Chirurgia (2023) 118: 20-26
No. 1, January - February

http://dx.doi.org/10.21614/chirurgia.2831

Review of Robotic Simultaneous Resection of Colorectal Cancer with Synchronous Liver Metastases Using Da Vinci Xi: Technical Considerations and Outcomes

Sabrina Hui Xian Cheok[1], Hiang Jin Tan[1], Marco Vito Marino[2], Nita Thiruchelvam[1], Adrian Kah Heng Chiow[1,3]*

[1]Hepatopancreatobiliary Service, Department of Surgery, Changi General Hospital, Singapore
[2]General Surgery Department, F. Tappeiner General Hospital, Merano, Italy
[3]Duke-NUS Medical School, Singapore

***Corresponding author:**
Adrian Kah Heng Chiow, MBBS, FRCS
Hepatopancreatobiliary Service
Department of Surgery
Changi General Hospital, Singapore
E-mail: adrian.chiow.k.h@singhealth.com.sg

Received: 26.01.2023
Accepted: 27.02.2023

Rezumat

Rezecția robotică simultană a cancerului colorectal și a metastazelor hepatice utilizând platforma Da Vinci Xi: considerații tehnice și rezultate

Context: Chirurgia robotică a revoluționat domeniul chirurgiei oncologice minim invazive. Platforma Da Vinci Xi reprezintă o actualizare semnificativă a platformelor Da Vinci mai vechi, care facilitează rezecția multi-viscerală şi în cadrane multiple. Acest articol analizează factorii tehnici actuali şi rezultatele chirurgiei robotice în colectomiile ce asociază rezecția simultană a metastazelor hepatice sincrone şi oferă o perspectivă asupra considerațiilor tehnice pentru rezecția combinată.
Metode: Studiul include articole indexate în PubMed publicate între 01 ianuarie 2009 şi 20 ianuarie 2023. Au fost analizați 78 de pacienți la care s-a practicat rezecție robotică colorectală sincronă cu cea a metastazelor hepatice prin intermediul platformei Da Vinci Xi şi au fost evaluate indicația, factorii tehnici şi rezultatele postoperatorii.
Rezultate: Pentru rezecția sincronă, timpul operator mediu a fost de 399 minute şi pierderea medie de sânge o fost de 180 ml. 71,7% (43/78) pacienți au dezvoltat complicații postoperatorii, 41% fiind Clavien-Dindo Grad 1 sau 2. Nu a fost raportată mortalitatea la 30 de zile. Factorii tehnici, inclusiv plasarea porturilor, şi factorii chirurgicali, au fost prezentați şi discutați pentru diferitele permutări ale rezecțiilor de colon şi hepatice efectuate.
Concluzie: Chirurgia robotică cu platforma Da Vinci Xi este o abordare sigură şi viabilă pentru rezecția simultană a cancerului de colon şi a metastazelor hepatice. Studiile viitoare şi diseminarea

experienței tehnice vor facilita standardizarea şi adoptarea rezecției robotice multi-viscerale în cancerul colorectal metastazat doar la nivel hepatic.

Cuvinte cheie: metastaze hepatice în cancerul colorectal, chirurgie robotică, cancer colorectal, platforma Da Vinci Xi

Abstract

Background: Robotic surgery has revolutionized the field of minimally invasive oncologic surgery. The Da Vinci Xi platform is a significant upgrade from older Da Vinci platforms facilitating multi-quadrant and multi-visceral resection. We review the current technical factors and outcomes in robotic surgery for simultaneous resection of colon and synchronous liver metastases (CLRM) and provide future perspective on technical considerations for combined resection.

Methods: A literature search on PubMed was performed and relevant studies from January 1st 2009 to January 20th 2023 were identified. Seventy-eight patients who underwent synchronous colorectal and CLRM robotic resection with the Da Vinci Xi were analysed and their indication, technical factors, and post-operative outcomes were studied.

Results: The median operative time was 399 minutes and mean blood loss of 180 ml for synchronous resection. Post-operative complications were developed by 71.7% (43/78) patients, 41% being Clavien-Dindo Grade 1 or 2. There was no 30-day mortality reported. Technical factors including port placements and operative factors were presented and discussed for the various permutations of colonic and liver resections performed.

Conclusion: Robotic surgery with the Da Vinci Xi platform is a safe and viable approach for simultaneous resection of colon cancer and CLRM. Future studies and sharing of technical experience will potentially facilitate standardization and increased uptake of robotic multi-visceral resection in metastatic liver only colorectal cancer.

