach, describing two cases of synchronous colorectal and kidney cancers, treated with right colectomy and low anterior rectal resection, respectively, associated with partial nephrectomy, performed with the da Vinci Si robotic system (Intuitive Surgical, Sunnyvale, CA); our aim is to depict the feasibility of the procedure and create a starting point for the standardization of the technique.

2 | MATERIALS AND METHODS

Between April and June 2019 two patients presented at our Hospital with synchronous colorectal and kidney cancer. Both cases underwent tumor board discussion and indication to surgery was confirmed; a concurrent robotic resection of both cancers was chosen as the first line of treatment. The procedures were performed by both the General Surgery and Urology teams, with the DaVinci Si System (Intuitive Surgical, Sunnyvale, CA).

All procedures performed in the study involving human participants were in accordance with ethical standards of Institutional and National research committee and informed consent and IRB approval were obtained.

2.1 | Case presentation and surgical technique

2.1.1 | Case 1

An 81-year old man, body mass index (BMI) 27, American Society of Anaesthesiologist (ASA) score 3, presented with severe anemia. Past medical history included ischemic cardiomyopathy and left nephrectomy for clear cells renal carcinoma. The colonoscopy revealed an adenocarcinoma of the ileocecal valve. The subsequent staging thoraco-abdominal CT-scan showed a solid 2 cm lesion of the mesorenal border of the right kidney, suspicious for malignancy (Figure 1A). Preoperative imaging was then three-dimensionally reconstructed with the DocDo app (Figure 1B), and Padua score as measured with 3D imaging revealed an intermediate risk renal mass (score: 9). No other lesion was reported. After multidisciplinary evaluation, the patient underwent concurrent full robotic right colectomy and robotic right kidney mass enucleation.

The patient was placed supine with legs apart in a 15° Trendelenburg position with a 15° left tilt, the robot was docked from the patient's right side. Pneumoperitoneum was achieved with a Veress needle at Palmer's point. A left paraumbilical 12-mm trocar was placed for the 30° robotic camera. Three 8-mm robotic trocars were placed in the left hypochondrium, hypogastrium, and right iliac fossa, respectively, as shown in Figure 2A. The 12-mm assistant port, connected with the AirSeal Insufflator (CONMED, Utica, NY), was placed in the left flank. Two Cadiere forceps and the Harmonic scalpel (Intuitive Surgical, Sunnyvale, CA) were used. A standard full robotic right colectomy was performed according to oncological principles: the ileocolic vessels, right colic artery, and right branch of the middle colic artery were isolated and sectioned between clips. Right colic flexure was mobilized; right ureter, right gonadal vessels, and right Gerota's fascia were identified and preserved. Terminal ileum and transverse colon were transected with a 60 mm linear stapler Signia (Medtronic, Watford, UK) purple cartridge, and the specimen was extracted through a suprapubic incision with a wall protector Alexis system (Applied Medical, Rancho Santa Margarita, CA). It was decided to perform the ileocolic anastomosis after the kidney mass enucleation, to allow the urologist to work in a more comfortable operating space and avoid field contamination.

The robot was undocked, and the patient was placed in a 45° left flank position with his right arm adducted on the head. Pneumoperitoneum was re-established and the urologist adjusted the

