

CASE REPORT

Robotic-assisted laparoscopic radical nephrectomy and lymph nodes dissection using Senhance robotic system and Senhance ultrasonic energy device: A case report

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Key Clinical Message

Using the Senhance robotic system and Senhance ultrasonic energy device for robotic-assisted radical nephrectomy with hilum lymph node dissection demonstrated safety and feasibility in managing a large renal tumor without the need for open conversion or transfusion, offering a cost-effective solution.

KEYWORDS

case report, nephrectomy, robotic surgery, Senhance robotic system, urology

1 | INTRODUCTION

Over the past few decades, robotic surgery has gained prominence across various surgical procedures.¹ In upper urinary tract surgery, robotic surgery has demonstrated advantages such as reduced intraoperative blood loss, shorter hospital stays, and comparable 5-year overall survival rates compared to the laparoscopic approach.² While recent studies have predominantly focused on the Da Vinci robotic platform, other surgical systems have entered the market. Among these, the Senhance robotic surgical system gained approval from the Food and Drug Administration in the United States in 2017. This innovative robotic platform has demonstrated feasibility and safety in urological surgeries, including radical prostatectomy and nephrectomy.^{3,4} By offering three-dimensional visualization, eye-tracking system, and haptic feedback, a precise dissection and stable suturing could be achieved during operation. The reusability of the instruments also

contributes a reduction in surgical expenses. Further enhancing its capabilities, the Senhance Ultrasonic advanced energy device provides an effective vessel sealing, and notable hemostatic outcomes.

This article reports a case of huge renal tumor with renal vein and hilar lymph nodes invasion, underwent radical nephrectomy with hilar lymph node dissection. The operation was done by Senhance robotic system and Senhance Ultrasonic energy device. This study was approved by the Institutional Review Board of National Taiwan University Hospital YunLin Branch (202004072RINA). Informed consent was obtained from the patient for clinical review and data collection.

2 | CASE HISTORY

A 68-year-old woman presented with symptoms of nausea and vomiting over the past few weeks. A significant renal

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tumor was detected during an abdominal ultrasound at a local clinic. Subsequent computed tomography (CT) at our hospital revealed a sizable 6cm left renal tumor with involvement of the left renal vein and enlarged lymph nodes at the hilum. (Figure 1) Renal cell carcinoma (RCC) was the suspected diagnosis. Further assessments, including a bone scan, showed no signs of metastasis. The patient was admitted to the hospital in March 2020 for surgical intervention.

3 | METHODS

The surgical procedure was conducted by a team of experienced urology surgeons. The patient was positioned in a right lateral decubitus position. A paraumbilical incision was made of a 5–12 mm camera port, while two 8 mm robotic working ports were positioned in the left subcostal and lower abdominal areas. Two additional assistant ports were set between the camera port and the robotic ports. The Senhance robotic surgical system (TransEnterix, Inc.) was employed for the entire operation. The setting of the robotic arms, booms, and also the assistant's operating area was demonstrated in Figure 2. The energy device employed was the Senhance Ultrasonic (TransEnterix, Inc.). A demonstration of the techniques during the operation is presented through a surgical video. (Video S1 and Video transcription 1 as Data S1).

A robotic-assisted laparoscopic left radical nephrectomy with hilum lymph node dissection was done with a total operation time of 158 min. The left adrenal gland was preserved during the procedure. The estimated blood loss was 50 mL and no blood transfusion required during the procedure. The patient's clinical progress following the operation remained stable and devoid of any complications or subsequent issues.

4 | CONCLUSION AND RESULTS

The pathology report revealed a high-grade invasive urothelial carcinoma with squamous differentiation. Pathological

examination confirmed cancer invasion in the hilum lymph nodes, left adrenal gland, and left renal vein. However, surgical margins were found to be uninvolved. A cancer staging of pT4N2 was confirmed. Subsequently, the patient was promptly referred to an oncologist for further oncological treatment. She was under regular follow up at our clinic for 18 months. There were no surgical associated sequelae to be noticed.