Key words: synchronous colorectal liver metastases, robotic surgery, colorectal cancer, Da Vinci Xi

Introduction

Synchronous colorectal liver metastases (CRLM) are present during diagnosis for in up to 15% of patients (1). Surgical resection is the standard of care for resectable CRLM and has shown survival rates of up to 50% (2). Many studies have been published that demonstrated the safety and feasibility of simultaneous resection (3,4). The METASYNC trial by Boudjema et al showed that simultaneous resection of primary colorectal tumour and CRLM results in similar morbidity rates and superior overall survival compared to delayed resection (5).

The robotic platform has revolutionized the field of minimally invasive surgery (MIS), with its purported ability to overcome the technical limitations of laparoscopy via three-dimensional visualization, superior ergonomics, and shorter learning curve. A recent meta-analysis showed that robotic liver resection had similar complication and conversion rates, but reduced readmission rates compared to laparoscopic approach (6). There have been an increasing number of publications sharing their experience with the use of the robotic platform for simultaneous resection of primary colonic tumour and synchronous CRLM, although these are limited to case series or case reports.

The introduction of the newer Da Vinci Xi platform (Intuitive Surgical, Sunnyvale, CA, USA) has allowed increased utility and application of robotic surgery. With its boom - mounted design, enhanced instrument arm

reach and flexibility, multi quadrant, multi-visceral surgery is now possible with a single docking of the robotic cart. With increasing adoption of robotic surgery for multi-visceral simultaneous resection, there have been multiple differences in approaches employed by experienced surgical units worldwide.

We aim to summarize the current technical factors in robotic surgery for simultaneous resection of colon and synchronous liver lesions using the Da Vinci Xi platform and provide future perspective on technical considerations for combined resection.

Methods

We conducted a non-systematic PubMed literature review from January 1st 2009 to January 20th 2023 using a combination of the search terms "robotic", "colon", "rectal", "colorectal", "liver", "hepatic", "resection", "synchronous" and "simultaneous". Relevant studies were identified, and the study team screened their reference lists manually to identify other potentially relevant studies to include in the analysis.

Case reports, case series, retrospective studies and brief reports were included if they utilized the Da Vinci Xi platform, underwent simultaneous robotic resection of colorectal and synchronous liver metastases, and were published in English language. Studies that reported robotic approach such as port placement and reported on at least one post-operative outcome (operative time, estimated blood loss, length of stay, complication, and recurrence rate) were included. Studies that did not sufficiently report on robotic approach, did not specify port placement, or employed mixed approach e.g., robotic resection of colorectal tumour and laparoscopic resection of liver tumour were excluded.

After identification of the included studies, our team sought to summarize the type of synchronous resection that the patients underwent, the technical factors such as port placement and patient positioning and post-operative outcomes such as Clavien-Dindo complication or 30-day mortality.

Article Selection and Data Extraction

Ten studies were selected for inclusion in our review (7-17). All the studies included details on patients who underwent simultaneous resection of colorectal cancer and liver metastases and reported on technical factors and post-operative outcomes. Five of the included studies were case reports, four were case series and one was a case series with literature review.

The data extracted were structured and presented in three tables: demographics, tumour characteristics, intraoperative, post-operative characteristics (*Table 1*) and technical considerations (*Table 2*).

Results

Characteristics

The 10 included studies comprised 78 patients who underwent simultaneous robotic resection of colorectal cancer and synchronous liver metastases and met the study inclusion criteria. Details on tumour characteristics, number of CLRM, and type of colorectal and liver resection are presented in *Table 1.*

Technical Factors for Robotic Surgery

The technical factors specific to the set up and use of robotic surgery for the included studies are detailed in *Table 2.* All studies utilized the robotic platform Da Vinci Xi. Most authors report 4 robotic ports, with some authors preferring a 12/8 mm port to allow for use of robotic staplers and 1-2 assistant ports, ranging between 5 mm to 12 mm.

The included studies employed the newer Da Vinci Xi system, which has boom mounted arms, increased instrument flexibility and guided targeting. The rotation provided with the boom mounted arms facilitates easier re-docking without having to reposition the entire robot.