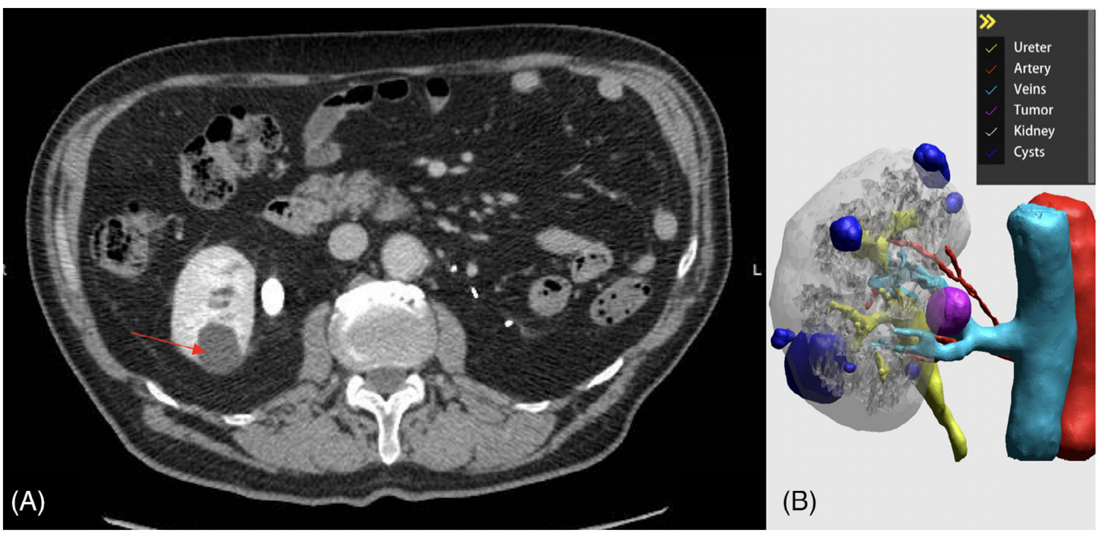

FIGURE 1 A, CT scan of the right renal tumor, the arrow points the lesion; B, DocDo three-dimensional reconstruction of 2D CT images

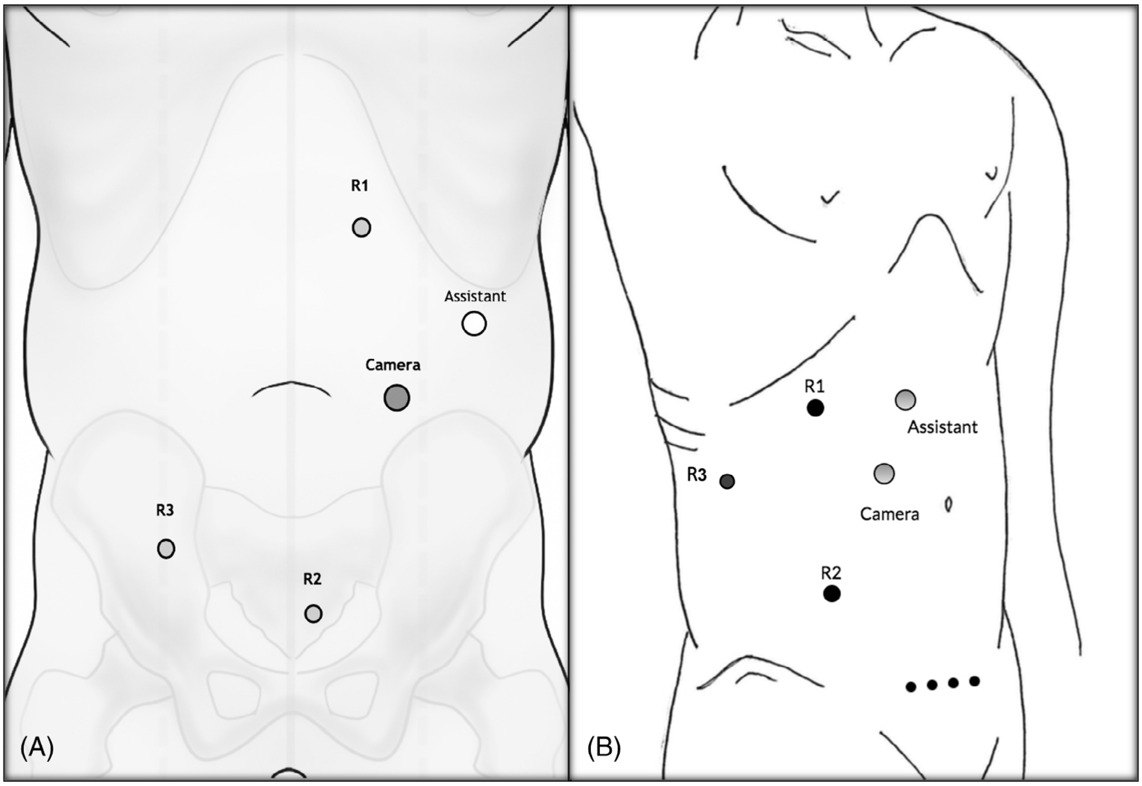

FIGURE 2 A, Port placement for robotic right colectomy with the patient in supine position; B, port placement for right partial nephrectomy with the patient in left lateral decubitus

port placement, adding a 12 mm port for the camera on the pararectal right line, and three 8 mm robotic ports under the right costal margin, in the right flank and medially from the right iliac spine, respectively (Figure 2B). The Airseal port was inserted through the Alexis system (Applied Medical, Rancho Santa Margarita, CA). The robot was then docked from the patient's right flank and a Maryland bipolar forceps, and monopolar scissors were inserted in the two operative arms.