5 | DISCUSSION

Operating a huge renal tumor is challenging for urologists, especially using laparoscopic method. In line with prior reports, laparoscopic procedures for renal masses exceeding 7 cm exhibited a mean operation time of 209.5 min, accompanied by an average estimated blood loss of 275 mL.⁵ In dedicating to minimally invasive surgeries, several robotic platforms have been developed since the 1980s. Different models with unique features have been established, including the Firefly by the Da Vinci system, the 'open' console by the Avatera system, and the full wrist capability with 7 degrees of freedom by the Revo-I system.⁶ A meta-analysis comparison between robotic-assisted radical nephrectomy and laparoscopic approach indicated that the former exhibited a longer operative time (weighted mean difference of 37.44 min), a shorter length of stay (weighted mean difference of -0.84 days), a higher total cost (weighted mean difference of US\$4700), and comparable estimated blood loss.⁷ However, the existing literature on the Senhance robotic system remains scarce. Likewise, publications to the Senhance Ultrasonic energy device is also notably lacking. Reflecting on perioperative data from previous studies, the Senhance robotic platform yielded a favorable surgical outcome and a minimal blood loss during our operation. Notably, the Senhance robotic system's three-dimensional visual perspective and haptic feedback mechanism appear advantageous, particularly during intricate surgical procedures.

According to a systemic review comparing high energy devices (HED) with ultrasonic sources and electrocautery

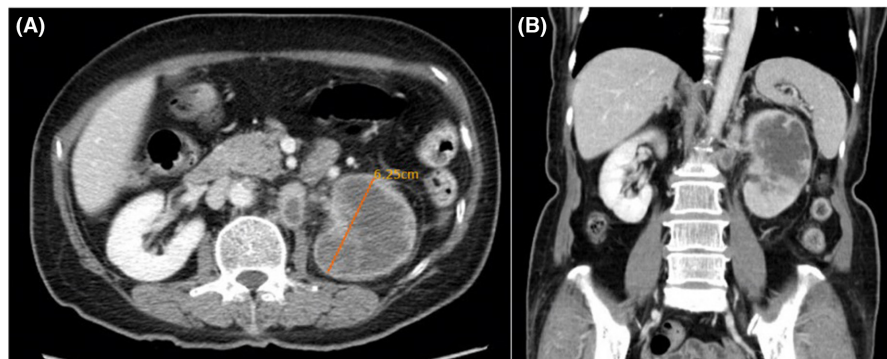
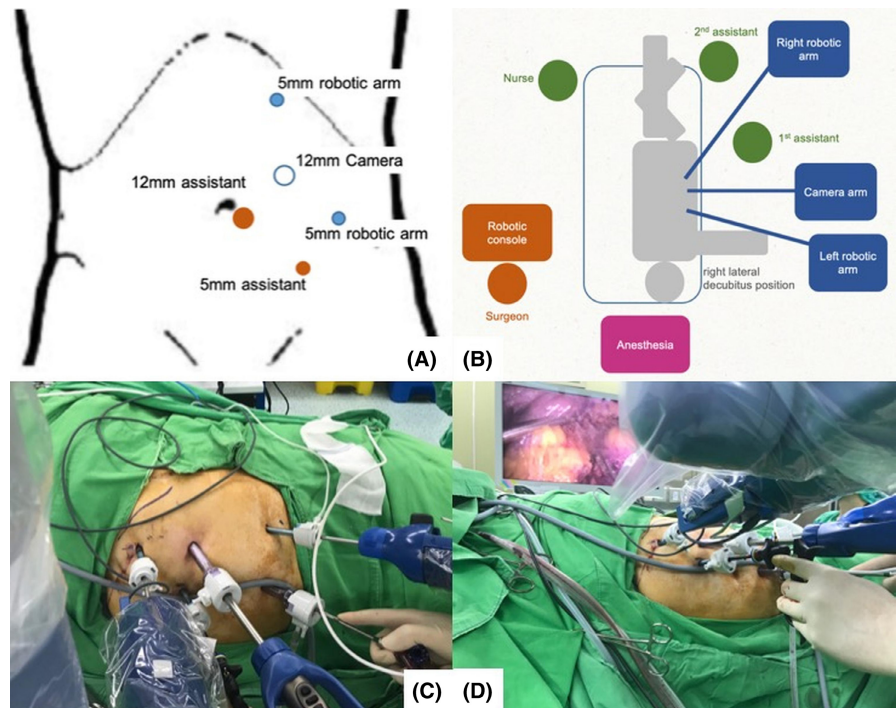