Table 1. Tumour characteristics, type of operations, intra-operative and post-operative characteristics

Author (year published)	Number of patients	Location of primary CLR	Location of CLRM	Type of CLR operation	Type of HPB operation	Total operative time (mins)	Total EBL (ml)	Total LOS (days)	Clavien- Dindo complications
Morelli (7) (2017)	3	Rectum	Nil mention	AR	Segmental hepatectomy	403	200	6	Nil
Soh (8) (2019)	4	Nil mention	Nil mention	Nil mention	Nil mention	399.2±146.1	281.5±205.6	9.6±4.9	G1
Giovanetti (9) (2019)	5	Rectum x 3 Right colon x 2	Segment IV,VI,VII Segment III,VII Segment III, IV Segment II,III Multiple liver segment	Low AR x 2 APR x 1 Right hemicolectomy x 2	Left lateral sectionectomy x 1 Non-anatomical segmentectomy x 4	439 (476.8±111.1)	150 (140.0±22.4)	5 (5.6 ± 2.7)	Grade 1 x 2: Post op ileus and stress CMP Grade 2 x 1: SSI
Navarro (10) (2019)	12	Rectum x 6 Sigmoid x 3 Descending x 1 Ascending x 1 Caecum x 1	Multiple liver metastases x 7 Single liver metastases x 5	Low AR x 6 AR x 2 Ultralow AR x 1 Right hemicolectomy x 2 Left hemicolectomy x 1	Wedge resection x 6 Right hepatectomy x 2 Left hepatectomy x 1 Caudate lobectomy x 1 ALPPS x 1 Left lateral sectionectomy x 1	449 (135-682)	274.3 (40-780)	12 (5-28)	Grade 1 x 1 Grade 2 x 2: SSI, liver abscess Grade 3A x 1: liver abscess Grade 3B x 1: anastomotic leak
Ceccarelli (11) (2020)	28	Rectum x 12, Descending x 7 Ascending x 9	Segment Ix6 Segment IIx3 Segment IIIx10 Segment IVx2 Segment Vx5 Segment VIx6 Segment VIIx8 Segment VIIIx2	AR: x 10 APR x 1 Hartmann x 1 Right hemicolectomy x 9 Left hemicolectomy x 7	Wedge resection x 20 Segmentectomy x 5 Left hepatectomy x 1 Left lateral sectionectomy x 1 Right bi-segmentectomy x 1	332 (280-385)	143 (50-600)	8 (7-13)	Grade 1-2: 24 Grade 3A: 1 Grade 3B: 2 Grade 4: 1, anastomotic leak
Masetti (12) (2020)	1	Ascending	Multiple liver metastases in right liver lobe	Left hemicolectomy	ALPPS	361	350	10	Grade 1 x 1: SSI
Konstantindis (13) (2020)	1	Ascending	Segment 5 & 6	Right hemicolectomy	Partial hepatectomy of segment 5 and 6	No mention	50	8	Nil
Guerra (14) (2022)	1	Ascending	Segment 6 and 7	Right hemicolectomy	Partial hepatectomy of segment 6 and 7	380	No mention	No mention	No mention
Shapera (15) (2022)	20	No mention	No mention	Right colectomy (40%) Low anterior resection (25%) Total colectomy (5%) Sigmoidectomy (16%) Left colectomy (14%	Central (1) Extended left (2) Formal left (2) Formal right (2) Non-anatomical right (9) Non-anatomical left (7)	446 (471±84.0)	150 (120±174.0)	5 (6±3.5)	Grade 1-2: no mention Grade 3A: 2 pleural effusion and ascites Grade 3B: 1 anastomotic leak
Ngu (16) (2023)	3	Recto-sigmoid	No mention	AR x 3	Left lateral sectionectomy x 2	243	25	No mention	Grade 1x 1: SSI
Eu (17) (2018)					Wedge resection x 1				Grade 3B x 1: anastomotic leak

CLRM: Colorectal liver metastases, AR: Anterior Resection, APR: Abdominoperineal resection, ALPPS: Associated liver partition and portal vein ligation for staged hepatectomy; CMP: cardiomyopathy, SSI: soft tissue infection