The first step was isolation of the right ureter, followed until the inferior pole of the right kidney; renal hilum elements were then isolated on a vessel-loop. Gerota's fascia was dissected, the renal tumor was recognized, and a complete enucleation of the lesion was performed under renal artery clamping, carefully sparing healthy renal parenchyma (Ischemia time: 9 minutes). The specimen was introduced in an endobag and extracted through the suprapubic incision.

The final surgical time was then completed: the patient was placed in a supine position; a new docking was performed and ports were repositioned as before. A latero-lateral intracorporeal ileocolic anastomosis was fashioned with the same 60 mm linear stapler, and the enterotomies were then closed with an absorbable barbed running suture (V-loc 3.0, Covidien, Mansfield, MA, USA). A laminar drain was located in the right renal lodge.

2.1.2 | Case 2

A 59 years old woman (BMI 24, ASA score 2) presented with blood per rectum. Past medical history included breast cancer, treated with surgery and radiation, and currently under hormonal therapy. Colonoscopy reported an adenocarcinoma at about 15 cm from the anal verge. The subsequent staging thoraco-abdominal CT-scan showed a 5 cm solid lesion of the upper third of the left kidney, strongly suspicious for malignancy (Figure 3). After multidisciplinary evaluation, the patient underwent concurrent full robotic anterior rectal resection and robotic left kidney enucleation.

The patient was supine in a 30° Trendelenburg position, with a 20° to 25° right tilt. The robotic cart was placed at the patient's left side and docked from the left lower quadrant over the left hip. The pneumoperitoneum was achieved with a Veress needle at Palmer's point. The 12-mm standard laparoscopic trocar for the robotic camera (30°) was placed about 2 cm lateral and 2 to 3 cm above the real umbilicus. Four 8-mm robotic trocars were positioned on the right lower quadrant, in the right upper quadrant, in the left upper quadrant, and in the left lower quadrant as shown in Figure 4A. The assistant 12-mm standard laparoscopic trocar was placed in the right flank. The same robotic instruments as Case 1 were used.

A complete exploration of the abdominal cavity was performed to rule out peritoneal seeding before docking the robotic cart. We performed a standard full robotic anterior resection with partial mesorectal excision (PME), adopting a single docking technique. During the PME step, arm 3 was moved to the left hypochondrium trocar and arm 2 to the left flank one to achieve optimal access to the mesorectum. R1 and R3 were the operative arms, whereas R2 was used to expose the pelvic area with traction on pelvic sidewalls. Rectal transection was performed with a 60 mm linear stapler Signia

