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**Robot-assisted one stage resection of rectal cancer with liver and lung metastasis: a case report**

Xu JM *et al*. rectal cancer with liver and lung metastasis

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**Abstract**

The Da Vinci Site robotic surgery platform may help to overcome some of the difficulties of laparoscopy for complicated abdominal surgery. The authors of this article present a case of robotic-assisted one stage radical resection of three tumors, included robotic anterior resection for rectal cancer, segmental hepatectomy for liver metastasis and wedge shaped excision for lung metastasis using this device. A 59-year-old male with primary rectal cancer, liver metastasis and lung metastasis was operated on with a one stage radical resection approach using the Da Vinci Surgery device. Resection and anastomosis of rectal cancer were performed extra-corporeally after undocking the robot. The procedure was successfully completed in 500 min. No surgical complications occurred during the intervention and the post-operative stay and no conversion to laparotomy or additional trocars were required. To the best of our knowledge, this is the first case of simultaneous resection for rectal cancer with liver metastasis and lung metastasis using the Da Vinci Surgery platform to be reported. The procedure is feasible and safe and its main advantages for patient are avoiding repeated operation and reducing surgical trauma, shorten recovery time, and the early begin to implement postoperative adjuvant therapy.

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**Key words:** Robotic surgery; Minimally invasive colorectal surgery; Liver metastasis; Lung metastasis; Da Vinci platform

**Core tip:** To the best of our knowledge, this is the first case of simultaneous resection for rectal cancer with liver metastasis and lung metastasis using the Da Vinci Surgery platform to be reported. The procedure is feasible and safe and its main advantages for patient are avoiding repeated operation and reducing surgical trauma, shorten recovery time, and the early begin to implement postoperative adjuvant therapy.

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**Introduction**

Since 2002, laparoscopic technique has revolutionized the treatment of colorectal cancer, and showing the similar oncological results with open technique [1,2]. The limitations of laparoscopic approaches for performance of colorectal cancer with resectable distant metastasis include 2-dimensional imaging, limited maneuverability of instruments, and an unsteady camera platform.

In an effort to improve standard laparoscopic techniques, the development of using robotic assistant system in surgery has been a recent advancement since last decade. The Da Vinci robotic system (Intuitive Surgical Inc. Mountain View, CA, United States) is a surgical robot with multiple arms operated remotely from a console, and is capable of 7 degrees of freedom and 2 degrees of axial rotation to replicate human wrist-like movements with magnifying 3-dimensional visualization.

The comparisons of robotic and laparoscopic colorectal cancer resections have shown feasibility and safety of the robotic platform despite longer operating times[3,4]. In addition, the data indicated that robotic-assisted hepatic resection can overcome the limitations of laparoscopic surgery, and open a new treatment strategy for benign and malignant liver tumors[5,6]. In the field of thoracic surgery, studies demonstrate that use of the Da Vinci robotic system for individual dissection, isolation, and division of the pulmonary hilar structures during video-assisted thoracic surgery (VATS) lobectomy is feasible and safety[7].

We hypothesized that we could use a robotic platform to perform radical resection for patients with both colorectal liver metastasis and lung metastasis. We present our first report of robotic one stage resection of three tumors, included anterior resection for rectal cancer, segmental hepatectomy for liver metastasis and wedge shaped excision for lung metastasis using this device.

**Case report**

A 59-year-old Chinese man presented with a four-month history of intermittent rectal bleeding, with increased stool frequency. A diagnosis of rectal cancer was made after colonoscopy revealed an ulcerative mass 13 cm from the anal verge. Histologic examination of the colonoscopy biopsy indicated moderately differentiated adenocarcinoma. The preoperative Abdominal computed tomography (CT) and rectal magnetic resonance imaging (MRI) examination indicated the stage of the primary tumor was cT3N0. But the chest CT, liver MRI scan, and positron emission ct (PET-CT) examination showed the rectal cancer with liver and lung metastasis (Figure 1). This patient was discussed in a multidisciplinary team (MDT), included colorectal surgeon, thoracic surgeons, liver surgeons, and radiologist. The decision is that the preoperative stage of this patient is cT3N0M1, but the primary rectal cancer, both liver and lung metastases was single lesion which were suitable for radical resection. After obtaining written informed consent, we carried out a one stage resection for three tumors using the Da Vinci robotic system.