Table 2. Technical factors for robotic surgery

Author (year published)	Number of robotic ports, position	Number of assistant ports, position	Energy device	Positioning	Sequence
Morelli (7) (2017)	4 x 8 mm, RIF, RPU, LPU, LUQ	2 x 12 mm, right flank, left flank	Robotic bipolar forceps	Modified lithotomy	CLR then Liver
Soh (8) (2019)	4 x 8 mm, oblique line from right ASIS to left costal margin	2 x 12 mm, right flank and left flank	No mention	No mention	No mention
Giovanetti (9) (2019)	4 x 8 mm, oblique line from right ASIS to left costal margin	2, nil mention	Robotic Vessel Sealer	No mention	CLR then liver
Navarro (10) (2019)	Rectal 2 x 8 mm, RIF LUQ 1 x 12 mm RPU Liver 3 x 8 mm LUQ, LPU, Right flank	Rectal 2 x 5 mm, RUQ, right flank Liver 1 x 8 mm RIF 1 x 5 mm RUQ	Robotic Harmonic Scalpel	Lithotomy	CLR then liver
Ceccarelli (11) (2020)	Single docking (right sided colon cancer + liver resection) 4 x 8 mm, oblique line from right ASIS to left costal margin Double docking (left sided colon cancer + liver resection) 4 x 8 mm, along right costal margin	Single docking 1 x 12 mm LPU Double docking 1 x 12 mm RIF	Robotic bipolar forceps	Supine with open legs	Depending on which is more technically challenging
Masetti (12) (2020)	4 x 8 mm, oblique line from right ASIS to left costal margin	1 x 12 mm	Robotic Harmonic Scalpel	Supine with open legs	CLR then liver
Konstantindis (13) (2020)	4 x 8 mm, oblique line from right ASIS to left costal margin	No mention	Robotic Vessel Sealer	Supine with open legs	No mention
Guerra (14) (2022)	4 x 8 mm, oblique line from right ASIS to left costal margin	2 x 12 mm, left flank, RPU	Robotic Vessel Sealer	No mention	No mention
Shapera (15) (2022)	2 x 8mm, left flank, right flank 1 x Access GelPort RPU	1 x 12 mm, LPU,	No mention	Supine with open legs	No mention
Ngu (16) (2023)	4 x 8 mm, RUQ, RPU, LUQ, RIF	1 x 12 mm, LPU (liver)	No mention	Lloyd Davis-Head up for liver,	No mention
Eu (17) (2018)				Trendelenburg for colorectal	

RUQ: Right upper quadrant; LUQ: Left upper quadrant; RPU: Right Para umbilical; LPU: Left Para umbilical; RIF: Right iliac fossa

Peri-operative Outcomes and Follow up

Median operative time was 399 (135-682) minutes with a mean blood loss of 180 ml. The median length of stay was 8 days. Post-operative complications occurred in 71.7% (43/78) patients. Majority of the complications, 41%, were Clavien- Dindo Grade 1-2 (32/78 patients). The case series by Ceccarelli et al (11) reported 17.9%, (5/28) of patients developed recurrence and a median overall survival of 27.5 months. Navarro et al (10) reported a 47.1-month disease free survival and median overall survival of 75.2 months. There was no 30-day mortality reported in any of the studies (*Table 1*).

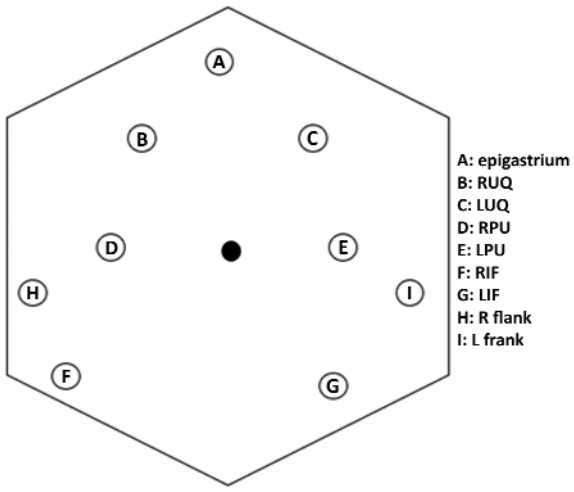
Discussion

Since the introduction of Da Vinci system, robotic surgery has become increasingly popular in the field of colorectal cancer surgery. Da Vinci models have evolved tremendously from their first model to the current Xi platform. Some surgeons raised concerns regarding utilizing robotic surgery for complex multi-visceral resection. However, from our study, it can be seen that recent publications have reported good outcomes with synchronous robotic resection of colo-rectal primary tumour and CLRM. While there are configuration guides for set up and port placement by Intuitive Surgical for "classic surgeries" such as anterior resection, there is no consensus or guidelines on the technical aspects for simultaneous organ resection using the robotic platform. This is reflected in our review from the wide variation in the approach to robotic simultaneous organ resection, ranging from the choice of number of ports, size of ports and even patient positioning by the different authors.