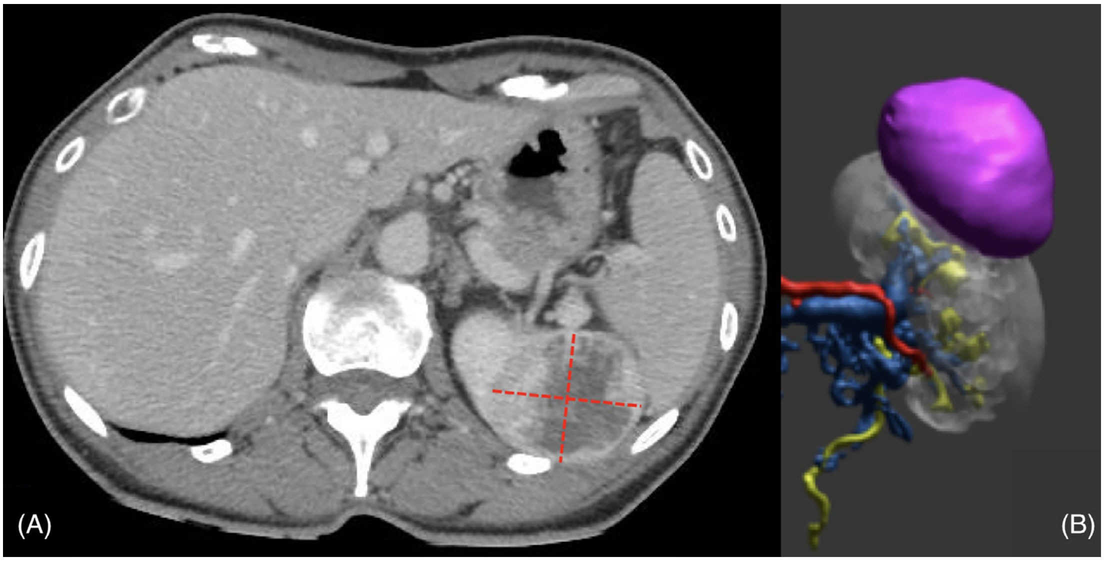

FIGURE 3 A, CT scan of the left renal tumor; B, DocDo three-dimensional reconstruction of 2D CT images

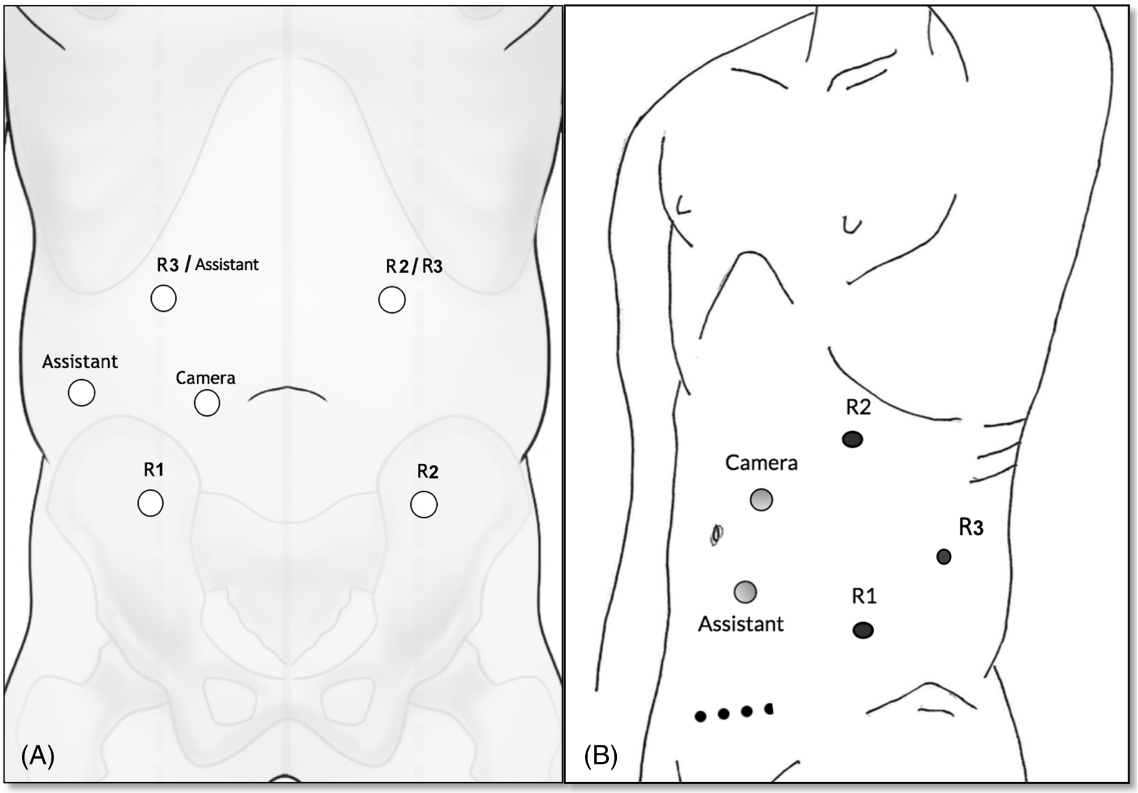

FIGURE 4 A, Port placement for robotic anterior rectal resection with the patient in supine position. For partial mesorectal excision (PME), R3 and R2 are moved to left hypochondrium and left flank, respectively. The trocar in the right hypochondrium can be used as a second assistant port; B, port placement for left partial nephrectomy with the patient in right lateral decubitus