FIGURE 1 Computed tomography revealed a huge left renal tumor with enlarged hilar lymph nodes.

FIGURE 2 (A) The port placement for the operation. We are using two robotic arms and two assistant ports during the entire surgery. (B) The settings of the robotic arms and booms. (C, D) Demonstrates the patient's position and the assistant's working area after docking the robotic arms.



for laparoscopic procedure, the HED group exhibited significantly shorter operative times.⁸ Furthermore, ultrasonic coagulating shears have been documented to offer improved bleeding control when contrasted with conventional electrosurgery, concurrently contributing to reduced operation times.⁹ These evidence might explain the short operative time and minimal blood loss recorded during our patient while using Senhance Ultrasonic as our primary energy device.

Comparative studies have indicated that the expenses associated with robotic radical nephrectomy notably surpass those attributed to laparoscopic procedures. These distinctions are evident both in terms of operating room costs (difference US\$ 1839, 95% CI) and supply costs (difference US\$ 985, 95% CI).¹⁰ While comparing to the widely adopted da Vinci robotic system, Senhance robotic platform was reported to have a significant lower instrument costs in gynecology operation.¹¹ The instruments provided by Senhance robotic system are resterilizable and reusable, making the supply costs lower than other robotic system. While the Senhance Ultrasonic, which is a single-used instrument, as an additional supply cost in our surgery, costed about US\$ 1000. However, giving the advantage from its vessel sealing effect capability, rather than conventional electrosurgery device, it is still a considerable choice for a cost-efficient result.

There were some limitations observed during this operation. The Senhance robotic system offers stable and precise dissection based on the laparoscopic operation field. However, unlike other robotic systems, it lacks full endo-wrist motion, which restricts the suturing process.

Additionally, the Senhance system does not include Firefly technology for real time fluorescence imaging. While fluorescence imaging is not necessary for a radical nephrectomy, its absence could be a drawback in other renal surgeries requiring real time decision-making, such as partial nephrectomy procedures. These factors may limit the future advancement of this robotic platform.⁶

To date, several new robotic systems have been developed and released to the market. Renal surgery with partial nephrectomy was reported to have a shorter operation time and less blood loss by using Da Vinci SP system compared to multiple arms models (Da Vinci Xi and Si).¹² Additionally, the Hugo Robot-Assisted Surgery System has demonstrated its feasibility and safety in renal surgery.¹³ Promising surgical outcomes have been reported in a case series of off-clamp partial nephrectomies using the Hugo surgical system.^{14,15} Further research is needed to confirm the safety and operative outcomes of these novel robotic systems and technological devices in renal surgeries.

This case report marks the first instance of discussing the utilization of the Senhance robotic surgical system alongside the Senhance Ultrasonic energy device for a radical nephrectomy with hilum lymph node dissection in the context of a huge renal tumor. The total operation time was only 158 min, with minimal blood loss and no need of blood transfusion during the operation. The surgical outcome was acceptable with no complication noted after the operation. This novel combination of surgical tools and high-energy device demonstrates its suitability and safety for complex procedures, offering a more affordable option for patients.

AUTHOR CONTRIBUTIONS

Kuan Chong Ng: Writing – original draft; writing – review and editing. **LunHsiang Yuan:** Conceptualization; methodology; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

This manuscript has been read and approved by all the authors, that the requirements for authorship as stated have been met, and that each author believes that the manuscript represents their honest works.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journals patient consent policy.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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