Earlier concerns regarding collision between robotic arms or time-consuming set up have been addressed with the newer Da Vinci Xi platform. Da Vinci Xi is the most dominant platform currently used by surgeon worldwide. It can accomplish multi-visceral resections with a high success rate. The benefit of this system is more apparent in resection of pathology in opposing quadrants such as in combined resection of left colon and CLRM (15). The versatility and flexibility of the Xi system has allowed for simplification of port configuration and easier multi-quadrant access for multiple organ resection (18). Furthermore, the development of operating table with integrated table motion (ITM) has further revolutionized the role of robotic surgery. ITM allows for patients to be repositioned without having to undock the robots and instruments thus making simultaneous complex organ resection more feasible and less time consuming (7). We acknowledge that technical considerations such as optimization of port positioning and sharing of same incision for dissection/extraction may still be required in multi-segment liver resection or extensive colonic resection. The sparsity and heterogeneity of available data suggests that this may be a limitation of the Da Vinci Xi system.

Our article summarized the latest available data focused only on the Da Vinci Xi platform and excluded all studies on the older Da Vinci platform e.g. Si platform. This will provide readers with less confusion with the different systems which have their inherent limitations and hence not suitable for multi-visceral resection. *Fig. 1* clearly demonstrates the comparison of various port placements in different cases to aid surgeons in deciding the setup and port positioning for every unique case. We hope that our article can be used as a platform to guide centres with significant experience in robotic colonic and liver resection as independent procedures to start simultaneous colonic and hepatic resection in patients with synchronous disease.

We acknowledge that our article has several limitations. Firstly, the number of included patients is still limited despite the wide utilisation of the Da Vinci Xi platform worldwide. Our review included 10 articles which comprised 78 patients. Furthermore, all the studies published are limited to specialized centres and outcomes may not be generalizable to a wider patient population.



Author (year published)	Ports placement (size in mm)
Morelli (2017)	Robotic: C(8), D(8), E(8), F(8) Assistant: H(12), I(12)
Soh (2019)	Robotic: B(8), C(8), D(8), F(8) Assistant: H(12), I(12)
Giovanetti (2019)	Robotic: B(8), C(8), D(8), F(8) Assistant: 2 (nil mention on position or size)
Navarro (2019)	Robotic: Rectal: C(8), F(8), D(12); Liver: C(8), E(8), H(8) Assistant: Rectal: B(5), H(5); Liver: B(5), F(8)
Ceccarelli (2020)	Robotic: B(8), C(8), D(8), F(8) Assistant: E(12) or F(12)
Masetti (2020)	Robotic: B(8), C(8), D(8), F(8) Assistant: 1x12 mm (no mention on position)
Konstantindis (2020)	Robotic: B(8), C(8), D(8), F(8) Assistant: 2 (nil mention on position)
Guerra (2022)	Robotic: B(8), C(8), D(8), F(8) Assistant: D(12), I(12)
Shapera (2022)	Robotic: H(8), I(8), D(8), E(8) Assistant: D(Gelport), E(12)
Ngu (2023)	Robotic: B(8), C(8), D(8), F(8) Assistant: E(12), F(12)

Figure 1. Summary of port placements in the included studies.

Furthermore, this study maybe less relevant as a guide for centres currently still using other robotic/Da Vinci platforms. Lastly, cost was not mentioned in most studies and hence there were limited data to assess the cost/benefit ratio of robotic surgery in comparison to laparoscopic surgery.

Conclusion

Future studies and continued sharing on individual surgeon experience with robotic approach to simultaneous organ resection will allow for the creation of a database of shared knowledge. Newer robotic platforms coming into the market may further widen the availability of robotic surgery and open up further possibilities for more complex resections. While robotic surgery has proven to be a safe and viable approach for simultaneous resection of colon cancer and CLRM, a greater understanding of the unique technical aspects such as port placement and patient positioning and its influence on outcomes will allow for standardization and thus increased uptake of such an approach in this group of patients in the future.

Conflicts of Interests

All authors do not have any conflict of interest to declare.

Author's Contributions

Study conception and design: SHXC, MVM, AKHC. Data collection, analysis and interpretation of results: SHXC, HJT. Analysis and interpretation of results: SHXC, HJT. Draft manuscript preparation: SHXC, HJT, NT, MVM, AKHC. All authors reviewed the results and approved the final version of the manuscript.