(Medtronic, Watford, UK) purple cartridge about 5 cm below the tumor tattoo. The specimen was extracted through a suprapubic incision with a wall protector Alexis system (Applied Medical, Rancho Santa Margarita, CA). Bowel continuity was restored through a circularly stapled end-to-end colorectal anastomosis (Covidien, EEA 28 mm, Mansfield, MA, USA). Intraoperative air testing of the anastomosis was negative, and a laminar drain was placed in the pelvis. The robot was then undocked and the urological time started. The patient was placed in a 45° right flank position with the left arm adducted on the head. Pneumoperitoneum was reestablished and the urologist adjusted the port placement, maintaining the 12 mm camera trocar and adding two 8 mm robotic trocars (Figure 4B). The robotic cart was then re-docked. The 5-cm lesion of the superior pole of the kidney was enucleated under renal artery clamping and a drain was placed in the left renal lodge. The specimen was extracted in an endobag through the same suprapubic incision. Ischemia time was 25 minutes.

3 | RESULTS

In case 1, the total operative time was 400 minutes. Total general surgery console time was 125 minutes, which included the fashioning of the anastomosis; total urology console time was 140 minutes.

The three different dockings, with change of patient's and cart's positions, required a total of 110 minutes. No intraoperative complications were registered, and the post-operative course was uneventful. First flatus was referred on the second post-operative day (POD), oral intake was started on the third POD, and the abdominal drain was removed on POD 7. The patient was discharged on POD 9.

Pathology examination reported a right colon adenocarcinoma (pT2, G2) with safety margins (R0) and no metastatic regional lymph nodes found between the 17 harvested (N0); the renal tissue revealed clear cell renal carcinoma, free margins, grade 2.

In case 2, the total operative time was 600 minutes, including docking and team switching. The total general surgery and urology console times were, respectively, 225 and 240 minutes; the two dockings, with change of patient's and cart's positions, required a total of 65 minutes. No intraoperative complications were registered, and post-operative course was uneventful. No intraoperative complications were registered, and blood loss was non-significant. Post-operative course was uneventful, and the patient was discharged on POD 10. First flatus was referred on POD 2, and oral intake started on the same day. The drain in the renal lodge was removed on POD 4, and the one in the pelvis was removed on POD 7.

Pathology examination reported a rectal adenocarcinoma (pT3, G2) with safety margins (R0) and no metastatic regional lymph nodes found between the 18 harvested (N0); the renal tissue revealed papillary renal carcinoma with free margins.

At 10 and 12 months follow-up, respectively, both patients present in good health, and no recurrences occurred.

4 | DISCUSSION

Synchronous primary malignancies represent 1% of cancer cases, with colorectal tumor associated with renal one in 4% of cases, and colorectal associated with prostate adenocarcinoma in 1% of those.[6-8] Specifically, the incidence of asymptomatic renal masses extensively increased during the last decades, due to the widespread diffusion of imaging performed for other diseases and the related technological advances.[1]

Given the role of surgery for either colorectal and renal malignancies, the rationale behind a combined approach is to remove both lesions at the same time with a single procedure, gaining advantages in terms of length of hospital stay and post-operative morbidity.[8,9] Furthermore, a postponed second surgery could result in a delay in the administration of adjuvant chemotherapy, with possible oncological drawbacks.

A minimally invasive approach for combined surgical interventions has been described before, as pure laparoscopic[2,10] or hybrid (laparoscopic and robotic)[8]: the latter is the case of robotic radical prostatectomy in which the consolidated robotic experience has been associated with laparoscopy to treat concurrent colorectal cancer.[3,8,11]

In our series, we describe a full robotic simultaneous conservative renal *plus* colorectal surgery, and to the best of our knowledge, these are the first reports of full-robotic partial nephrectomy combined with robotic colorectal procedures.

Descriptions of simultaneous full-robotic approach for colorectal and genitourinary cancers are scarce, and a standard surgical procedure is missing.[8,12]

Morelli et al[9] recently reported a series of 10 cases of colorectal procedures combined with other major surgeries using a full robotic approach, including two cases of right colectomy combined with right radical nephrectomy. The authors chose a sequence of dissection similar to ours, leaving the fashioning of the intracorporeal anastomosis as the final step.

In our series, general surgeons performed colon resection first, and then the Urology team followed with partial nephrectomy. In case 1, we preferred to restore bowel continuity after the urologic time, to leave the urologists more comfortable in the operating set and avoid contamination of the surgical field, while in case 2, colorectal anastomosis was performed before the urologic procedure.