***Wedge shaped excision for lung metastasis***

The patient was placed in the left lateral decubitus position under general anesthesia and single-lung ventilation. The robotic arm was established on the operating table anterior to the patient’s thigh. Incisions included an anterior 1.5-cm incision in the eighth intercostal space and a middle 3-cm working incision in the fifth intercostal space. The camera was connected with the robotic arm and introduced through the anterior incision. The ribs were not spread or traumatized. The right lower lobe where tumor was located was transected with Endo GIA stapling device (Figure 2). The resection of lung tumor was finished in just half an hour.

***Segmental hepatectomy for liver metastasis***

The patient was placed in a supine position under general anesthesia and bilateral-lung ventilation, and 4 trocars were used. A 12-mm trocar for the robotic camera was placed below the umbilicus by the Hasson method. Two additional 12-mm trocars were placed at the left upper quadrant and epigastric under the laparoscopic guidance, respectively. A 12-mm trocar for an assistant was also placed at the right upper quadrant area. Intraoperative ultrasonography was used to examine the liver lesions and obtain adequate surgical resection margins (Figure 3A). The liver was mobilized by dividing the right triangular ligament and round ligament. Parenchymal division proceeded from the anterior edge of the liver by harmonic scalpel and electrocautery. The small vessels and bile ducts exposed during parenchymal dissection were ligated and divided by clipping. The Glisson's pedicles of segments VII were clamped and divided by suture technique (Figure 3B). A closed suction drain catheter was placed in the subhepatic space. The segmental hepatectomy used 270 min.

***Anterior resection for rectal cancer***

The patient was placed in a modified lithotomy position, with the legs apart, on a beanbag mattress to prevent sliding. The dissection starts with an incision of the peritoneum at the origin of the inferior mesenteric artery (IMA) using the monopolar scissors. The assistant provides gentle traction to the sigmoid colon anteriorly to enable clear identification of the incision line. The IMA and inferior mesenteric vein (IMV) were carefully skeletonized, clipped, and divided while preserving the periaortic hypogastric nerve plexus (Figure 4A). Medial-to-lateral dissection of the sigmoid colon was carried out between Toldt’s fascia and the left colonic mesentery. Anterior traction allows dissection of the avascular plane between the mesorectal fascia and presacral fascia while avoiding injury to the hypogastric nerves posteriorly (Figure 4B). Dissection was carried out to a level approximately 5 cm from the anal verge. After adequate pelvic dissection, the robot cart was undocked, and a laparoscopic articulating linear stapler was used to transect the rectum from the left lower quadrant port. Bowel continuity was restored with a circular stapler.

**Discussion**

The procedure was successfully completed in 480 min with a docking time of 90 min and a console time of 390 min. Intraoperative blood loss was 600 mL. The chest tube was removed on the second postoperative days and abdomen tubes were removed on day 5, respectively. Passing of flatus was on post-operative day 2. A liquid diet was then allowed and well tolerated. The pathological outcome of the liver and lung tumor was both metastatic adenocarcinomas, rectal cancer was adenocarcinoma and the stage was pT3 N1 M1. The margin of both primary and metastatic lesions was negative. A total 18 lymph nodes were resected, and 2 of them were positive. No postoperative complications occurred and the patient was discharged from hospital on day 7 after surgery. Just two weeks after surgery, this patient began to receive postoperative adjuvant chemotherapy and radiotherapy at two months later respectively. At a follow-up of 90 d no further complications and tumor recurrence were observed.

Colorectal cancer (CRC) is the third leading cause of cancer death in the world. The 5-year survival rate is currently only 5% for patients with inoperable stage IV disease[8]. For patients with liver metastases or lung metastases, surgical resection remains the only treatment which associated with a long survival time with a 40% survival at 5 years and almost 25% of patients demonstrating a postoperative survival duration up to 10 years in specialized centers[9]. Therefore, the current guidelines recommend that the treatment strategy should be directed toward resectability[10]. However, the best type of surgical procedure is still controversy for patients with resectable both primary and metastatic lesions. Research shows that the one stage resection of colorectal cancer and synchronous liver or lung metastases can be performed safely with similar outcomes compared with staged procedures[11]. The focus of this case report was on whether the Da Vinci system assisted surgery was feasible and safety for one stage radical resection of rectal cancer and distant metastases.

Robotic-assisted laparoscopic abdominal surgery has gained attention because it can compensate for the inherent limitations of conventional laparoscopic surgery[12,13]. The Da Vinci system improves the vision that becomes three-dimensional, and provides more accurate hand–eye coordination that increases the surgeon’s skill. Furthermore, it also eliminates the tremor and increases the so-called degree of freedom of operating instruments. These advantages make it possible to proceed with surgery that would otherwise be difficult or impossible, especially for those who already have experience with laparoscopic surgery. In rectal surgery, robotic-assisted surgery for rectal cancer can be carried out safely and in accordance with current oncological principles[14]. Robotic total mesorectal excision may allow for better preservation of urinary and sexual functions, and robotic surgery may attenuate the learning curve for laparoscopic rectal resection[15]. However, to date, the impact of robotic rectal surgery on the long-term oncological outcomes of minimally invasive total mesorectal excision remains undetermined. Large-scale prospective randomized clinical trials such as the international randomized trial ROLARR are required to establish the benefits of robotic rectal surgery [16].