References

1. Jegatheeswaran S, Mason JM, Hancock HC, Siriwardena AK. The liver-first approach to the management of colorectal cancer with synchronous hepatic metastases: a systematic review. JAMA Surg. 2013;148(4):385-91.
2. Schadde E, Grunhagen DK, Verhoef C, Krzywon L, Metrakos P. Limitations in resectability of colorectal liver metastases 2020- A systematic approach for clinicians and patients. Semin Cancer Biol. 2021;71:10-20.
3. Machairas N, Dorovinis P, Kykalos S, Stamopoulos P, Schizas D, Zoe G, et al. Simultaneous robotic-assisted resection of colorectal cancer and synchronous liver metastases: a systematic review. J Robot Surg. 2021; 15(6):841-848.
4. Rahimli M, Perrakis A, Schellerer V, Gumbs A, Lorenz E, Franz M, et al. Robotic and laparoscopic liver surgery for colorectal liver metastases: an experience from a German Academic Center. World J Surg Oncol. 2020; 18(1):333.
5. Boudjema K, Locher C, Sabbagh C, Ortega-Deballon P, Heyd B, Bachellier P, et al. Simultaneous Versus Delayed Resection for Initially Resectable Synchronous Colorectal Cancer Liver Metastases: A Prospective, Open-label, Randomized, Controlled Trial. Ann Surg. 2021;273(1):49-56.
6. Kamarajah SK, Bundred J, Manas D, Jiao L, Hilal MA, White SA. Robotic versus conventional laparoscopic liver resections: A systematic review and meta-analysis. Scand J Surg. 2021;110(3):290-300.
7. Morelli L, Di Franco G, Guadagni S, Palmeri M, Gianardi D, Bianchini M, et al. Full Robotic Colorectal Resections for Cancer Combined With Other Major Surgical Procedures: Early Experience With the da Vinci Xi. Surg Innov. 2017;24(4):321-327.
8. Soh JS, Joo JI, Park YH, Lim SW. Robotic rectal cancer surgery simultaneously performed with combined abdominal surgeries. Asian J Surg. 2019;42(12):1024-1027.
9. Giovannetti A, Sucandy I, Dinallo A, Chudzinski AP, Ross SB, Massarotti H G, et al. Combined Robotic Colon and Liver Resection for Synchronous Colorectal Liver Metastasis: A Movement Toward a New Gold Standard. Am Surg. 2019;85(8):e374-e376.
10. Navarro J, Rho SY, Kang I, Choi GH, Min BS. Robotic simultaneous resection for colorectal liver metastasis: feasibility for all types of liver resection. Langenbecks Arch Surg. 2019;404(7):895-908.
11. Ceccarelli G, Rocca A, De Rosa M, Fontani A, Ermili F, Andolfi E, et al. Minimally invasive robotic-assisted combined colorectal and liver excision surgery: feasibility, safety and surgical technique in a pilot series. Updates Surg. 2021;73(3):1015-1022.
12. Masetti M, Lombardi R, Romboli A, Jovine E. Fully Robotic ALPPS and Simultaneous Left Colectomy for Synchronous Colorectal Liver Metastases. J Laparoendosc Adv Surg Tech A. 2020;30(10):1106-1109.
13. Konstantinidis IT, Raoof M, Zheleva V, Lafaro K, Lau C, Fong Y, et al. Multivisceral robotic liver surgery: feasible and safe. J Robot Surg. 2020; 14(3):503-507.
14. Guerra F, Giuliani G, Saccucci G, Coratti A. Simultaneous, single-docking robotic resection for right colon cancer with synchronous liver metastases. Surg Oncol. 2022;43:101816.
15. Shapera E, Ross SB, Chudzinski A, Massarotti H, Syblis CC, Crespo K, et al. Simultaneous Resection of Colorectal Carcinoma and Hepatic Metastases is Safe and Effective: Examining the Role of the Robotic Approach. Am Surg. 2022;31348221093533. Online ahead of print.
16. Ngu JC, Shannon NB, Eu EW, Lee LS, Tan SS, Lim SKT, Ng FC, et al. Technical insights to multivisceral resections using the da Vinci Xi. ANZ J Surg. 2023;93(1-2):166-172.
17. Eu EW, Ngu JC, Chiow AKH. How to do a combined robotic anterior resection and liver resection: da Vinci Xi. ANZ J Surg. 2018;88(10): 1076-1077.
18. Morelli L, Guadagni S, Di Franco G, Palmeri M, Caprili G, D'Isidoro C, et al. Use of the new da Vinci Xi® during robotic rectal resection for cancer: a pilot matched-case comparison with the da Vinci Si®. Int J Med Robot. 2017;13(1).