In the case of robotic right colectomy, combined with right partial nephrectomy, we had to perform three different dockings, thus extending the operative times; for the second case, we preferred to complete the colorectal procedure before leaving the operative field to the urologists, thus avoiding one docking. Despite multiple dockings and changes in the patient's position, we were able to use a full robotic approach without having to resort to a hybrid laparoscopic/robotic technique.

Our cases involved robotic-assisted partial nephrectomy, which is to be preferred over radical nephrectomy for T1 tumors since it can provide equivalent oncological outcomes with reduced postoperative complications and greater preservation of renal function.[13,14]

An accurate pre-planning is always mandatory in the case of robotic multiorgan surgery; in addition to tumor board discussion, there was a pre-operative briefing between general surgery, urology, and operating room team to plan the sequence of dissection and operative room and patient's set-up.

The profound knowledge of both tumor's and patient's characteristics remains of uttermost importance. Surgical indication should be tailored on the patient and should consider comorbid conditions contra-indicating a prolonged pneumoperitoneum or Trendelenburg position. Afterward, surgical strategy should be also tailored on disease's characteristics: this occurrence applies especially to partial nephrectomy, in which a 3D reconstruction of imaging improves the pre-operative understanding of renal anatomy and tumor complexity.

During the pre-planning, the following issues should be considered:

- Laterality of involved organs: surgery for organs located in the same hemiabdomen (ipsilateral) is affordable without changes in the robotic cart position (same side for both interventions);
- Patient positioning: consider different tilting required for colorectal (15°-25°) and kidney exposure (45°), which results in a supine position moved to lateral decubitus.
- Ports arrangement: for ipsilateral procedures, colorectal surgery could be successfully performed with a port arrangement similar to the one generally used in urogenital surgery, resulting in a minimum number of additional ports.
- Undocking and re-docking: required for changes in patient positioning and in the case of additional port placement; to retarget pre-existing ports to the different field.
- Sequencing of the procedures and fashioning of the bowel anastomosis: for ipsilateral procedures, consider colorectal surgery to be performed first, to have the bowel mobilized when approaching the kidney. The restoration of bowel continuity could be postponed after urological time or performed before, based on the anatomical site and potential interference posed by the anastomosis to the field of the urologist.

Robotic surgery has already proven to offer several advantages in terms of post-operative and intraoperative outcomes. A simultaneous robotic approach for synchronous malignancies combines the benefits of minimally invasive surgery with the technical advantages of the robotic platform over standard laparoscopy. The patient has the possibility to undergo two surgeries at the same time, without increasing morbidity, thus avoiding delays in post-operative chemotherapy administration. Several authors have already reported the advantage of robotic-assisted partial nephrectomy over laparoscopy in terms of conversion to open, reduction of warm ischemia time, length of hospital stay, and preservation of renal function.[15,16]

On further analysis, operative times of course resented of the dockings and changes in patient position; however, they were comparable with those of other reports.[8,12] Experience has proven to shorten the operative times, as well as preoperative planning of port placement and operative room set-up. Advances in technology, such as the use of the latest robotic platforms (DaVinci X, Xi and SP systems) and integrated table motion, could further contribute to reduce operative times and help standardize combined procedures.

5 | CONCLUSIONS

Our experience, although limited, allows us to state that combined multiple organ surgeries with a full robotic technique are safe and produce oncological adequate results. A full robotic approach to synchronous colorectal and genitourinary malignancies represents a step toward the optimization of surgical strategy with advantages for both the patient and for overall cancer cure. To the best of our knowledge, these are the first reports of full robotic partial nephrectomy combined with robotic colorectal procedures.

Multiorgan surgery is feasible with da Vinci robotic system: multidisciplinary surgical pre-planning is the key-point in order to reduce the invasiveness of the whole procedure, to define ports arrangement, the sequencing of steps, undocking and re-docking, and it could result in acceptable operative time and low morbidity.

Our study offers a further experience in this field of application of robotic surgery and could represent a good starting point to implement robotic multiorgan procedures. Further studies are needed to investigate the topic and eventually standardize combined robotic surgeries.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

RESEARCH INVOLVING HUMAN PARTICIPANTS AND/OR ANIMALS

All procedures performed in the study involving human participants were in accordance with ethical standards of Institutional and National research committee.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

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