Robot for treatment of metastatic colorectal cancer is still at the initial stage. From 2005 to 2013, we have performed more than 500 cases of traditional operations used one stage resection procedure for colorectal cancer and liver metastasis in Zhongshan hospital. This treatment was associated with a long survival time with a 40% survival at 5 years[17,18]. Also, as to June 2014, a total of 365 cases of Da Vinci system assisted colorectal operations had been done. Our preliminary experience suggests that Da Vinci system treated with synchronous colorectal liver metastasis is safe and feasible in selective patients. However, large-scale prospective randomized trials are urgently needed to evaluate the outcomes of this procedure.

This article first present a case of robotic-assisted one stage resection of three tumors included rectal cancer, liver metastasis and lung metastasis. The main advantages for patient are avoiding repeated operation and reducing surgical trauma, when compared with the traditional operation which patients need to be admitted three times and accept repeated operations[11]. In addition, the patient was discharged from hospital on day 7, and accepted adjuvant chemotherapy after two weeks of surgery. The shorten recovery time will allow the patient early begin to accept postoperative adjuvant therapy and lead to improved long time outcome[19].

**comments**

***Case characteristics***

A 59-year-old Chinese man presented with a four-month history of intermittent rectal bleeding, with increased stool frequency.

***Clinical diagnosis***

A diagnosis of rectal cancer was made after colonoscopy revealed an ulcerative mass 13 cm from the anal verge.

***Differential diagnosis***

The preoperative Abdominal computed tomography (CT) and rectal magnetic resonance imaging (MRI) examination indicated the stage of the primary tumor was cT3N0M1.

***Laboratory diagnosis***

Histologic examination of the colonoscopy biopsy indicated moderately differentiated adenocarcinoma.

***Imaging diagnosis***

The chest CT, liver MRI scan, and positron emission tomography CT (PET-CT) examination showed the rectal cancer with liver and lung metastasis

***Pathological diagnosis***

The pathological outcome of the liver and lung tumor was both metastatic adenocarcinomas, rectal cancer was adenocarcinoma and the stage was pT3 N1 M1.

***Treatment***

This patient was discussed in a multidisciplinary team (MDT), and the decision is that the preoperative stage of this patient is cT3N0M1, but the primary rectal cancer, both liver and lung metastases was single lesion which were suitable for radical resection, and we carried out a one stage resection for three tumors using the Da Vinci robotic system.

***Related reports***

Large-scale prospective randomized clinical trials such as the international randomized trial ROLARR are required to establish the benefits of robotic rectal surgery**.**

***Term explanation***

PET-CT is the abbreviation of positron emission computed tomography examination. MDT is the abbreviation of multidisciplinary team. IMA is the abbreviation of inferior mesenteric artery.

***Experiences and lessons***

The procedure is feasible and safe and its main advantages for patient are avoiding repeated operation and reducing surgical trauma, shorten recovery time, and the early begin to implement postoperative adjuvant therapy.

***Peer review***

This paper is the exploratory study. The rectal cancer is aggressive malignant tumor, metastasis to liver or lung is the common appearance in rectal cancer. Simultaneous resection of primary tumor, liver metastasis and lung metastasis is recommended surgical procedure. It is valuable exploration to perform the simultaneous resection by The Da Vinci Site robotic surgery platform.

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**Figure 1 Preoperative** positron emission tomography- computed tomography **examination showed the rectal cancer with liver and lung metastasis.** A, B: Rectal cancer; C, D: Lung metastasis; E, F: Liver metastasis.

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**Figure 2 Robotic-assisted wedge shaped resection of the right lobe for lung metastasis.** A: The arrow indicated the location of tumor; B: The arrows indicated the cut line of Endo GIA stapling device.

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**Figure 3 Robotic-assisted segmental hepatectomy for liver metastasis.** A: Intraoperative ultrasound was used to mark the location of tumor; B: The tumor was resected.

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**Figure 4 Operative images of robot-assisted anterior resection for rectal cancer.** A: 1, IMV; 2, IMA; 3, inferior hypogastric nerve; B: 1, presacral space; 2, rectum; 3, iliac vessels; 4, ureter.